

Inter-Firm Efficiency Comparisons: U.S. and U.K. Manufacturing Enterprises in Britain *

1. Introduction

The purpose of this paper is to suggest a method of evaluating the efficiency of firms (1), with a view to comparing the performance of British and U.S. firms operating in the United Kingdom. In later sections of this paper we shall:

- (a) define the efficiency of the firm;
- (b) propose an operational measure of efficiency as defined;
- (c) carry out a number of tests of the proposed measure, and
- (d) draw certain tentative conclusions regarding the relative efficiency of British and U.S. firms operating in the United Kingdom.

Before embarking on the analysis as a whole we give a brief preliminary account of the origins and aims of the research study for which a means of undertaking inter-firm efficiency comparisons was required.

2. The Origins and Aims of the Research

As a result of official enquiries and earlier research undertaken at Southampton (2) evidence has accumulated regarding:

- (a) the rates of return on capital (at book values) obtained by British manufacturing enterprises operating overseas;

* The authors are indebted to Miss H. Gibbs and Mrs. A. Harris of the University of Southampton and Mr. M. Barron of the University of Reading for their help in the preparation of the statistics for this article.

(1) A preliminary paper on the subject was presented to British Association (Section F) at Southampton in September 1964.

(2) See Board of Trade [1], U.S. Department of Commerce [18], J. H. Dunning [3], [4]. Also, more recently, W. B. Reddaway [17].

(b) the rates of return on capital (at book values) obtained by British manufacturing enterprises operating in the United Kingdom;

(c) the rates of return on capital (at book values) obtained by U.S. enterprises operating:

- (i) in overseas countries in which U.K. enterprises also operate, and
- (ii) in the U.K., and

(d) in some cases, the rates of return on capital obtained by domestic enterprises in overseas countries in which both U.S. and U.K. enterprises operate.

Given this data, which was aggregative in nature, it became possible to compare the rates of return obtained by U.K. firms with those obtained:

- (a) by U.S. firms operating in the same economy, and
- (b) by domestic firms.

The results of these comparisons, which have been set out in other articles (3) suggested two main conclusions:

(a) U.K. firms (in aggregate) were consistently less profitable than U.S. firms:

- (i) in the United Kingdom;
- (ii) overseas, and

(b) U.K. firms operating in overseas markets were (in aggregate) frequently less profitable than *all* firms, both domestic and foreign, operating in the same country.

From this evidence, on the assumption that the rate of return on capital employed was a plausible index of economic "efficiency", the obvious inferences were that:

- (i) U.K. firms were less efficient than a surprisingly wide range of their competitors, and
- (ii) that this lesser "efficiency" must, in some measure, be due to the shortcomings (avoidable and unavoidable) of U.K. management.

These inferences, though appealing, could not, however, be drawn with any great confidence from the data available. For this

(3) See particularly Dunning [5] and Dunning and Rowan [8].

there were a number of reasons, the most compelling being that the industrial distribution of U.K. firms operating in overseas countries was known to differ very considerably from those of U.S. firms and firms of other nationalities, while attempts to correct for this factor could not be other than crude. Accordingly an attempt was made to check the impression created by the aggregative figures by comparing:

(a) the rates of return on capital earned by a selective sample of U.S. firms engaged in manufacturing in the U.K., and

(b) the rates of return earned by U.K. firms over the same period which:

(i) operated in the same industry;

(ii) were of approximately the same size, and

(iii) produced broadly similar products.

The results of these "paired" comparisons are shown in Table I. Clearly they support the aggregative data rather than the reverse.

TABLE I
RATES OF RETURN ON CAPITAL EARNED BY U.S. SUBSIDIARIES
AND « PAIRED » U.K. COMPETITORS IN THE U.K. 1958-61 (1)

	1958-59		1959-60		1960-61		1958-61	
	U.S.	U.K.	U.S.	U.K.	U.S.	U.K.	U.S.	U.K.
Food	15.9	12.7	13.4	9.9	17.8	9.4	15.6	11.1
Chemicals	26.2	15.6	19.4	16.0	13.8	16.4	19.0	16.0
Engineering:								
(a) Motor vehicles .	29.8	14.7	25.1	16.6	17.3	8.3	24.0	13.2
(b) Electrical equip- ment	21.2	16.8	20.1	19.0	19.3	11.4	21.3	17.0
(c) Instruments & watches	21.5	13.3	17.9	13.8	15.4	14.5	17.7	14.2
(d) Other	17.8	12.3	17.2	14.5	18.4	13.2	18.0	14.7
All Engineering . .	26.8	15.1	18.8	15.3	17.8	12.8	19.2	15.1
Other Manufacturing .	21.2	12.9	20.5	15.5	19.0	11.1	20.6	13.5
All firms	20.9	14.5	18.7	15.4	17.3	12.9	19.0	14.5

Source: Published Company Accounts.

(1) Unweighted average of Gross Operating Profit ÷ Total Assets.
Firms paired included those producing abrasives, photographic equipment, office machinery, pharmaceuticals, refined oil, canned foods, rubber tyres, cork products, domestic appliances, boilers, machine tools, toys, printing machinery, plastics, pens, telephones and watches.

Unfortunately the "paired" comparisons were open to serious objections for, although the "pairs" were selected as carefully as possible, problems of product heterogeneity and spread could not be entirely resolved. Hence Table I, though suggestive, was very far from being conclusive.

At this stage, all that could be said with any confidence was that a problem of relative efficiency might well exist. The evidence was considered by the National Economic Development Office (N.E.D.O.) to be sufficient to initiate a more systematic enquiry. The aims of this enquiry, which was carried out at the University of Southampton, were to discover whether:

(i) the apparent differences in rates of return on capital earned by U.S. and U.K. firms operating in the United Kingdom reflected a real difference in economic efficiency rather than conceptual and statistical differences, and

(ii) if differences in efficiency could be shown to exist, a significant part of them could be attributed to identifiable weaknesses in U.K. management.

Because of the difficulties, already mentioned, with aggregative data, statistical information was sought directly from firms by means of a Questionnaire. The Questionnaire was sent to:

(a) all U.S. firms known to be manufacturing in the U.K., and

(b) to those U.K. firms designated by U.S. firms as their "closest" competitors.

In this way it was hoped to undertake "paired" comparisons in which the method of defining the "pairs" was itself defined and in which the resultant "pairs" would have a relatively unambiguous and acceptable meaning.

Depending on the response of firms to these requests for data, it was planned to send Questionnaires to a sample of U.K. firms structured, on the basis of industrial classifications, in the same way as U.S. firms which returned usable data. In the event, though the response rate from U.S. firms (some 45%) was acceptable, if rather disappointing (4), the response rate of U.K. firms (roughly 8%)

(4) Though the firms which did reply accounted for more than 75% of the total U.S. investment in U.K. manufacturing industry in 1960.

was not only disappointing but entirely unacceptable. In view of this it seemed entirely futile to proceed with the structured sample.

The practical upshot, therefore, is that our enquiry failed to provide the data necessary for a comprehensive comparison of U.K. and U.S. firms manufacturing in the U.K. Nevertheless, a considerable amount of useful information regarding U.S. firms in the U.K. was obtained and some of this data can be fruitfully compared with the information already available regarding U.K. firms. In addition, we found it possible to make fairly detailed comparisons between the performance of seventeen U.S. and U.K. firms (5).

3. Inter-Firm Efficiency Comparisons: Preliminary Problems

Few words in the English language (and probably in most others) can be more loaded than "efficiency". Since its employment in this context cannot be avoided, the essential first step of our analysis must be to define it as precisely and as unprovocatively as possible. To begin with we must distinguish two general senses in which it can be employed: the first of these is *private* efficiency; the second is *social* efficiency.

If we examine, even rather superficially, the private efficiency of a firm, it is clearly capable of at least two definitions. These arise from the interests of the owners of the enterprise on the one hand and its controllers or managers upon the other.

From the point of view of the owners of the firm (that is the shareholders) it is a plausible first approximation to think of efficiency as a function of two variables:

- (i) the rate of return on shareholders' funds;
- (ii) the risk factor.

Taking the argument one stage further we can argue that:

(a) the rate of return on shareholders' funds is itself determined by:

- (i) the rate of return on total assets;
- (ii) the debt/equity ratio (the gearing) of the firm, while

(5) Details of which have been published elsewhere. See Dunning [7].

(b) the risk element is a function of:

- (i) the variance of the rate of return on total assets, and
- (ii) the debt/equity ratio.

Proceeding one stage further again (b)(i) — the variance of the rate of return on total assets — may be thought of as depending on two groups of factors:

- (a) those arising out of the characteristics of the industry concerned, and
- (b) those arising out of the characteristics of the firm's managers.

This would give, as a first approximation, an efficiency index of shareholders (including potential shareholders) for the i^{th} firm in the j^{th} industry as:

$$[3.1] \quad {}_sE_{ij} = f \left[\frac{P_i}{TA_i}, \frac{D_i}{TA_i}, \sigma_j, \sigma_i \right]$$

where:

${}_sE_{ij} \equiv$ the efficiency index of shareholders

$\frac{P_i}{TA_i} \equiv$ rate of return on total assets

$\frac{D_i}{TA_i} \equiv$ debt/total assets ratio

$\sigma_j \equiv$ "cyclical" variance of $\frac{P_j}{TA_j}$ about its mean when $\frac{P_j}{TA_j}$

is the average rate of return for the industry.

$\sigma_i \equiv$ variance of $\frac{P_i}{TA_i}$ about the industry mean.

This index is, of course, extremely crude. Its definition implies that in valuing the shares of the firm, and thus in determining the flow of new equity capital, the relevant variables are those appearing in [3.1]. This immediately invites the objection that some investigators have found that share values are differentially influenced by distributed and undistributed profits. On this argument the more relevant variable is not $\frac{P_i}{TA_i}$ but that part of $\frac{P_i}{TA_i}$ which, after tax

and depreciation, is in fact distributed. Against this finding it can be argued that the proportion of the net rate of return which is distributed is based on management's assessment of the long-run rate of return net of tax and depreciation. Hence, if tax and depreciation policies are relatively stable, the dividend rate is, given the debt/equity ratio, simply a proxy for the long-run expected $\frac{P_i}{TA_i}$

while allocations to reserves are residual (6).

These problems, though of considerable interest, are not of major importance in this context. Our index, though crude, is simply concerned to suggest that, in valuing firms, shareholders and potential shareholders might well think along the lines it implies. Moreover, an index of this form, or a modification of it, is testable.

The index defined in [3.1] is derived from a very general and probably rather naive hypothesis about the utility functions of shareholders and potential shareholders. Our second index of private efficiency relates not to shareholders but to managers. In general there is no reason to suppose, other than their need (which may be relatively infrequent) to raise funds in the equity market, that the managerial efficiency index should be related to [3.1]. The divorce of ownership from control in modern enterprise is too familiar to need extended comment. To define a managerial index we need to know, or at least formulate plausible hypotheses about, the form of the managerial utility function.

Unfortunately, not much is known about the specification of managerial utility functions (7). An attempt to obtain further information on this point was made in the Questionnaire. The results are tabulated in Table II. From this it seems that managers attach primary importance to the rate of return on total assets. After this appears the growth in sales; and only after this comes the rate of return on shareholders' funds.

This information, though interesting, must nevertheless be treated with some caution (8). The sample from which it is derived consists

(6) The literature on this question is extensive, cf. F. Modigliani and M. H. Miller [15].

(7) For a summary of the work done in this field see O. E. Williamson [19], R. Marris [13] and M. Howe [12].

(8) As regards inter-firm comparisons the point is sometimes made that British and American managers possess significantly different utility functions and that the difference between these is an important factor in determining the relative profitability of the firms they manage. Our information is not adequate to throw any light on the question.

TABLE II
MANAGERIAL EFFICIENCY INDICATORS. RANKING OF IMPORTANCE (% OF FIRMS)

	1st	2nd	3rd	4th	5th	Not listed	Total
Rate of Return on Total Assets	52.8	22.0	10.2	12.6	—	2.4	100.0
Growth of Total Assets	3.1	7.1	18.1	27.6	33.9	10.4	100.0
Rate of Return on Shareholders Funds	16.5	22.8	18.1	20.5	11.8	10.2	100.0
Growth of Sales	25.2	30.7	26.0	15.7	—	2.4	100.0
Growth of Market Share	6.3	15.0	20.5	11.8	18.9	27.6	100.0

Source: Southampton enquiry.

in only 130 U.S. and U.K. enterprises operating in Britain. Moreover, the data is subjective in that it relates to what managers *say* guides their actions not what can, in practice, be shown to guide them. However, these results do accord quite well with those of previous enquiries. Hence as a tentative first approximation it seems reasonable to define the efficiency index of managers as a function of:

(a) the rate of return on total assets $\frac{P_i}{TA_i}$

(b) the rate of growth of sales $\dot{S}_i \equiv \frac{dS}{dt}$

(c) the rate of return on shareholders' funds
and write:

$$[3.2] \quad mE_{ij} = f \left[\frac{P_i}{TA_i}, \dot{S}_i, \frac{D_i}{TA_i}, \sigma_i \right]$$

We have called these two indexes "private" simply because they are derived from the assumed utility functions of two distinct groups of persons identified by both legal and functional relationships with the firm. There is no obvious reason why, if we look at the efficiency of a firm from the social point of view, we should be concerned with either index. This does not, of course, mean that [3.1] and [3.2], assuming they (broadly) reflect the behaviour of the two groups for whom they are defined, have no social relevance. On the contrary [3.1], or some refinement of it, may well influence the flow of capital to firms (and thus the industrial pattern

of growth). Similarly [3.2] will influence managerial decisions and thus the rate of innovation. From the social point of view the forms of [3.1] and [3.2] are of great significance. Nevertheless, in assessing the social efficiency of an enterprise, neither the rate of return on total assets nor the rate of return on shareholders' funds is necessarily an adequate index. Nor, by the same token, is the rate of growth of sales.

Strictly speaking, any attempt to define an index of the social efficiency of an individual firm must involve a detailed assessment, in terms of cost-benefit analysis, of the firm's performance. To put matters formally, define:

$O_{ijm} \equiv$ the quantity of the m^{th} output of the i^{th} firm in the j^{th} industry

$P_{ijm} \equiv$ the price of the m^{th} output.

so that:

$$\sum_{m=1}^{m=s} O_{ijm} P_{ijm} \equiv \text{value added of the firm:} \quad m = 1, 2, \dots, s$$

Next define:

$X_{ijk} \equiv$ quantity of the k^{th} input of the i^{th} firm in the j^{th} industry: $k = 1, 2, \dots, r$

and:

$\bar{P}_{ijk} \equiv$ {the price of a unit of the k^{th} input of the i^{th} firm in the j^{th} industry: $k = 1, 2, \dots, r$

so that:

$$\sum_{k=1}^{k=r} X_{ijk} \bar{P}_{ijk} \equiv \text{total cost of the firm's inputs}$$

Lastly define:

$\hat{S}_{ijb} \equiv$ value of the social benefits generated per period by the firm

$\hat{S}_{ijc} \equiv$ value of the social costs generated per period by the firm.

Then our index of social efficiency \hat{E}_{ij} is given by:

$$[3.3] \quad \hat{E}_{ij} \equiv \frac{\sum_{k=1}^{k=r} X_{ijk} \bar{P}_{ijk} + \hat{S}_{ijc}}{\sum_{m=1}^{m=s} O_{ijm} P_{ijm} + \hat{S}_{ijb}}$$

and measures the social cost, on a number of assumptions which we have not yet examined, of producing a unit of social value output.

Since the purpose of the index is precisely inter-firm comparisons we need to assume that:

- (i) all the P_m and \bar{P}_m are the same for each firm within the j^{th} industry, and
- (ii) the O_m and X_k are homogenous for each firm within the same industry.

Provided these assumptions are satisfied then [3.3] defines an acceptable index of the social efficiency, in any given period, of the firm under observation.

The index [3.3] is, of course, static. It tells us nothing about the direction or rate of change of the firm's social efficiency. A simple dynamic index to meet these requirements can, however, readily be defined in terms of [3.3] as:

$$[3.4] \quad \hat{E}_{ij}^t \equiv \frac{\hat{E}_{ij}^{(t)} - \hat{E}_{ij}^{(t-1)}}{\hat{E}_{ij}^{(t-1)}}$$

which gives the relative rate of change of social efficiency for the firm between periods t and $t-1$ (9).

Logically [3.3] and its dynamic variant [3.4] are acceptable indexes, given the assumptions set out earlier, of the social efficiency of the firm and its rate of change. They raise, however, three important difficulties. The first of these arises because, granting their acceptability, they may, as a matter of fact, be only very loosely related to the indexes of private efficiency defined in [3.1] and [3.2]. Since these are assumed to influence the behaviour of managers and investors, this would mean that maximising behaviour on the part of these two groups, even if successfully conducted, would not necessarily increase social efficiency.

The second and third difficulties are essentially ones of measurement. In the first place social costs and social benefits are not readily given operational definition. In the second there are, even

(9) A method similar to this has been applied to industry data by Reddaway and Smith [16] and Dunning and Utton [9].

given the definition, considerable problems of measurement. Hence, though social costs and benefits may well differ significantly between firms in the same industry, it is necessary to exclude them and work with a truncated index.

We can thus argue that, if the truncated version of [3.3] namely

$$[3.3^*] \quad \bar{s}E_{ij} = \frac{\sum_{k=1}^{K=r} X_{ijk} \bar{p}_{ijk}}{\sum_{m=1}^{m=s} O_{ijm} p_{ijm}}$$

is to be useful we need to show that, in practice, low values of [3.3*] are associated with high values of [3.1] and [3.2] or their principal components. If it can be shown that such an association exists then two conclusions follow:

- (i) our index has a behaviouristic significance consistent with the *modus operandi* of the market mechanism, and
- (ii) where measurement of [3.3*] is not possible it can be replaced by some more readily measurable variable which is a principal component in [3.1] and [3.2].

4. Inter-Firm Efficiency: Some Alternative Measures

Now that we have defined our index [3.3*] it is worthwhile to give a very brief account of its relationship to other commonly used indexes of social efficiency. The discussion which follows is not meant to be exhaustive and, in theoretical terms, is elementary. Nevertheless a short illustrative account may be beneficial.

Suppose for each of the firms (call them A, B) producing the homogenous products ($O_1, O_2 \dots O_m$) and employing only two factors of production, homogenous capital (K) and homogenous labour (L) in the process, we have observations (which are known to be correct) of the following variables:

$$\sum_{m=1}^{m=n} O_m p_m \equiv \text{gross value added} \equiv Op$$

$$\bar{K}p_k \equiv \text{gross value of the capital stock}$$

$$L \equiv \text{labour input}$$

$$w \equiv \text{money wage rate of labour}$$

We can then define the following familiar ratios:

$$(i) \text{ labour productivity index} \equiv \frac{Op}{wL} \equiv \gamma \equiv \text{value added per unit of labour ... [4.1]}$$

$$(ii) \text{ capital productivity index} \equiv \frac{Op}{Kp_k} \equiv \delta \equiv \text{value added per unit of capital ... [4.2]}$$

$$(iii) \text{ profitability index} \equiv \frac{Op - wL}{Kp_k} \equiv \Pi \equiv \text{rate of profit per unit of capital ... [4.3]}$$

Our index [3.3*] becomes, in this notation,

$$[4.4] \quad \alpha \equiv \bar{s}E \equiv \frac{wL + q^*Kp_k}{Op}$$

where q^* is the social "cost", in a sense to be defined, of employing a unit value of capital over the accounting period for which we have data. Assume also that q^* is measurable and known. We can now, by means of a simple diagram, depict the relationship between the indexes defined in [4.1] ... [4.4].

In Figure 1, for unit value output, we have plotted assumed values of:

$$Kp_k \text{ and } wL \text{ for firms A and B;}$$

these values define the points A and B on the diagram.

Suppose also, as is perfectly possible, that for the period of observation,

$$\Pi_A = \Pi_B$$

that is both firms have an identical observed rate of profit.

Then:

$$\text{since } \frac{Op_A}{wL_A} > \frac{Op_B}{wL_B} \text{ by [4.1] firm A is more efficient}$$

$$\text{since } \frac{Op_B}{Kp_k} > \frac{Op_A}{Kp_k} \text{ by [4.2] firm B is more efficient}$$

since $\Pi_A = \Pi_B$ by [4.3] both firms are equally efficient.

On this basis, none of the ratios [4.1] to [4.3] is very helpful individually. Together they simply confuse. Observing all three

FIGURE 1

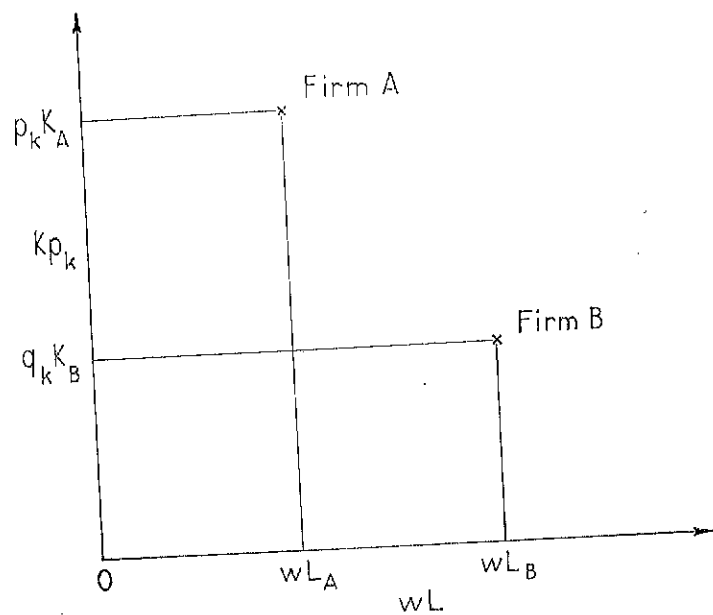
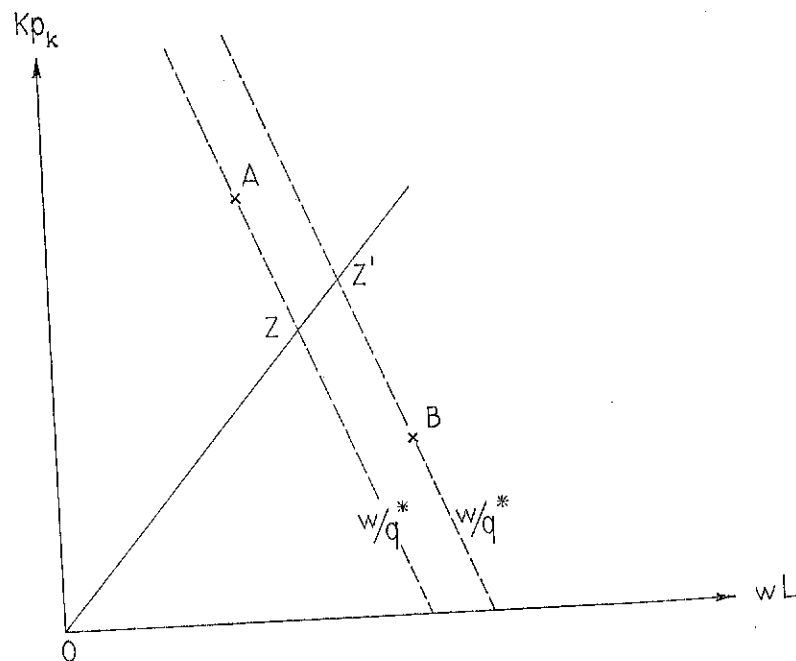


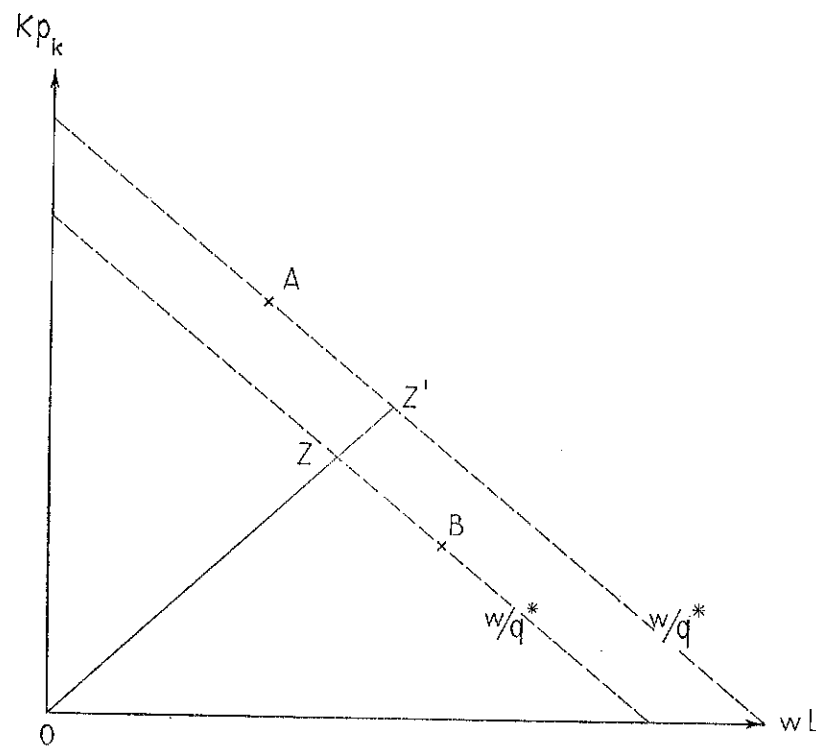
FIGURE 2



does not help us in the least to rank the firms ordinarily or cardinally.

The point at issue is, of course, extremely simple and familiar. Until the relative cost of the two inputs is known it is impossible

FIGURE 3



to say, ordinarily or cardinally, which firm is the more efficient unless the following pairs of inequalities holds:

$$[4.4] \quad \frac{Op_A}{wL_A} > \frac{Op_B}{wL_B} \text{ and } \frac{Op_A}{K_{Apk}} \geq \frac{Op_B}{K_{Bpk}}$$

If this holds then A is more efficient than B. In addition, Π_A will then be greater than Π_B . Two, or if both [4.4] are inequalities, all three criteria will rank A above B. However there need not be, and in general will not be, any common cardinal ranking.

Consider now the meaning of our own index. In Fig. 2 we have simply added to Fig. 1 two lines constructed with slope w/q^* . One of these lines passes through A, the other through B. Each line defines the total social cost of unit value production by A and B. Two points are now clear:

- (i) Firm A is more efficient than Firm B (although, by assumption $\Pi_A = \Pi_B$), and
- (ii) the ratio OZ/OZ' provides a cardinal ranking of the two firms.

Clearly, as we have done in Fig. 3, had we chosen a different slope w/q^* , it would have been Firm B which was the more efficient. Equally clearly if $q^* = \Pi_A = \Pi_B$ then both firms would have been equally efficient.

This discussion, of course, does no more than reiterate the familiar point that [4.1] and [4.2], since they each implicitly define efficiency in terms of minimising the input of a single factor, are conceptually inadequate. The use of the profitability criterion [4.3] is free from criticism on this score. Nevertheless the observed rate of profit, as we have seen, is not necessarily a good indicator, either ordinally or cardinally, of the relative efficiency of firms. By contrast α , as defined in [3.3*] and [4.4] is an acceptable index of static efficiency. However, since α is defined in terms of q^* — a non observable variable — it remains to be seen whether it can be made operational.

From this discussion the rationale of our approach becomes clear. Our procedure is:

- (a) to regard α (a simple approximation to [3.3*]) as an appropriate index of efficiency, and

- (b) after estimating α for each firm to compare it with:

- (i) $\frac{Op}{wL} \equiv \gamma$ (the index of labour productivity)
- (ii) $\frac{Op}{Kp_k} \equiv \phi$ (the index of capital productivity), and
- (iii) $\frac{Op - wL}{Kp_k} \equiv \Pi$ (the index of profitability)

in order to examine how far, if at all, each of these variables is correlated with α and thus capable, where data do not permit the measurement of α , as acting as a proxy for it.

Before carrying out this exercise, however, it seems desirable to undertake a short digression setting out some possible alternative approaches to measuring the economic efficiency of the firm.

5. Alternative Approaches to Measuring Efficiency

Economic theory implies that we should distinguish three elements in determining the relative efficiency of two firms in the same industry. These are:

- (a) relative technical efficiency which arises because one firm possesses a production function which, for all possible ratios of factor prices, requires less inputs to generate a unit of output;
- (b) relative allocative efficiency which arises because one firm selects its minimum cost combination of factor inputs for a given set of factor prices while the other does not;
- (c) relative scale efficiency where one firm selects the optimal (least cost) scale of production and the other does not.

Where constant returns to scale is the rule and the most efficient production function is known (or computed from the data) it is possible, as M. J. Farrell has shown, to provide precise indexes of relative technical and allocative efficiency (10). This is illustrated, following Farrell, in Figure 4 where:

- (i) the relative technical efficiency of firm A in relation to Firm B is given by the ratio OL/OB
- (ii) the relative allocative efficiency is given by OA/OL , and
- (iii) the relative overall efficiency is given by the product of these OA/OB .

There are two types of difficulty inherent in this approach. The first is the amount of information required. This is illustrated in Fig. 4 where it is clear that, to give a precise meaning to technical and allocative efficiency we need to know:

- (a) the ratio q^*/w , and
- (b) the production function of the more efficient firm 'A' in order to construct the isoquant $A'A'$.

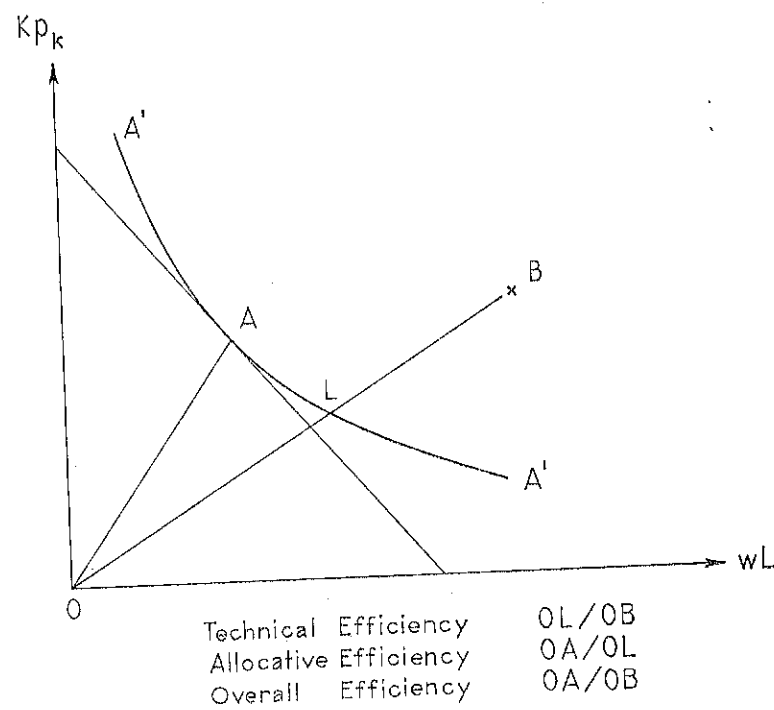
(10) M. J. Farrell [10].

Beyond this, if comparisons are to be made over a group of firms constituting an industry, we need:

(c) to establish one firm as the most efficient in the industry, and

(d) to postulate that there is a single most efficient production function within the industry.

FIGURE 4



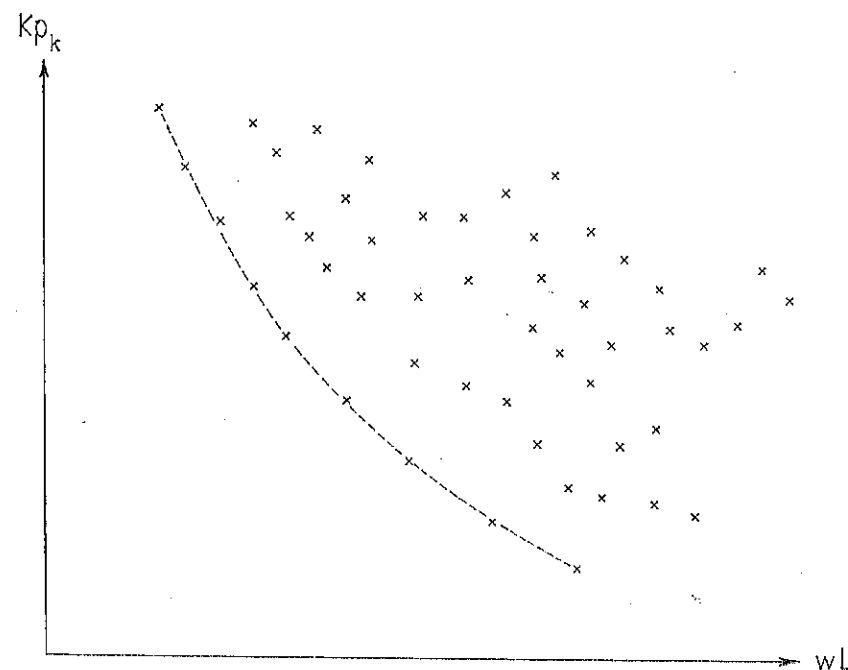
These difficulties are illustrated in Fig. 5. Suppose, assuming constant returns to scale, that for each firm in industry K, we observe for all i firms:

- (i) $\frac{K_i p_k}{O p_i} \equiv$ capital stock associated with unit value output
- (ii) $\frac{w L_i}{O p_i} \equiv$ labour cost associated with unit value output.

These observations define, for each firm, a point in the plane $\frac{K_i p_k}{O p_i}$ and $\frac{w L_i}{O p_i}$. They thus generate a scatter diagram of the form of Fig. 5.

Now along any line drawn from the origin, the ratio $K_i p_k / w L_i$ is constant. For this given ratio, the most efficient firm is that

FIGURE 5



located nearest the origin. A line joining the observations of all such firms, for all observed $\frac{K_i p_k}{w L_i}$ can be regarded as the "efficiency frontier" of the industry. This frontier is shown by the dotted line. Given this frontier it is possible to compare the efficiency of any two firms with the same $\frac{K_i p_k}{w L_i}$ ratio. That is to obtain an index of technical efficiency.

As between firms *on* the frontier, no comparison is possible unless the ratio q^*/w is known. Even if it is known, it is entirely

possible that two firms on the frontier may display identical efficiency either because the superior allocative efficiency of one offsets the superior technical efficiency of the other or because two (or more) firms have a minimum cost combination, given q^*/w , which differs because their production functions differ. To unambiguously interpret the comparative efficiency of a group of firms we must know the specification of their production functions and not simply be able to identify a point (or points) upon them.

If we know the production functions of all firms then, assuming constant returns to scale, we can, for any given value of q^*/w calculate, for each firm, the minimum social cost of producing unit value output. We can then define the relative technical efficiency of firms A and B as:

(a) the ratio of the minimum total costs of A to the minimum total costs of B for unit value output given q^*/w ; and measure the allocative efficiency of any firm by

(b) comparing its observed $\frac{K_i p_k}{w L_i}$ ratio with the optimal ratio, given q^*/w , defined by its production function.

It should be noted that, even if the production function of each firm is known, the most efficient firm is defined only for a given q^*/w , or more probably for a given range of values of q^*/w . For the production contours of different firms for unit value output may easily cut. If they do then, beyond certain critical values of q^*/w , the efficiency ranking may be reversed. Logically, therefore, this approach, to be helpful, requires us to:

(a) have knowledge of the production functions of all firms, and

(b) set (or calculate) a value for q^*/w .

In principle it should be possible to estimate the production functions of each firm within an industry. However, in order to be able to discriminate between various plausible forms of the production function and obtain worthwhile estimates of its parameters, there must be an adequate number of observations of both output and factor inputs.

In practice we have far too few observations, commonly 3 or 4, to permit us to undertake an exercise of this kind. Moreover, price indexes for the inputs and outputs of individual industries are not

always available. Thus shortage of data (and its shortcomings) make it impossible to estimate firms' production functions even if, as we would be loath to do, we restricted ourselves, for convenience, to production functions of a given type (say the familiar Cobb-Douglas) and reduced the number of parameters to be estimated by assuming that labour was always paid its marginal product. Indeed even if we accept a number of special assumptions of this kind, each of which has its cost, our data are still too scanty to make estimation along these lines worthwhile.

On the other hand, our proposed index of efficiency (α) is defined in such a way that it is:

(a) independent of assumptions about the form of the production function of any firm;

(b) independent of assumptions regarding managerial behaviour;

(c) independent of the assumption that the firm is in complete equilibrium (marginal products of both factors equal to their marginal real costs) or partial equilibrium (marginal product of labour equal to the real wage rate).

Admittedly α , to be measurable, requires an assumed value of q^* . But, as we have seen, this is also true for cardinal inter-firm efficiency comparisons which employ either a modification of the Farrell technique or depend upon the estimation of a production function for each firm.

We therefore conclude that the employment of α as an index of the static social efficiency of the firm has a great deal to recommend it on the grounds of:

(a) its simplicity;

(b) its small information requirements, and

(c) its independence of special or even general assumptions.

6. Methods of Relating α to Alternative Indexes of Efficiency

Our index of social efficiency is defined as:

$$\alpha = \frac{wL_i + q^*Kp_k}{Op}$$

Our problem is to examine the relationship between this and three alternative indexes namely:

$$(i) \Pi \equiv \frac{Op-wL}{Kp_k}$$

$$(ii) \gamma \equiv \frac{Op}{wL}$$

$$(iii) \phi \equiv \frac{Op}{Kp_k}$$

Of these we would prefer the relationship between α and Π to be the closest for, as we have seen, there is some reason to suppose that Π influences the behaviour of both shareholders and managers and thus the dynamic social process of increasing industrial efficiency.

Within the limitations imposed by our data Π , the exact value of which will depend on the definitions of Kp_k (11), γ and ϕ are generally observable. α , which depends upon the value of q^* is not. We need therefore to give careful consideration to the value or values we propose to assign to q^* .

Notionally q^* is the social cost of employing a value unit of capital in one use rather than in another over the accounting period of a year. It is thus the social opportunity cost of capital.

One way of defining q^* is therefore to equate it to the minimum rate at which an enterprise can borrow. This is probably, for enterprises in general, commonly the rate charged on bank advances. This rate, of course, varies over time. In recent years it has rarely, if ever, been below 5 per cent. We can thus define a minimum value of q^* as:

$$q^*_{\min} = 5 \text{ per cent.}$$

The justification for setting the minimum value of q^* at this low level is twofold:

- (a) enterprises can often borrow at rates close to this figure but rarely at rates significantly below it, and
- (b) where risk factors are negligible then a management seeking to maximise profits would clearly tend to employ capital until its marginal yield was equal to the minimum rate at which it could borrow.

(11) For a discussion of four variants of Π see Section 7, p. 26 ff.

Let us now look at the other end of the spectrum. Since it is the social opportunity cost of capital which we are attempting to value there are clearly good reasons for arguing that this is correctly estimated by the highest gross operating profit which can be earned on total assets in any use. Rates of return of over 50% are not unknown. Hence even if a very substantial discount is made for the excess of private over social risks, this suggests a social opportunity cost of the order of 30-40%.

At first sight this argument is persuasive. On the other hand our very definition of α requires a social opportunity cost for capital which is of *general* applicability. Rates of return of the order of 50% or more are not unknown. They are, however, uncommon and occur only in disequilibrium situations or where there are peculiar social or institutional constraints on the mobility of capital. To permit them to provide a numerical estimate of q^* would imply that those rates were of general applicability. This is not the case.

If we look at published data on the profits earned (gross of tax and depreciation) on total assets (at book value) by the leading public companies in U.K. industry in recent years (12), these seem to lie, in the main, between 15-19%. These rates are, of course, the averages for industries. In any industry the rates for individual firms are distributed about the mean. If the rate earned by firms in the upper quartile is taken and a rough allowance made for the excess of private over social risk, this would give us a social opportunity cost of capital on total assets at book value of the order of 15-20%.

It thus seems not unreasonable to put the upper value of q^* ($\equiv q^*_{\max}$) at 20% and the most plausible value at 15%.

We thus arrive at three possible values for q^* :

$$q^*_{\min} = 5\%$$

$$q^*_{\text{mid}} = 15\%$$

$$q^*_{\max} = 20\%$$

Hence, for each firm, there are three values of α which can be calculated.

The value of α depends not only on q^* but also upon the value placed on capital. Data obtained in the enquiry enables us to com-

(12) Viz 1950/65. See Ministry of Labour [14].

pute various estimates of the value of capital employed by an enterprise. We have chosen to examine two in detail. The first is:

$$K_{pk} \equiv \text{Net Fixed Assets (book value) + Current Assets (book value).}$$

The second attempts to correct for the well known shortcomings of book valuations by making use of the insurance valuations of both fixed assets and inventories. Data on insurance valuations were obtained in the Questionnaire. We thus obtain an estimate of the revised value of capital as:

$$K_{pkr} \equiv \text{Net Fixed Assets (Insurance Valuation) + Current Assets + Inventories (Insurance Valuation) — Inventories (Book Value).}$$

Since each estimate of α can be constructed on the basis of either K_{pk} or K_{pkr} , we now have six possible values of α .

By their definition, both Π and α can be calculated on the basis of either capital estimate.

We now consider the problems of calculating — or more strictly — interpreting γ the labour productivity index.

The data obtained from our Questionnaire gives information not only on wL (\equiv employee compensation) for each firm but also on L (\equiv the number of employees). For any two firms in the same industry, since our method is essentially a cross section rather than a time series study, unless there are strong reasons for thinking that the firms face demand schedules of significantly differing elasticities we can then calculate either γ as we have defined it or the more familiar index:

$$\frac{Op}{L} \equiv \frac{\text{value added}}{\text{number of employees}} \Bigg\} \equiv \gamma^*$$

These indexes will give the same result only if w is invariant between firms.

In practice w is not invariant between firms in the same industry. We need, therefore, to make some assumption which justifies our selection of γ rather than γ^* .

The simplest assumption, which we have not tested, is that firms in general tend to pay each employee his or her marginal value product (13). If this assumption is made then, where two firms have different values of wL but identical numbers of employees, the inference is that this is to be explained by the firm with the

higher wage bill choosing to employ a more productive labour force and paying the same rate as its rivals not for labour measured by the number of employees, but for labour measured in efficiency units. In this case wL is an index of some notional variable $L^* \equiv$ labour input measured in efficiency units.

It is not, of course, difficult to think of objections to this assumption. One firm may pay an average wage per "efficiency employee" greater than another for a variety of reasons of which managerial inefficiency may be one. Nevertheless the assumption seems acceptable as a first approximation (13).

Given this assumption it is clearly necessary to use γ and not γ^* as our index of labour productivity.

7. The Relationship between α and Π

Before summarising the relationship between these variables revealed in our data it may be worthwhile to recall briefly what we are attempting to test.

We have argued that α is a theoretically acceptable index of the static social efficiency of an enterprise. If this is so and can, in fact, be shown to be closely related to Π we can accept, provisionally, that:

- (i) Π is related to social efficiency, and
- (ii) where α is not calculable Π may be used as a proxy for it.

From (ii) it further follows that if two firms exhibit differing rates of profit on capital (Π) we may infer that the probability is that the firm with the higher rate of profit is the firm with the higher social efficiency — though not necessarily in the same proportion.

Finally (i) implies that the market processes, provided shareholders' and managers' utility functions are of the types assumed earlier, do in fact tend to both static and dynamic social efficiency.

By definition α and Π should be negatively related since the former is an index of the social cost of producing unit value output and the latter is the rate of profit. In general, however, in the absence of any assumptions regarding the forms of firms' production

(13) Tests were made [See Section 7] imputing the average earnings per employee in the industry in which the competing firms were operative. They did not materially affect the rankings of α .

functions, we cannot put forward any *a priori* expectation regarding the form of the relationship.

Since α is the social cost of producing unit value output we can, on the assumption that K_{pk} is a superior measure of the real capital employed by a firm to K_{pk} , confine our attention to values of α based upon it. Our first task is therefore to test the relationship between:

$$\left. \begin{array}{l} \alpha_r (q^* = 0.05) \\ \alpha_r (q^* = 0.15) \\ \alpha_r (q^* = 0.20) \end{array} \right\} \text{and } \Pi \text{ and } \Pi_r$$

where the suffix *r* indicates that K_{pk} has been replaced by K_{pk_r} .

A scatter diagram of observations of α_r (0.15) and Π_r for the two years 1960-61 suggests that the relationship between the two is well approximated by either of the following forms:

$$\Pi_r = a \log \alpha_r$$

$$\Pi_r = a^1 + \frac{b}{\alpha_r}$$

These observations, which are for all industries, also suggest that to either of these forms the fit will be close.

In the Table below we set out the correlation coefficients between α_r and Π_r for each of the years 1958-61 for all the firms British and American for which we have usable data.

TABLE III
CORRELATION BETWEEN α_r AND Π_r
1958-1961

	$\Pi_r = a^1 + \frac{b}{\alpha_r}$				$\Pi_r = a \log \alpha_r$			
	1958	1959	1960	1961	1958	1959	1960	1961
α_r (0.05) . . .	0.909	0.897	0.945	0.955	-0.915	-0.748	-0.879	-0.910
α_r (0.15) . . .	0.967	0.924	0.981	0.979	-0.942	-0.746	-0.895	-0.894
α_r (0.20) . . .	0.968	0.925	0.985	0.979	-0.922	-0.733	-0.885	-0.874
No. of observations	78	79	86	90	78	79	86	90

From this Table two provisional inferences may be drawn:

- (i) the linear relationship between Π and $1/\alpha$ provides a better fit than the semi-logarithmic relationship between Π and α , and
- (ii) for each of the four years for which we have data α_r is closely related to Π_r particularly when q^* is given the value of 0.15 or 0.20 (14).

It is also clear that a comparison of firms by profit rates tends to overstate relative social efficiency. For example a fall in α_r from 1.0 to 0.5, which is a doubling of efficiency, will, in general, be associated with an increase in the rate of profit Π_r from 10 per cent to close to 35 per cent.

On the basis of Table III it seems that, with some reservations, we may regard Π_r as an acceptable proxy for α_r . Unfortunately Π_r is not always measurable since the insurance valuation of fixed assets and inventories is not in general available. We therefore need to see how close a relationship exists between α_r — the efficiency index — and alternative measures of Π which can be derived from published data. These alternative definitions of Π are:

$$\Pi_1 \equiv \text{Profits/Total Assets (net of depreciation)}$$

$$\Pi_2 \equiv \text{Profits/Total Assets (gross of depreciation)}$$

$$\Pi_3 \equiv \text{Profits/Net Assets}$$

$$\Pi_4 \equiv \text{Profits/Net Assets (gross of depreciation).}$$

Of these four definitions Π_2 and Π_4 require a word of comment. It is a commonplace that depreciation policies differ between enterprises. It follows that where any estimate of the capital stock net of depreciation is employed to calculate a variant of Π the results may be seriously distorted by the cumulative effect of differing depreciation policies. Where figures for accumulated depreciation are available some attempt to eliminate this possible source of bias can be made by adding accumulated depreciation to the net capital stock estimates. Admittedly, since Π_1 - Π_4 all depend on book values, other important sources of bias may still be present in the figures. But

(14) It is worth noticing that the values of α are not very sensitive to estimates selected for q^* .

this, though unavoidable, is not a good reason for failing to attempt some correction for variation in depreciation policies.

In the Table below we give the correlation between α_r (0.15) and Π_1 - Π_4 as well as the correlation between Π_r and Π_1 - Π_4 .

TABLE IV

Year	Correlation Coefficients of α_r with $q^* = 0.15$ and $\Pi_1 = a' + b/\alpha_r$				Correlation Coefficients of Π_r and			
	Π_1	Π_2	Π_3	Π_4	Π_1	Π_2	Π_3	Π_4
1958	0.907	0.936	0.788	0.823	0.941	0.967	0.866	0.890
1959	0.951	0.969	0.907	0.924	0.975	0.987	0.922	0.928
1960	0.939	0.971	0.838	0.950	0.957	0.984	0.857	0.957
1961	0.963	0.973	0.931	0.948	0.979	0.988	0.954	0.966

The first comment on this Table is that all of the Π variants particularly the two total assets concepts — Π_1 and Π_2 — are very closely related to Π_r . This is helpful and, at the same time, a little surprising since only in the case of one firm was the book value and insurance value of capital the same while only 10 firms in our sample had revalued their assets.

The second point which emerges is that all the Π variants, despite their being based upon book values, are about as closely related to α_r as Π_r . This implies that if Π_r is an acceptable proxy for α_r to too are Π_1 and Π_2 . This is an important point since one or the other of these concepts can be fairly readily calculated for many firms from published data.

On the basis of these calculations we can reach the following provisional conclusions:

- (i) a close relationship between α_r and Π_r exists for each year for which we have data;
- (ii) the relationship is least close for 1958;
- (iii) in each year the relationship is significant at the 1% level or below;

- (iv) the form of the relationship is probably best expressed by the function:

$$\Pi_r = a' + \frac{b}{\alpha_r} \text{ where } a' < 0;$$

- (v) hence, in comparing the social efficiency of firms on the basis of profit rates, the relative efficiency of those with the greater profit rate tends to be overestimated;
- (vi) provided we use profit rates based upon total assets (defined either gross or net of accumulated depreciation) the relationship between rates of profit on book values of assets and α_r seems to be about as close as that for Π_r ;
- (vii) if the relationship between α_r and Π_r is taken to be sufficiently close to justify the use of Π_r as a proxy for α_r then little distortion of results is likely if any of the Π variants are used instead of Π_r .

The calculations which we have reported above compared α_r and Π for a sample of approximately 90 firms operating in different industries. As a test of the relationship between α and Π this is unobjectionable. Unfortunately when comparisons are made across industries it is not possible to accept α_r as an index of efficiency. This is so because if, in two industries, the degree of monopoly possessed by firms in the two industries differs — as it may — α will reflect this since its denominator is value added which is a function of price and which, as a result, for any given social cost per unit of real output, will be lower per unit value output in the more monopolistic industry. Since Π will be correspondingly higher this will not weaken the α , Π relationship. It does, however, invalidate the use of α as an index of social efficiency across industries.

Accordingly we need to show that, in addition to the relationship between α and Π which exists *across* industries, a similar relationship exists between firms in the same industry. To this end the data has been re-examined on the basis of the following industrial groups for which a sufficient number of observations exist to permit the calculation of correlation coefficients:

- (i) Food, Drink and Tobacco;
- (ii) Chemicals;
- (iii) Non-Electrical Engineering.

The results of this further investigation are set out in the Tables below.

TABLE V

		1. FOOD, DRINK AND TOBACCO							
		$\Pi_r = a_1 + b_1/\alpha$				$\Pi_1 = a_{11} + b_{11}/\alpha$			
		1958	1959	1960	1961	1958	1959	1960	1961
$q^* = 0.05$	0.949	0.953	0.937	0.996	0.819	0.818	0.736	0.939	
$q^* = 0.15$	0.999	0.998	0.943	1.000	0.676	0.655	0.686	0.932	
$q^* = 0.20$	0.999	0.996	0.941	0.999	0.628	0.605	0.671	0.929	
N	6	6	6	6	6	6	6	6	
		2. CHEMICALS							
		$\Pi_r = a_j + b_j/\alpha_r$				$\Pi_1 = a_{1j} + b_{1j}/\alpha$			
		1958	1959	1960	1961	1958	1959	1960	1961
$q^* = 0.05$	0.950	0.965	0.971	0.982	0.921	0.953	0.969	0.978	
$q^* = 0.15$	0.986	0.989	0.989	0.994	0.964	0.979	0.986	0.988	
$q^* = 0.20$	0.992	0.993	0.993	0.996	0.972	0.984	0.989	0.990	
N	14	15	16	17	14	15	16	17	
		3. NON-ELECTRICAL ENGINEERING							
		$\Pi_r = a_k + b_k/\alpha$				$\Pi_1 = a_{1k} + b_{1k}/\alpha$			
		1958	1959	1960	1961	1958	1959	1960	1961
$q^* = 0.05$	0.849	0.818	0.777	0.774	0.813	0.701	0.602	0.699	
$q^* = 0.15$	0.954	0.963	0.955	0.874	0.883	0.877	0.745	0.842	
$q^* = 0.20$	0.944	0.956	0.966	0.876	0.868	0.885	0.753	0.857	
N	29	29	29	36	29	29	32	36	

Extensive comment on these results is probably not necessary. It is clear, however, that the relationship between α and Π_r remains a very close one. On the other hand the relationship between α and a measure of profit rates related to unadjusted valuations of the capital stock is a good deal less close — particularly in the case of Food, Drink and Tobacco.

In this case, with only six observations, the results are of very dubious value. It is thus not unreasonable to conclude that, such as they are, the results for the three identifiable industry groups do not seriously weaken our two main conclusions that:

- (i) Π_r and α are sufficiently closely related for the former to be regarded as a useful proxy for the latter, and
- (ii) where estimates of Π_r cannot be obtained any of the variants of Π , and particularly Π_1 or Π_2 may be provisionally accepted as a proxy.

One point remains to be established in this section — namely that α and Π exhibit significant variation: that is that there is considerable variation in social efficiency. A statistic which can, with reservations, be used to establish this is the coefficient of variation. This statistic is defined as:

$$V \equiv \frac{\text{Standard Deviation}}{\text{Mean}} \equiv \frac{\sigma}{M}$$

and it obviously needs to be interpreted with caution where the mean of any series is close to zero.

TABLE VI
COEFFICIENT OF VARIATION
(All Firms)

	Variable	1958	1959	1960	1961
$1/\alpha$	$q^* = 0.20$	0.424	0.613	0.686	1.130
$1/\alpha$	$q^* = 0.15$	0.439	0.639	0.680	1.110
Π_r	—	0.834	1.021	0.998	2.558
Π_2	—	0.932	0.941	0.943	2.425

Finally it is worth asking whether, in view of their high correlation both across all industry and within an industry, the index α often yields an index of efficiency substantially different from that which would be inferred from Π or, more precisely, whether the use of α would seriously change the efficiency ranking of a firm which would be inferred from its observed Π . Clearly since the correlation between α and Π is high, such cases could not be plentiful. Nevertheless examination of the data readily reveals a number of such cases. It is equally simple to find cases in which,

though earning identical observed rates of profit, firms are of considerably different social efficiency according to our index.

These points are not without interest. In the first place they remind us that α and Π , though related by definition, are not necessarily closely correlated. A firm can raise its profit rate while reducing its efficiency, and increase its efficiency while reducing its profit rate. But precisely because this can and does happen, the use of observed profit rates as indexes of social efficiency between pairs of firms is a dangerous proceeding. For comparisons between the two or more reasonably large groups of firms Π in one of its variants may be an acceptable proxy for α . But for comparisons between small groups — or at the limit between pairs of firms — the use of Π is far more hazardous. Wherever possible comparisons of this kind should be supplemented by comparisons using α_r . If this cannot be done they need to be treated with very considerable reserve.

8. Alternative Measures of Efficiency

So far this study has set out to establish that, on the assumption that α is an acceptable approximation to a theoretically correct measure of static efficiency, then where α cannot be measured it may plausibly be approximated by either Π_r or one of the Π variants. This enables us to argue that if two firms record different Π_r there is a probability that the firm with the higher value of Π_r is the more efficient.

We now turn to a second issue — the relative performance of alternative measures of efficiency noted in Section 6 namely:

$$\gamma \equiv \frac{Op}{wL} \equiv \text{Value added per efficiency unit of labour}$$

$$\phi \equiv \frac{Op}{Kp_k} \equiv \text{Value added per unit of capital}$$

and, on rather weaker assumptions

$$\gamma^* \equiv \frac{Op}{L} \equiv \text{Value added per worker employed.}$$

The theoretical inadequacy of these measures has already been discussed briefly. It remains, however, to investigate empirically whether they are, in practice, related to α or Π_r . The information

bearing on these matters is set out below. Because of lack of observations, information relating to the Food, Drink and Tobacco industry has not been used.

Examination of the results for all firms makes it clear that two measures, namely:

$$\gamma^* \equiv \frac{Op}{L} \text{ and}$$

$$\phi \equiv \frac{Op}{Kp_k}$$

perform relatively poorly. On the other hand the remaining two measures:

$$\gamma \equiv \frac{Op}{wL} \text{ and}$$

$$\phi_r \equiv \frac{Op}{Kp_{kr}}$$

display a useful degree of correlation with both $\frac{I}{\alpha}$ and Π_r though

these correlations are less high than that of $\frac{I}{\alpha}$ with Π_r .

This impression is confirmed by the data for the Chemical industry for which even ϕ (value added as a percentage of the book value of capital) shows a useful correlation. Data for the Non-Electrical Engineering industry, on the contrary, shows that all four measures perform extremely poorly, though, as before, γ and ϕ_r provide a higher measure of correlation than γ^* and ϕ .

The conclusions which can be drawn from this brief examination are these:

- (i) none of the four alternative measures of "efficiency" performs as well (in terms of correlation with $\frac{I}{\alpha}$) as Π_r ;
- (ii) their performance is unreliable;
- (iii) the two measures which give the most useful performance (γ and ϕ_r) depend upon:
 - (a) the availability of data on the wage bill, and
 - (b) data on the insurance value of fixed capital and stocks;

ALTERNATIVE MEASURES OF EFFICIENCY
(All Firms: British and American)

TABLE VII

	Correlations with $\frac{I}{\alpha}$ $q^*=0.15$				Correlations with Π_r			
	1958	1959	1960	1961	1958	1959	1960	1961
	γ^* . . .	0.672	0.789	0.730	0.736	0.670	0.778	0.710
γ . . .	0.803	0.935	0.926	0.894	0.789	0.890	0.875	0.812
\varnothing . . .	0.396	0.537	0.492	0.566	0.308	0.544	0.503	0.510
\varnothing_r . . .	0.726	0.815	0.786	0.794	0.650	0.829	0.819	0.767
N . . .	78	79	86	90	78	79	86	40

ALTERNATIVE MEASURES OF EFFICIENCY
(Chemical Industry)

	Correlations with $\frac{I}{\alpha}$ $q^*=0.15$				Correlations with Π_r			
	1958	1959	1960	1961	1958	1959	1960	1961
	γ^* . . .	0.699	0.799	0.777	0.864	0.736	0.787	0.787
γ . . .	0.950	0.971	0.982	0.987	0.893	0.928	0.948	0.967
\varnothing . . .	0.882	0.943	0.949	0.960	0.918	0.973	0.977	0.976
\varnothing_r . . .	0.943	0.957	0.954	0.968	0.977	0.987	0.936	0.987
N . . .	14	15	16	17	14	15	16	17

ALTERNATIVE MEASURES OF EFFICIENCY
(Non-Electrical Engineering)

	Correlations with $\frac{I}{\alpha}$ $q^*=0.15$				Correlations with Π_r			
	1958	1959	1960	1961	1958	1959	1960	1961
	γ^* . . .	0.511	0.418	0.637	0.705	0.482	0.366	0.488
γ . . .	0.702	0.589	0.713	0.608	0.646	0.536	0.560	0.550
\varnothing . . .	0.310	0.326	0.227	0.396	0.213	0.258	0.210	0.334
\varnothing_r . . .	0.582	0.668	0.538	0.615	0.520	0.634	0.602	0.650
N . . .	29	29	32	36	29	29	32	36

Note: N ≡ number of observations.

- (iv) hence where \varnothing_r is calculable Π_r will usually also be calculable and is to be preferred both on theoretical and empirical grounds;
- (v) similarly when γ is calculable, providing information regarding the book value of the capital stock is available, so too will be the variants of Π . Hence the value of γ , in practice, depends very much on its ability relative to that of Π_1 - Π_4 .

TABLE VIII
RELATIVE PERFORMANCE: EFFICIENCY PROXIES
(γ and Π)

	Correlations of $\frac{I}{\alpha}$ with $q^*=0.15$ with								
	γ			Π_1			Π_2		
	All Firms	Non-Elect. Eng.	Chemicals	All Firms	Non-Elect. Eng.	Chemicals	All Firms	Non-Elect. Eng.	Chemicals
1958 . . .	0.803	0.702	0.930	0.907	0.883	0.964	0.936	0.923	0.968
1959 . . .	0.935	0.589	0.971	0.951	0.877	0.979	0.969	0.939	0.981
1960 . . .	0.826	0.713	0.982	0.939	0.745	0.986	0.971	0.893	0.989
1961 . . .	0.894	0.608	0.987	0.861	0.861	0.988	0.900	0.900	0.991

We illustrate by comparing the relative performance of γ , Π_1 and Π_2 . These are set out in Table VIII. Two points emerge immediately:

(a) both Π_1 and Π_2 exhibit a closer relation with $\frac{I}{\alpha}$ than \varnothing whether the data is that for all firms or either of the industry sub-groups, while

(b) the correlation coefficients of Π_2 in particular show not only higher values but considerably greater stability.

It thus seems not unreasonable to conclude that none of the four alternative proxies (γ , γ^* , \varnothing and \varnothing_r) is comparable in performance to Π_r , or the various variants of Π_1 as an indicator of efficiency provided that $\frac{I}{\alpha}$ is regarded as an appropriate measure of efficiency.

9. The Relative Efficiency of U.S. and U.K. Firms

The argument of this paper so far has been directed to establishing that:

(a) the statistic $\frac{I}{\alpha} \left(\equiv \frac{Op}{wL + q^*K_{pk}} \right)$ is a theoretically valid approximation to an index of social efficiency, and

(b) where this statistic cannot be measured, the rate of profit on capital (appropriately defined) may usefully be employed as a proxy.

If we accept these propositions it follows that meaningful comparisons of the relative efficiency of groups of firms can be undertaken. However, due to the very poor response rate of U.K. firms to the Southampton Questionnaire the best we have been able to do with the data available is to make broad comparisons between $\frac{I}{\alpha}$ for U.S. firms and U.K. industry in general. In this connection two exercises were attempted.

First we compared $\frac{I}{\alpha}$ for the U.S. firms in our sample with that of all U.K. manufacturing industry for each year 1958-61 by taking as q^* the average rate of profit (II) actually earned by the leading U.K. public companies (15). The results are set out in

TABLE IX
COMPARATIVE OVERALL PERFORMANCE OF U.S. FIRMS & U.K. INDUSTRY 1958-61

	1958	1959	1960	1961	1958-61
1. Average II for all firms	12.0	15.0	15.0	15.0	13.5
2. $\frac{I}{\alpha}$ for U.S. firms assuming II in 1 as q^*	1.20	1.20	1.20	1.18	1.19
3. No. of U.S. firms with $\frac{I}{\alpha} > 1$	50	45	50	51	50
4. No. of U.S. firms with $\frac{I}{\alpha} < 1$	20	25	28	29	27

Source: U.K. data: Ministry of Labour - *Statistics on Incomes, Prices, Employment and Production*.
U.S. data - *Southampton Enquiry*.

(15) In this instance, gross income ÷ by gross assets (II₄ on p. 26). See Ministry of Labour [14].

Table IX. These tell us *inter alia* that (i) the average social efficiency of U.S. firms for the period 1958-61 was 20% higher than it would have been had U.S. firms been earning the average rate of profit in U.K. industry and (ii) that three-quarters of U.S. firms operated at a higher level of social efficiency than the average during this period.

The second exercise was to compare the average $\frac{I}{\alpha}$ for U.S. firms in particular industries with that of their competitors by taking as q^* the average rate of profit (II) earned by U.K. public companies in those industries. In Table X we present these results for the year 1961.

TABLE X
PRODUCTIVITY ($Op/wL + q^*K_{pk}$) OF AMERICAN FIRMS IN U.K. INDUSTRY. 1961

Industry	U.K. Average II	$\frac{I}{\alpha}$ U.S. firms	Number of U.S. Firms with	
			$\frac{I}{\alpha} > 1.00$	<1.00
Chemicals, etc.	13.7	1.58	14	3
Metal Manufacturing	13.2	1.25	3	1
Non-Electrical Engineering	13.7	1.03	11	12
Vehicles	12.2	1.37	6	1
Electrical Engineering	12.1	1.08	3	3
Metal Goods n.c.s.	15.9	0.95	2	2
Textiles and Clothing	13.2	1.07	1	1
Food, Drink, Tobacco	15.5	1.25	6	0
Other Manufacturing	15.2	1.09	8	3
All Manufacturing	13.8	1.18	51	29

Source: U.K. data: Ministry of Labour - *Statistics on Incomes, Prices, Employment and Production*.

U.S. data - *Southampton Enquiry*.

Note: The Total Manufacturing line was calculated separately. Hence, the industry data will not add or average to it.

Again we see in all industries except metal goods [not elsewhere specified], U.S. firms recording a higher social efficiency, with the comparative advantage being most clearly marked in the chemicals, vehicles, metal manufacturing and food, drink and tobacco industries.

The remaining comparisons of inter-firm efficiency in this section of the paper are based upon evidence that Π — of one variant or another — is an acceptable proxy to $\frac{I}{\alpha}$. It needs, however, to be emphasized that differences in Π tend to overstate differences in efficiency as measured by $\frac{I}{\alpha}$.

Using Π as the appropriate proxy we can proceed by classifying U.S. firms into broad industrial groups and comparing their average Π to:

- (i) the average for U.K. industry as a whole;
- (ii) the average for the "best" (i.e. most profitable) U.K. companies.

These comparisons, which are summarised in Tables XI and XII, use:

- (a) Questionnaire responses for U.S. firms;
- (b) data from *Company Assets and Income* for U.K. firms.

TABLE XI
PROFIT/CAPITAL RATIOS FOR SELECTED U.S. FIRMS
& U.K. PUBLIC QUOTED COMPANIES 1958-61

Industry	1958		1959		1960		1961		Overall 1958-61	
	UK	US	UK	US	UK	US	UK	US	UK	US
Chemicals	13.7	17.1	16.5	27.2	16.5	28.6	13.7	22.5	15.1	24.0
Metal Engineering . .	15.1	26.7	14.6	26.2	16.0	17.2	13.2	15.5	14.7	19.3
Non-electrical Engineering	15.9	19.5	15.1	20.5	14.7	23.5	13.7	19.6	14.8	20.8
Vehicles	17.7	19.3	19.1	24.5	18.6	22.3	12.2	14.7	16.7	20.0
Electrical Engineering .	15.7	30.9	15.7	39.1	13.6	23.4	12.1	15.5	14.1	26.8
Metal Goods n.e.s. . .	18.3	23.8	18.6	25.6	18.8	26.2	15.9	19.8	17.8	23.7
Textile & Clothing . .	10.5	13.2	13.7	5.3	13.8	4.6	13.2	4.6	12.9	6.8
Food, Drink & Tobacco	16.4	25.6	16.0	22.8	15.8	21.7	15.5	20.6	15.9	22.5
Other Manufacturing .	14.7	14.4	15.4	19.2	16.0	21.0	15.2	17.1	15.4	18.0
All Manufacturing . .	15.0	20.4	15.7	24.8	15.7	22.9	13.8	17.0	15.0	21.1

Nes - Not elsewhere specified.

Source: U.S. firms - Southampton enquiry.

U.K. firms - Ministry of Labour *Statistics on Incomes, Prices, Employment & Production*, April 1962 and March 1964.

TABLE XII
FREQUENCY DISTRIBUTION OF U.K. & U.S. COMPANIES BY PROFITABILITY 1958-60 *
(% of all Companies in Group)

II (%)	Food		Chemical		Metal & Engineering		Other		All Industry	
	U.S. firms	U.K. firms	U.S. firms	U.K. firms	U.S. firms	U.K. firms	U.S. firms	U.K. firms	U.S. firms	U.K. firms
0-4	—	7	—	3	2	29	2	50	4	89
5-9	1	36	11	11	8	82	2	136	13	265
10-14	—	78	26	26	7	195	6	229	14	528
15-19	—	61	2	29	12	194	3	166	19	450
20-24	4	25	16	16	11	130	7	87	25	258
25-29	—	5	11	11	6	49	8	23	19	88
30-34	2	2	1	1	3	22	2	13	10	38
35-39	—	1	2	2	1	13	1	11	2	27
40 & over	2	—	1	1	4	14	2	6	15	21
Total	11	215	23	100	54	728	33	721	121	1,764
0-4	—	3	—	3	4	4	6	7	3	5
5-9	9	17	9	11	15	11	6	19	11	15
10-14	—	36	4	26	13	27	18	32	12	30
15-19	18	28	9	29	22	26	9	23	16	26
20-24	37	12	13	16	20	18	21	12	20	15
25-29	—	2	22	11	11	7	25	3	16	5
30-34	18	1	13	1	6	3	2	2	8	2
35-39	—	1	1	1	2	2	6	1	1	1
40 & over	18	—	30	1	7	2	3	1	12	1
Total	100	100	100	100	100	100	100	100	100	100

* U.K. companies exclude U.S. firms.

Source: U.K. firms - *Company Assets, Income and Finance in 1960*. H.M.S.O. 1962.

U.S. firms - Southampton enquiry.

These Tables require no very extensive comment. Essentially Table XI does no more than confirm the hypothesis from which the enquiry began. Table XII is, however, rather more interesting and its findings may be more conveniently examined by reference to a chart.

Consider Figure 6 which gives a cumulative distribution of Π for all firms. If (returning to our earlier convention that $q^* = 0.15$) we take 15% as the social (gross) opportunity cost of capital then almost exactly 50% of U.K. firms exceed this figure. By contrast the figure is exceeded by 76% of U.S. firms. The same information is presented in Figure 7 in the form of a frequency polygon. This shows that the modal Π for U.K. firms is 12%; for U.S. firms it is 22%. Charts drawn up for the main industrial sub-groups broadly confirm this particular picture.

Since the data for U.K. firms is derived from that of the 1912 largest British public companies, it seems likely that it overstates, rather than understates, the rate of profit of British industry as a whole. If this is so, and Π is an acceptable proxy for $\frac{I}{a}$, there seems to be good reason for arguing that a *prima facie* case exists for the view that, in general, British firms operating in Britain are less efficient than U.S. firms.

There remains the possibility that the particular years of the comparison (1958-60) overstate the relative profitability of U.S. firms and thus their relative efficiency. This can be tested rather crudely by examining a time series of relative profitability in manufacturing. The time series is reproduced in Table XIII.

Examination of this series shows that for 1958-60 the relative profitability index defined as:

$$\frac{\Pi_{\text{U.S.}}}{\Pi_{\text{U.K.}}} \times 100$$

averaged 181.67 while for the whole period (1950-1964) it averaged 177. On the other hand this series suggests that the relative profitability index has been declining. It is thus possible, even if some allowance is made for the apparent tendency of the index to rise in cyclical upswings, that the comparisons made possible by the Questionnaire do somewhat overstate the relative profitability advantage of U.S. firms and thus their apparent relative efficiency. Nevertheless the qualitative case must remain.

Figure 6
CUMULATIVE DISTRIBUTION OF GROSS RATE OF RETURN
ON ASSETS (π) FOR FIRMS IN ALL INDUSTRIES 1958-1960
Average 1958-60

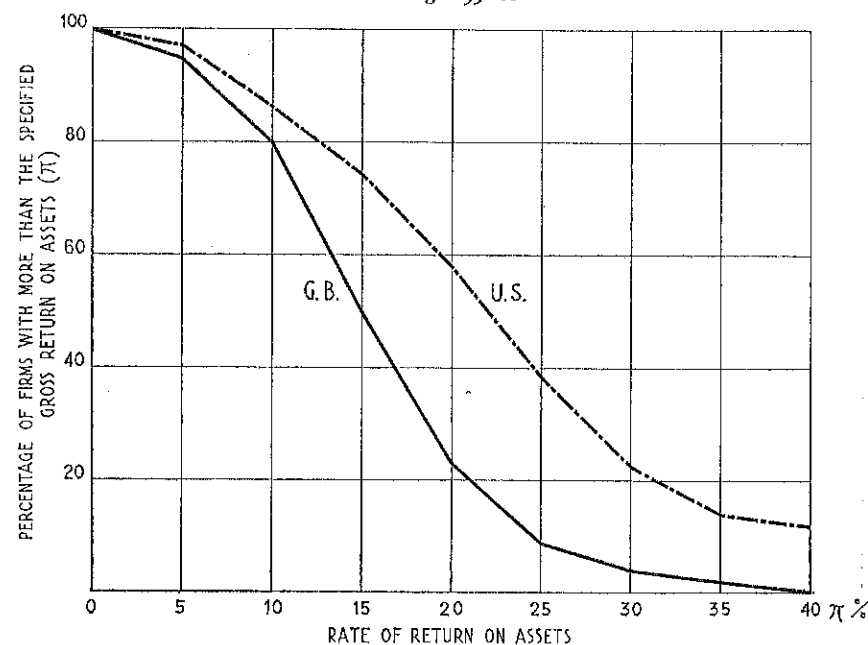


Figure 7
FREQUENCY POLYGON OF GROSS RATE OF RETURN
ON ASSETS (π) FOR FIRMS IN ALL INDUSTRIES 1958-1960
Average 1958-60

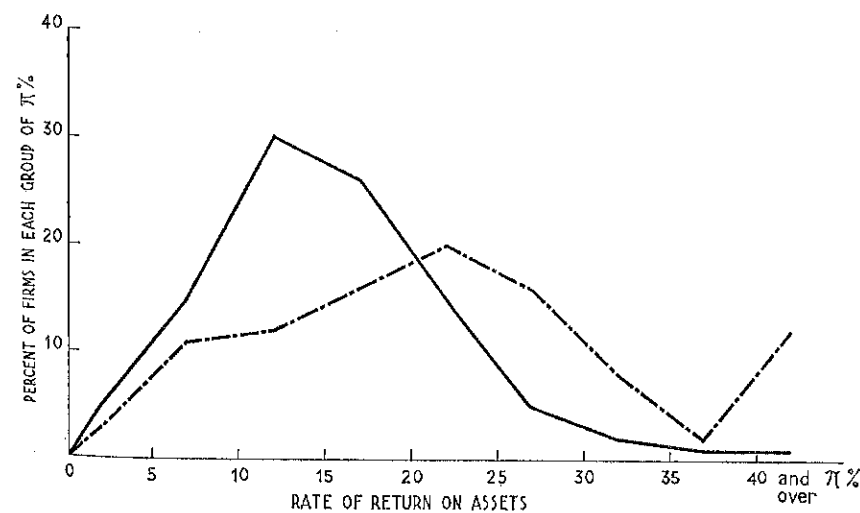


TABLE XIII

RATES OF RETURN ON CAPITAL OF BRITISH AND AMERICAN FINANCED FIRMS
IN MANUFACTURING INDUSTRY 1950-64

Year	U.K. Public companies	U.S. Capital in U.K.	U.S./U.K. %
1950	11.1	20.3	183
1951	10.8	20.5	190
1952	7.9	15.2	192
1953	8.1	16.3	201
1954	9.6	19.1	199
1955	9.8	18.4	188
1956	8.7	13.9	160
1957	8.3	14.7	177
1958	8.1	16.9	209
1959	9.1	17.0	187
1960	8.9	13.3	149
1961	7.5	11.3	151
1962	6.8	9.4	138
1963	7.4	11.5	155
1964	7.8	12.5	160
1950-64	8.7	15.4	177

Rate of return on capital is defined as trading profits—taxation—depreciation÷total assets—accumulated depreciation—current liabilities.

Source: U.K. data - Ministry of Labour *Statistics on Incomes, Prices, Employment and Production*. Taxation data derived from *Economic Trends* for comparability with tax deducted from earnings of U.S. Cos. in U.K.

U.S. data - *Survey of Current Business*, U.S. Dept. of Commerce.

10. Deficiencies in the Data

It is obvious that the comparisons of paragraph 9 establish a *prima facie* case for arguing that U.S. firms in Britain are, in general, more efficient than their British counterparts only to the extent that the data is not biased in the direction of this conclusion. We may distinguish the following possible sources of bias:

(i) Accounting Conventions:

If accounting conventions differed systematically between the two groups of firms this might have the result of overstating (or understating) the relative profitability of U.S.

firms. Since U.S. firms are essentially subsidiaries (in effect branches) of parent U.S. enterprises it is possible that U.S. tax laws might encourage U.S. firms to "shift" profits to their U.K. subsidiaries by charging, for example, low prices for products or services purchased from the U.S. parent.

(ii) Concealed Subsidiaries:

Undercharging for products or services purchased from the U.S. parent provides a concealed subsidy. A particular form of this is the access which U.S. subsidiaries have to the benefits of research, development, design and, in some cases, marketing expenditures undertaken by the U.S. parent. In so far as this access is not charged as a cost at the appropriate rate, U.S. subsidiaries operating in the U.K. will enjoy higher profits than they otherwise would. Accordingly they will appear to be more efficient than they in fact are. It is indeed entirely possible that an "appropriate" (which is difficult both to define and measure) adjustment for these elements would reduce the profitability of U.S. firms below that of their British counterparts.

(iii) The Industrial Choice:

The data for U.K. firms used in our comparisons refer to the largest British public companies. The industrial distribution of these is not the same as the industrial distribution of the U.S. firms replying to the Southampton enquiry. Since this is so it is obviously possible that the aggregate figures (all firms) of relative profits might be influenced by a relatively greater concentration of U.S. firms in the higher profit industries. This objection does not, of course, apply to the comparisons for industrial sub-groups provided the product mix for firms in these sub-groups is comparable and provided profitability is not correlated with variations in the product mix within any sub-group.

Accounting Conventions

The evidence available from the Southampton enquiry suggests that U.S. firms operating in the U.K. follow British accounting practices as regards such items as depreciation. There is thus, on this count, little reason to suspect overstatement of profits. By the

same token, since Britain is a high tax country, there is small advantage in shifting profits to the U.K. by undercharging. Finally, of the purchases made by U.S. firms operating in the U.K. it seems that only about 5% comes from the U.S. and not all of this was purchased from U.S. parent companies. Hence the scope, as well as the incentive, for profit shifting by undercharging was, in general, rather small. There seems, therefore, little reason to expect the profit figure to be significantly distorted by accounting practices.

The basis of our comparison is, however, the rate of profit per unit of capital measured at book values. Clearly book values may reflect replacement costs differentially between the two groups. This possibility cannot be excluded. However, U.S. firms have, in recent years, expanded at a much faster rate than British industry as a whole. As a consequence, it seems likely that the book values of their assets correspond more closely to current replacement values than those of their U.K. counterparts. If this is correct, accounting distortions seem likely to decrease rather than increase the apparent relative advantage of U.S. firms so that an appropriate adjustment, if it could be made, would increase the apparent relatively greater efficiency of U.S. firms.

Concealed Subsidies

In this field there is certainly a bias in favour of U.S. firms, particularly those in the pharmaceutical, electronic and industrial instrument industries. In the first of these cases the extent of the bias has been estimated to be very considerable, amounting to about half of the recorded rate of profit on capital (16). Unfortunately it is not possible to give any worthwhile estimate of the extent of the general bias. It is therefore not possible to adjust the profit figures for U.S. firms appropriately. It is, perhaps, worth recording that, though U.S. firms certainly enjoy a measure of subsidy from the research and development expenditure of their U.S. parents, their own research expenditure in the U.K. generally exceeds, as a percentage of value added, the average of British firms in the same industry (17). Hence, though the concealed research subsidy undoubtedly tends to raise the apparent profitability (and hence effi-

(16) Committee of Public Accounts [2].

(17) Dunning [7].

ciency) of U.S. firms, it does not seem to inhibit research by U.S. firms operating in the U.K.

Industrial Choice

A test of the influence of the differing industrial distribution of U.S. and U.K. firms on the profit comparisons can in principle be carried out as follows:

Let:

$\Pi_{U.S.} \equiv$ recorded rate of profit for U.S. firms

$\Pi_{U.K.} \equiv$ recorded rate of profit for U.K. firms

$\Pi^*_{U.S.} \equiv$ calculated rate of profit which would have been recorded by U.S. firms if their industrial distribution of sales had been that of U.K. firms.

Then:

$\Pi_{U.S.} - \Pi_{U.K.} \equiv$ apparent profit advantage

$\equiv (\Pi_{U.S.} - \Pi^*_{U.S.}) + (\Pi^*_{U.S.} - \Pi_{U.K.})$

\equiv Distribution Effect + Apparent Efficiency Effect.

Such evidence as we have suggests that, for U.S. firms engaged in manufacturing, the distribution effect was *negative* for the years 1958 and 1961. Hence the measured profit advantage tends to *understate* rather than *overstate* the apparent efficiency advantage of U.S. firms. In 1958 this understatement was very considerable: the profit advantage of U.S. firms was 27% while the distribution effect was -15%. In 1961, it was small. Compared with a profit advantage of 18%, the distribution effect was -3% (18). It seems, however, not unreasonable to conclude that for the period covered by the Southampton enquiry, the apparent profit advantage is probably understated.

It appears then that the profit rate comparisons of section 9 are likely to involve:

- (i) understatement of the relative U.S. advantages on two counts;
- (ii) overstatement on one count.

(18) Dunning [7].

Where the balance lies must be a matter of "guesswork" or "judgment" since no quantitative calculation is possible. For what it is worth we believe that the apparent profit advantage of U.S. firms is not overstated — except in the pharmaceutical industry. It is, indeed, more likely that the reverse is true.

11. Static Efficiency and Managerial Efficiency

The index of efficiency employed in this paper is essentially static. Though, as we know, a dynamic index of efficiency change can be derived from it, the data available do not permit us to make comparisons of the rate of change of efficiency achieved by U.S. and U.K. firms. Indeed, even if the response of British firms to the Questionnaire had been more acceptable, the time span covered by the enquiry (1958-1961) would have been rather too short, and probably too strongly influenced by the cycle, to permit worthwhile comparisons to be made. However, if the arguments of this paper are accepted, it seems that U.S. firms' static efficiency is greater than that of U.K. firms. This inevitably raises the question as to how far the (apparent) lesser efficiency of U.K. firms is to be explained by avoidable managerial shortcomings.

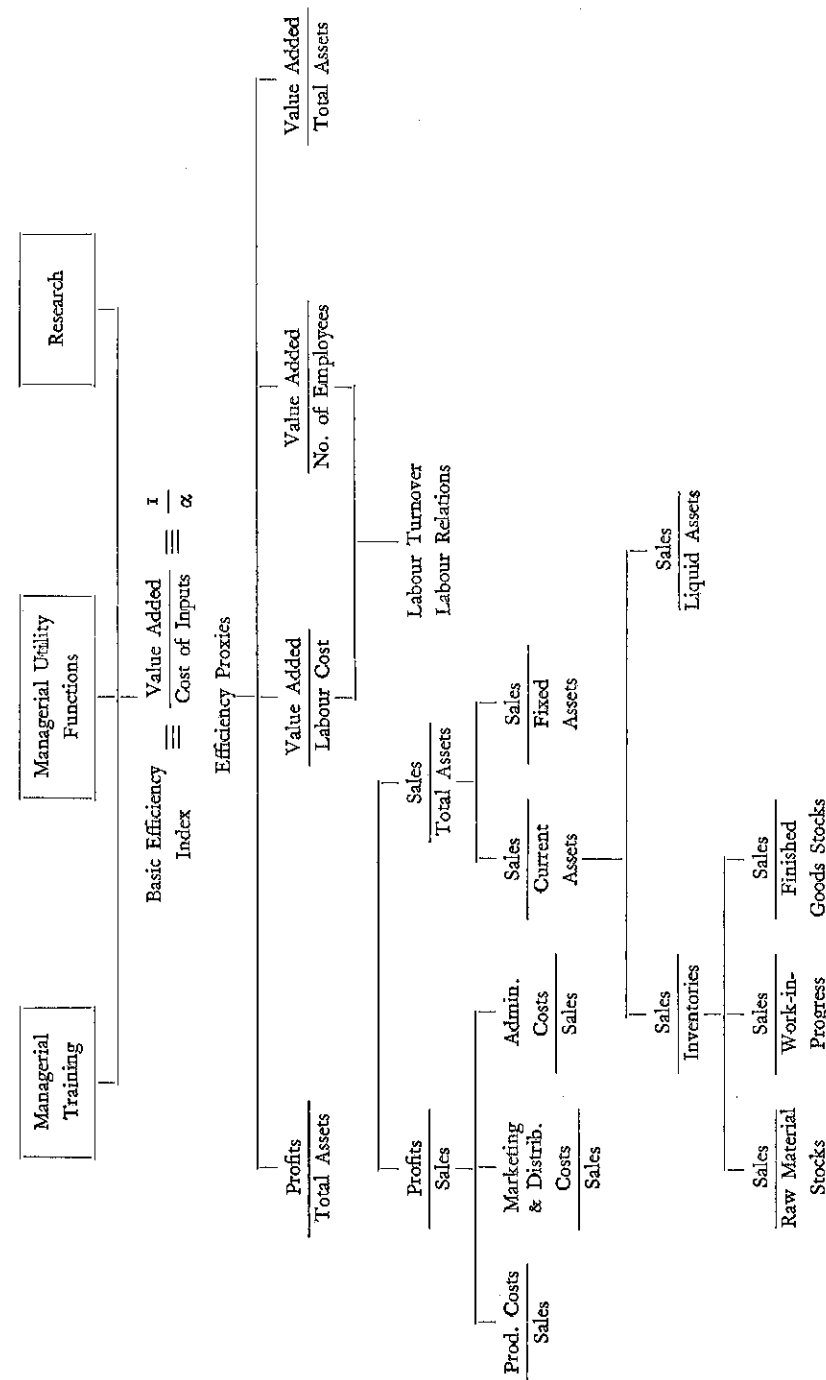
Before considering this difficult and controversial issue let us make a short digression to explain the approach to the analysis of differences in efficiency which we had hoped to follow at the start of the Southampton enquiry. In planning our Questionnaire, we aimed to obtain data which would make it possible to compare not

only the efficiency index $\frac{I}{\alpha}$ for U.S. and U.K. firms, but also certain *secondary* and *tertiary* ratios which, for U.S. and U.K. firms operating in the same industry over the same period of time, would have permitted a potentially useful classification of comparative performance. To exemplify, the aim of the Questionnaire was to obtain data which would make it possible, for each firm participating in the enquiry, to construct the following schematic classification of performance.

As it happened, we obtained the necessary data to make such detailed comparisons from only seventeen "pairs" of U.K. and U.S. firms — hardly a sufficient number on which to make any generalisations about comparative Anglo-American performance. An analysis of the secondary and tertiary ratios of these groups of firms

TABLE XIV

CLASSIFICATION OF PERFORMANCE



ed elsewhere (19); we will do no more than repeat conclusions in this paper.

seem that the superior profits earned by American firms in the U.K. are associated with three main relationships:

- (i) a higher labour/productivity and/or a more intensive capital/labour ratio;
- (ii) a lower administrative cost to sales and/or a more intensive marketing and distribution to other departmental costs ratio. There is no reason to think that U.S. firms record a lower manufacturing costs to sales ratio than U.K. firms;
- (iii) a broadly comparable sales/fixed assets ratio but a lower sales/liquid assets ratio.

Even these ratios, however — or any others of a similar kind — do not, and by their nature, cannot tell us *why* differences in efficiency between firms exist, still less how far such differences reflect *avoidable* managerial shortcomings. Their function is simply to show in a fairly systematic manner in which area of a firm's operations its performance differs from that of other firms.

If one tries to trace the *reasons* for the superior profitability of U.S. firms, the most common explanation advanced is that such firms have access to more, and sometimes better, research and managerial and marketing methods than are available to their U.K. competitors. This, so it is argued, gives them an unavoidable managerial advantage, or alternatively puts the U.K. firms at an unavoidable managerial disadvantage. What are the formal implications of this statement?

Consider the problem of comparing two firms, one U.S. and one British, where both belong to the same industrial group and have an identical product mix. Assume that $\frac{1}{\alpha}$ of the U.S. firm is higher than that of the U.K. firm. The problem is to say how much of its relative inefficiency is attributable to "avoidable managerial shortcomings". The simplest approach is to argue that the U.K. firm could have made use of the production function of the U.S. firm (that is that the same technical opportunities were open

(19) Dunning [7].

to it) and also could have used the same techniques for maximising the same objective function. On these assumptions the U.K. firm could have been at the position shown for the U.S. firm. Since it was not, this could only have been because of the avoidable ignorance, sloth or perversity of its management. This is substantially the approach of elementary economic theory. There is assumed to be a production function for the industry which defines, for a given range of relative input prices, "best practice" technique. This production function is generally available. Firms that are not on the optimal profit maximising point (as the hypothetical U.S. firm may be assumed to be) simply exhibit avoidable technical and allocative inefficiency. In the long run they either mend their ways or cease operations. In short a dynamic adjustment process operating through competition *eventually* ensures an equilibrium in which all firms arrive at the U.S. position and all firms earn the normal rate of profit (= opportunity cost of capital *plus* the risk premium attributable to the industry).

However, the long-run may be very long indeed — certainly far too long for an analysis of this kind to have any diagnostic value or policy implications. For in practice the production function of the U.S. firm may *not* be generally available either because:

- (i) the technical knowledge it embodies is not generally accessible, or
- (ii) because the extent to which the U.K. firm can reconstruct its operations is constrained by the period of time allowed for the reconstruction process itself.

There is, unfortunately, even if the reconstruction period is arbitrarily defined, no way of giving clear cut meaning to the alternative positions open to any given management without detailed knowledge of the situation existing in each firm. It is thus impossible to give any precise quantitative assessment of the extent to which (apparent) differences in efficiency are due to avoidable managerial shortcomings. On the other hand it is arguable that the classificatory scheme illustrated in Table XIV may, on rather weak assumptions, suggest areas in which avoidable managerial shortcomings exist. For example if U.S. firms showed, on average, relatively high sales/inventory ratios it might be argued that, simply because of the nature of inventory, adjustment to this ratio (in whole or in part) by British competitors could be accomplished fairly

has been presented elsewhere (19); we will do no more than repeat our very tentative conclusions in this paper.

It would seem that the superior profits earned by American firms in the U.K. are associated with three main relationships:

- (i) a higher labour/productivity and/or a more intensive capital/labour ratio;
- (ii) a lower administrative cost to sales and/or a more intensive marketing and distribution to other departmental costs ratio. There is no reason to think that U.S. firms record a lower manufacturing costs to sales ratio than U.K. firms;
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Even these ratios, however — or any others of a similar kind — do not, and by their nature, cannot tell us *why* differences in efficiency between firms exist, still less how far such differences reflect *avoidable* managerial shortcomings. Their function is simply to show in a fairly systematic manner in which area of a firm's operations its performance differs from that of other firms.

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(19) Dunning [7].

to it) and also could have used the same techniques for maximising the same objective function. On these assumptions the U.K. firm could have been at the position shown for the U.S. firm. Since it was not, this could only have been because of the avoidable ignorance, sloth or perversity of its management. This is substantially the approach of elementary economic theory. There is assumed to be a production function for the industry which defines, for a given range of relative input prices, "best practice" technique. This production function is generally available. Firms that are not on the optimal profit maximising point (as the hypothetical U.S. firm may be assumed to be) simply exhibit avoidable technical and allocative inefficiency. In the long run they either mend their ways or cease operations. In short a dynamic adjustment process operating through competition *eventually* ensures an equilibrium in which all firms arrive at the U.S. position and all firms earn the normal rate of profit (= opportunity cost of capital *plus* the risk premium attributable to the industry).

However, the long-run may be very long indeed — certainly far too long for an analysis of this kind to have any diagnostic value or policy implications. For in practice the production function of the U.S. firm may *not* be generally available either because:

- (i) the technical knowledge it embodies is not generally accessible, or
- (ii) because the extent to which the U.K. firm can reconstruct its operations is constrained by the period of time allowed for the reconstruction process itself.

There is, unfortunately, even if the reconstruction period is arbitrarily defined, no way of giving clear cut meaning to the alternative positions open to any given management without detailed knowledge of the situation existing in each firm. It is thus impossible to give any precise quantitative assessment of the extent to which (apparent) differences in efficiency are due to avoidable managerial shortcomings. On the other hand it is arguable that the classificatory scheme illustrated in Table XIV may, on rather weak assumptions, suggest areas in which avoidable managerial shortcomings exist. For example if U.S. firms showed, on average, relatively high sales/inventory ratios it might be argued that, simply because of the nature of inventory, adjustment to this ratio (in whole or in part) by British competitors could be accomplished fairly

quickly. In short, a general tendency for U.K. firms to record significantly higher inventory/sales ratios might be regarded as qualitative evidence of an "avoidable managerial shortcoming".

The implication of this discussion is clear. "Avoidable managerial shortcomings" can be defined only with reference to the alternative positions open to management. Since the range of alternative positions is a function of the length of the reconstruction (or adjustment) period, the problem of assigning a meaning to them is explicitly dynamic. It is thus hardly surprising — though at first sight possibly disappointing — that the essentially static approach of the paper can provide only very limited and qualitative suggestions concerning it.

Suppose, however, we had sufficient data to permit us to construct, for each firm, an index of dynamic efficiency:

$$\alpha'_{ij(t)} = \frac{\frac{1}{\alpha_{ij(t)}}}{\frac{1}{\alpha_{ij(t-1)}}} \times 100$$

This would provide a measure of the rate at which, in any period, the social efficiency of the firm was changing (20).

Using α' it would be possible to compare the dynamic performance of U.S. and U.K. firms. On the not very strong assumption that the significant range of choice confronting a management within any period was the same for other firms in the same industry, it would then be possible to compare the managerial efficiency of U.K. and U.S. firms at the margin of managerial decision.

This information would not, of course, enable us to say how far "managerial shortcomings" (as revealed by the static approach) were avoidable: it would, however, enable us to say how far existing differences in efficiency were being increased or diminished by managerial decisions at the margin. This is, of itself, useful information since the fact that the gap between the ratio of profit of U.S. and U.K. firms has recently been diminishing in the U.K. (and indeed, in Australia also) suggests that investigation along these lines might show that α' for U.K. firms was greater than that for U.S. firms.

(20) The idea of α' and other measures of changes in productivity and efficiency is worked out more fully in J. H. Dunning and M. Utton [9].

The dynamic index would permit us to make crude tests of other hypotheses. For individual industries we might expect the rate of change of efficiency of U.K. firms to be a function of the gap between their efficiency and that of U.S. firms in the same industry. This could fairly readily be noted. We could also test how far the rate of change in the efficiency in U.K. firms in a particular industry depends upon the presence of U.S. competitors — an hypothesis of some interest since it is commonly argued that one result of extensive U.S. investment in a country is to improve the efficiency of domestic producers through competition.

At this stage, since data which would enable us to measure α' are not available, it is not worthwhile to elaborate the tests which could be based upon it. It seems clear, however, that in order to form any worthwhile judgment upon such matters as:

(a) how far relative managerial shortcomings are being reduced (and are therefore avoidable);

(b) how far U.K. firms exhibit managerial efficiency at the margin as great or greater than their U.S. competitors, and

(c) how far the presence of U.S. firms in an industry stimulates technical advance
an index of the form of α' is required.

Our suggestion, therefore, is that further research should be directed towards obtaining data which could be analysed in terms of the classificatory scheme of Table XIV and the index α'_{ij} . The main contribution of our static approach is probably to show that the *prima facie* evidence of differing efficiency is sufficiently strong to point to the need for such research.

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