PERFORMANCE AND EFFICIENCY MEASUREMENT IN LOCAL AUTHORITY BUILDING ORGANISATIONS

A Thesis submitted for the degree of

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by

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Abstract

This work constitutes a study of the operations of local authority building direct labour organisations (DLOs) during the 1980s.
An overt aim of Part III of the 1980 Local Government, Planning and Land Act was to improve efficiency in the operations of local authority building direct labour organisations (DLOs). Whilst the Act did not specify how DLOs should be organised, the legislation on accounting and accountability clearly had important organisational implications.
Even prior to 1981, some DLOs already obtained the majority of work via competitive tender, had control over their functions and had systems for demonstrating their efficiency. Others were not operated in such ways and fundamental changes were needed to successfully meet the challenge of the new legislation.

By 1988, the Audit Commission admitted that DLOs had very largely been successful in meeting the competitive requirements of the 1980 Act, but expressed concern over the varying levels of effectiveness and efficiency of operation that existed amongst organisations.

An objective of the study is to look at the problems associated with efficiency and productivity measurement in the context of DLO performance. The Conservative government of this period had a strong commitment to the improvement of efficiency of the public sector. In other areas of public services, various forms of performance indicator were being employed to monitor performance, but for a DLO the sole measure of efficiency was the ability to meet the 5% target rate of return. The concern with efficiency produced new interest in the application of quantitative techniques to provide methods of efficiency measurement.

This work undertakes a study of the problems associated with efficiency and performance measurement in this sector of the U.K. construction industry.

The availability of appropriate data at the individual organisation level from 1981 onwards, enabled, for the first time, viable inter-DLO comparisons to be undertaken at the micro-level and sectoral comparisons to be made at the macro-level.

The data used in the study were obtained over a five year period from a variety of sources of published and unpublished sources. A unique database of expenditure and revenue information from over 150 DLOs has been developed, which in many ways is even more comprehensive than the 'official' statistics collected by the Chartered Institute of Public Finance and Accountancy.

Methods used for efficiency measurement

With the great emphasis placed on ensuring that the public sector of the construction industry acts in an efficient manner, the data are employed in various methods for the measurement of efficiency.

1. At the sector level, total factor productivity neasurement is used to gauge the rate of growth of the DLO sector of the industry.

2. At the organisation level, 'Farrell' measures of efficiency are used.
A model for measuring the efficiency of individual organisations is presented.
Data Envelopment Analysis is used to consider inefficiency that raises costs above their feasible minimum.

PART A

DIRECT LABOUR ORGANISATIONS IN CONTEXT

CHAPTER 1

INTRODUCTION

1.1 The origins of local authority direct labour organisations

Direct labour has its origins in the 1890s when local government was emerging in the form we know it today. It was set up as a response to the failure of private contractors to provide an adequate building service for the new local authorities. Scandals involving private contractors were rife at the end of the nineteenth century, particularly over public building works in London.

Also, unemployment was high during the depression years up until 1895, and local authority direct labour was seen by many as an effective way of creating employment. There was much work to be done in the construction of housing and public buildings.

It was in order, though, mainly to break up the monopolistic position of contractors that the growing demand for a Works Department was accepted by the London County Council in 1892. This lead given by the LCC being soon followed by Battersea in 1894 and West Ham in 1896.

After 1918, the number of DLOs steadily rose. Between 1919 and 1920, with growing unrest over housing conditions, seventy new departments were set up. Out of 43 700 council houses built under the 1919 Housing Act, 5 855 were built by these new direct labour schemes.

The emergence of a large number of DLOs after the First World War, was repeated after the Second War. As building prices soared, local authorities needed a method which both checked the prices quoted by contractors and got the work done. By 1949, the number of DLOs had doubled compared to 1939, coinciding with the renewed Government commitment to a large-scale council house building programme. In 1948, local authority house building reached an unprecedented height of 175 213 units.
Soon after the return of the Conservative Government in 1951 came a fall in the amount of local authority house building, but the private industry was now enjoying boom conditions and private contractors were able to draw labour away from DLOs, as the local authorities were empowered only to pay the lowest local level Trade Union rates.

In the late 1950s and early 1960s though, the DLOs grew, from employing 70 000 operatives in 1955 to 122 000 in 1964. This was in spite of the fact that the Government had imposed the recommendation in 1959 that direct labour must win every third contract in competition with local and national firms - a requirement later revoked in 1965 - and also in spite of the fact that industrialised systems of building were expanding in that period. (Many local authorities were too small to have the resources to break away from traditional techniques). These new systems came to dominate house building during the 1960s, and DLOs had to play a subsidiary role, competing with smaller firms for non-industrialised contracts (usually small-scale projects or in-fill housing).

During the property boom years of the early 1970s, contractors were less interested in local authority work and this meant that tender prices for council work were high. With the collapse of the speculative building boom in 1973-74 and the decline of systems building, however, the public sector came to be seen by many private contractors as a reliable source of work.

It was this desired growth in the competition for local authority work which was the major reason for government concern over the role of DLOs in the late 1970s and the consequent introduction of the 1980 legislation.

1.2 DLOs in the 1970s: The prelude to the 1980 legislation

The 1980 Act, setting out new accounting, reporting and tendering measures was the culmination of a concern with DLO operations which had been the subject of controversy for many years prior to 1980.

Since the 1972-3 construction boom, there had been more and more concern about the development of DLOs. The relative decline of the building industry since its peak and concern for the future of the private sector, coupled with increased demand for reviews of public spending, all led to the setting up of a Working Party on DLOs in 1976, and the ensuing Report in 1978. Its original terms of reference were 'to review the organisation and operation of local authority direct labour departments including tendering and accounting procedures' and to look at ways ' to provide a proper framework for their operations .... and to achieve maximum growth of efficient DLOs.' (Department of the Environment. 1978)

Even though the main source of controversy surrounding DLOs had been their relationship to the larger private sector of the industry within the context of construction as a whole, the working party emphasised the role of DLOs within local authorities themselves, especially the permanent on-call emergency service for council tenants - a service which it doubted any private sector contractor would be prepared to offer.

There was resistance from contractors' organisations to proposals in the Report for increasing the scope of DLOs, but again the accounting measures were generally acceptable to those involved. However, the Report made

it clear that such extension could only be allowed to DLOs with accounting on a 'profit/loss' basis and a contractual relationship aligned exactly with that of a private contractor.
Whilst accepting the trading accounts approach, the 1978 Working Party did not believe this would show the total picture relative to DLO performance because of difficulties of comparison with private contractors' prices. For accounting, the recommendations were that accounts should enable basic divisions of work to be separately identified, costed and scrutinised; that each division of DLO activity should include its direct and indirect costs and show how these compare with value and income; and that DLO accounts should be supported by an analysis of results and an annual report.

The main recommendation to assist with accountability was that on annual reports, but the 1978 Working Party found it impracticable to compare satisfactorily public and private sectors. After commenting on the degree of contractors' interest varying according to work available and to attractiveness of type of work, the report included a warning that division of work into 'DLO' and 'private contractor' was an over-simplification and it underlined the essential difference where private contractors work without restriction and have a primary duty to maximise return on capital employed, and the position of a DLO in existence to provide 'specific services'. The Working Party considered that those services to the authority and the community it represented, together with the production of proper value for money, were the chief criteria on which DLOs should be judged.

Pressures to apply controls to DLOs continued, and the next major step followed the 1979 Conservative election victory with the production by the Department of the Environment of a Consultation Paper (1979). This set out proposals for monitoring and controlling the efficiency of DLOs, and and although it acknowledged that there was a place for efficient DLOs and that it was for individual local authorities to decide for themselves, on the basis of local circumstances, whether to use direct labour and for what sort of work, the aim was to ensure that 'facts about direct labour shall emerge, and that councils shall take their decisions in the light of full and publicly demonstrable information'.
After outlining objectives, the Consultation Paper proposed accounting and accountability measures based on principles put forward by the Chartered Institute of Public Finance and Accountancy (CIPFA) and in spite of criticism the main issues were incorporated into the 1980 Act.

1.3 The legislative framework of the 1980s

The 1980 Local Government, Planning and Land Act introduced criteria for assessing the performance of DLOs within all local authorities carrying out construction or maintenance work.
(The pre-1980 legislative controls on DLOs are explained in Appendix 1.)
The main requirements of the 1980 Act for DLOs were twofold:

(a) Accounting requirements :
The legislation made it necessary (for the first time) for an authority to maintain separate DLO Revenue accounts for the following four categories of work :

Category D1	Highways and sewerage works (new construction and maintenance).
Category D2	Major works of new construction, other than of highways and sewers, where it is estimated that the cost of each job will exceed £50 000.
Category D3	Minor works of new construction, other than of highways and sewers, where it is estimated that the cost of each job will not exceed £50 000.

Category D4 Works of maintenance other than of highways and sewers. (Minor alterations may be considered as maintenance.)

Each local authority is required to achieve a prescribed rate of return on each of the above-mentioned accounts. This return is calculated on the value of the fixed assets and stock utilised by the DLO in carrying out the work during the year. The capital assets are valued on a current cost accounting basis, and the prescribed rate of return for each year in the period under consideration was 5%.
The legislation requires that each authority produces separate revenue accounts for each category of work together with a statement of the rate of return achieved in each category and balance sheet for the DLO as a whole.

(b) Competition requirements :
The legislation requires that a significant proportion of an authority's construction and maintenance work may only be carried out by the DLO if that work has been won in competition with private contractors. The extent to which competition applies to the various categories of work was the subject of frequent changes in the legislation between the 1st April 1981 (when the 1980 Act became effective) and the end of the 1980s.

Table 1.1 shows how the amount of work which local authorities were forced to put out to tender increased during the period.

Table 1.1 <u>Summary of the tendering regulations effective (1981-89)</u>

A. Work requiring all jobs to be subject to tendering.

Category of work	Regs. from 1.4.81	Regs. from 1.10.82	Regs. from 1.4.87
General highway work	Jobs > £100 000	Jobs > £50 000	Jobs > £25 000
Sewerage work	Jobs > £100 000	Jobs > £50 000	
New construction works	Jobs > £50 000		
Maintenance works	Jobs > £10 000		

B. Work subject to partial tendering. (Percentage by value of all work under the 100% tendering threshold which must go out to competition)

Category of work	Regs. from 1.4.81	Regs. from 1.10.82	Regs. from 1.10.83	Regs. from 1.4.88
General highway works	0		30	60
Sewerage works	0			
New construction works	33		60	
Maintenance work	0	30	60	

1.4 The level of construction activity in the 1980s

When assessing the performance of DLOs in the years subsequent to the 1980 legislation, due consideration must be given to the overall state of the construction industry during this period.

It was the downturn years of the mid- to late- 1970s which produced the orchestrated campaign against DLOs by the private contracting sector of the industry. Unfortunately for the DLOs, the early post-legislation period was also a relatively lean one for the industry.

Table 1.2 Value of output (GB) (at 1985 prices) [£ million]

	All work	Public new housing	Public other new work
1982	25 550	1 166	3 874
1983	26 611	1 241	3 943
1984	27 519	1 129	3 991
1985	27 835	931	3 767
1986	28 583	826	3 759
1987	31 022	868	3 603
1988	33 269	789	3 639
1989	34 648	754	3 832

(Source: Housing and Construction Statistics. HMSO)

Table 1.2 shows that the first half of the decade saw a fairly slow rate of growth in total construction output, followed by an upsurge in output in 1987 and 1988.
This 'mini boom' was, however, private sector based with the small increase in public sector housing output in 1987 providing a brief interruption to the general decline in public sector new build work between 1983 and 1988.
The local authority housing sector in particular suffered in two ways from governmental policies in the 1980s.

Table 1.3 Housing starts in the public sector (England & Wales)

(000 dwellings)

1982	43.7
1983	41.5
1984	34.7
1985	28.9
1986	26.8
1987	24.4
1988	13.4
1989	12.2

(Source: Housing and Construction Statistics. HMSO)

Firstly, restrictions on capital expenditure and housebuilding imposed on local councils meant that the number of new dwellings constructed was greatly curtailed.
The dramatic decline in house building starts is illustrated by the figures in Table 1.3.
Secondly, the 'right to buy' policy for council house tenants meant that over one million dwellings were taken out of local authority ownership between 1982 and 1989. (Table 1.4)

Table 1.4 Sale of local authority dwellings (England & Wales) (1982-89)

1982	201 875
1983	141 615
1984	103 315
1985	92 293
1986	88 738
1987	105 107
1988	155 556
1989	170 691

(Source: Housing and Construction Statistics. HMSO)

Taken together with the reductions in other areas of current and capital expenditure in the public sector, affecting both building and civil engineering work, it is not surprising that Table 1.5 illustrates a continuous reduction in the number of workers in the public sector of the industry throughout the period.

Table 1.5 Construction manpower (G.B.) (1982-89)

(Thousands)

	All	Public Authorities
1982	1 123	282
1983	1 084	271
1984	1 055	256
1985	1 022	253
1986	985	242
1987	1 002	240
1988	1 009	239
1989	1 011	217

(Source: Housing and Construction Statistics. HMSO)

This is in contrast to the turnaround in the private sector in 1987.

The upswing in contractors orders started in 1987 and continued into 1988. (Table 1.6)

Table 1.6 Value of new orders obtained by contractors (England & Wales) (at 1985 prices)

(£ million)

1982	11 330
1983	13 247
1984	14 005
1985	14 003
1986	14 902
1987	18 313
1988	19 523
1989	17 630

(Source: Housing and Construction Statistics. HMSO)

In the 1980s, therefore, DLOs were operating under conditions in which the local authority building workload was generally in decline. They were confronted with a new situation requiring them to face more competition and operating in a climate in which private contractors were, for most of the period, experiencing little growth in demand from the private sector and were themselves, therefore, taking a stronger interest in a declining public sector market.

CHAPTER 2

DATA SOURCES ON DLOS

2.1 Published statistics on DLOs

Financial and other data on DLOs can be obtained from two main sources:

a. The annual report which each individual DLO has been required to produce since the financial year 1981-82, and

b. The CIPFA annual publication 'Direct Labour Organisations Statistics Actuals' first published for the same year.

The CIPFA series was occasioned by the change in DLOs' statutory position arising from the 1980 Act.
Previously, even simple facts such as the number of DLOs, the types of work done and the size of undertakings had not been available and this hindered a proper appreciation of the roles which DLOs play.
The DLOs' individual reports vary considerably in the degree of detail provided on a DLO's operations with the basic provision tending to be based on the CIPFA code of practice.

2.2 The basis of the annual reports

The annual reports constitute the best source of data on the operations of individual DLOs.
DLOs under the 1980 Act were regarded as trading

undertakings and this fact was reflected in the formal accounting arrangements and the statutory duty to produce an annual report.

2.2.1 The accounting framework

Authorities in England and Wales are required to keep separate DLO revenue accounts for each of the following four areas of work:

D 1 General highways and sewers work

D 2 Works of new construction (other than of highways and sewers, except where they form part of some larger construction job) estimated to cost more than £50 000.

D 3 Works of new construction as above, but estimated to cost not more than £50 000.

D 4 Maintenance work (other than on highways and sewers) within the meaning of the Local Authority (Goods & Services) Act 1970. This includes minor improvements and extensions.

During the period under study, where not more than thirty employees were engaged in any financial year on

any description of work , an authority did not need to keep a separate DLO revenue account for that description of work in the following year. (The 'de minimis' rule.)
In addition to the basic financial data, the reports also tend to provide information on employment, tendering performance, organisational structure, and some provide detailed expenditure breakdowns.

2.3 The CIPFA surveys

The total number of local authorities in England and Wales is 450. (458 prior to the abolition of the GLC and metropolitan county authorities).
Whilst all these authorities undertake some building work, many of them keep only a small workforce in some or all of the specified areas of work and thus qualify from exemption from the requirements of the 1980 Act on 'de minimis' grounds.
The CIPFA annual survey questionnaire covering DLOs' Actuals accounts elicits a response of between 280-340 with only about 170 authorities responding each year for the full period from 1981 through to 1989.
The CIPFA statistics make year by year comparisons difficult due to the differing number of responses each year and cannot easily be used, therefore, to undertake

a 'consistent' study of DLOs' operations.
Also, comparison within each year is made even more difficult by the fact that some authorities respond to some parts of the questionnaire but not to others.

2.3.1 Data provided in the CIPFA reports

The CIPFA statistics provide annual data on over-all expenditure for each category of work undertaken by a DLO.
The survey questionnaire elicits information from the summary (historical cost) revenue account of the DLO but does not provide an expenditure breakdown within each category of work.
(To obtain more detailed form of expenditure data, recourse to the annual reports of an individual authority is needed.)

2.3.2 The form of the CIPFA statistics

The legislation introduced for many authorities some significant changes in both the accounting and management systems for their DLOs. This resulted from the Act's requirement to treat the DLO operation on a formal, quasi-trading basis even though the DLO was still a part of the authority itself.

One aim of the publication of the statistics is 'to provide a range of information, both financial and non-financial, to assist the management of DLOs and other interested parties in seeking an efficient and effective DLO.' (CIPFA. 1982)
The legislation sets down the accounting arrangements required e.g. Section B of Part III of the Act prescribes that there shall be a balance sheet, a revenue account and a statement of rate of return; that the balance sheet shall show a true and fair view of the state of affairs of the authority's DLO; and that the revenue account and statement of rate of return should be calculated for each of the four types of work.
Additionally, separate 'Directions' specify certain extra information which authorities have to include in their annual reports.

The government accepted that CIPFA should be responsible for preparing specific guidance on the detailed application of the DLO legislation, where it related to accounting and related financial management matters.
CIPFA issued the 'Accounting Code of Practice for DLOs' in 1981 with subsequent revisions in 1982, 1983 and again in 1986.
The Accounting Codes provided, therefore, the framework on which its collection of statistics could be based.

2.3.3 Accounting Code of Practice for DLOs

Whilst compliance with the CIPFA Code is voluntary, except of course where it states the law, the form and content of DLO revenue accounts follow best accounting practice including all relevant advice issued by the Institute.
There is inevitably a degree of variation in the ways in which individual DLOs lay out their accounts but using the CIPFA Code and the notes to individual accounts, it is possible to take any individual authority's accounts from its annual report and put the information in a standardised form.
The four categories into which the DLOs work is divided for accounting purposes are considerably varied in nature with obvious differences between the resources required to produce the output for highways work,new construction work and maintenance work.

For most DLOs, previous arrangements had meant that the actual cost of work had been charged, but now a DLO had to give a firm quotation before undertaking any work for a client department , irrespective of DLO tendering regulations, and charge that amount regardless of how much the work actually cost.

2.4 Financial performance and capital measurement

Legislation requires DLOs to work on a quasi-commercial basis and to seek to achieve a financial performance target which is common to all DLOs.
The data cannot normally be found directly from the historical cost accounts of a DLO operation. The financial target is intended to measure the productive use of assets. This means that account has to be taken of physical consumption of assets, rather than the financing costs of those assets which is what the historical costs accounts of local authorities normally show. In any event the historical cost information does not yield comparable data between authorities, since each is based on essentially arbitrary effects such as the age and the data of acquisition of the assets, the financing policy towards those assets and the provision for future assets, and the rate of inflation relevant to those assets which has prevailed from purchase to the present day.

The purpose of current cost accounting is to measure costs at current prices, rather than out-of-date prices. It produces a current cost operating surplus which differs from the historical cost operating surplus in two ways - it allows for depreciation at current prices and for additional working capital made necessary by price increases.

Consequently, it is the surplus after providing for the maintenance of existing levels of operation.

The following is therefore involved;

1. The current value of the capital employed in the DLO is usually based on its equivalent current replacement cost.

2. Depreciation costs measured at current prices have to be added back to the historical cost operating surplus, after removing financing costs such as principal repayments and revenue contributions to capital outlay.

3. A cost of sales adjustment is made to ensure the costs charged for the use of stock are shown at the current replacement cost.

The latter two adjustments convert the historical cost surplus to a current cost operating surplus before interest, which can then be expressed as a rate of return on the capital employed.

2.5 Acquisition of detailed cost and revenue data

The CIPFA statistics do not provide a breakdown of costs by work category when a DLO undertakes work in more than one area. For a breakdown of cost data between work

categories from the CIPFA data, it is possible only to refer to those authorities which undertook a single category of work throughout the 1981-89 period.
There were twenty one authorities, who undertook only Highways and Sewers work (D1) and thirty four authorities, who undertook only Maintenance (D4) work.
There were no authorities undertaking only work of New Construction (D2 and/or D3).
To obtain data on these latter categories of work (and also to increase the amount of data on the other categories), recourse had to be made to individual authorities' annual reports.

In order to obtain a consistent set of data, one hundred and eighty local authorities in England and Wales were contacted and a full set of their DLO's annual reports from 1981-82 were requested. Additionally, the opportunity was sought to obtain a contact in the authority who would be willing to furbish me with information not found in the reports and to discuss the contents of the reports with me.

Seventy five authorities made favourable responses i.e. provided a full set of reports, showed a willingness to provide further information on the operations of their organisation and agreed to a personal visit.

This may be considered to be a good response rate, in view of the fact that DLO managers were inevitably, at this time, wary of divulging cost information in a competitive environment. The response compares well with that from an Association of Direct Labour Organisation (ADLO) survey. In 1988, all building DLOs in ADLO membership were sent a questionnaire asking for a range of information relating to workload and operations, employment and training. Even after a considerable amount of pressure, only 67 of ADLO's members were persuaded to complete the survey.

Many of the other authorities were able to provide me with an incomplete series of reports, but some insisted on charging the permissable 'nominal fee' for their reports which, for a full series, turned out to be prohibitive.

Appendix 2 lists those authorities, whose DLO's financial data are used in this study.

The total number providing cost data for each category of work are :

D1	50	authorities
D2	27	
D3	29	
D4	61	

(Note: By 1988-89 only 65 authorities in the country were involved in any new construction work.)

2.6 Information from the annual reports

With the data from the authorities, cost information can be obtained on the separate areas of work.
The financial data sheet depicted in Table 2.1 shows my attempt to standardise the cost and revenue data for each DLO and for each category of work.

Table 2.1 Financial data sheet for DLOs

Expenditure:
Direct Labour
+ Direct Materials / Stores
+ Transport and plant
+ Sub-contractors
+ Overhead accounts
+ Change in work-in-progress
+ Change in loss provision
+ Exceptional items
= Total Expenditure
- Total Income
= Surplus
- Adjustment
= Current cost operating surplus (CCOS)
[Capital employed = Land & buildings + Vehicles + Stock]
Rate of return on capital employed
= CCOS / Capital employed

A major aim of this study is to use the data in the computation of cost and productivity measures but several questions can be considered when the annual reports are studied.
All of the following questions will be addressed in ensuing chapters :

What are the objectives of the DLO ? These may be:

- To provide and market an efficient, value for money, cost effective, high quality building service.
- To be a good employer, providing fair wages, safeguarding employees' safety and welfare.
- To contribute to the future of the industry by training and employing a proper ratio of apprentices.

Has the departmental structure of the authority's DLO altered in reponse to the new conditions ?

- There may now be separate contracting and client organisations.

How does the DLO gauge success ? This may be in terms of:

- Percentage of work won in competition.
- Maintenance of employment levels.
- Outturn for repair work.

2.7 The value and 'validity' of the annual reports

The advent of annual reports meant that new accounting procedures had to be introduced for DLOs, and their 'validity' as a reliable source of data had to be considered.

A study of selected annual DLO reports for 1981-82 (Department of the Environment. 1984) was carried out to assess the value of DLO reports for that first year. The sample size was 123 with 30 selected for a more detailed study.

The following points arising from this study were relevant to the data usage made for this work.

- Presentation of accounts :

Of the accounting documents, the revenue accounts were generally the best. They commonly provided some measure of performance, disclosed a surplus or deficit as appropriate and often gave more detailed information than profit and loss accounts prepared in accordance with the minimum disclosure requirements of the Companies Acts.

The DLO legislation created difficulties for authorities by an implied move towards private sector accounting practices in respect of DLOs, and by the creation of a 'fictitious' DLO entity within the legal entity of an authority.

- Capital employment :

In 1981-82 there was confusion as to what should be included as capital employed.

They estimated that in 49 of the sample reports, the capital employed was understated. (Since 1982 there has been considerable clarification in respect of internally leased assets.)

- Impact of DLO legislation in 1981-82 :

The impact of the DLO legislation was felt evenly across all types of authority and all sizes and types of DLO activities.

The legislation introduced new practices and requirements regarding the operation and accounting of DLOs. Only 45 of the reports sampled gave details of any changes which had been made to enable compliance with the regulations.

Although the DLO legislation introduced new competition requirements there was only limited competition between DLOs and private sector contractors during 1981-82.

- Form of accounting documents :

Disclosure of information was in some respects more extensive in DLO accounts than in company financial statements, particularly with respect to revenue account information.

As for expenditure, practically all indicated costs of material and labour, as well as providing some breakdown of indirect costs. A very high proportion also identified general overheads separately, usually representing a proportion of central establishment charges allocated to the DLO.

Practically all accounts identified transport and plant costs. However, authorities differed considerably as to the basis on which these transport charges were included. While some DLOs clearly operated their own transport and bore the costs, in other cases the authority itself was deemed to be the owner and operator of the transport and the DLO was charged with a proportion of attributable costs for its use of the vehicles.

Greater disclosure of the treatment of hire and leasing costs generally was recommended, particularly because of the implications when considering the rate of return on assets employed.

The number of people working in a DLO was frequently not disclosed. The practice (of disclosure) could provide data upon which to find a possible alternative measure of DLO efficiency in terms of value added per man employed.

- Conclusion :

The rate of return on capital employed would still seem to be the best available measure of performance of DLOs.

The conclusion must be subject to all the reservations which inevitably follow from applying any one single measure of efficiency. Other possibilities were considered. To an extent the possibilities were limited in that any calculation of a measure of performance would have to be based on financial data published in the DLO accounts.

CHAPTER 3

DLOS' RESPONSE TO THE LEGISLATION

3.1 DLOs in a competitive environment

In the 1980s a central theme of Ministerial statements was the question of efficiency and of improving Britain's industrial performance. The fundamental reason for this poor track-record being stated to be a lack of incentives to improve performance.
In the case of local authority building work, protection from competition granted by statutory monopoly powers and the availability of local authority support in times of trouble have supposedly enabled inefficiency to exist.
Greater efficiency in the operation of DLOs was one of the main objectives of the 1980 Act and this was to be achieved by increased competition, pre-estimation for work and by setting a required rate of return.

3.2 The rate of return requirement

DLOs are required to earn a rate of return of five per cent on capital employed in the organisation. The rate of return is to be achieved in each category of work and must be determined on a current cost accounting basis. The rate of return is calculated by dividing the current operating surplus by the net operating assets at the end of the year. This entails the valuation of all land, buildings and stock held by a DLO, together with an allowance to reflect the impact of price changes on stock consumption.

Any authority which fails to earn the specified rate of return for any category of work is required to notify the Secretary of State of the Environment within six months of the end of the financial year. Failure for any category of work for two consecutive years can be the subject of a report to be considered by an authority and a copy must be sent to the Secretary of State, who may direct that an authority shall cease to have power to do direct labour work of all or any description.

As a result of the legislation, each authority is required to secure such a positive rate of return on capital employed as the Secretary of State may direct. The rate of return is required in each financial year for each description of work and must be determined on a current cost accounting basis. The statutory requirements to meet a target expressed in terms of a return on capital employed can lead to contradictions between efficiency and meeting the rate of return. For example, stocks are included in the measurement of capital employed, and therefore a reduction in the level of stocks will increase the rate of return, all other things being equal. This, however, may be incompatible with the need to carry such a level of stocks as will enable emergency and other repairs to be carried out more efficiently.

The legislation discriminates against DLOs on the question of the rate of return. The requirement to meet a rate of return on a current cost basis is inconsistent with the requirements of private industry, where there was, in the 1980s, considerable debate as to the usefulness of current cost accounting altogether. The Inland Revenue do not accept accounts prepared on a current cost basis as being valid for taxation purposes. Inevitably, the requirement to conform with current cost accounting requirements, in itself, increases the administrative cost of DLOs. Most of the small private companies competing with DLOs do not keep their accounts on a current cost accounting basis. Indeed, the Statement of Standard Accounting Practice was drawn up with large companies in mind. (See Brier. 1981 and Folwell. 1981).
To impose such measures on DLOs, when the meaning of current costs accounts themselves are in question, seems to be most unfair. In addition, DLOs are required to make, each year, a rate of return on each individual area of work as a measure of efficiency. The same rules and limits do not apply to private contractors and they

are not required to achieve any particular rate of return, or show any other comparable measure of efficiency.

DLOs are not allowed to transfer surplus across the different work areas as defined in the legislation. So a DLO could comfortably exceed the statutory rate of return on its operation as a whole, but one or more individual areas may fail to meet the required rate of return.

3.2.1 The choice of target rate

The purpose of the financial target is to ensure that DLOs account for the use, and identify the true economic cost, of resources that might otherwise be made available to the private sector. This is supposedly achieved by creating a financial regime for DLOs equivalent to that faced by their private sector competitors so that the prices they quote can be compared directly.

The 5% figure is drawn from the government's policy of ensuring that financial targets are consistent with the long-run marginal 'opportunity cost' of resource use to the private sector. The use of the 5% figure has been questioned. (Notably by Folwell. 1981). Table 3.1 shows how rates of return in industry in general have varied considerably in the nineteen eighties.

Table 3.1 Net real rates of return - Industrial companies

1980	3.8%
1981	2.9
1982	3.6
1983	4.8
1984	6.1
1985	7.5
1986	8.0
1987	6.2
1988	5.3
1989	4.9

(Source: British Business)

As certain categories of work carry more risk than others, it would make more sense to reflect this by, for instance, requiring a higher rate of return to be achieved on major construction work than on routine maintenance work. But the question must be asked of whether the performance of a DLO can be measured by calculating its return on capital.

Generally, building and civil engineering work are not capital intensive so doubts must arise about a specified financial target being worthy of consideration. The variability of results for individual authorities appears to bear this out.

Table 3.2 shows the rates of return achieved by DLOs responding to the CIPFA survey for a year in the mid-eighties.

Table 3.2 Distribution of percentage rates of return for all categories of work combined (DLOs England & Wales) 1984-85

%	No. of DLOs
<5	6
<10	59
<15	53
<20	31
<25	35
<30	18
<35	16
<40	13
<45	12
<50	15
<55	6
<60	6
<65	7
<70	4
>70	25

(Source: CIPFA)

Other accounting ratios, such as return on turnover or value added per employee, may be considered more appropriate, but the use of other targets based on non-financial measures and incorporating some measure of quality has found favour amongst many DLO managers.

3.3 The general effects on DLO operations

Two important changes might have been expected in the new environment, notably:

a. Comparatively less work being undertaken by DLOs due to the increased competition.

b. An increased rate of return being achieved as DLOs are forced to gear their operations towards meeting this particular requirement.

The CIPFA data give an indication of the validity of these assumptions and show some broad trends.

3.3.1 Increased competition

A DLO is obliged to submit a written statement of its charge for carrying out work and the Accounting Code of Practice puts forward five main methods of providing these written statements.

The government and CIPFA consider tenders/lump sum contracts and schedules, where tenders specify percentages on- or off-schedule rates (put forward by the authorities) for doing work, as the appropriate basis for competition.

Once a schedule rate for doing a job has been prepared, it can be used for all an authority's work for that trade and, for building maintenance, it allows for a proper comparison of tenders.

Neither 'target hour' and day works contracts nor 'bulk' offers normally provide the right basis for competition. The 'target hour' method requires the use of bonus schemes. DLOs give client departments copies of their bonus schemes together with statements of the prices per productive target hour, which they will require to be credited to their account. Day works contracts require that prices are expressed as amounts per actual hour worked, not per target hour earned.

It is a less satisfactory method as the charge would be partly dependent on the speed with which a job is done. It would involve the ability on the part of the department to forecast and compare the total number of hours which different tenderers would take, and the tenderer with the lowest hourly price could take the longest time to do a job.

'Bulk' offers made to client departments require a DLO to tell each of its client departments how much it would require to do all jobs of specified types for a specific period.

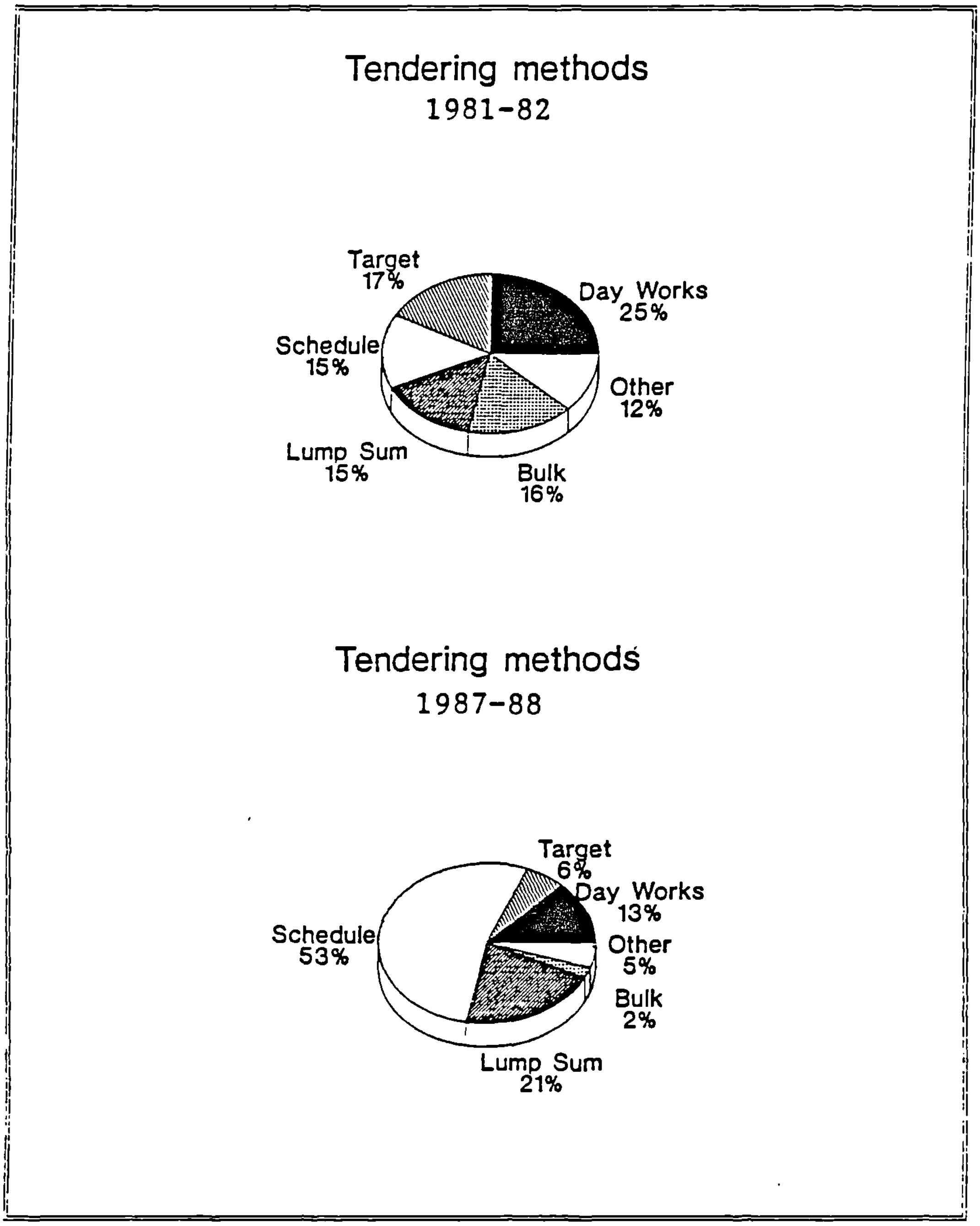
Changes in the methods used to charge for work are shown in Table 3.3 and illustrated in Fig. 3.1. In 1981-82 day works contracts still achieved 25% of total income compared with only 15% for schedule contracts, but by 1988-89 there had been considerable movement towards the more competitive methods with a 55% figure for schedule contracts.

Table 3.3 <u>Methods of charging for DLO work</u>

	1981-82	1982-83	1983-84	1984-85
Lump sum contracts	15	20	24	22
Schedule contracts	15	24	32	43
'Target hours'	17	17	14	11
Day works contracts	25	25	22	18
'Bulk offers'	16	8	4	2
Other	12	6	4	4
	1985-86	1986-87	1987-88	1988-89
Lump sum contracts	21	22	21	23
Schedule contracts	48	51	53	55
'Target hours'	8	7	6	5
Day works contracts	17	16	13	11
'Bulk offers'	3	2	2	2
Other	3	3	5	4

(Source: Derived from CIPFA DLO Statistics 1981-89)

Fig. 3.1 Changes in the tendering methods used by DLOs



3.3.2 Loss of work by DLOs

The total value of the construction work undertaken in one mid-eighties year (1985-86) was just under £4bn,for the 318 local authorities showing full statistics in the CIPFA survey of that year. This represents a large market for construction work yet a reduction in the proportion of work undertaken by DLOs was inevitable over the period.

There was clear variability in the proportion of work undertaken by DLOs but Table 3.4 shows the greatest relative loss to be in the field of major works due to the increased competition. This represented a loss of almost a third in the eighties in the value of larger scale capital work.

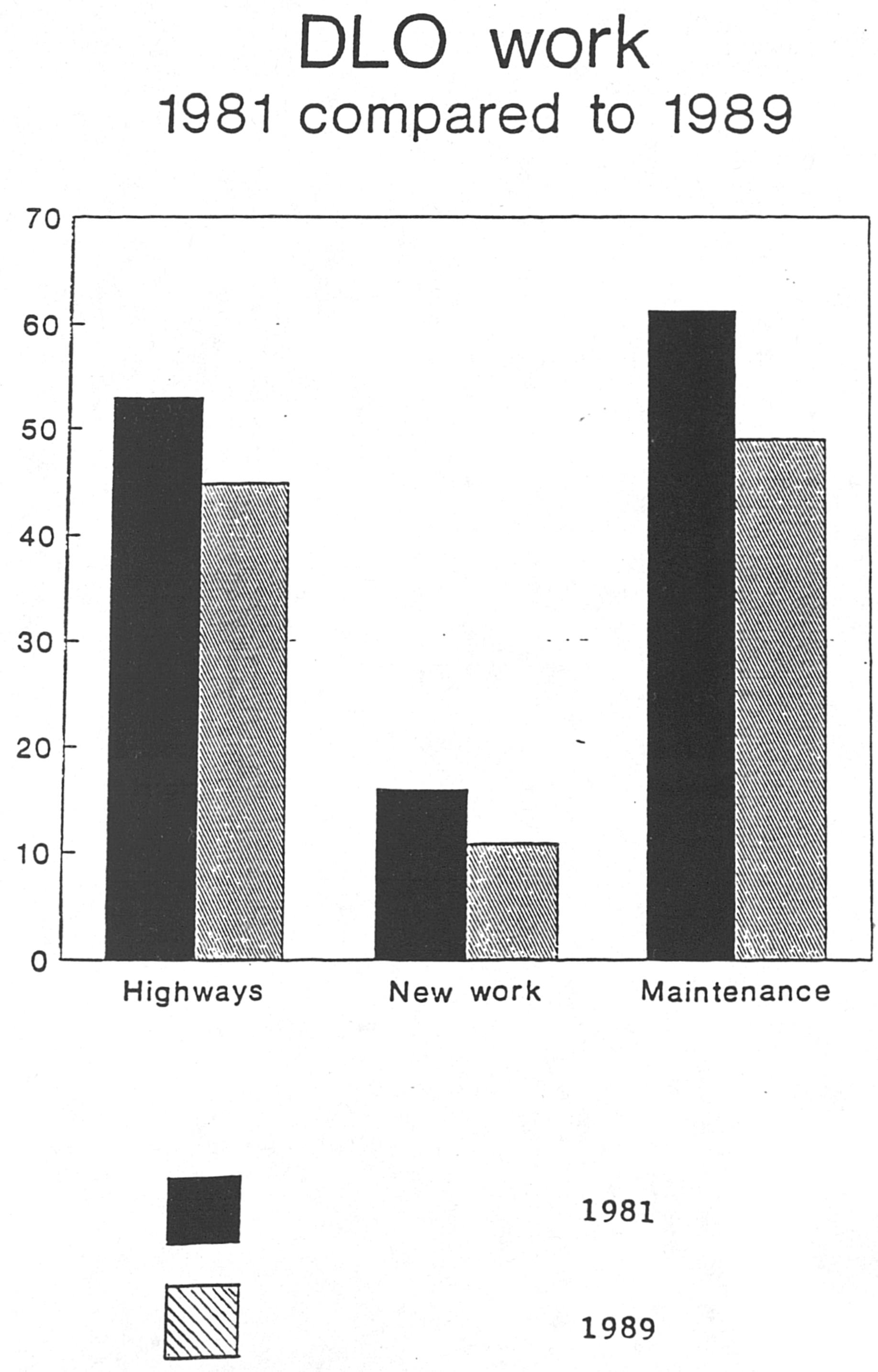
Fig. 3.2 illustrates the over all change 1981 to 1989.

Table 3.4 DLO work undertaken as a percentage of an authority's construction and maintenance work

Category	1981-82	1982-83	1983-84	1984-85
D1	53.0	51.6	48.5	48.1
D2	16.0	12.9	14.6	10.3
D3	24.4	23.6	26.9	24.3
D4	61.2	57.8	55.1	51.2
All categories	44.3	43.3	42.6	39.9

(Source: Derived from CIPFA DLO Statistics 1981-89)

Fig. 3.2 Percentage of work won by DLOs



Category	1985-86	1986-87	1987-88	1988-89
D1	46.6	46.0	42.9	44.8
D2	11.5	12.1	12.4	10.8
D3	25.6	22.3	23.0	33.2
D4	53.6	52.5	51.0	48.9
All categories	42.6	41.9	40.4	39.9

(Source: Derived from CIPFA DLO Statistics 1981-89)

3.3.2.1 Maintenance organisations

The Audit Commission (1989) looking at DLOs in London reported that DLOs were market leaders in building maintenance because of their size and approach to jobbing repairs with many DLOs being substantial businesses - (70%) having a turnover greater than £1m i.e. employing at least 40 operatives. There were very few private sector firms of this size in the jobbing maintenance industry with building maintenance in the private sector being a cottage industry of small firms and the self-employed.

DLOs have usually been successful, for this category of work, in meeting the targets imposed by the 1980 Act. In 1987-88 only 9 out of the 284 DLOs quoted in the CIPFA statistics made a loss and a further nine made less than 5% rate of return on capital employed.
When a DLO fails to achieve its rate of return, the

authority must notify the Secretary of State, who has had the ability to order a special report at any time, once an authority failed to make the required rate of return. It has been normal policy to order a special report from the authority when this occurs in two consecutive years (until February 1987, it was three consecutive years). In the light of these reports, he could order the DLO to wind up its operation.

For general building maintenance DLOs there were, pre-1989, nine such reports, but no closures were ordered. This contrasts with DLOs engaged in new construction, where twelve reports were ordered and four DLOs were instructed to close.

DLOs managed to increase their turnover in maintenance work in real terms during the 1980s, but their market share fell from 61% to 51%, though it is notable that most of the fall occurred between 1981 and 1983.

One contributory factor behind this fall in shares has been the growth of planned maintenance as a proportion of the total.

THe managers of DLOs themselves recognised, in an ADLO members' survey, that DLOs' traditional area of strength is jobbing repairs, which probably account for 70-80% of DLO turnover. (ADLO. 1989)

3.3.2.2 New construction work

Only 52 local authorities had DLOs undertaking works of new construction in 1987-88 compared to 90 in 1981-82, and their turnover was relatively small and declining as shown in Table 3.5.

Table 3.5 DLO turnover (£m) on new construction

	Major works of new construction	Minor works of new construction
1981-82	106	25
1987-88	94	34
(1987-88 at 1981-82 prices)	68	24
Real terms change on 1981-82	-30%	

(Source: Derived from CIPFA DLO Statistics 1981-89)

As Table 3.4 showed, in 1981-82 DLOs were undertaking 16.0% of their authorities' large new construction work, but this proportion had fallen to 10.8% by 1988-89.

3.3.2.3 Smaller workforce

Lower workloads, particularly in new building work obviously reduced the average number of operatives

engaged in this area.
For the sample of 27 DLOs shown in Appendix 2 who were undertaking category D2 work, the total number of direct employees fell from 2 235 to 1 928 between 1981-82 and 1988-89. The corresponding fall in category D4 work (for 51 DLOs) was from 9 868 to 8 497 employees.
The average number of direct employees also fell as a proportion of the total workforce.

3.3.2.4 Higher average rates of return

In 1981-82 little of the work was competitive so that DLOs had a comparatively easy task in fixing their charges. So long as these covered their costs with a little bit to spare, they were home and dry. The test became more difficult each year though, as more work had to be put to competition.
Yet even though the proportion of DLOs showing a deficit increased from 6.4% in 1981-82 to 7.8% in 1988-89, the average rate of return (for those DLOs showing a positive rate of return) rose from 15.1% to 18.4% and the proportion with a rate of return greater than 7% went up by a third.

3.4 Review

Every DLO, just like a private contractor, has to constantly make economies and review working methods in order to keep costs, particularly overheads, as low as possible.

Coupled with reduced public sector spending, increased competition had been reducing DLO work. Looking at the results on a purely objective basis it is apparent that many DLOs found difficulty in achieving the objective of transforming a service department into what was essentially needed - a commercial contracting organisation.

Oft-made criticisms that DLOs are not allowed to compete 'freely and fairly', being denied the right to compete against private industry on the open market and being unable to offset losses in one division by profits in another, did appear in the 1980s to have some justification.

PART B

PRODUCTIVITY AND EFFICIENCY

MACRO-ASPECTS

CHAPTER 4

AGGREGATE PRODUCTIVITY MEASUREMENT

4.1 Productivity measurement for DLOs

Common measures of productivity involve the use of the ratio of a measure of output to a measure of a single input. Labour productivity, in particular, is a widely used measure of an organisation's efficiency, but this is mainly due to the difficulties in obtaining quantitative measures for the other productive inputs. The calculation of output per worker is, at best, a crude measure of the ability of an organisation to use efficiently its resources in production.

It was on the basis of this partial productivity measure - the average product of labour - that the campaign against DLOs in the late 1970s, which led to the subsequent 1980 legislation, was launched (Fleming. 1978 : O'Brien. 1977). Criticism was levelled at direct works departments, based on the claim that the productivity of private contractors' labour was significantly higher than that of direct labour. The implication being, that any extension of direct labour would lead to an inefficient use of resources.

The validity of the argument, based on aggregate gross output data, was extremely suspect, with such a large degree of variation in the type of output produced in the industry.

This prompted others, such as Lowe (1987), to advocate the virtue of average capital productivity as an alternative single factor productivity measure, but it is total factor productivity which is the ideal against which other approaches should be measured.

4.2 Concerning factor productivity

In the late 1950s and early 1960s, Fabricant (1959), Kendrick (1961) and Solow (1959) established on the basis of single factor productivity measures that the conventially measured inputs, capital and labour, leave a large portion of the growth of output unexplained. Since then, considerable research on the measurement, determinants and consequences of factor productivity has been undertaken.

4.2.1 Technical change and the production function

Productivity indices are deduced from an explicitly defined production function.
The accurate specification of the form and estimation of the parameters of the production function are crucial to the measurement of these indices.
Consider the aggregate, two factor, twice differentiable production function for output Q using the two factors labour (L) and capital (K) :

$$Q = A.F(L,K) \tag{1}$$

where A is a measure of disembodied technical change and the function F is homogeneous.

Suppose the production function (1) is $Q = AL^{\alpha}K^{\beta}$, then $\beta = 1-\alpha$ and constant returns to scale prevailing. This supposition is confirmed by a number of empirical studies carried out in various countries. (See Chau and Walker.1988 and Lowe.1987).

If the inputs K and L are measured erroneously, say, by multiplicative factors V_l and V_k denoting the quality improvement of L and K, then it can be shown that:

$$\frac{dA}{A} = \alpha\left(\frac{dV_l}{V_l}\right) + (1-\alpha)\left(\frac{dV_k}{V_k}\right) \tag{2}$$

That is, the "residual" becomes a weighted sum of the growth rates of the quality changes "embodied" in the conventional inputs.

Similar results are obtained when a third factor is left out of the production function (1). Suppose the function is defined as $Q = A\,L^{\alpha}K^{\beta}M^{\gamma}$

then the corresponding productivity relation would be

$$\frac{dA}{A} = \frac{dQ}{Q} - \left(\alpha \frac{dL}{L} + \beta \frac{dK}{K} + \gamma \frac{dM}{M} \right) \qquad (2a)$$

where M is the omitted variable.

It is clear then, that any misspecification or errors in estimatimg the parameters of the aggregate production function - errors in measuring the variables, errors due to omission of relevant inputs - will spill over to the measure of total factor productivity. If these sources of bias are successfully removed, the remaining portion of dQ/Q, unexplained by the combined rate of growth of all the factors of production, is the measure of 'true' total factor productivity or technical change.

4.3 Total factor productivity (TFP)

Although several theoretical approaches to the measurement of TFP in industries and individual firms have been developed, a measurement method proposed by Caves (1980a and 1980b) can be justifiably selected, because it avoids restrictive assumptions about the form of the underlying production function selected to represent an industry or firm.

A production function shows the maximum obtainable output rates for all possible sets of input usage rates and, by definition, specifies a particular technology. Caves begins by assuming that output Y is produced by combining a set of inputs X_i according to a general implicit production function:

$$f\ (\ Y;\ X_1,\ X_2,\ldots..X_n;\ T\ )\ =\ 0 \tag{3}$$

where T is time, which allows for shifts over time in the production function. Such shifts in the production function are equivalent to changes in technology, which could represent changes in productivity. Using a duality theorem developed by McFadden (1978), the following unique cost function corresponding to this production function can be specified:

$$C = g\ (Y;\ W_1,\ W_2,\ldots.W_n;\ T\ ) \tag{4}$$

where W_i is the price of input X_i and C is total cost:

$$C = \sum_{i=1}^{n} W_i X_i \tag{5}$$

By taking the natural logarithm of the cost function, and totally differentiating with respect to time, Caves allocates the rate of growth of cost among changes in the output level, changes in input prices and shifts in the cost function (i.e. productivity changes in the opposite direction) respectively.

$$\frac{d \ln C}{dT} = \frac{\partial \ln g}{\partial \ln Y} \frac{d \ln Y}{dT} + \sum_{i=1}^{n} \frac{\partial \ln g}{\partial \ln W_i} \frac{d \ln W_i}{dT} + \frac{\partial \ln g}{\partial T} \quad (6)$$

Following Shephard's lemma, it can be shown that the first partial derivative of the logarithm of the cost function with respect to the logarithm of each input price is equal to the cost share of that input:

$$\frac{\partial \ln g}{\partial \ln W_i} = \frac{W_i X_i}{C} = S_i \qquad (7)$$

where S_i represents the cost share of the ith. input.

This useful characteristic of the cost function can be illustrated by the hypothetical data in Table 4.1.

Table 4.1 Hypothetical industry data for two time periods

	1987	1988
W_i	£100	110
X_i	£200	200
C	£100 000	102 000

Since the price of input i has increased by £10 between 1987 and 1988, if we hold output, technology, all input quantities, and all other prices constant, then total cost will increase by £2 000.

Using 1987 as the base year, the continuous partial derivative:

$\ln\delta g \ / \ \delta \ln W_i$, can be approximated with discrete data by the ratio of the percentage change in total cost to the percentage change in the price of input i, that is :

((102 000-100 000 / 100 000)) / ((110-100) / 100)
= 0.2

Consequently, $\delta \ln g \ / \ \delta \ln W_i = S_i$, since the cost share of input i in the base year is

((100)(200)) / 100 000 = 0.2

Caves takes the total derivative of the natural logarithm of equation (5) with respect to time and obtains:

$$\frac{d \ln C}{dT} = \sum_{i=1}^{n} \frac{W_i X_i}{C} \frac{d \ln W_i}{dT} + \sum_{i=1}^{n} \frac{W_i X_i}{C} \frac{d \ln X_i}{dT} \quad (8)$$

Substitution of equation (8) into equation (6) and further substitution of equation (7) into the result yields the following expression for productivity change:

$$-\frac{\delta \ln g}{\delta T} = \frac{\delta \ln g}{\delta \ln Y} \frac{d \ln Y}{dT} - \sum_{i=1}^{n} Si \frac{d \ln Xi}{dT} \quad (9)$$

If constant returns to scale are exhibited in the production process, and if, in a competitive market, the firm is unable to influence input prices, then the given percentage change in inputs will lead to the same percentage change in total cost. So, the percentage change in total cost is equal to the percentage change in output and the partial derivative $\delta \ln g \,/\, \delta \ln Y$ can be assumed to be equal to one.

Equation (9) can be modified to

$$-\frac{\delta \ln g}{\delta T} = \frac{d \ln Y}{dT} - \sum_{i=1}^{n} Si \frac{d \ln Xi}{dT} \qquad (10)$$

In order to apply this index to discrete data, the first diferences in natural logarithms and of beginning and end-of-period averages for the input cost shares can be used.

For equation (10), one obtains the following formula for measuring the rate of growth in TFP compounded continuously over the time period T-1 to T:

$$\text{TFPGrowth Rate} = \ln Y_T - \ln Y_{T-1} - \sum_{i=1} \tfrac{1}{2}(S_{i,T}+S_{i,T-1})(\ln X_{i,T} - \ln X_{i,T-1}) \qquad (11)$$

The application of equation (11) can be illustrated with the hypothetical data in Table 4.2.

Table 4.2 Hypothetical data on output and input quantities, input prices and cost shares of an industry for two time periods

	1987 Quant.	1987 Price (£/unit)	1987 Cost share	1988 Quant.	1988 Price (£/unit)	1988 Cost share
Y Output	100			110		
X_1 Labour	40	15	0.115	30	16	0.082
X_2 Capital	30	20	0.115	40	22	0.150
X_3 Materials	2000	2	0.770	2200	2.05	0.768

The r.h.s. of equation (11) would be evaluated as:

$$\begin{aligned} \ln 110 - \ln 100 &- \tfrac{1}{2}(0.082 + 0.115)(\ln 30 - \ln 40) \\ &- \tfrac{1}{2}(0.150 + 0.115)(\ln 40 - \ln 30) \\ &- \tfrac{1}{2}(0.768 + 0.770)(\ln 2200 - \ln 2000) \end{aligned}$$

$$= 0.0122$$

This means that the continuous rate of growth in TFP between these two periods is approximately 1.2%. Since the data are given as annual values for successive years, this result is interpreted as a continuous annual rate of productivity increase of 1.2%

4.4 Choice of methodology

This work attempts to develop an analytical framework for productivity analysis of the DLO sector of the construction industry after examining various analytical standpoints by which productivity can be defined and measured. The work draws upon previous research in other countries concerning construction productivity. Whilst the methodologies adopted elsewhere are useful, data availability is significantly different between the U.K. and the countries in which the previous work was conducted, to such an extent that the previous studies cannot be adopted directly.

The original concept of total factor productivity can be traced to the work of Stigler (1947). The concept was later developed by researchers such as Kendrick (1956), Solow (1957), Denison (1962), Abramovitz (1956) and Griliches and Jorgenson (1966).
Domar (1962) described the trend of TFP as the trend of 'residual', which is a measure of the change of aggregated tangible inputs to aggregated total outputs,

neither input nor output being adjusted for quality change. This measure of productivity will reflect change in real output resulting from changes in intangibles such as economies of scale, change in qualities of inputs and advance in technology.

4.5 Empirical research into productivity at the industry level for construction

Empirical research into TFP at the industry level for the U.K. is rather lacking.

In the U.S., Dacy (1965) estimated total factor productivity of the construction industry with indices of building price, hourly wages, output per man-hour and material price, and Stokes (1981) noted a decline in labour productivity and attempted to explain such decline by error in measurement of output, change in output mix, change in capital per worker, demographic change in construction labour, economies of scale, change in regulations and regional shifts.

Chau and Walker (1988) estimated TFP for the Hong Kong construction industry but aggregation of inputs and outputs renders the results of the study to be rather limited.

Lowe (1987 and 1988) considered the problems of TFP measurement for the U.K. construction industry as a whole and, pointing out the difficulties inherent in obtaining suitable data concentrated on the relative merits of labour and capital productivity.

4.6 Multi-output techniques

Index number procedures represent production processes and it is necessary to choose a procedure capable of representing a diversity of possible production structures.
Duality theory allows the derivation of a procedure which avoids restrictive assumptions, viz; constant returns to scale, predetermined elasticity of substitution and transformation, homogeneity or homotheticity of the input structure and Hicks neutral technical change.

This approach begins with a general transformation function and its corresponding (multi-) product cost function.
Total differentiation of the cost function leads to an index of productivity which is a function of the rates of growth of the individual outputs and inputs. The

weights for the input growth rates are the elasticities of total cost with respect to the corresponding input prices. The weights for the output growth rates are the elasticities of total cost with respect to the output levels.

If cost elasticities with respect to input prices and output levels are not directly observable, input cost shares provide defensible estimates of the input weights.
If relative prices for all outputs do not reflect their relative marginal costs of production, then revenue shares do not provide defensible estimates of the output weights. Estimates of the cost elasticities with respect to output levels can be found from cross-sectional cost function regressions.

4.6.1 Methodology

Transformation function

$$f\ (Y_1, Y_2 \ldots Y_m;\ X_1,\ X_2 \ldots . X_n\ :\ T\ ) = 0 \qquad (12)$$

Cost function

$$C = g\ (\ Y_1, Y_2 \ldots .. Y_m:\ W_1,\ W_2 \ldots W_n:\ T\ ) \qquad (13)$$

Total cost

$$C = \sum_{i=1}^{n} W_i X_i \qquad (14)$$

(W_i = price at which Xi can be purchased)

The cost function is homogeneous of degree one, non-decreasing and concave in the factor prices (Wi). The first partial derivatives of the cost function with respect to the Wi's are equal to the cost minimising input levels, (the property known as Shepherd's lemma), written in log form as :

$$\frac{\delta \ln g}{\delta \ln W_i} = \frac{W_i X_i}{C} = S_i$$

(S_i = share of factor i in total cost) (15)

Total differentiation of the log of the cost function with respect to time yields :

$$\frac{d\ lnC}{dT} = \sum_{i=1}^{m} \frac{\delta\ lng}{\delta\ lnY_i} \frac{dlnY_i}{dt} + \sum_{i=1}^{n} \frac{\delta\ lng}{\delta\ lnW_i} \frac{dlnW_i}{dT} + \frac{\delta\ lng}{\delta\ T} \quad (16)$$

This shows the rate of growth in total cost can be allocated among changes in output levels, changes in factor prices and shifts in the cost function (changes in productivity).

Total differentiation of total cost with respect to time now gives:

$$\frac{dlnC}{dT} = \sum_{i=1}^{n} \left(\frac{W_i X_i}{C} \right) \left(\frac{dlnW_i}{dT} + \frac{dlnX_i}{dT} \right)$$

$$= \sum_{i=1}^{n} S_i \frac{dlnW_i}{dT} + \sum_{i=1}^{n} S_i \frac{dlnX_i}{dT} \quad (17)$$

(15) and (17) can be substituted into (16) to obtain

$$- \frac{\delta lng}{\delta T} = \sum_{i=1}^{m} \frac{lng}{lnY_i} \frac{dlnY_i}{dT} - \sum_{i=1}^{n} S_i \frac{dlnX_i}{dT} \quad (18)$$

The $\delta\ lng/\delta lnY_i$ are cost elasticities of output and if output prices reflect marginal costs (feasible in the highly competitive construction industry) and the industry exhibits constant returns to scale (undesirable 'a priori' assumption) then the cost elasticities would be equal to the shares of the outputs in total revenue. This means the use of cost elasticities with respect to outputs, rather than revenue shares, to weight the output growth rates. However, costs shares provide satisfactory estimates of cost elasticities with respect to factor prices if inputs are purchased in free markets.

The index of productivity (18) is defined in continuous time.

For a discrete approximation, differences in natural logs can be used to approximate the log derivatives, and arithmetic averages of the weights at the beginning and end of the period approximate the instantaneous weights.

$$-(\ln g_T - \ln g_{T-1}) = \sum_{i=1}^{m}\left(\tfrac{1}{2}\left(\frac{\delta \ln g}{\delta \ln Y_T}\right) + \tfrac{1}{2}\frac{\delta \ln g}{\delta \ln Y_{T-1}}\right)(\ln Y_T - \ln Y_{T-1}) \qquad (19)$$

$$-\sum_{i=1}^{n}(\tfrac{1}{2}S_{i,T} + \tfrac{1}{2}S_{i,T-1})(\ln X_{i,T} - \ln X_{i,T-1})$$

All the variables in (19) are observable, except for the elasticities of cost with respect to output.

These can be estimated from cross-section data from a sample of DLOs.

CHAPTER 5

TOTAL FACTOR PRODUCTIVITY (TFP): METHODOLOGY

5.1 Components of productivity indices

Ideally, components of productivity indices are denominated in physical units of measurement, but with a lack of such data, use can be made of quantity indices that are obtained by deflating, to their constant £ equivalent, the current £ values corresponding to their physical quantities, in order to correct for price changes.

Other measurement considerations that apply to all components include:

(a) Development of an appropriate weighting system, if heterogeneous items comprise a single component.

(b) Adjustment for changes in component quality over time.

(c) Inclusion of new outputs and inputs introduced into the production process.

5.1.1 Measurement considerations for individual inputs

Labour input:

In a competitive labour market, in which any category of labour is paid a wage equal to its marginal contribution to output, we can weight labour by the corresponding average earnings. A measure of labour input can be obtained by deflating total labour compensation with an index of average earnings.

Materials input:

Materials input basically refers to all inputs not classified as labour or capital.

Capital input:

Capital input is by far the most difficult component of productivity indices to quantify. Unlike materials, measurable quantities of which are completely consumed during the current time period, capital provides a flow of services that extends beyond the current period. Real (i.e. constant value) capital input must therefore be derived.

Output:

An appropriate value measure for output is receipts. (No inventory changes arise when payment is based on completed work - the usual case in construction). The value of receipts should be deflated with an index of output prices rather than of input costs. Categorisation of construction output into homogeneous units obviously poses some problems but the breakdown of DLO data into the four categories of work does impose a considerable degree of uniformity.

For aggregate time series data on each category of work, a breakdown of input costs can be made and appropriate index series applied to the costs, in order to construct a constant price estimate and measure changes in the volume of these inputs and of the output as well.

5.2 Input identification

From a DLO's revenue accounts, a breakdown of input costs into three areas is possible. This is illustrated in the Data Appendix: Section 1, where the aggregated data for the sample authorities in each category are shown.

The basic breakdown is :

Labour costs	-	Direct labour and indirect labour, including employee related costs.
Material costs	-	Supplies and services, including sub-contractors.
Capital costs	-	Transport and plant; administration overheads; loan repayments and interest charges

Note on capital costs:

Vehicle and plant replacement may be financed in various ways:

- By external leasing or by internal leasing, with the DLO paying hourly rate hire charges for the use of transport and mobile plant to another department, which manages the fleet, and whose charges are set at rates which include depreciation and renewals provisions.
- From an authority's specific repairs and renewals fund, with annual contributions based on the current replacement cost and anticipated future life of

individual assets.

- The other charges made within the revenue accounts for the utilisation of assets are payments of principal on outstanding capital advances from an authority's capital loans fund. Interest changes paid by the loan fund tend to be recharges to revenue accounts at an average rate of interest.

5.3 Choice of appropriate deflators

Data on cost and price indices for the construction industry are available from various sources. In addition to governmental publications, a major source is Building Management Information Ltd. (BMI), formerly the Building Management Cost Information Service (BMCIS). For each separate input and for output prices, the most appropriate index has been chosen as a deflator.
Each index has been adapted or constructed to have a base year of 1984-85, a middle year in the series.

5.3.1 Labour costs

For direct labour costs, the source of cost data is the 'Joint Negotiating Committee for Local Authority Services'.

Circulars 'Building and Civil Engineering' (1982-89) give the basic weekly rate for 39 hours (40 hours prior to 1982 - adjustment made here).
As more than 95% of authorities follow these pay and conditions, the data provide an appropriate basis for a deflator. (ADLO. 1989).

Table 5.1 shows the weighted mean labour wage rates for DLOs.

Table 5.1 Index of direct labour costs

	Basic rates for craftsmen (£) (weighted according to trade proportions for all DLOs)	Index (1984-85=100)
1981-82	87.90	86.3
1982-83	91.65	90.0
1983-84	95.32	94.2
1984-85	100.82	100.0
1985-86	103.93	103.0
1986-87	109.02	106.0
1987-88	125.77	112.1
1988-89	133.0	136.8

For indirect labour, LACSAB, the local authorities employers organisation, produce indices of white-collar workers' pay rates. A weighted composite index based on the grading structure of a typical DLO can be used as a deflator. This is shown in Table 5.2.

Table 5.2 Index of indirect labour costs

	Index of clerical staff pay rates (1984-85=100)
1981-82	87.9
1982-83	91.2
1983-84	95.0
1984-85	100.0
1985-86	103.6
1986-87	108.5
1987-88	125.1
1988-89	131.5

5.3.2 Materials costs

The source of cost data is the BMI Quarterly Cost Briefing : Building Maintenance Cost (April 1990). Separate indices can be compiled for materials prices for highways work and for new construction work.
The following table shows the compiled indices, amended to give the mean value for a financial year.

Table 5.3 Indices of materials prices

	Material prices (1984-85=100)	
	Highways Work	New Construction Work
1981-82	81.2	81.5
1982-83	86.8	87.6
1983-84	92.8	93.6
1984-85	100	100
1985-86	104.9	105.3
1986-87	111.1	109.1
1987-88	116.8	115.0
1988-89	123.8	121.1

For maintenance work, an index is provided by the BMI to reflect the general movement of the cost of carrying out maintenance work in local authorities using directly employed labour.

The index is based on the BMI maintenance materials index and the costs of employing operatives under the local authorities' services agreements for builders, plumbers, electricians and engineers.

Table 5.4 shows this index series expressed on a financial year basis.

Table 5.4 General maintenance cost index

	(1984-85=100)
1981-82	86.0
1982-83	91.0
1983-84	95.2
1984-85	100
1985-86	103.5
1986-87	108.8
1987-88	117.1
1988-89	123.8

5.3.3 Capital costs

Capital costs can be split into those costs associated with plant and other overhead costs, mainly associated with property occupation.

For plant, the BCIS Input Cost Indices include a 'Basic Plant Cost Index' based on the cost model for the General Building Cost Index (ABa7) Sept 1989.
The following table shows this index rebased on 1984-85.

Table 5.5 Basic plant cost index

	(1984-85 = 100)
1981-82	93.3
1982-83	97.4
1983-84	98.3
1984-85	100
1985-86	105.5
1986-87	104.5
1987-88	110.8
1988-89	115.3

As property is the other major component, recourse needs to be made to indices showing commercial and industrial rents, in order to compile a cost index to be applied to overheads. The validity of this application is based on the large proportion (over 95% of revenue account overheads for a typical DLO) of overheads related to property costs

Appropriate sources for such data are the 'Hillier Parker' - 'All Commercial Rent Index' and 'Industrial Rent Index' (August 1991).
A weighted, composite rental index, adapted to a base period of 1984-85, is shown in Table 5.6.

Table 5.6 Composite rent index (Overheads)

	(1984-85=100)
1981-82	90.8
1982-83	94.0
1983-84	94.6
1984-85	100
1985-86	105.4
1986-87	112.5
1987-88	139.1
1988-89	182.1

5.3.4 Output

The source of data on appropriate output prices is 'Housing and Construction Statistics' (1980-90) (HMSO). 'Table A' Construction Cost and Price Indices provides an index of output prices for public sector construction work. In a competitive market it can be assumed that the index applies to work undertaken by DLOs as well as by private contractors.
Table 5.7 shows the index based on 1984-85.

Table 5.7 Output price index

	(1984-85 = 100)
1981-82	95.2
1982-83	94.2
1983-84	96.5
1984-85	100
1985-86	103.3
1986-87	106.2
1987-88	110.5
1988-89	121.7

5.4 Calculation of growth rates

The derived cost and price indices can be used to deflate the input and output value data.
The input and output cost / price indices, when applied to the expenditure and income values, allow the calculation of input and output volume coefficients for use in the computation of growth rates. These calculations are shown on a category by category basis.

The data to be used as the input and output values in the calculations on expenditure categories and income are taken from the figures in the Data Appendix: Section 1. The breakdown is on the basis of the three inputs of labour, materials and capital, except for Category D4 work, where the use of the combined direct labour / materials cost index means that it is more appropriate to deal with indirect labour on its own.

The calculation of the input and output volumes is shown in detail for Categories D1 and D2 but only in summary for the other two categories, except where the direct labour / materials index is used for maintenance work (Category D4).

The formula used for measuring the rate of growth in TFP compounded continuously over the time period (T-1) to (T) is:

TFP Growth Rate

$$= \ln \text{Output}_T - \ln \text{Output}_{T-1} - \Sigma \tfrac{1}{2}(S_{i,T} + S_{i,T-1}) (\ln X_{i,T} - \ln X_{i,T-1})$$

where X is an input and S is the cost share of the i th. input.

The cost shares are calculated from the breakdown in the Data Appendix: Section 1.

The calculation of input and output volumes and their use, together with the cost share values, in the determination of TFP growth rate, are shown in the Data Appendix: Section 2.

A summary of the growth rates is shown in Table 5.8.

Table 5.8 Growth rate (%)

	D1	D2	D3	D4
1981/2 to 82/3	8.0	3.7	9.8	7.4
1982/3 to 83/4	0.6	0.5	11.9	0.3
1983/4 to 84/5	2.5	9.4	4.3	1.1
1984/5 to 85/6	0.8	12.6	-13.4	3.2
1985/6 to 86/7	1.1	-10.4	12.2	1.6
1986/7 to 87/8	2.3	8.5	-10.0	4.5
1987/8 to 88/9	0.1	-1.7	-7.1	-0.4

5.5 Comments on TFP results

The inconsistent TFP growth rate for new construction work (both D2 and D3) is not really unexpected in view of the fluctuating level of work in this area. This has been a 'difficult' area of work for DLOs as shown by the fact that 90 DLOs undertook work in this category in 1981-82 but less than 50 did so in 1988-89. Apart from the high value for the first year of the series (which was the first year of the 'financial independence' of DLOs and one in which the compilation of some DLOs' accounts may have lacked some accuracy) the figures for maintenance work (D4), (apart from 1987/8-88/9), reflect a healthy situation and offer a basic impression of efficient resource usage.

In highways work (D1) the figures are even more consistent after the first year. This is not too surprising, in view of the relatively stable workload presented by the authorities and a degree of competition considerably lower than that in existence in other categories of work.

PART C

PRODUCTIVITY AND EFFICIENCY

MICRO-ASPECTS

CHAPTER 6

ORGANISATIONAL OBJECTIVES AND PERFORMANCE ASSESSMENT

6.1 Efficiency assessment in the local authority sector

With the great emphasis placed on public sector efficiency by the Conservative government of the 1980s, Mrs. Thatcher, on the advice of her first 'efficiency adviser' Lord Raynor, instituted a programme of management reforms.

The 'Financial Management Initiative' resulting from the programme of management reforms for central government, had repercussions in the establishment of economy and efficiency measures at the local authority level too.

Prior to 1981, in many building and highways departments, there was no separation of the functions of client and contractor, and the same people were expected to perform both buyer and seller roles.

In housing maintenance, there had already been, in many authorities such as Manchester City Council, a separation of 'contractor' people with Housing Departments acting as landlord and contracting work out. This was especially the case in the metropolitan areas, where there had developed large DLOs, which engaged in new building during the 1960s and had turned themselves into mainly maintenance organisations by the end of the 1970s.

The new arrangements though, divided the roles within the organisation into client and contractor function, which was considerably different from the traditional way of thinking.

Since the contractors are operating in competition, the control over their expenditure is carried out through the bidding mechanism and the payment for work due at the previously agreed price. Corporate policy (e.g. on redundancy) is not relevant to the contractors. If they fail in competition, jobs cannot be preserved. Nor need the contractor be involved in corporate decisions about budgets.

A few years after the introduction of compulsory competition tendering for local authority building work, it was found that over 70% of authorities had made some reorganisation. (ADLO. 1989). This mainly consisted of separating the clients from the contractors at management level.

The best way to achieve a good service is not necessarily to separate buyer and seller, but to be clear about the different functions.

6.1.1 The 'buyer'

One of the difficulties which managers in local authorities have faced, is in deciding who is responsible for pay and conditions. The traditional model was that nationally agreed rates and conditions would be applied throughout local government, with personnel and finance departments monitoring gradings and pay. When part of the organisation is set up to compete with outside firms, its managers feel that they need more discretion. This implied that those people at the 'centre' of the organisation have correspondingly less power over these matters.

Another difference is that those elements of the 'centre', which are traditionally concerned with control (such as the accounting and finance functions), are now more concerned with developing support systems, such as management accounts and management information systems, which are useful for managers as well as for financial accountability. Some central personnel have found it difficult to make these changes; switching from being a relatively powerful controller to being a support service is not easy. A struggle for control emerges as the managers of the new, relatively autonomous contracting organisations try to manage all the important aspects of their 'business'.

6.1.2 The 'seller'

In the early 1980s, local authorities' response to the introduction of compulsory competitive tendering in highways and building work ranged from panic to complacency according to the first of ADLO's members' surveys. (ADLO. 1985). Panic was inappropriate in the circumstances, given that the phasing was relatively gradual and that, in general, authorities had already been using private contractors extensively in these areas of work. This gave the in-house teams time to prepare and also allowed them to bid for work, which had previously been carried out by contractors. By 1983, the numbers of people employed in public sector highway construction and maintenance had actually increased.

In the longer term, there were significant changes in management; costs were examined and reduced, structures altered, working practices streamlined, new systems installed, payment schemes reformed. In many cases, local authorities displayed classic elements of private sector corporate turnaround strategies experienced by companies, which were bankrupt or close to it, and which were bought by new owners. (ADLO. 1986).

6.1.3 Change of management

Many authorities felt that the old style of local government manager was inappropriate to the new competitive circumstances. In any case, in many authorities there was no position of manager in the contracting part of the organisation. Such a role had not previously existed.

Finding completely new management was not easy. The jobs were not especially attractive to private sector managers, unless they were in areas where employment opportunities were scarce. For example, in the early 1980s, jobs for civil engineers were scarce as road building declined in the UK and opportunities in the Middle East were reduced. Many engineers were attracted to jobs running DLOs. In the mid- 1980s, as civil engineering and building work picked up it became more difficult to attract new people and the new jobs simply created a circular movement of managers fom one authority to another.

6.2 Performance measurement for management

6.2.1 Organisational objectives

Whilst DLO managers were forced to recognise the required change in focus from service delivery to business management, non-economic factors were still important to those who supervise DLOs. An Audit Commission survey (1988) found ' management for quality' to be the most important objective. Typical of many DLOs was Kirklees MDC whose Building Services Division's objectives were:

> 'To provide and market an efficient, value for money, high quality building and constuction service.'
> (Kirklees MDC. 1989)

Of concern, is how these long range objectives are translated into more specific and unambiguous goals at the level of individual projects.

For the management and professional staff who are part of the DLO unit, overall assessment of performance must be based on their unit's ability to compete. The actual existence of the DLO depends on its ability to do the job more cheaply than private competitors. The ultimate test of a private firm's performance is the bottom line of profit.

Performance measures in public sector organisations, such as DLOs, are substitutes for profitability measures in the private sector. This measurement, however is much more difficult and calls for a complex mosaic of indicators.

It would, though, be a mistake to make too much out of the difference between the public and private sectors. Information about profit performance comes a long time after the events that generate the profits have taken place. Profit is only known once the accounts have been finalised. In the meantime, private sector managers require a series of indicators, against which the performance of current activities can be judged. There is, therefore, not as much difference between public and private sector performance management as is often supposed.

Performance measurement can be distinguished from monitoring and assessment. The former involves attempts to appraise service delivery in a quantitative fashion, usually by developing what are known as output or performance indicators. The recurring measurement of performance is performance monitoring. Performance monitoring systems are orientated to administrative objectives and can be distinguished from longer-term approaches by the fact that they must be simple, understandable, cost-effective and within the administrative and financial capacity of an organisation.

The term performance assessment is used here to denote a broader managerial function encompassing quantitative and qualitative approaches, and recurring and one-off attempts to assess performance of agencies or individual professionals.

6.2.2 Performance indicators

A distinction can be drawn between performance measures and performance indicators, but whilst it is possible to make this difference conceptually, in practice the two concepts tend to merge. Where performance can be measured precisely, reference is made to a performance measure; like reading data from a drawing. If, however, as is frequently the case, there is no precise interpretation of the data then it is referred to as a performance indicator; an alarm bell.

A performance indicator is provocative and suggestive. It alerts management to the need to consider the issue further. Thus, for example, the target times for jobs completed for one work team might be three times those in another. That piece of data is not a measure that one team is three times more efficient than the other. Instead, it is an indicator that further investigation is required to find out why this is so.

6.2.3 Quality and performance

Quality of service is an important element of any performance review. Value for money is not synonymous with economy or effectiveness. Costs can be cut by sacrificing the quality of service.

Whilst the consumer's perception of quality differences is highly subjective, the manager of public services has some idea of the factors that give rise to these differences. Quality differences stem from:

(a) A different degree of technical sophistication or technology used in producing the service.

(b) Differences in the quality of materials, workmanship or maintenance used.

(c) The varying quality of the management of services.

For example, when comparing the quality of public sector housing provided by different local authorities, or by the same authority over time, indicators can be used such as the speed at which housing repairs are completed or how often the lift in a high-rise flat is out of order.

6.2.4 Performance assessment and service delivery

Progress has been made in performance measurement for manual services at the local authority level. But more problematic is the measurement of the quality of service delivery for the non-manual professional services of local government.

The main argument here is that although performance measurement may be difficult for some public services, systematic performance assessment is an important managerial function and can substitute for measurement.

In other words, what is important is not the measurement of performance **per se**, but its enhancement, and where measurement is too difficult or not cost-effective, the task must be recast in terms of managerial review which is both contextual and constructive.

In general, performance measurement requires that two related questions receive positive answers.

The first question asks whether agreed objectives of the service can be set out clearly and simply. This is necessary to understand what a service should be doing, and to generate criteria for evaluating performance.
The second question asks whether it is possible to measure reliably the extent to which these objectives are being fulfilled. To answer 'yes' to the second question requires a prior affirmative answer to the first.

6.3 Value-for-money management

6.3.1 Interpretation

A management handbook for DLOs, published in 1989, was concerned with advising management on ways of improving the value-for-money service they deliver. (Audit Commission. 1989).
The three 'E's' - economy, efficiency and effectiveness - are widely viewed as the principal components of the value-for-money approach to management. However, there is some confusion as regards the interpretation and use of these concepts in the public sector; particularly the interpretation of 'effectiveness'.
Effectiveness is defined by Butt and Palmer (1985) as

'ensuring that the output of any given activity (or the impact that services have on the community) is achieving the desired results.'

To evaluate effectiveness we need to establish that approved/desired goals are being achieved. Yet the achievement of goals is potentially an overly narrow interpretation of effectiveness. Those organisations which choose instrumental or low-level goals may be able to demonstrate 'effectiveness' against such goals without any significant impact on the community.

The kind of performance indicators that each of the three 'E's require, include:

Economy:

The tendering, contract and project control procedures to establish how far construction work had been built to specification, on time and at lowest achievable cost or within approved cost limits.

Efficiency:

Utilisation of workforce and equipment; direct and administrative staff allocations and mix; integration of services; management and resource allocation systems etc.

Effectiveness:
Results in terms of, for example, reductions in job waiting lists, increases in jobs performed.

6.3.2 Value-for-money auditing

The Audit Commission has done much to promote the concept of value-for-money auditing and to develop performance indicators for local government services. (Audit Commission. 1988).
The Commission publishes occasional profiles of local authority activities across a wide range of dimensions, including comparative costing profiles in which the cost of providing a specific activity is measured and compared for all authorities in England and Wales.
One such profile presented for the housing maintenance department is the cost of painting a standard door. This is an example of an 'economy' performance indicator. Nothing is said about what the cost should be. Local authority management is provided with information that shows there is a variance in the cost between local authorities.
An individual local authority can identify its maintenance costs on the profile and ask itself foı example:
Are there acceptable reasons why our costs are above o below those of others ?

Note that being below the average can be of as much concern as being above, since it could indicate that, rather than being superior in terms of 'economy', an inferior quality of output is being produced.

6.4 Improving productivity and effectiveness

In the 1980s, many DLOs began to see the need to prepare a business plan to set out ways in which they intend to improve performance. The nature of the plan depends upon the authority's individual objectives but needs to reflect a continuing quest for improved efficiency and effectiveness. The 'management handbook' proposes a list of basic questions - drawn from a survey of DLOs' annual reports and relating to the bases of DLC management operations - to be addressed in the determination of the plan. These are:

(a) What is the DLO good at?

The DLO's productivity can be compared with benchmarks If the DLO is not efficient then potential improvement need to be identified.

(b) What does the customer think?

Too few DLOs have established systems which regularly provide them with the customers' views. Sample surveys of tenants and tenant report cards will provide valuable market information.

(c) What are the threats and opportunities?

The first two stages give managers a view of the DLO's strengths and weaknesses. The next step is to look at the threats and weaknesses e.g. the likely introduction of new capital controls.

(d) Where can the DLO do better?

Many DLOs can improve their effectiveness and efficiency and very often the incentive scheme is the starting point. This not only improves productivity but can also improve efficiency by freeing supervisors etc.

(e) What are the views of the workforce?

Consultation is not a sign of weakness but an essential element of maintaining the morale of the workforce.

(f) Do the managers have the right information?

Few businesses with a turnover of more than £ 1m would survive with the poor information that is available to many DLOs. The use of standard costing would let managers know how each work unit was performing.

Such questions as these enable managers to identify a number of items or projects, and to set out an improvement programme with each programme having an idetified aim to improve cost, productivity and efficiency.

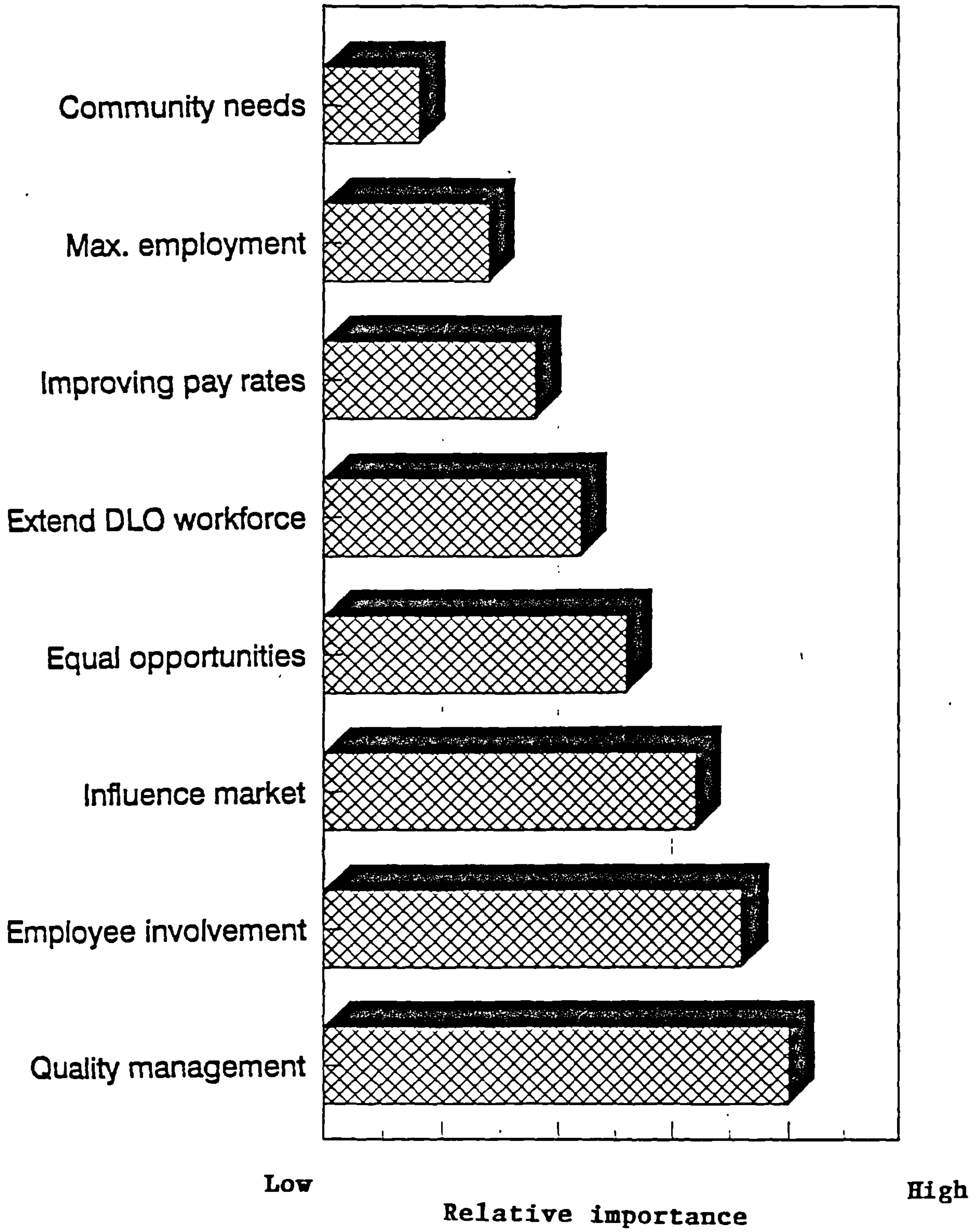
The successful management of any organisation depends upon the managers' ability to meet predetermined objectives, which in the case of DLOs may vary considerably from authority to authority. Indeed, the performance of any DLO must be seen within the context of the parent authority's own objectives. Whilst legislation and regulation have introduced another dimension and DLOs have had to recognise the importance of financial performance, there has still been a clear desire by the leaders of many authorities to pursue wider objectives.
For example, a wish to maximise full-time employment and therefore aim for as high a turnover as possible. Others have aimed for a mixed economy with the DLO

restraining private sector prices. Yet others have DLOs which may only undertake emergency work that the private sector cannot provide.

Fig 6.1 shows the results of the 1988 survey of DLO managers on non-economic factors important as objectives.
Managers were asked to give a score for each of eight factors as a measure of the relative importance of the factor.

The authority's choice must be made clear to DLO managers before the business plan is set.
The nature of the objectives may be much more complex than for a private sector organisation but the new environment, in which DLOs have been placed, has at least forced them to examine their reasons for existence in a rational manner and structure their management strategies accordingly. In the creation of a management for quality ethos, the reforms have helped to create organisations better equipped to survive in a competitive environment with their private sector counterparts.

Fig. 6.1 Non-economic management objectives of DLO managers (ADLO. 1988)



CHAPTER 7

FRONTIER METHODS AND ORGANISATIONAL EFFICIENCY

7.1 Approaches to efficiency measurement

In the late 1980s, the U.K. Government's commitment to the improvement of efficiency of the public sector led to the development of various forms of performance indicators (PIs) by government agencies.
Their application in the broad fields of health, education, police services etc. produced a common criticism that they shed little light on the question of efficiency. (See Jackson and Palmer. 1990).

Dissatisfaction with performance indicators led to attempts by researchers to try to improve on them, using statistical and other quantitative techniques. One result has been the development of new methods for measuring efficiency, many of which, have in common the concept of the frontier: efficient organisations are those operating on the cost or production frontier, whilst inefficient organisations operate either below the frontier (in the case of the production frontier) or above the frontier (in the case of the cost frontier). Though empirical applications of such frontier techniques has tended to be mainly in the private sector, several of the methods have been used to analyse the efficiency of public sector bodies.

7.1.1 The modelling and measurement of inefficiency

According to many studies on industrial inefficiency in the 1980s, technical ineficiency appeared to be an important source of under-performance.(Caves 1988).
Daly (1985) suggests that the major discrepancy between efficient and inefficient producers is not a lack of capital, in the form of plant and machinery, but an inability to exploit that capital due to poor skills of both operatives and management. Technical inefficiency therefore embodies all the managerial and organisational sources of inefficiency, what Leibenstein (1966) refers to as X-inefficiency.
The approach used in this research is based on the notion that productivity may vary among organisations, due to their ability to produce different levels of output from the same levels of input.
This means that there may be inefficiency of some description in the production process.

Traditional economic analysis relies heavily on the production function to describe a hypothetical relationship between inputs and output. The measurement of efficiency tends to be output orientated, based on product per unit of labour or some other input.
However, as an alternative to this type of output-orientated efficiency measure, an input-orientated

approach first suggested by Farrell (1957) may be adopted. This is based on the notion that , if a production unit is technically efficient, it must be using the minimum amounts of inputs required to produce any given level of output.

7.1.2 Cost Frontiers

The main concern in this study of DLOs, is with inefficiency that raises costs above their feasible minimum. In theory, costs can exceed their minimum feasible level for one of two reasons. The first is that the inputs are being used in the wrong proportions given their prices and productivity at the margin - this is allocative or price inefficiency. The second is that too little output is being produced from a given bundle of inputs - technical inefficiency.

Whilst it may be possible to distinguish the absolute frontier, indicating what could be achieved if the available technology were used to full advantage, in practice, this study concentrates on the best-practice frontier, which reflects the achievements of the organisations in the sample.

Different methods though, interpret the term frontier differently. Some methods aim to uncover the absolute frontier, indicating what could be achieved if the available technology were used to full advantage.

Others aim to uncover what Farrell (1957) termed the best-practice frontier. This reflects the achievements of the organisations in the sample. Exercises aiming to reveal the absolute frontier may well fail to find an authority in the sample operating at 100% efficiency. This is not true of methods aiming to uncover the best-practice frontier.

A more important distinction concerns whether the method used is parametric or non-parametric.

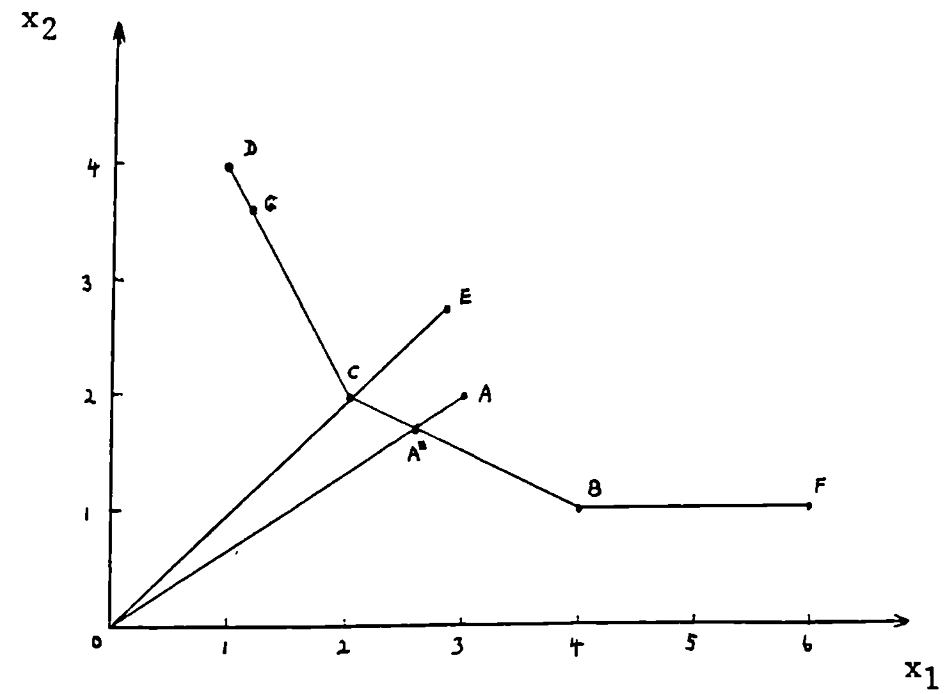
7.2 Non-parametric approaches to efficiency measurement

The non-parametric approach, referred to in management science literature as data envelopment analysis (DEA), has its origins in Farrell's article.

The approach can be illustrated with the aid of a diagram (Fig. 7.1).

Here there are seven organisations (A to G), all producing a single output (y) with two inputs (x_1 and x_2). It is assumed that all seven organisations produce one unit of output. In the absence of information on the exact location of the unit isoquant, there are no grounds for supposing B,C or D to be technically inefficient. Organisation B uses more x_1 than organisation C but less x_2. Similarly, organisation D uses more x_2 than organisation C but less x_1. There are grounds, however, for believing authority E to be technically inefficient. It uses more of both inputs than organisation C and yet produces no more output.

Fig. 7.1 A hypothetical best-practice frontier



Measuring the technical efficiency of an organisation requires an estimate of the location of the efficient unit isoquant. Farrell proceeded by assuming that the latter is never upward-sloping and is always convex to the origin. Convexity means that if two input bundles can each produce one unit of output, then so can any weighted average of them. In terms of the diagram it means that an organisation could, for example, operate at C or D or anywhere along the line segment CD. These two assumptions allow efficient input bundles to be separated from inefficient bundles. Efficient bundles are found by picking adjacent pairs of bundles and joining them with a line segment. If the line segment has a non-positive slope and none of the other bundles on the isoquant map lie between it and the origin, the chosen bundles are declared efficient. Otherwise they are not. Bundles B and C, for instance, would be declared efficient. The line BC has a negative slope and there are no bundles between it and the origin.

The line segments linking all the efficient input bundles trace out the efficient isoquant. This isoquant envelops all the inefficient organisations (such as A) - hence the term DEA. Points at the kinks (such as B and C) represent real organisations. Points between the kinks represent hypothetical organisations formed by taking weighted averages of of the input bundles of the real organisations. The technical efficiency of an organisation 'dominated' by two organisations is then measured by comparing its input usage with that of a hypothetical organisation which uses the inputs in the same proportions.
In A's case the relevant hypothetical organisation is organisation A_* - a weighted average of its 'peers' B

and C - and its technical efficiency is measured as OA_*/OA. The technical efficiency of organisations, dominated by only one organisation, is measured with reference to the organisation at the beginning of the flat portion of the isoquant.

An organisation's technical efficiency is computed using linear programming techniques.

The linear programming approach allows the construction of a frontier production function without the imposition of artificial restrictions concerning functional form. Importantly, the method also allows the calculation of the technical efficiency (TE) of each observation in the sample.

7.2.1 Reasons for not using non-frontier approaches

A number of authors have attempted to improve on PI-type measures of efficiency using standard regressioin techniques.

An early attempt was made by Feldstein (1967) to estimate technical inefficiency in N.H.S. hospitals based on a Cobb-Douglas type production function.

With a production function of

$$\ln y = \beta_0 + \Sigma \beta_j \ln x_{ij} + u_i$$

Where y = output $\quad x_j$ = inputs

β_j = coefficient of output elasticity

u_i = error terms

Application of, say ordinarly least squares to (7.2) gives estimates of the β_j from which the residuals can be computed.

Feldstein suggested that the latter may be used as estimates of technical inefficiency. Similar approaches have also been used to analyse the technical efficiency of local education authorities (Department of Education and Science 1983) and police authorities (Levitt and Joyce 1987).

The non-frontier approach suffers though from two major shortcomings.
It does not tend to provide information on the level of efficiency.
Obviously, it is important to know whether inefficient organisations are very inefficient or only marginally so. Second, it implicitly assumes that all cross-sample variation in the error term of the estimating equation is due to variation in efficiency: in reality, the

residuals are also likely to reflect random influences outside the organisation's control, as well as statistical 'noise'.

7.2.2 Measurement of technical efficiency

Following a methodology proposed by Barrow and Wagstaff (1989), a non-parametric approach can be used in which the technical efficiency of any authority 0 is obtained by solving a linear programming problem of the form :

$$TE^0 = \min_{\mu} \theta \tag{1}$$

subject to

$$\sum_j \mu_j x_{ij} \leqslant \theta x_i^0 \qquad i = 1....n \tag{2}$$

$$\sum_j \mu_j y_{rs} \geqslant y_r^0 \qquad r = 1....m \tag{3}$$

x_{ij} = amount of the ith input used by the jth organisation

y_{rj} = amount of the rth output produced by the jth organisation

y_r^0 = amount of the rth output produced by org. 0

μ_j = weights

θ measures the technical efficiency of organisation 0

This formulation implicitly imposes constant returns to scale. Reducing the μ_j to sum to unity allows for non-constant returns to scale. (See Byrnes, Fare and Grosskopf. 1984).

The right-hand side of (2) gives the potential input usage of the organisation whose efficiency is being measured, which, if the organisation is inefficient, will be a fraction of its actual input usage.
The left-hand sides of (2) and (3) represent the hypothetical organisation formed by taking weighted averages of the real organisations. The fact that the j are the same in all of the constraints, means that each of the inputs and outputs of the hypothetical organisation is the same weighted average of those of the real authorities. The first set of constraints indicates that the weights will generally be chosen so that the hypothetical organisation uses the inputs in the same proportion as the organisation whose efficiency is being measured. The inequality is to allow for the possibility that the organisation, whose efficiency is being measured, is on a flat segment of the isoquant, such as point G in Fig.7.1.

The second set of constraints indicates that the weights must be such that the hypothetical organisation produces at least as much of the output as the organisation whose efficiency is being measured.

7.3 Application of DEA to DLO data

The basic categorisation of output into the four areas of work means that a single output method of application of DEA can be employed.

Consider the organisations in Fig. 7.1. It may be verified that, in the case of organisation A, equations (2) and (3) hold with equality, with :

$$2\mu_C + 4\mu_B = 3\theta \qquad (2a)$$

$$2\mu_C + \mu_B = 2\theta$$

$$\mu_C + \mu_B = 1 \qquad (3a)$$

These equations solve to give:

$\mu_C = 5/7$ $\quad\mu_B = 2/7\quad$ and $\theta = 6/7$

The latter can be interpreted to mean that A's coefficient of Technical Efficiency is 6/7 (= 0.8571).

The μ_j are the weights used to construct the hypothetical organisations on the isoquant diagram. Their values in this example indicate that the hypothetical organisation A* is formed by taking 5/7 of C's input bundle and 2/7 of B's.

7.3.1 Definition of output and inputs

The measure of output used is that of net output (i.e. gross output net of direct and indirect materials and services).

[Net output = Total income <u>less</u> supplies and services (materials and stores)
<u>less</u> expenditure on subcontractors
<u>less</u> variations in work in progress
<u>less</u> loss provisions and other exceptional items]

This means that inputs can be classified in terms of the two basic factors - labour and capital.
The labour input includes both direct and indirect labour.
[Salaries and wages + Support costs]

The capital input incorporates transport and plant usage (rental and depreciation costs), oncosts and administration overheads.
[Transport and plant + Depots + Support costs]

As output is measured in value terms, the inputs are expressed per £000 of output produced.

7.3.2 DLO data employed

From the DLO database, those organisations who undertook a particular category of work during two specific years were identified.
One objective of the exercise being to compare the relative performances of individual authorities over a period, a year near the beginning of the period (1982-83, in preference to 1981-82 when authorities were less certain of the new accounting system) and one near the end of the eighties (1987-88, in preference to 1988-89 when less data were available) were chosen.

The number of organisations for which the requisite data were available for both years were as follows:

Category	D1	47 organisations
	D2	26

D3	28
D4	55

Data Appendix: Section 3 shows the value of the labour and capital inputs per £ unit of output produced for the four categories of output for the two years and these input data are illustrated by appropriate diagrams.

The effective best-practice frontier isoquants are derived from the input diagrams and are also illustrated.
From these 'frontiers' the Technical Efficiency (TE) of each individual organisation can be measured.

7.4 Results from TE measurement

The results of the measurement using the reiterative linear programming technique of the program DEA (University of Bristol.1990) are contained in the Data Appendix: Section 3.

CHAPTER 8

A COMPARISON OF PERFORMANCE MEASURES

8.1 Efficiency indicators for DLOs

Prior to 1981 no local government trading service had ever been required by central government to achieve a specific financial target, so why did the government set such a target for DLOs ?
The purpose was to ensure that DLOs account for the use, and identify the true economic cost, of resources that might otherwise be made available to the private sector. This was to be achieved by creating a financial regime for DLOs equivalent to that faced by their private sector competitors, so that the prices they quoted could be compared directly.
During the first year of operating the new requirements, only one in ten authorities failed to meet the 5% requirement, a fact which led to criticism of the appropriateness of the measure. A target which is too easily achieved being unlikely to stimulate a local authority to achieve an improvement in the performance of its DLO.

8.1.1 Low capital employment

A particular problem which affects DLO performance measurement is that the building industry is highly labour intensive with low capital employment. Percentage rates of return are, therefore, unstable with

very high rates of return on capital being common.
Also, to replicate the functions of the capital markets, different targets would be appropriate to reflect different levels of risk. Major construction work, for example, is likely to be a higher risk, and should therefore, have a higher target rate of return when compared with routine maintenance work.

8.1.2 Performance indicators

The annual DLO reports are important not only in providing an assessment of individual DLOs but also in making public, information which was not previously available about other features of DLO operations. In consequence, other accounting ratios and performance indicators may be measured using such data.
Other accounting ratios, such as return on turnover or value added per employee, could be used as performance indicators. For central government, the suitability of such measures is limited by the fact that there is no readily available external standard against which DLO performance could be measured, but for a comparative assessment of a DLO's performance they could supplement the rate of return on capital measure.

8.2 The performance measures employed

Having undertaken the measurement of Total Efficiency (TE) for the different categories of DLO, comparisons may be made with other measures of performance using the DLO data.

For such comparisons, the performance measures chosen are:

(a) The rate of surplus to turnover.

As early as 1983, CIPFA indicated that it deemed this to be the most appropriate performance measure for DLOs. (CIPFA.1983)

Profit to turnover rates for firms in the private sector of the industry could be used by the Secretary of State to formulate a yard stick rate against which DLO performance might be measured.

(b) The rate of return on capital employed.

The 'official' performance measure.

(c) Value added per employee (direct and indirect).

Value added can be calculated from gross output net of materials and services.

(d) Coefficient of total efficiency.

Data Appendix: Section 4 shows the performance measures (by category) for individual DLOs for the years 1982-83 and 1987-88.

The number of DLOs, for which these data were available are as follows :

Category 1	47 DLOs
Category 2	24
Category 3	23
Category 4	51

The weighted arithmetic mean, maximum and minimum values for performance measures (a), (b) and (c) annually for the full period 1981-89 are also shown in Data Appendix: Section 4.

8.3 Observations on the performance measures

8.3.1 The rate of surplus on turnover:

The rates are significantly lower for the major capital works category than for other areas of work, with a greater degree of variation in this area, too.
With the nature of such capital works, this type of variation might be expected.

8.3.2 The rate of return on capital:

The quite massive variation which occurs in the rates of return is a main reason for the criticism levied by CIPFA at the rate of return as a performance measure.
The undermeasurement of capital in the measure is the obvious reason for the peculiarly large returns in the minor capital works category. As the 5% figure is the crucial minimum for a DLO, it is worth considering how well the sampled DLOs performed in meeting this requirement.
Table 8.1 indicates a particularly high failure rate in the major capital works category.

Table 8.1 Number of DLOs (by category) failing to meet the rate of return requirement

	D1	D2	D3	D4
1981-2	5	4	1	3
1982-3	2	3	0	1
1983-4	0	2	1	0
1984-5	0	4	0	5
1985-6	0	7	2	2
1986-7	2	5	2	1
1987-8	1	6	4	3
1988-9	3	8	1	6
Total	13	39	11	21
Failure rate (%) over total period.	3.5	20.3	5.9	4.9

(Source: Department of the Environment. 1990)

8.3.3 Value added per employee:

The results illustrate a fairly steady growth (in money terms) in all categories but at different rates. VA per employee more than doubled in the minor capital works category over the eight year period in significant

contrast to the mere twenty per cent rise in the major capital works category over the same period.
The changing nature of the work undertaken in the D3 category was probably a major factor here. The massive decline in the local authority housebuilding programme in the eighties, meant that housebuilding formed a much smaller proportion of local authorities' major capital programmes, with school, offices and other non-housing projects now relatively more important. The value-added for the latter type of scheme tends generally to be lower than for housing work.

8.4 Ranking the DLOs by performance measure

To consider the overall picture, and to compare the relative performance of the various DLOs using the different measures. Data Appendix: Section 5 shows rankings by performance measures for two chosen years, 1982-83 and 1987-88.
To consider the idea of being able to determine a notionalised overall ranking of DLOs by 'performance', an aggregated ranking by measures (a),(b) and (c) is shown.

CHAPTER 9

ATTRIBUTE TESTING

9.1 Attributes and efficiency

The ranking list of DLOs can be used to analyse the differences between 'good performance' and 'poor performance' authorities.
As the ranking of authorities by performance measure is intended to indicate the relative efficiency of DLOs, hypotheses may be put forward regarding the attributes which exist in the 'good performance' authorities but not in the others.
Statistical analysis of attributes may be performed to indicate the significance of attributes, but as a first stage in the analysis, appropriate attributes need to be identified.

The question needs to be posed:

What are the features that can be found in DLOs, which perform well, but are absent from those organisations at the lower end of the rankings ?

Statistical methodology exists to gauge the significance of specific attributes to ranked data and an initial step in the use of such analysis is the choice of the appropriate features or attributes for testing.

In general, studies of the productivity of building organisations have considered a wide variety of factors but many are not relevant in this context.

Several attributes were considered for inclusion in the analysis but were rejected. This was due mainly to their unsuitability in the context of the specific DLO data.

For example, studies on productivity have often found a relationship between productivity and unionisation of the workforce. (See Allen. 1984 and Cremeans. 1981) With comparisons of local authority DLOs, though, this has not tended to be a factor, due to the high unionisation rate amongst all DLOs.

In early work on productivity in the U.S. construction industry, Dacy (1965) put forward three major explanatory variables of (labour) productivity levels:

a. A shift in the construction product mix. A change in composition favourably affects productivity if the shift is in the direction of less labour-intensive activities. At the extremes for the major components of DLOs' activities, the labour share in highways is 15 % and about 40 % in maintenance and repairs, but the DLO data are, of course, already split into the four work categories and it is comparisons within each category that are being made here.

b. The size of the construction organisation. There was an indication that economies of scale were in evidence up to a firm size of $ 1.5m.

c. The success of the construction organisation in resource management.

The latter two factors can be considered to be relevant in this study.

The important difference between this study and the general research into productivity in the industry, is the fact that it is a set of efficiency measures being used in the inter-DLO comparison and not just a single productivity measure.

9.2 General hypotheses on required characteristics

Following on from Dacy's and others' ideas, several hypotheses may be put forward concerning the characteristics required for an efficient organisation, for which there may be theoretical or preconceived justification.

a. The fact that scale economies may exist in building operations has received recognition both in the U.K. (Hillebrandt. 1989) and in the U.S.A., where Koch et al. (1979) and Stokes (1981) found evidence of scale economies in both highways and building maintenance work.

Generally, the larger the amount of work undertaken by a DLO, the greater the scope for scale economies, which result in cost saving and a higher level of efficiency.

This has been acknowledged by DLOs such as Ceredigion recognising the threat from competitors and, being concerned with the need to "undertake expansion aimed at achieving lower unit costs for the benefit of clients through economies of scale". (Ceredigion. 1989)

The potential for economies of scale, in terms of bulk purchase of materials, better utilisation of capital equipment, dilution of overheads and labour specialisation is apparent in many different areas of DLO operation, and specific examples gleaned from the 1987-88 annual reports of various DLOs can be used to illustrate the point.

- Manchester DLO, engaged in large-scale material purchasing, found it worthwhile to create a specialist buying department, which can ensure the most favourable terms for acquiring supplies.

In terms of capital usage, Redbridge DLO, with its large maintenance operations, purchased in 1987 a large fleet of well-equipped, radio-controlled trade vehicles to "meet the demand on their services with efficiency".

- S.Tyneside DLO was, according to its annual report, an organisation which achieved considerable unit cost savings over the period, due to its ability to maintain a large workload. Its own joinery service, for all aspects of new construction, modernisation and maintenance work, had been operational since 1981 and this was complemented, in 1987, by a UPVC window fabrication unit, which also gained success in tendering for the supply of windows to other authorities. A computerised stock control and purchasing system was fully implemented by 1987 with an on-line system to provide up-to-date cost information.

- In terms of labour specialisation, a DLO with a large workload is able to carry a workforce with a variety of skills. Sheffield DLO for instance, employed a workforce containing sixteen different categories of tradesman and had a "policy of diversifying wherever possible into specialist areas of maintenance work to provide flexibility to respond to its clients' requirements". As an example, it introduced an inspection service to the authority's highrise and multi-storey buildings to identify spalling concrete. The inspections being undertaken using abseiling techniques to traverse the face of the buildings. The cost of the operation was 50% cheaper than that charged by specialist sub-contractors.

b. The more efficient organisations win a larger proportion of the work for which they are forced to compete.

The justification for the 1980, and subsequent, legislation requiring DLOs to compete for work was that only the more efficient DLOs would be able to compete successfully with private contractors for local authority work.

c. Efficient DLOs have reorganised since (or even before) 1981 by developing a contracts division divorced from the service division.

The separation producing a situation in which a DLO can be clear about the different functions.

In the authorities where no split occurred, the lack of a distinct position of manager in the contracting part of the organisation was less appropriate to the new circumstances. (See Chapter 6)

d. Those DLOs which operate in all areas of work benefit from cross-fertilisation of experience and expertise. There is a greater likelihood that specialised skills as well as plant and equipment exist in those DLOs undertaking a wider spread of activity.

Additionally, fuller utilisation of such skills and equipment makes for cost savings.

Again some specific examples from the 1987-88 annual reports can be used to provide evidence that economies of scope do exist in DLO operations.

- Sheffield DLO started to operate a separate engineering services division to provide services to other divisions.
It won contracts in its own right in direct competition with the private sector, and also provided 'sub-contract' services to other divisions e.g. the lifts section was able to provide a design, advisory and supervisory role on new installation work.

- Mid-Glamorgan DLO, like the majority of county authorities' organisations, specialised in civil engineering work but the 'Trans-Plant' section of the civil engineering unit provided services and repaired all types of plant and vehicles for use by other units of the DLO.

- A DLO carrying out Category 4 work only, is unlikely to be able to carry a wide enough variety of tradesmen to prevent it having to rely heavily upon specialist private contractors, whereas an organisation undertaking capital work as well, will have a wide variety of specialist tradesmen.
Boothferry DLO, with a maintenance unit only, and having four types of craftsmen, contrasted with the situation in nearby Sheffield, with its ability to cater for sixteen different types of craft.

e. Bonus schemes based on productivity have a positive effect on the level of efficiency in a DLO. Whilst some DLOs operated some form of bonus scheme throughout this period, others did not. For those that did, a variety of forms of schemes were in operation, but they can be split into those which were based on an assessment of operative performance (e.g. work study, schedule of rates etc) and those which were not.

   The Audit Commission (1988) study on DLO management took the view that the schemes based on performance were more conducive to higher productivity.

9.3 Testable attributes.

The chosen attributes for testing in this work were ones for which:

- Suitable data could be obtained.
- There was theoretical, or preconceived, justification for supposing it to be a characteristic required for for an efficient organisation.

A small set of independent attributes was chosen, in order to simplify the problem of interpretation.

Five such characteristics were considered for the analysis.

Relating back to section 9.2, the chosen attributes were based on:

a. The size (by value) of the DLO's output.
b. The proportion of the work won by the DLO in competition with private contractors.
c. The management structure of the DLO in the competitive climate.
d. The degree of cross-fertilisation and number of areas of work in which the DLO operated.
e. The types of bonus schemes operated in the DLO.

9.4 Attributes defined

For the type of attribute analysis used in this study, it is necessary to designate an attribute as being either present or absent.
The following designations are used:

a. Designation	1	Output > Prescribed level
	0	Output < Prescribed level

(For category D1 the prescribed level is £5.0 million
D2 £3.0 million
D3 £0.5 million
D4 £1.5 million)

b. Designation	1	Proportion of work won > 50%
	0	Proportion of work won < 50%
c. Designation	1	Separate contracts division
	0	No separate contracts division.
d. Designation	1	> 3 categories of work undertaken
	0	< 3 categories of work undertaken.
e. Designation	1	Bonus scheme based on productivity employed.
	0	No such scheme employed.

Data Appendix: Section 6 shows the attribute designations of DLOs (by work category) for 1982-83 and 1987-88.

9.5 Explanation of choice of thresholds in designations

a. The size distribution of DLOs by value of output (when categorised) appears to follow the general spread of firms in the U.K. construction industry as a whole. This pattern is characterised by a clear distinction between those operations at the lower end of the output scale and those at the upper end, with a relative void in the middle ground.

The reason for this characteristic is fairly apparent in the case of highways work. The majority of district authorities concern themselves with smaller roadworks, whilst the counties and those larger district authorities carrying out agency work for the counties undertake major roadworks.

In the other categories of work, there also appear to be bimodular distributions of output values.

Figs. 9.1 (a - h) illustrate the nature of these distributions for 1982-83 and also indicate the appropriateness of the threshold value chosen. The distributions for 1987-88 follow a similar pattern.

The counterbalance of price inflation to the general decline in local authority work make appropriate the same threshold values for this later year.

In the case of repair and maintenance, the majority of smaller authorities deal only with 'ad hoc' emergency repair work or minor routine maintenance programmes. This stands in contrast with those authorities who have, historically, had a large number of council properties and need to continually award large-scale repair contracts, often won by their own direct labour department.

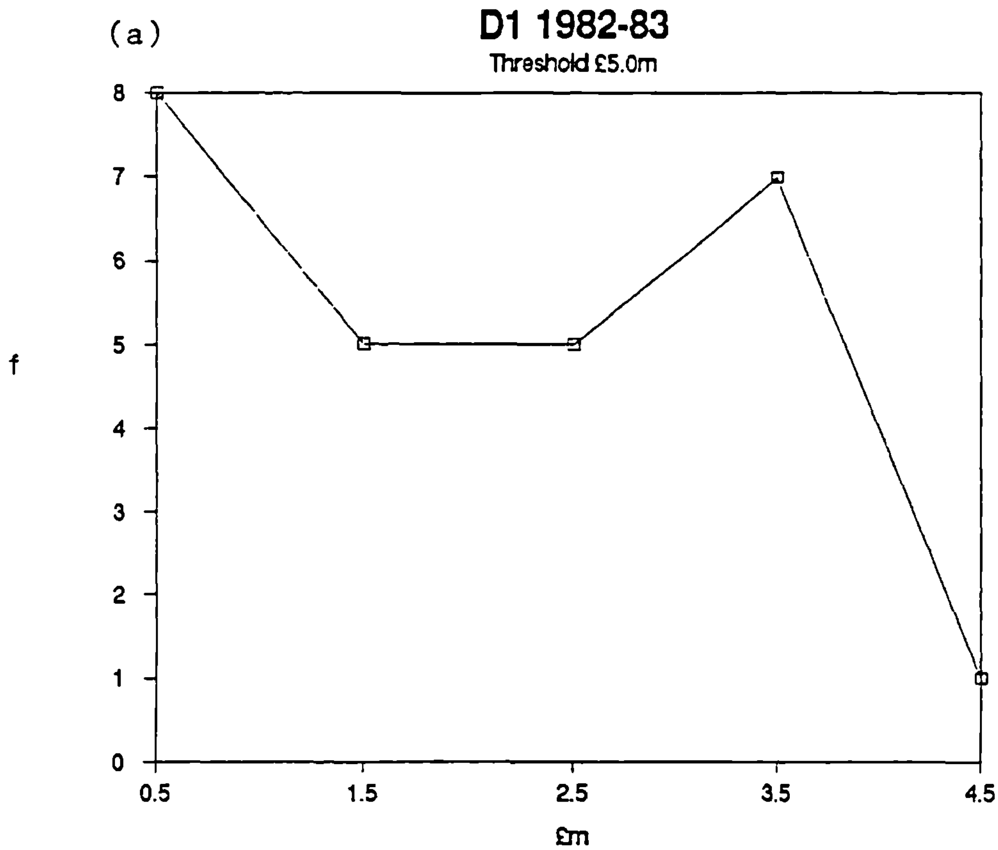
Alyn and Deeside DC is a good example of a smaller authority with a DLO workforce just above the reportable minimum of thirty employees in 1987-88 and a workload of emergency repair work only. Manchester DLO, on the other hand, employed almost three thousand workers on the repair and maintenance of its eighty thousand council properties.

b. The distributions of 'work won' percentages for 1982-83 are shown in Figs. 9.2 (a - d) and illustrate the appropriateness of the 50% threshold.

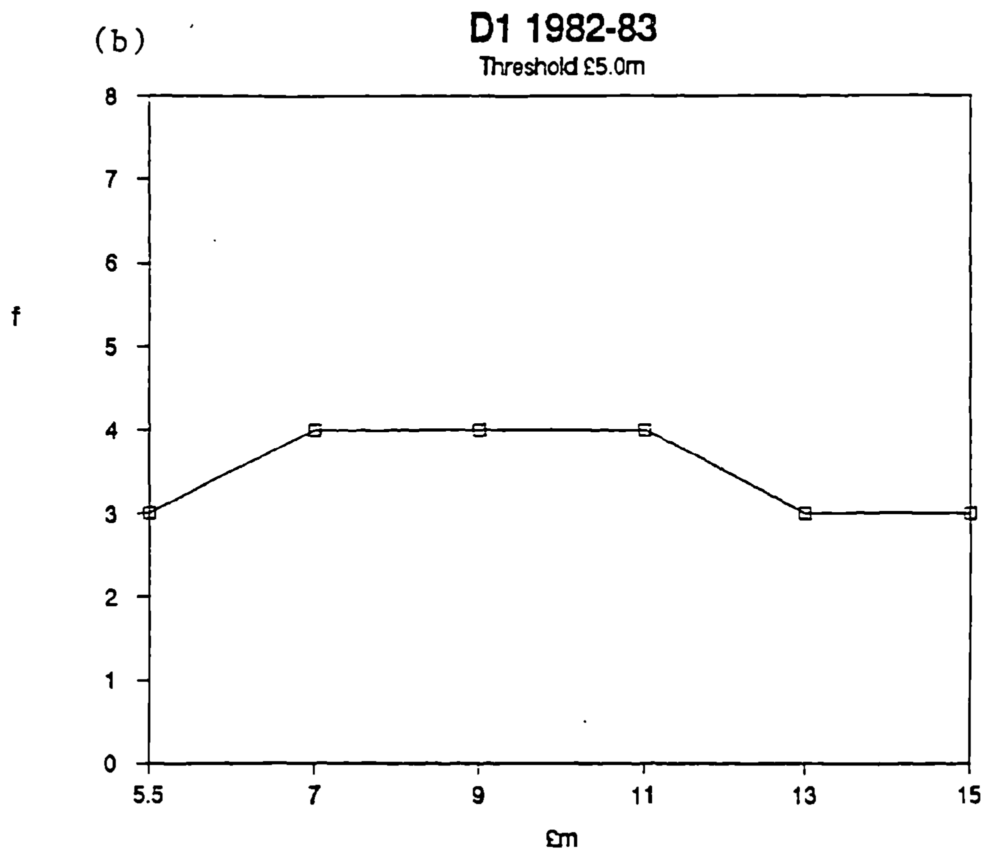
The general tendency is for DLOs to split into two categories - those who are able (or content) to acquire around a quarter to a third of their authority's work, and those who remain the dominant force in undertaking such work in the face of private sector competition. This pattern of distribution is particularly apparent for categories D1, D3 and D4 work. A bimodular type distribution also exists for category D2 work but with a general lowering of the values as fewer authorities are equipped to compete for major capital work than is the case for other work areas.

Figs. 9.1 (a-h) Size distribution of DLOs by value of work (by category) 1982-83

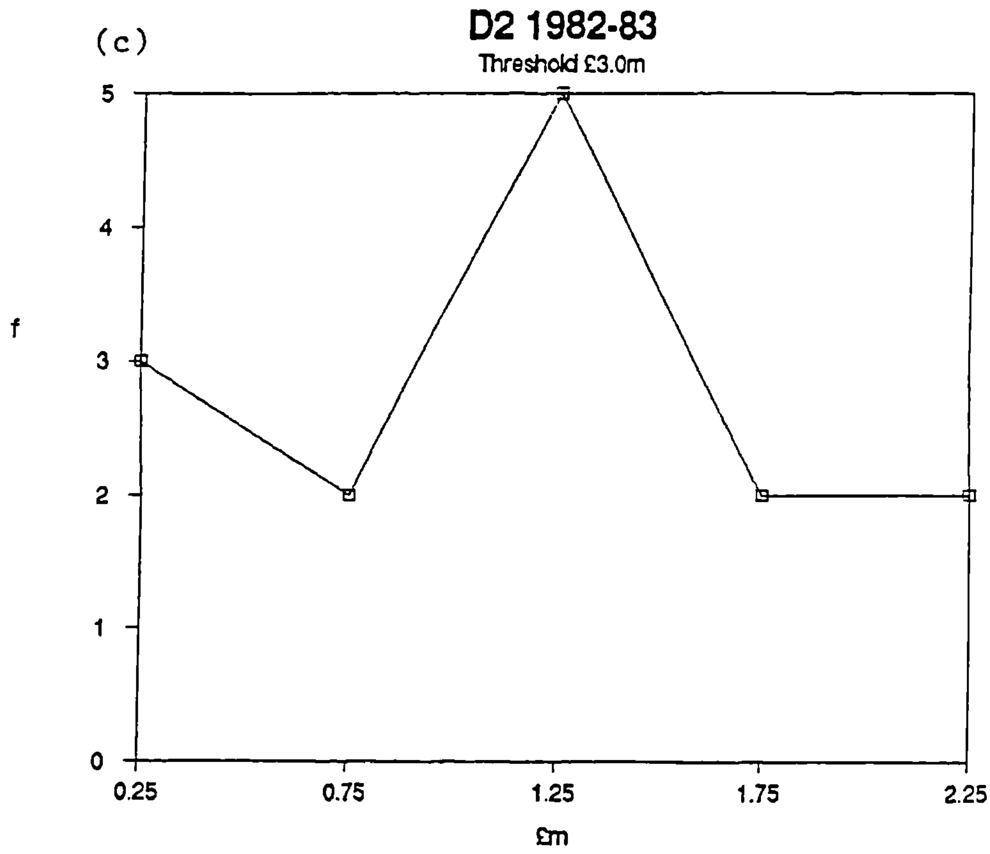
(a)



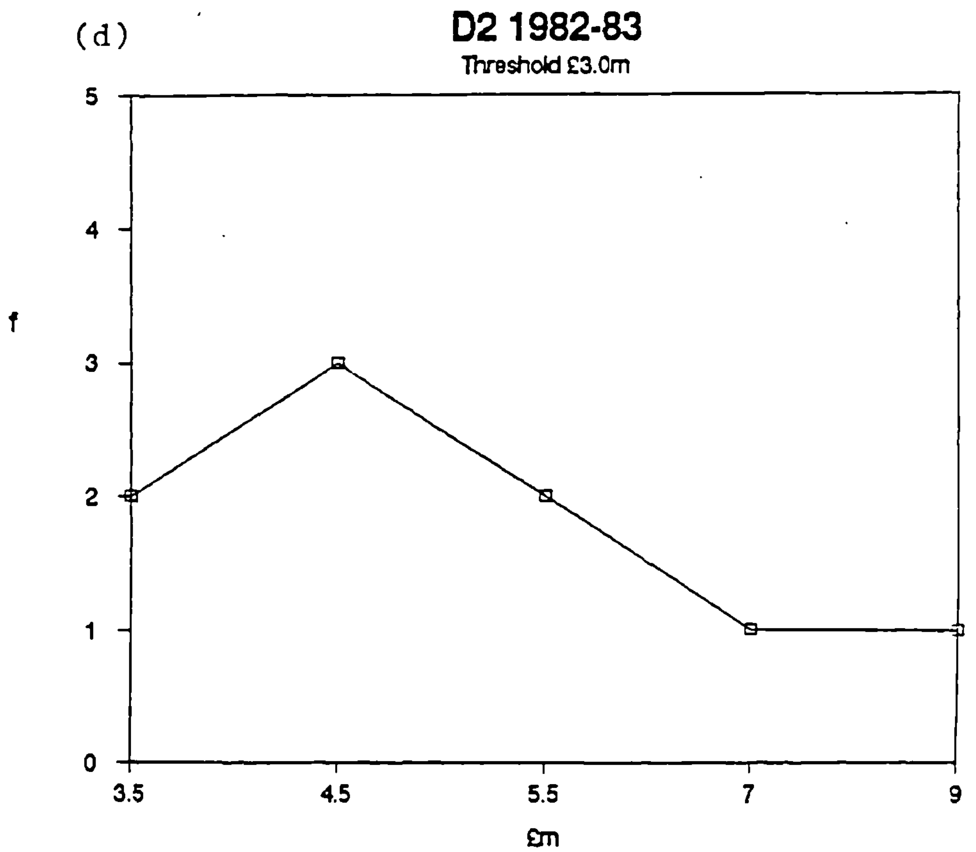
(b)



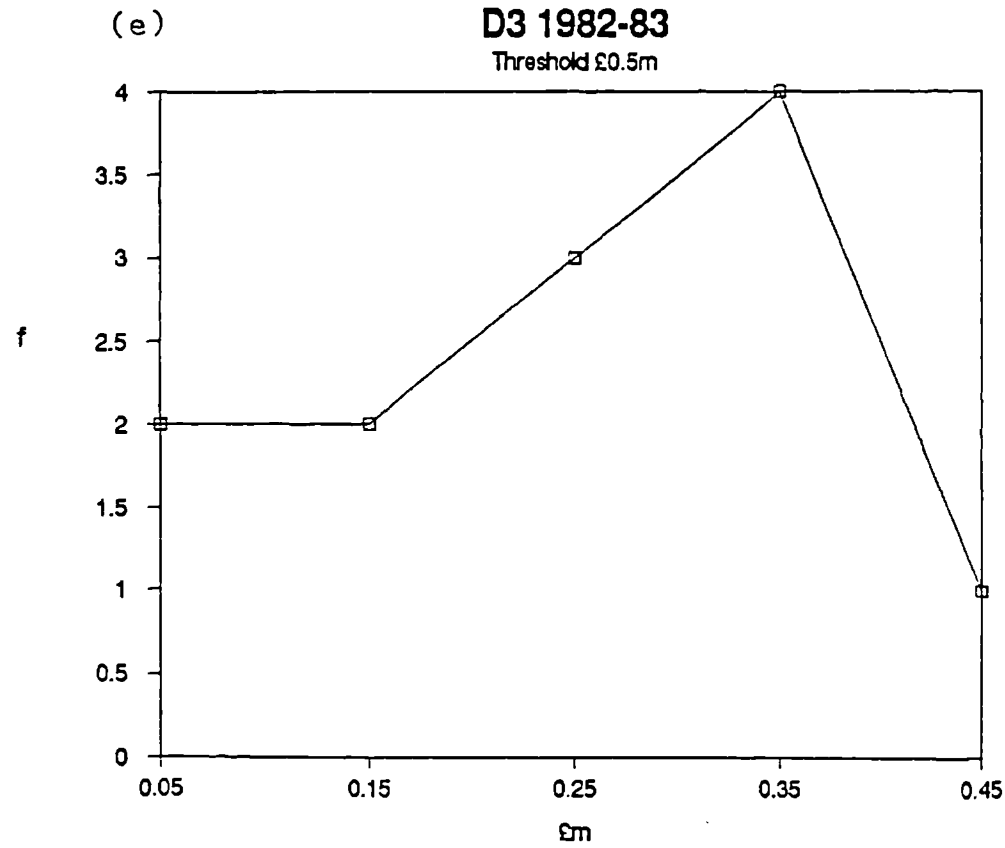
(c)


D2 1982-83
Threshold £3.0m
f
5
4
3
2
1
0
0.25
0.75
1.25
1.75
2.25
£m

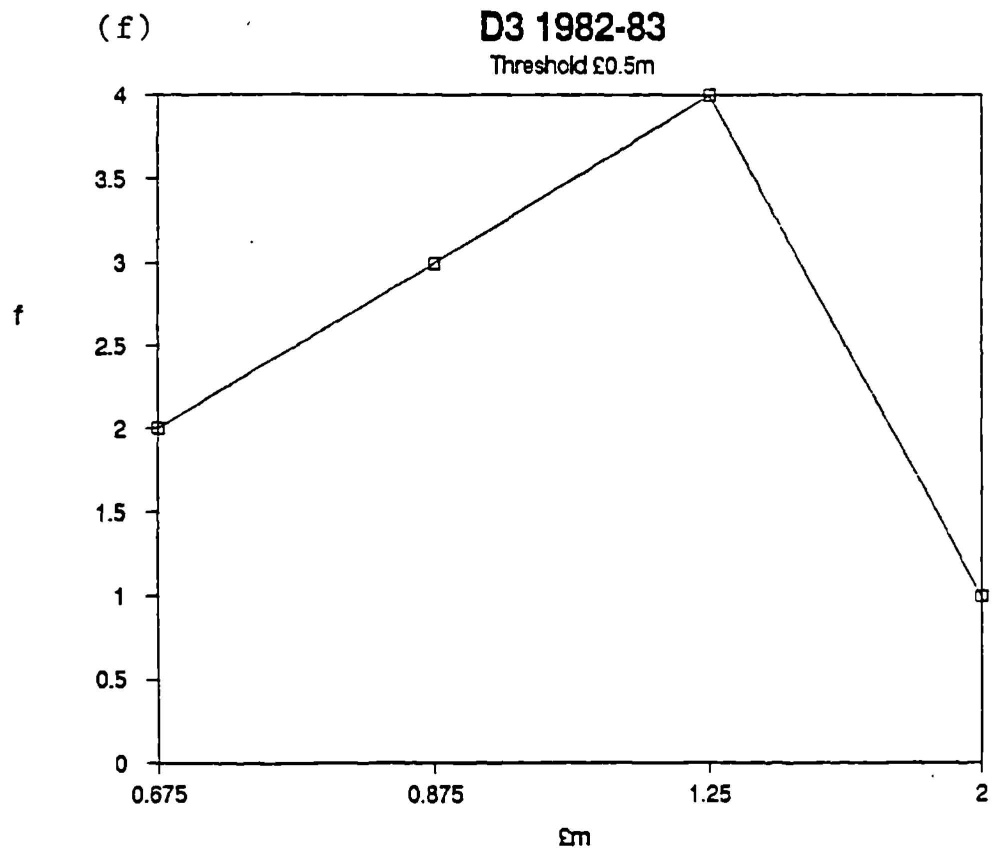
(d)


D2 1982-83
Threshold £3.0m
f
5
4
3
2
1
0
3.5
4.5
5.5
7
9
£m

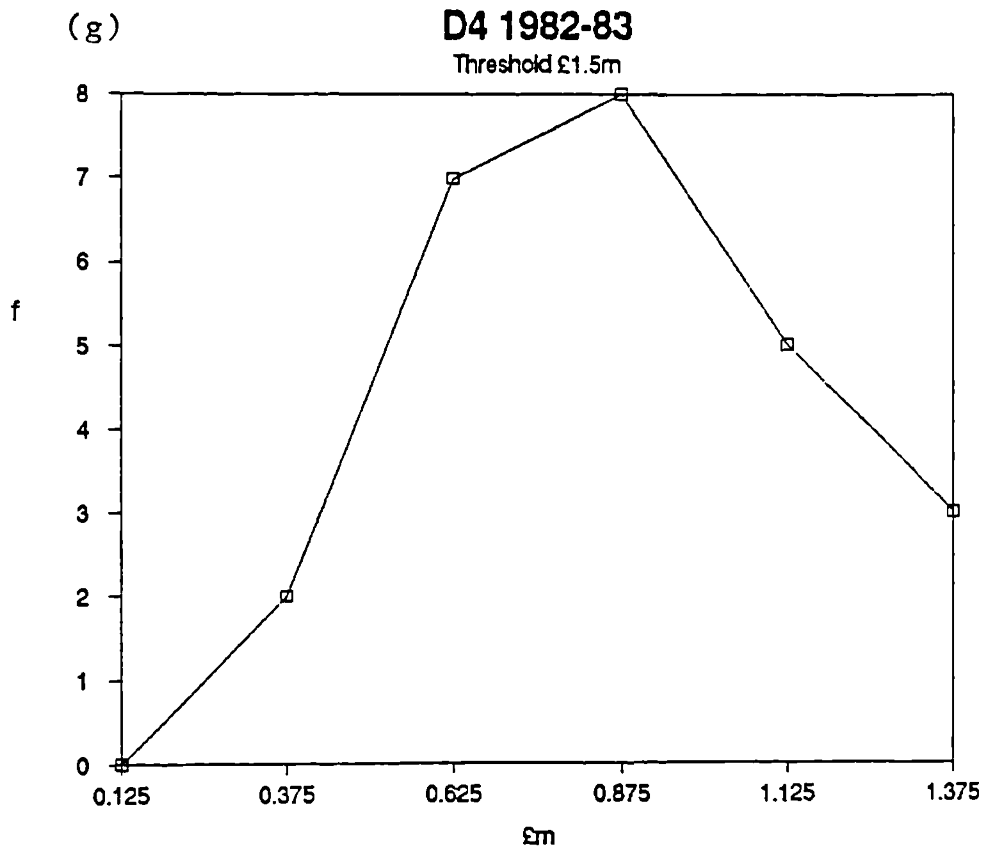
(e)


D3 1982-83
Threshold £0.5m
f
4
3.5
3
2.5
2
1.5
1
0.5
0
0.05
0.15
0.25
0.35
0.45
£m

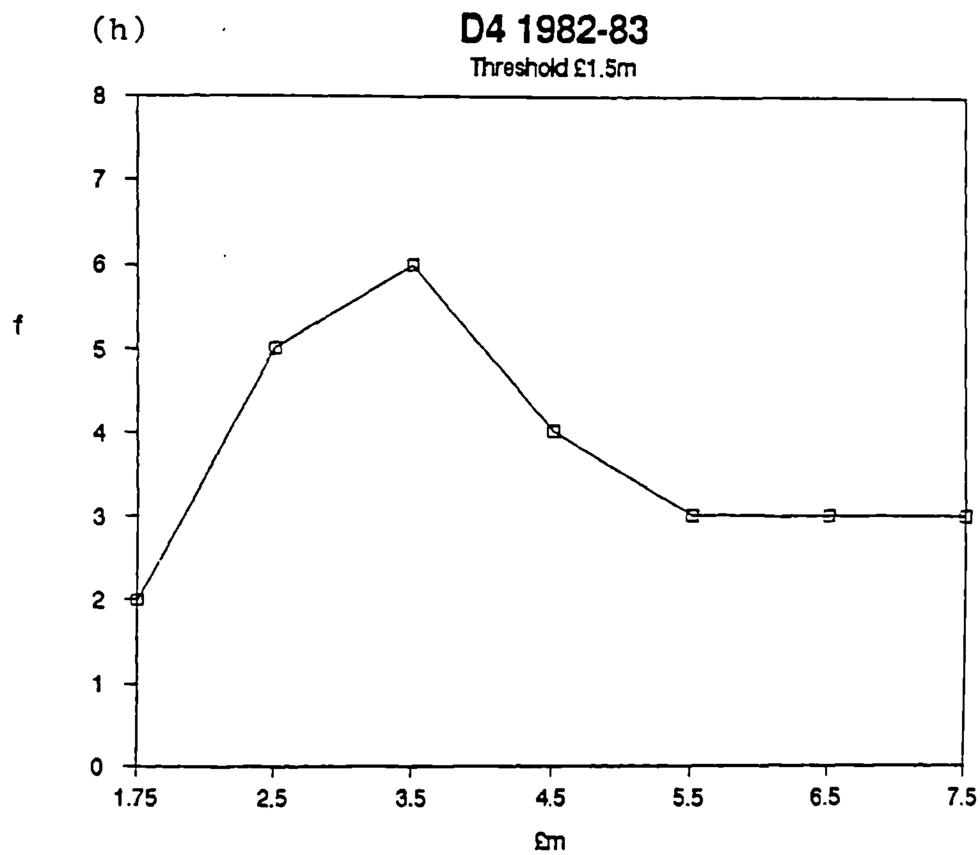
(f)


D3 1982-83
Threshold £0.5m
f
4
3.5
3
2.5
2
1.5
1
0.5
0
0.675
0.875
1.25
2
£m

(g)

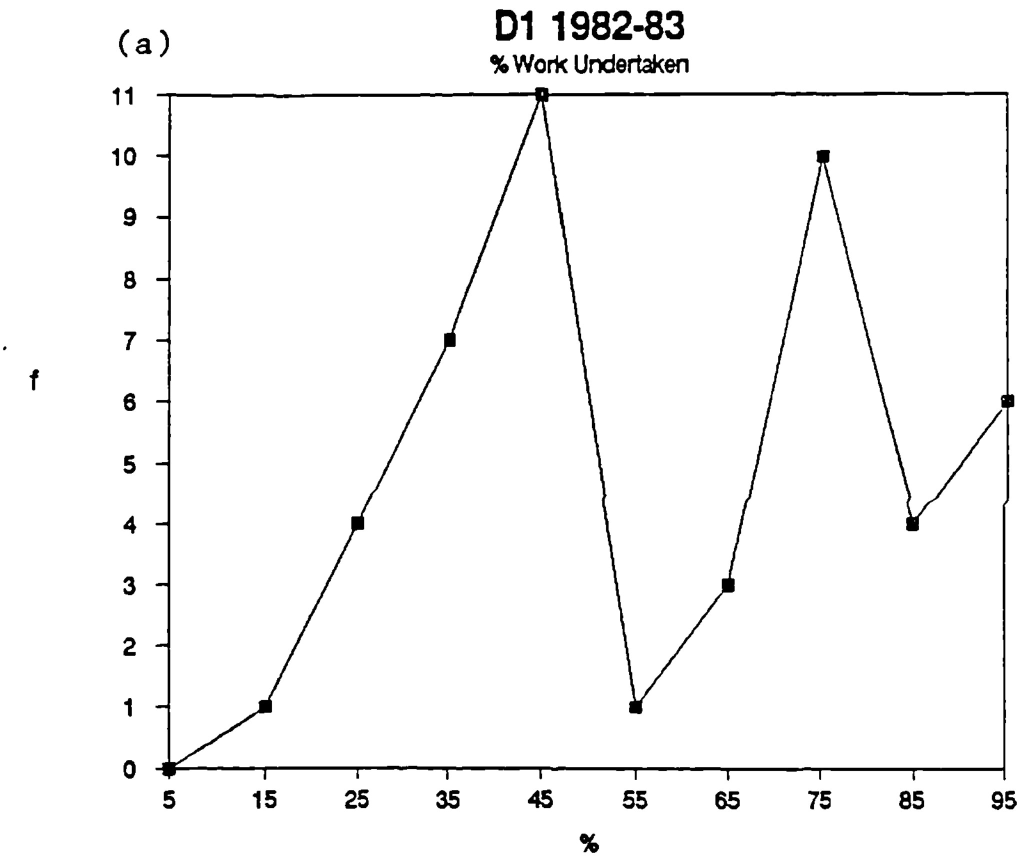

D4 1982-83
Threshold £1.5m
f
0
1
2
3
4
5
6
7
8
0.125
0.375
0.625
0.875
1.125
1.375
£m

(h)

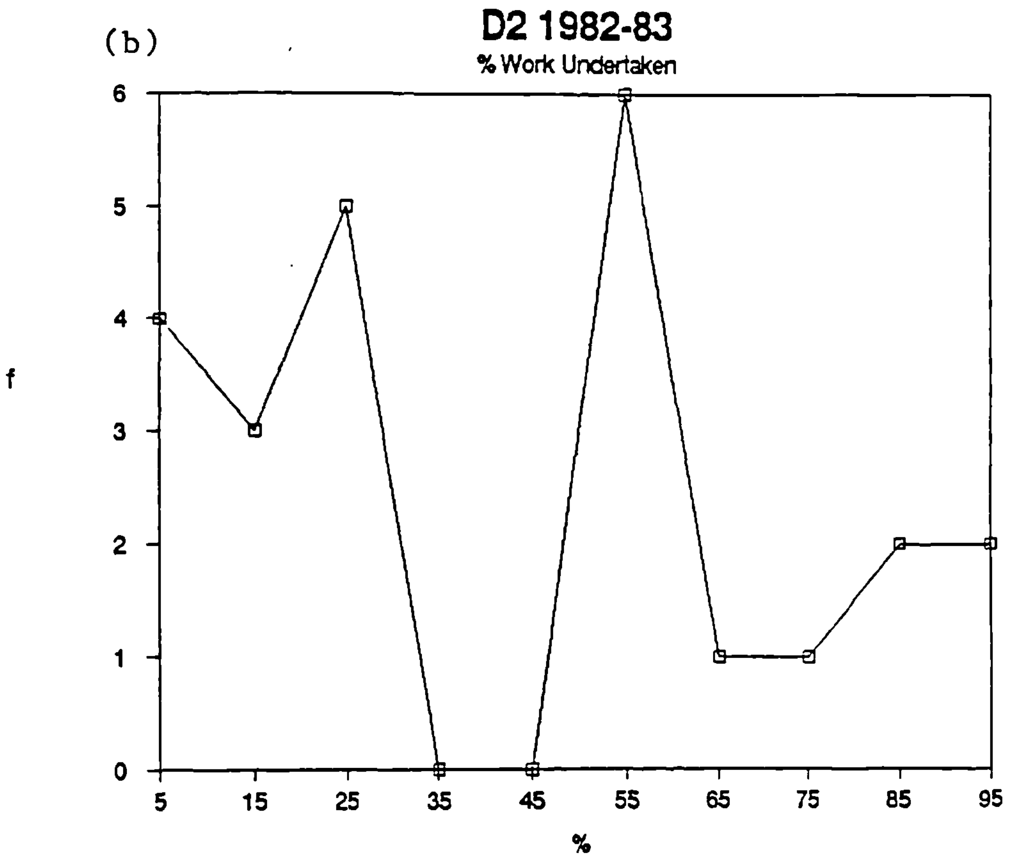

D4 1982-83
Threshold £1.5m
f
0
1
2
3
4
5
6
7
8
1.75
2.5
3.5
4.5
5.5
6.5
7.5
£m

Figs. 9.2 (a-d) 'Work won' by DLOs (by category) 1982-83

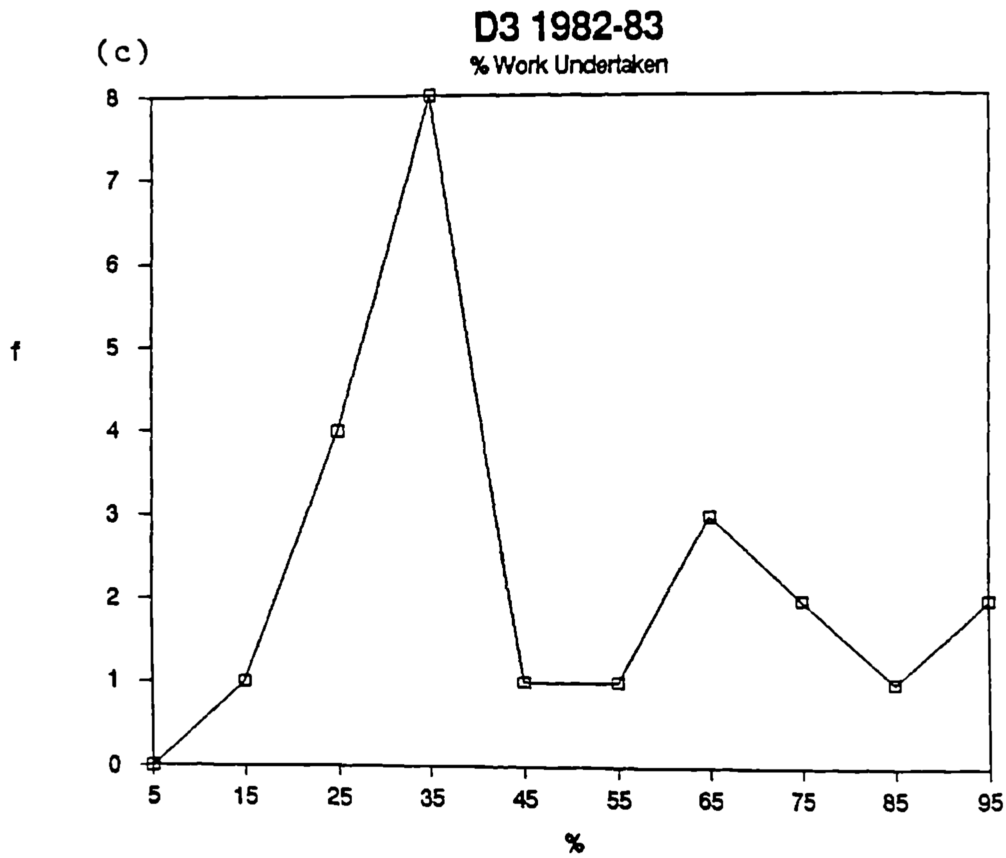
(a)



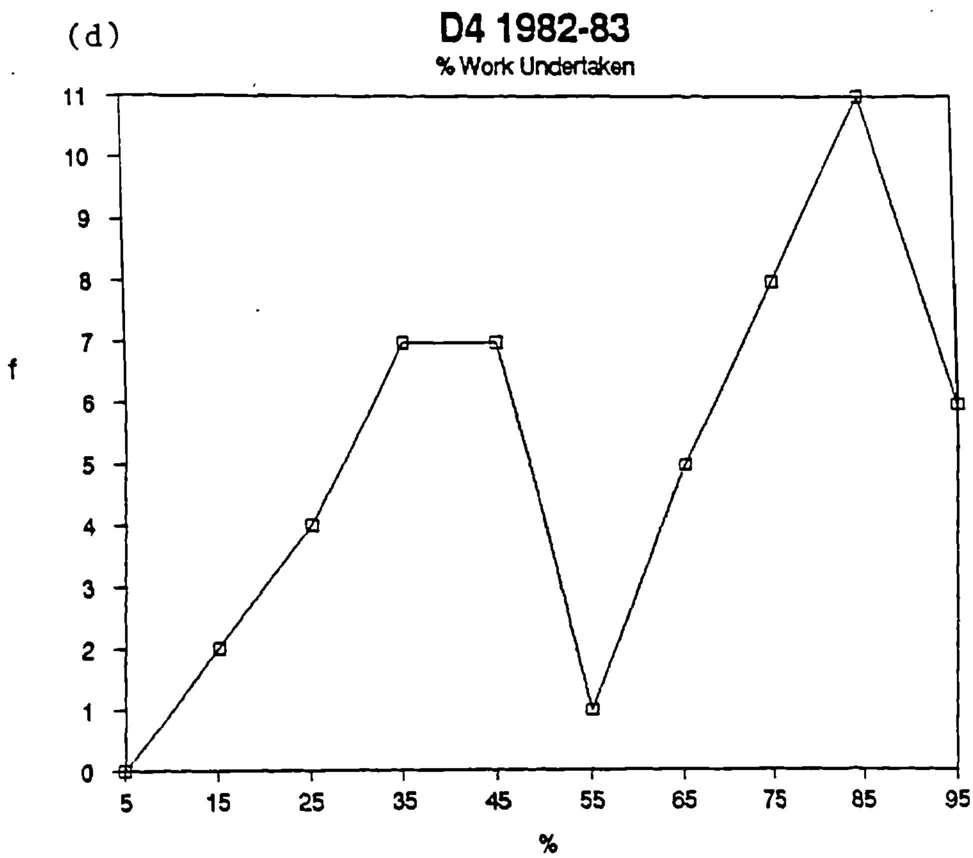
(b)



(c)


D3 1982-83
% Work Undertaken
f
0
1
2
3
4
5
6
7
8
5
15
25
35
45
55
65
75
85
95
%

(d)


D4 1982-83
% Work Undertaken
f
0
1
2
3
4
5
6
7
8
9
10
11
5
15
25
35
45
55
65
75
85
95
%

9.6 The analysis of attributes by a method of monotone regression

Conjoint measurement is a technique that can be used to measure the joint effects of a set of independent variables on the ordering of a dependent variable. The procedures of conjoint analysis require only rank-ordered input yet yield interval-scaled output.
The practical usefulness of conjoint measurement techniques is well established in such areas as consumer research but such techniques may also be gainfully employed in any area where attribute analysis needs to be carried out.

A model of attribute analysis, which is appropriate here, is the simple additive one, in which the existence of an attribute is considered to have a 'part value', and where the 'total value' is the sum of the 'part value 'of its attributes. The input data for analysis consists of rank orders of organisations, which differ in known ways on several attributes.
In additive conjoint measurement, one asks if the cell values can be monotonically transformed so that additivity can be achieved. The method entails the development of numerical estimates on a 'single factor at a time basis' i.e. without explicit consideration of interactions.

For a model of this type, some regression-like procedure is required to estimate the part values.
A principal advantage of using regression analysis is that the coefficient estimates possess certain desirable qualities, if it can be assumed that the error terms are normally distributed.
However, the normality assumption requires that the dependent variable be measured on at least an interval scale. Unfortunately, the efficiency measure uses an ordinal scale, violating the requirement for the normality assumption.
Since the input data are scaled only at the rank order level, standard regression techniques are often inadequate. However, 'nonmetric' or 'monotone' regression can be used.

In conjoint measurement, a coefficient matrix of dummy variables consisting of zeroes and ones can be used to indicate presence or absence for an organisation of each attribute. This matrix has a row for each organisation and a column for each attribute level. A unit element in the i,j th. position would indicate that organisation i had the j th. attribute level.

A set of weights has to be found, one for each column, so that the weighted row sums of the coefficient matrix are monotonic with the rank order of the organisations described by that matrix. The weights can then be interpreted as the part value to that organisation of each attribute level.

The program NMREG, using a multi-dimensional scaling technique, is an algorithm for this purpose (see Smith. 1988) and is used in this analysis.

9.7 Nonmetric regression

NMREG performs nonmetric regression analysis using dummy variables. The use of factorial designs is permitted.

A nonmetric regression algorithm performs an evaluation of attribute pair preferences for multi-attribute products.

DLO rankings are input to the analysis in the form of attributes.

NMREG uses an iterative monotonic regression procedure to maximise congruence between a weighted X vector of dummy variables and a Y vector of rankings for the pairs of independent variables.

Given an unknown vector W, which contains weights XW = Z, the nonmetric regression problem may be described as one of finding a vector of weights W, so that the elements of Z have the same rank orders as Y.

Mathematically, this relationship may be defined as one of minimizing the sum of squared differences between predicted values (that is, the squared differences of those in the wrong order divided by the total sum of all squared differences). This is the percentage of the variation among the Zs which is inconsistent with the Ys.

As a measure of the monotonicity of elements of Z with those of Y, the measure θ can be used, the square of which is defined by Johnson (1973):

$$\theta^2 = \frac{\Sigma \, \delta_{ij} (z_i - z_j)^2}{\Sigma (z_i - z_j)^2}$$

$$\delta_{ij} = \begin{array}{ll} 1 & \text{if sign } (z_i - z_j) \neq (y_i - y_j) \\ 0 & \text{otherwise} \end{array}$$

The numerator of θ^2 is the sum of squared differences between the predicted values in the wrong order, and the denominator the sum of all squared differences (both in correct and incorrect order). The denominator tends to normalize the function, constraining θ^2 to be of unit interval with minimum and maximum values of 0 and 1.

Output from the NMREG procedure can be produced in the form of a set of impact values for the independent variables included in the analysis.

The results of the NMREG application, together with the impact values of the five attributes, are shown in the Data Appendix: Section 7.

9.8 Comments on results

a. Value of output :

For category D1 the negative impact values appear to indicate a poorer performance on the part of those DLOs undertaking a larger workload.

Only for larger capital work does the attribute seem to have relative importance.

b. Proportion of work :

In highways work (in the earlier year) and in maintenance work, the higher-ranked DLOs are those holding this attribute.

c. Separate divisions :

An important attribute in categories D1, D2 and D4 particularly in the earlier year.

d. Categories of work :

It is almost inevitable that a DLO performing category D3 work will have this attribute, hence the relatively low impact value.

The DLOs undertaking all categories of work hold higher rankings in category D1 especially in the later year.

e. Productivity bonus :

Perhaps the most important of the tested attributes particularly in the area of category D1 work in the later year.

PART D

RESULTS AND CONCLUSIONS

CHAPTER 10

A REVIEW OF THE FINDINGS

10.1 The initial analysis

The early part of this study (Chapter 2) was concerned with an analysis of the annual reports of seventy five DLOs in order to obtain basic data on their financial operations and perceived objectives. By 1988, the reports contained valuable information on financial aspects of DLOs. Various propositions were to be investigated concerning the effects of the legislation on DLO operations and part of this work has been concerned with an attempt to answer the questions posed therein.

The findings of this analysis in relation to those questions were as follows:

On the objectives of a DLO:

The provision of a value-for-money, high quality building service was mentioned in over fifty annual reports in 1988-89, whereas only about twenty reports gave prominence to the aim of employment maintenance in the organisation, and very few mentioned the training role of the DLO.

On departmental structures:

As detailed in Chapter 6, a strong response to the need to acquire a more business-like' organisational structure was shown by the fact that over 60% of authorities had restructured to provide separate client and contractor functions.

On conditions of successful operation:
The percentage of work won in competition with private contractors was the main concern. This was the most popular benchmark of success rather than the rate of return figure - provided of course that the 5% criterion had been met.

10.2 The general effects of the legislation

General findings on DLO response to the legislation were shown in Chapter 3.
The target rate of return remained unchanged throughout the decade, in spite of the fact that the net real rate of return in the private sector of industry only exceeded 5% over the period 1984-88.

Considerable changes to the methods of charging for DLO work occurred over the decade, with a move towards the more competitive method of using schedule contracts and a move away from 'target hours' and day works contracts. It was expected that DLOs would be undertaking less work due to the increased competition.
Overall,the proportion of local authority work obtained

fell from 44% to 39% over the period of study, with a major trend being the loss in the value of larger scale capital work undertaken. It fell by more than one-third over the decade. Of the ninety DLOs undertaking new construction work in 1982, only fifty two remained in that field of work by 1988.

Yet, many DLOs still remained big business by the end of the decade, with 60% of DLOs still having a turnover of £1 million and one with work valued at more than £70 million. Their success in operations was shown by the fact that only nine out of the two hundred and eighty four DLOs quoted in the 1987-88 CIPFA statistics made a loss.

In general building maintenance work, by 1989 no closures had been ordered but four authorities had been forced out of new construction work.

The results of the measurement of total factor productivity (TFP), shown in Data Appendix: Section 2, indicate that growth had occurred throughout the period in some areas of work.

The growth in the area of highways work was not so surprising , with the inconsistent workload in these areas producing an unclear picture, but generally the TFP figures indicate a reasonably healthy situation concerning resource usage in this sector of the construction industry.

10.3 The assessment of performance

Chapter 6 was concerned with the organisational objectives of, and performance assessment measures utilised in, DLOs.

As already mentioned, a split into separate contractor and client functions was a necessary response to the new climate in many organisations. This type of change in structure tended to go hand-in-hand with an examination of potential cost savings and a streamlining of work practices. The Audit Commission (1989) attempted to promote value-for-money auditing and the development of performance indicators, and its comparison costing analysis helped to provide benchmarks for all maintenance DLOs.

Another notable change was the adoption of business plans by DLOs.

Over fifty DLOs were found to have developed detailed business plans by 1988. Invariably, the plan recognised the importance for improved management information and also a requirement for the organisation to recognise its own strengths and weaknesses. What was really emphasised in virtually every instance, though, was the essential need to take account of the views of the customer and to work towards meeting these needs with the constraint of market conditions.

10.4 Alternative performance measures

A consideration of alternative performance measures, and calculation of appropriate ratios was undertaken in Chapter 8.
Criticism had been levelled at the government for the imposition of a specific financial target which was too easy to attain. In an industry with a low capital base, the use of a target based on the achievement of a rate of return on capital employed can lead to misleading results.
The use of data from the annual reports to measure other accounting ratios and performance indicators represents an attempt to overcome this problem. CIPFA (1983) indicated that it considered the operating surplus to turnover ratio to be the most appropriate measure for comparison of DLO performance with the private sector.

The results of my study indicate that the rate of return on capital employed is too volatile a measure, due to possible problems in the undermeasurement of capital, to give it any great validity as a measure of performance. The 5% figure is too easy a target to reach, and offers no incentive to improve performance beyond that level. The rate of surplus results, as a test of relative success in the market situation, confirm the view that the level of this measure varies inversely with the degree of competition. For instance, the results show that the ratio tended to be significantly lower in the category of major capital works, where there was greater competition for a limited amount of work.

10.5 Efficiency rankings

The idea of a 'good performance' authority is a notion pursued in Chapter 9, and the work carried out in the calculation of technical efficiency measures in this study enables the ranking of DLOs by performance, in the different categories of work.

Having obtained the rankings of authorities on the basis of efficiency, the concern in Chapter 9 is with answering the question:
" What makes for a 'good performance' authority? "

The answer requires an examination of the features, that can be found in DLOs, which perform well, but are absent from those organisations at the lower end of the rankings.
The characteristics used for the Attribute Analysis were based on 'a priori' assumptions with their origins, either in economic theory or in previous studies of the construction industry.

The results of the Non-metric Regression technique used in the analysis validated most of the assumptions:

- Economies of scale were found to exist in terms of highways and large capital work but not with maintenance work.
- The separation of divisions within a DLO was found to be important, as those DLOs with distinct contracts and client divisions ranked well in all categories.
- The greater the proportion of a local authority's work won by a DLO, the higher tended to be the DLO's ranking. This appeared to be particularly true for maintenance work.
- As the Audit Commission (1988) speculated, bonus schemes based on performance were conducive to better performance.
- But, surprisingly, authorities, who undertook several categories of work, did not appear to benefit from specialisation economies to any great degree. This may have been due to the way in which resources (specialist labour and equipment) are allocated to one division within a large DLO and expertise does not cross divisional boundaries.

Table 10.1 summarises Data Appendix *Section* 5 in terms of the ranking of DLOs, by category, for the two years 1982-83 and 1987-88.

Table 10.1 DLOs' performance rankings

	Highly ranked both years	Lowly ranked both years	Biggest rise	Biggest fall
D1	Sunderland Hinckley	Greenwich Kent	Redbridge	Northumb.
D2	Sunderland Durham	Bradford Reading	S.Tyneside	Burnley
D3	Derby Durham	Leeds Stoke	Sunderland	Easington
D4	Bracknell Sunderland	Oldham Bradford	Bassetlaw	Crawley

In the next Chapter, the particular strengths and weaknesses of some of these authorities are examined. Attempts are made to explain how some of the DLOs, who improved their performance over the decade managed to achieve those improvements.

CHAPTER 11

DLOS IN AN ERA OF CHANGE

11.1 An assessment of the effects of the changes

Any review of the effects of the legislative changes on the operations of DLOs in the 1980s, must take account of the basic rationale for the introduction of the new competitive environment. The basic premise of this form of competition policy was that the formerly inefficient public sector DLOs would be forced to become as efficient as their private sector counterparts in the contracting industry.

To consider the justification for this view, it is worth looking at the evidence from other fields of study, where private-public sector comparisons have been made.

11.1.1 Private-public sector efficiency comparisons

The most comprehensive comparison of public and private enterprises in the U.K. was that carried out by Pryke (1982). He was able to compare three activities where services were provided by both the public and private sector - airlines, ferries and hovercraft, and the sale of gas and electricity appliances. In each case, Pryke's analysis showed a picture of a more profitable private enterprise increasing its market share at the expense of the public sector. Comparisons of cost and productivity showed the private enterprises in a favourable light. Pryke concluded that the public enterprises he studied had been badly managed and that the main explanation for the poor performance was a weakening of incentives resulting from public ownership.

When looking at the whole range of studies which have compared the efficiency of public and private provision, it is far from clear that private enterprise is better than public enterprise. The many studies carried out in the U.S. in the 1970s and early 1980s came to contradictory conclusions.

Alchian and Demsetz (1972) showed that that there was a greater incentive to shirk in public than in private enterprise, for the public employee's wealth is generally not affected by his decision. Moreover, the private firm must meet the test of the market place which inefficient operations do not survive for long, but: 'government firms, particularly those endowed with a politically influential clientele, can survive for long periods, and their managers prosper in the presence of persistent deficits (let alone economic losses) and grossly inefficient management.' (De Alessi 1974.)

To assess the empirical evidence on whether the private production of goods and services is more efficient than public production, Spann (1977) reviewed five different activities: airline service, fire protection, health care and hospitals, electric utilities and refuse collection. He concluded that: 'For the majority of activities, private producers can provide the same services at the same or lower costs than can public producers. In some cases, the costs of private firms are half that of government agencies for producing the same goods or services.' Spann attributes this lower cost of private production to two factors:

1. Private profit-maximising firms having an incentive to minimise costs whereas public sector firms do not, and
2. The size of private firms not being restricted by political boundaries, as is the size of governmental producers. Private firms are able to reach the maximum efficient size, which is an opportunity not necessarily allowed to public firms.

(The latter point has particular validity in the case of DLOs, where the restrictions placed on a DLO's ability to compete for work outside the localauthority, have often been a source of irritation to those large DLOs with manufacturing workshops and operatives with highly specialist skills. Manchester DLO, for instance, had developed by the early 1980s, one of the largest joinery workshops in the country and would have been able to provide a window-frame supply service to meet the needs of all the other nine local authorities throughout Greater Manchester.)

Yet, there was conflicting evidence on the impact of ownership on the cost of even such an uncomplicated service as refuse collection. Kemper and Quigley (1976) reported from their econometric analysis of refuse collection in various U.S. jurisdictions that: 'Collection cost appears to vary systematically with the organisation of collection, even after controlling for other factors. Private collection appears to be about 30% more expensive than municipal collection, which in turn appears to be about 25% more expensive than contract collection.'

Other studies, such as Edwards and Stevens (1978) on sanitation services, Hirsch (1977) and Savas (1977) on refuse collection and Florestano and Gordon (1980) on general municipal services, come to reserved judgments on the improvements in efficiency resulting from increased competition.

11.1.2 Efficiency assessment studies in the U.K. local authority sector

There may be doubt over whether there is anything inherently superior about performance under private ownership.

Yet, support by the Thatcher government for the view that the economic performance of all firms, private or public, is improved by a competitive output market and that, under competition, private firms are likely to do better, was shown to be strong. In a speech made in

November 1983, the Financial Secretary to the Treasury, John Moore, stated that: 'The long-term success of the privatisation programme will stand or fall by the extent to which it maximises competition.' The government did not, in general, choose to pursue the option of increasing competition in its privatisation policy, probably due to its emphasis on the other effects of privatisation (raising revenue and widening share ownership), except in the local authority sector.

In this sector, the study of the costs of refuse collection services emphasised the diversity in the efficiency of public suppliers in different locations (Audit Commission. 1984.) It was clear from that analysis that an efficient supplier (public or private) should be able to undercut substantially the costs incurred by the least efficient local authorities. But the Commission also concluded that the most effective local authorities (the top 25%) achieved cost levels as low as those of the private contractors they investigated.
In their look at the introduction of competitive tendering in the U.K., Hartley and Huby (1985), appeared to provide evidence that increased competition increases efficiency. Domberger, Meadowcroft and Thompson (1986), examining the consequences of tendering and contracting out for the efficiency of refuse

collection, estimated a single-equation model relating an authority's costs of refuse collection to a range of explanatory variables, such as the method of collection, frequency of collection and the number of properties from which collections are made. The authors then compared the distribution of residuals for authorities, where tendering had taken place, with the distribution of residuals for those where it had not. They found that authorities, which had tendered, were likely to have a negative residual, whilst those which had not, tended to have a positive residual. The authors concluded that 'where tendering has been introduced, this has resulted in a significant improvement in the efficiency with which refuse services are provided.'

The later study by Cubbin, Domberger and Meadowcroft (1987) did not support the view that the bulk of the recorded cost savings arose from lower wages, but found that the efficiency gains resulted from greater productivity of labour and vehicles.

The investigation, carried out by the Audit Commission (1989) into DLOs' performance, came to the conclusion that: 'There is powerful evidence to show that the operating performance of DLOs is highly variable and that in many cases there are significant opportunities for improvement.' This rather narrow study, based on detailed visits to only twelve DLOs, and concerned with only housing maintenance work, showed that the inter-

quartile range for a comparable basket of work varied by more than 20% above and below the median.
This diversity was further illustrated by the later report on London and metropolitan DLOs' production costs (Audit Commission 1990) which indicated that London DLOs' costs were twice the metropolitan average.

11.2 Contributions to improved performance

By the end of the 1980s, whilst there had been no notable contraction in the overall aggregate real value of output or in employment in the DLO sector, there had been significant changes in category workloads of the organisations.
Having been faced with a new competitive climate and tighter accounting regulations for eight years, DLOs had responded to the new conditions in different ways. Some DLOs had responded successfully and held their ground - in some cases even expanding operations in the face of competition; some had concentrated their effort on those areas in which they could compete most successfully, and some had been forced to withdraw from areas in which they were not economic.
The successful organisations had taken on board new practices. As discussed in earlier chapters, the

important attributes of reorganisation into two distinct departments, revised tender-led productivity schemes and the introduction of senior management with private sector experience, were all important factors.
Yet, individual DLOs approached their own particular problems, and sought to improve efficiency and respond to the new competitive climate, in specific ways.

11.2.1 The achievement of efficiency : The case of Sunderland DLO

Those organisations, which obtained high efficiency rankings achieved their success by adapting to the conditions imposed by the new competitive climate.
Some of the organisations were ranked highly in the different categories during both years, and other DLOs managed to greatly improve their performance in specific areas of work over the period.
Sunderland DLO is an example of both the former and the latter type of organisation. A high ranker in three of the work categories in 1982-83, it maintained this status for 1987-88 and also managed to become the most improved organisation in its previously 'weak' new minor works category.

In Chapter 9, the attributes of an efficient organisation were expressed in terms of the production of output large enough for scale economies to exist; the organisation winning a large proportion of the authority's work; the separation of contracts and service divisions, and the implementation of incentive-based bonus schemes.
A fundamental question to pose, therefore, is:

How did an 'efficient' organisation such as Sunderland DLO achieve these attributes?

Section 6 of the Data Appendix displays those authorities, which introduced productivity bonus schemes, reorganised into separate divisions etc.
What the information does not show, is the mechanism by which these characteristics arose.

Sunderland DLO, as indicated in Table 10.1, is an organisation which performed well over the period, and even achieved apparent improvements in the one area for which its ranking had not been high in the early years.

As early as 1982, the Public Works Board had decided to set out a business plan to reflect the continuing quest for improved efficiency and effectiveness. Together with the Works Director and his senior management team, a business plan was formulated, which included both internal DLO changes and recommendations for changes on the client side and on the part of central departments.

A summary exhibit of this initial business plan is shown in Fig. 11.1 .

This plan was set out in general terms, and its development was based on the concept that Sunderland DLO would continue to operate as the main provider of building services to the local authority, but with a redefined operational ethos.
The business plan included the adoption of a business and marketing approach and recommended organisational changes, including a new financial policy, and a change in management style, all of which was incorporated in a new management structure. Four separately accountable business units were created along with a commercial and support services unit. Each unit being managed by an Assistant Director to enable independence and accountability, and enable the Works Director to concentrate on the strategic direction and profitability of the whole organisation.

Fig. 11.1 Business Plan for Sunderland DLO

Vision	A large all-embracing building company
Strategy	Maximise workload
Structure	Member board
Systems	Computerised management accounting Cost centres Tender performance monitoring
Style	Corporate identity
Staff	Qualified professionals
Skills	Full range Marketing Apprentice training

(Source: Derived from Sunderland Public Works Department Annual Report. 1982-83)

From the findings of the 1989 ADLO members' survey, it was apparent that all of the top ten ranked maintenance organisations in 1987-88 had developed a business plan by that financial year, and were showing a strong response to the need to acquire a more business-like organisational approach.

11.2.2 Improvements in the organisation of Sunderland DLO

With reference to earlier parts of this study (particularly Chapter 2), two basic questions on DLOs' operations have been posed :

- What are the objectives of a DLO ?

- How does a DLO gauge the success of its operation ?

In Sunderland DLO's 1982-83 Annual Report, both these questions were answered.
The prime objective of the organisation was:

The provision of a value-for-money high quality building service.

After meeting the minimum rate of return requirement, the percentage won in competition was stated to be the most important benchmark of successful operation.

A preliminary internal report, instigated by the Public Works Board, focused on areas of potential improvement in the operation of the DLO in order to meet its prime objective. (See Sunderland DLO Annual Report 1982-83). There were three themes which the report sought to address:

a. Cost control
b. Improved management information
c. Customer needs

In the light of these themes, the report put forward several areas of improvement to the department's operations. The more important of these recommendations were put into operation during the period 1983 to 1987 and are exemplified below:

a. **Cost control**

Greater cost control and cost savings resulted from several aspects of policy:

- Better materials management:

To achieve greater control over materials usage, it was determined that each materials store should set limits on the issue of materials to about £ 150 000 per annum and transport costs should be identified to allow calculation of the cost at site. Additionally, it was decided that, in many areas, imprest stocks should be used for jobbing maintenance.

- Controlling overhead costs:

The department sought to limit the paperwork generated by a poor bonus scheme and place more emphasis on work planning and control.
Money had been wasted in the administration of an over-complex bonus scheme, and savings occurred when simplified incentive schemes linked to schedules of rates were introduced.
DLO management, together with central establishment charges, accounted for about 12% of total operating costs in 1982-83. (This had been reduced to about 7% by 1986-87). Prior to the changes in tendering regulations, accountability in Sunderland, as in many local authorities, had been from the services to the centre. The introduction of competitive tendering reversed the direction. The DLO came to 'service level'

agreements specifying the service and its costs with the Treasurers and other central departments.

- Increasing the working time:

Although persistent short-term sickness was not a major problem, firm management action by way of interviews and medical reports were instigated. A two per cent reduction in days lost through sickness occurred over the period 1984 to 1986.
Management began to monitor sickness time closely. Time on productive work was increased by improved materials delivery, use of imprest stocks and flexible working - a policy was agreed with trades unions to reduce the ratio of labourers to tradespeople.

- Improving the rate of work:

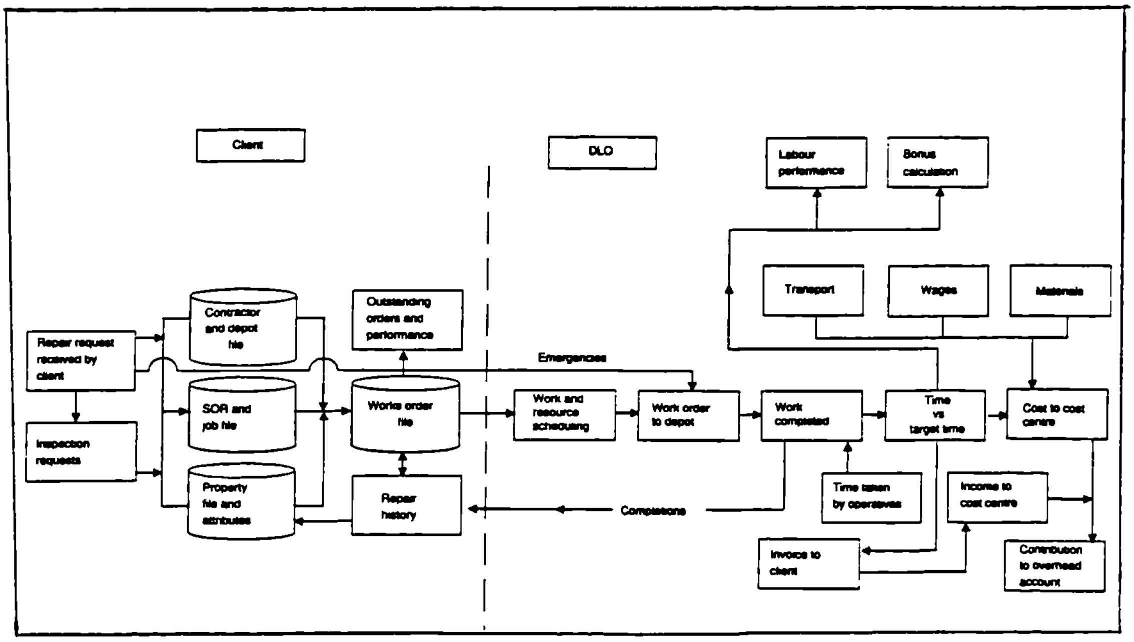
The organisation was operating too detailed an incentive scheme. The new scheme, introduced in 1985, consolidated allowances for travel, and abortive calls were incorporated into the basic job times. The number of jobs was simplified and the times updated in response to changes in working methods. It was decided to improve incentives and not consolidate bonus with basic wages.

The over all success of the changes may be gauged by the fact that cost per comparative hour (all categories of work) was at least twenty per cent below the target rate in the Audit Commission Management Handbook.

b. Management information

It was, of course, recognised as a prerequisite to a sensible tendering strategy, that there was a need to prepare a business plan, setting out ways in which the organisation intended to improve performance.
Emphasis was placed on the acquisition of management information to allow the performance and profitability of one unit of the DLO to be compared with another.
For its information needs, the department had been using custom-built programs on the local authority's mainframe, but in 1983 decided to make use of a proprietary system, which was part of a housing management and maintenance computer suite. The system had the ability to provide an overview as well as progress orders and generate charges and thereby provide management at a more aggregated level.
(See Fig. 11.2).

Fig. 11.2 Sunderland DLO and client computer system



(Source: Sunderland DLO Report 1984)

c. Customers' needs

- Increasing effectiveness:

Effectiveness was improved by operative training, emphasising the implications of working in someone's home, by keeping tenants informed of the progress of their repair order and by keeping the quality of the work up to standard through post-inspection.

- Improved customer service:

The DLO tried to project a new image.
Sunderland DLO organised a series of two-day courses for both management and front line staff, which outlined the importance of customer care, and trained staff on ways of identifying and meeting customer needs and dealing with their problems. One change was the introduction of customer satisfaction cards and appointment systems. The development was reinforced by renaming the DLO and by the introduction of uniforms and a new logo for the vans and letter headings.
In 1985, the workforce was decentralised into six local neighbourhoods for maintenance work and the DLO began to undertake non-urgent repairs through a zoning system. One problem of adhering to planned response times was the variable nature of the workload, and to accommodate the variation in orders without a large backlog, the DLO switched tradespeople between work groups and used overtime.

11.2.3 Setting improvement targets

In addition to the identification of a range of potential improvements, the management of Sunderland DLO attempted to quantify the major elements and set estimates of potential cost savings for each financial year.

By way of example, the estimates for the financial year 1984-85 is summarised in Table 11.1 .

Table 11.1 Estimated potential cost savings

Input cost	Potential saving as % of cost of comparative hour
Management plus CEC	3
Cost per vehicle (inc. fuel)	2
Sickness	5
Stores overheads	2
Comparative productivity	3

(Source: Sunderland DLO Report 1984)

Whilst management recognised that improvements in major elements could not be quantified in such a simple way, a strong recognition of the need to improve the effectiveness of its service continued throughout the period, especially as further legislative changes occurred. The word 'target' was avoided in the cost saving estimates, but the annual report refers each year to the organisation's success in meeting the cost savings objectives.

11.3 Conclusions and epilogue

The findings of this study of the effects of the legislation on DLO operations have been detailed in Chapter 10, where the conclusions to be drawn from these findings have also been considered.

The study has had two main aims.

A global aim of the study has been to analyse the ways in which DLOs responded, during the ensuing decade, to the requirements of the 1980 legislation. Such analysis has been carried out in terms of organisational structure and resource usage with consideration of how the changes in operational performance could be measured.

The study has dealt with several issues of performance measurement. The DLOs found themselves, in 1981, for the first time, faced with an externally imposed performance constraint. Of major concern was the nature of the choice of constraint.

Alternative options have been discussed and calculated in some detail, as a second major aim has been one of considering whether the available data could be used in the more appropriate performance measures.

One conclusion of the study is that alternative measures of performance would certainly constitute a better appraisal of resource usage within the organisation. There are obviously many blatant discrepancies between the relative performance of some authorities under total efficiency (TE) measurement and under the rate of return on capital measurement.

Indeed, on the basis that TE measurement gives an 'ideal' performance measure, the rate of surplus especially, and also the value-added measure are more closely correlated with TE than the rate of return on capital.

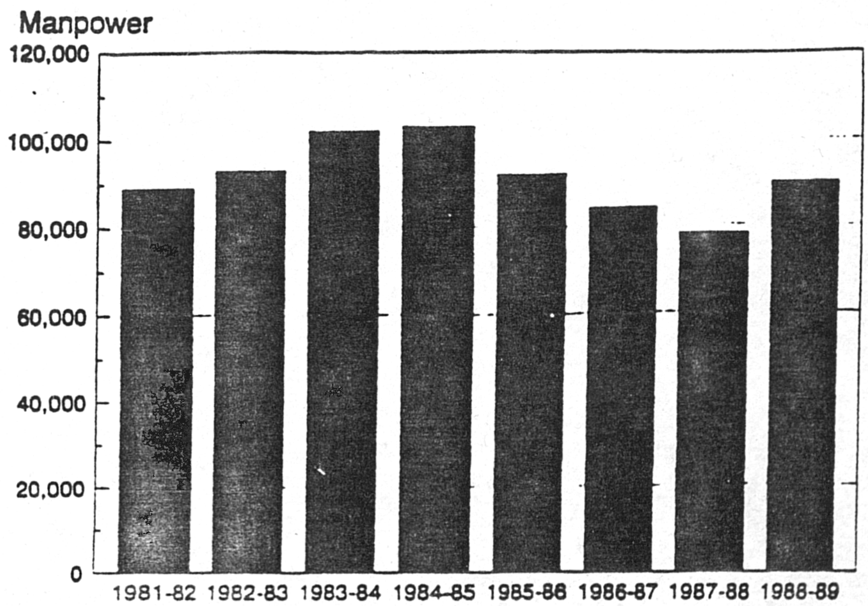
The rate of return is too volatile a measure, due to possible problems in the undermeasurement of capital to give it any great validity as a measure of performance.

However, the rate of surplus measurement results, as a test of relative success in the market situation, confirm the view that the level of this measure varies inversely with the degree of competition, when considered on a work category basis.

Regardless of the inappropriateness of the rate of return on capital the need to meet a performance measure initially constrained behaviour in many authorities.

After eight years of enforced competition and the imposition of a rate of return requirement, it was perhaps surprising that so many local authorities still operated a viable DLO. Certainly the increases in compulsory competitive tendering throughout the 1980s had forced DLO managers to make greater effort to ensure that enough work was won to maintain the economic viability of the organisation.
As Fig. 11.3 shows that the number of workers in this sector of the industry was at about the same level in 1988-89 as it was in 1981-82 (based on CIPFA survey figures), there had been no major shedding of jobs as might have been predicted at the beginning of the decade.

Fig. 11.3 Total manpower of responding DLOs



By 1989, DLOs had generally been forced to realise that, in building work, their strength lay in their ability to provide a maintenance and repair service as opposed to new build work. Table 11.1 shows the value of work undertaken by DLOs in each of the four work areas (based on CIPFA survey data).

Table 11.2 Estimated cost of all functional work and contracts undertaken by DLOs. (£ 000)

	Category				(Total no. of
	D1	D2	D3	D4	respondents)
1981-82	536 853	123 509	22 114	540 656	(268)
1982-83	724 542	119 452	40 357	801 060	(327)
1983-84	729 196	133 843	45 876	864 390	(337)
1984-85	708 081	100 042	36 575	843 864	(335)
1985-86	694 366	81 315	31 425	880 422	(318)
1986-87	720 211	91 766	28 949	940 934	(301)
1987-88	705 576	93 870	29 974	931 465	(279)
1988-89	650 633	80 783	47 742	845 601	(263)

(Source: DLO Statistics [Actuals] 1981-89. CIPFA)

So, whilst the legislation had forced DLOs to undergo a period of adaptation and reorganisation, very few had gone to the wall, and after eight years most were much better equipped to survive in an increasingly competitive environment.

The results of the study of total factor productivity indicate that, in basic economic usage terms, DLOs had generally operated on an efficient basis.

Regardless of the constraint of a performance measure, the single most important factor to have influenced the efficiency and effectiveness of operation of local authority building departments was undoubtedly the introduction of the market and the setting-up of 'private-sector' practices in DLO management and operation, as indicated in previous sections of this work.

There was powerful evidence to show that the operating performance of DLOs in the early 1980s was highly variable and that in many cases there were significant opportunities for improvement, yet, by the end of the decade, the objective of transforming a service department into a commercial contracting organisation had generally been achieved.

With a clear view of the existing performance of its DLO, a local authority was better placed to make the longer-term strategic decisions and to establish a business plan for its DLO.

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APPENDICES

Appendix A   Legislation affecting DLOs prior to 1980

Until April 1981, there was no specific piece of legislation concerning DLOs.

The 1972 Local Government Act gave certain 'permissive' powers to local authorities, to provide services for their areas in addition to their duties.

Sections 111 and 137 of this Act, were interpreted to mean that a local authority could provide any services, which it thought would benefit the area and which cost the equivalent of a 2p property rate.

This Act and the various Housing Acts, which empowered local authorities to build houses provided the statutory basis for DLOs. This scant legislation was supplemented by circulars from the Department of the Environment, which were mainly concerned with tendering procedures.

Until 1981, therefore, the operations of DLOs were guided still by Circular 57/69 'Building by Direct Labour Organisations'. (Department of the Environment. 1969).

There were three main points made in this document:

a. The successful operation of a DLO requires stability 'built up over the years from continuity of operations, which enables labour and plant to be used effectively and continuously. It is, therefore, necessary to avoid a workload which fluctuates from year to year; to plan any build-up of activity with care and with due regard to the capacity of the management; and to proceed very cautiously into types of construction with which the organisation has had little previous experience'.

b. For DLOs to be fully effective, their productivity must match that of the industry as a whole. They should introduce bonus schemes based upon standards of output established by work study, and these should be applied to all work which can be measured.

c. Efficiency is best tested by requiring DLOs to tender in competition with contractors for a 'considerable and representative proportion by value of their work'.
'The Ministers have no intention of reverting to the over-rigid one-in-three rule ... but an application to DLOs of the practice of awarding contracts either in competition, or in continuation of contracts which have been the subject of competition, would go a long way towards meeting the requirements of competition and of continuity, and they wish local authorities to follow it as a general practice'.

Appendix B Local authorities providing data on their DLOs

County councils (England)

Avon	Bedfordshire	Berkshire
Cambridgeshire	Cornwall	Cumbria
Devon	Dorset	E.Sussex
Gloucestershire	Hampshire	Humberside
Kent	Leicestershire	Norfolk
Northamptonshire	Northumberland	Oxfordshire
Shropshire	Somerset	Staffordshire
Suffolk	Surrey	Warwickshire
Wiltshire		

London and metropolitan district councils

Barnsley	Bradford	Bury
Gateshead	Greenwich	Kirklees
Leeds	Newham	Newcastle-U-Tyne
N. Tyneside	Oldham	Redbridge
Rochdale	Sefton	Solihull
S. Tyneside	Stockport	Sunderland
Waltham Forest	Wigan	Wirral

Non-metropolitan district councils (England)

Aylesbury	Barrow	Bassetlaw
Blackpool	Bracknell	Braintree
Breckland	Burnley	Blyth Valley
Cambridge	Chester	Chester-le-Street
Copeland	Crawley	Derby
Derwentside	Durham	Easington
E. Devon	Forest of Dean	Gravesham
Harlow	Hinckley	Hull
Kennet	Kings Lynn	Lincoln
Mansfield	Mid-Sussex	New Forest
N. Devon	N.E. Derbyshire	N. Wiltshire
Norwich	Pendle	Preston
Reading	Rushmoor	St.Edmundsbury
Sedgefield	S. Oxfordshire	S. Staffordshire
Stockton	Stoke	Teignbridge
Torridge	Thanet	Thurrock
W. Derbyshire	W. Lindsey	Wrekin
Wychavon	Wyre	Wyre Forest
York		

County councils (Wales)

Gwent	S. Glamorgan	W. Glamorgan

District councils (Wales)

Blaenau	Ceredigion	Colwyn
Cynon	Glyndwr	Islwyn
Lliw Valley	Neath	Rhondda

DATA APPENDIX

SECTION 1

Aggregate expenditure on inputs

(a) Category D1 (50 authorities)

Aggregate expenditure on inputs (£ 000)

	1981-2	1982-3	1983-4	1984-5
Direct Labour	50 997	55 738	55 706	61 154
+Indirect Labour	13 539	15 843	16 681	16 450
=LABOUR COSTS	64 536	71 581	72 387	77 604
Supplies/ Services	71 733	76 978	70 951	72 971
+Sub-contractors	12 687	13 692	13 266	15 618
=MATERIAL COSTS	84 420	90 670	84 217	88 589
Transport & plant	50 667	50 419	50 219	48 717
+Overheads	20 829	23 863	23 827	25 449
=CAPITAL	71 496	74 282	74 046	74 166
Surplus	8 142	12 795	10 040	11 372
TOTAL INCOME	228 594	249 328	240 690	251 731

D1 Aggregate expenditure on inputs (£ 000)

	1985-6	1986-7	1987-8	1988-9
Direct				
Labour	60 259	65 584	72 036	61 380
+Indirect				
Labour	17 490	19 158	22 642	16 194
=LABOUR				
COSTS	77 749	84 742	94 678	77 574
Supplies/				
Services	78 170	79 705	85 608	71 822
+Sub-				
contractors	15 004	19 820	22 856	21 077
=MATERIAL				
COSTS	93 174	99 525	108 464	92 899
Transport				
& plant	53 588	53 166	56 567	46 159
+Overheads	27 857	30 256	30 384	30 340
=CAPITAL	81 445	83 422	86 951	76 599
Surplus	10 961	13 024	10 185	4 079
TOTAL				
INCOME	263 326	280 713	300 278	251 181

(b) Category D2 (10 authorities)

Aggregate expenditure on inputs (£ 000)

	1981-2	1982-3	1983-4	1984-5
Direct Labour	5 804	6 002	6 981	8 399
+Indirect Labour	1 629	2 262	2 809	3 014
=LABOUR COSTS	7 433	8 264	9 790	11 413
Supplies/ Services	3 971	4 991	5 479	6 636
+Sub-contractors	3 246	3 103	2 678	2 826
=MATERIAL COSTS	7 217	8 099	8 157	9 462
Transport & plant	464	645	717	736
+Overheads	2 444	3 394	4 213	4 521
=CAPITAL	2 908	4 039	4 930	5 257
Surplus	198	-675	-651	333
TOTAL INCOME	17 660	19 862	21 654	26 574

D2 Aggregate expenditure on inputs (£ 000)

	1985-6	1986-7	1987-8	1988-9
Direct Labour	7 079	7 906	8 105	8 614
+Indirect Labour	2 516	3 278	3 356	3 524
=LABOUR COSTS	9 595	11 184	11 461	12 138
Supplies/ Services	5 979	6 901	7 376	7 150
+Sub-contractors	2 272	1 704	4 114	4 949
=MATERIAL COSTS	8 251	8 605	11 490	12 099
Transport & plant	810	945	651	1 031
+Overheads	3 773	4 916	5 535	6 602
=CAPITAL	4 583	5 861	6 186	7 633
Surplus	2 792	492	588	-291
TOTAL INCOME	25 618	26 154	29 745	31 579

(c) Category D3 (11 authorities)

Aggregate expenditure on inputs (£ 000)

	1981-2	1982-3	1983-4	1984-5
Direct Labour	946	1 510	1 357	1 669
+Indirect Labour	209	355	488	614
=LABOUR COSTS	1 155	1 865	1 845	2 283
Supplies/ Services	787	1 175	1 043	2 098
+Sub-contractors	100	236	194	547
= MATERIAL COSTS	887	1 411	1 237	2 645
Transport & plant	329	422	281	341
+Overheads	321	534	696	951
=CAPITAL	650	956	977	1 292
Surplus	136	146	221	422
TOTAL INCOME	2 828	4 378	4 280	6 642

D3 Aggregate expenditure on inputs (£ 000)

	1985-6	1986-7	1987-8	1988-9
Direct				
Labour	1 932	1 234	1 349	1 490
+Indirect				
Labour	683	500	453	450
=LABOUR				
COSTS	2 615	1 734	1 802	1 940
Supplies/				
Services	1 961	1 559	2 031	2 570
+Sub-				
contractors	971	483	663	692
= MATERIAL				
COSTS	2 932	2 042	2 694	3 262
Transport				
& plant	1 012	1 148	206	166
+Overheads	1 087	789	609	843
=CAPITAL	12 099	1 937	815	1 009
Surplus	463	637	465	544
TOTAL INCOME	8 109	6 350	5 776	6 755

(d) Category D4 (61 authorities)

Aggregate expenditure on inputs (£ 000)

	1981-2	1982-3	1983-4	1984-5
Direct Labour	52 987	55 243	58 310	65 442
+Indirect Labour	8 213	8 563	9 038	10 144
=LABOUR COSTS	61 200	63 806	67 348	75 586
Supplies/ Services	28 279	26 150	28 000	35 539
+Sub-contractors	2 195	2 266	6 674	7 155
=MATERIAL COSTS	30 474	28 416	34 674	42 694
Transport & plant	6 463	6 661	7 143	7 855
+Overheads	20 917	22 493	25 534	31 554
=CAPITAL	27 380	29 154	32 677	39 409
Surplus	3 583	5 134	4 662	4 874
TOTAL INCOME	122 599	126 586	139 236	162 563

D4 Aggregate expenditure on inputs (£ 000)

	1985-6	1986-7	1987-8	1988-9
Direct Labour	69 302	74 165	81 654	58 990
+Indirect Labour	10 742	11 496	12 656	9 143
=LABOUR COSTS	80 044	85 661	94 310	68 133
Supplies/ Services	37 302	43 700	49 549	41 597
+Sub-contractors	6 772	12 779	13 607	14 365
=MATERIAL COSTS	44 074	56 479	63 156	55 962
Transport & plant	8 218	8 926	10 109	9 382
+Overheads	29 558	37 989	37 504	32 025
=CAPITAL	37 776	46 915	47 613	4 1407
Surplus	7 740	9 469	8 603	3 024
TOTAL INCOME	170 892	198 524	213 686	170 380

SECTION 2

Category D1

Labour input :

	(a) Direct labour costs (£ 000)	(b) Index of direct labour costs	(a/b)x100	Expressed as a volume of direct labour
1981-2	50 997	86.3	59 093	0.9663
1982-3	55 738	90.0	61 931	1.0127
1983-4	55 706	94.2	59 136	0.9670
1984-5	61 154	100	61 154	1.0000
1985-6	60 259	103.0	58 504	0.9567
1986-7	65 584	106.0	61 872	1.0117
1987-8	72 036	112.1	64 260	1.0508
1988-9	61 380	136.8	44 868	0.7337

	(a) Indirect labour costs (£ 000)	(b) Index of indirect labour costs	(a/b)x100	Expressed as a volume of indirect labour
1981-2	13 539	87.9	15 408	0.9367
1982-3	15 843	91.2	17 370	1.0559
1983-4	16 681	95.0	17 561	1.0675
1984-5	16 450	100	16 450	1.0000
1985-6	17 490	103.6	16 882	1.0263
1986-7	19 158	108.5	17 654	1.0732
1987-8	22 642	125.1	18 095	1.1000
1988-9	16 194	131.5	12 319	0.7489

	Overall volume of labour (weighted)
1981-2	0.9601
1982-3	1.0223
1983-4	0.9902
1984-5	1.0000
1985-6	0.9724
1986-7	1.0256
1987-8	1.0615
1988-9	0.7390

Materials input :

	(a) Material costs (£ 000)	(b) Index of material costs	(a/b) x 100	Expressed as a volume of materials
1981-2	84 420	81.2	103 966	1.1736
1982-3	90 670	86.8	104 459	1.1791
1983-4	84 217	92.6	90 947	1.0266
1984-5	88 589	100	88 589	1.0000
1985-6	93 174	104.9	88 822	1.0026
1986-7	99 525	111.1	89 581	1.0112
1987-8	108 464	116.8	92 863	1.0482
1988-9	92 899	123.8	75 040	0.8471

Capital input :

	(a) Transport & plant costs (£ 000)	(b) Index of plant costs	(a/b) x 100	Expressed as a volume of plant
1981-2	50 667	93.3	54 305	1.1147
1982-3	50 419	97.4	51 765	1.0626
1983-4	50 219	98.3	51 087	1.0486
1984-5	48 717	100	48 717	1.0000
1985-6	53 588	105.5	50 794	1.0426
1986-7	53 166	104.5	50 877	1.0443
1987-8	56 567	110.8	51 053	1.0480
1988-9	46 159	115.3	40 034	0.8218

	(a) Overhead costs (£ 000)	(b) Index of overhead costs	(a/b) x 100	Expressed as a volume of overheads
1981-2	20 829	90.8	22 939	0.9014
1982-3	23 863	94.0	25 386	0.9975
1983-4	23 827	94.6	25 187	0.9897
1984-5	25 449	100	25 449	1.0000
1985-6	27 857	105.4	26 430	1.0385
1986-7	30 256	112.5	26 894	1.0568
1987-8	30 384	139.1	21 843	0.8583
1988-9	30 340	182.1	16 661	0.6547

	Overall volume of capital
1981-2	1.0526
1982-3	1.0417
1983-4	1.0296
1984-5	1.0000
1985-6	1.0323
1986-7	1.0488
1987-8	0.9817
1988-9	0.7555

Output :

	(a) Value of Output (£ 000)	(b) Output price index	(a/b) x 100	Expressed as a volume of output
1981-2	228 594	95.2	240 120	0.9539
1982-3	249 328	94.2	264 679	1.0514
1983-4	240 690	96.5	249 420	0.9908
1984-5	251 731	100	251 731	1.0000
1985-6	263 326	103.3	254 914	1.0126
1986-7	280 713	106.2	264 325	1.0500
1987-8	300 278	110.5	271 745	1.0795
1988-9	251 181	121.7	206 394	0.8199

Category D1

Growth rate

$$
\begin{aligned}
\underline{1981/2\text{-}1982/3} \quad & \ln 1.0514 - \ln 0.9539 \\
& - 0.2977 (\ln 1.0233 - \ln 0.9601) \\
& - 0.3831 (\ln 1.1791 - \ln 1.1736) \\
& - 0.3192 (\ln 1.0417 - \ln 1.0526) \\
& = \underline{0.0802}
\end{aligned}
$$

$$
\begin{aligned}
\underline{1982/3\text{-}1983/4} \quad & \ln 0.9908 - \ln 1.0514 \\
& - 0.3082 (\ln 0.9902 - \ln 1.0223) \\
& - 0.3742 (\ln 1.0266 - \ln 1.1791) \\
& - 0.3176 (\ln 1.0296 - \ln 1.0417) \\
& = \underline{0.0059}
\end{aligned}
$$

$$
\begin{aligned}
\underline{1983/4\text{-}1984/5} \quad & \ln 1.0000 - \ln 0.9908 \\
& - 0.3184 (\ln 1.0000 - \ln 0.9902) \\
& - 0.3669 (\ln 1.0000 - \ln 1.0266) \\
& - 0.3147 (\ln 1.0000 - \ln 1.0296) \\
& = \underline{0.0250}
\end{aligned}
$$

$$
\begin{aligned}
\underline{1984/5\text{-}1985/6} \quad & \ln 1.0126 - \ln 1.0000 \\
& - 0.3155 (\ln 0.9724 - \ln 1.0000) \\
& - 0.3689 (\ln 1.0026 - \ln 1.0000) \\
& - 0.3156 (\ln 1.0323 - \ln 1.0000) \\
& = \underline{0.0079}
\end{aligned}
$$

<u>1985/6-1986/7</u> ln 1.0500 - ln 1.0126

- 0.3124 (ln 1.0256 - ln 0.9724)
- 0.3705 (ln 1.0112 - ln 1.0026)
- 0.3171 (ln 1.0488 - ln 1.0323)

= <u>0.0114</u>

<u>1986/7-1987/8</u> ln 1.0795 - ln 1.0500

- 0.3215 (ln 1.0615 - ln 1.0256)
- 0.3729 (ln 1.0482 - ln 1.0112)
- 0.3056 (ln 0.9817 - ln 1.0488)

= <u>0.0234</u>

<u>1987/8-1988/9</u> ln 0.8199 - ln 1.0795

- 0.3202 (ln 0.7390 - ln 1.0615)
- 0.3750 (ln 0.8471 - ln 1.0482)
- 0.3048 (ln 0.7555 - ln 0.9817)

= <u>0.0006</u>

Category D2

Labour input :

	(a) Direct labour costs (£ 000)	(b) Index of direct labour costs	(a/b) x 100	Expressed as a volume of direct labour
1981-2	5 804	86.3	6 725	0.8007
1982-3	6 002	90.0	6 669	0.7940
1983-4	6 981	94.2	7 411	0.8624
1984-5	8 399	100	8 399	1.0000
1985-6	7 079	103.0	6 873	0.8183
1986-7	7 906	106.0	7 458	0.8880
1987-8	8 105	112.1	7 230	0.8608
1988-9	8 614	136.8	6 297	0.7497

	(a) Indirect labour costs (£ 000)	(b) Index of indirect labour costs	(a/b) x 100	Expressed as a volume of indirect labour
1981-2	1 629	87.9	1 854	0.6151
1982-3	2 262	91.2	2 480	0.8228
1983-4	2 809	95.0	2 957	0.9811
1984-5	3 014	100	3 014	1.0000
1985-6	2 516	103.6	2 429	0.8059
1986-7	3 278	108.5	3 021	1.0023
1987-8	3 356	125.1	2 682	0.8898
1988-9	3 524	131.5	2 681	0.8895

	Overall volume of labour index
1981-2	0.7538
1982-3	0.7960
1983-4	0.9084
1984-5	1.0000
1985-6	0.8162
1986-7	0.9092
1987-8	0.8077
1988-9	0.8100

Materials input :

	(a) Material costs (£ 000)	(b) Index of material costs	(a/b) x 100	Expressed as a volume of materials
1981-2	7 217	81.5	8 858	0.9362
1982-3	8 099	87.6	9 249	0.9775
1983-4	8 157	93.6	8 717	0.9213
1984-5	9 462	100	9 462	1.0000
1985-6	8 251	105.3	7 838	0.8284
1986-7	8 605	109.1	7 887	0.8335
1987-8	11 490	115.0	9 990	1.0558
1988-9	12 099	121.1	9 988	1.0556

Capital input :

	(a) Transport & plant costs (£ 000)	(b) Index of plant costs	(a/b) x 100	Expressed as a volume of plant
1981-2	464	93.3	497	0.6752
1982-3	645	97.4	662	0.8994
1983-4	717	98.3	729	0.9904
1984-5	736	100	736	1.0000
1985-6	810	105.5	768	1.0434
1986-7	945	104.5	904	1.2282
1987-8	651	110.8	588	0.7989
1988-9	1 031	115.3	894	1.2146

	(a) Overhead costs (£ 000)	(b) Index of overhead costs	(a/b) x 100	Expressed as a volume of overheads
1981-2	2 444	90.8	2 692	0.5954
1982-3	3 394	94.0	3 611	0.7987
1983-4	4 213	94.6	4 453	0.9850
1984-5	4 521	100	4 521	1.0000
1985-6	3 773	105.4	3 580	0.7919
1986-7	4 916	112.5	4 370	0.9666
1987-8	5 535	139.1	3 979	0.8801
1988-9	6 602	182.1	3 625	0.8018

	Overall volume of capital
1981-2	0.6083
1982-3	0.8150
1983-4	0.9859
1984-5	1.0000
1985-6	0.8362
1986-7	1.0007
1987-8	0.8717
1988-9	0.8577

Output :

	(a) Value of Output (£ 000)	(b) Output price index	(a/b) x 100	Expressed as a volume of output
1981-2	17 660	95.2	18 550	0.6981
1982-3	19 862	94.2	21 085	0.7934
1983-4	21 654	96.5	26 574	0.8444
1984-5	26 574	100	26 574	1.0000
1985-6	25 618	103.3	24 872	0.9360
1986-7	26 154	106.2	24 627	0.9267
1987-8	29 746	110.5	26 919	1.0130
1988-9	32 111	121.7	26 385	0.9929

Category D2

Growth rate

1981/2-1982/3 ln 0.7934 - ln 0.6981
- 0.4186 (ln 0.7960 - ln 0.7538)
- 0.4083 (ln 0.9775 - ln 0.9362)
- 0.1731 (ln 0.8150 - ln 0.6083)
= 0.0371

1982/3-1983/4 ln 0.8444 - ln 0.7934
- 0.4341 (ln 0.9084 - ln 0.7960)
- 0.3923 (ln 0.9213 - ln 0.9775)
- 0.1736 (ln 0.9859 - ln 0.8150)
= 0.0049

1983/4-1984/5 ln 1.0000 - ln 0.8444
- 0.4409 (ln 1.0000 - ln 0.9084)
- 0.3664 (ln 1.0000 - ln 0.9213)
- 0.1927 (ln 1.0000 - ln 0.9859)
= 0.0940

1984/5-1985/6 ln 0.9360 - ln 1.0000
- 0.4020 (ln 0.8162 - ln 1.0000)
- 0.3391 (ln 0.8284 - ln 1.0000)
- 0.2589 (ln 0.8362 - ln 1.0000)
= 0.1257

$$\underline{1985/6\text{-}1986/7}\quad \ln 0.9267 - \ln 0.9370 - 0.4011(\ln 0.9092 - \ln 0.8162) - 0.3256(\ln 0.8335 - \ln 0.8264) - 0.2733(\ln 1.0007 - \ln 0.8362) = \underline{-0.1043}$$

$$\underline{1986/7\text{-}1987/8}\quad \ln 1.0130 - \ln 0.9267 - 0.4065(\ln 0.8077 - \ln 0.9092) - 0.3577(\ln 1.0558 - \ln 0.8335) - 0.2358(\ln 0.8715 - \ln 1.0007) = \underline{0.0852}$$

$$\underline{1987/8\text{-}1988/9}\quad \ln 0.9929 - \ln 1.0130 - 0.3661(\ln 0.8100 - \ln 0.8077) - 0.3816(\ln 1.0556 - \ln 1.0558) - 0.2523(\ln 0.8577 - \ln 0.8717) = \underline{-0.01698}$$

Category D3

Labour input :

	Volume of labour
1981-2	0.6710
1982-3	1.0263
1983-4	0.8896
1984-5	1.0000
1985-6	0.4034
1986-7	0.8353
1987-8	0.9772
1988-9	1.0491

Materials input :

	Volume of materials
1981-2	0.3951
1982-3	0.6076
1983-4	0.4994
1984-5	1.0000
1985-6	1.0526
1986-7	0.7081
1987-8	0.8802
1988-9	1.0125

Capital input :

	Volume of capital
1981-2	0.8274
1982-3	0.9079
1983-4	0.7670
1984-5	1.0000
1985-6	1.9427
1986-7	1.4985
1987-8	0.7237
1988-9	0.9102

	Volume of output
1981-2	0.4473
1982-3	0.6998
1983-4	0.6677
1984-5	1.0000
1985-6	1.1819
1986-7	0.9002
1987-8	0.7870
1988-9	0.8357

Category D3

Growth rate

1981/2-1982/3 ln 0.6998 - ln 0.4473
- 0.4348 (ln 1.0263 - ln 0.6710)
- 0.3315 (ln 0.6076 - ln 0.2951)
- 0.2337 (ln 0.9079 - ln 0.8274)
= 0.0984

1982/3-1983/4 ln 0.6677 - ln 0.6998
- 0.4476 (ln 0.8896 - ln 1.0263)
- 0.3191 (ln 0.4994 - ln 0.6076)
- 0.2333 (ln 0.7670 - ln 0.9079)
= 0.1192

1983/4-1984/5 ln 1.0000 - ln 0.6677
- 0.4108 (ln 1.0000 - ln 0.8896)
- 0.3650 (ln 1.0000 - ln 0.4994)
- 0.2242 (ln 1.0000 - ln 0.7670)
= 0.0430

1984/5-1985/6 ln 1.1819 - ln 1.0000
- 0.3545 (ln 1.4034 - ln 0.8896)
- 0.4044 (ln 1.0526 - ln 1.0000)
- 0.2411 (ln 1.9427 - ln 1.0000)
= -0.1339

$$\underline{1985/6-1986/7}\ \ln 0.9002 - \ln 1.1819$$
$$- 0.3228\ (\ln 0.8353 - \ln 1.4034)$$
$$- 0.3705\ (\ln 0.7081 - \ln 1.0526)$$
$$- 0.3068\ (\ln 1.4985 - \ln 1.9427)$$
$$= \underline{0.1218}$$

$$\underline{1986/7-1987/8}\ \ln 0.7870 - \ln 0.9002$$
$$- 0.3214\ (\ln 0.9772 - \ln 0.8353)$$
$$- 0.4323\ (\ln 0.8802 - \ln 0.7081)$$
$$- 0.2463\ (\ln 0.7237 - \ln 1.4985)$$
$$= \underline{-0.0996}$$

$$\underline{1987/8-1988/9}\ \ln 0.8357 - \ln 0.7870$$
$$- 0.3258\ (\ln 1.0491 - \ln 0.9772)$$
$$- 0.5162\ (\ln 1.0123 - \ln 0.8802)$$
$$- 0.1580\ (\ln 0.9102 - \ln 0.7237)$$
$$= \underline{-0.0716}$$

Category D4

Direct labour and materials input :

	(a) Direct labour & maintenance material costs (£ 000)	(b) Index of direct labour & material costs	(a/b) x 100	Expressed as a volume of of direct lab./mats.
1981-2	83 461	86.0	97 048	0.8975
1982-3	83 659	91.0	91 933	0.8502
1983-4	92 984	95.2	97 672	0.9032
1984-5	108 136	100	108 136	1.0000
1985-6	113 376	103.5	109 542	1.0130
1986-7	130 644	108.8	120 077	1.1104
1987-8	144 810	117.1	123 664	1.1436
1988-9	114 952	123.8	92 853	0.8587

Indirect labour input :

	(a) Indirect labour costs (£ 000)	(b) Index of indirect labour costs	(a/b) x 100	Expressed as a volume of indirect labour
1981-2	8 213	87.9	9 347	0.9214
1982-3	8 563	91.2	9 388	0.9255
1983-4	9 038	95.0	9 515	0.9380
1984-5	10 144	100	10 144	1.0000
1985-6	10 742	103.6	10 369	1.0222
1986-7	11 496	108.5	10 593	1.0443
1987-8	12 656	125.1	10 114	0.9970
1988-9	9 143	131.5	6 955	0.6856

Capital input :

	Overall volume of capital
1981-2	0.7660
1982-3	0.7843
1983-4	0.8708
1984-5	1.0000
1985-6	0.9111
1986-7	1.0735
1987-8	0.9197
1988-9	0.6173

<u>Output</u> :

	Volume of output
1981-2	0.7922
1982-3	0.8266
1983-4	0.8876
1984-5	1.0000
1985-6	1.0177
1986-7	1.1499
1987-8	1.1896
1988-9	0.8612

Category D4

Growth rate

$$
\begin{aligned}
\underline{1981/2-1982/3} \quad & \ln 0.8266 - \ln 0.7922 \\
& - 0.6950 (\ln 1.0263 - \ln 0.6710) \\
& - 0.0698 (\ln 0.6076 - \ln 0.2951) \\
& - 0.2353 (\ln 0.9079 - \ln 0.8274) \\
& = \underline{0.0743}
\end{aligned}
$$

$$
\begin{aligned}
\underline{1982/3-1983/4} \quad & \ln 0.8876 - \ln 0.8266 \\
& - 0.6904 (\ln 0.8896 - \ln 1.0263) \\
& - 0.0689 (\ln 0.4994 - \ln 0.6076) \\
& - 0.2416 (\ln 0.7670 - \ln 0.9079) \\
& = \underline{0.0033}
\end{aligned}
$$

$$
\begin{aligned}
\underline{1983/4-1984/5} \quad & \ln 1.0000 - \ln 0.8876 \\
& - 0.6884 (\ln 1.0000 - \ln 0.8896) \\
& - 0.0659 (\ln 1.0000 - \ln 0.4994) \\
& - 0.2477 (\ln 1.0000 - \ln 0.7670) \\
& = \underline{0.0109}
\end{aligned}
$$

$$
\begin{aligned}
\underline{1984/5-1985/6} \quad & \ln 1.0177 - \ln 1.0000 \\
& - 0.6746 (\ln 1.4034 - \ln 0.8896) \\
& - 0.0650 (\ln 1.0526 - \ln 1.0000) \\
& - 0.2604 (\ln 1.9427 - \ln 1.0000) \\
& = \underline{0.0317}
\end{aligned}
$$

$$\underline{1985/6\text{-}1986/7}\quad \ln 1.1499 - \ln 1.0177 - 0.6772\,(\ln 0.8353 - \ln 1.4034) - 0.0638\,(\ln 0.7081 - \ln 1.0526) - 0.2595\,(\ln 1.4985 - \ln 1.9427) = \underline{0.0160}$$

$$\underline{1986/7\text{-}1987/8}\quad \ln 1.1896 - \ln 1.1499 - 0.6986\,(\ln 0.9772 - \ln 0.8353) - 0.0613\,(\ln 0.8802 - \ln 0.7081) - 0.2402\,(\ln 0.7237 - \ln 1.4985) = \underline{0.0445}$$

$$\underline{1987/8\text{-}1988/9}\quad \ln 0.8612 - \ln 1.1896 - 0.6991\,(\ln 1.0491 - \ln 0.9772) - 0.0584\,(\ln 1.0123 - \ln 0.8802) - 0.2426\,(\ln 0.9102 - \ln 0.7237) = \underline{-0.0041}$$

SECTION 3

Labour (L) and Capital (K) ratios

and TE measure

(a) D1 1982-83

		L	K	TE
1	Cynon	0.537	0.400	0.8416
2	Devon	0.426	0.440	0.9329
3	Greenwich	0.427	0.426	0.9468
4	Hinckley	0.529	0.311	0.9581
5	Humberside	0.333	0.597	0.9395
6	Newcastle-U-Tyne	0.465	0.455	0.8764
7	New Forest	0.463	0.516	0.8367
8	N.E.Derbyshire	0.521	0.414	0.8381
9	N.Tyneside	0.426	0.541	0.8604
10	Oldham	0.394	0.572	0.8790
11	Redbridge	0.378	0.572	0.8968
12	Rochdale	0.630	0.295	0.8937
13	St Edmundsbury	0.367	0.581	0.9013
14	Sedgefield	0.584	0.252	0.8587
15	Solihull	0.614	0.322	0.8698
16	S.Tyneside	0.412	0.443	0.9549
17	Stockport	0.581	0.355	0.8552
18	Stockton	0.681	0.208	1
19	Sunderland	0.548	0.324	0.9237
20	Thanet	0.640	0.266	0.9353
21	Wigan	0.424	0.487	0.9018
22	Avon	0.395	0.501	0.9266
23	Beds.	0.392	0.542	0.8971

24 Berks.	0.386	0.507	0.9336
25 Cambs.	0.290	0.599	1
26 Cornwall	0.428	0.358	1
27 Cumbria	0.426	0.494	0.8962
28 Dorset	0.389	0.503	0.9369
29 E.Sussex	0.535	0.279	1
30 Gloucs.	0.413	0.561	0.8627
31 Hants.	0.314	0.591	0.9643
32 Kent	0.510	0.479	0.8093
33 Leics.	0.311	0.670	0.9535
34 Norfolk	0.420	0.478	0.9146
35 Northants.	0.469	0.445	0.8786
36 Northumberland	0.533	0.333	0.9273
37 Oxfords.	0.405	0.559	0.8974
38 Shrops.	0.609	0.358	0.8288
39 Somerset	0.600	0.320	0.8849
40 Suffolk	0.416	0.569	0.8491
41 Warwicks.	0.357	0.571	0.9251
42 Wilts.	0.518	0.445	0.8192
43 Blackpool	0.467	0.368	0.9408
44 Blaenau	0.660	0.294	0.8665
45 Bradford	0.396	0.591	0.8607
46 Ceredigion	0.581	0.402	0.8081
47 Copeland	0.661	0.332	0.8212

(b) D2 1982-83

		L	K	TE
1	Greenwich	1.288	0.768	0.4044
2	Newcastle-U-Tyne	0.262	0.144	0.8099
3	N.Tyneside	0.634	0.061	1
4	N.E.Derbyshire	0.657	0.331	0.7905
5	Sedgefield	0.779	0.176	0.7615
6	S.Tyneside	0.667	0.365	0.7717
7	Sunderland	0.603	0.365	0.8530
8	Bradford	0.552	0.522	0.8701
9	Gwent	0.466	0.526	1
10	Barnsley	0.631	0.421	0.8018
11	Leeds	0.611	0.375	0.8365
12	Reading	0.634	0.337	0.8107
13	Barrow	0.571	0.423	0.8666
14	Derby	0.546	0.364	0.9222
15	Chester-le-Street	0.664	0.298	0.7961
16	Derwentside	0.586	0.359	0.8700
17	Durham	0.519	0.255	1
18	Easington	0.717	0.377	0.7198
19	Harlow	0.874	0.108	0.7154
20	Hull	0.490	0.488	0.9670
21	Burnley	0.510	0.417	0.9596
22	Mansfield	0.683	0.307	0.7736
23	Wrekin	0.634	0.247	0.8632
24	Islwyn	0.894	0.930	0.5279

25 Stoke	0.559	0.439	0.8774
26 Lincoln	0.682	0.292	0.7847

(c) D3 1982-83

		L	K	TE
1	Devon	0.330	0.466	1
2	Greenwich	0.490	0.510	0.7649
3	Newcastle-U-Tyne	0.506	0.353	0.8398
4	N.E.Derbyshire	0.743	0.090	1
5	N Tyneside	0.573	0.461	0.7091
6	S.Tyneside	0.500	0.285	0.9096
7	Sunderland	0.730	0.235	0.7241
8	Barrow	0.675	0.251	0.8150
9	Blaenau	0.430	0.461	0.8608
10	Gwent	0.430	0.280	1
11	W.Glamorgan	0.521	0.545	0.7155
12	Newham	0.588	0.376	0.7389
13	Bury	0.386	0.392	0.9764
14	Barnsley	0.606	0.356	0.6198
15	Gateshead	0.699	0.328	0.7097
16	Leeds	0.614	0.265	0.8413
17	Derby	0.466	0.412	0.8511
18	Chester-le-Street	0.657	0.289	0.8394
19	Derwentside	o.657	0.289	0.7822
20	Durham	0.564	0.227	0.9471
21	Easington	0.595	0.377	0.7282
22	Harlow	0.828	0.196	0.7692
23	Hull	0.449	0.491	0.8155
24	Lincoln	0.612	0.172	0.9981
25	Blyth V.	0.690	0.249	0.8049

26 Wrekin	0.699	0.315	0.7269
27 Stoke	0.542	0.497	0.7207
28 Islwyn	0.456	0.301	0.9434

(d) D4 1982-83

		L	K	TE
1	Copeland	0.720	0.291	0.8249
2	Cynon	0.638	0.147	1
3	Greenwich	0.570	0.359	0.9606
4	Hinckley	0.646	0.260	0.9173
5	Kirklees	0.749	0.211	0.8151
6	Newcastle-U-Tyne	0.563	0.329	0.9875
7	New Forest	0.651	0.319	0.8818
8	N.E.Derbyshire	0.769	0.191	0.8185
9	N.Tyneside	0.557	0.389	0.9548
10	Oldham	0.521	0.458	0.9795
11	Redbridge	0.780	0.155	0.8706
12	Rochdale	0.783	0.187	0.8083
13	Rushmoor	0.798	0.166	0.8319
14	St.Edmunds	0.765	0.205	0.8166
15	Sedgefield	0.764	0.193	0.82551
16	Solihull	0.925	0.062	1
17	S.Tyneside	0.572	0.340	0.9635
18	Stockport	0.756	0.186	0.8326
29	Stockton	0.862	0.097	0.9426
20	Sunderland	0.670	0.240	0.8995
21	Thanet	0.798	0.103	0.9824
22	Wigan	0.681	0.356	0.8321
23	Aylesbury	0.736	0.238	0.8278
24	Bassetlaw	0.570	0.379	0.9505
25	Bracknell	0.661	0.285	0.8847

26 Braintree	0.758	0.146	0.9017
27 Breckland	0.572	0.402	0.9270
28 Chester	0.605	0.376	0.9104
39 Colwyn	0.611	0.403	0.889619
40 Crawley	0.677	0.262	0.8818
31 E.Devon	0.757	0.212	0.8083
32 Forest of Dean	0.661	0.307	0.8760
33 Glyndwr	0.645	0.298	0.8975
34 Gravesham	0.730	0.209	0.8326
35 Kennet	0.706	0.248	0.8535
36 Kings Lynn	0.817	0.156	0.83881
37 Lliw V.	0.512	0.421	1
38 Mid Sussex	0.648	0.294	0.9012
39 Neath	0.651	0.343	0.8669
40 N.Devon	0.596	0.403	0.9064
41 N.Wilts.	0.693	0.278	0.8495
42 Rhondda	0.543	0.438	0.9477
43 S.Oxfords.	0.687	0.248	0.8788
44 S.Staffs.	0.634	0.265	0.9301
45 Teignbridge	0.656	0.338	0.8769
46 Torridge	0.663	0.333	0.8653
47 W.Derbs.	0.813	0.189	0.7822
48 W.Lindsey	0.591	0.464	0.8729
49 Wychavon	0.687	0.282	0.8582
50 Barrow	0.565	0.327	0.9875
51 Blackpool	0.687	0.249	0.8780
52 Blaenau	0.680	0.282	0.8653

53 Bradford	0.540	0.439	0.9444
54 Cambridge	0.546	0.429	0.9507
55 Ceredigion	0.676	0.318	0.8527

(e) D1 1987-88

		L	K	TE
1	Cynon	0.665	0.406	0.7554
2	Devon	0.414	0.532	0.8902
3	Greenwich	0.410	0.553	0.8824
4	Hinckley	0.367	0.520	0.9881
5	Humberside	0.495	0.492	0.7753
6	Newcastle-U-Tyne	0.467	0.499	0.7925
7	New Forest	0.396	0.520	0.9375
8	N.E.Derbyshire	0.537	0.400	0.8307
9	N.Tyneside	0.430	0.473	0.8618
10	Oldham	0.626	0.362	0.8353
11	Redbridge	0.513	0.391	0.8656
12	Rochdale	0.599	0.322	0.9099
13	St Edmunds.	0.433	0.355	0.9857
14	Sedgefield	0.449	0.332	1
15	Solihull	0.652	0.255	1
16	S.Tyneside	0.370	0.391	1
17	Stockport	0.540	0.359	0.8861
18	Stockton	0.661	0.283	0.9445
19	Sunderland	0.531	0.319	0.9643
20	Thanet	0.587	0.368	0.8487
21	Wigan	0.476	0.469	0.8111
22	Avon	0.506	0.462	0.8079
23	Beds.	0.418	0.463	0.8875
24	Berks.	0.457	0.432	0.8656
25	Cambs.	0.542	0.418	0.8111

26 Cornwall	0.552	0.375	0.8525
27 Cumbria	0.443	0.532	0.8334
28 Dorset	0.402	0.499	0.9164
29 E.Sussex	0.485	0.446	0.8240
30 Gloucs.	0.357	0.604	1
31 Hants.	0.416	0.559	0.8764
32 Kent	0.433	0.500	0.8555
33 Leics.	0.372	0.615	0.9584
34 Norfolk	0.410	0.555	0.8818
35 Northants.	0.493	0.461	0.8079
36 Northumberland	0.546	0.427	0.8016
37 Oxfords.	0.529	0.425	0.7985
38 Shrops.	0.411	0.583	0.8866
39 Somerset	0.601	0.340	0.8836
40 Suffolk	0.507	0.464	0.7948
41 Warwicks.	0.565	0.374	0.8468
42 Wilts.	0.483	0.403	0.7962
43 Blackpool	0.529	0.403	0.8374
44 Blaenau	0.421	0.453	0.8824
45 Bradford	0.418	0.552	0.8718
46 Ceredigion	0.522	0.346	0.9211
47 Copeland	0.496	0.474	0.7924

(f) D2 1987-88

		L	K	TE
1	Greenwich	0.500	0.476	0.9265
2	Newcastle-U-Tyne	0.829	0.360	0.7115
3	N.Tyneside	0.667	0.308	0.8371
4	N.E.Derbyshire	0.828	0.072	1
5	Sedgefield	0.965	0.259	0.6974
6	S.Tyneside	0.660	0.323	0.8711
7	Sunderland	0.555	0.368	0.9493
8	Bradford	0.420	0.500	1
9	Gwent	0.664	0.335	0.8550
10	Barnsley	0.609	0.373	0.8843
11	Leeds	0.632	0.253	0.9511
12	Reading	0.737	0.259	0.8480
13	Barrow	0.492	0.491	0.9246
14	Derby	0.519	0.422	0.9457
15	Chester-le-Street	0.721	0.253	0.8689
16	Derwentside	0.657	0.337	0.8659
17	Durham	0.604	0.235	1
18	Easington	0.619	0.377	0.8714
19	Harlow	0.817	0.091	0.9785
20	Hull	0.470	0.472	0.9625
21	Burnley	0.661	0.388	0.8269
22	Mansfield	0.619	0.348	0.8919
23	Wrekin	0.670	0.315	0.8667
24	Islwyn	0.651	0.279	0.9076

25 Stoke	0.504	0.500	0.9003
26 Lincoln	0.787	0.197	0.8689

(g) D3 1987-88

		L	K	TE
1	Devon	0.450	0.466	0.8844
2	Greenwich	0.490	0.510	0.8199
3	Newcastle-U-Tyne	0.481	0.353	0.9594
4	N.E.Derbyshire	0.887	0.090	1
5	N Tyneside	0.413	0.461	0.9721
6	S.Tyneside	0.602	0.285	0.9099
7	Sunderland	0.697	0.235	0.8810
8	Barrow	0.406	0.251	1
9	Blaenau	0.502	0.461	0.8294
10	Gwent	0.560	0.280	0.9614
11	W.Glamorgan	0.428	0.545	0.9245
12	Newham	0.570	0.376	0.8431
13	Bury	0.564	0.392	0.8388
14	Barnsley	0.580	0.356	0.8577
15	Gateshead	0.666	0.328	0.8109
16	Leeds	0.680	0.265	0.8594
17	Derby	0.446	0.412	0.9254
18	Chester-le-Street	0.718	0.252	0.8500
19	Derwentside	0.562	0.289	0.9492
20	Durham	0.585	0.227	1
21	Easington	0.615	0.377	0.8092
22	Harlow	0.785	0.196	0.8712
23	Hull	0.492	0.491	0.7987
24	Lincoln	0.688	0.172	1
25	Blyth V.	0.708	0.249	0.8604

26 Wrekin	0.669	0.315	0.8222
27 Stoke	0.501	0.497	0.7886
28 Islwyn	0.703	0.301	0.8059

(h) D4 1987-88

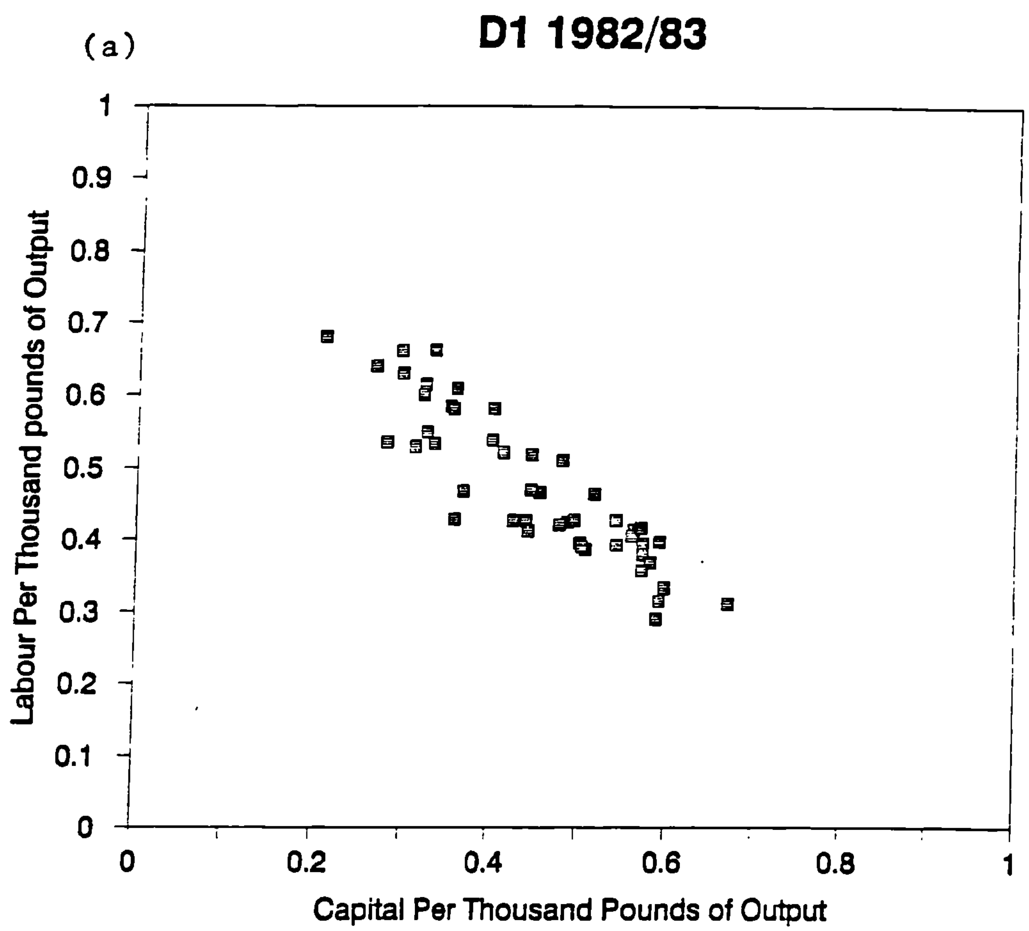
		L	K	TE
1	Copeland	0.653	0.284	0.8625
2	Cynon	0.904	0.192	0.6397
3	Greenwich	0.527	0.455	1
4	Hinckley	0.680	0.216	0.8304
5	Kirklees	0.710	0.256	0.7933
6	Newcastle-U-Tyne	0.579	0.337	0.9595
7	New Forest	0.544	0.397	1
8	N.E.Derbyshire	0.662	0.232	0.8482
9	N.Tyneside	0.569	0.399	0.9706
10	Oldham	0.845	0.141	0.6911
11	Redbridge	0.660	0.170	0.8725
12	Rochdale	0.792	0.190	0.7242
13	Rushmoor	0.783	0.193	0.7375
14	St.Edmunds.	0.704	0.186	0.8120
15	Sedgefield	0.750	0.252	0.7560
16	Solihull	0.664	0.268	0.8432
17	S.Tyneside	0.571	0.325	0.9791
18	Stockport	0.714	0.220	0.8009
19	Stockton	0.924	0.181	0.6277
20	Sunderland	0.798	0.087	1
21	Thanet	0.629	0.360	0.8868
22	Wigan	0.576	0.307	0.9658
23	Aylesbury	0.720	0.200	0.7930
24	Bassetlaw	0.661	0.110	0.8808
25	Bracknell	0.668	0.145	0.8700

26 Braintree	0.624	0.129	0.9301
27 Breckland	0.626	0.199	0.9033
28 Chester	0.564	0.309	0.9870
29 Colwyn	0.655	0.188	0.8750
30 Crawley	0.792	0.219	0.7240
31 E.Devon	0.617	0.143	0.9408
32 Forest of Dean	0.863	0.243	0.6606
33 Glyndwr	0.587	0.229	0.9612
34 Gravesham	0.728	0.167	0.7919
35 Kennet	0.585	0.091	1
36 Kings Lynn	0.722	0.150	0.7581
37 Lliw V.	0.558	0.214	1
38 Mid Sussex	0.672	0.211	0.8500
39 Neath	0.685	0.202	0.8318
40 N.Devon	0.687	0.153	0.8365
41 N.Wilts.	0.603	0.164	0.9524
42 Rhondda	0.665	0.179	0.8606
43 S.Oxfords	0.602	0.132	0.9667
44 S.Staffs.	0.631	0.180	0.9050
45 Teignbridge	0.716	0.175	0.8000
46 Torridge	0.629	0.171	0.9086
47 W.Derbs.	0.707	0.185	0.8091
48 W.Lindsey	0.610	0.263	0.9193
49 Wychavon	0.749	0.186	0.7662
50 Barrow	0.565	0.227	0.9954
51 Blackpool	0.711	0.226	0.7974
52 Blaenau	0.615	0.276	0.9127

53 Bradford	0.585	0.405	0.9424
54 Cambridge	0.684	0.270	0.8182
55 Ceredigion	0.614	0.215	0.9135

Figs. DA3 (a - h) Labour and capital combinations

(a)



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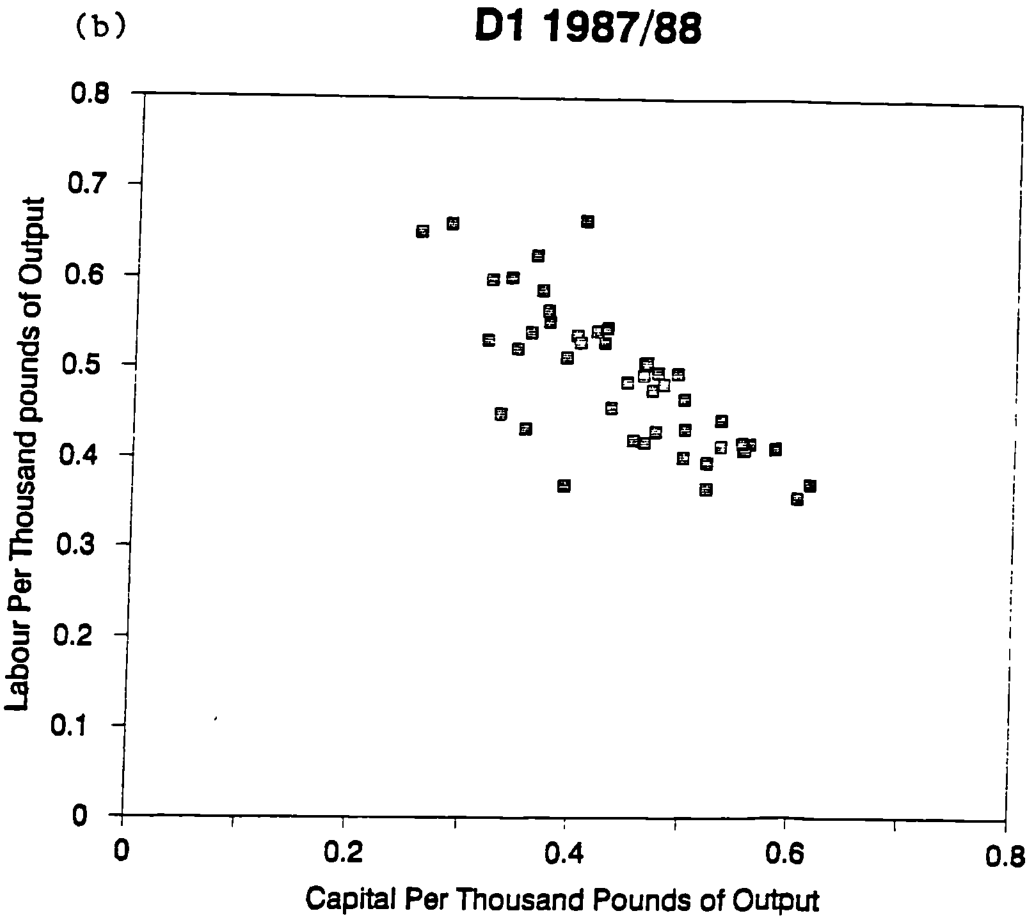
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0.7
0.6
0.5
0.4
0.3
0.2
0.1
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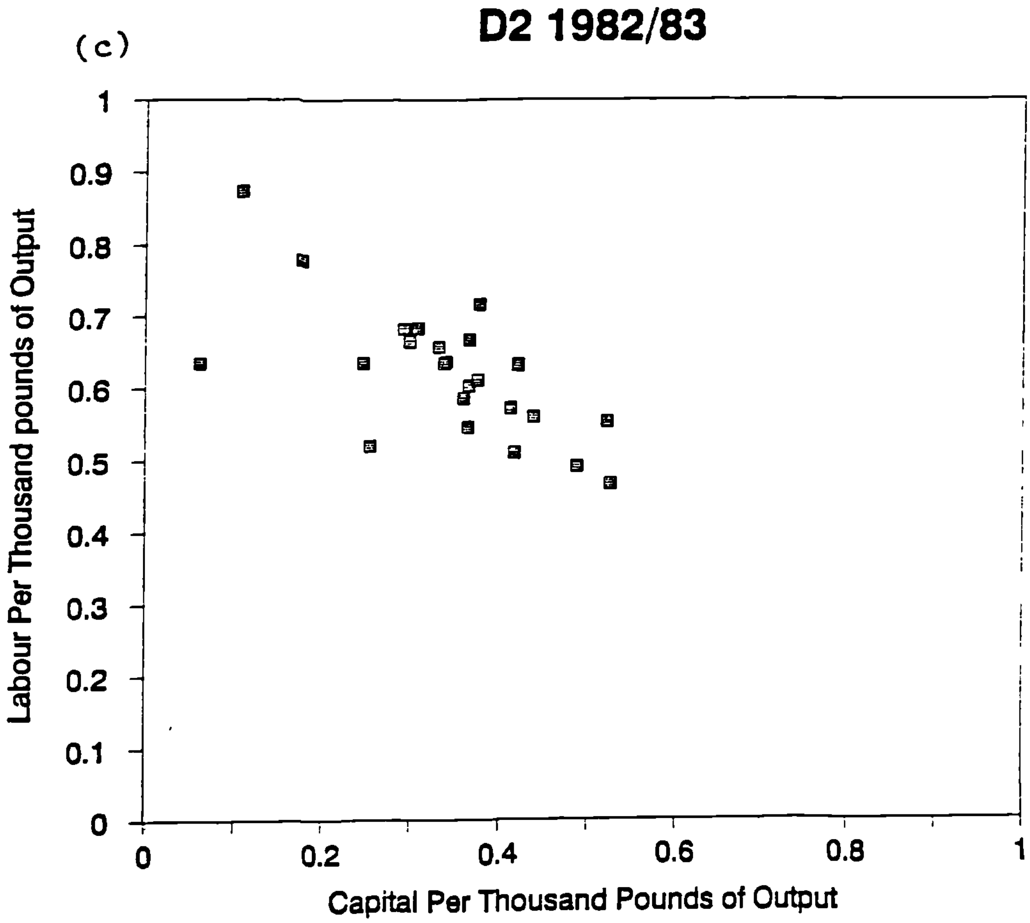
Labour Per Thousand pounds of Output
0
0.2
0.4
0.6
0.8
Capital Per Thousand Pounds of Output

(c)


D2 1982/83
Labour Per Thousand pounds of Output
Capital Per Thousand Pounds of Output
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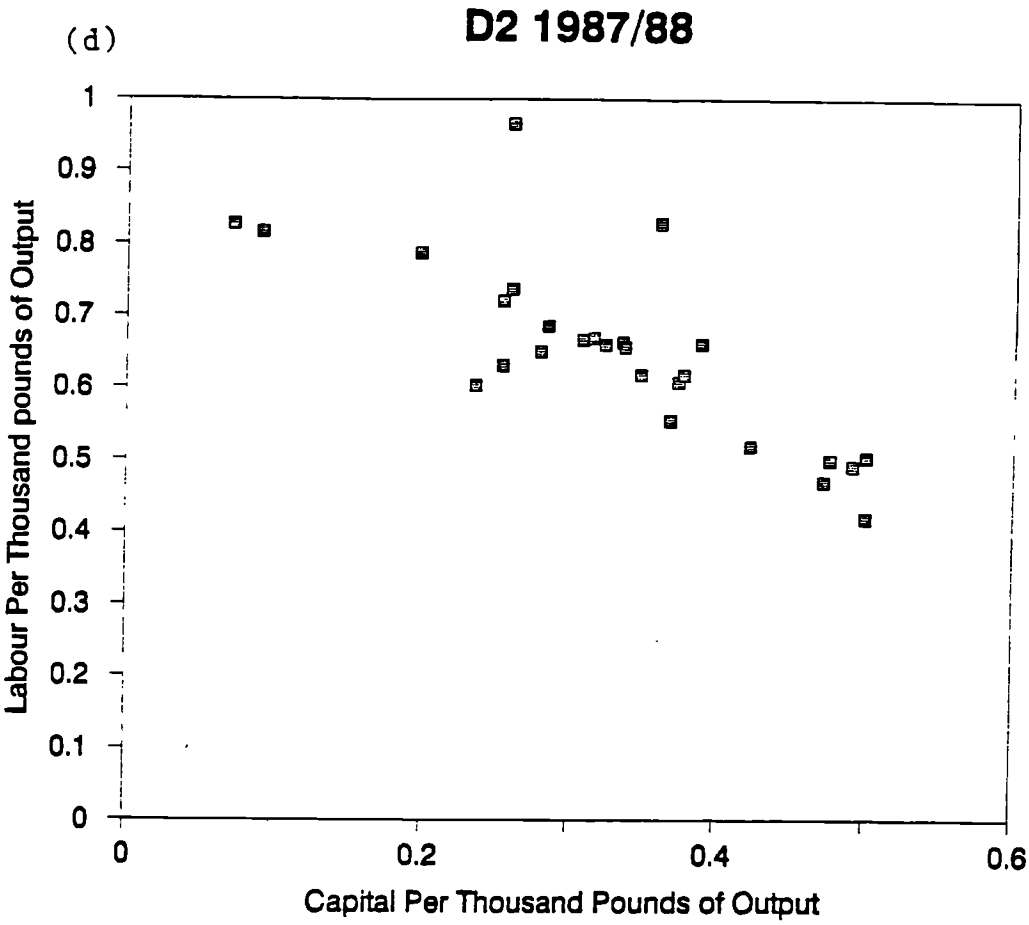
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0
0.2
0.4
0.6
0.8
1

(d)


D2 1987/88
Labour Per Thousand pounds of Output
Capital Per Thousand Pounds of Output
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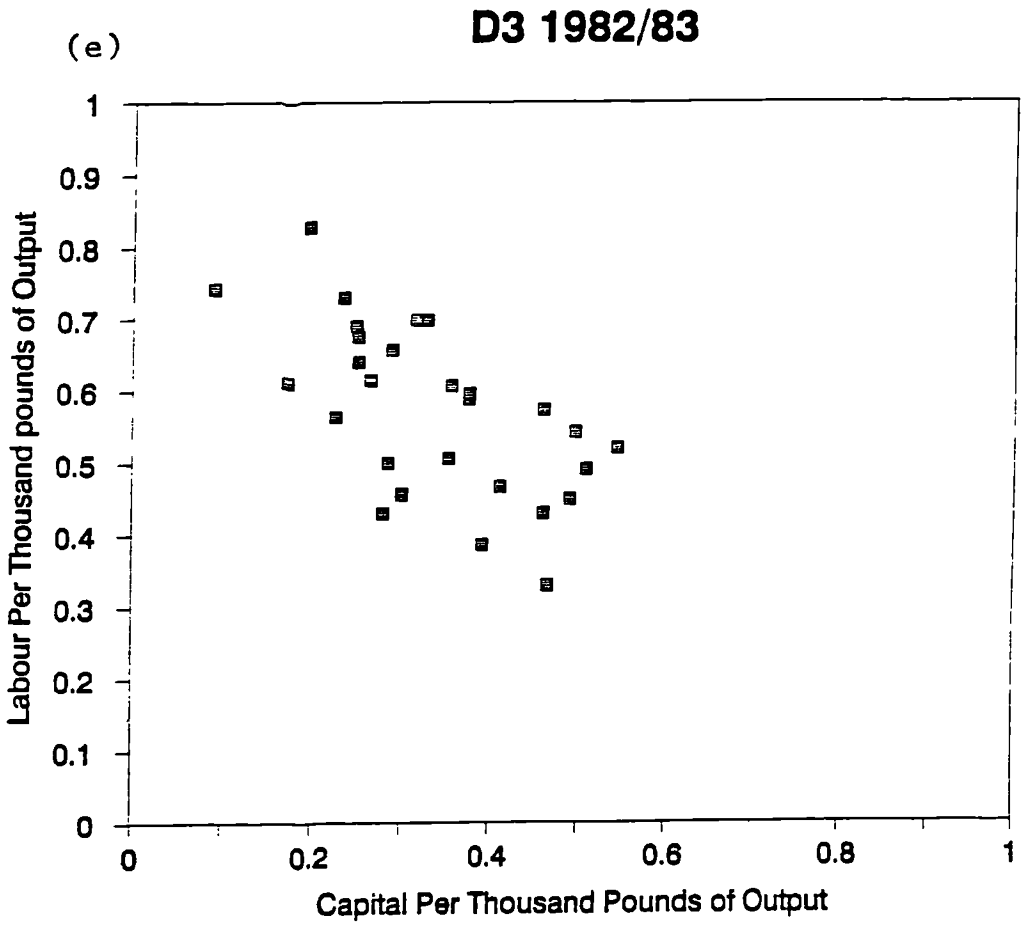
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.2
0.4
0.6

(e)


D3 1982/83
Labour Per Thousand pounds of Output
Capital Per Thousand Pounds of Output
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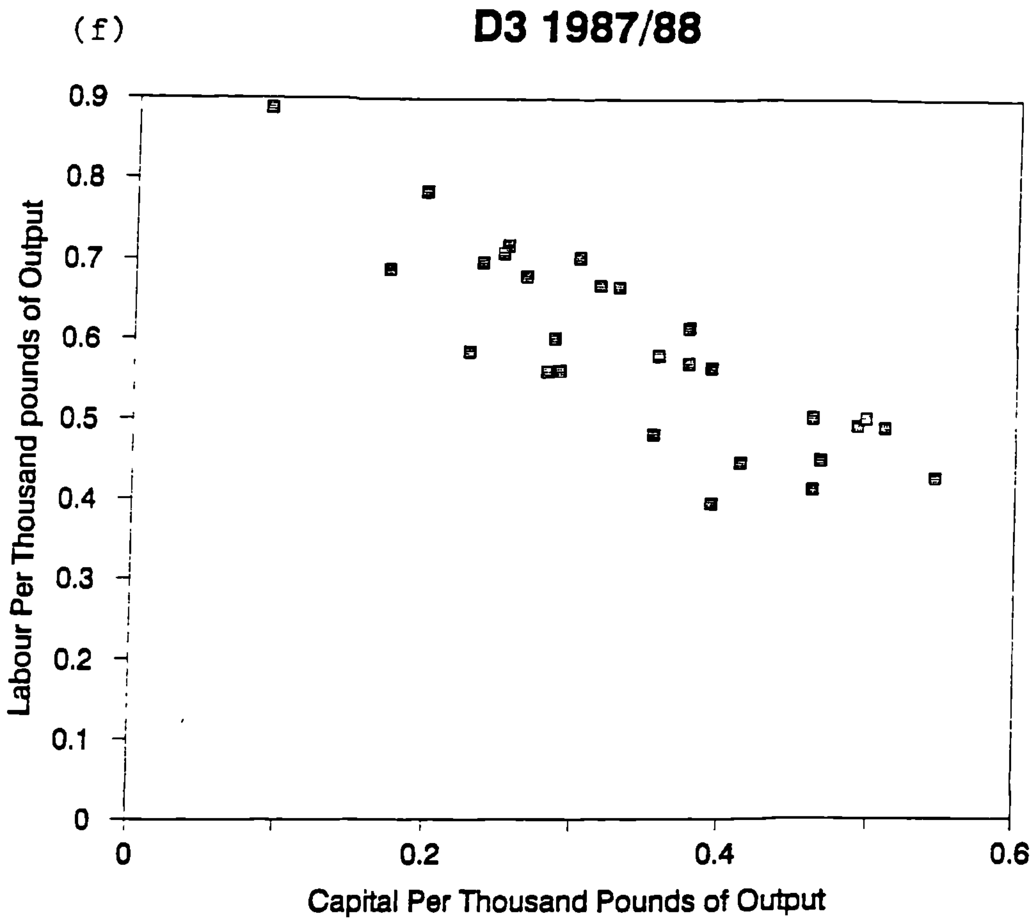
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0
0.2
0.4
0.6
0.8
1

(f)


D3 1987/88
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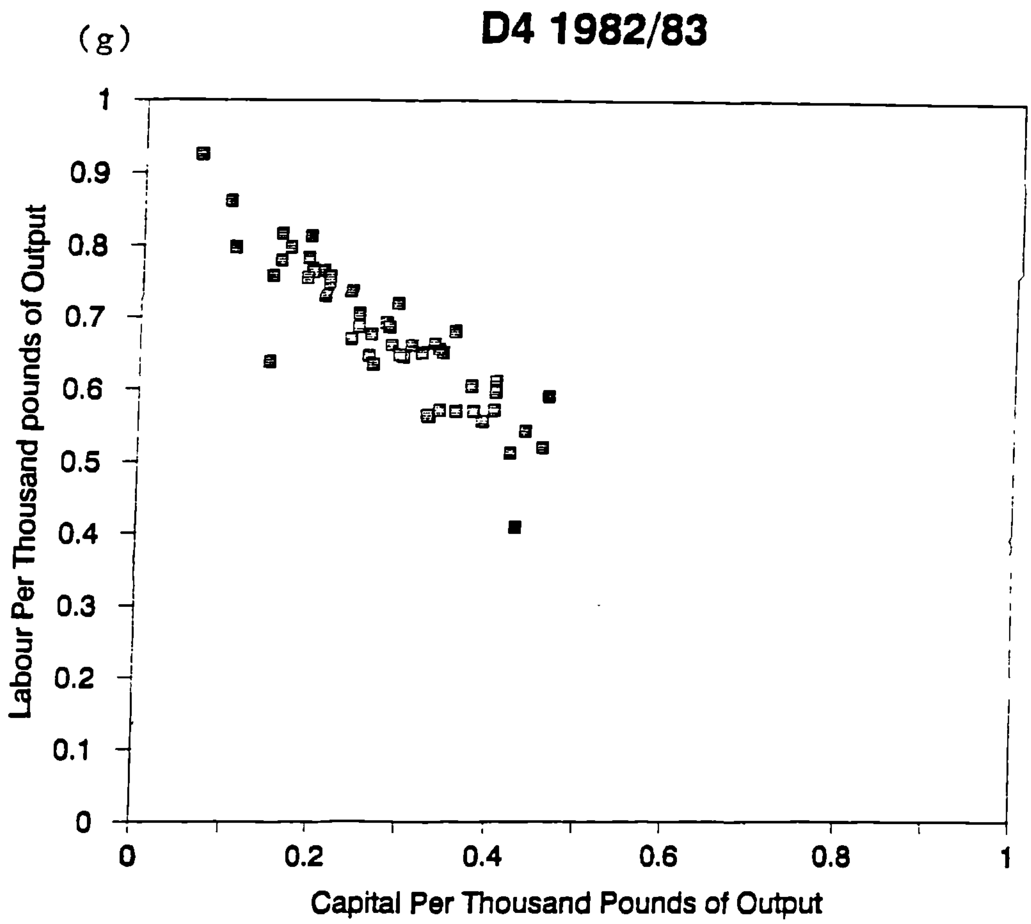
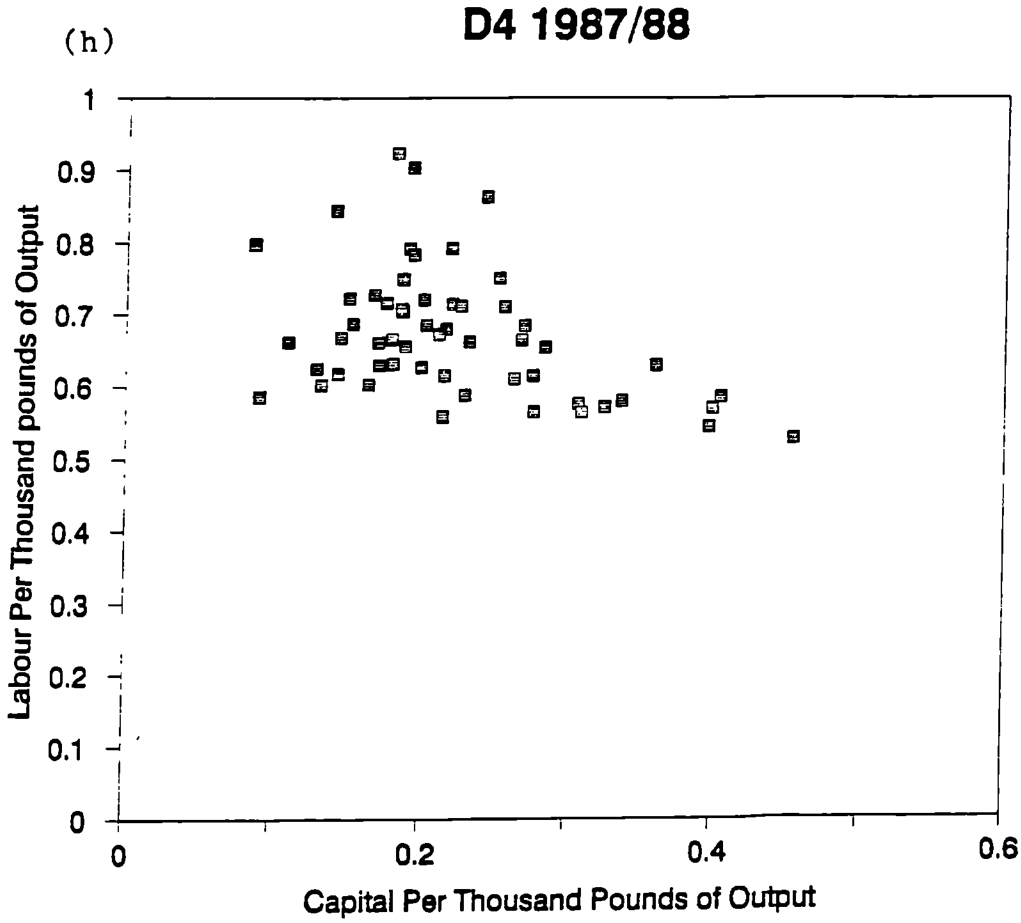
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.2
0.4
0.6
Labour Per Thousand pounds of Output
Capital Per Thousand Pounds of Output

(g)

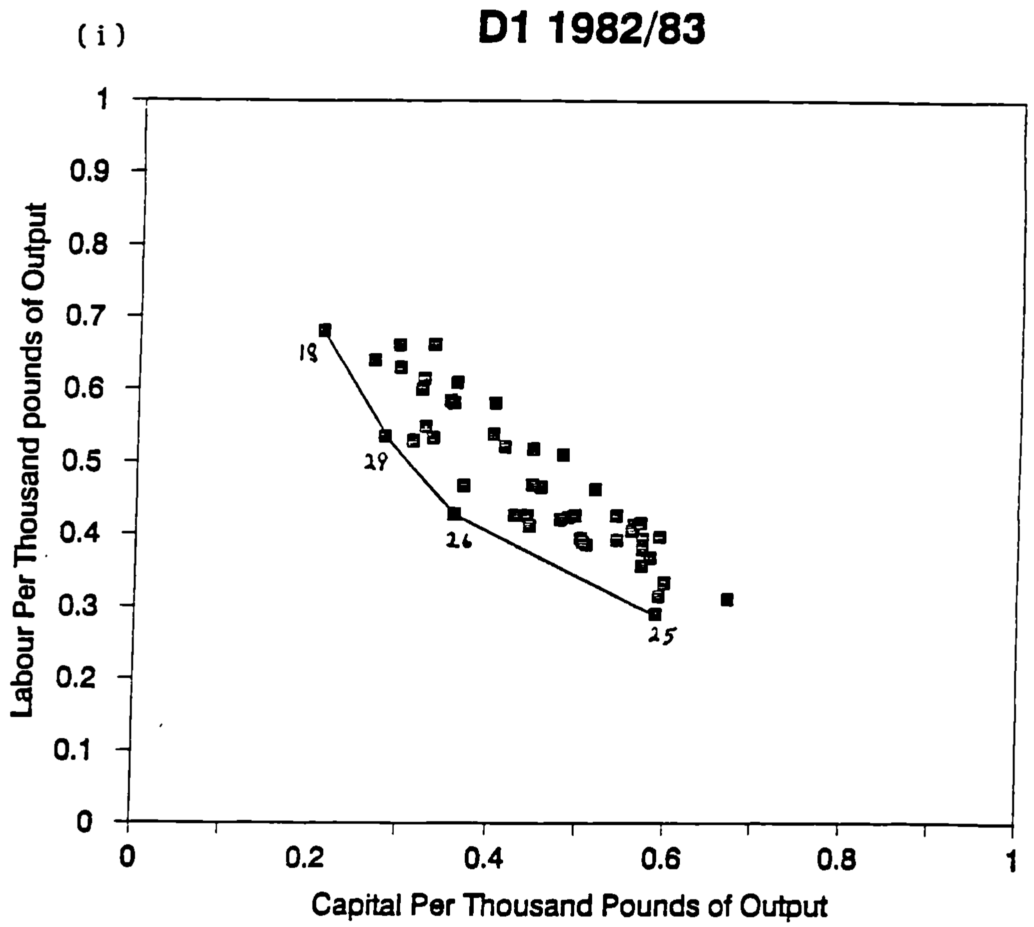

D4 1982/83
Labour Per Thousand pounds of Output
Capital Per Thousand Pounds of Output
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.2
0.4
0.6
0.8
1

(h)

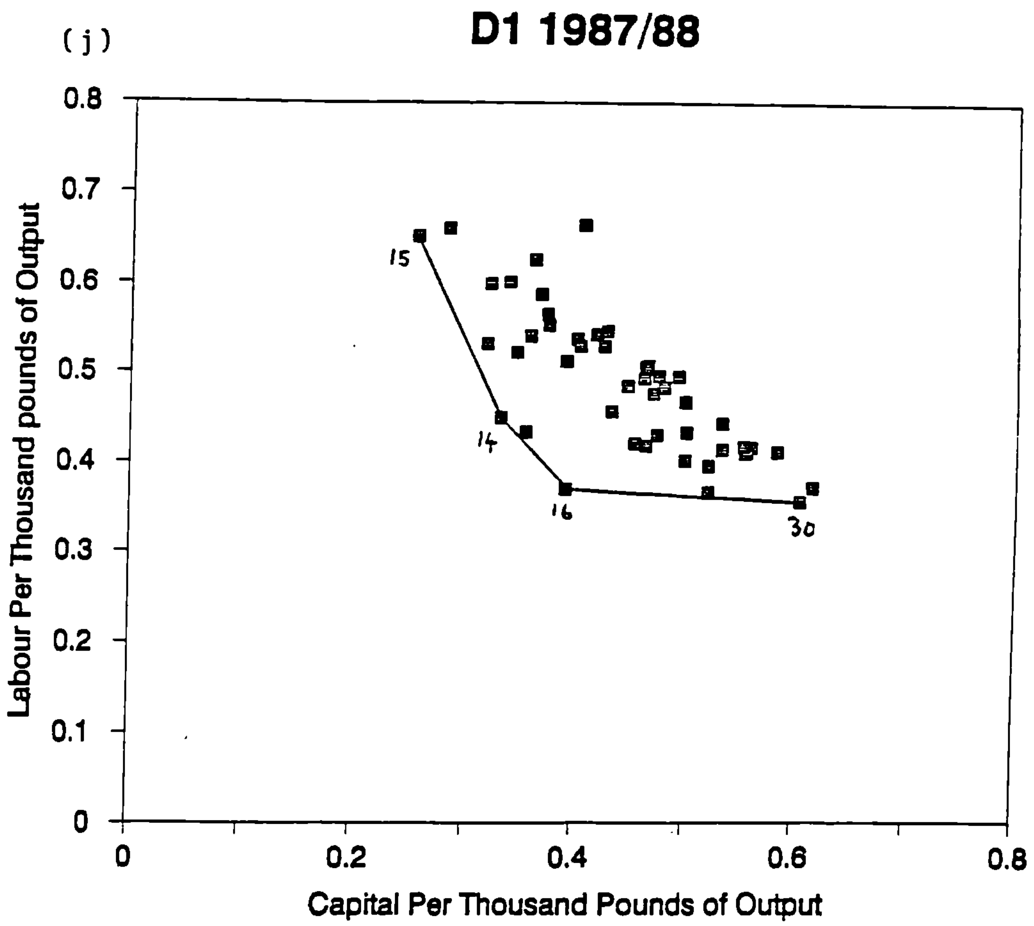

D4 1987/88
Labour Per Thousand pounds of Output
Capital Per Thousand Pounds of Output
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0
0.2
0.4
0.6

Figs. DA3 (i - p) Unit isoquants

(i)



(j)


D1 1987/88
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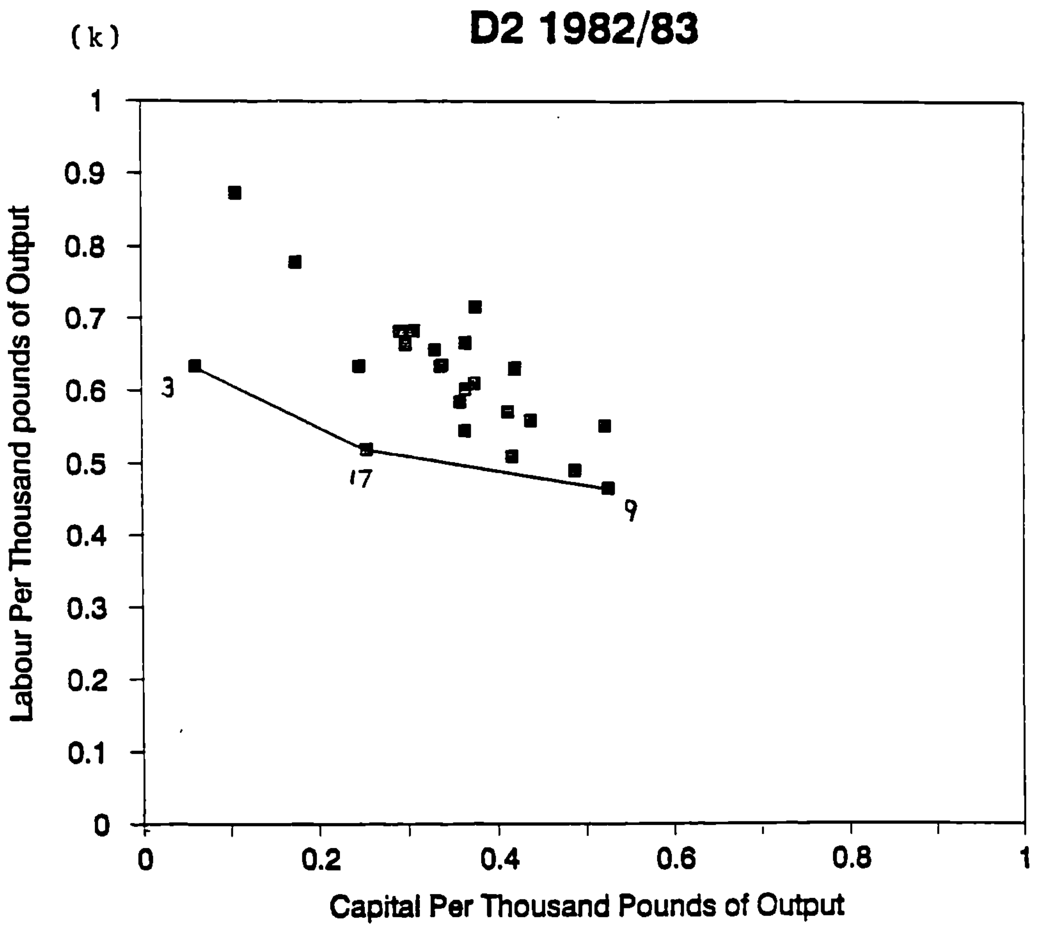
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.2
0.4
0.6
0.8
Labour Per Thousand pounds of Output
Capital Per Thousand Pounds of Output
15
14
16
30

(k)


D2 1982/83
Labour Per Thousand pounds of Output
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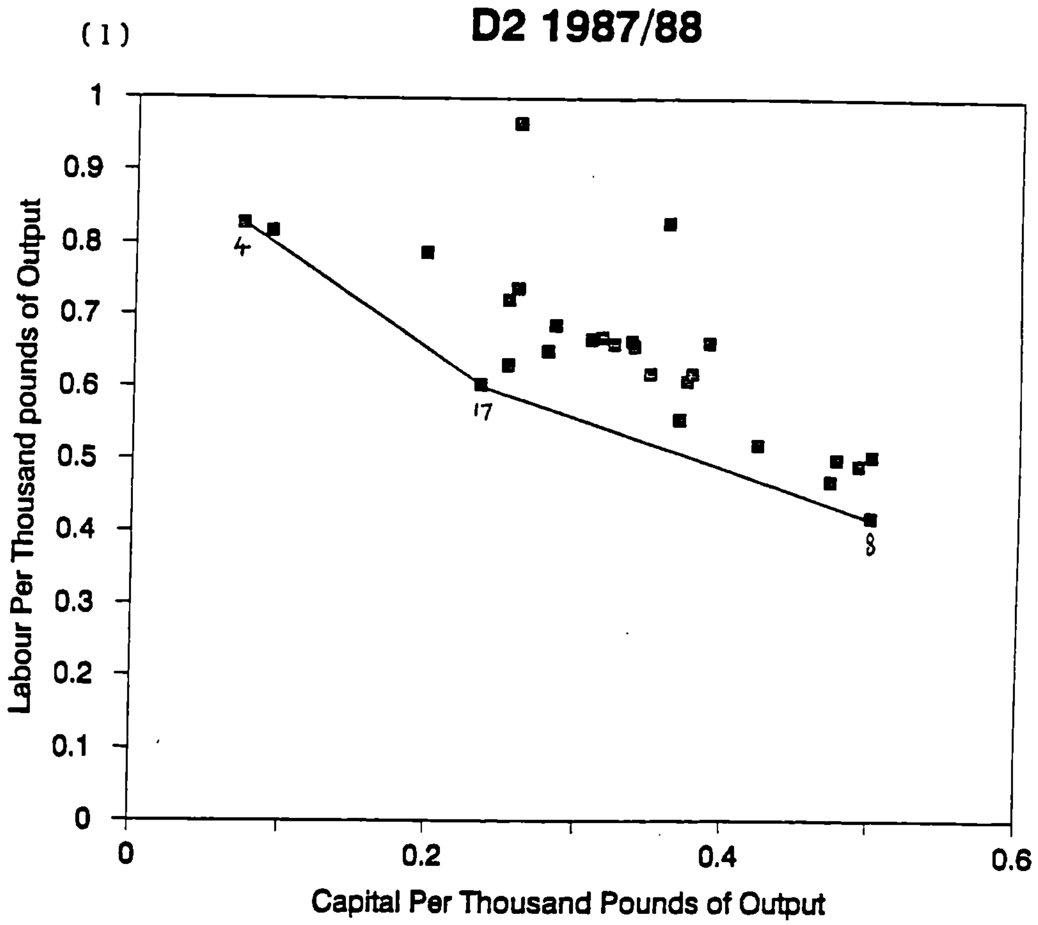
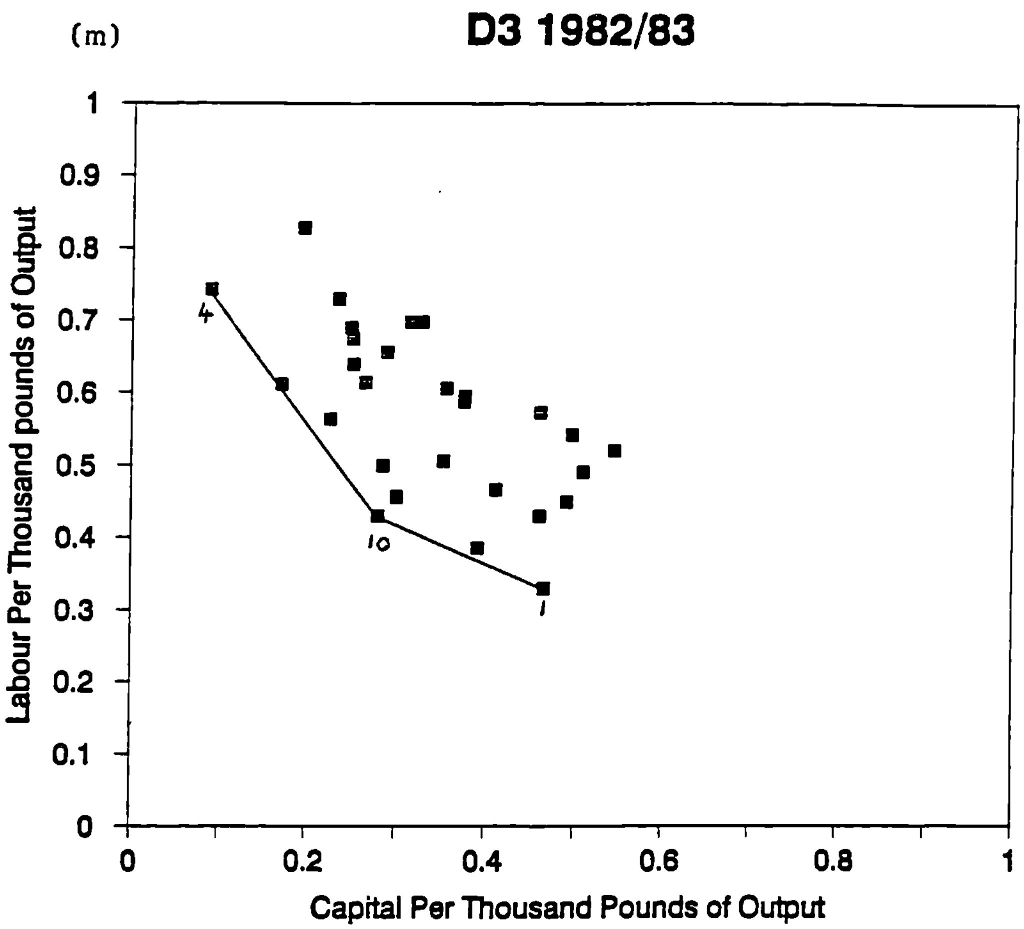
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
3
17
9
0
0.2
0.4
0.6
0.8
1
Capital Per Thousand Pounds of Output

(1)


D2 1987/88
Labour Per Thousand pounds of Output
Capital Per Thousand Pounds of Output
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0
0.2
0.4
0.6
4
17
8

(m)


D3 1982/83
Labour Per Thousand pounds of Output
Capital Per Thousand Pounds of Output
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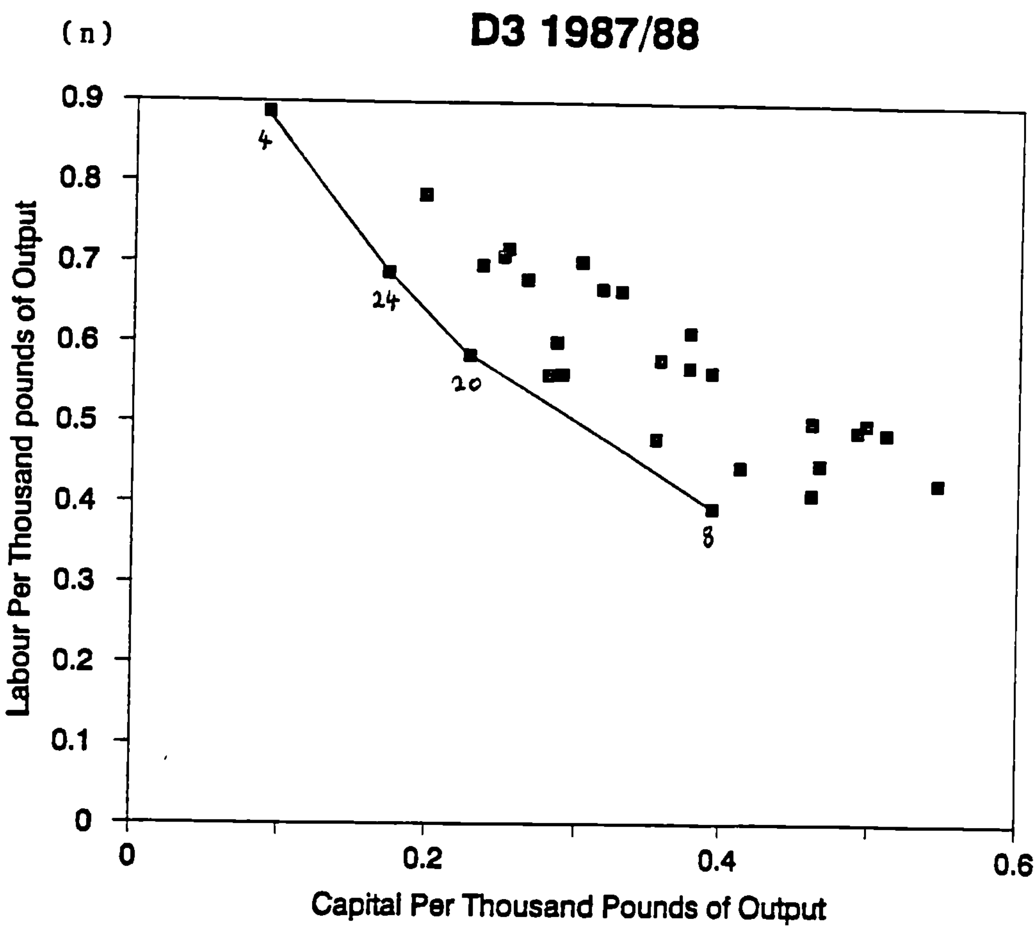
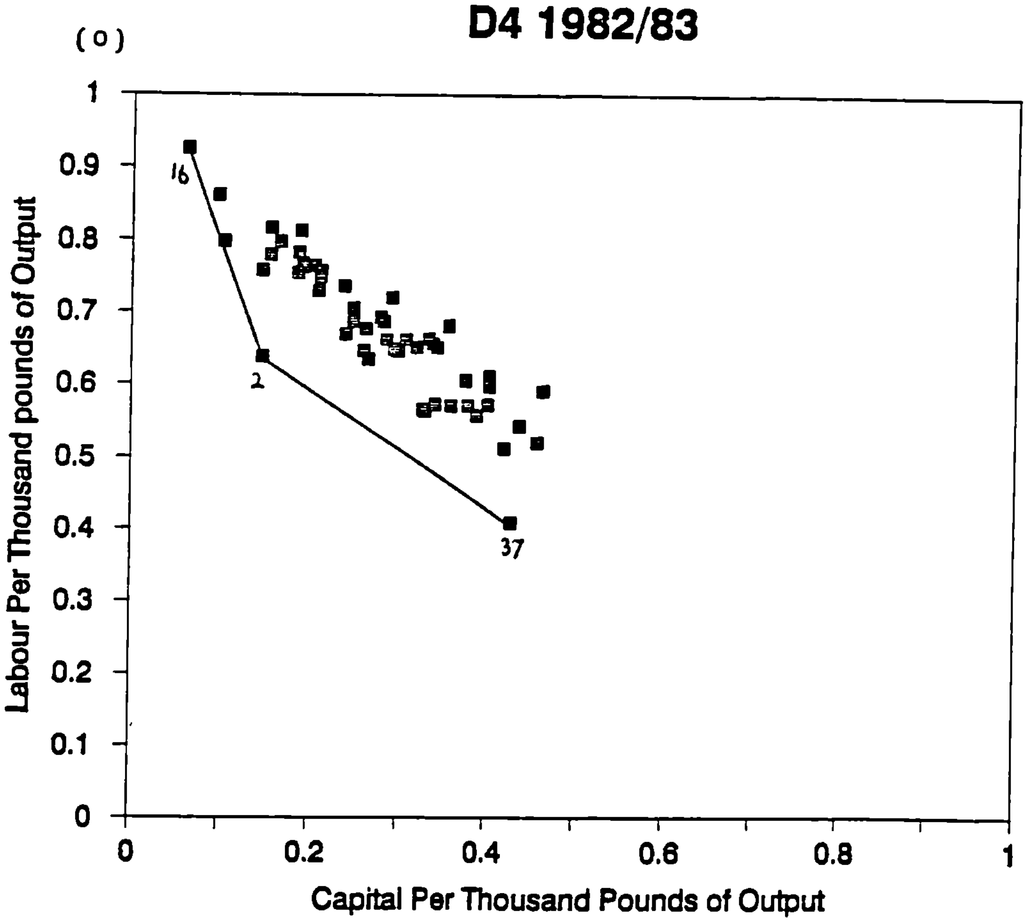
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.2
0.4
0.6
0.8
1
4
10
1

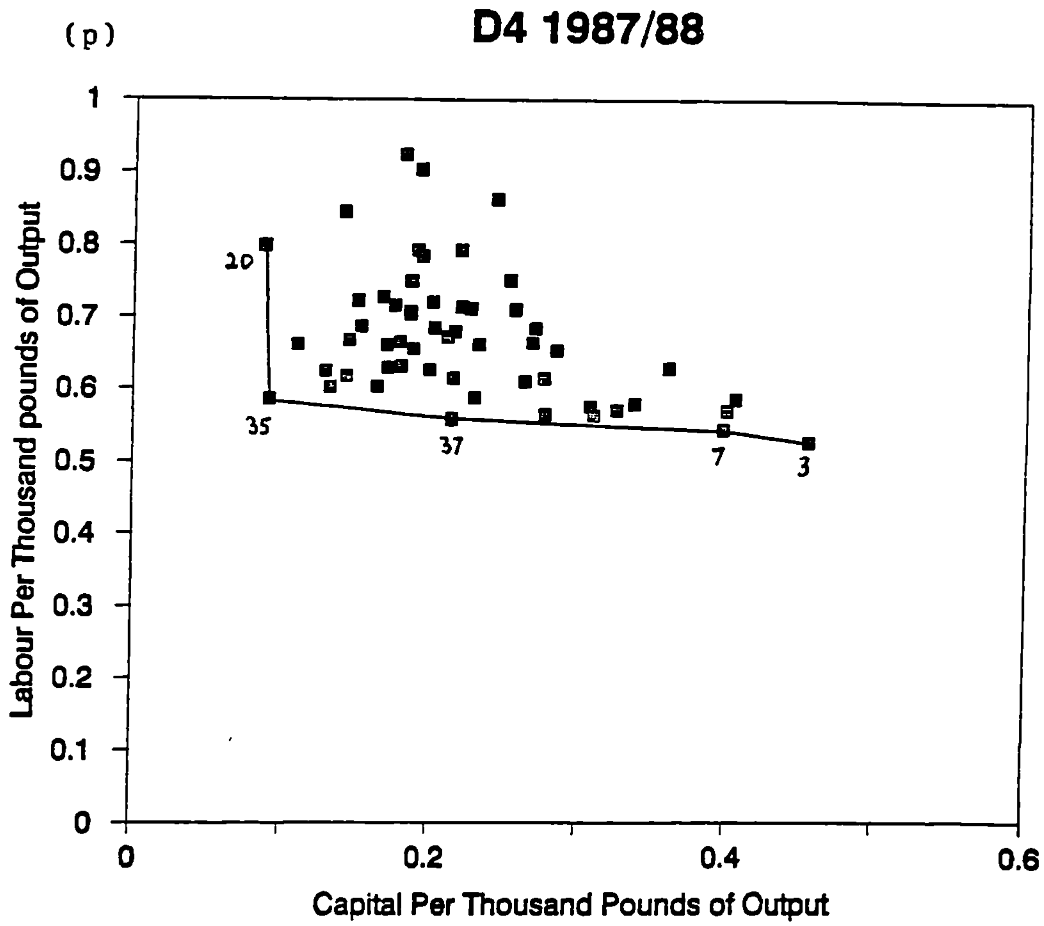
(n)


D3 1987/88
Labour Per Thousand pounds of Output
Capital Per Thousand Pounds of Output
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.2
0.4
0.6
4
24
20
8



(o)
D4 1982/83
Labour Per Thousand pounds of Output
Capital Per Thousand Pounds of Output
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0
0.2
0.4
0.6
0.8
1
16
2
37

(p)


D4 1987/88
Labour Per Thousand pounds of Output
Capital Per Thousand Pounds of Output
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.2
0.4
0.6
20
35
37
7
3

SECTION 4

Performance measures for individual DLOs

(a) D1 1982-83

		%Surplus Output	%Return Capital	VAper Worker	TE
1	Cynon	5.1	50.2	6340	0.8416
2	Devon	8.4	15.8	6441	0.9329
3	Greenwich	-17	-48.6	6700	0.9468
4	Hinckley	13.4	30	6958	0.9582
5	Humberside	5	27.4	740	0.9395
6	Newcastle-U-Tyne	5.3	37.9	4918	0.8764
7	New Forest	1.7	15.1	4529	0.8367
8	N.E.Derbys.	3.6	33.3	9350	0.8381
9	N.Tyneside	2	20.1	6197	0.8604
10	Oldham	2.2	17	4056	0.8790
11	Redbridge	3.8	13	5337	0.8968
12	Rochdale	5.5	6.3	7582	0.8937
13	St.Edmunds.	5.1	14.9	5650	0.9013
14	Sedgefield	4.3	8.2	7210	0.8587
15	Solihull	3.4	21.1	6490	0.8698
16	S.Tyneside	11	170	4950	0.9549
17	Stockport	3.5	16.8	7979	0.8552
18	Stockton	6.8	38	8910	0.8552
19	Sunderland	10.7	42.3	10088	0.9237
20	Thanet	5.1	8.4	10000	0.9353
21	Wigan	7	37.4	5096	0.9018
22	Avon	7	43	5102	0.9266

23 Beds.	4	27.7	7026	0.8971
24 Berks.	8.9	27.9	6646	0.9336
25 Cambs.	6.6	17	5253	1
26 Cornwall	12.7	46.9	9024	1
27 Cumbria	5.2	15.5	6401	0.8962
28 Dorset	6.7	16.3	5558	0.9369
29 E.Sussex	13.9	47.5	11432	1
30 Gloucs.	3.6	19.3	5306	0.8627
31 Hants.	6.5	5.7	5796	0.9643
32 Kent	0.7	3.6	6742	0.8093
33 Leics.	1.2	6.3	3978	0.9535
34 Norfolk	6.3	23.2	5596	0.9146
35 Northants.	5.1	7.7	7381	0.8786
36 Northumberland	8.2	25.1	9955	0.9273
37 Oxfords.	2.9	9.5	5456	0.8974
38 Shrops.	1.8	8	9439	0.8288
39 Somerset	3.9	17.8	7534	0.8849
40 Suffolk	0.9	15.1	5263	0.8491
41 Warwicks.	3.6	5.7	5306	0.9251
42 Wilts.	2.7	20.3	8757	0.8192
43 Blackpool	11.4	44.6	8438	0.9408
44 Blaenau	3.4	20.4	7347	0.8665
45 Bradford	0.8	5.3	4335	0.8607
46 Ceredigion	1.4	36	4857	0.8081
47 Copeland	0.3	7.5	7100	0.8212

(b) D1 1987-88

		%Surplus Output	%Return Capital	VAper Worker	TE
1	Cynon	-4.9	-1	10667	0.7554
2	Devon	4.0	8.6	7711	0.8902
3	Greenwich	2.3	7.9	2236	0.8824
4	Hinckley	8.0	48	9500	0.8810
5	Humberside	0.5	8.5	12206	0.7753
6	Newcastle-U-Tyne	3.4	23.2	5732	0.7925
7	New Forest	6.6	17	3140	0.9375
8	N.E.Derbys.	4.0	47.5	11864	0.8307
9	N.Tyneside	6.7	54.5	6431	0.8618
10	Oldham	2.4	10	8966	0.8353
11	Redbridge	7.3	25.6	11618	0.8656
12	Rochdale	5.8	18.0	11232	0.9099
13	St.Edmunds.	14.8	28.1	8353	0.9857
14	Sedgefield	13.3	42.7	11083	1
15	Solihull	4.6	40.0	11930	1
16	S.Tyneside	14.6	273	9890	1
17	Stockport	6.3	29.4	10809	0.8861
18	Stockton	3.3	11	12103	0.9445
19	Sunderland	13.0	52.2	15580	0.9643
20	Thanet	2.9	6.5	8226	0.8487
21	Wigan	2.6	22.9	7900	0.8111
22	Avon	0.7	5.2	10484	0.8079
23	Beds.	7.9	49.9	12763	0.8875
24	Berks.	8.0	24.8	12063	0.8656

25 Cambs.	2.1	9.5	9871	0.8111
26 Cornwall	3.9	8.4	10101	0.8525
27 Cumbria	1.6	7	7531	0.8334
28 Dorset	6.3	20.4	9858	0.9164
29 E.Sussex	4.0	28.7	10788	0.8240
30 Gloucs.	5.1	17	7852	1
31 Hants.	1.4	8.7	8053	0.8764
32 Kent	4.3	14.9	14600	0.8555
33 Leics.	0.8	6,2	2490	0.9584
34 Norfolk	2.2	7.4	6489	0.8818
35 Northants.	2.5	6.5	9191	0.8079
36 Northumberland	1.3	8.2	8076	0.8016
37 Oxfords.	3.2	5.2	10234	0.7985
38 Shrops.	0.3	5	6903	0.8866
39 Somerset	3.1	10.7	8548	0.8836
40 Suffolk	1.8	15.5	9283	0.7948
41 Warwicks.	3.6	18.3	13297	0.8468
42 Wilts.	2.5	26.8	14373	0.7962
43 Blackpool	4.4	6.6	9028	0.8374
44 Blaenau	8.7	62.6	6783	0.8824
45 Bradford	2.0	9.6	7271	0.8718
46 Ceredigion	10.6	49.2	8833	0.9211
47 Copeland	1.9	8	10750	0.7924

(c) D2 1982-83

		%Surplus Output	%Return Capital	VAper Worker	TE
1	Greenwich	-24.4	-1454.7	2823	0.4044
2	Newcastle-U-T	33	86.4	7000	0.8099
3	N.Tyneside	0.8	7.4	5536	1
4	N.E.Derbyshire	18.1	358.8	10467	0.7905
5	Sedgefield	1.1	48	6292	0.7615
6	S.Tyneside	-1.2	-68.5	4783	0.7717
7	Sunderland	2.7	42.3	7698	0.8530
8	Bradford	3.2	15	2653	0.8702
9	Gwent	1.7	736.7	7243	1
10	Barnsley	-5.2	-100	1281	0.8019
11	Leeds	1.4	13.6	5990	0.8366
12	Reading	0.6	5.9	6420	0.8107
13	Barrow	1.2	8.1	3684	0.8667
14	Derby	9	8.2	5623	0.9223
15	Chester-le-St.	3.8	22.9	9955	0.7962
16	Derwent	5.4	34.2	6005	0.8700
17	Durham	21	177.4	9121	0.8700
18	Easington	6.4	57	4848	0.7199
19	Harlow	1.8	13.1	9020	0.7155
20	Hull	2	18.8	7010	0.9670
21	Burnley	7.3	72.5	8995	0.9596
22	Mansfield	0.8	7.6	4772	0.7736
23	Stoke	0.5	9.8	5005	0.8774
24	Lincoln	2.5	145.8	7424	0.7847

(d) D2 1987-88

		%Surplus Output	%Return Capital	VAper Worker	TE
1	Greenwich	0.2	14.3	7720	0.9265
2	Newcastle-U-T.	-0.1	0	4686	0.7115
3	N.Tyneside	1	22.2	5481	0.8371
4	N.E.Derbyshire	5.7	44	10380	1
5	Sedgefield	1.3	4	4312	0.6974
6	S.Tyneside	0.5	27.1	10526	0.8711
7	Sunderland	7.5	170.9	10240	0.9493
8	Bradford	0	0	3840	1
9	Gwent	0.1	0	5824	0.8550
10	Barnsley	1.8	0	7110	0.8844
11	Leeds	0	123.5	5522	0.9512
12	Reading	0.4	6.1	7255	0.8480
13	Barrow	1.6	6.9	7757	0.9246
14	Derby	0.2	16.4	8130	0.9457
15	Chester-le-St.	2.6	22	7823	0.8689
16	Derwent	0.5	9.9	7717	0.8660
17	Durham	16.1	138.2	10520	1
18	Easington	0.1	10.3	6800	0.8714
19	Harlow	9.2	338.6	10883	0.9785
20	Hull	5.9	142.9	10842	0.9625
21	Burnley	-4.9	-10	4840	0.8269
22	Mansfield	3.2	6.2	6891	0.8919
23	Stoke	0	25.4	7123	0.9004
24	Lincoln	1.6	23.2	8932	0.8689

(e) D3 1982-83

		%Surplus Output	%Return Capital	VAper Worker	TE
1	Devon	9.5	33.6	8583	1
2	Newcastle-U-Tyne	1.3	26.2	4742	0.8398
3	N.E.Derbyshire	12.5	214.5	8958	1
4	N.Tyneside	4.6	51.9	4690	0.7091
5	S.Tyneside	15.7	608	5350	0.9097
6	Sunderland	0.7	5.4	8714	0.7242
7	Barrow	8.5	65.4	4357	0.8150
8	Gwent	0.3	148	8840	1
9	W.Glamorgan	9.9	101.5	7425	0.7156
10	Newham	2.2	35.5	5090	0.7390
11	Bury	5.1	32.2	4860	0.9764
12	Gateshead	2.6	35.7	5640	0.7097
13	Leeds	1	7.6	3021	0.8413
14	Derby	22	795.6	9640	0.8512
15	Chester-le-St.	7.1	17.9	5910	0.8394
16	Derwentside	4	100	5550	0.7822
17	Durham	14.7	107.8	9100	0.9471
18	Easington	12.7	42.2	2840	0.7282
19	Harlow	2.9	21.2	4120	0.7693
20	Hull	10.1	67.8	7640	0.8156
21	Lincoln	12.8	722.3	9204	0.9982
22	Wrekin	2.9	41.1	6710	0.7269
23	Stoke	3	25.4	4211	0.7208

(f) D3 1987-88

		%Surplus Output	%Return Capital	VAper Worker	TE
1	Devon	4.1	12.1	3000	0.8844
2	Newcastle-U-Tyne	5.1	96.4	7932	0.9594
3	N.E.Derbyshire	3.3	0	10167	1
4	N.Tyneside	5.5	151.2	3096	0.9721
5	S.Tyneside	1.2	151.2	8938	0.9099
6	Sunderland	6.1	78.4	11000	0.8810
7	Barrow	1	142.4	18250	1
8	Gwent	5	0	7612	0.9614
9	W.Glamorgan	2.6	78	9086	0.9245
10	Newham	3.4	149	11410	0.8431
11	Bury	4.4	39.2	10835	0.8388
12	Gateshead	0.6	37	7121	0.8577
13	Leeds	0	0	9928	0.8110
14	Derby	4.9	80	14144	0.8594
15	Chester-le-St.	2.9	26.3	8493	0.9254
16	Derwentside	5	331.2	16479	0.8500
17	Durham	8.8	175.2	8942	0.9492
18	Easington	0.8	30.4	6292	1
19	Harlow	1.8	61.5	14972	0.8092
20	Hull	1.6	55.5	8190	0.8713
21	Lincoln	4	695.8	16257	0.7988
22	Wrekin	1.6	61.9	9522	1
23	Stoke	0.1	0	9432	0.8223

(g) D4 1982-83

		%Surplus Output	%Return Capital	VAper Worker	TE
1	Hinckley	5.9	13.8	7333	0.9174
2	Kirklees	7	19.7	6148	0.8152
3	Newcastle	8.5	93.9	5755	0.9875
4	New Forest	7.1	20.7	8750	0.8819
5	N.E.Derbyshire	3.6	22.3	6586	0.8186
6	N.Tyneside	4.2	33.9	5822	0.9549
7	Oldham	1.2	15.3	3783	0.9796
8	Redbridge	6.3	62.4	8594	0.8707
9	Rochdale	2.4	6.9	7101	0.8084
10	Rushmoor	2.8	7.2	8071	0.8320
11	St.Edmunds.	6.5	48.6	6980	0.8167
12	Sedgefield	2.1	6.6	7832	0.8256
13	Solihull	3	11.1	8187	1
14	S. Tyneside	9.4	118	4381	0.9636
15	Stockport	5.2	29.5	7458	0.8327
16	Stockton	2.6	20.4	7418	0.9427
17	Sunderland	6.3	40.9	8698	0.8996
18	Thanet	5	16	7095	0.9825
19	Wigan	4.2	18.4	4356	0.8323
20	Aylesbury	3.4	4.2	7444	0.8279
21	Bassetlaw	1.4	5.3	4667	0.9506
22	Bracknell	3.7	35.1	9414	0.8848
23	Braintree	7.5	77	8200	0.9018
24	Chester	1.5	33	4048	0.9270

25	Colwyn	6.4	32	4386	0.9105
26	Crawley	4.5	23.2	7365	0.8897
27	E.Devon	3.5	11.8	7063	0.8819
28	Forest of Dean	3.2	14	5907	0.8084
29	Glyndwr	5.1	8.7	5292	0.8760
30	Gravesham	5.4	31.1	7220	0.8976
31	Kennet	2.8	11.2	7348	0.8327
32	Kings Lynn	4.5	12.9	8216	0.8536
33	Lliw Valley	3.4	15.1	3897	0.8389
34	Mid-Sussex	2.5	9.3	6975	1
35	Neath	1.7	13.6	5108	0.9000
36	N.Devon	1.9	12.5	4270	0.8670
37	N.Wilts.	7.6	15.7	7069	0.9065
38	Rhondda	1.7	13.7	5556	0.8496
39	S.Oxfords.	0.7	45.7	7099	0.9478
40	S.Staffs.	3.4	9.6	6407	0.8789
41	Teignbridge	1	5.9	5192	0.9301
42	Torridge	2.5	9.2	5912	0.8770
43	W.Derbyshire	5.2	9	7310	0.8654
44	W.Lindsey	2.1	8.8	3885	0.7823
45	Wychavon	2.5	7.2	6415	0.8730
46	Barrow	7.9	32.4	5676	0.8583
47	Blackpool	5.7	23.2	8984	0.9875
48	Blaenau	3.1	7.2	6069	0.8781
49	Bradford	2.8	10.8	4286	0.8654
50	Cambridge	3.2	10.2	9914	0.9445
51	Ceredigion	2.4	14.5	4657	0.9508

(h) D4 1987-88

		%Surplus Output	%Return Capital	VAper Worker	TE
1	Hinckley	8	23.5	8959	0.8304
2	Kirklees	2	21.8	8318	0.7934
3	Newcastle	8.2	87.2	6667	0.9596
4	New Forest	3.9	15	10622	1
5	N.E.Derbyshire	9.7	28.6	8517	0.8483
6	N.Tyneside	2.5	27.8	6445	0.9706
7	Oldham	1.2	11.5	9776	0.6911
8	Redbridge	3.4	120	12851	0.8726
9	Rochdale	1.1	7.6	8960	0.7243
10	Rushmoor	1.3	5.9	12940	0.7375
11	St.Edmunds.	0.8	33.8	10817	0.8121
12	Sedgefield	-0.1	7.2	11713	0.7560
13	Solihull	4.4	39.7	9333	0.8433
14	S. Tyneside	7.8	90	5754	0.9791
15	Stockport	4.7	31.1	9044	0.8009
16	Stockton	2.5	19.4	8974	0.6278
17	Sunderland	9.1	58.9	11285	1
18	Thanet	8.6	26.7	9722	0.8868
19	Wigan	1.2	17.4	7426	0.9659
20	Aylesbury	4.5	5.6	9946	0.7930
21	Bassetlaw	7.9	78.3	10034	0.8809
22	Bracknell	7.4	110.6	14909	0.8700
23	Braintree	4.9	15.2	10578	0.9302
24	Chester	0.2	2.5	6246	0.9034

25	Colwyn	5.9	21.7	11286	0.9871
26	Crawley	-7.7	-16.5	8571	0.8750
27	E.Devon	9.4	51.6	9700	0.7240
28	Forest of Dean	-5.8	-7.8	6818	0.9409
29	Glyndwr	8.5	16.9	8073	0.6606
30	Gravesham	3.1	14.2	9831	0.9612
31	Kennet	0.3	49.8	12286	0.7919
32	Kings Lynn	2.7	9.2	10482	1
33	Lliw Valley	8	42.9	8582	0.7582
34	Mid-Sussex	1.8	6.9	8625	1
35	Neath	3.1	49	8626	0.8500
36	N.Devon	6.1	33.8	9419	0.8319
37	N.Wilts.	1.3	55.9	11604	0.8366
38	Rhondda	5.1	88	8927	0.9524
39	S.Oxfords.	6.8	29.2	12507	0.8606
40	S.Staffs.	4.6	6.1	8343	0.9667
41	Teignbridge	1.1	5.4	7945	0.9050
42	Torridge	3	42.9	10281	0.8000
43	W.Derbyshire	8.2	17	8167	0.9087
44	W.Lindsey	3.9	17.1	8541	0.8091
45	Wychavon	5.2	113.6	12330	0.9193
46	Barrow	3	92.8	10832	0.7663
47	Blackpool	4.6	13.8	10657	0.9955
48	Blaenau	8	223.3	8962	0.7975
49	Bradford	0.5	6.4	6459	0.9127
50	Cambridge	3.3	11.6	10667	0.9425
51	Ceredigion	3.6	51.6	8587	0.8182

Arithmetic mean, maximum and minimum values

(a) D1

		% Surplus Output	% Return Capital	VA per worker(£)
1981-82	Mean	3.8	13.9	6070
	Min	-2.3	-65.4	2095
	Max	23.4	160	10310
1982-83	Mean	4.8	18.4	6798
	Min	-17	-48.6	7400
	Max	13.9	170	11432
1983-84	Mean	3.9	14.2	6806
	Min	1	5.2	3656
	Max	11.1	148	12235
1984-85	Mean	4.8	21.4	7722
	Min	0.2	5.1	2472
	Max	16.9	243	11974
1985-86	Mean	4.2	16.1	8088
	Min	0	5	2684
	Max	18.8	198	16588
1986-87	Mean	4.3	19.0	8936
	Min	-8.8	-42.9	3171
	Max	13.8	153	17353
1987-88	Mean	3.4	15.7	9174
	Min	-5	-1	2236
	Max	14.88	273	15580
1988-89	Mean	2.9	26.0	9185
	Min	-44	-167	3334
	Max	18.4	427	14922

(b) D2		% Surplus Output	% Return Capital	VA per worker(£)
1981-82	Mean	3.5	40.5	6050
	Min	-16.2	-933	1185
	Max	17.2	500	9842
1982-83	Mean	3.9	12.2	6342
	Min	-24.4	-1454.7	1281
	Max	33	736.7	10467
1983-84	Mean	0.8	3.8	6611
	Min	-80.1	-3129.4	1520
	Max	15.6	229.1	10324
1984-85	Mean	1.4	42.8	5968
	Min	-9	-20.4	533
	Max	6.8	220	10249
1985-86	Mean	1.9	70.5	6804
	Min	-6.5	-12.2	4002
	Max	8.8	519.5	10568
1986-87	Mean	1.6	64.2	6793
	Min	-13.1	-3.1	3680
	Max	6.3	517.7	10024
1987-88	Mean	2.4	47.3	7212
	Min	-4.9	-10	3840
	Max	16.1	338.6	10883
1988-89	Mean	1.32	23.7	7409
	Min	-35.3	-423.9	1136
	Max	9.6	300	11533

(c) D3		% Surplus Output	% Return Capital	VA per worker(£)
1981-82	Mean	8.0	121.3	4811
	Min	-8.8	-154.5	1260
	Max	28.6	872	9286
1982-83	Mean	6.9	137.8	6123
	Min	0.3	5.4	2840
	Max	22	795.6	9640
1983-84	Mean	5.7	159.1	6695
	Min	-0.9	-7.1	2938
	Max	23.9	1922.3	10217
1984-85	Mean	4.9	83.4	6072
	Min	0.4	8.9	1655
	Max	26	450	11800
1985-86	Mean	3.7	159.5	8238
	Min	-9.5	-30	1212
	Max	8.9	834	16667
1986-87	Mean	4.3	125.8	9004
	Min	1.2	0	3000
	Max	9.2	712	17121
1987-88	Mean	3.0	99.4	9635
	Min	0	0	3000
	Max	8.8	695.8	18250
1988-89	Mean	4.0	128.6	10311
	Min	0.1	0	4250
	Max	9.9	507.2	17871

(d) D4		% Surplus Output	% Return Capital	VA per worker(£)
1981-82	Mean	4.8	22.2	5920
	Min	0.2	1.6	2814
	Max	18.4	307.5	10213
1982-83	Mean	3.5	14.7	6213
	Min	0.7	4.2	3783
	Max	9.4	118	9914
1983-84	Mean	5.4	25.9	6861
	Min	0.8	5.7	3198
	Max	19.1	118.1	14699
1984-85	Mean	2.7	29.3	7506
	Min	-7.5	-9	4259
	Max	9.7	226.1	15984
1985-86	Mean	3.8	35.3	8123
	Min	-2.3	-4	4687
	Max	9.6	101	15143
1986-87	Mean	4.1	38.4	8973
	Min	-1.1	-5.5	5550
	Max	9.3	144.9	17093
1987-88	Mean	4	41.6	9245
	Min	-7.7	-16.5	5754
	Max	9.7	223.3	14909
1988-89	Mean	3.4	12.6	9877
	Min	-4.1	-25.3	5141
	Max	9.2	89.6	16071

Figs. DA4 (a-c) illustrate the overall mean values of the performance measures (by category) over the period.

Fig. DA4 (a) Mean value : % Surplus / Output

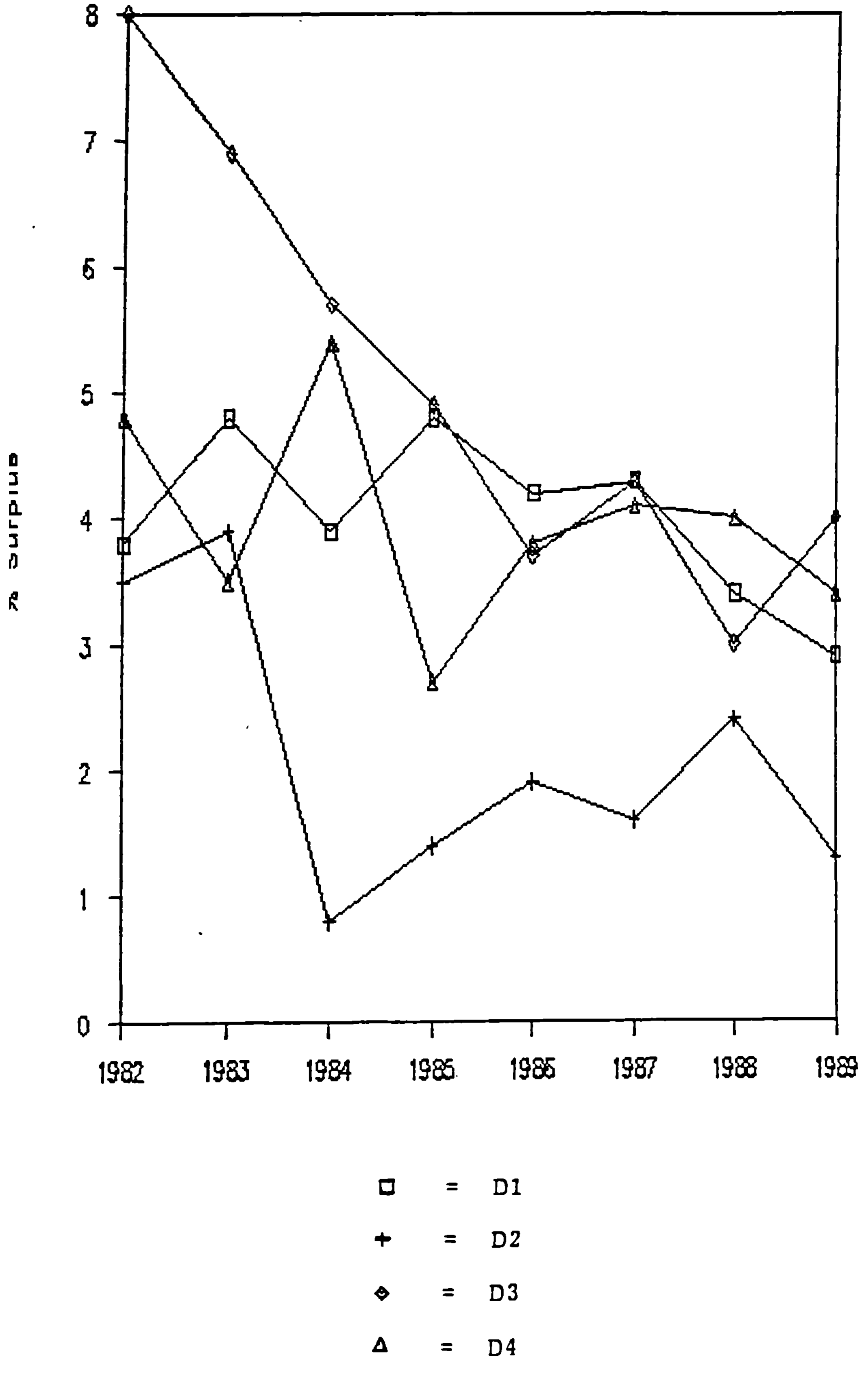


Fig. DA4 (b) Mean value : % Return / Capital

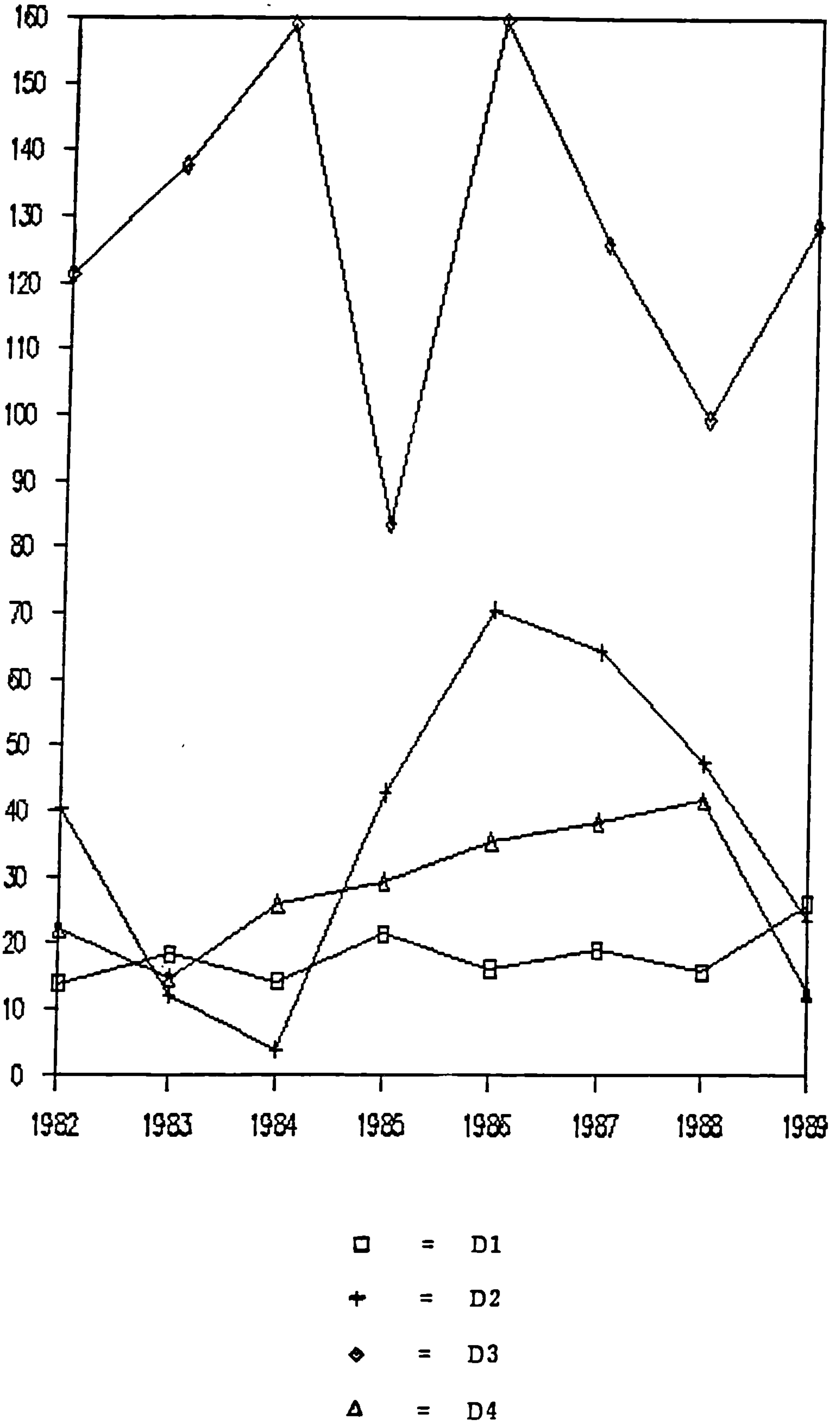
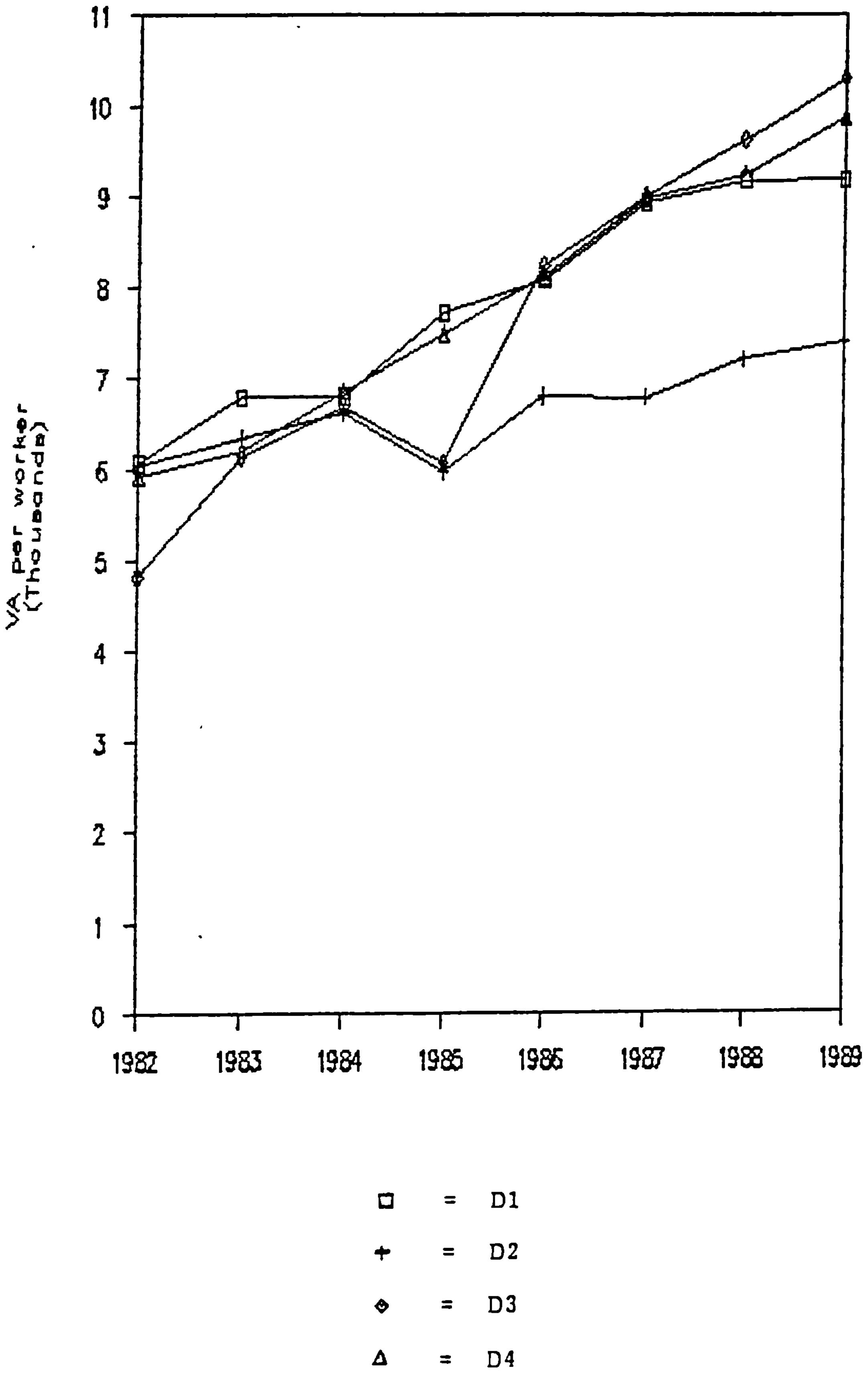


Fig. DA4 (c) Mean value : Value added per worker (£)



SECTION 5

Rankings by performance measure for 1982-83 and 1987-88

(a) D1 1982-83 .

		%Surplus Output	%Return Capital	VA per Worker	TE	Overall
1	Cynon	19	2	27	40	11
2	Devon	8	29	26	15	16
3	Greenwich	47	47	22	9	45
4	Hinckley	2	13	20	6	7
5	Humberside	23	16	14	11	12
6	Newcastle-U-Tyne	17	9	42	31	22
7	New Forest	40	31	44	42	44
8	N.E.Derbys.	28	12	6	41	9
9	N.Tyneside	38	22	28	36	35
10	Oldham	37	25	46	29	41
11	Redbridge	27	34	34	25	36
12	Rochdale	16	40	12	27	21
13	St.Edmunds.	19	33	30	22	32
14	Sedgefield	24	36	17	37	30
15	Solihull	33	19	23	32	28
16	S.Tyneside	5	1	41	7	10
17	Stockport	32	27	11	38	24
18	Stockton	12	8	8	1	5
19	Sunderland	6	7	2	19	3
20	Thanet	19	45	3	13	20
21	Wigan	10	10	40	21	15

22 Avon	10	6	39	17	13
23 Beds.	25	15	19	24	14
24 Berks.	7	14	24	14	8
25 Cambs.	13	25	38	1	29
26 Cornwall	3	4	7	1	2
27 Cumbria	18	30	25	26	26
28 Dorset	14	28	32	12	27
29 E.Sussex	1	3	1	1	1
30 Gloucs.	28	23	35	34	34
31 Hants.	15	42	29	5	33
32 Kent	45	46	21	46	43
33 Leics.	42	40	47	8	46
34 Norfolk	16	18	31	20	18
35 Northants.	19	38	15	30	25
36 Northumberland	9	17	4	16	6
37 Oxfords.	35	35	33	23	38
38 Shrops.	39	37	5	43	31
39 Somerset	26	24	13	28	17
40 Suffolk	43	31	37	39	41
41 Warwicks.	28	42	35	18	40
42 Wilts.	36	21	9	45	19
43 Blackpool	4	5	10	10	4
44 Blaenau	33	20	16	33	23
45 Bradford	44	45	45	35	47
46 Ceredigion	41	11	43	47	37
47 Copeland	46	39	18	44	39

(b) D1 1987-88

		% Surplus Output	%Return Capital	VA per worker	TE	Overall
1	Cynon	47	47	17	46	42
2	Devon	22	32	37	14	35
3	Greenwich	34	37	47	20	45
4	Hinckley	8	7	25	5	11
5	Humberside	45	33	6	46	27
6	Newcastle-U-Tyne	25	17	44	44	29
7	New Forest	12	22	45	10	24
8	N.E.Derbys.	21	8	10	34	8
9	N.Tyneside	11	3	43	26	20
10	Oldham	33	28	28	32	30
11	Redbridge	10	15	11	24	6
12	Rochdale	15	20	12	13	15
13	St.Edmunds.	1	13	31	6	12
14	Sedgefield	3	9	13	1	3
15	Solihull	17	10	9	1	6
16	S.Tyneside	2	1	22	1	4
17	Stockport	14	11	14	17	9
18	Stockton	26	26	7	9	21
19	Sunderland	4	4	1	7	1
20	Thanet	29	41	32	29	37
21	Wigan	30	18	35	36	26
22	Avon	44	44	18	38	38
23	Beds.	9	5	4	15	2
24	Berks.	7	16	8	24	5

25	Cambs.	36	30	23	37	31
26	Cornwall	23	35	20	28	23
27	Cumbria	40	39	38	33	44
28	Dorset	13	19	24	12	19
29	E.Sussex	20	12	15	35	14
30	Gloucs.	16	22	35	1	22
31	Hants.	41	31	34	22	40
32	Kent	19	25	2	27	13
33	Leics.	43	43	45	8	46
34	Norfolk	34	38	42	21	43
35	Northants.	32	41	27	38	36
36	Northumberland	42	35	33	40	41
37	Oxfords.	27	44	19	41	33
38	Shrops.	46	46	40	16	47
39	Somerset	28	27	30	18	28
40	Suffolk	39	24	26	43	32
41	Warwicks.	24	21	5	30	18
42	Wilts.	31	14	3	42	16
43	Blackpool	18	40	21	31	25
44	Blaenau	6	2	41	19	17
45	Bradford	37	29	39	23	39
46	Ceredigion	5	6	29	11	10
47	Copeland	38	36	16	45	34

(c) D2 1982-83

		%Surplus Output	%Return Capital	VA per Worker	TE	Overall
1	Greenwich	24	24	22	24	24
2	Newcastle-U-Tyne	1	5	10	14	4
3	N.Tyneside	18	20	16	1	18
4	D.E.Derbys.	3	2	1	17	1
5	Sedgefield	17	8	12	21	14
6	S.Tyneside	22	22	19	20	22
7	Sunderland	10	9	6	11	8
8	Bradford	9	13	23	9	16
9	Gwent	14	1	8	1	7
10	Barnsley	23	23	24	15	23
11	Leeds	15	14	14	12	15
12	Reading	20	21	11	13	17
13	Barrow	16	18	21	10	20
14	Derby	4	17	15	6	13
15	Chester-le-St.	8	11	2	16	5
16	Derwent	7	10	13	8	9
17	Durham	2	3	3	1	2
18	Easington	6	7	18	22	10
19	Harlow	13	15	4	23	11
20	Hull	12	12	9	4	12
21	Burnley	5	6	5	5	3
22	Mansfield	18	19	20	19	21
23	Stoke	21	16	17	7	19
24	Lincoln	11	4	7	18	6

(d) D2 1987-88

		%Surplus Output	%Return Capital	VA per Worker	TE	Overall
1	Greenwich	16	13	11	9	12
2	Newcastle-U-Tyne	22	20	22	23	23
3	N.Tyneside	12	10	20	21	15
4	D.E.Derbys.	5	6	5	1	5
5	Sedgefield	11	19	23	24	20
6	S.Tyneside	13	7	3	15	6
7	Sunderland	3	2	6	7	4
8	Bradford	20	20	24	1	22
9	Gwent	18	20	18	19	21
10	Barnsley	8	20	15	13	16
11	Leeds	20	5	19	6	17
12	Reading	15	18	13	20	18
13	Barrow	9	16	10	10	9
14	Derby	16	12	8	8	10
15	Chester-le-St.	7	11	9	16	8
16	Derwent	13	15	12	18	13
17	Durham	1	4	4	1	2
18	Easington	18	14	17	14	19
19	Harlow	2	1	1	4	1
20	Hull	4	3	2	5	3
21	Burnley	24	24	21	22	24
22	Mansfield	6	17	16	12	11
23	Stoke	20	8	14	11	14
24	Lincoln	9	9	7	16	7

(e) D3 1982-83

		%Surplus Output	%Return Capital	VA per worker	TE	Overall
1	Devon	9	16	7	1	8
2	Newcastle-U-Tyne	20	18	17	10	21
3	N.E.Derbys.	6	4	4	1	4
4	N.Tyneside	13	11	18	23	14
5	S.Tyneside	2	3	14	7	5
6	Sunderland	22	23	6	19	19
7	Barrow	10	10	19	13	11
8	Gwent	23	5	5	1	9
9	W.Glamorgan	8	7	9	21	7
10	Newham	19	15	15	16	18
11	Bury	12	17	16	5	17
12	Gateshead	18	14	12	22	15
13	Leeds	21	22	22	9	23
14	Derby	1	1	1	8	1
15	Chester-le-St.	11	21	11	11	16
16	Derwentside	14	8	13	14	10
17	Durham	3	6	3	6	3
18	Easington	5	12	23	17	13
19	Harlow	16	20	21	15	22
20	Hull	7	9	8	12	6
21	Lincoln	4	2	2	4	2
22	Wrekin	16	13	10	18	12
23	Stoke	15	19	20	20	20

(f) D3 1987-88

		%Surplus Output	%Return Capital	VA per worker	TE	Overall
1	Devon	9	19	23	12	17
2	Newcastle-U-Tyne	4	8	18	7	9
3	N.E.Derbys.	12	20	9	1	15
4	N.Tyneside	3	4	22	5	8
5	S.Tyneside	18	4	15	11	12
6	Sunderland	2	10	7	13	4
7	Barrow	19	7	1	1	7
8	Gwent	5	20	19	6	16
9	W.Glamorgan	14	11	13	10	13
10	Newham	11	6	6	18	6
11	Bury	8	15	8	19	10
12	Gateshead	21	16	20	16	22
13	Leeds	23	20	10	21	20
14	Derby	7	9	5	15	5
15	Chester-le-St.	13	18	16	9	18
16	Derwentside	5	2	2	17	1
17	Durham	1	3	14	8	3
18	Easington	20	17	21	1	23
19	Harlow	15	13	4	22	11
20	Hull	16	14	17	14	19
21	Lincoln	10	1	3	23	2
22	Wrekin	16	12	11	1	14
23	Stoke	22	20	12	20	21

(g) D4 1982-83

		%Surplus Output	%Return Capital	VA per worker	TE	Overall
1	Hinckley	13	28	17	16	16
2	Kirklees	8	20	30	48	18
3	Newcastle-U-Tyne	3	2	35	3	9
4	New Forest	7	18	4	25	5
5	N.E.Derbys.	25	17	27	46	23
6	N.Tyneside	22	9	34	8	20
7	Oldham	50	24	51	6	48
8	Redbridge	11	4	6	32	2
9	Rochdale	41	47	20	49	40
10	Rushmoor	36	44	10	43	30
11	St.Edmundsbury	9	5	25	47	8
12	Sedgefield	43	48	11	45	36
13	Solihull	33	35	9	1	26
14	S.Tyneside	2	1	44	7	11
15	Stockport	16	14	12	40	10
16	Stockton	37	19	14	13	24
17	Sunderland	11	7	5	21	3
18	Thanet.	19	22	22	5	19
19	Wigan	22	21	45	42	29
20	Aylesbury	22	51	13	44	32
21	Bassetlaw	49	50	41	10	51
22	Bracknell	24	8	2	24	7
23	Braintree	6	3	8	19	1
24	Chester	48	10	48	15	38

25	Colwyn	10	12	43	17	21
26	Crawley	20	15	15	23	13
27	E.Devon	25	33	24	25	27
28	Forest of Dean	30	27	33	49	31
29	Glyndwr	18	43	38	30	34
30	Gravesham	15	13	19	22	12
31	Kennet	34	34	16	40	28
32	Kings Lynn	20	31	7	37	17
33	Lliw Valley	27	25	49	39	35
34	Mid-Sussex	38	39	26	1	37
35	Neath	46	30	40	20	45
36	N.Devon	45	32	47	33	47
37	N.Wilts	5	23	23	18	14
38	Rhondda	46	29	37	38	44
39	S.Oxford	1	6	21	11	4
40	S.Staffs.	27	38	29	27	33
41	Teignbridge	51	49	39	14	50
42	Torridge	38	40	32	29	42
43	W.Derbys.	17	41	18	34	25
44	W.Lindsey	43	42	50	51	49
45	Wychavon	38	44	28	31	43
46	Barrow	4	11	36	36	15
47	Blackpool	14	15	3	3	6
48	Blaenau	32	44	31	28	39
49	Bradford	34	36	46	34	46
50	Cambridge	30	37	1	12	22
51	Ceredigion	41	26	42	9	41

(h) D4 1987-88

		%Surplus Output	%Return Capital	VA per worker	TE	Overall
1	Hinckley	8	26	31	33	18
2	Kirklees	37	27	41	40	41
3	Newcastle-U-Tyne	7	8	47	12	16
4	New Forest	25	35	15	1	27
5	N.E.Derbys.	1	23	39	29	17
6	N.Tyneside	35	24	49	8	43
7	Oldham	41	39	22	49	40
8	Redbridge	28	2	3	25	4
9	Rochdale	43	41	30	47	44
10	Rushmoor	39	46	2	46	34
11	St.Edmundsbury	45	19	12	35	28
12	Sedgefield	49	42	7	45	39
13	Solihull	24	18	26	30	21
14	S.Tyneside	12	6	51	7	23
15	Stockport	20	21	27	37	22
16	Stockton	35	29	28	51	37
17	Sunderland	3	10	10	1	2
18	Thanet	4	25	23	22	10
19	Wigan	41	30	45	10	46
20	Aylesbury	23	47	20	41	35
21	Bassetlaw	11	9	19	23	6
22	Bracknell	13	4	1	26	1
23	Braintree	19	34	16	16	24
24	Chester	48	49	50	21	51

25	Colwyn	16	28	9	6	11
26	Crawley	51	51	37	24	49
27	E.Devon	2	12	24	48	5
28	Forest of Dean	50	50	46	15	50
29	Glyndwr	5	33	43	50	32
30	Gravesham	30	36	21	11	33
31	Kennet	47	14	6	42	20
32	Kings Lynn	34	40	17	1	36
33	Lliw Valley	9	16	36	44	15
34	Mid-Sussex	38	43	34	1	45
35	Neath	31	15	33	28	29
36	N.Devon	15	19	25	32	14
37	N.Wilts.	39	11	8	31	13
38	Rhondda	18	7	32	13	12
39	S.Oxford	14	22	4	27	7
40	S.Staffs.	21	45	40	9	42
41	Teignbridge	43	48	44	20	47
42	Torridge	32	16	18	38	19
43	W.Derbys.	6	32	42	19	31
44	W.Lindsey	25	31	38	36	38
45	Wychavon	17	3	5	17	3
46	Barrow	33	5	11	43	9
47	Blackpool	21	37	14	5	25
48	Blaenau	10	1	29	39	8
49	Bradford	46	44	48	18	48
50	Cambridge	29	38	13	14	30
51	Ceredigion	27	12	35	34	26

SECTION 6

Attribute designations of DLOs for 1982-83 and 1987-88

(a) D1 1982-83

		Ranking Overall	Output Value	Work Prop.	Sep. Div.	Work Cats.	Prod. Bonus
			Attributes				
1	Cynon	11	0	0	0	0	0
2	Devon	16	1	0	1	0	1
3	Greenwich	45	0	0	0	1	0
4	Hinckley	7	0	1	1	1	1
5	Humberside	12	1	0	1	0	1
6	Newcastle-U-Tyne	22	1	1	1	1	1
7	New Forest	44	0	0	0	0	0
8	N.E.Derbys.	9	0	1	1	1	1
9	N.Tyneside	35	0	1	0	1	1
10	Oldham	41	0	1	0	0	0
11	Redbridge	36	0	0	0	0	0
12	Rochdale	21	0	0	1	0	0
13	St.Edmunds.	32	0	1	0	0	0
14	Sedgefield	30	0	1	0	0	0
15	Solihull	28	0	1	0	0	1
16	S.Tyneside	10	0	1	0	1	0
17	Stockport	24	0	0	0	0	0
18	Stockton	5	0	1	1	0	1
19	Sunderland	3	0	1	1	1	1
20	Thanet	20	0	0	1	0	1
21	Wigan	15	0	1	1	1	0
22	Avon	13	1	1	0	0	0

23 Beds.	14	0	0	1	0	0
24 Berks.	8	0	0	1	0	1
25 Cambs.	29	1	0	0	0	0
26 Cornwall	2	1	1	1	0	1
27 Cumbria	26	1	1	0	0	0
28 Dorset	27	0	0	0	0	1
29 E.Sussex	1	0	0	1	0	1
30 Gloucs.	34	1	1	0	0	0
31 Hants.	33	1	1	0	0	1
32 Kent	43	1	0	0	0	0
33 Leics.	46	1	0	0	0	0
34 Norfolk	18	1	0	1	0	0
35 Northants.	25	1	0	1	0	0
36 Northumberland	6	1	1	0	0	1
37 Oxfords.	38	1	0	0	0	0
38 Shrops.	31	1	1	0	0	0
39 Somerset	17	1	1	0	0	0
40 Suffolk	42	1	0	0	0	0
41 Warwicks.	40	1	0	0	0	0
42 Wilts.	19	1	0	0	0	0
43 Blackpool	4	0	1	1	0	1
44 Blaenau	23	0	1	0	0	0
45 Bradford	47	0	1	0	0	0
46 Ceredigion	37	0	0	0	0	0
47 Copeland	39	0	1	0	1	0

(b) D1 1987-88

		Ranking Overall	Output Value	Work Prop.	Sep. Div.	Work Cats.	Prod. Bonus
			Attributes				
1	Cynon	42	0	0	0	0	1
2	Devon	35	1	0	1	0	1
3	Greenwich	45	1	0	0	0	0
4	Hinckley	11	0	1	1	0	1
5	Humberside	27	1	0	1	0	1
6	Newcastle-U-Tyne	29	1	0	1	1	1
7	New Forest	24	0	1	1	0	1
8	N.E.Derbys.	8	1	1	1	1	1
9	N.Tyneside	20	0	1	0	1	1
10	Oldham	30	0	0	0	0	0
11	Redbridge	6	0	0	1	0	1
12	Rochdale	15	0	0	1	0	0
13	St.Edmunds.	12	0	1	1	0	0
14	Sedgefield	3	0	1	1	0	0
15	Solihull	6	0	0	1	0	1
16	S.Tyneside	4	0	1	1	1	0
17	Stockport	9	0	0	1	0	1
18	Stockton	21	0	1	1	1	1
19	Sunderland	1	1	1	1	1	1
20	Thanet	37	0	1	1	0	1
21	Wigan	26	0	1	1	0	0
22	Avon	38	1	1	0	0	0
23	Beds.	2	1	0	1	0	1
24	Berks.	5	1	0	1	0	1

25	Cambs.	31	1	0	0	0	0
26	Cornwall	23	1	1	1	0	1
27	Cumbria	44	1	1	0	0	0
28	Dorset	19	1	0	1	0	1
29	E.Sussex	14	1	0	1	0	1
30	Gloucs.	22	1	0	0	0	1
31	Hants.	40	1	1	0	0	1
32	Kent	13	1	0	1	0	1
33	Leics.	46	1	1	0	0	0
34	Norfolk	43	1	0	1	0	0
35	Northants	36	1	0	1	0	0
36	Northumberland	41	1	1	0	0	1
37	Oxfords.	33	1	0	0	0	0
38	Shrops.	47	1	1	0	0	0
39	Somerset	28	1	1	1	0	0
40	Suffolk	32	1	0	0	0	0
41	Warwicks.	18	1	0	1	0	1
42	Wilts.	16	1	0	0	0	1
43	Blackpool	25	0	0	1	0	1
44	Blaenau	17	0	1	1	0	1
45	Bradford	39	1	0	0	0	1
46	Ceredigion	10	0	0	0	0	0
47	Copeland	34	0	0	0	0	0

(c) D2 1982-83

			Attributes				
		Ranking Overall	Output Value	Work prop	Sep Div	Work Cats	Prod Bonus
1	Greenwich	24	1	0	0	1	0
2	Newcastle-U-Tyne	4	1	0	1	1	1
3	N.Tyneside	18	1	0	0	1	1
4	N.E.Derbyshire	1	0	1	1	1	1
5	Sedgefield	14	0	0	1	0	0
6	S.Tyneside	22	1	0	0	1	0
7	Sunderland	8	1	0	1	1	1
8	Bradford	16	1	1	0	1	1
9	Gwent	7	0	1	1	1	1
10	Barnsley	23	0	0	0	1	0
11	Leeds	15	1	1	1	1	0
12	Reading	17	1	1	0	0	0
13	Barrow	20	1	0	0	1	0
14	Derby	13	1	1	1	1	0
15	Chester-le-St.	5	0	0	1	1	1
16	Derwent	9	1	1	1	1	1
17	Durham	2	1	1	1	1	1
18	Easington	10	1	1	1	1	0
19	Harlow	11	0	1	0	1	0
20	Hull	12	0	0	0	1	1
21	Burnley	3	0	1	1	0	1
22	Mansfield	21	0	0	0	1	0
23	Stoke	19	0	1	0	1	0
24	Lincoln	6	0	0	1	1	1

(d) D2 1987-88

			Attributes				
		Ranking Overall	Output Value	Work prop	Sep Div	Work Cats	Prod Bonus
1	Greenwich	12	0	0	0	0	0
2	Newcastle-U-Tyne	23	0	0	1	1	1
3	N.Tyneside	15	1	0	0	1	1
4	N.E.Derbyshire	5	0	0	1	1	1
5	Sedgefield	20	0	1	1	0	0
6	S.Tyneside	6	1	1	1	1	0
7	Sunderland	4	1	0	1	1	1
8	Bradford	22	0	0	0	0	1
9	Gwent	21	0	0	1	1	1
10	Barnsley	16	0	0	0	1	0
11	Leeds	17	0	0	1	1	0
12	Reading	18	1	1	0	0	0
13	Barrow	9	1	1	1	1	1
14	Derby	10	1	1	1	1	0
15	Chester-le-St.	8	0	1	1	1	1
16	Derwent	13	1	1	1	1	1
17	Durham	2	1	1	1	1	1
18	Easington	19	1	1	1	1	0
19	Harlow	1	0	1	1	1	1
20	Hull	3	0	0	1	1	1
21	Burnley	24	0	1	1	1	1
22	Mansfield	11	0	0	0	0	0
23	Stoke	14	0	1	0	1	0
24	Lincoln	7	0	1	1	1	1

(e) D3 1982-83

		Ranking Overall	Output Value	Work Prop	Sep Div	Work Cats	Prod Bonus
			Attributes				
1	Devon	8	0	0	1	0	1
2	Newcastle-U-Tyne	21	1	0	1	1	1
3	N.E.Derbyshire	4	0	1	1	1	1
4	N.Tyneside	14	0	0	0	1	1
5	S.Tyneside	5	1	1	0	1	0
6	Sunderland	19	1	1	1	1	1
7	Barrow	11	0	1	1	1	0
9	W.Glamorgan	7	1	1	1	0	1
10	Newham	18	0	0	0	1	0
11	Bury	17	0	0	0	0	1
12	Gateshead	15	1	1	0	1	0
13	Leeds	23	1	0	1	1	0
14	Derby	1	0	0	1	1	0
15	Chester-le-St.	16	0	0	1	1	1
16	Derwentside	10	0	0	1	1	1
17	Durham	3	1	1	1	1	1
18	Easington	13	0	0	1	1	0
19	Harlow	22	0	1	0	1	0
20	Hull	6	1	0	0	1	1
21	Lincoln	2	1	0	1	1	1
22	Wrekin	12	0	0	0	1	0
23	Stoke	20	1	1	0	1	0

(f) D3 1987-88

		Ranking Overall	Output Value	Work Prop	Sep Div	Work Cats	Prod Bonus
			Attributes				
1	Devon	17	0	0	1	0	1
2	Newcastle-U-Tyne	9	1	1	1	1	1
3	N.E.Derbyshire	15	0	1	1	1	1
4	N.Tyneside	8	1	1	0	1	1
5	S.Tyneside	12	1	1	1	1	0
6	Sunderland	4	0	1	1	1	1
7	Barrow	7	1	1	1	1	1
8	Gwent	16	1	0	1	1	1
9	W.Glamorgan	13	1	0	1	1	1
10	Newham	6	1	0	1	1	0
11	Bury	10	0	0	0	0	1
12	Gateshead	22	0	1	0	1	0
13	Leeds	20	1	1	1	1	0
14	Derby	5	0	1	1	1	0
15	Chester-le-St.	18	0	1	1	1	1
16	Derwentside	1	0	0	1	1	1
17	Durham	3	0	1	1	1	1
18	Easington	23	0	0	1	1	0
19	Harlow	11	0	1	1	1	1
20	Hull	19	0	0	0	1	1
21	Lincoln	2	1	1	1	1	1
22	Wrekin	14	1	0	1	1	1
23	Stoke	21	1	1	0	1	0

(g) D4 1982-83

			Attributes				
		Ranking Overall	Output Value	Work Prop	Sep Div	Work Cats	Prod Bonus
1	Hinckley	16	0	0	1	1	1
2	Kirklees	18	1	1	0	0	0
3	Newcastle	9	1	1	1	1	1
4	New Forest	5	0	0	0	0	0
5	N.E.Derbyshire	23	1	1	1	1	1
6	N.Tyneside	20	1	1	0	1	1
7	Oldham	48	1	1	0	0	0
8	Redbridge	2	1	0	0	0	0
9	Rochdale	40	1	0	1	0	0
10	Rushmoor	30	1	1	0	0	0
11	St.Edmunds	8	0	1	0	0	0
12	Sedgefield	36	1	1	0	0	0
13	Solihull	26	1	0	0	0	1
14	S. Tyneside	11	1	1	0	1	0
15	Stockport	10	1	1	0	0	0
16	Stockton	24	1	1	1	0	1
17	Sunderland	3	1	1	1	1	1
18	Thanet	19	0	0	1	0	1
19	Wigan	29	1	1	1	1	0
20	Aylesbury	32	0	0	0	0	0
21	Bassetlaw	51	0	1	0	0	0
22	Bracknell	7	1	1	1	0	1
23	Braintree	1	0	1	1	0	1
24	Chester	38	0	0	0	0	1

25	Colwyn	21	0	0	0	0	1
25	Crawley	13	0	0	1	0	1
27	E.Devon	27	0	0	0	0	0
28	Forest of Dean	31	0	1	0	0	0
29	Glyndwr	34	0	1	0	0	0
30	Gravesham	12	1	1	0	0	1
31	Kennet	28	0	0	0	0	0
32	Kings Lynn	17	0	0	1	0	1
33	Lliw Valley	35	0	1	0	0	0
34	Mid-Sussex	37	0	0	0	0	0
35	Neath	45	1	1	0	0	0
36	N.Devon	47	0	1	0	0	0
37	N.Wilts.	14	0	0	1	0	0
38	Rhondda	44	1	1	0	0	0
39	S.Oxfords.	4	1	1	1	0	1
40	S.Staffs.	33	0	1	0	0	0
41	Teignbridge	50	0	0	0	0	0
42	Torridge	42	0	0	0	0	0
43	W.Derbyshire	25	0	1	1	0	1
44	W.Lindsey	49	0	0	0	0	0
45	Wychavon	43	0	0	0	0	0
46	Barrow	15	1	1	1	1	0
47	Blackpool	6	1	1	1	0	1
48	Blaenau	39	1	1	0	0	0
49	Bradford	46	1	0	0	1	1
50	Cambridge	22	1	1	0	0	1
51	Ceredigion	41	0	1	0	0	0

(h) D4 1987-88

			Attributes				
		Ranking Overall	Output Value	Work Prop	Sep Div	Work Cats	Prod Bonus
1	Hinckley	18	0	1	1	0	1
2	Kirklees	41	1	1	0	0	0
3	Newcastle	16	1	1	1	1	1
4	New Forest	27	0	0	1	0	1
5	N.E.Derbyshire	17	1	1	1	1	1
6	N.Tyneside	43	1	1	0	1	1
7	Oldham	40	1	1	0	0	0
8	Redbridge	4	1	0	1	0	1
9	Rochdale	44	1	0	1	0	0
10	Rushmoor	34	1	0	0	0	0
11	St.Edmunds	28	0	1	1	0	0
12	Sedgefield	39	1	1	1	0	0
13	Solihull	21	1	0	1	0	1
14	S. Tyneside	23	1	1	1	1	0
15	Stockport	22	1	1	1	0	1
16	Stockton	37	1	0	1	0	1
17	Sunderland	2	1	1	1	1	1
18	Thanet	10	0	0	1	0	1
19	Wigan	46	1	1	1	0	0
20	Aylesbury	35	0	0	0	0	0
21	Bassetlaw	6	0	1	1	0	1
22	Bracknell	1	1	1	1	0	1
23	Braintree	24	0	0	1	0	1
24	Chester	51	0	0	0	0	1

25 Colwyn	11	0	1	1	0	1
25 Crawley	49	0	0	1	0	1
27 E.Devon	5	0	0	1	0	1
28 Forest of Dean	50	0	1	0	0	0
29 Glyndwr	32	0	0	0	0	0
30 Gravesham	33	1	0	0	0	1
31 Kennet	20	0	1	0	0	0
32 Kings Lynn	36	0	0	1	0	1
33 Lliw Valley	15	0	0	0	0	0
34 Mid-Sussex	45	0	0	0	0	0
35 Neath	29	1	0	0	0	0
36 N.Devon	14	0	1	1	0	1
37 N.Wilts.	13	0	0	1	0	0
38 Rhondda	12	1	1	1	0	1
39 S.Oxfords.	7	1	1	1	0	1
40 S.Staffs.	42	0	0	1	0	0
41 Teignbridge	47	0	0	0	0	0
42 Torridge	19	0	0	0	0	0
43 W.Derbyshire	31	0	1	1	0	1
44 W.Lindsey	38	0	1	0	0	0
45 Wychavon	3	0	0	1	0	1
46 Barrow	9	1	1	1	1	1
47 Blackpool	25	1	1	1	0	1
48 Blaenau	8	1	1	1	0	1
49 Bradford	48	1	0	0	0	1
50 Cambridge	30	1	1	1	0	1
51 Ceredigion	26	0	1	0	0	0

SECTION 7

Results from NMREG application

Input parameters. D1 1982/83

No. of observations : 47

No. of independent variables: 5

Solution reached

Independent variable

1	-0.22143
2	0.29589
3	0.51222
4	0.04824
5	0.47995

Input parameters. D1 1987/88

No. of observations : 47

No. of independent variables: 5

Solution reached

Independent variable

1	-0.24891
2	0.02011
3	0.43431
4	0.48740
5	0.32536

Input parameters. D2 1982/83

No. of observations : 24

No. of independent variables: 5

Solution reached

Independent variable

1	-0.16622
2	0.21201
3	0.52341
4	0.11710
5	0.44825

Input parameters. D2 1987/88

No. of observations : 24

No. of independent variables: 5

Solution reached

Independent variable

1	0.22451
2	0.13387
3	0.14926
4	0.22361
5	0.29758

Input parameters. D3 1982/83

No. of observations : 23

No. of independent variables: 5

Solution reached

Independent variable

1	0.19629
2	0.19180
3	0.28513
4	0.08527
5	0.29333

Input parameters. D3 1987/88

No. of observations : 23

No. of independent variables: 5

Solution reached

Independent variable

1	0.26909
2	0.17130
3	0.16578
4	0.09806
5	0.22314

D4 1982/83

Input parameters.

No. of observations : 51

No. of independent variables: 5

Solution reached

Independent variable

1	0.04956
2	0.16464
3	0.39924
4	0.18808
5	0.37214

D4 1987/88

Input parameters.

No. of observations : 51

No. of independent variables: 5

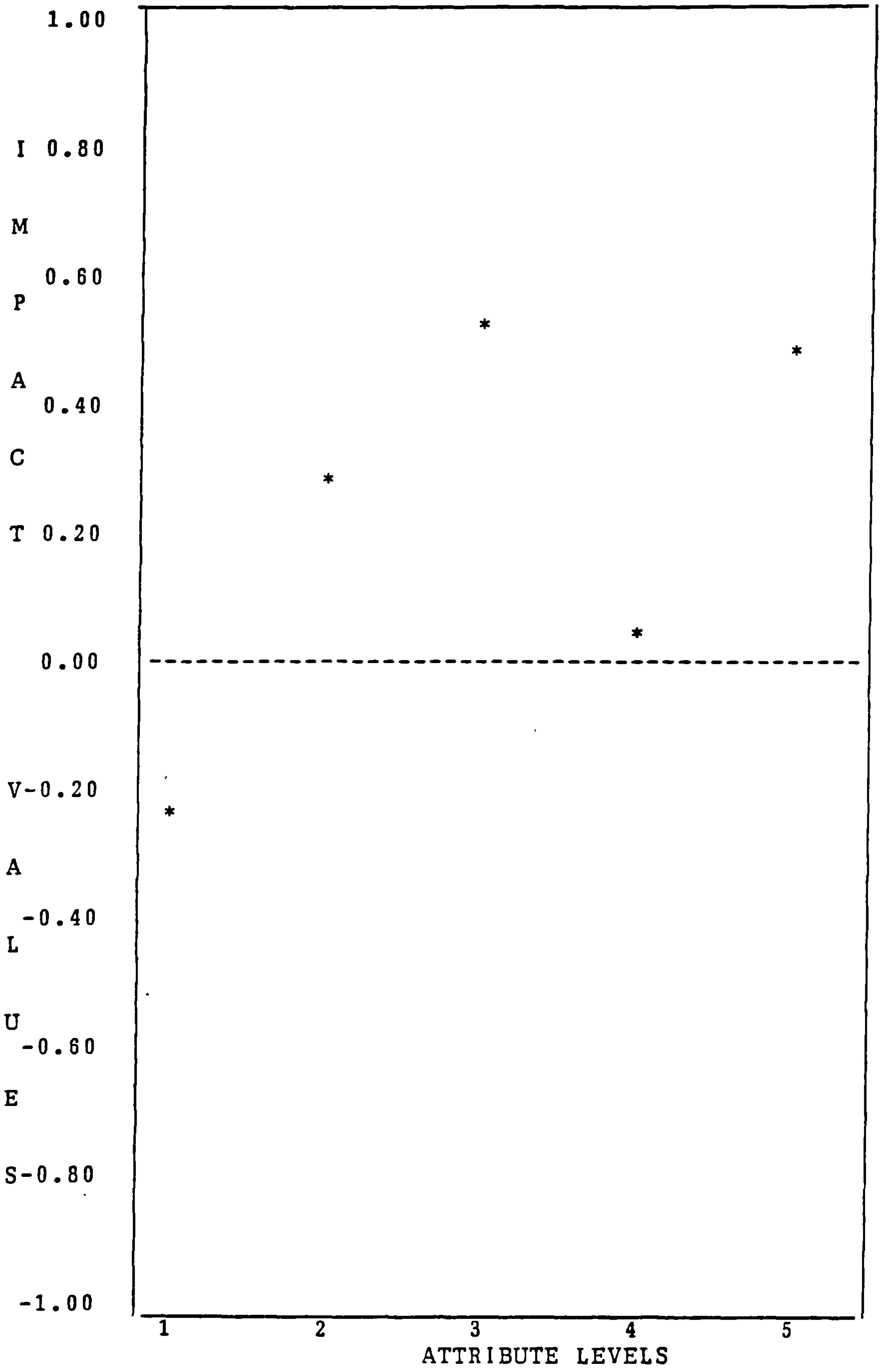
Solution reached

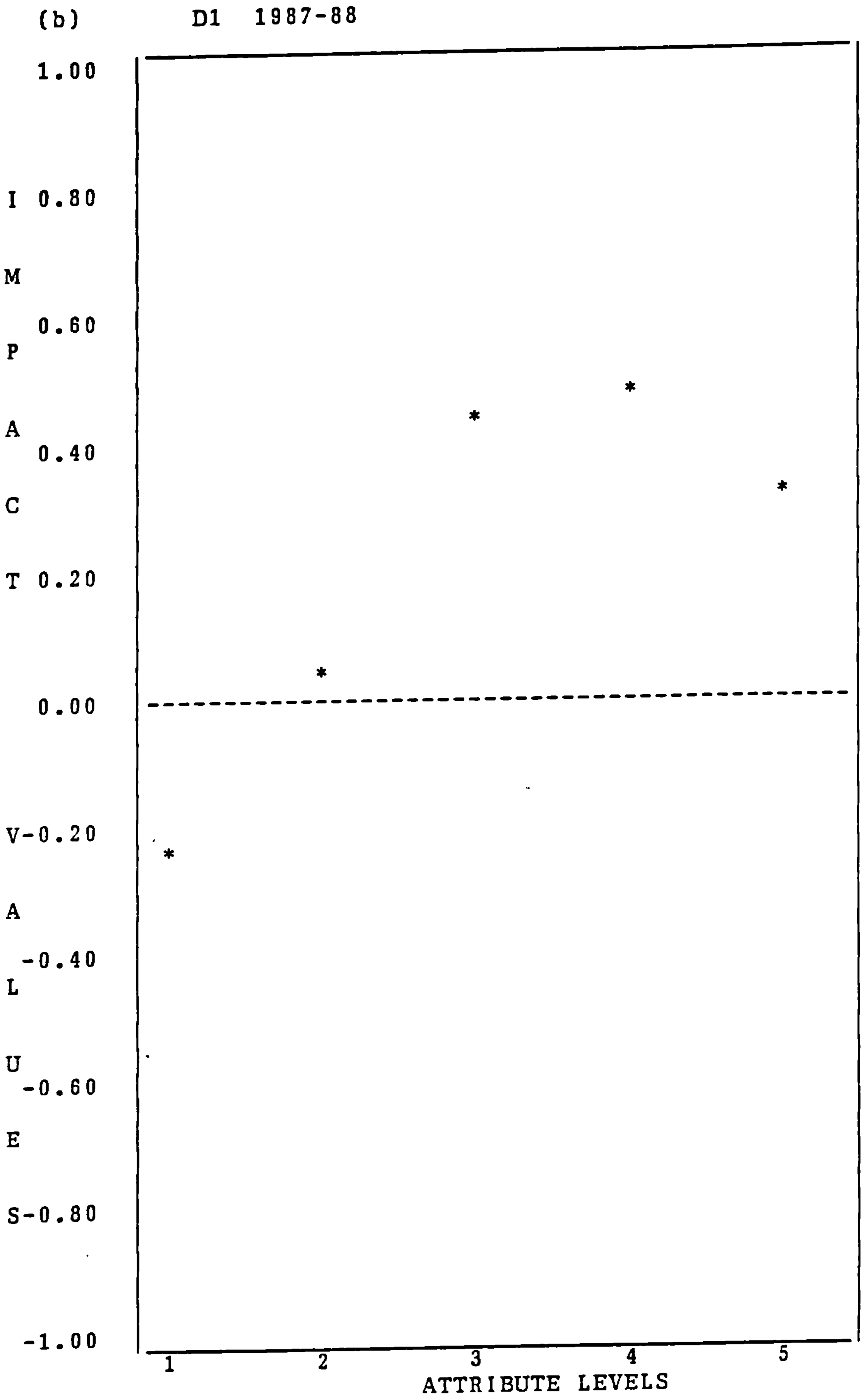
Independent variable

1	0.02439
2	0.24175
3	0.31885
4	0.28430
5	0.26961

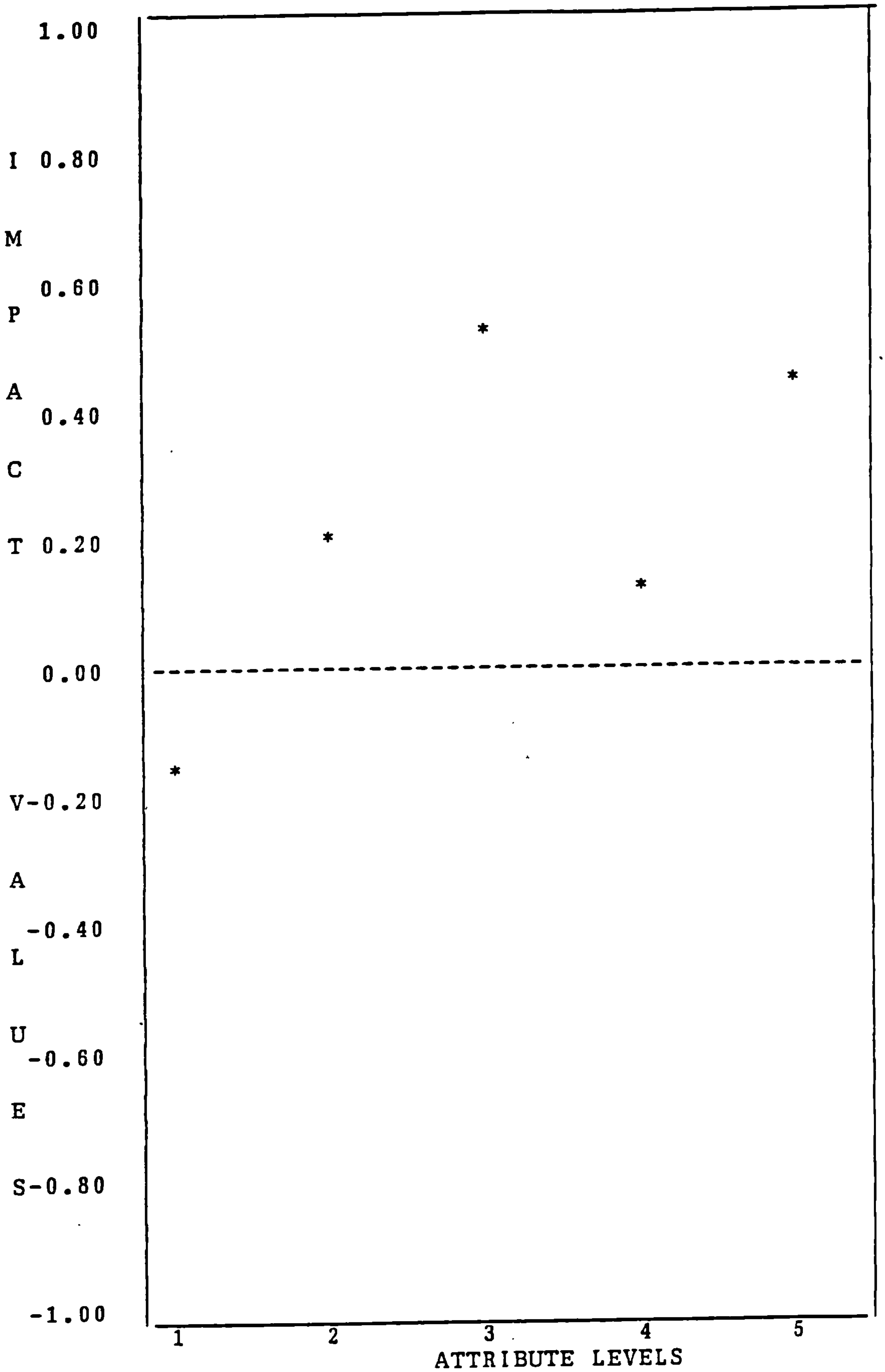
Figs. DA 7 (a-h) illustrate the impact values of the attributes.

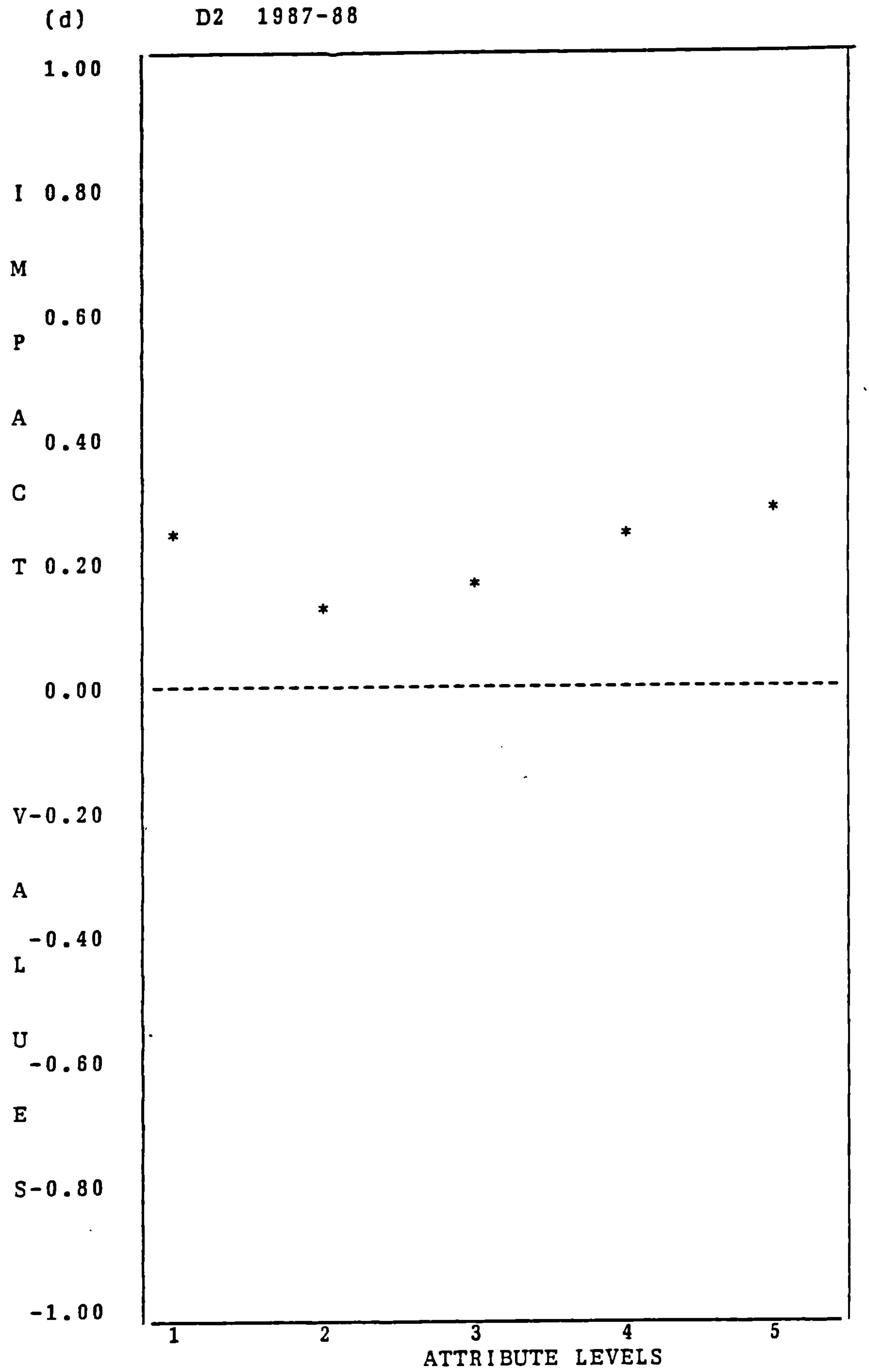
Figs. DA 7 (a-h) Impact values of attributes
(a) D1 1982-83

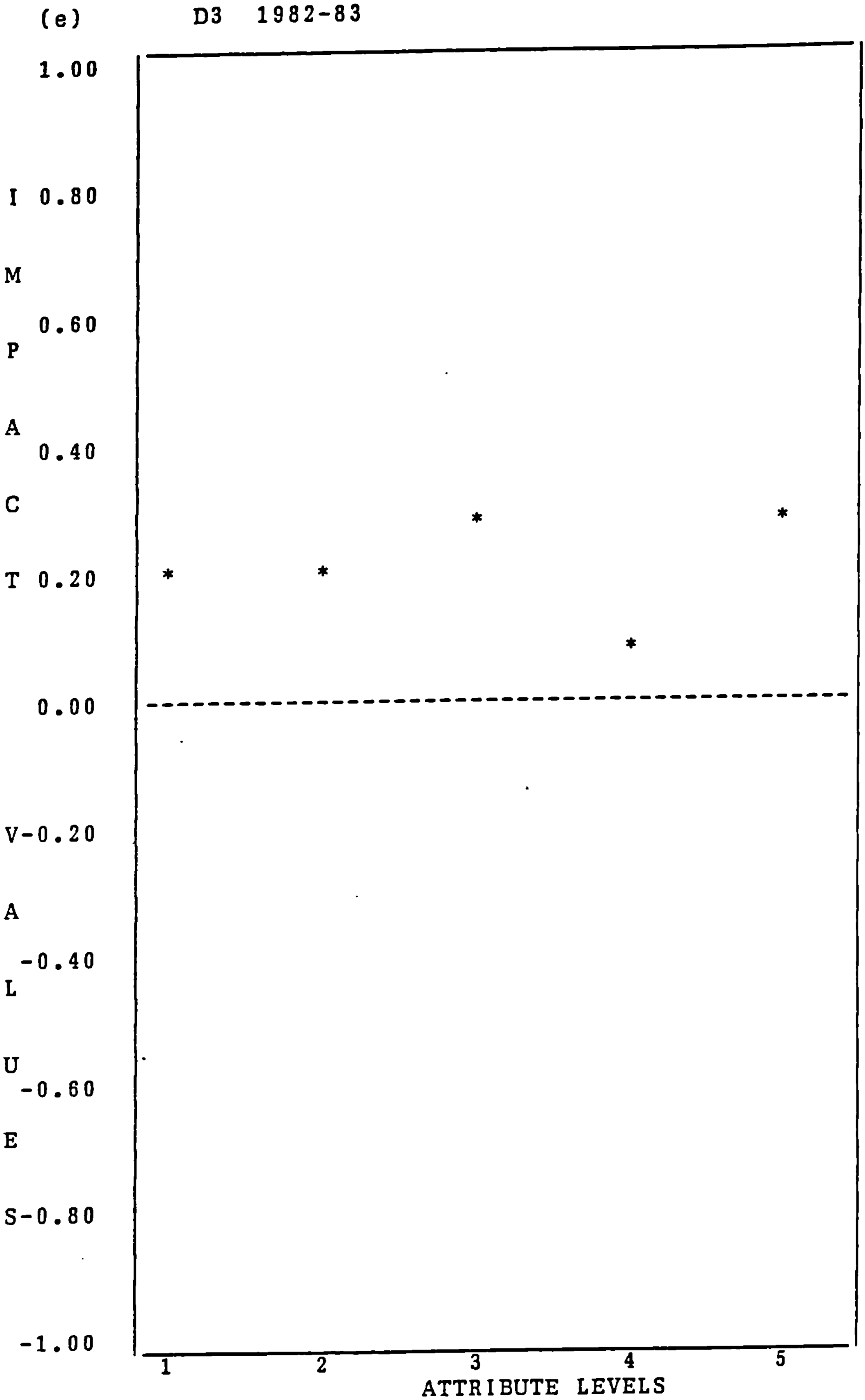


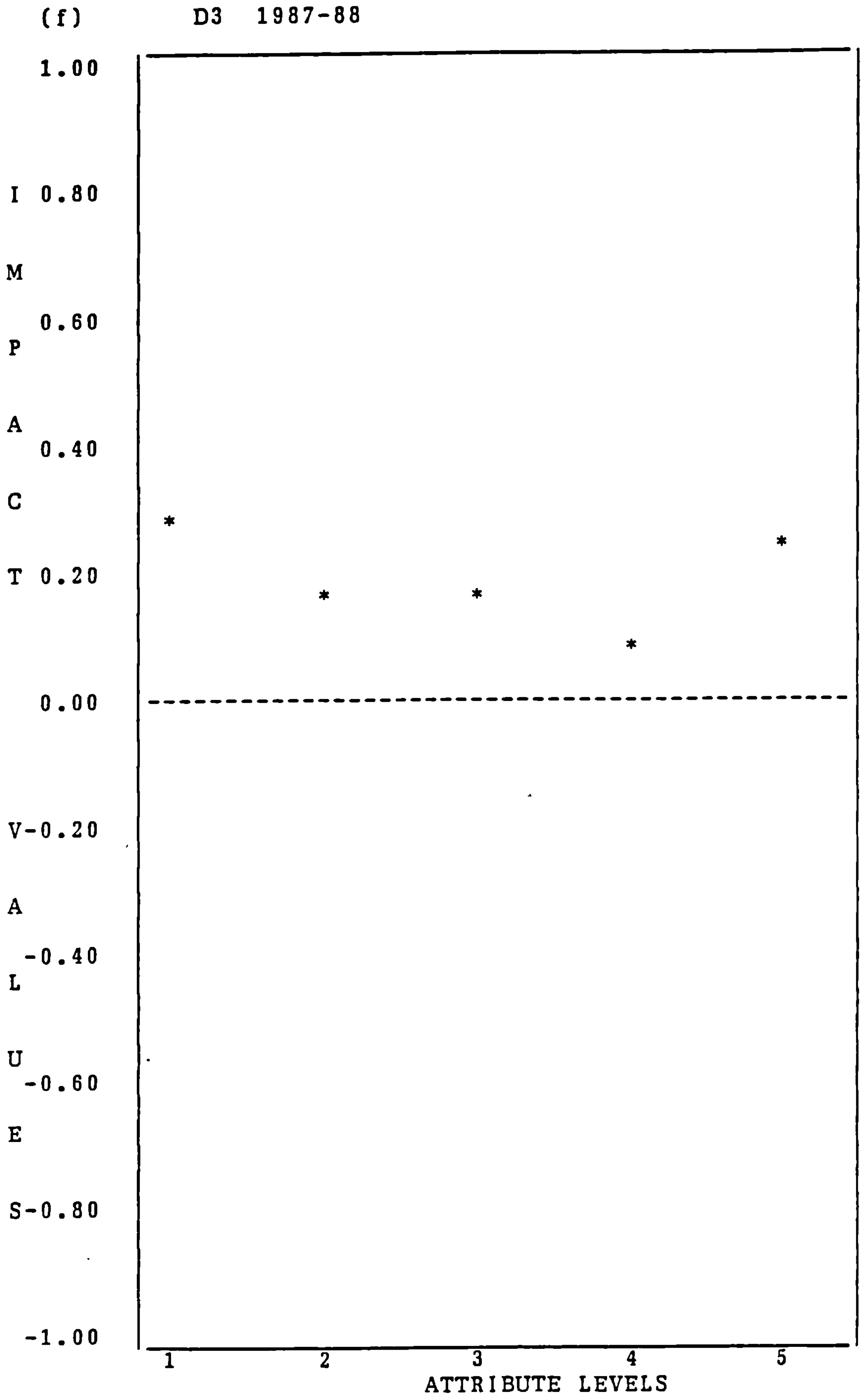

(b) D1 1987-88
1.00
0.80
0.60
0.40
0.20
0.00
-0.20
-0.40
-0.60
-0.80
-1.00
IMPACT VALUES
1
2
3
4
5
ATTRIBUTE LEVELS

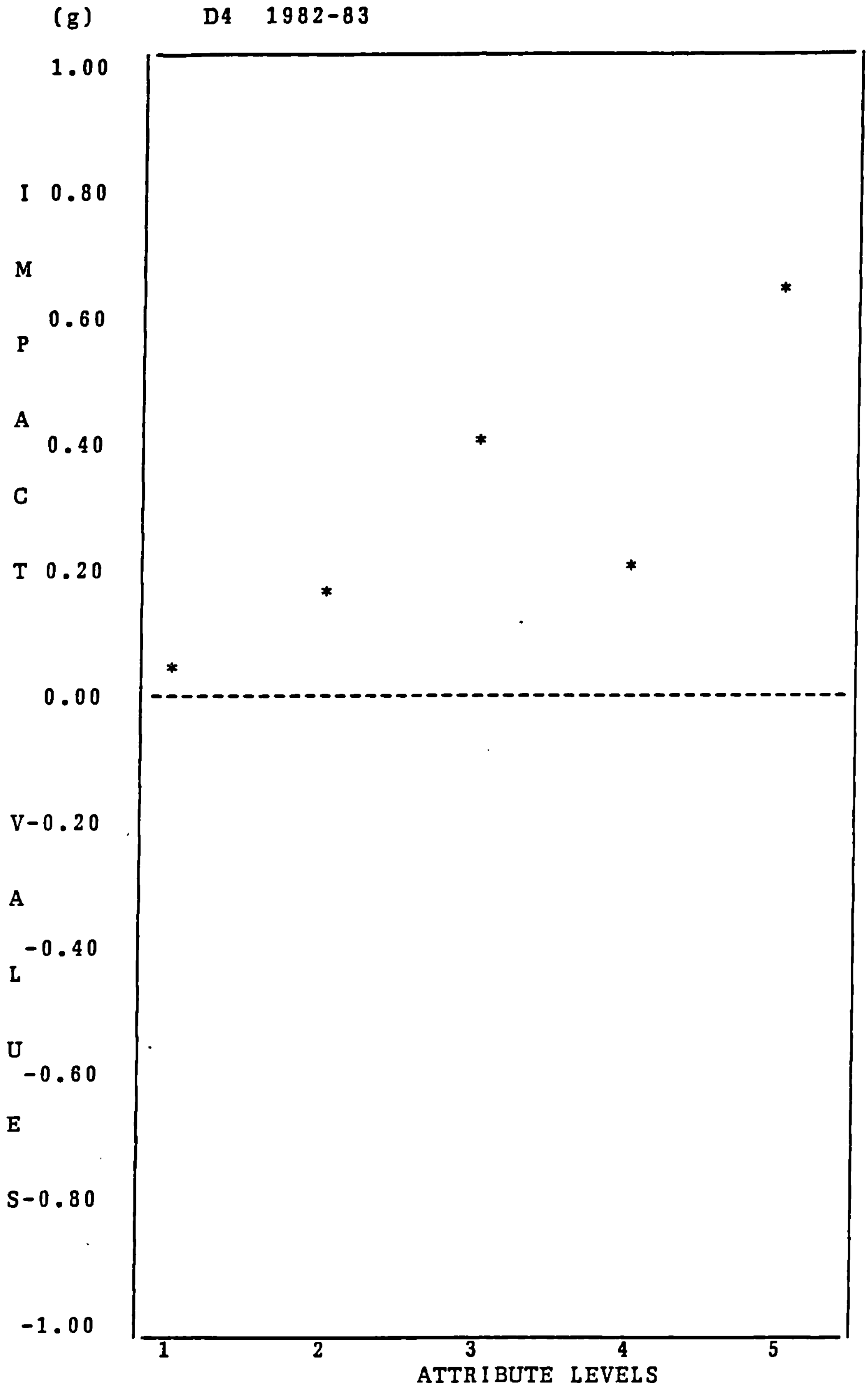
(c) D2 1982-83

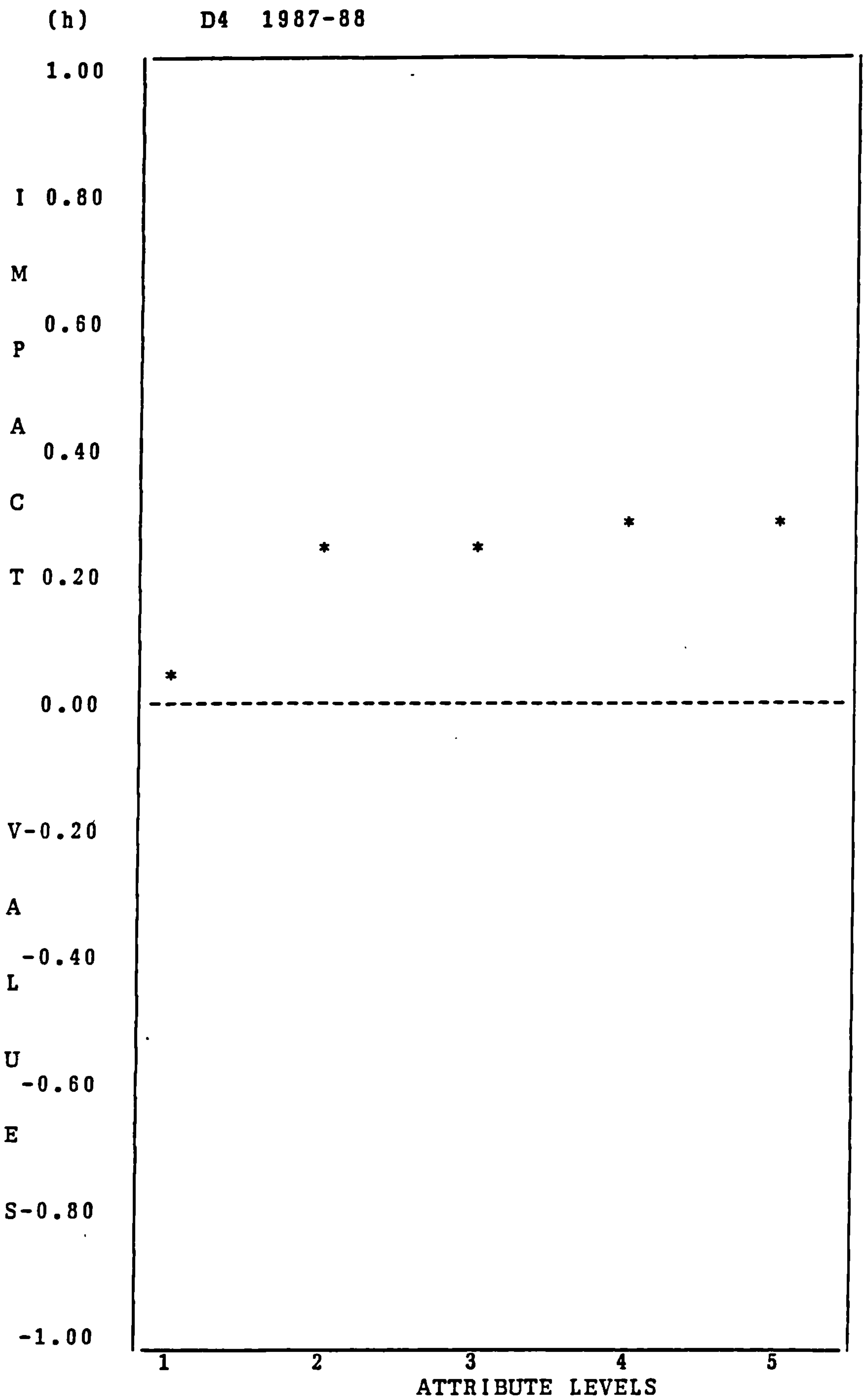

IMPACT VALUES
1.00
0.80
0.60
0.40
0.20
0.00
-0.20
-0.40
-0.60
-0.80
-1.00
1
2
3
4
5
ATTRIBUTE LEVELS


(d)
D2 1987-88
1.00
0.80
0.60
0.40
0.20
0.00
-0.20
-0.40
-0.60
-0.80
-1.00
IMPACT VALUES
1
2
3
4
5
ATTRIBUTE LEVELS


(e) D3 1982-83
1.00
0.80
0.60
0.40
0.20
0.00
-0.20
-0.40
-0.60
-0.80
-1.00
IMPACT VALUES
1
2
3
4
5
ATTRIBUTE LEVELS


(f) D3 1987-88
1.00
0.80
0.60
0.40
0.20
0.00
-0.20
-0.40
-0.60
-0.80
-1.00
IMPACT VALUES
1
2
3
4
5
ATTRIBUTE LEVELS


(g) D4 1982-83
IMPACT VALUES
1.00
0.80
0.60
0.40
0.20
0.00
-0.20
-0.40
-0.60
-0.80
-1.00
1
2
3
4
5
ATTRIBUTE LEVELS


(h)
D4 1987-88
1.00
0.80
0.60
0.40
0.20
0.00
-0.20
-0.40
-0.60
-0.80
-1.00
IMPACT VALUES
1
2
3
4
5
ATTRIBUTE LEVELS