'Measuring the Efficiency of Management in Nonprofit Organisations'

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DEDICATION

TO MY **MOTHER** AND **FATHER**
WHO HAVE MADE SO MUCH SACRIFICES
FOR THE SAKE OF MY EDUCATION

Abstracts

Ahmad MLOUk

Measuring the Efficiency of Management in Nonprofit Organisations.

THE prime purpose of this study is to explore and open up a new doorway by using a relatively new technique for measuring efficiency in nonprofit organisations (NPOs), public and private NPOs. This study employs **Data Envelopment Analysis (DEA)** to measure the efficiency of management in the said organisations. That is, DEA is employed to determine: the overall technical efficiency (OTE), pure technical efficiency (PTE) and scale efficiency (SE) which is derived from the above two measures.

This attempt is the first of its kind to use DEA for measuring the efficiency of management in universities. It used four factors of inputs (research expenditure per FTE academic, cost per student, student/staff ratio and average 'A' Level scores) and six factors of outputs (degree results, the non-completion rate, the destination of graduates in full-time employment and in further education and training, average research output, and research income per FTE academic) to provide a single summary measure of relative efficiency for each university that included in the study. With the aid of DEA, we were able to identify those universities which are relatively efficient (about 50 % of the sample were identified as best-practice) and those which are relatively inefficient by providing the following measures for each university, OTE, PTE and SE. The study also identified the target of outputs and inputs for those relatively inefficient universities if they were to become efficient. Furthermore, peer groups are identified for inefficient universities. The latter can therefore consider strategies, policies and practices that are pursued by their peer groups, so they can adopt to become efficient.

Finally, this study provides measures of the relative efficiency of a university that compared to others being evaluated. The study's most significant contributions may be summarised as that, after taking advantage of DEA's unique characteristics, we produced a set of one single summary measure of relative efficiency for the universities we have studied and it also indicates to the level(s) and area(s) of possible improvement which are needed before a relatively inefficient institution is to become efficient.

Table of Contents

CHAPTER		Page
One:	**INTRODUCTION**	1.1
1.1	Statement of the Problem	1.2
1.2	Purpose of the Study	1.4
1.3	Measuring Performance in NPOs	1.7
1.4	Conceptual Background	1.10
1.5	Drawing Boundaries for the Study	1.15
1.6	Research Development	1.16
Two:	**NONPROFIT ORGANISATIONS AND THEIR ENVIRONMENT**	2.1
2.1	Definitions	2.1
2.2	Characteristics of NPOs	2.3
2.2.1	Nondistribution Constraint	2.4
2.2.2	Multiple Publics	2.5
2.2.3	Nonprofit Objectives	2.7
2.2.4	Provision of Services Rather than Physical Goods.....	2.10
2.2.5	Professional Domination	2.10
2.2.6	Public Scrutiny and Nonmarket Pressures	2,12
2.3	Governing Board and Top Management in NPOs ..	2.14
2.3.1	Top Management	2.15
2.4	The Rules and Regulations Governing NPOs	2.17
2.4.1	Registration of Charities	2.18
2.4.2	Advice and Assistance	2.19
2.4.3	Supervision of Charities	2.19
2.4.4	Consent to Sales	2.22

2.5 Taxation Treatment 2.22
2.5.1 Income Tax 2.23
2.5.2 Capital Gains Tax 2.25
2.5.3 Inhertiance Tax 2.26
2.5.4 Some Restrictions 2.27
2.5.5 Restrictions on Expenditures 2.28
2.5.6 Gifts by Companies 2.29
2.5.7 Payroll Deduction Schemes 2.29
2.5.8 Exempt and Excepted Charities 2.30

Three: COMPARISON BETWEEN DEA AND OTHER METHODOLOGIES FOR EFFICIENCY MEASUREMENT IN NPOs 3.1

3.1 NPOs and Performance Evaluation 3.1
3.1.1 Choice of Performance Measures 3.4

3.2 The Question of Effectiveness 3.5

3.3 Measures of Efficiency 3.7
3.3.1 Technical Efficiency 3.8
3.3.2 Scale Efficiency 3.11
3.3.3 DEA Versus Ratio and Regression Analysis 3.12
3.3.4 Farrell's Measure of Efficiency 3.17
3.3.5 Byrnes, Fare, and Grosskopf Measure of Efficiency 3.19
3.3.6 Constrained Facet Analysis 3.21
3.3.7 Measures of Efficiency Dominance 3.24

Four: DATA ENVELOPMENT ANALYSIS AS A MODEL FOR PERFORMANCE EVALUATION 4.1

4.1 Deficiencies in Prior Methods Employed 4.2

4.2 Measuring Relative Efficiency of Units Performing Similar Tasks 4.4

4.3 The Assumptions Underlying DEA Approach 4.5

4.4 The Model: DEA 4.6
4.4.1 The Linear Programming Equivalent 4.10
4.5 Managerial, Programme and Technical Efficiency 4.18
4.6 DEA and Business Enterprises 4.24
4.7 Sensitivity Analysis 4.25
4.7.1 Variable Addition/Disaggregation Effects 4.26
4.8 Strengths and Limitations of DEA 4.28

Five: THE MANAGEMENT OF HIGHER EDUCATION INSTITUTIONS IN A TURBULENT ENVIRONMENT 5.1

5.1 The Setting of Objectives 5.1
5.2 Organisational Structure 5.6
5.2.1 The University Management 5.9
5.3 Organisational Change 5.12
5.3.1 Understanding Organisational Change 5.13
5.3.2 Managing Change Effectively 5.14
5.3.3 Institutional Arrangement for Responsiveness. 5.16

5.4 HEIs and Business Organisations 5.19

5.5 Leadership in HEIs 5.20
5.5.1 Leadership Skills 5.20
5.5.2 Sources of Power 5.21

5.6 Leadership and Institutional Success 5.22
5.6.1 Faculties and Departments 5.24
5.6.2 Executive Style and Institutional Culture ... 5.25
5.6.3 The Dual Role Model 5.27
5.6.4 The Domain of Preofessional Leadership 5.28

5.7 Leadership Development in Universities 5.32
5.8 Higher Education for the Future 5.42

Appendix to Chapter Five 5.39

Six: PERFORMANCE ASSESSMENT IN UNIVERSITIES: AN APPLICATION OF DEA 6.1

6.1 University Outputs and Performance Measurement 6.3

6.2 Consideration of Selected Inputs and Outputs. 6.9

6.3 Inputs and Outputs Explained 6.12
6.3.1 Measuring Unit Costs 6.13
6.3.2 Degree Results 6.15
6.3.3 Non-Completion Rates (NCRs) 6.17
6.3.4 Research Rating and Allocation of Resources . 6.17
6.3.5 Research Income 6.19

6.4 Assumptions about the Experiment 6.23

6.5 Results and Conclusions Discussed 6.25

6.6 The Relatively Least and Most Efficient DMUs. 6.29

6.7 Some Limitations od DEA 6.30

Seven: SUMMARY OF STUDY FINDINGS AND AVENUES FOR FURTHER RESEARCH 8.1

Appendix A: A List of Performance Indicators and Their Definitions A.1

Bibliography..... B.1

Capter One

INTRODUCTION

An interesting and growing area of research in economics is the nont-for-profit sector, or the nonprofit organisations **(NPOs)**. Despite the importance of these organisations in terms of their size and their economic and social contribution to society, not much interest has been directed to them.

This study will cover all types of nonprofit organisations (NPOs) in an economy such as those charity, education, health and religion. The focus will be on educational institutions with special emphasis on higher education institutions like universities and social welfare charities.

Over the last twenty years, management practices have been influenced by the management science and other aspects of technologies. Management science started to have strong impact on the decision-making processes by applying scientific approaches and techniques to operations, strategic planning and problem solving. These made the best utilisation of scarce resources and helped in the development of new programmes.

The effective use of management science goes back to 1937 (Davis et al. 1987) when The Britain Government employed a team of natural scientists, mathematicians, and engineers to study the strategic and tactical problems associated with the defence of the country. The team's objectives were to determine the most effective utilization of limited military resources. After the successful application to military problems, management science techniques were also applied to

the private sector.

In order to apply properly the techniques of management science to decision making and problem solving processes, it is necessary to be able to utilise them in management control and evaluation conducts. To this end, Charnes and Cooper (1980) indicated that the next phase in the growth of management science should be directed to the evaluation and control of management. This will be the prospective consideration and concentration of this thesis.

1.1. Statement of the Problem

Economists have developed a sophisticated theory to explain and predict the rational behaviour of individuals and firms. According to this theory, the former allocate their resources in a way which achieves them the highest possible utility. While the latter do so in order to maximise profits and minimise costs respectively.

Furthermore, there has been intensive research into various aspects of management. This resulted in a better theory along with many methods of applications. These together with the economists' theory apply basically to profit-making enterprises due to the heavy emphasis on elements like earnings, profits, And costs which centralise on monetary terms.

In addition to the above, economists have extended their theory to include the public sector. However, there still appears to be a missing link among the various activities in the economy. Ireland and Johnson (1970), with this respect indicated that, if economics is to provide a framework in which the many activities of individuals and firms may be categorised and integrated, then economic theorists should

consider the diversity of institutional mechanisms through which individuals strive to achieve their objectives. That is making a clear reference to the activities of NPOs. In short, there has been little attention devoted to NPOs in comparison to business enterprises and public sector organisations.

A great deal of the resources that are made available to NPOs are the society's. Those resources should be applied properly to their cause in order to achieve the sought objectives with the least possible costs. In addition to the direct government funding of many NPOs, there is also the lost revenue to the government from the exempt donations made by individuals and business enterprises to philanthropic or charitable organisations. Furthermore, when individuals make donations to a particular organisation on the light of its objectives, they like to see these donations applied towards the goals that are set by this organisation. Therefore, my study shall contribute towards providing a means by which effective control over the activities of NPOs can be exercised.

As NPOs are of a unique nature and characteristics, they can be classified neither with the public sector organisations, nor with business enterprises. However, there has been little research on this type of organisations, and this cannot be related to their contribution or to their importance in any economy. In the US for example, the philanthropic sector spent $129.2 billion in 1980[1] and the total giving (contributions) to this sector totalled $48.74 billion in the same year and nearly doubled by 1986 to become $87.22 billion (Rodney 1987).

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[1]. This exceeds the total budgets for many nations added up together.

1.2. Purpose of the Study

The aim of this research is to review, validate, and extend the available information on performance evaluation in NPOs. This shall result in adopting and perhaps developing some aspects of data envelopment analysis **(DEA)** as a linear programming based technique. DEA technique will be used for measuring the efficiency of English Universities.

The main purpose of this study is to consider various aspects of NPOs and to concentrate on the issue of performance appraisal in these organisations. Hence, the available methods which can be used will be studied, and a technique that is suitable to performance assessment in NPOs will be identified. It will be shown that **DEA** as a method for performance appraisal is the best for achieving this objective in NPOs. This technique will be tested in the context of higher education sector (i.e., universities). It will be demonstrated that despite some limitations, DEA is the most advantageous method for handling the problem of performance measurement in NPOs. When properly applied, it can serve as a good criterion for the allocation of resources, a warning device on weak performance for NPOs. Hence, it provides a reasonable and effective management tool for performance appraisal and control procedures in NPOs.

In summary, the purpose of this research is to study and then develop a better approach for evaluating performance in nonprofit organisations. These organisations have multiple objectives for which market forces cannot be relied upon to promote efficient operations. Therefore, the goals which will be achieved are: to provide a way to evaluate and determine the best possible performance and allocation of resources for nonprofit organisations (NPOs) in general with special reference to universities, and to provide a means for management control processes.

This research focuses on DEA, an approach developed by Charnes, Cooper and Rhodes in (1978), and then by others to measure efficiency in NPOs. DEA is able to handle multiple outputs and multiple inputs simultaneously and does not require any 'a priori' specification of weights or explicitly formulated functional relations. The resulting efficiency measures are independent of the measurement units used and hence offer the advantages of flexible choices for the units of measures for each input and each output which are of interest.

Charnes, Cooper and Rhodes (1978; 1979); Banker (1984; 1986); and Charnes et al. (1981) among others, provided a precise mathematical formulation and development which relates these DEA ideas to a variety of other ideas such as Pareto optimality, production function frontiers, activity analysis and efficiency in economics[2].

These properties are appealing for use in NPOs for two reasons. Firstly, the functional relations are difficult to prescribe for the kinds of activities such organisations undertake. Secondly, the choices of 'a priori' weights are subject to challenge and are difficult to defend for many of the outputs and some of the inputs in NPOs. The fact that DEA can be brought into contact with other ideas such as Pareto optimality and related concepts of efficiency frontiers suggests that the already existing knowledge from disciplines such as economics, accounting and management can be utilised for interpretive purposes. It also means that the concepts from these disciplines are available as a guide to synthesis,

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[2]. As shown by Charnes et al. (1978), DEA also generalises the engineering and natural sciences single output to single input definitions to deal with multiple outputs and multiple inputs. DEA also relates these ideas to a new extremal principle as it will be seen.

testing and extension of DEA and other alternatives.

A point worth mentioning here is that, DEA has been tested against other alternatives such as ratio analysis and regression analysis which are commonly used for efficiency measurement (See Sherman, 1981 and 1984). It was noted that DEA performed better than either of these approaches in indicating and locating inefficiencies in the operation of NPOs. Compared to alternative approaches, DEA proceeds via a series of optimisations, one on each observation, as contrasted to the usual least squares regression approach which proceeds via a single optimisation across all observations. As a result, DEA is able to identify and estimate the amounts of overall technical efficiency **(OTE)**, and pure technical efficiency **(PTE)**. From these two measures, we can then calculate the level of scale efficiency **(SE)** for each DMU being evaluated. Hence, the inefficiencies that are present in the observations generated by each DMU being evaluated.

The property of optimising on each observation also makes DEA suitable for individual organisational control and performance evaluations which are wanted for different managerial purposes. In this respect, DEA provides analogous criteria to those commonly used in standard cost accounting systems. This also leads to types of testing that differ from the one employed for use in least squares regressions. For example, standard types of statistical tests use the properties of small or large samples to test the validity of ensembles of observations. That is, the test is obtained by reference to known properties of sampling behaviour. In particular, it evaluates each such observation, and it does so by reference to the most comparable subsets in the set of observations. The latter are readily identifiable as members of the same relevant facet by available DEA computer programmes. In any event, the term 'most comparable' may be

given a precise meaning by reference to the fact that the relevant comparison set is the one that assigns the highest possible relative efficiency score to the DMU being evaluated.

1.3. Measuring Performance in NPOs

It is more difficult to measure performance in a NPO than in a profit-making enterprise. Service is a less measurable concept than profit and many of the outputs of NPOs have no market prices and therefore cannot easily be given values. In addition, it is also more difficult to make clear-cut choices among alternative courses of action in NPOs, because in this type of organisations the relationship between costs and benefits cannot be known, and even the amount of benefits cannot be determined. Despite these difficulties, an organisation must be controlled, its management performance must be assessed and a trial test of whether the goals set by the organisation are achieved must be carried out. The management of a NPO must do all what it can to ensure that resources are used efficiently and effectively. In addition, an outside party like commissioner or auditor will need to be involved too in the assessment process.

Within the business sector, the market structure performs a relatively satisfactory cost/benefit analysis via the money measure of profits and returns on investment which are associated with different activities. These measures, either realised or projected, can be used to guide the allocation of resources within and among firms. Similarly, any associated non-profit activities can be evaluated by reference to the effect they might have in reducing or enhancing the profits of a business firm. Thus, profit is a cost/benefit measure even for remote activities because the market mechanism provides a measure of the value of goods and services

business sell. That is, the money value of sales represents the pertinent output and the money value of purchases represents the corresponding input measure with the difference representing the net profit from operations, from which all other activities can be supported. Net profit thus provides an indicator of both efficiency and effectiveness of the enterprise. Effectiveness in this context refers to the directions being pursued such as the markets to be served, while efficiency refers to the costs and benefits which accrue from pursuing these directions[3].

One further problem facing the higher education sector and other NPOs in allocating their resources is the unavailability of market for their outputs. Consequently, there is no guidance for their investment decisions. Therefore, the universities and other NPOs do not have direct access to measures of the value of their services.

Most of the university outputs and some of the inputs cannot be reduced to monetary terms. The cost of an additional professor is known, at least in principle, but what about the benefits?. Similarly, how much benefits does a square foot space of building generates?. That is, without some way of evaluating these kinds of outputs we are driven back to some combination of judgement and input cost minimisation in any search for optimum performance.

Due to the lack of a market mechanism, the higher education sector and other NPOs have relied upon the development of historical unit costs for specified activities. Hence, various ratios derived from these costs along with judgemental adjustments and evaluations have generally served

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[3]. See Kohler's Dictionary of Accountants, 6th. ed., pp.190-191.

as support for the various budgets and allocations and more recently, performance indicators. Ever existing problems with this process involve the need to avoid budgetary allocations which are excessive, not in terms of the objectives being pursued but in terms of outputs to inputs relations achieved in pursuit of those objectives. This excess may take one or two forms; the first is a response to inefficient operations and the second is the inclusion in the budget of what is sometimes called budgetary slack.

If a decision making unit **(DMU)**[4] was operating inefficiently in the past, Budgeting on historical costs basis would mean that this unit was rewarded for its poor operations. That is providing excessive funds and other resources which serve to sustain and perhaps increase inefficiencies.

The comparison of particular activities among various DMUs or even among departments whether within a DMU or across a number of DMUs may help to locate such inefficiencies. However, two factors are missing from such comparisons, even at a departmental level. For one thing, inputs such as staff/students ratios need to be related to multiple outputs such as the number and quality of graduates research produced, and income earned. For another thing, the relationship between these inputs and other inputs such as floor space per student and member of staff is a heterogeneous one. Finally, such a 'piecemeal' approach does not lend itself to the overall evaluation that is really wanted.

All of the above refers to inefficiencies and efficiencies in

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[4]. This notation, DMU, will be used throughout the thesis to refer to an organisation, institution, firm, university etc.

performance and should not be confused with budgetary slack. The latter, when it can be located, indicates that an organisation has exaggerated its budget, perhaps to absorb anticipated cuts in its funding request. The budgetary slack may take the form of building excess resources into the budget, or understating production capabilities. In either case, the requested funding associated with the requirements of a particular organisation can be excessive if the costing of the inputs has been done accurately.

The opposite of budgetary slack can also occur when a DMU demands too little funding, especially when anticipated evaluation is going to be based on the amount of allocated resources compared to the outputs. Therefore, this DMU may increase its outputs without using additional funds, by simply reallocating the available resources and increasing its overall outputs at the cost of quality. One such possibility occurs when that DMU is not operating on its efficiency frontier. Another such possibility occurs when an increase in some inputs produces more than proportional increase in outputs because this DMU is not operating at its most productive scale size as well as due to increasing returns to scale. Finally, even when operating at its most productive scale size, inefficient mixes of inputs may be used and therefore produce inefficient mixes of outputs. These possibilities and others will be dealt with in more details in chapter three.

1.4. Conceptual Background

Efficiency, Effectiveness, and related issues

Generally speaking, there are three conventional measures for reviewing and evaluating the performance of management in NPOs. These measures focus on three different aspects: propriety, effectiveness and efficiency. Was the action taken

by the management proper ?. How effectively did the organisation do its job ?, and how efficiently did the organisation use its resources?.

Propriety is used in evaluating management performance in the sense of the objectives pursued and the methods used to achieve those objectives. Firstly, propriety is concerned with whether objectives are legal, moral, or ethical and secondly, propriety can arise around the methods used to attain these objectives. This measure shall not be considered any further since we assume that the system under consideration is well established and hence, there is no need to question further the validity of its objectives, neither the methods by which these objectives are attained.

Effectiveness is defined in two ways: the ability to set objectives and the ability of management to achieve the stated objectives.

Efficiency, can be defined as a difference or as a ratio of benefit or outputs achieved to resources or inputs used. The process in which resources are combined to obtain outputs enters into the efficiency of an organisation's performance. Like in commercial accounting, it is often the case that efficiency is measured by comparing an actually attained output to a standard or predetermined output. Furthermore, in engineering the following formula is frequently found in the literature:

$$\text{Efficiency} = \frac{\text{Net Output}}{\text{Total Input}} = \frac{\text{Output - Losses}}{\text{Input}}$$

In engineering, outputs and inputs are measured in terms of energy, so that a natural unit is thereby provided. Also the law of conservation of energy requires that the energy

produced (output) must not exceed the energy consumed (input). Since all units of measurement are the same, a dimensionless ratio results with $0 \leqslant \text{efficiency} \leqslant 1$.

This concept, however, is not applicable to NPOs. It is not possible to specify a single output, neither it is possible to predetermine a maximum achievable level of output. In other words, no production function has been developed which can forecast the maximum output given the multitude of resource combinations and environmental conditions. Thus, NPOs must rely on relative measures of efficiency derived from empirically based comparison of inputs and outputs measures. The efficiencies of interest, can be subdivided into three components: technical, price or allocative, and scale efficiency.

Technical efficiency is the ability to obtain the greatest possible output from a given input, in the single output case, or to produce a given output with the lowest possible amount of input. It refers to the absence of waste. In economics, this is usually formalised for the single output case saying that output must be maximised for any collection of inputs used. That is, technical efficiency is achieved only if no input can be reduced without increasing some other input and/or reducing output by the indicated reduction of any input.

Price or allocative efficiency occurs when the inputs are related to their prices in manner that results in minimum total cost of any output level that may be specified. Naturally, this presupposes an absence of technical inefficiencies since otherwise the total cost could not be minimal.

Scale efficiency is calculated as the ratio of overall technical efficiency to pure technical efficiency and it

refers to situations in which decreasing returns need to be considered in order to achieve maximum output. This may be assessed from the cost side when multiple outputs are to be considered or it may be idealised in terms of a single output to single input elasticity. In any case, technical efficiency is required for this concept to be meaningful. For any scale of operation and in the case of business firms for instance, profit maximisation implies that costs have been minimised for the corresponding output and this in turn implies that technical efficiency also has been achieved. Evidently, achieving technical efficiency is fundamental to the other two forms of efficiencies, and in economics it is usually assumed to have been achieved by the force of market competition. In our case, we are dealing with NPOs where the assumption of perfect competition is not defensible. Hence, we cannot make such an assumption and are therefore, forced to turn to DEA or like concepts and methods to ascertain whether technical efficiency has been achieved.

Generally speaking, we will need to deal with multiple inputs and multiple outputs, and access to market or market like prices or weights of relative importance are generally not available. Hence, we will need to alter the concept of scale efficiency for use in such multiple cases. Similar adjustment will be needed to deal with multiple outputs and inputs in order to insure that optimality is simultaneously achieved. These topics will attract major attention in subsequent discussions. We will only be able to deal with price or allocative efficiency in very limited ways.

To avoid any need for using 'a priori' weights we shall follow Charnes, Cooper and Rhodes (1978) and adopt the concept of Pareto optimality from welfare economics. This idea enters into DEA, CFA and other concepts of efficiency that we will be using, where it plays a role analogous to its role in welfare economics. In particular, this concept will

enable us to avoid making 'a priori' assumptions about the relative worth (relative weights) to be assigned to different outputs and inputs. On the other hand, this conceptual avoidance offers very little advantage for our purposes unless we can give it operational form. This is done by our use of the efficiency measurement approaches we have already identified in DEA, but in a manner that leads back to the more fundamental Pareto optimality characterisations that are provided by Charnes and Cooper (1961).

The distinguishing characteristic of the efficiency measure used in this study is that for example, when we say unit A is only 90% efficient we want this to mean that a 10% gain in efficiency is possible. We want to apply our measure to input or output magnitudes so that if, say, £100 of input was used with 90% efficiency, then under constant returns to scale, only 90% (or £90) of this amount should have been used to obtain the output levels that were achieved. This is analogous to what is done in many forms of standard cost systems except that we also want to extend this so that it will apply to the efficiencies of output attainment as well as input utilisation.

In summary, we are after something that is very much like the standard cost accounting control[5] used in manufacturing and other private sector enterprises. In particular, we are searching for a system or process analogous to that portion of a standard cost accounting system concerned with promoting and measuring efficiencies, controlling and reducing costs, and variance analysis. We are interested in individual organisational control and want to be able to identify not

[5]. Here we are referring to what are sometimes called "ideal" or "perfection" standard costs. See Horngren (1980), p. 180.

only efficient and less efficient operations but also the sources and amounts of efficiency (or inefficiency) in each pertinent input and output. The main differences between our desired system of NPOs whether in the public or private sector and those standard cost controls used in business and commerce are: (1) For the most part we are restricted to working with actual observations without recourse to the kinds of firm theoretical or engineering studies employed in setting standard costs, (2) we want to be able to track inefficiencies in outputs as well as in inputs, and (3) we want to be able to deal with multiple outputs and multiple inputs simultaneously rather than in the one-at-a-time manner used in the standard setting practices of business enterprises.

1.5. Drawing boundaries for the study

NPOs are those which do not seek to make profit for their owners. They are usually set up for the sake of providing goods and/or services either free of charge or at least below the free market prices, or perhaps, there is no market price available for their goods and/or services. NPOs play a very important role in any economy. Their range includes educational institutions, scientific and social research, health care, art and culture, public broadcasting, social services, religion, public advocacy and charities in the many forms. Whatever their form may be, their financial resources are from one or a mixture of the following: sales of goods and services, endowments, individual and business donations, and government funds.

Since nonprofit organisations are a wide range of different organisations, it is natural for them to diverge in their missions, objectives, goals and characteristics. They vary from those who by the very nature of their mission cannot

make enough money to cover their expenditures like religious and voluntary organisations, to those which could make profits, but for a variety of reasons, decide not to, and operate within the umbrella of the tax-exempt, not-for-profit form.

In business firms, success is measured by the amount of profits that is earned, the market share, management-employees relations, product innovation and development. By contrast, in a NPO, management is intended to provide the best possible service or good with the available resources to yield the greatest possible social benefits. Hence, success is measured by the level of service the organisation provides and by how well this service is rendered taking into account the amount of resources used. In other words, the success of a NPO should be measured by how much it contributes to the welfare of the society when compared to its rival organisations (those operating in the same field and providing similar services) while of course, allowing for any variations in the level of resources available to each organisation.

1.6. Research development

In summary, the fundamental purpose of this research is to develop a way of using DEA and related approaches to evaluate performance as a basis for efficiency evaluation en route to allocating or reallocating resources in NPOs. In a sense we are developing a standard cost system for NPOs that is an adjunct to the budgetary process.

Here follow a brief description of the coming chapters:

In chapter two, a definition of the nonprofit organisations is provided, the characteristics of these organisations are

discussed together with a brief reference to their governing boards and senior management. The chapter also draws on some of the most important administrative issues within the legal framework in general and the taxation treatment of charities in particular. Therefore, this chapter defines the boundaries for the study.

Chapter three deals with the issue of efficiency measurement in NPOs, hence it provides a full account for the available methods of performance evaluation in NPOs. The discussion covers the following methods: ratio and regression analysis; Farrell's measure of efficiency; Byrnes, Fare and Grosskopf's measure; and other DEA variants like constrained Facet Analysis and Measure of Efficiency Dominance.

Chapter four studies Data Envelopment Analysis as a model for efficiency measurement in NPOs, its underlying assumptions and formulation. It also considers the usefulness of DEA and the scope of its applications.

Chapter five considers the issues of objectives' setting, policy and decision making in universities, and the organisational structure in higher education. It further discusses other aspects such as organisational changes and the ways to managing them and the leadership in the context of higher education.

Chapter six deals with the practical application of Data Envelopment Analysis for efficiency measurement in NPOs. The inputs and outputs used in the study were selected and studied in some details and then a number of DEA assessments were performed on the selected sample of 35 universities in England. The results were recorded and analyzed, hence conclusions were drawn.

Chapter seven concludes the thesis with a summary of the

major findings of this study, the implications of these conclusions for both internal and external policy and decision makers whether for higher education sector or any other NPOs. The chapter concludes with some suggestions for possible advancement in the use of DEA technique for measuring efficiency in NPOs.

Chapter Two

NONPROFIT ORGANISATIONS AND THEIR STRUCTURAL AND LEGAL FRAMEWORK

Introduction

Private NPOs have not received enough attention during the fast development of major theories and research in the twentieth century as it was indicated in the previous chapter. In order to proceed with our research, the following points will be discussed in this chapter. First, nonprofit organisations will be defined. Second, their characteristics and the nature of their services will be described and distinguished from business and public sector organisations. Third, the top level of management in NPOs will be considered in conjunction with the regulations which govern NPOs. Finally, tax treatment and their restrictions will be examined.

2.1. Definitions

It is worth mentioning at this stage that throughout the thesis three terms will be used interchangeably. These are: Nonprofit organisations (NPOs), Charities, and Philanthropic organisations.

Nonprofit organisations (NPOs) are those which do not seek to make profits for their owners or to any individuals who may have substantial control over them. They are usually set up for the sake of enhancing the community's welfare by providing goods and/or services either free of charge or at least below the free market prices.

Hansman (1980), and James and Rose-Akerman (1986) among others proposed the following definitions within the U.S. context. The first one suggested that NPOs are those which are barred from distributing their net earnings to officers or directors who might dominate them. The second one considered NPOs as private organisations that are prohibited from distributing any financial residual.

According to Oxford Dictionary, charity represents the Latin word 'caritas' which means love, dearness and care. In general, charity means goodwill to the poor, to worthy causes and to benevolent institutions.

The legal definition of charity dated back to the Charitable Uses Act 1601 which named and defined a list of purposes which were held to be charitable[1].

The Act set up a body of Charity Commissioners whose function was to protect the public interest arising out of trusts for those objects which the 'preamble' to that act declared charitable. The classification contained in the preamble remained the only general classification of charitable purposes on the statute book until it was replaced by the Charities Act in 1960. This Act simply stated that 'Charitable purposes' means purposes which are exclusively charitable according to the law of England and Wales. That is, the most applicable classification of charitable purposes in the legal sense comprises four main divisions: trust for the relief of poverty, trust for the advancement of education, trust for the advancement of religion and trust for other purposes beneficial to the community, not falling under any of the preceding divisions.

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[1]. Charitable Uses Act (Statute of Elizabeth I), (43 Eliz.1, c.4)

By looking at the above classification, it can be seen that it also is no more than a summary of the 1601 preamble list of purposes. Especially the fourth division, 'purposes beneficial to the community' are simply those listed in the preamble. By law, however, to be charitable, the income of any trust must be applied exclusively to charitable objects. This means that it must not be possible for any of the funds to be applied to objects which the law does not recognise as charitable. Therefore, any trust must be applied to the public benefit, to the community as a whole or a significant section of the community.

The third and last term to be defined is philanthropic organisations. The word philanthropy is composed of the two Greek words: Philos which means love, and anthropos which means man. Hence, philanthropy means the love of mankind. However, according to Webster's dictionary, philanthropy means 'the spirit of active good will towards one's fellows' and deals with the broad problems of humanity by preventing calamity.

Having defined the terms which will be used throughout the thesis, we turn to consider the characteristics of NPOs and the ways that they differ from other types of organisations. We shall also consider to what extent that the economic and organisation theories explain and predict the behaviour of NPOs and the environment that they operate in.

2.2. Characteristics of NPOs

NPOs are a wide range of different institutions that vary in their missions, goals, objectives and characteristics. There are those which cannot make enough money to cover their expenditures like voluntary and religious organisations and those which could make profits but for a variety of reasons, decide not to, and operate within the umbrella of the

tax-exempt, not-for-profit form.

Although NPOs differ in their objectives, characteristics and nature they have one common aim, that is the advancement of the community's welfare position. They share within themselves more similarities than with profit-making or public sector organisations.

Generally speaking, NPOs may be characterised by some four major characteristics (see Lovelock and Weinberg, 1984; Anthony, 1980; Knoke and Prensky,1984; and Benedetto, 1987). These are: the nondistribution constraints, multiple publics, nonprofit objectives and provision of services rather than physical goods.

2.2.1. Nondistribution constraint

As stated above, NPOs do not operate for profit. Therefore, it is safe to argue that their success or failure cannot be measured in strictly financial terms. The lack of even a theoretical goal of profit maximisation makes it more difficult to choose among strategic and tactical alternatives. This is a fundamental distinction of NPOs.

The objectives of NPOs include education for the public, help for the poor, enhancement of religious beliefs, health services for those in need, protection to the environment and so on. These kinds of activities are sensitive to quantitative measures.

Among the effects of this constraint on the conduct of a productive organisation is the reduction of the incentive to gain an advantage from a favourable position in respect to its counterparts. The organisation then becomes less aggressive in its relation with other agents. Hence, NPOs differ from profit-making businesses in that way, since

producers are better informed about the characteristics of the product or service. Therefore, profit seeking firms can easily end in harm from the consumers whose request and expectations of the quality or quantity are being neglected. Hansmann (1980) maintained that these organisations are a possible institutional answer to a particular kind of 'market failure'. That is the usual contractual arrangements cannot protect the purchasers at a reasonable cost.

Furthermore, nondistribution's constraint reduces the incentive to violate moral standard of behaviour. It also reassures potential contributors by guaranteeing that the donations would not be used up in larger incomes for those who control the organisation. This makes the organisation more trustworthy for its potential donors.

2.2.2. Multiple Publics

These include beneficiaries/clients, financial supporters, controllers/ watchdog groups. In addition, there are the suppliers, employees, managers, board of trustees, regulators, and other groups. In business enterprises, clients pay money for the product or service received. In NPOs, the clients who receive the goods or the services and the donors or tax payers who provide funds are often unrelated groups. Thus, fund raising and service delivery may involve separate but interrelated activities to two different publics. Monitoring and controlling the activities of NPOs is the responsibility of the watchdog groups who are unfortunately weak, especially when it comes to performance measurement, allocation of resources, and the soliciting of individual donors contributions.

Clients pay money for the products or services purchased from business firms. Hence, these firms cannot survive unless they provide adequate goods and services in terms of quality,

quantity and prices because clients are the essential financial sources of these firms. Thus, the free market is the dictator of profit-making organisations. Also, there are some nonprofit organisations which manage to cover all of their expenditures from clients. These include hospitals, schools, colleges and research groups. These organisations as Anthony and Herzlinger (1980) called 'client-supported organisations' are subject to the free market pressure. However, most of NPOs obtain a significant proportion of their finance from sources other than clients, such as donations from individuals, business and government. Anthony and Herzlinger (1980) called these organisations 'public-supported organisations'. In the case of these organisations, the clients who receive the goods and/or services and the donors or tax payers who provide the funds are often unrelated groups. Thus, fund raising and service delivery involve separate, but interrelated activities to two different publics.

For business organisations, the amount of profits, returns on investments, growth and revenues provide a fair measure of performance. However, in NPOs there is no such corresponding measure of output. For Public-supported organisations the amount of available resources is fixed by appropriations, as in the case of government grants, or by income from endowment and annual giving. This is the case with many educational, and charitable organisations. They are constrained from expansion and thus any additional clients may place a strain on their resources. Furthermore, some NPOs are expected to decrease their clients' number, rather than add to it. Hence, they have contrary motivations to those of business organisations, decreasing rather than increasing number of clients. Despite this fact, in many cases a steady long-term increase in demand on their products or services in the market place could still count towards the success of such institutions (i.e. the number of applicants to a particular university or college). This would indicate that an

organisation which is facing high demand on its service is running a good service and gaining good reputation. As the success of a profit-making organisation depends on its ability to satisfy its customers, the success of a NPO depends on its ability to satisfy both, those who receive the service and those who provide the resources. This can be derived only from the satisfaction of clients and the achievement of the purposes of the organisation. Therefore, NPOs must bare a great responsibility of accounting to the community they serve.

In conclusion, both profit and nonprofit-making organisations must satisfy the clients they serve in order to survive and achieve their goals. However, the difference between them is that NPOs must satisfy those who finance them first while profit making organisation do well by just making their clients happy.

In some areas like education and health for-profit and nonprofit organisations operate together and for-profit ones do better. Hodgkinson (1973) indicated that there are an estimated 10,000 proprietary schools in the US with an enrolment of 9 million students. These schools have no endowment and no income from alumni fund drives he indicated, and yet they survive. Universities and other NPOs might learn from the practices developed by these schools.

2.2.3. Nonprofit Objectives

As NPOs do not usually operate for profit, it has been argued that their success or failure cannot be measured in strictly financial manner. In addition, there is a lack of a theoretical goal of objective function optimisation, which would lead to a difficulty in choosing among different alternative courses of action. The question which imposes itself is; are there alternative measures to the financial

ones?. This question will be tackled at this stage.

Any organisation must use its available resources effectively and efficiently to produce its outputs and try to secure the achievement of its targets. Effectiveness measures the extent to which the organisation's outputs accomplish its goals, and efficiency measures the relationship between inputs and outputs. For profit-making organisations, profit could provide a mare measure of both effectiveness and efficiency. However, for most NPOs, output cannot easily be measured in quantitative terms. In addition, most NPOs have multiple objectives that producing several outputs. Therefore, a feasible measure of each output is required which at the same time can handle all of the outputs which to accomplish different objectives.

(a) Measuring Performance in NPOs.

Even if the output of NPOs could be measured in financial terms, and that the difference between expenditures and revenues can be known. This measure is of no good value for NPOs. There are two reasons for this: first, since profit is not one of their objectives and their common goal is to use the available resources in the best possible way to achieve the highest level of advancement of the community's welfare. However, the ideal financial performance over a long period of time a NPO should have balanced accounts. Second, is that Although revenue is an important measure for profit-making organisations it should be viewed differently in NPOs. For instance, the amount of revenue in any one year does not reflect the overall performance because in most cases it is not related directly to either the amount of service, or to the accomplishment of the organisation's goals. However, in the long-run, an increase in revenue may indicate that potential financiers are viewing the organisation to be effective and consequently are willing to increase their support.

(b) Consequences of absence of the profit measure.

The absence of profit as a performance indicator in NPOs causes several difficulties not only in measuring and assessing performance, but also in performing other tasks of NPOs. Some of these difficulties are:

(1) Difficulties in choosing among alternative courses of action. Management in a profit-making organisation would debate a certain proposal on the ground that, by how much the profit of the organisation will be affected taking into consideration the level of risk involved. While in a NPO since there is no objective function to be maximized, managers will view a proposal in terms of the relative importance that they personally attach to the several objectives of the organisation (i.e. how much the addition of a professor will add to the effectiveness of a university? compared to other expenditures on providing certain equipments or facilities).

(2) Difficulties of relating costs to benefits. Since there is no accurate ways of estimating the output of most NPOs, then, it is very difficult (if not impossible) in many cases to make judgement to what effect that a certain amount of expenditures will have on achieving the goals of the organisation.

(3) Difficulties of decentralization. Most, if not all NPOs have multiple goals, and because there is no good ways of measuring performance in attaining these goals. Hence, important decisions cannot be delegated to lower level managers. For this reason we find that in NPOs most problems must be resolved in their headquarters rather than in regional or local offices. This could be a reason of management inefficiency because central managers cannot spare the time needed for solving such problems and at the same time may lack the understanding of a particular problem related to a specific region.

2.2.4. Provision of Services Rather than Physical Goods

Most NPOs produce services rather than physical goods and they are labour intensive, while most profit-making organisations produce tangible goods and are capital intensive. Therefore, to monitor tangible goods is far more easier than monitoring services as well as monitoring non- human activities than human ones.

Demands for goods or services can rarely be in the form of a straight horizontal line. Hence, regarding goods, they can be produced and stored when demand is at a low trends awaiting customers orders when demand is high. In contrast, Since services cannot be stored, the revenue from unused capacity is lost forever. Taking into consideration the fact that the idle capacity is of a very low marginal cost and sometimes zero cost, for example unoccupied places at a university and empty seats in a theatre. Therefore, service organisations, whether for profit or not-for profit cannot and should not be compared to those which produce tangible goods when considering issues such as performance assessment. Finally, it may be said that management in NPOs should benefit from business firms with regard to their managing of services and other aspects. But such a move is faced with two difficult steps, from business enterprises to NPOs and from goods to services.

2.2.5. Professional Domination

In most NPOs, top people are professionals such as physicians, scientists and teachers. These people are better informed about job performance in their particular specialisation, but they may have motivations that are inconsistent with good resource utilisation and their success as perceived by their professional colleagues reflects these motivations. Therefore, they are motivated by dual standards: (a) those of their organisations and (b) those of their professional colleagues.

The former standards are related to organisational objectives, the latter may be inconsistent with organisational objectives. The rewards for achieving organisational objectives may be less potent than those for achieving professional objectives.

Furthermore, professionals who are departmental managers tend to work only part-time on management activities. They spend a substantial amount of their time doing the same work that their subordinates do. For example, the head of the chemistry department teaches and does research in chemistry. In organisations which are not dominated by professionals, management tends to be a full-time job, and managers do not do the same type of work that their subordinates do.

By nature, professionals like academics, researchers and physicians prefer to work independently. However, as the essence of management is getting things done through collective action, professionals with such a character are not suited to the role of managers.

In NPOs promotions criteria may not place much emphasis on efficiency and effectiveness in relation to the organisations and they are not always an accurate reflection of the individuals worth to the organisation. In education for example, emphasis is placed on profession rather than management skills. As a conclusion, professionals tend to underestimate the importance of the management function. In addition, financial incentives tend to be less effective with professional people either because they consider their current compensations to be adequate or because their primary satisfaction comes from their work.

Even the leadership job may require more management skills than professional skills, tradition often requires that the manager of a NPO to be a professional. That is, the head of a research group is a scientist, the president of a university is an academic, and the head of a hospital is a physician.

However, this tradition seems to be diminishing indicating good signs for better management in NPOs. Professionals tend to give inadequate weight to the financial implication of their decisions. The physician feels that no limit should be placed on the amount spent to save a human life, but such an attitude in a world of limited resources may be unrealistic.

2.2.6. Public scrutiny and nonmarket pressures

Most NPOs are subject, at least in theory, to close public scrutiny because of their role in the provision of services, an expressed desire for openness in government, and a need to prevent abuse of any kind. For public and NPOs, profit is not among their objectives, they are heavily subsidised and they are not constrained by the 'discipline of the market place'. Instead, they may be expected to provide services or serve market segments that a profit-making organisation would find uneconomic. Furthermore, political or social pressures may force retention of inefficient services and economically sub-optimal strategies.

Although NPOs are different from business enterprises, they have to perform many tasks that are common to both types of organisations, these tasks are as follows:

(a) Accounting and financial management; records and information for planning and communication are necessary, money must be raised, budgeted and managed,

(b) tax planning; even for tax-exempt NPOs, they must engage in this task to protect their exempt status and to minimise potential taxation of any unrelated income that they may earn,

(c) production; given the level of inputs, NPOs should also seek to produce the optimum level of outputs,

(d) personnel management; people must be recruited, trained, assigned, and promoted in the course of the organisation's work and,

(e) other tasks like marketing activities (purchasing and selling), public relations, research and development are also necessary for NPOs.

In order to achieve our target, it is necessary to study many of the aspects which can influence the performance of NPOs. For example, the financial and human resources, the environment they operate in, their management structure, their financial systems, and the measurement and control criteria they employ.

It is an unrealistic claim for one person over a limited period of time to be able to cover such a wide range of issues in depth. Hence, when seeking a particular target one must be specific and selective. Therefore, the steps which may lead to achieving the target we set may be as follows:

1. the characteristics of NPOs,
2. the rules and regulations which govern NPOs,
3. the financial and administrative systems of NPOs,
4. the financial and human resources available to NPOs,
5. the environment which NPOs operate in and
6. the methods and criteria which are used for performance assessment in NPOs.

On examination of the above points, we look at some performance measurements and control criteria that are applied or could be applied in NPOs. The evaluation and control of operating activities in NPOs is the most striking problem. One aspect of this problem is the absence of an acceptable summary measure of productive efficiency. Since most NPOs do not operate in competitive output markets, measures such as net income and rates of return do not exist. However, if they ever

do, they do not provide useful indication of operating efficiency.

2.3. Governing Board in NPOs

In private profit-making organisations shareholders have the right to control their organisations and to exercise their ultimate authority whenever they want to. But policy and management responsibilities are vested in the board of directors, which derives its power from the shareholders. In turn, the board delegates power to the president, who serves at the board's pleasure, act as the board's agent in the administration of the organisation and who is replaced if there are serious differences in interest or opinion.

In NPOs, the corresponding line of responsibility is often not clear. The presumably controlling body does not necessarily represent the source of the organisation's power. Instead of being selected formally by those ultimately responsible for the organisation, it may be self- perpetuating, selected by outside parties, or selected 'de facto' by the top management of the organisation. Its members are seldom paid for their services. The governing board represents the public interest, either the interest of the general public, or in some cases the interest of that part of the public that is providing the major financial support. What course of action best represents the public interest is much more difficult to decide than the course of action that is most likely to increase the profit for a profit- making firm. Thus, governing boards tend to be less influential in NPOs than in profit-making organisations.

The governing board of a NPO, as a minimum has the responsibility of acting when the organisation is in trouble. Since there is no profit measure to provide an absolute warning, the personal appraisal by board members of the health of the organisation is much more important in a NPO than in a

profit-making corporation. In order to have a sound basis for such an appraisal, board members need to spend a considerable amount of time learning about what is going on in the organisation, and they need to have enough expertise to understand the significance of what they learn. However, many governing boards do an inadequate job of this. There is not even a general recognition that this is the board's responsibility. In universities, Anthony (1980) indicated that the function of a board is to hire a president and back him.

Another example concerning the function of the board of trustees of universities shows that they are less involved in the operational management of the institution. Patridge (1974) concluded from a detailed analysis of 7,000 board actions recorded in the minutes of over 100 meetings by 19 trustee boards of public colleges and universities that only 6 percent of the decisions were planning decisions. Most actions were routine decisions on administrative and operational matters, and about 25 percent of these were ratification of decisions previously made by the administration.

2.3.1. Top Management

Most organisations have a 'Number One' person who is the boss, the president, the chief executive officer (CEO) etc. In most business organisations the CEO has responsibility for everything. However, in many NPOs the CEO does not have such overall responsibility. For example, the president of a university may say that he or she is the leader of a 'community of scholars', and that he or she should not become involved in many aspects of the university management. For instance, the Number One person in a hospital often has the title of 'medical director' which has the implication of lack of involvement in non-medical matters.

Furthermore, Number One person usually spends much time on

political or politically related activities which leaves them with less time to spend on the internal activities. These management inadequacies of the Number One person could be overcome by selecting a fully qualified manager as the number two person and giving that person full responsibility for the operation of the organisation.

One of the important characteristics of NPOs is that the relatively low compensation of top management. As an example, a survey by Bowen (1987) showed the average of 1987 salaries of chief executive officers of medium-sized universities to be $50,800, compared with about $131,000 for the chief executive officers of medium-sized business companies in the United States. For the next highest manager, the salaries were $43,000 in universities and $120,000 in businesses. The same survey showed the salaries of tradesmen and unskilled workers to be about the same in universities as in business. The reasons behind these differences in management compensation are not entirely clear. It probably reflects a lack of understanding on the part of decision makers and those who control funds as to the importance of the management function and the importance of compensation as a motivating device. Some believe that NPOs should not use bonuses or other forms of incentive compensation.

The characteristics of NPOs that were described above can be grouped into two classes, one technical and the other behavioural. The former consists of matters described under the heading, the absence of the profit measure, that is, the difficulty of measuring outputs and the relationship between inputs and outputs. What is important about this class is that the problems are inherent in NPOs. Improvement in performance appraisal are indeed possible, and the problem is so important that a considerable effort to make such improvement is worthwhile. The latter, consists of all other headings that considered and the significance of these behavioural characteristics are: (a) proper understanding and education

can bring to the right path the behavioural factors which obstruct good management control, and (b) improvements in the technical area are likely to have some real impact on the management control process if other problems are overcome. Hence, if performance measures are improved, this would put enormous pressures on higher authorities in NPOs to cope with highly competitive performance and things will improve.

2.4. The Rules and Regulations Governing NPOs

As indicated earlier, charity is used in this thesis to refer to the same kind of NPOs which we are concerned with. In the English and Welsh Law, a charity is defined in Section 45(1) of the Charities Act 1960 as "any institution, corporate or not, which is established for charitable purposes and is subject to the control of the High Court's in the exercise of the court's jurisdiction with respect to charities."

The Charity Commission is the official governing body of charities, its constitution is governed by the Charities Act 1960. It was established to provide an inexpensive and simple means of dealing with problems encountered by charities. The Charity Commissioners' jurisdiction extends only to England and Wales[2]. The Chief Charity Commissioner and two other colleagues are appointed by the Secretary of State of whom two should be lawyers. They are promoted from among lawyers within the Commission. The Charity Commissioners **(CCs)** act as a board rather than individually and they do not involve themselves personally with particular cases.

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[2] Charities in Scotland and Northern Ireland are the concern of the Scottish Office and the Northern Ireland Office respectively.

The function of the CCs as indicated in Section 1 of the Charities Act 1960, shall be to promote the effective use of charitable resources. Generally speaking, it can be divided into four different categories; (a) to register new charities and maintain a register of all charities, (b) to provide charity trustees with advice, information and assistance, (c) to encourage and supervise the development of better methods for charity administration and to investigate and check abuses and, (d) to give consent as required by statute to certain transactions.

To provide a fair picture of the CCs' function and the role they play, we shall consider the above points in more details.

2.4.1 Registration of Charities

The number of registered charities in 1987 were over 161 thousands. Only during that year, 3,672 charities were registered. In addition to that number, it has been estimated that there are as many as a hundred thousand charities (Cairns, p.28, 1988) which are not required to register. These are exempt and excepted charities, examples of these are: places of worship and charities which have no permanent endowment or income from property of more than £15 per year or the use or occupation of land. The consequence of this exemption is that charities with little or no investment income but receive large sums of donations and subscriptions are not required to register. Except the above mentioned groups, all other charities are required to register. However, there are no hard measures taken against those which fail to register.

Registered charities are required to submit accounts to the Charity Commission on request or, in the case of charities with permanent endowment, annually. However, due to inadequate regulations and scrutiny, the National Audit Office Survey indicated that only 36 percent of registered charities had submitted accounts over a period of five years and a further

16 percent could not be contacted at the registered address. Hence, the Efficiency Scrutiny Report recommended that failure to submit accounts should be ground for removing a charity from register. Registration in itself, however, does not mean that a charity is run properly and is worthy of support. Nevertheless, it provides a useful service to the CCs in checking abuses and dishonesty in fund-raising and other matters, to Inland Revenue and to charity donors.

2.4.2. Advice and Assistance

Section 1(3) of the Charities Act 1960 indicated that the CCs should promote the effective use of charitable resources and also encourage the development of better methods of administration. This implies that the CCs are responsible for changing the purposes of a charity where these have become unsuitable. They are also liable to advising on the interpretation of the governing instrument and the powers of the trustees and directors. Moreover, they are responsible for appointing new trustees where the chain of trusteeship has been broken, and also encourage the amalgamation of small charities. However, the CCs may not interfere in the administration of charities which is the sole concern of the charity trustees. Their role is limited to a high general standard in administration and they may take steps to remove trustees where there has been neglect or breach of duty.

2.4.3. Supervision of Charities

Malpractice on the part of charities can take the form of bad management and improper activities as well as dishonesty in dealing with the funds of charities. The effectiveness of CCs is of some doubt in relation to supervising the activities of charities and checking abuses. With a staff of only 330 and responsibility of over 161 thousand charities, it is not surprising to find that the CCs have confined their supervisory role to responding to problems which are brought to their notice by members of the public, rival charities, the police or through their own dealings with the charities rather

than initiating enquiries into the activities of charities themselves. Since the Finance Act 1986 became law, the Inland Revenue has been able to pass information to the CCs. In consequence the CCs will now be made aware of cases of breach of trust or misapplication of funds which are discovered by the Revenue when processing claims for tax relief and will be able to take appropriate action.

The accounts which are submitted by charities should provide sufficient information to enable a judgement to be made as to whether they are being administered properly and efficiently. The accounts give some information about the activities undertaken, thus enabling the CCs to take the appropriate course of action when malpractice exists. In exercising their power, the CCs could replace the trustees of a charity or even remove it from the register.

Although charities are required to prepare a balance sheet along with an income and expenditure account, there is no requirement that these statements must be professionally audited unless they are incorporated under the companies Acts, War Charities Act, the Trust Deed or the Charter. The CCs have the power to order an audit to be carried out, but then they have either to pay for it or devote some of their very limited staff number, and in both cases it is costly and may be less done in practice.

In addition, since SSAPs are not fully applicable in the case of charities, each charity has to work out its own methods of dealing with such issues as legacies, budgeting for fixed assets, accruals and covenants, and therefore, the matter is complicated further for an outside auditor. Consequently, because of the different accounting practices used and the way expenditures are detailed, it is difficult to judge whether 'value for money' is obtained.

The National Audit Office Survey disclosed that only four

percent of the accounts submitted were examined. It is impractical to suggest the examination of all charity accounts, but the selection process of the accounts to be examined is very important. The Register of charities should contain every possible information about all registered charities, and from this information, the CCs should be able to decide upon what accounts must be examined.

Section six of the Charities Act 1960 gives the CCs the power to investigate the way in which a charity is administered and to protect its assets. They could carry out an enquiry themselves or appoint some other person to conduct it and report back to them. As a result of an enquiry, the CCs have the power of taking a remedial action under Section twenty. They may remove any charity trustee, officer, or employee who has facilitated breach of trust. The assets of the charity may be frozen and restriction placed upon the transactions which may be entered into on behalf of the charity without the CCs consent.

Recommendations[3] have been made for strengthening the CCs' power. It has been suggested that the circumstances under which the CCs may exercise the powers given to them by Section twenty of the Charities Act 1960 should be relaxed. Therefore, action may be taken if the CCs are satisfied that a charity is not established in good faith, it is not properly administered or that fund raisers and other individuals are taking an excessive amount of the charity's property.

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[3]. These recommendations have been made by the CCs themselves and The National Council for Voluntary Services in their Reports 'Malpractice in Fund-raising for Charity', and the Efficiency Scrutiny Report, respectively.

2.4.4. Consent to Sales

The Charities Act 1960 required that the CCs' consent should be given to the sale, lease mortgage or charge of land which is permanent endowment of a charity, or has been occupied for the purposes of the charity. The CCs may only give consent if they are satisfied that the sale is for the benefit of the charity and that the full market value of the property is obtained. In this case advertisements are required to invite higher offers or the property may be auctioned. This monitoring process requires much of the CCs time and likely to cause delays in many cases. However, the amount of work required from the CCs may be reduced without affecting their monitoring role. Thus, a set of procedures could be required the charity trustees to ensure proper reasoning and price for sales. These procedures must be complied with before any disposition of a charity property can take place.

Section 3 of the Charities Act 1960 established an official custodian for charities whose function is to hold land and other property on behalf of charity trustees. The CCs point out one of their officials as an Official Custodian. The appointment of a custodian trustee avoids the need for assets to be transferred to new trustees on every new appointment and for a number of signatures to be obtained each time assets are to be disposed of. He shall play no part of the administration of the charity which is in the hands of managing trustees and he must deal with the trust assets in accordance with the direction of the managing trustees unless he is aware that to do so would constitute a breach of trust.

2.5. Taxation Treatment

Sections 505 and 506 of the Income and Corporation Tax Act 1988 defined 'charity' for taxation purposes and applies to income tax, inheritance tax and capital gain tax. A charity is defined as "any body of persons or trust established for

charitable purposes."

2.5.1. Income Tax

Sections 505 and 506 of the Income and Corporation Tax Act 1988 provided the principles of exemption to charities from income tax. Exemption from income tax may be claimed in respect of income which forms part of the income of a charity or which is applied to charitable purposes. Income which may be exempted covers only income from the following sources:

(a) the rents and profits of land and interests in land. The exemption covers rent payable under a lease and income from a leasehold as well as free hold property. It does not apply to profit derived from transactions such as the sale of land which constitute capital rather than income payments;

(b) interests, annuities and dividends on stocks and shares; any yearly interest or other annual payment including covenanted payments, interest on a bank or a building society deposit account and money out on loan; and income representing a distribution from a company;

(c) interest, annuities and dividends applicable solely to the repairs of a cathedral, college, church or chapel or building used solely for divine worship; and

(d) profits of a trade carried on by a charity subject to certain restrictions, these restrictions are explained below.

Income from other sources will be subject to tax and in order to qualify for relief the income must be applied to charitable purposes only. That is;

(1) income applied to any purposes that are considered by the courts to be non-charitable will not be entitled to tax relief, an example of this is the income applied to the benefit of private individuals;

(2) the relief available in respect of income applied to meet the cost of the administrative expenses of the charity. However, relief may be refused in cases where expenses have been incurred improperly or where the cost of administration appears to take up an undue proportion of the charity's income;

(3) the charity could retain part of its income as a reserve for the future and this could be reinvested without loosing tax relief. However, a charity which accumulated all its income over a substantial period of time would risk its entitlement to relief and could be removed from the register of charities;

(4) payment under a covenant will not qualify as annual income payments forming part of the income of the charity if the covenantor receives substantial benefits from the charity. On the contrary, they will constitute only one element in calculating the total income of the charity, the cost of providing the benefits being another. In such cases the covenantor is not entitled to deduct tax before making the payments nor may the charity reclaim the tax paid[4];

(5) a charity which is established abroad is not entitled to relief in respect of its U.K. source of income[5].

2.5.1.1. Profits from Trade

The exemption from income tax set out in section 505 and described above do not extend to trading profits except in two

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[4]. Camille and Henry Dreyfus Foundation Inc.v. I.R.C. [1956], A. C39, in Cairns, 1988.

[5]. I.R.C.v. National Book League [1957], Ch. 488, in Cairns, 1988.

situations [Section 505(1) (e)]: **(a)** when the trade is undertaken in the course of carrying out a primary purpose of the charity such as where a theatre trust charges the public for tickets in order to cover the cost of the performances or a trust to preserve an historic house charges an entrance fees in order to meet the expense of maintenance; and **(b)** when the trade is mainly carried out by the beneficiaries of the charity (e.g. workshops for the disabled). The trading profit of voluntary organisations, derived from bazaars, jumble sales and similar fund raising activities will not be taxed if the organisation does not trade regularly, the trading is not in competition with other traders, the activities are supported by the public substantially because they are aware that the profits will be devoted to charity and the profits are actually transferred to charities or applied for charitable purposes. Except what is mentioned above, any trading activities will be subject to income tax. Therefore, in the situation where a charity wants to carry out permanent trading operations, it is recommended that non-charitable companies should be set to undertake such activities to reserve its exemption status.

2.5.2. Capital Gain Tax

Section 145 (1) of the Capital Gain Tax Act 1979 exempted charities from capital gain tax in sofar as property is applicable or applied for charitable purposes. So, any gains arising from assets are applied by a charity in furtherance of its charitable objects are exempt. However, the Finance Act 1986 has now required from charity trustees to take reasonable steps to ensure that property transferred to a non-U.K. body will be applied for charitable purposes if relief from capital gains tax is to be allowed.

A gift or transfer at an undervalue by an individual or a corporation to a charity is wholly exempt from tax being treated for the purposes of the capital gain tax legislation as a disposal giving rise to neither gain or loss (Section 146

(1)). Any gain arising on a sale to a charity will be taxable even if the price was less than the market value.

2.5.3. Inheritance Tax[6].

Section 23 exempt from inheritance tax dispositions by which property is given to charity or is held for charitable purposes. Since March 14, 1983, there has been no restriction on the amount which may be given free of tax. Section 23 contains a number of restrictions which must be complied with if tax relief is to be allowed, these are;

(i) the gift to charity must take effect immediately. If the gift is to take effect only after a prior interest or laps of time no relief will be available.

(ii) In the case where the gift is subject to any condition, tax relief will only be available if the condition is satisfied within 12 months.

(iii) A gift to charity which is either subject to an overriding power of appointment or can be revoked will not therefore qualify for tax relief. However, if the gift is not actually defeated within 12 months and thereafter cannot be defeated it will be treated for tax purposes as being indefeasible. The exemption will therefore apply if the power of appointment or revocation is exercisable only for a period of 12 months from the time the gift takes effects and is not actually exercised.

(iv) A gift to a charity of an interest less than the donor's interest in the property is not eligible for relief from tax.

(v) A gift to a charity for a limited period is not eligible

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[6]. All references in this section are made to the Inheritance Tax Act 1984 unless specifically stated otherwise.

for relief. This prevents donors from channelling gifts to third parties through charities to avoid tax.

(vi) Finally, tax relief is not available in cases where the donor retains an interest in the gifted property for himself or his spouse or a connected person.

2.5.4. Some Restrictions[7].

The reason of the legislation may be that, there is belief that tax and other privileges enjoyed by charities are very high figures. It has been estimated that those figures amount to about £2.5 billion a year[8]. In 1985-86 the Inland Revenue repaid £270 million tax which had been deducted at source. There is some concerns that charities have been used for tax avoidance as well as concern about the benefit to the public from this enormous fiscal benefits were conferred on charities.

The above concerns resulted or led to strict legislation for both income tax and capital gain tax was imposed by section 31 of and Schedule 7 to the Finance Act 1986 in respect of periods after June 11, 1986 (Consolidated in I.C.T.A. 1988, Ss. 505 and 506, Sched. 20). The provision in the 1986 Finance Bill were originally designed to penalise all charities which failed to apply their funds for public benefits or were involved in tax avoidance schemes. However, the proposals were revised after some opposition and its application limited to the larger endowed charities.

Small charities having 'relevant income and gains' of less

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[7]. These restrictions are made by Sections 505 and 506 of I.C.T.A., 1988.

[8]. Cairns (1988), p. 96

than £10,000 in any period of assessment do not come under the imposed restrictions. 'Relevant income and gains' includes only income and gains which would be taxable were it not for the concessions allowed by section 505 (1) and the Capital Gains Tax Act 1979, S.145. It therefore does not include donations, legacies and street collections which would not in any event be taxable. Also donations from companies which are treated as a charge on the income of the company under section 338 of I.C.T.A. 1988 and payment from another charity are relevant income. The restrictions do not apply to those charities which derive most of their income from gifts and donations from individuals.

2.5.5. Restrictions on Expenditures[9].

Expenditure which may be entitled for relief is defined in Section 506 and Schedule 20 as expenditure for charitable purposes. A payment to a non-UK body will however be treated as qualifying expenditure only if the charity has taken reasonable steps to ensure that the payment will actually be applied for charitable purposes only. There is no guidance as to what steps are to be considered reasonable and this would vary from one case to another and can cause some problems.

Expenditure which may not be entitled for relief is defined as expenditure applied for non-charitable purposes and expenditure on investments and loans which are not " qualifying" investment or loans as defined in Section 506 and Schedule 20. If the charity incurred unqualified expenditure and where an individual makes annual covenanted payments to the charity of £1,000 or more, Section 683 (4) of I.C.T.A. 1988 provides that tax relief is not available to the charity on those payments, then the donor is not entitled to higher rate relief in respect of the covenanted payments. An element

[9]. See Section 505 and 506, and Sched. 20 of I.C.T.A. 1988

of uncertainty has therefore been introduced. Accordingly, repayment of tax may be delayed until the affairs of the charity have been agreed with the Inland Revenue. It will be recalled that where a liability to tax arises under section 505 (3) the charity may select which items of income shall be treated as taxable. Higher rate tax relief will be unavailable only if the tax payable is attributable to the covenanted payments.

2.5.6. Gifts by Companies[10]

Uncovenanted payments to charity by UK companies which are not close companies have, since April 1, 1986, been treated as charges on the income of the company and therefore may be deducted when calculating the taxable profits and gains of the company if: (a) such payments do not exceed 3 percent of the dividends paid by the company for the accounting period; and (b) income tax is deducted by the company before the payment is made. The charity may recover the tax paid by the company. It should be noted, however, that the Revenue requires that the same strict compliance with paragraph 2, Schedule 16 as for covenanted payment which requires the company to account to the Revenue for the tax within 14 days from the end of the relevant quarter, if the payment is to be allowed as a charge on the income of the company.

2.5.7. Payroll Deduction Schemes[11]

Since April 1988 an employer may, if so required, deduct up to £240 per anum from an employee's pay and transfer it directly to an approved agency which will pass the payments on to the charity selected by the employee. The payment will be deducted from the employee's total income in calculating his liability

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[10]. See Sections 38 and 39 of I.C.T.A., 1988.

[11]. See Section 202 of I.C.T.A., 1988.

to tax. The last thing to mention is Value Added Tax (VAT), charities were not granted exemption from VAT except for particular items such as medical equipments and aids for the disabled. However, the detailed provisions for VAT are beyond this study and are not considered here.

A charity or a NPO should pay high attention to tax matters in order to preserve its exempt status. Tax laws and legislations as well as law cases related to tax issues may be complex and professionals are needed to provide advice in tax planning. Tax planning is as important to the success of an exempt NPO as it is to a business firm, and it can protect some of the organisation's revenues which might otherwise be taxed. Finally, failing to obey the tax law and Inland Revenue regulations can threaten the exempt status of a NPO.

2.5.8. Exempt and Excepted Charities

Exempt charities are those specified in Schedule 2 to the Charities Act 1960 and those specifically exempted by Order in Council[12]. Exempt charities are not subjected to the supervisory of the CCs, but they are subject to the jurisdiction of the Court in relation to charities. They are not required to register, to submit accounts, or to obtain consent for sale of land nor they are subject to Section 6 inquiry.

Certain charities are excepted by regulations made from time to time from the requirement to register and to submit accounts. However, they are fully subject to the supervisory functions of the CCs. Examples of the excepted charities include funds held for Boy Scouts or Girl Guides Associations;

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[12]. These include a number of universities and medical schools, the British Museum, the Victoria and Albert Museum and Science Museum, the Royal Botanical Gardens at Kew and Registered Friendly Societies.

voluntary schools within the state Section which have no permanent endowment other than the school site itself, and other specified charities.

Conclusion

As we have seen, private nonprofit organisations are very different from both government and business organisations. This is hardly surprising because many authors believe that the very reason for the existence of NPOs may be only justified by the simultaneous occurrence of market and government failures.

NPOs are different with regards to their objectives which are to increase the well being of the society rather than to make profit, and politicians have little or no influence over them. This leads to real differences in managerial motivations and attitudes. Hence, they allow for space to motives other than profit and as Benedetto (1987) indicated that NPOs are able to channel in a socially beneficial manner precious human resources not directed towards financial gains.

Measuring performance in NPOs seems to be a troublesome issue. This is due to two main factors: namely, a lack of research into the area, and a lack of understanding of measures other than financial ones. Overcoming these difficulties is possible by devoting more energy and resources to research and studies into NPOs.

The highest level of authority such as the board of trustees (or governors) in NPOs seems to bear the least possible responsibility towards both financiers and clients. However, more pressures should be exercised to put those in charge face to face with their responsibility. In addition, top management is mostly dominated by professionals, this matter remains to be examined in order to discover whether it is a good or a bad thing.

The rules and regulations that govern charities or NPOs are loose in some cases and strict in others. Special attention and care are needed with respect to such matters. That is, on the one hand, it is worth paying some extra cost to protect the public interest and prevent a high cost in the form of fraud and breach of trusts. On the other hand, it may be beneficial to ease some tax related legislations without loosing control over the conducts of these organisations.

Chapter three

COMPARISON BETWEEN DEA AND OTHER METHODOLOGIES FOR EFFICIENCY MEASUREMENT IN NPOs.

Introduction

This chapter consists of two sections, in section one performance measurement in NPOs will be considered along with related issues such as management control systems and the difficulties faced by NPOs management when monitoring their affairs. Furthermore, the effectiveness of management in these organisations will also be studied and strategies to improve efficiency will be suggested. In section two, DEA will be examined and compared with other methodologies that have been developed for measuring efficiency in the 'world' of NPOs. These methods will include Farrell's measure of efficiency; Byrnes, Fare and Grosskopf's (BFG) measure of efficiency; Constrained Facet Analysis; and Measures of efficiency Dominance. Before doing so however, we shall first expand the general definitions of both technical and scale efficiency.

3.1. NPOs and Performance Evaluation

Nonprofit organisations (NPOs), especially those service providing ones, are usually faced with many problems. Two of them are readily observable; the first one is created by the fact that many NPOs operate under close government supervision, hence, they are more constrained by the political environment. They are not financially independent for most part of their budget, they depend partly on the government and partly on charitable contributions. Correspondingly, even when they ought to be autonomous

organisations, they have an urgent need to tailor certain aspects of their operations to suit third parties. Therefore, the NPOs' opportunities to introduce new 'brands' in their products or services are very limited, hence the movement to a new market or the delivery of services to new clients. In other words, the independent initiation of strategic plans by NPOs' senior managers is something highly restricted.

Based on the above, NPOs which operate in the same field are criticised as being organisations which have a low level of competition amongst themselves and therefore little incentive to improve their efficiency and high level of collaboration. Hence, these issues can be considered to be sources of both inefficiency and obstruction to creative programmes.

The second set of problems is the performance measurement problem. NPOs are of the kind of multi-objectives, aims, and missions organisations. They usually provide several none homogeneous type of services and/or products to a wide range of clients. Consequently, their performance cannot be measured by the value of their outputs since this is not available, or simply by comparing outputs to inputs. The overall performance measurement is a matter frequently discussed in terms of an organisation's output. This is particularly true for business organisations since at least all of their direct outputs can be measured in monetary terms. Anthony and Herzlinger (1975) stressed the importance of this fact for the development of management control systems; that is "The measurement of output, which is essential in a management control system, is facilitated by the fact that the number of clients can at least be counted, and in many cases the amount of service can be measured by the revenue that is collected from them."[1]

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[1]. Anthony and Herzlinger, 1975, p. 10.

The fact that NPOs do not charge for their services in accordance with the conventional economic theory; revenue does not exist even if it does, it is unlikely to reflect the real amount of operations that is accomplished, and therefore, cannot be used as a measure of performance. Generally though, a number of good surrogates for revenue does exist; for example, number of graduates and trainees, number of articles written, counselling hours delivered, number of patients discharged, number of adoption completed, number of clients processed over some period of time, and many others. While these measures might be considered good indicators of outputs, they do not necessarily measure performance, simply because their value is not readily assessed. Again, Anthony and Herzlinger make the same point when they distinguish between efficiency and effectiveness, they indicated that output information is needed to measure both efficiency as well as effectiveness. In a business firm, revenue margin provides a good measure for both of these purposes. However, In a NPO, no such monetary measure is available.

In an internal management control context, the trend now is toward schemes which are more concerned with assessing the extent to which an individual sub-unit has contributed towards the achievement of an organisation's goals or objectives in a particular period. In other words, emphasis is made on effectiveness, to what extent objectives are achieved, by using the least possible amount of resources.

Since most NPOs including health care and higher education, are exempt from taxation, the lost revenue to the government is regarded as tax expenditure. There seems to be a strong case for those who argue in favour of priorities being set by legislators (who are elected to represent the public interests) for public money to be spent rather than self perpetuating private groups. Therefore, NPOs must be made accountable to a centrally appointed body.

3.1.1. Choice of Performance Measures

Choice must be made between objective measures and subjective measures, the former are those which provide some kinds of quantitative criteria while the latter are those which cannot be quantified. However, Pollitt (1988) argued that the situation is not simply a choice between white and black measures. It follows that every set of performance indicators, however 'hard' the measure, is thoroughly infused with values and judgemental uncertainties. Therefore, it is important not exclude subjective measures or regard them as somehow irrelevant. Doing so would mean excluding the consumer as an essential body in the evaluation process. There is actually nothing inherently inferior in measures of feelings, perceptions or judgements. Business firms use surveys of consumer satisfaction and wants to inform their investment decisions. Yet, they are effective and reliable measures.

Indeed if 'value for public money' is to be observed, there is no alternative but to involve subjective measures, because while it is possible to observe the cost of a particular service in monetary terms, it is not possible to observe its value. The value of a service will vary from one consumer to another and still varies for individual consumers over time, depending on their circumstances. Then, consumers representatives must be incorporated into the evaluation process.

Efforts should be directed towards developing outcome measures and less importance should be placed on easily and cheaply collected input and process measures. However, such emphases should not be interpreted as a call for abandonment of other kind of measures. Input costs remain relevant because they provide one leg of the value for money ratio. Even relatively crude indicators of staffing input can provide invaluable warning signs (Yates, 1983).

Process measure can also be extremely useful. This is especially the case where the NPO in question involves prolonged personal contact with consumers. Health care and education obviously fall within this category. In these cases it is not only the eventual outcome that matters to the consumers but the way they have been treated. In health care for example, one of the most advanced techniques for assessing outcome value per pound spent is that particular manifestation of cost-benefit analysis known as the Quality-Adjusted Life-Year (QALY), (for further details on this method refer to Drummond, 1987). The QALY is a powerful criterion because it enables comparisons to be made between the length and quality of additional life years generated by one kind of medical procedure against another. Furthermore, one of the crucial elements in the make-up of the QALY is the set of relative weighting given to different qualities of life.

Parallel to the argument above, Anthony and Herzlinger (1975) suggested a more comprehensive method for performance evaluation in NPOs. This method can be accomplished through three different but related ways; first, process measures, second, results measures and third, social indicators. For a NPO such as university, process measures might include the teaching, research and training processes; results measures might consider graduates of all types, research outputs etc., and social indicators would consider the overall impact of the organisation on the well-being of the community as a whole.

3.2. The Question of Effectiveness

Grizzle (1984) suggested that the important criteria in evaluating an organisation's effectiveness depend upon its

stage in the life cycle[2]. Most stable organisations are in the formalisation and control stage. In which stage the effectiveness criteria emphasise planning, goal setting, efficiency, productivity, information management, stability and control.

This study is most concerned with the issues of efficiency, effectiveness and hence the issue of management control. Two essential elements of a management control system are: first, information about the organisation operation and second, standards against which to compare this information in order to make an objective judgement about the performance of the organisation.

Developing performance measures and collecting performance data is a difficult, time consuming and expensive task. This information is not of much use to managers unless it identifies areas that need corrective action. Identifying problem areas requires comparing operations information to standards or benchmarks. Possible sources of such standards for NPOs include an organisation's goals, objectives or targets; standards established by relevant professional associations; the performance of similar organisations; the organisation's own historical performance record; and optimal or technically efficient performance levels. Therefore, these standards may be summarised in three main categories: first is the organisation's own objectives; second, the optimal level of outputs, given specified environmental and technical constraints; and third, the performance of other similar organisations.

The important elements for reviewing the efficiency of an

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[2]. It is suggested that there are four stages in an organisation's life cycle; these are: entrepreneurial, collectivity, formalisation and control, and finally, elaboration.

organisation, Williams and Anderson (1975) suggested that: it is important to be clear as to the extent to which the analysis is restricted by taking certain features of the situation as fixed; and it is as important to explore how far these restrictions could be made less stringent given more time to adjust. Moreover, it is essential to point out to the relative strengths and weaknesses of the analysis and to suggest possible actions to be taken so information deficiencies can be revealed and therefore improved for future use. That is the efficiency problem can be curved up into easily digestible bits. This will show that even in quite limited context, systematic thinking can protect the organisation from simple errors, and provides clues as to where there may be scope for improving the efficiency of its operations.

There are two major ways by which efficiency could be increased, these are: first, reducing operational costs per unit without changing organisational structures and second, changing organisational structures to create conditions in which cost per unit can be reduced (see Cuthbert, 1987). Jarratt's recommendations to improve efficiency fall into the former and there were no mention to any significant organisational changes, in fact, changes were effectively excluded by the terms of reference of the study. However, the Audit Commission, through its emphasis on marketing, could be said at least to have established the foundation for major changes in the structure of the relationships between education institutions and their various clients. Finally, it should be considered which structural forms for the sector higher education (HE) as a whole are likely to be most efficient. that is the forms which are expected to minimise transaction costs.

3.3. Measures of Efficiency

In this section the present state of efficiency measurement will be reviewed in order to determine which the method that is most suited to the research we are undertaking. A relative evaluation of the presently available alternatives will also be attempted. Our approach will use the Charnes, Cooper and Rhodes **(CCR)** (1978) formulation of Data Envelopment Analysis **(DEA)** as the basis of comparison to determine the advantages and disadvantages of each method.

We begin by comparing the DEA with the traditional techniques of ratio and single equation regression analyses which are currently in common use. We then proceed to review efficiency measures which are currently proposed in the literature. This includes Farrell's measure of efficiency, Byrnes, Fare, and Grosskopf's **(BFG)** measure and DEA variants- constrained Facet Analysis **(CFA)** and Measure of Efficiency Dominance **(MED)**.

Figure **3.1a** illustrates the different types of efficiencies, (a single output, single input case) where the following concepts apply; the curve labelled **TO** for total output represents the efficiency frontier. It is the graph of the maximum output **y**, obtainable from each level of input **x**. Thus, this frontier defines the production function, and points below this frontier will represent inefficiencies because the **y** values obtained from any such **x** is not the maximum possible value. The ray from the origin to any point on this graph of the production function will have a slope y/x = average output **(AO)** per unit input, the slope of the production function is **dy/dx** or marginal output. These values are graphed in figure **3.1b**.

3.3.1. Technical Efficiency

Technical efficiency is defined as the ability to obtain the

greatest possible output from a given input; or to produce a given output with the lowest possible amount of input[3]. Points **P1**, **P2**, **P4**, and **P5** are technically efficient in Figure **3.1a**. They are the maximum outputs which could be produced from their given inputs, with the production function as graphed in Figure **3.1a**. However, **P3** is not technically efficient, that is, **P3** is not on the frontier so the same output can be achieved with a lower input or, conversely, this input amount was capable of producing a larger output. A technical efficiency rating can be computed either with respect to a theoretically known production technology or with respect to the production technology of other producers. The former refers to theoretical (absolute) efficiencies while the latter is a measure of relative technical efficiency.

Byrnes, Fare, and Grosskopf (1984) discussed a form of technical inefficiency they referred to as congestion[4]. To illustrate congestion we continue with the single output, single input case in Figure **3.1a**, where **P5** depicts such an inefficiency. Note that **P5** is on the production frontier. Nevertheless it is not efficient since a reduction in **x** may actually increase **y** in movement from **P5** to **P4**. This is what Byrnes, et al. meant by congestion. However, Banker et al. (1983a), generalised this idea to the concept of mix efficiency which requires consideration of more than one input or more than one output or both. In mix efficiency, reduction in one or more input may cause an increase in one

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[3]. See Kohler's Dictionary for Accountants, 6th. Ed., p.191.

[4]. In economics it is assumed that this will not occur since it is inconsistent with optimising behaviour. On the other hand we must consider this as empirical problem and hence we must show that it too can be handled.

Figures (3.1a) & (3.1b): Production Economics.

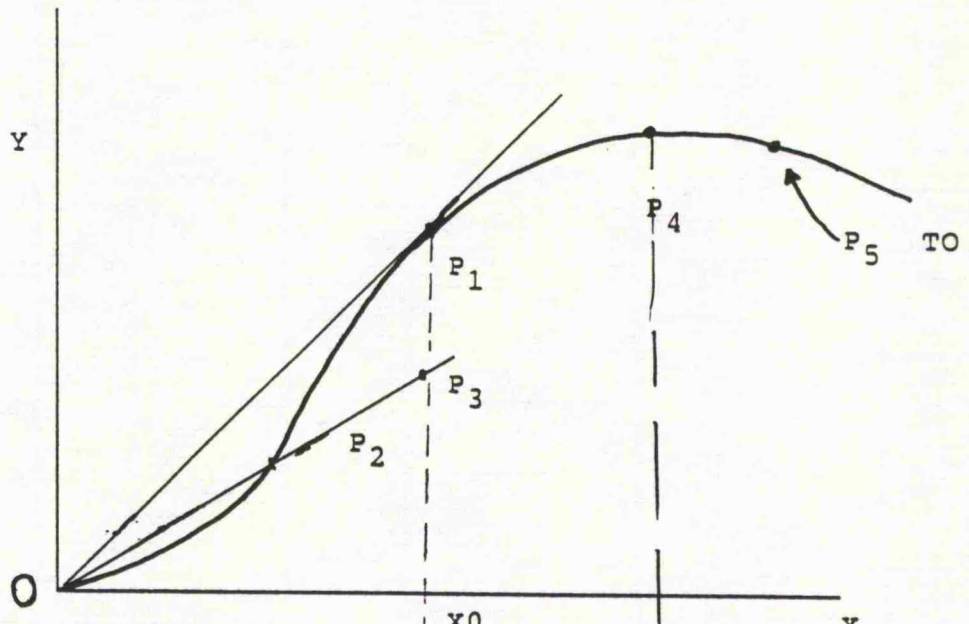

Figure (3.1a)

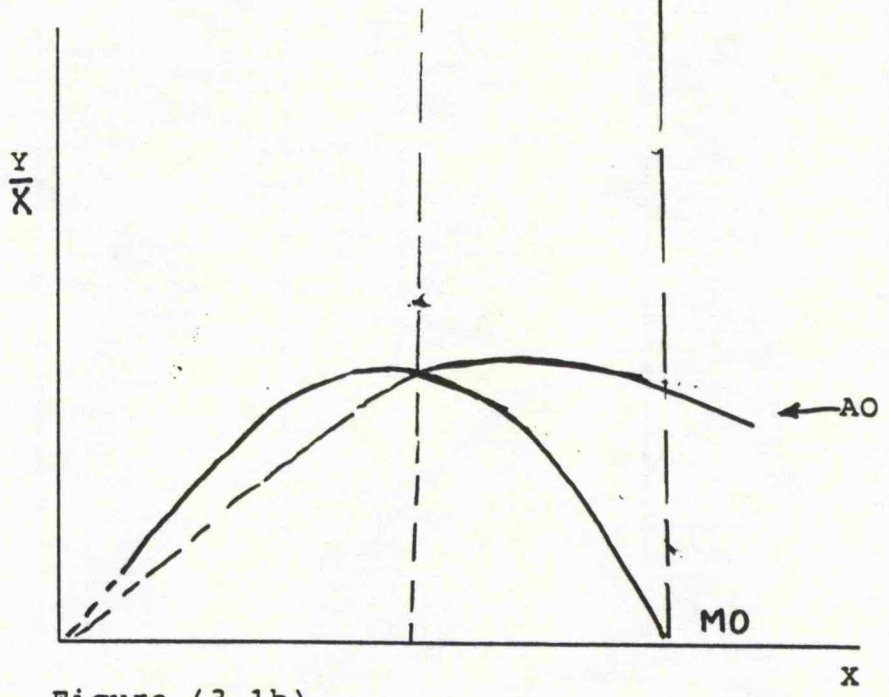

Figure (3.1b)

3.3.2. Scale Efficiency

The need to alter the normal economic concept of scale efficiency is useful, because we need to deal with multiple outputs and also to allow for lack of access to market-like prices in NPOs operations. In our case we need to distinguish between the problem of determining the minimum cost mix of inputs, and the problem of determining the Most Productive Scale Size **(MPSS)**[6] for particular input and output mixes. Here, we are concerned with the **MPSS** which corresponds to different input and output mixes. While the overall optimal scale size is determined by the current market prices. Thus for a particular input and output mix, **MPSS** is the scale size at which the output produced per unit of inputs is maximised.

For our purposes, scale efficiency refers to **MPSS** and results from producing at the optimum scale or where in particular, constant returns to scale prevail. For clarity we continue to use the single output, single input case portrayed in Figure **3.1a**, and observe that at $x0$ we have $y/x = dy/dx$ which means that we have **AO** = **MO** at $x0$. To the left of this point we have $dy/dx > y/x$ and to the right $dy/dx < y/x$. To the left, marginal output exceeds average output, and output is increasing more than proportionately to the input increases. Thus increasing returns to scale are present to the left of $x0$. To the right of $x0$ there is decreasing returns to scale while at $x0$ there is constant returns to scale.

As can be seen from the Figure **3.1b**, the average output is maximal at $x0$. This is the point of most productive scale size (**MPSS**) for this one output, one input case. Relating the above discussion to points **P1**, **P2**, and **P4** we have the followings: **P1** exhibits constant returns to scale and is scale efficient, **P2** has increasing returns to scale and

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[6]. This concept was first introduced by Banker (1984).

therefore, is scale inefficient, P4 has decreasing returns to scale and it is scale inefficient.

Naturally, the very simple situation of only one output to one input will need to be generalised to the case of multiple outputs and multiple inputs, If ideas like returns to scale and MPSS are to be of use in the analysis we shall be making. Now we may turn to briefly review the work of others in the area of efficiency.

3.3.3. DEA Versus Ratio and Regression Analysis

Higher education is a multi-product process which involves the joint production of multiple outputs, it is not possible to obtain a wholly satisfactory evaluation by taking one output at a time and analysing its relation to the various inputs. Therefore, in order to support our argument for the use of DEA as a method of efficiency measurement in HEIs, it is important at this stage to summarise the characteristics, and the advantages it possesses over two commonly used efficiency approaches; namely, ratio analysis and regression analysis.

Regression analysis can be used to model the output level of an organisation as a function of the various input levels. It produces an estimated relationship that can be used to compute the predicted output level of a particular DMU, given its input levels. The relatively efficient DMUs would lie above the estimated relationship, in other word, these DMUs produce more outputs than the model predicts, given their input levels. Conversely, the relatively inefficient DMUs lie below the relationship, that is, given their input levels, they produce less outputs than the model predicts. Therefore, relative efficiency is reflected in the residuals. Positive residuals present relative efficiency, while negative ones present relative inefficiency. This estimation of average or

typical relationships among the variables masks the differences in the relative performance of the DMUs in the set.

The drawbacks to this approach are; firstly, single-equation regression analysis requires that there be one output or that all outputs be combined into a single measure of production. Multiple-equation regression models can be used, but then there are multiple sets of residuals and no clear way of interpreting them in terms of efficiency. Hence, the the tendency to use a single output measure instead of multiple output measures.

Secondly, regression technique measures efficiency relative to average performance, which in itself may not be efficient. It uses a single optimisation by ways of averaging across mixes of efficient and inefficient DMUs without distinguishing between them, in order to arrive at a single 'smooth best fit' to all observations. Hence, it provides little direct information concerning the magnitudes of efficiency gains that are possible at various DMUs within the sample. Sherman (1981) indicates that 'regression techniques reflect efficient relationships only when the observations themselves are efficient'. This implies that, using inefficient mean observations will automatically result in an incorrect estimation. DEA, however, uses n optimisation (one on each observation), in order to arrive at a 'piecewise linear surface'. It also distinguishes between efficient and inefficient DMUs in the process of arriving at its 'best fit'. Furthermore, from a managerial viewpoint, DEA's ability to locate sources and estimate amount of efficiency in particular DMUs is perhaps more important than either ranking DMUs by the efficiency scores or even just simply classifying them as efficient or inefficient.

Thirdly, regression analysis requires the parametric specification of a production function, that is, an equation

detailing how inputs are combined to produce outputs. In our case study of universities, the appropriate mathematical form of a production function is largely unknown. It is extremely difficult to say on average how universities combine or could combine their resources in order to produce outputs. Yet regression technique requires such a specification, which introduced an important source of errors that can weaken the entire analysis. Consequently, regression analysis is an inadequate technique to be used for efficiency analysis in our case. Perhaps, the use of regression techniques in business organisations could be justified on the ground that, it is easy to measure their outputs in one single money measure, the motive of profit maximisation, and high competition which motivate firms to operate at or near the efficient frontiers.

Fourthly, DEA assumes that corrective action is possible for the inefficiencies that are detected. When this is not possible, a use of regression approaches might be better employed to predict future behaviour on the assumptions that the present mix of behaviours, efficient or inefficient, will continue into the future. Furthermore, although DEA is not capable of setting efficiency standards, it has the power of analysing output as well as input efficiencies and dealing with their simultaneous interaction possibilities in ways that are beyond the capability of regression techniques. Finally, DEA is also favoured by its simplicity to use as compared to what is required by regressions. It is a form of ratio analysis, while it is more complex than simple types of ratios, DEA shares their properties of not requiring explicit specification of underlying relations and possible connections between the inputs and outputs. Under many circumstances, however, regression techniques and DEA can perhaps be used in various combinations to obtain comprehensive analysis. For the reasons indicated above, DEA is favoured over regression approaches in our study at least.

The use of the well developed statistical tests and related sampling distribution is not readily available when using DEA, as would be true for a regression approach. However, DEA approach lends itself to testing by reference to direct observations of each DMU in a way that is not easily available from such statistical regression. Moreover, in our study, we are concerned with the use of DEA as a management tool for internal control as well as its use by external parties who may be in the position of strategy formulation for the organisations under consideration. Hence, DEA provides an important tool for internal as well as external control and resource allocation.

As with regard to ratio analysis, the comparison with DEA is simple; in order to account for multiple inputs and outputs, several ratios must be used simultaneously. This results in some of the DMUs under consideration ranking high on the basis of some ratios and low with respect to others. Hence, no clear indication of the true efficiency. In addition ratio analysis does not provide insight into the magnitude of the inefficiency as is available with DEA. Furthermore, DEA has the advantage that it mathematically finds the maximum possible aggregate efficiency score, by finding the best combination of all possible ratios while maintaining strict equity in this relative evaluation. In addition, it provides insights via the slack analysis as to the sources of the inefficiencies in terms of attainable levels of resource conservation and output augmentation.
Another important characteristic of DEA is that it can be applied to study the performance of a DMU over time relative to itself. Such an analysis can indicate whether the administrative efficiency of a DMU is improving or deteriorating over time and whether specific internal or external events (e.g. introduction of new technology, changes in management and/or system, etc) can account for changes in performance scores. Hence, DEA can be used to evaluate the results of administrative experimentation, such as

organisational changes.

Furthermore, DEA can be useful as diagnostic tool for distinguishing between most and least efficient DMUs. Detailed administrative field audits could then be utilized to identify internal structures, administrative policies and standard operating procedures which might account for the differences in the observed performances. In other words, based on the DEA, inefficient and efficient DMUs could be selected for in-depth comparisons to determine which organisational practices utilized by the efficient DMUs account for their superior performance over the inefficient DMUs.

In summary, we note some important qualitative differences between DEA and those traditional approaches. DEA differs from regression and related statistical techniques in that it is non-parametric and thus does not require specification of the functional forms and relationships which are to be employed. It differs from ratio approaches in that it employs an optimising principle and can handle multiple outputs and multiple inputs simultaneously. In support of the use of DEA, Sherman (1982) argues that ratio and regression econometric techniques are less powerful, and in some cases may be misleading in identifying inefficiencies and efficient production relationships.

Another interesting property is that DEA's convenience and ease to use. DEA along with other alternatives have all been given operational form via existing computer programmes. The subset of DMUs from which an evaluation was made are also printed out along with the identified sources and estimated amounts of inefficiencies (which extend to outputs as well as inputs) for each DMU that is evaluated. Thus a check can be made to the individual observations and the subset of DMUs which served as the reference set. Simultaneous treatment of all outputs and inputs for such efficiency/ inefficiency

identification is not readily available from statistical, ratio, and cost accounting approaches.

3.3.4. Farrell's Measure of Efficiency

Before moving to evaluate and compare BFG, CFA and other methodologies, we shall provide some historical perspective on the research efforts directed to obtain an overall empirical measure of efficiency. This line of research began with Farrell (1957). Farrell's approach is considered to be the cornerstone for efficiency measurement. He defined overall efficiency (OE) as: **OE = TE.AE**, where **TE** denotes technical efficiency, and **AE** denotes allocative efficiency. Each of these efficiency measures could be defined in terms of a production frontier as the ratio of actual to potential performance and this will be illustrated in Figure **3.2**.

Figure **3.2**, as adapted from Farrell represents an isoquant diagram for the single output case with two inputs **x1** and **x2**. Farrell used ratio **OQ/OP** to measure technical efficiency by bringing the observed value **P** back on to the unit (normalised) isoquant, **Io**, at **Q**. If "b" was the budget line with price ratio **P1/P2** (P1 is the price for x1 and P2 is the price for x2) for the two inputs, then following Farrell, allocative or price efficiency would be measured by **OR/OQ** to reflect the fact that this output could have been achieved at lower cost at this price ratio. Combining the two efficiencies would yield **OR/OP** as a measure of 'overall efficiency', as Farrell suggested.

Farrell also recognised and studied the possible presence of scale efficiencies by turning to total costs as in Farrell and Fieldhouse (1962). Only because this was restricted to the case of a single output, Farrell could avoid the difficulties involved in distinguishing between mix and scale variations. Such difficulties are persistent in a multiple

input and/or multiple output approach. Hence, Farrell was unable to combine these scale efficiencies with the other two measures he had identified with overall efficiency.

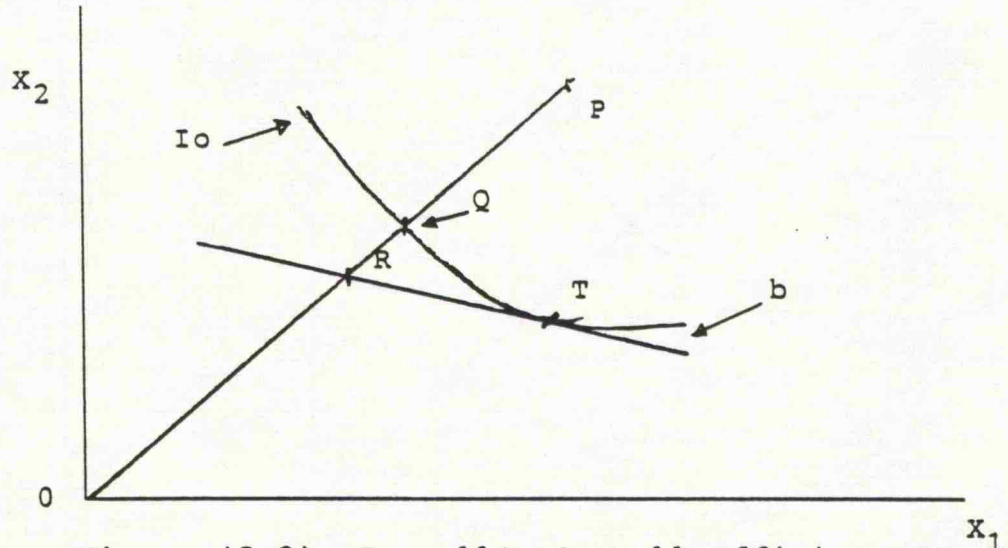

Figure (3.2): Farrell's Overall Efficiency Measure.

3.3.5. Byrnes, Fare, and Grosskopf (BFG) Measure of Efficiency

Byrnes et al. (1984) provided a series of linear programming models which identified technical, scale and mix inefficiencies with the latter being referred to as 'congestion'. The efficiency measures are obtained as real scalars from the optimal values of the corresponding linear programming problems and the product of these values was the 'overall efficiency'.

The term congestion can be explained with the aid of Figure (3.3). Here the isoquant **Io** is extended to portray a complete cross section through the production function at the output level corresponding to **Io**. The situation of Figure **3.2**, is portrayed in the area labelled A', but this is only one range of possible inefficiencies in the input choices. In this case one may use the inputs to gauge inefficiency either by reference to the output level that could have been attained without reducing the input amounts or by holding to the attained output level and reducing the inputs.

The other segments allow both reduced inputs and augmented outputs to be attained simultaneously. The situations of B', C', and D' are usually assumed to be of no interest in economics, since they are incompatible with optimising behaviour. That assumption cannot be made in our study, and so Byrnes et al. (1984) made an important contribution in bringing it to the fore.

Unfortunately, the approach by Byrnes et al. like that of Farrell is restricted to single output situations and is of very little use for application to activities of NPOs[7]. In

[7]. See Banker, Bowlin, Charnes and Cooper (1983a), for full discussion on the BFG measure of overall efficiency.

addition, there are other problems with the BFG measure besides its deficiency of being applicable only to single output cases. In particular, their use of repeated linear programmes is inefficient and cumbersome for large numbers of DMUs. As shown by Banker et al. (1983a), the DEA approach of CCR provides all what is wanted by BFG and even more than that, because it extends to the possible presence of 'synergistic' behaviour which can occur when complementary relations are present in the multiple outputs. Although this approach would seem to supply what is wanted except for price or allocative efficiency. It retains the concept of non-Archimedean values for identifying the slack. This can be difficult, not only for computation, but also for uses such as the study of statistical behaviour of efficiencies where restrictions to a single real valued measure of overall efficiency is required.

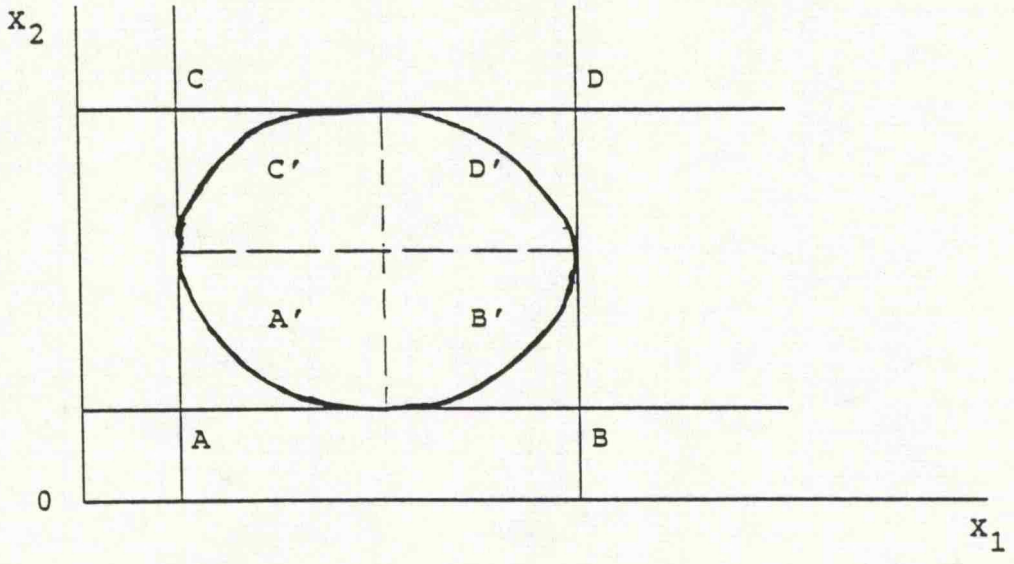

Figure (3.3): Congestion and Mix Efficiency.

3.3.6. Constrained Facet Analysis (CFA)

Clark (1983) and Bessent et al. (1986) essayed a variant of DEA which they called Constrained Facet Analysis (CFA). This approach ignores the underlying distinctions between technical, scale, and mix efficiencies and proceeds directly to a measure of overall efficiency which eliminates the non-Archimedean components used in DEA. The approach used is best described in connection with Figure 3.4 as adapted from Clark (1983).

Consider the point E exhibited in the two dimensional space of Figure 3.4. To obtain its unit (rate) of output, E used input $x2 = 1$, the same as C, but it also used input $x1 = 6$ which exceeds the value used by C for this input by 2 units or 50 percent. Two different representations of E are possible on the frontier for the observation. In one case E can be represented in terms of itself with zero slack. In the other E can be represented in terms of C and will have a slack value for the first input in the amount of $S^* = 2$. Under DEA the latter will be chosen since this yields a value of $\theta > 0$ in the functional and DEA seeks to maximise the total slack.

The approach suggested by Clark (1983) eliminates the non-Archimedean θ by projecting the frontier from the edge connecting B and C until it meets the $x1$ axis. The ratio OQ/OE is then used as the overall measure of efficiency. Although this case can be extended to the multiple outputs and inputs, we shall not extend our discussion to the mathematical development. Instead we keep to the simple situation presented in Figure 3.4 and consider the concept of Pareto optimality as introduced into DEA by CCR. Note that movement from E to C may be effected in a way that reduces $x1$ from $x1 = 6$ to $x1 = 4$ without requiring any increase in $x2 = 1$. Since, by definition, we remain on the same isoquant the output level is not disturbed. Consequently, E is not Pareto

optimal.

The point at **C**, however, is Pareto optimal and so is every point on the frontier connecting **B** and **C**. Movement along this frontier can be effected only if at least one input is increased in order to achieve a reduction of the other input, while holding output fixed. The extrapolation from **C** to **Q** represents an extrapolation of this same Pareto optimality property.

Returning to the use of **OQ/OE** as a measure of efficiency we can see by reference to the Figure **3.4**, that the movement from **E** to **Q** involves a reduction in both x_1 and x_2. Note however, that we are now outside the empirical production possibility set defined by the original observations[8]. Furthermore the movement from **E** to **Q** fails to reduce x_1 to the value it would achieve at **C** in exchange for a reduction in x_2 which would not have been achieved at **C**.

Justification for this approach is required, as always the case of movement along any Pareto efficient frontier. Since a trade-off between two resources is implicitly required. In other words, the CFA approach imputes a rate of exchange or substitution between x_1 and x_2 which is not implied in DEA. From a management standpoint, the manager of unit **E** is being asked to reduce both inputs and may well demand to be shown the evidence that this can be done without lowering outputs. Evidence for the reduction can be obtained under DEA by pointing to unit **C** which used the same amount of x_2 and a lower amount of x_1 at the specified output level. However, this same type of evidence is not available under CFA for the imputed lowering of both inputs.

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[8]. See Charnes, Cooper, Golany, Seiford, and Stutz (1985) for a formal definition of an empirical production possibility set).

Although Clark's approach addressed the non-Archimedean problem with DEA and provided an overall measure of efficiency, it did so at the expense of estimating efficient input and output levels that might be outside the empirical production possibility set. Banker et al. (1986) argued that this can lead to estimates which are erratic and significantly different from those that are the true efficient values obtained from the production possibility set, and that they may not be attainable. Even its use as a lower bound efficiency estimate is in question since, as it has just been noted that it can yield estimates which are both too high as well as too low.

The best way to use CFA is as an ordinal ranking of the DMUs. For other, more exact, uses it is probably best either to stay with DEA or else to obtain other supporting information. Even in the latter case, however, DEA has the additional advantage of distinguishing between technical and scale efficiencies so that inquiries into these efficiencies may be used as further guides to possible sources of any "overall" inefficiency. Note, in particular, that movement from **E** to **C** in Figure **3.4** attains the position of Most Productive Scale Size (MPSS) where, as shown by Banker (1984), $j^* = 1$ and removal of the slack effects the adjustment required for attaining technical efficiency. Thus the solution at **E** with $j^* = 1$ attains scale efficiency, but not technical or mix efficiency. However, with the adjustment to **C** both technical and mix efficiency are attained in addition to scale efficiency while movement to **Q** under CFA does not distinguish between any of these components of efficiency.

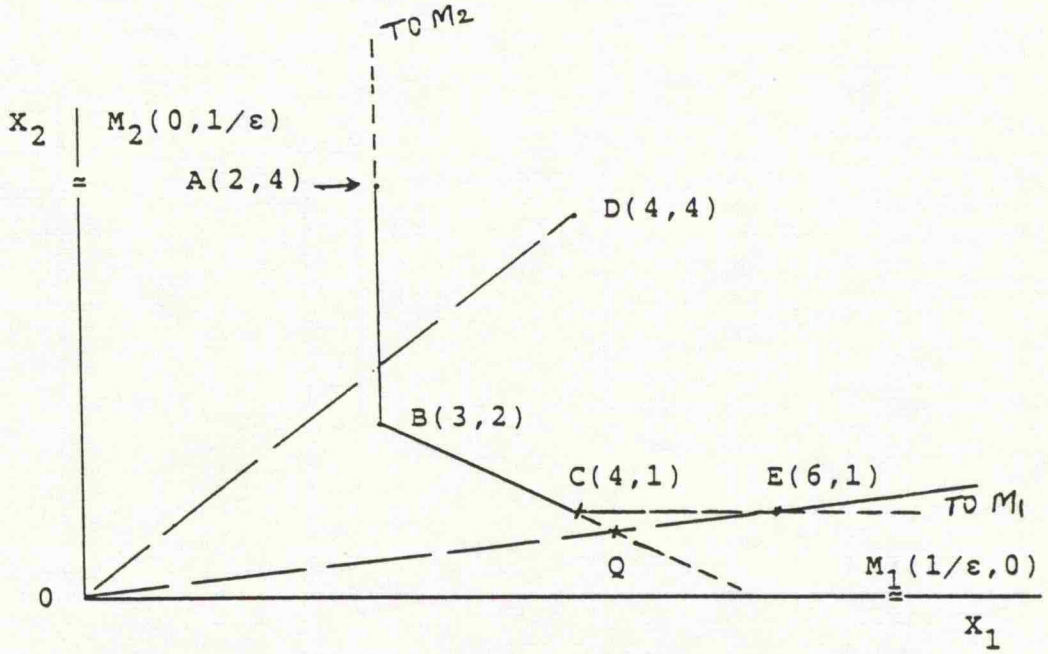

Figure (3.4): Illustrating CFA.

3.3.7. Measures of Efficiency dominance (MED)

Bowlin, Brennan, Charnes, Cooper, and Sueyoshi (1984) have developed another methodology for evaluating efficiency which they called Measure of Efficiency Dominance **(MED)**. MED is a variant of DEA but is based on dominance concept in which the efficiency of any decision making unit is always evaluated relative to the actually observed input and output amounts of some other DMU.

With MED the convexity[9] property of DEA is dropped, and the efficiency comparison is accomplished using dominance analysis. To be rated inefficient, a DMU must be dominated in

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[9]. Convexity, at its simplest, implies that "if two points are attainable in practice then so is any point representing a weighted average of them." (Farrell, 1957).

every dimension by at least a single DMU. When more than one dominant DMU is present, then the one which is 'most dominant' is used to identify and estimate the inefficiencies.

MED's estimates are less stable than DEA ones, Bowlin et al. (1983) indicate, but in any case MED is of little interest for this research since we do not want to drop DEA's convexity assumption.

Finally, there have been various forms of testing and evaluation to DEA relative to other alternatives including MED model which is considered to be a version of DEA (see for example Bowlin, Charnes, Cooper and Sherman, 1983; Rhodes 1978). All of the findings favoured or showed some advantages of DEA over other rival methods.

Conclusion

the CCR formulation of DEA seems to provide the best methodology yet for the purpose of our research. It provides us with a reliable differentiation between relatively efficient and inefficient operations. More important, it provides us with reliable information on the sources and magnitude of the inefficiencies which is essential for using this approach as a system for measuring management efficiency. Finally, the BFG measures are not suitable for our purposes since they cannot handle multiple outputs.

Chapter Four

DATA ENVELOPMENT ANALYSIS AS A MODEL FOR PERFORMANCE EVALUATION

Introduction

Does management science have anything to offer for NPOs when setting to evaluate the performance of their management?. In such a field there is a severe shortages of programmes and techniques which allows one to make firm judgement with respect to performance appraisal based on what information may be available. This proposed question is what we will try to answer in this chapter.

Since we are concerned with the evaluation and assessment procedures of managementt performance in nonprofit organisations. This chapter will concentrate on Data Envelopment Analysis (DEA) as a technique that is used for this purpose. First, we shall briefly comment on the defeciencies of previously employed methods. Second, a detailed study of the model is conducted, which includes consideration of sensitivity analysis and managerial efficiency issues. Furthermore, a look at the possible use of DEA in business enterprise. And finally, a statement on the strengths and limitations of DEA is made.

We shall first consider a management science technique[1] that is capable of measuring the relative efficiency of management in nonprofit organisations (NPOs). This model was first introduced by Charnes, Cooper and Rhodes (1978). And it is of the form of input/output ratios, and it makes it possible to relate efficiency measurement approaches from engineering, economics, and other related areas to each

[1]Data Envelopment Analysis is a version of the linear programming simplex method.

other (see Charnes and Cooper, 1980). The model is so called Data Envelopment Analysis (DEA) and is based upon relative efficiency concepts originally proposed by Farrell (1957). Charnes et al. (1978) reproduced Farrell's technical efficiency notions into a linear programming (LP) format which provides a 'scalar' efficiency measure for all Decision Making Units (DMUs) which produce similar outputs using common inputs.

4.1. Deficiencies in Prior Methods Employed

Despite intensive attempts to define a production function for higher education, there has been no methods to provide an overall operational definition of efficiency of universities and other similar institutions. Levin (1976), and Hanushek (1979) characterize current methodologies as being deficient both conceptually and in their implementation. Following one such attempt, Levin (1974) concluded that the analysis is full of difficulties that are unusually severe given the present analytical state of the art.

The difficulties involved in defining an efficiency criterion for nonprofit organisations (NPOs) include:

1) The economic theory of production functions requires extremal estimates and it does not adequately deal with multiple nonhomogeneous inputs and outputs situation that prevails in NPOs.

2) As noted by Bowles (1974), regression coefficients do not necessarily indicate the most efficient way to produce an impact on outputs.

3) The interdependency of inputs and outputs (which is known as multi-collinearity) may produce misleading results if the resulting coefficients are used to determine

alternative input mixes or levels (See Bowles 1974; and Bowles and Levin 1968).

4) The output-input relationships may not be linear or independent and, moreover, there are no guides available, theoretical or otherwise, for determining the classes of parametric functional forms to be used in these statistical estimation models (Levin 1976 and Bowles 1974).

5) None of the production function studies for nonprofit organisations are based upon controlled experiments in which inputs have been manipulated (Averch et al., 1974) Note, however, that the theory of experimental design does not deal at all with problems involved in allowing for differences in managerial efficiencies and/or other such variables that enter importantly into the resulting outputs.

Data Envelopment Analysis (DEA) approach that proposed by Charnes, Cooper and Rhodes (1981), and (1978) bypasses these difficulties. Firstly, it does not require the production function to be specified. The latter may differ from one NPO to another by ways such as that the multiple outputs and multiple inputs may be related to each other in numerous ways such as linear or nonlinear.

Furthermore, the resulting overall scalar measures of efficiency are obtained from 'extremal methods' that relate the results to mathematical programming models in which all outputs are explicitly identified. The values assigned to these inputs and outputs which are referred to as virtuals multipliers help to locate sources of inefficiency on the one hand and also to indicate trade-offs along the efficiency frontiers for additional use as required.

4.2. Measuring Relative Efficiency of Units Performing Similar Tasks

One aspect of the measurement problem in NPOs is that most of these organisations do not operate in competitive markets. Implying that net income or profit even when exists, does not provide a useful indicator of productive efficiency. A solution to the problem of performance evaluation in NPOs would provide concerned parties with a wealth of information like the followings: firsly, an adequate evaluation of the efficient of NPOs would mean determining the productivity of professional staff while making allowance for the conditions under which they are working. Secondly, targeted output goals and identification of needed input modifications and output improvement possible in addition to the identification of areas in which efficiency could be increased.

The multiple inputs and outputs in NPOs, in addition to being noncommensurable, often cannot be valued through market prices. Therefore, it would be desirable to have a sort of procedures that offer a single summary measure that capable of handling noncommensurate multiple inputs and outputs to measure the relative efficiency for a set of decision making units (DMUs). Such an approach can be most useful for organisations like, local councils, district schools, universities, hospitals and others. This would also provide insights on the possibilities for increasing outputs and/or conserving inputs for the inefficient units in order to become efficient. Furthermore, it is also desirable for the approach to enable adjustment to be made for factors outside the control of the unit being evaluated.

DEA is a model that was designed to have all of the above desirable features and it is capable of evaluating the relative efficiency of those NPOs performing similar missions and for which a single measures of output is not available. DEA does not require any predetermination of

weights for the relative importance or values of the various types of outputs. Similarly, it does not require any per unit prices or costs associated with the inputs.

4.3. The Assumptions Underlying DEA Approach

DEA as a model for efficiency measurement has been used in a variaty of nonprofit organisations (NPOs) settings (see for example Bessesnt and Bessent 1980; Charnes et al. 1981; Lewin and Morey 1981; Lewin et al. 1982; Nunamaker 1983 and 1985 and Smith and Mayston 1987). The model is based on the following assumptions:

1) The production frontier is defined by the most efficient DMUs. That is, there is always at least one efficient DMU that defines the frontier, and all inefficient DMUs lying below the frontier. It further implies that all points along the efficient surface are practically attainable production possibilities.

2) DEA approach assumes constant returns to scale for each DMU evaluated. That is, an equal proportionate increase in all inputs leads to the same proportionate increase in all outputs along the efficient frontier. This implies that the production frontier is a ray, with constant gradient and passing through the origin. In the case of just one input and one output the most efficient organisation therefore is deemed to be the one with the highest ratio of output to input.

3) The production frontier is convex to the origin and has nowhere a positive slop. That is a reduction in the use of one input for efficient DMUs necessitates an increase in the use of other inputs in order to maintain output levels.

4) The application of DEA approach does not require any set

of a priori weights or prices for the inputs or the outputs of those DMUs to be evaluated.

There has been some development to the above assumptions which is that an attempt to relax the assumption of constant returns to scale by Banker et al., (1984). This has so far concentrated on the case in which decreasing returns to scale exist. Under this method, the organisation using the smallest amount of a particular input will always be labelled efficient.

4.4. The Model: DEA

Before the consideration of the model (DEA), there are the following points worth consideration:

Firstly, output and input identification and measurement. It is important to determine the set of input factors and output measures to be included in the analysis and at the same time determine which outputs and/or inputs are inter-correlated. That is, those inputs or outputs which may be redundant can be excluded. In addition, it is important to determine which of the inputs and outputs are related, as well as the direction of the relationships; (i.e. whether it is positive or negative). The procedures for identifying relevant outputs and inputs for a DEA efficiency measurement are critical to the validity of the results. When relevant outputs and inputs are excluded because they were overlooked, too difficult to measure, or immeasurable, the DEA results can be biased and possibly misleading.

The above, is an issue of overriding importance, particularly in any regulatory application of the model. DMUs, when an external evaluation is to take place, should be expected to argue for inclusion of those variables which permit them to appear as efficient as possible. At the extreme, DMUs would prefer the largest variable set

imaginable, as we shall see latter, the larger the set of variables included, the greater the likelihood a given DMU will be rated efficient.

Secondly, Correlation and regression analysis; as an initial step, it is desirable to explore some of the key inter-correlations to select the candidate set of inputs for the regression analysis. The strength of the intercorrelation is important in illuminating variables which are highly interrelated, as their introduction into the regression analysis can bias the results.

The next step in the analysis involves a determination of the appropriate specification of the model which is to be used for candidates selection. Two types of regression models were applied; a linear model and a log-log model. The latter is a much richer model in that it allows diminishing return to scale to prevail. Furthermore, the estimates of the coefficients in the log-log model can be interpreted as elasticities (i.e. the percent change in an output measure for each 1% change in an input measure). Banker (1984) indicated that the log-log model outperformed the linear model, based upon both the R^2s generated and the reasonableness of the estimates produced.

The characteristics of DEA that prompt interest in evaluating public sector and NPOs are: first, its ability to consider simultaneously multiple inputs and outputs in evaluating efficiency. Second, the production function (i.e. efficient input-output relationship, need not be known.

The efficiency measure of a DMU is obtained as the maximum of a ratio of weighted outputs to weighted inputs subject to the condition that the similar ratios for every DMU in the sample be less than or equal to unity. That is;

$$\text{Max } h_o = \sum_{r=1}^{s} u_r y_{ro} \Big/ \sum_{i=1}^{m} v_i x_{io} \qquad (4.1)$$

$$\text{Subject to } \sum_{r=1}^{s} u_r y_{rj} \Big/ \sum_{i=1}^{m} v_i x_{ij} \leq 1$$

$$j = 1\ldots., \text{ n DMUs}$$

$$i = 1 \ldots, m .$$

$$u_r, v_i \geq 0 \quad ; r = 1 \ldots, s;$$

Where:

$y_{rj} > 0$ = measurement of rth valued output for DMU_j,

$x_{ij} > 0$ = measurement of ith observed input for DMU_j,

$u_r, v_i \geq 0$ = the variable weights to be determined by the solution of this problem,

"o" : denotes the DMU that being evaluated.

The weights u_r and v_i yield the efficiency measure for each DMU. They are determined objectively from the observed data in terms of the model in order to maximise the h_o value which is the scalar measure of that particular DMU being evaluated. That is the solution sought is the set of u_r and v_i values which will give the highest efficiency ratio h_o. However, this ratio must not exceed unity when applied to any DMU in the observation set, neither any of the weights u_r and v_i may be negative.

Each of the jth DMUs utilizes similar inputs to produce similar outputs in different amounts, this is a character of being belong to the same industry and using similar technology. The 'n' constraints in equation (4.1) ensure that no DMU can achieve an efficiency rating which will exceed unity.

The ensuing optimisation yields a positive set of u^*_r, v^*_i which generate an optimal $0 \leq h^*_o \leq 1$ if, and only if, the thus distinguished DMUs are efficient in the sense of Pareto Efficiency which in turn, is a natural extension of the well known social choice criterion of Pareto Optimality. Pareto Efficiency may paraphrased from Bessent and Bessent (1980) as follows:

(i) Output orientation: a DMU is not efficient in producing its output if it can be shown that some other DMU or combination of DMUs under the same environmental conditions can produce more of some output, without producing less of any other output and without utilising more of any resources;

(ii) input orientation: a DMU is not efficient in utilising its inputs to produce given amount of output, if it can be shown that some other DMU or combination of DMUs under the same environmental conditions can produce the same amount of output with less of some resources and no more of any other resources.

Therefore, a DMU will be characterized as efficient if, and only if, neither (i) nor (ii) can be possible.

The objective here is that, to find among like units those having the greatest amount of output for the amount of resources used. The analysis requires the weights by means of constraints to be set relative to the input/output ratios of all of the other units in the comparison set. In simple terms, all DMUs are compared in order to locate the most efficient ones in the set and to use these as criterion of efficiency.

The efficiency of one member of the (j = 1, ..., n) DMUs set is to be related relative to the others. It is therefore represented in the functional, for optimization -as well as in the constraints- and further distinguished by assigning

it the subscript "o" in the functional but preserving its original subscript in the constraints. The indicated maximisation then accords this DMU the most favourable weighting that the constraints allows.

The fractional programming model presented above in (4.1) provides the conceptual definition of efficiency. For its operational expression, however, it is necessary to transform it into an ordinary linear program (LP) model. One which has the power and convenience of readily available solution methods. This provides ease of interpretability of results as well since the solution provides us with measures of slack and opportunity cost in terms of the measured inputs and outputs.

4.4.1. The Linear Programming Equivalent

Equation (4.1) above is a fractional linear program which in its original formulation is both nonlinear and nonconvex. However, as Charnes et al. (1978) and (1981) demonstrated that it can be solved by one of two linear programming formulations. It should be noted that all inputs and outputs are defined in the same way as given above for computational ease and interpretability, first consider the following model which is the reciprocal (inefficiency) measure version of (4.1) which constrains the sum of the weighted output at unity, and minimises the inputs needed, its formulation is as follows:

$$\text{Min. } f_o = \sum_{i=1}^{m} v_i x_{io} \Big/ \sum_{r=1}^{s} u_r y_{ro} \qquad (4.2)$$

$$\text{S.T.} \quad \sum_{i=1}^{m} v_i x_{ij} \Big/ \sum_{r=1}^{s} u_r y_{rj} \geq 1$$

$$j = 1, \ldots, n \quad \text{and} \quad v_i, u_r \geq 0$$

In Equation (4.2) the weights u_r and v_i are respectively assigned to the observed outputs and inputs, as in Equn. (4.1). Thus, the resulting f_o is a scalarised measure of the minimum ratio of weighted inputs to weighted outputs. In other words, this inefficiency measure, f_o, is the minimum ratio of weighted inputs to weighted outputs. That is, the weights are the variables with values to be determined from observational data in accordance with the formulation specified in (4.2).

The above formulation is a nonconvex nonlinear one, however, the Charnes-Cooper[2] theory of fractional programming is employed to replace (4.2) by an ordinary Linear Programming (LP) problem as follows:

$$\text{Min} \quad g_o = \sum_{i=1}^{m} w_i x_{io} \tag{4.3}$$

$$\text{S.T.} \quad -\sum_{r=1}^{s} \mu_r y_{rj} + \sum_{i=1}^{m} w_i x_{ij} \geq 0$$

$$\sum_{r=1}^{s} \mu_r y_{r0} = 1$$

$$\mu_r, w_i \geq 0$$

$$\varepsilon \leq v_i \ , \ \varepsilon \leq u_r$$

Because Equation (4.3) is an ordinary linear programming

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[2]Charnes, A., and W.W. Cooper, Programming with Linear Fractional Functional", Naval Research Quarterly, Vol. IX, PP.181-186, Sept-Dec., 1962.

problem it has a LP. dual, hence, we may take advantage of the duality relations when the number of the DMUs is larger than the number of the inputs and outputs to be considered. Therefore, (4.3) is replaced by the followings:

$$\text{Max} \quad z_o$$

$$\text{S.T.} \quad -\sum_{j=1}^{n} y_{rj}\lambda_j + y_{ro}z_o \leq 0 \qquad (4.4)$$

$$\sum_{i=1}^{m} x_{ij}\lambda_j \leq x_{io}$$

$$r = 1, \ldots, s;$$

$$i = 1, \ldots, m;$$

$$j = 1, \ldots, n;$$

$$\lambda_j \geq 0$$

We call g^*_o = minimum g_o the reciprocal of the efficiency index, defined by $h^*_o = 1/g^*_o$. Hence, we have not only the computational power of ordinary LP. at our disposal but also the very sharp duality theory that is associated with that branch of mathematics. Thus, since (4.4) has a finite optimum it follows that the same is true for (4.3) with also at an optimum we have:

$$\text{Min } g_o = g^*_o = z^*_o = \max z_o \qquad (4.4a)$$

At an optimum we have $z^*_o = g^*_o$ so that $h^*_o = 1/z^*_o$ with the resulting relations showing how to move between the ratio and linear programming forms of the problems. That is, the wanted efficiency measure values can be obtained directly from any of the above formulations. It is possible to work directly from any of these models without further need for

transforming up and back between them.

Because of the structure of (4.3), one can recognise that it is equivalent to an ordinary linear fractional programming problem. To see that the above is possible, then referring to (4.3) and defining new variables v_i and u_r via the relations:

$$w_i = tv_i \; ; \quad i = 1, \ldots, m$$
$$\mu_r = tu_r \; ; \quad r = 1, \ldots, s \tag{4.5}$$

with $t \geq 0$, w_i, μ_r, ≥ 0 implies that v_i, $u_r \geq 0$ and vice versa. Then, we can proceed in either direction as we would like to, for instance we can utilise these definitions in (4.3) and obtain:

$$\text{Min } g_o = t \sum_{i=1}^{m} v_i x_{io} \tag{4.6}$$

With $$-t \sum_{r=1}^{s} u_r y_{rj} + t \sum_{i=1}^{m} v_i x_{ij} \geq 0$$

$$t \sum_{r=1}^{s} u_r y_{rj} = 1$$

$j = 1, \ldots, n;$

$t, u_r, v_i, \geq 0;$

$r = 1, \ldots, s;$

$i = 1, \ldots, m.$

The last expression in (4.6) gives;
Hence, direct substitution in the functional and obvious manipulation of the constraints produces:

$$t = 1 \Big/ \sum_{r=1}^{s} u_r y_{rj} \qquad (4.6a)$$

$$\text{Min } g_o = \sum_{i=1}^{m} v_i x_{io} \Big/ \sum_{r=1}^{s} u_r y_{ro} \qquad (4.7)$$

$$\text{S.T.} \quad \sum_{i=1}^{m} v_i x_{ij} \Big/ \sum_{r=1}^{s} u_r y_{rj} \geq 1$$

$i = 1, \ldots, m; \qquad r = 1, \ldots, s;$

$j = 1, \ldots, n; \qquad v_i, u_r \geq 0$

Direct comparison with (4.2) shows that we therefore have

$$\text{Min } f_o = \min g_o = g^*_o = z^*_o = \max z_o \qquad (4.8)$$

Where the last part of this expression is obtained from (4.4a). Alternatively, we have:

$$1/\ z^*_o = \max 1/g_o = \max h_o =$$

$$\sum_{r=1}^{s} u_r y_{ro} \Big/ \sum_{i=1}^{m} v_i x_{io} \qquad (4.9)$$

With

$$\sum_{r=1}^{s} u_r y_{rj} \Big/ \sum_{i=1}^{m} v_i x_{ij} \leq 1$$

$v_i, u_r \geq 0;\ i = 1, \ldots, m;$

$r = 1, \ldots, s.$

Which is the same as Equation (4.1) Q.E.D.

Therefore, having a flexible approach with a variaty of alternatives to choose from at any stage of the analysis puts us in an advantageous position for obtaining both the overall measures of efficiencies and the respective weights. Furthermore, having all y_{rj}, $x_{ij} > 0$ with u_r, $v_i \geq \varepsilon > 0$ guarantees that $h^*_o > 0$ will apply and a solution satisfying these conditions exists.

Drawing all of the above conditions together we then say that $h^*_o = 1$ if and only if DMU "o" is efficient relative to the others using these same inputs and producing these same outputs in the set of (j = 1, ..., n) DMUs considered. The LP model is solved for each DMU providing an inefficiency value (z_o) from the measure of efficiency $h_o = 1/z_o$.

When we are to analyse inefficient units, an additional concept needs to be introduced, this is the efficiency adjustment. That is, it must be determined what the outputs and inputs for a DMU would be if the unit were to become efficient. To do so, all the outputs and inputs must be adjusted rather than considered one at a time.

Outputs are adjusted by adding the slack value to the product of z_o and the observed output. And inputs are adjusted by subtracting the slack value from the observed input. Thus, slack has a different interpretation for outputs and inputs: slack is the amount of additional output that would be expected if the DMU were efficient, and it is how much less of the input efficient units have for the adjusted output.

At this point we may form a new formulation to show how Equation (4.4) can be adjusted to eliminate all the inefficiencies which can be detected. This formulation can be stated as follows:

$$\max \hat{z}_o$$

$$\text{Subject to:} \quad -\sum_{j=1}^{n} y_{rj}\hat{\lambda}_j + (y_o z_o^* + s^{*+})\hat{z}_o \leq 0 \qquad (4.10)$$

$$\sum_{j=1}^{n} x_{ij}\hat{\lambda}_j \leq x_{io} - s^{*-}$$

$$\hat{\lambda}_j \geq 0; \quad j = 1, \ldots, n.$$

The elimination of inefficiencies which may exist is done via (a) reducing inputs from the original observations x_{io} to the newly adjusted inputs in the form of $x_{io} - s^{*-}$ and also (b) increasing the originally observed outputs y_{j*} to the newly adjusted output values in the form of $(y_o z_o^* + s^{*+})$.

However, when the following inequalities of, $z^*_o < 1$ and/or $s_r^{+*} > 0$ or $s_i^{-*} > 0$ prevail. This represents sources of inefficiency and it can be treated in an alternative way of the above. Alternatively, efficiency can be obtained if we apply these results to the original data in the forms:

$$\hat{x}_{io} = z_i j_0^* x_{io} - s_i^{-*}, \quad i = 1, \ldots, m \qquad (4.11)$$

$$\hat{y}_{ro} = y_{ro} + s_r^{+*}, \quad r = 1, \ldots, s.$$

In other words, if the original x_{io} and y_{ro} observations were adjusted in the manner indicated above by (4.10), we would obtain new values $\hat{x}_{io}$, $\hat{y}_{ro}$ that would render DMU "o" efficient. Note, in particular, that input reduction and output augmentation may be required simultaneously.

It is important to stress that the optimal u's and v's from

(4.1) may vary for each DMU being evaluated; they represent the relative value system that provides the highest possible rating for the particular DMU's performance, consistent with the notion that the value system must be feasible for the other (n-1) DMUs.

For all units having the best combination of inputs and outputs, both z_o and h_o will equal to 1.0 and h_o will be less than 1.0 for less efficient units with the value of h_o indicating the degree of relative efficiency. This is an advanced stage, as Charnes et al., 1978, indicate, "We have a completely symmetric definition of efficiency which generalizes single output ratio definitions not only in economics but in engineering and other natural sciences."

The h_o^* score having $1 \geq h_o^* > 0$ where $h_o^* = 1$ indicates an efficient DMU, and as Nunamaker (1985) indicated that h_o^* can be interpreted as a scalar efficiency measure according to a 'proportionate contraction of resources' criterion. That is $(1-h_o^*)$ measures the reduction in each input required for the DMU being evaluated to produce its given outputs as efficiently as the subset of DMUs to which it is being compared (Nunamaker, 1985). Note that if inputs are measured in cost terms, it becomes possible to calculate the total cost savings assuming inefficient DMUs were to become efficient.

For inefficient DMUs, some units of inputs are not fully utilised in the solution when the constraints have been satisfied. The interpretation of this condition is that efficient units are getting more output per unit of input for these resources. This, then is termed slack which is the usual terminology for an excess resource.

From this ongoing discussion we may conclude that, no DMU can be rated efficient unless the following conditions are both satisfied: first, $z_o^* = 1$ and second, the slack variables are all zero. This assumes that the reduction in

any input or an expansion in any output has some value. It does not require that these values be stipulated or prescribed in advance in any way. Indeed, if efficient measures are to be restricted to a scalar measure only, then, objective computation of weights from (4.4) as already discussed, will suffice to produce what is wanted by direct substitution in (4.1).

4.5. Managerial, Programme and Technical Efficiency

The variations in the efficiency/inefficiency scores over a number of DMUs may be due to differences in resource allocation procedures, factors special to particular DMUs and managerial philosophy with respect to cost accounting methods. In a divisional form of organisation it may be informative to separate out the inefficiency which occurs within a division, i.e. technical inefficiency due to individual operating units implementation of division plans and policies and the inefficiency which occurs between divisions. This latter component reflects differences in managerial philosophies and resource allocation strategies used by each DMU.

In order to calculate technical and managerial efficiencies, a two step calculation procedure is required. First step is that the DMUs within each region are adjusted to the efficient frontier of the region. In other words, the original output and input observations for the inefficient units are adjusted by the amount of their slacks (outputs are increased and inputs under management control are decreased by their respective slacks). This results in adjusting the DMUs within each region to a level of maximum technical efficiency in line with the regional managerial resource allocation policies and managerial philosophy. The second step involves calculation of the efficiency/ inefficiency scores and slack estimates over all DMUs using the adjusted output and input measures for the inefficient

DMUs in step one.

A comparison of the aggregate slack values by region before and after adjustment to the efficient frontier of each region provides a direct measure of the component of technical and managerial efficiency.

Furthermore, the fluctuation of efficiency scores over time of a DMU may be due to managerial factors within the DMU or to external factors unique to that DMU. In either case they serve to identify the time period in the history of that DMU which warrant review to obtain further insights as to why this DMU achieves various levels of efficiencies. This feature would serve as a parallel mean to that of the economic theory assumption which indicates that, in a free market economy, market forces tend to force all firms in the same industry up to the efficiency frontier (or at least to the frontier which occupied by the most efficient firms). Hence, for those firms which cannot make it to the frontier are supposedly eliminated from the industry in due course.

Figure (4.1), below may help to explain what we mean by managerial and program efficiency, we have one input of x which rsults in output y for a number of DMUs. These DMUs operate under two different technologies so that the efficient frontiers for one set are at B while the efficient frontiers for the other are at A.

From Fig. (4.1) it can be seen that even efficient DMUs in B cannot achieve the levels of those in A, and also some of the less efficient DMUs operating under A exceed what is attainable under B. Therefore, DEA tries to locate the boundaries that envelop the observations as in A and B of Figure (4.1) and it also brings all the observations up to the envelop that is pertinent in each case. Furthermore, it imputes any remaining efficiency differences to the respective programmes so that in the situation of Figure

Illustrative plot of observations of a one variable input/ one output production process for DMUs of programs A and B with identified DMU specific relative efficiency frontiers.

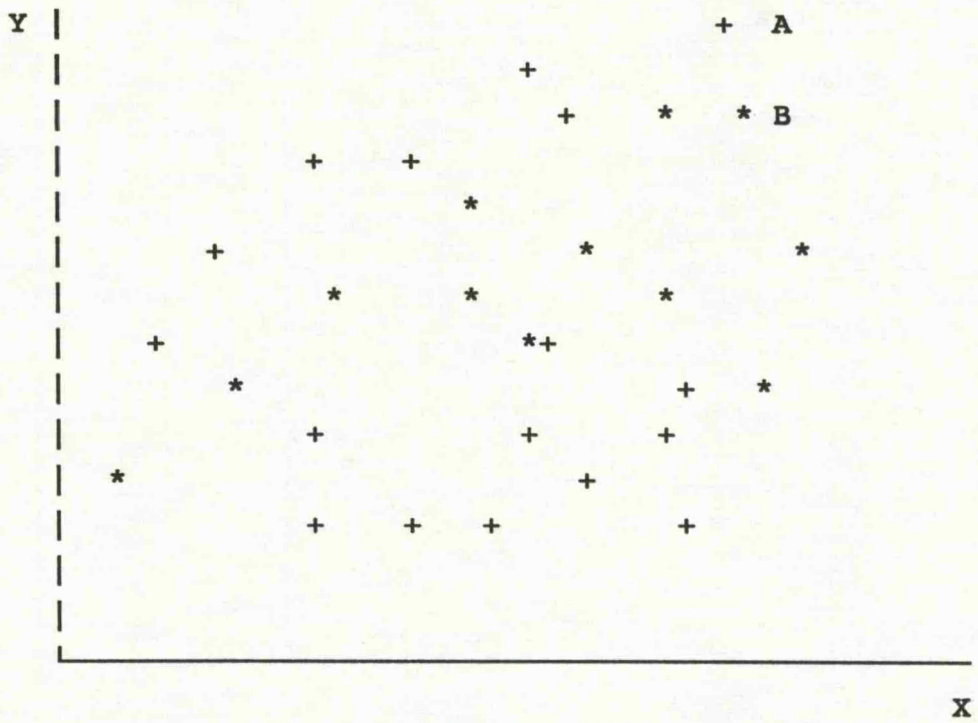

Figure (4.1)

Where:

Y = Output of DMUs of programs A and B,
X = Single variable input utilised in producing Y,
Pluses (+) = Observations for DMUs of A,
Asterisks (*) = observations for DMUs of B.

(4.1) for instance, the programme associated with A would be characterised as more efficient than that associated with B. Moreover, the numerical value of these efficiencies (measured as the difference in the statistical distributions resulting from the indicated adjustments) is intended to represent the amount of output gain that is attainable by moving the DMUs from B to A.

A standard approach via statistical regressions might have concealed some of the alternatives for choice that are present because the observations generally contains a mix of technological possibilities with their utilisation. This is the situation we would now like to confront by extending our previous analysis in order to bring it to bear in ways that might help us distinguish what Charnes and Cooper, 1980, referred to as "managerial efficiency and program efficiency". The latter may be thought of in terms of the kinds of frontiers depicted in Figure (4.1), while the former may contain inefficiencies resulting from managerial decisions that fail to utilize these opportunities to the full.

To be able to distinguish the program from managerial efficiency in the different reference sets of DMUs, we refer to Rhodes' work (1978), who demonstrates that it is possible to consider different programmes at a time, represented by (α=1, ..., k). Assuming that we have n^{α} DMUs in the αth programme. Therefore, we may introduce the following extension of (4.4):

$$\text{Max } z^{\alpha}_{o}$$

$$-\sum_{j=1}^{n^{\alpha}} y^{\alpha}_{rj}\lambda^{\alpha}_{j} + y^{\alpha}_{ro}z^{\alpha}_{o} \leq 0 \qquad (4.12)$$

$$\sum_{j=1}^{n^{\alpha}} x^{\alpha}_{ij}\lambda^{\alpha}_{j} \leq x^{\alpha}_{io}$$

$$\lambda^{\alpha} \geq 0$$

$$\alpha = 1, \ldots, k \ ;$$

$$r = 1, \ldots, s^{\alpha} \ ;$$

$$i = 1, \ldots, m^{\alpha} \ ;$$

$$j = 1, \ldots, n_{\alpha} \ ;$$

Notice that we allow m^{α}, n^{α}, and s^{α} to vary with each of the $\alpha = 1,2, \ldots, k$ programmes. This is to say that there is no requirement for the inputs, outputs or even the number of DMUs to be the same in every programme. However, the inputs and outputs within each program are still required to be the same for within programme comparability as before.

As it should be evident, the previous results of the relations in Equations (4.1) to (4.10) are all extended to the case of any specified α programmes. So that we can take h^{α}_{o} as our measure of efficiency for the $P^{j\alpha} = Po^{\alpha}$ DMU under the αth programme. Alternatively, we may take $z_{o}^{*\alpha} = 1/h_{o}^{*\alpha}$ as a measure of its inefficiency. These are evaluated relative to other DMUs in the same programme. Hence, it is referred to each such h_{o}^{α} as a measure of 'intra-program' efficiency as contrasted with 'inter-program' efficiencies (Rhodes 1978). To address the latter we proceed as follows: first, we introduce the concept of an 'envelop function' (Rhodes, 1979) which contains all of the n^{α} DMUs for a given programme in which the envelope lies in the direction in which we wish to conduct our evaluations. Such an example is provided by our efficiency frontier for which the h^{α}_{j} gives us the wanted direction which, of course, $0 \leq h^{\alpha}_{j} \leq 1$ in any case. Next, we adjust the observations in each program in a way that brings every DMU up to the αth efficiency frontier which serves as the envelop for the αth set of observations. This may be written as follows:

$$P_{j}^{\alpha} = \begin{bmatrix} y_{j}^{\alpha} \\ x_{j}^{\alpha} \end{bmatrix} \qquad (4.13)$$

Where y^{α}_{j} is the vector of observed outputs (with components y^{α}_{rj}, $r = 1, \ldots, s^{\alpha}$) and x^{α}_{j} is the vector of observed inputs (with components x^{α}_{ij}, $i = 1, \ldots, m^{\alpha}$) for the jth DMU in the αth programme. Proceeding via (4.4) we then adjust the output vector for P^{α}_{j} via;

$$y_j^{*\alpha} = y_j^{\alpha} z_j^{*\alpha} \qquad (4.14)$$

in which $z_j^{*\alpha} = \max z_o^{\alpha}$ for that DMU as obtained from (4.4). Next we adjust for any positive slack variables $s_j^{*\alpha+}$ and $s_j^{*\alpha-}$ for outputs and inputs respectively in this same optimum solution to obtain;

$$\hat{P}_j^{\alpha} = \begin{matrix} \hat{y}_j^{\alpha} = y_j^{*\alpha} + s_j^{*\alpha+} \\ \hat{x}_j^{\alpha} = x_j^{*\alpha} + s_j^{*\alpha-} \end{matrix} \qquad (4.15)$$

This $\hat{P}^{\alpha}_j$ then represents an efficient adjusted vector obtained in the indicated manner from the original data. These efficiency adjusted vectors must necessarily satisfy $\hat{z}_o^{*\alpha} = h_o^{*\alpha} = 1$ with also $\hat{s}^{*\alpha+}$ and $\hat{s}^{*\alpha-} = 0$ under any further optimisations relative to the n^{α} DMUs in this programme. In other words, these adjustements take us to the efficiency frontier.

As $\alpha = 1, 2, \ldots, k$, respectively, indexes the sets which are of interest. Within each set we will have the same efficiency measurement situation as before, viz. $0 \leq h_o^{*\alpha} \leq 1$ with $h_o^{*\alpha} = 1$ if, and only if, the DMU being evaluated relative to the αth set of DMUs is efficient. Within each such set we shall assume that we are securing a measure of managerial efficiency. Only when allowance has been made for the presence of this source of inefficiency will we be in a position to assess the programme efficiency that is also of interest.

Analysis could be centered on each of the latter segments, but something more might be wanted. We might, in particular, want an overall assessment to enable us to choose between the two programmes, and for this we might replace the originally observed output values y^1_{rj} and y^2_{rj} with new

values $\hat{y}^1_{rj}$ and $\hat{y}^2_{rj}$ which result when the originally observed values are adjusted in a manner that brings them onto their respective envelops. Similarly, we can replace the original x^1_{ij} and x^2_{ij} input values by new values $\hat{x}^1_{ij}$ and $\hat{x}^2_{ij}$ that are derived from their efficiency frontiers. Then we can derive a new envelop which it is referred to as the 'inter-envelope' via:

$$\text{Max} \quad \hat{h}_o = \sum_{r=1}^{s} u_r \hat{y}_{ro} \Big/ \sum_{i=1}^{m} v_i \hat{x}_{io} \qquad (4.16)$$

$$\text{S.T.} \quad 1 \geq \sum_{r=1}^{s} u_r \hat{y}^1_{rj} \Big/ \sum_{i=1}^{m} v_i \hat{x}^1_{ij} \; ;$$

$$j = 1, \ldots, n_1,$$

$$\text{and} \quad 1 \geq \sum_{r=1}^{s} u_r \hat{y}^2_{rj} \Big/ \sum_{i=1}^{m} v_i \hat{x}^2_{ij} \; ;$$

$$j = 1, \ldots, n_2$$

Where as before, all variable values are constraint to be positive. Note that we are assuming that all managers are operating efficiently, by which means that they will always move to the boundaries indicated by their respective envelopes.

4.6. DEA and Business Enterprises

One may question whether a business enterprise should or can use DEA, when measures like profitability and returns on investment are available and are widely used and

acknowledged as key indicators of performances, in contrast to the nonprofit case where such measures are less relevant. From the literature there appears to be at least two justifications for using DEA in the for-profit context.

firstly, AICPA (1987) indicated that the financial ratios and analytical review techniques are highly dependent on the use of pound measures which can be biased because of inflationary factors, regional price differences, or differences in methods for cost accounting used. DEA provides a means to evaluate performance based on physical units of inputs and outputs and can, therefore, suggest which DMUs are efficient using their inputs without respect to the price they pay for these inputs and without regards to the cost accounting methods applied. Financial ratios may provide valid insights about profitability and costs, but DEA can provide additional insights about inefficiencies which, if remedied, may further increase profitability through improved efficiency.

Secondly, DEA seems appropriate in the for-profit setting in that the profit and return on investment measures tend to reflect current operation and may even be penalised by expenditures for training, maintenance and repair, and R & D which incurred to promote future profitability. Similarly the case of raping the benefits of past expenditures. These other expenditures may result in outputs which are not reflected in current sales and therefore, are not considered in the profit measure. These outputs can however, be included in a DEA evaluation.

4.7. Sensitivity Analysis

A key feature of DEA is that the efficient frontier is formed by the outer frontier of all organisations' actual achievements. This is in contrast to many existing techniques, such as regression analysis, which seek to

average out stochastic error terms in order to estimate pre-specified functional forms for the production frontier, such as that of Cobb-Douglas production frontier, for which there may be no strong a priori justification in the case of education for example. The avoidance of distributional assumptions for the underlying variables also, however, means that one has no direct way under DEA of assessing whether an organisation's deviation from the frontier is statistically significant.

Another property of DEA is that it depends simply on the organisations' actual achievements. This point is particularly important in view of the problems of estimating the resources necessary to deliver services to acute problem areas. Moreover, if a DMU concentrates on one particular output to the exclusion of others, and is the only DMU to do so, it will automatically be deemed to be efficient. This is because it will form part of its own unique 'facet' of the efficiency frontier, albeit towards the extreme of one axis. However, this kind of behaviour can easily be detected by means of an important supplementary measure in assessing the robustness of this result. This is done by checking the number of inefficient DMUs for which that DMU forms the efficient frontier. If this number is high, the DMU is most likely to be genuinely efficient with respect to a large number of organisations. On the other hand, if the number is low, the DMU may still be efficient, but there is not enough comparable evidence to form a final judgement.

4.7.1. Variable Addition/Disaggregation effects

Previous DEA studies have generally advocated identification and measurement of those dimensions deemed 'most relevant' for a particular set of DMUs. However, since in any practical application of DEA, there are usually several alternative variable sets of input and output variables that are plausible. The question which may arise is, by whom and

how are the 'most relevant' dimensions selected?.

The importance of a particular variable to DEA results is established via: a panel of experts, prior statistical works or the researcher's knowledge of the decision environment, or a combination of the three approaches.

Variables which are highly correlated with existing model variables can be omited (see Charnes et al., 1981) from further analysis without significantly impacting the DEA efficiency results. This view has been formalised and made explicit by Lewin et al. (1981) who suggested the use of regression and correlation techniques for identifying the relevant set of input factors and output measures. Their variable selection methodology assumes that addition of a highly correlated variable will have an insignificant impact upon subsequent DEA results. Whereas Nunamaker (1985) indicated that addition of a highly correlated variable may alter substancially the DEA efficiency evaluations. He also indicated that a redundant variable within a regression model does not mean it is also redundant within DEA. Furthermore, with regard to the omission of correlated variables, Nunamaker (1985) believed that the omission of a variable would alter some of the DEA results and the efficiency evaluations of certain DMUs may change substantially.

It is important to consider what impact an expansion or reduction in the variable sets would have upon the DEA results. Some observations are offered as follows:

The addition of a variable that is perfectly positively correlated with an existing variable, cannot decrease the h_o^* scores for any inefficient DMUs. The same impact would accrue when disaggregating two variables that are perfectly positively correlated with each other (Nunamaker 1985). However, positive slack may occur in the optimal solutions for the inefficient DMUs yet the h_o^* scores may actually

increase. Hence, addition (or disaggregation) of a perfectly positively correlated variable (two variables) can only increase or leave unchanged the h_o^* rating for the inefficient DMUs. In summary, the addition or disaggregation indicated above cannot decrease h_o^* for any DMU, it may increase h_o^* for some inefficient DMUs, though none can become efficient and finally, it may result in a greater occurence of positive slack values in the optimal solution for certain DMUs.

Addition of a variable (or disaggregation of two variables) such that the variable added (or the two disaggregated variables) is (are) less than perfectly correlated with an existing variable (or with each other) results in the followings:

a) cannot decrease h_o^* for any DMU,
b) the number of efficient DMUs will probably increase,
c) the efficient frontier will be drawn closer to the inefficient DMUs, resulting in larger h_o^* values, this is becuase of (b) and
d) may rersult in a greater incidence of positive slack in the optimal solution for certain DMUs.

Nunamaker (1985) observed that a greater impact would be anticipated in the case of the less than perfect correlation situation. These observations imply a special character for the DEA in the variable selection process which is that conclusions from regression analysis cannot be relied upon with respect to redundant variables or highly correlated ones within a regression model.

4.8. Strengths and Limitations of DEA

DEA has been tested using physical output and input measures and consequently has been limited in its use to assessment of technical output-input efficiency. Hence, when

inefficiencies are identified, DEA indicates that the same output could have been produced with fewer inputs than were used. DEA does not, however, address issues of whether a firm is purchasing inputs at the lowest price or whether the input mix results in the lowest cost of producing a good or service.

DEA has been shown to be theoretically sound and consistent with economic theory. It is observed that those DMUs which are identified inefficient with DEA are strictly inefficient compared with other DMUs in the data set (Charnes, Cooper, and Rhodes, 1979 and 1981). In addition, when inefficient DMUs are located, they are found to be inefficient with respect to a narrower set of relatively efficient DMUs. This is the efficient reference set which helps to focus the management investigation into the source and nature of the inefficiency.

DEA identifies alternative paths for improving the efficiency of inefficient DMUs in the data set. However, it does not identify the one path that will move the inefficient DMU to the underlying efficient production relationship. Hence, managers' judgement is always required to assess the improvement paths which are most appropriate for a particular DMU.

Moreover, DEA does not undermine, but rather is highly dependent on managerial judgement and knowledge of the environment in which the particular DMUs under investigation operate. This extends to the determination of where DEA is appropriate, identifying and accurately measuring all the relevant inputs and outputs of the investigated DMUs, and interpreting the results. Indeed, a low efficiency rating only signifies potential problems, some of which may be due to non- comparable units being compared with DEA, for instance, different environment, capacity, and operating constraints.

Finally, DEA assessement can help managers better understand the control process by requiring that all relevant outputs and inputs be identified. Another benefit from DEA is that it encourages organising the achievement evidence and provides documentation that can be presented in an objective form that can be subject to review.

Conclusions

Though, DEA generates a wealth of information useful in a variety of decision setting, its principle strength lies in its ability to combine multiple inputs and outputs into a single summary measure of efficiency without requiring specification of any a priori weights such as market prices, neither the variables to be in a unfied measure like pounds for example and finally, the production function need not be known. Therefore, the two most important characters of the DEA approach are: first, its 'synthesis' of a single summary measure of relative efficiency for each DMU being evaluated and second, its indication to the level of improvement that needed before an inefficient DMU can becom efficient.

In addition, DEA is of enormous potential in measuring NPOs' efficiency. Several applications have already been published, and the method has been commended as a paradigm for assessing organisational efficiency as well as effectiveness (see Lewin and Minton, 1986).

The value of DEA with respect to management control is that according to Lewin and Morey, (1984), "the units located as being inefficient are clearly inefficient compared to other DMUs in the data set." Hence, a transfer of techniques from more efficient units to the less efficient units can potentially improve the inefficient DMUs. In addition, DEA provides information which helps locate the inefficiencies. And further, it focuses the search for sources of and remedy for inefficiency.

DEA appears to be a technique that is well suited to efficiency evaluation in certain managerial audit contexts. And it is capable of achieving the location of relatively inefficient DMUs among a set of DMUs that use multiple inputs to produce multiple outputs where the efficient production function is not known. This type of information may be useful in a managerial control context for two purposes: (a) control over resource allocation and (b) analytical review of operations.

Finally, DEA capabilities may be strengthened by assigning relative prices or priority weights to outputs and inputs whenever possible.

Chapter five

THE MANAGEMENT OF HIGHER EDUCATION INSTITUTIONS IN A TURBULENT ENVIRONMENT

Introduction

This chapter consists of two main sections. Section one deals with various aspects of the environment in which higher education institutions (HEIs) operate, with special emphasis being placed on universities. It starts with a view of objectives setting in higher education (HE) followed by consideration of policy and decision making in this sector. Then it proceeds to consider the organisational structure and university management. In light of the recent changes in the system, we therefore, study this aspect and the difficulties posed for implementation of these changes in a turbulent environment like the higher education one, and how to manage organisational changes effectively.

Section two addresses the issue of leadership. The effect of leadership on the success of an organisation is grand, and therefore this issue will be studied in detail. Hence, the different kinds of leadership are considered together with the skills required for a successful leader. There will be a specific reference to HEIs and the impact of the recent changes on their leadership styles from administrative to executive.

5.1. The Setting of Objectives

The environment of the higher education institutions (HEIs) is a complex one. First is, the clients' environment, it constitutes potential students, their parents, and the schools from which they come. Most HEIs put great effort into

recruiting students. Furthermore, There are the employers whose take-up of graduates has become a growing concern for many HEIs and indeed they are affected by their students employability grading in the process of evaluation.

Second is, the financial sponsorship, it is the state which sponsors the core activities of HE. Private industry, commerce and government agencies also seek research or consultancy from institutions, usually in return for money or equipments and the overseas sources, government and individual students. All these sources have grown greatly since the 1981 cuts in universities' budget. Kogan and Youll (1988) indicate that HEIs have increasingly tried to step into the role of the entrepreneur seeking to market and sell services.

The environment of both clients and sponsors are important to HEIs. In the case of universities, the increased pressure from the government through the central intermediary bodies such as the UGC/UFC which has so far proved to be the most important influence. The pressure from the employers, potential students, schools and other groups within the HEIs environment is less systematic and often less obvious in its effects. It is only recently, however, that it became part of government policy (White Paper, 1987, and MSC, 1987) to ensure that the world of employment will have a stronger impact on the work of HEIs.

The entrepreneurial strategy, as described by Lockwood and Davies (1985), could be found in individual departments. Institutions encouraged basic units through financial inducements and sanctions in order to increase external earnings. Thus, various steps have been taken in order to promote industrial liaison, to increase research contracts, to enhance earnings from consultancies and to earn money by offering new vocational and post-qualifying courses. Just to give few examples, during the 1980s, many institutions have

created the post of industrial relations officer to liaise with firms seeking research and/or consultancy as well as specific training programmes for their employees from HEIs. In many universities for example, a sub-committee of council was set up to promote a more positive attitude to industries. Furthermore, entrepreneurial paths were pursued in the setting of science parks at many university sites[1].

Over the last decade, HEIs have been forced to adjust to changes in the environment. As the need to find sources of external funding increased, HEIs became more outward looking. They recognised the influence of many groups including the government, potential employers and students. They learned about potential sources of finance. In addition, HEIs responded to external pressures by adopting more managerial style of management within their organisational structure.

The setting of objectives for both the Department of Education and Science (DES) and individual universities has been proposed by the Jarratt Report (1985) and Croham Report (1987), as a way of ensuring that institutional policies will be negotiated and secured. Objectives-setting is an important issue, not only for HEIs, but for every organisation. Government is attempting to reassert itself and reinforce its role, the Jarratt and Croham Reports have made detailed proposals to that effect. These influences are most noticed in the appointment of institutional leaders, the sub-committees concerned become to have definite ideas about selecting not only an academic leader but also someone to take a broader leadership role, to include, public relations and institutional representation, an entrepreneurial as well as a stronger managerial approach.

Governors are expected to take a stronger part in the

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[1]. For further details on this issue, see Cerych, (1985).

decision-making process especially when conflicts arise. They are also expected to hold the boundary of the HEIs against any other interests for as far as the institution's objectives are concerned. However, Kogan et al. (1988) in their study of nine HEIs, indicated that, the councillors and governors who they interviewed expressed reservations about their influence. "Most doubted the extent to which they could or should attempt to initiate or influence policy. Many of those interviewed were freely critical of operation of the full council or governing body and saw the 'real work' as being conducted in sub-committees." (p. 167) That is, They reached uncertain conclusion as to the extent effective governmental influence over HEIs. Councils governors regard themselves to be essentially reactive to and supportive of the institutional leadership. They also indicated that industrial members were often drawn from a wide range of work and not necessarily from local firms. This made it difficult for them to develop any kind of group perspective and therefore, become able to speak with a single voice.

Furthermore, most members also doubted that the governing body was an avenue through which they could put forward view or ideas about the needs of industry. They referred to the agendas being firmly in the hands of the academics and the committees system. Industrial governors seemed to be aware of their lay status in relation to the experience and expertise of the academics and educationalist. However, where they were able to link more directly with departmental staff, industrial governors enjoyed the opportunity and considered they had a useful contribution to make. Such arrangements were usually informal and owed much to the individuals involved (Kogan et al., 1988).

Traditional policy making rests on the interaction between powerful groups and individuals located mainly on the basic units. Baldridge (1978) described how systems change in a process of political negotiation. "As familiar issues follow

increasingly familiar paths they become structured into accepted procedures." The political bargaining which has always been overlaid by the authority, sometimes explicit and sometimes implicit, of the institutional leader and the managerial system working under him/her. The power to appoint and to allocate may be vested in committees but the vice-chancellor or director is present at, and usually chairman of, the decisive committees. The Jarratt Committee (1985) formulations gave the vice-chancellor the role of chief executive which implied reduced dependence on the consensus of senior colleagues acting within a committee system.

The study of management in HEIs is based on the twin assumptions that the institution can specify educational objectives within which those of the basic and individual units can be contained, and that the ability to determine and control the pursuit of objectives can be distributed hierarchically. Its moral justification is that it is essential to secure the economic and legal base, reasonable convergence of working between different parts, and predictable planning.

Kogan et al. (1988) study of nine HEIs found that all but one apply collegial form of leadership in determining their educational policies. However, they emphasised that the scene is changing rapidly and that many HEIs now have new leaders. Moreover, the Education Reform Act (1988) has led to proposals from heads of institutions which weakened the representative powers of faculty on governing bodies. In some universities, decision making has become concentrated into smaller executive groups in which governors have a more prominent role.

5.2. Organisational Structure

Davies and Morgan (1983) identified four models of organisations in higher education; these are bureaucratic, collegial, political and organised anarchy.

The bureaucratic model assumes a formal organisational structure, the other three are more flexible, participatory and non-authoritarian. The collegial model assumes consensus decision-making by academics with no decisive administrative role. It assumes that there will be sufficient cooperation, commitment and resources to enable participatory decision making to be successful without resorting to hierarchical, academic or administrative structures. The political model is set in a state of continual conflict focusing upon issues brought forward by interest groups with different goals. It proceeds by using the decision-making machinery to translate the pressures of these groups into action. The organised anarchy models prevails when the institution lacks common goals and there is ambiguity and inconsistency in its operation. It introduces decentralisation and its formal mechanisms allow participants to pose preferences in carrying out their tasks. The success of the head of the institution depends on his/her ability to have sufficient tactical skill to influence decisions.

None of these types exist in isolation, the basic model is bureaucratic, the other three represent features all or some of which are present within a university. The degree to which they are present may vary according to the nature of the university or events at a particular time which provoke a response.

Hudson Committee[2] favoured the managerial rather than the

[2]. Kedourie, E. (1989): Appointed in 1986 to review the efficiency and effectiveness of Australian HE.

collegial mode of operation in HE, it also recommended more flexibility in academic employment conditions, systematic review and evaluation of the performance of departments and individual academics, strategic planning and the preparation and implementation of research management. Furthermore, plans involving the competitive allocation of resources and the concentration of research funds on work of 'national importance'. This emphasis on efficiency and effectiveness is well in place in the UK since the beginning of the 1980s. It has been accompanied by a view of education that is increasingly instrumental, linking HE to economic performance.

The Education Reform Bill (1988) empowered the UFC to make payments subject to the terms and conditions which they think fit. The Bill allowed redundancies to be made in the system, so that teachers could be replaced by more competitive ones or by other at lower salaries. But, there was an amendment made by lord Wedderburn which prevented such favoured treatment.

The Review of the UGC[3] pointed out to the government intention to set priorities and establish a nationwide policies for universities. These policies must be formulated in the light of policy for higher education sector as a whole, as well as national social and economic policies. Thus, under this new arrangement there will be some strategic decisions for which Government Ministers must take explicit responsibility and answer to Parliament.

To make central planning and policy-making effective, the UGC

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[3]. Review of the University Grant Committee, (Croham Report), Cm.81, London: HMSO, Feb. 1987. It quotes a letter of July 1982 from the Secretary of State for Education and Science to the chairman of the UGC.

was replaced by a the Universities Funding Council which should be more activist and interventionist, the council's role would be to initiate and promote plans for development of university teaching and research that fit well the national economic objectives. Its principle responsibility is to construct a national strategy for the investment of public funds and to reconcile universities separate strategies with perceived national needs. It has the power to attach conditions to grants, "including the positive or negative earmarking of elements of the grants", and finally, the Council should assume responsibility for the allocation of student places and concentration as well as rationalisation with respect to individual subjects.

It is recommended that the Council chairman should have substantial experience outside the academic world combined with a strong personal interest in higher education. The chairman is assumed to play the role of a Director General whose professional and leadership skills will significantly contribute to the effective and powerful role of the Council in restructuring the universities.

The White Paper (1987)[4] followed similar patterns of recommendations by placing high level of responsibility on HE in helping with the economic progress. It committed the government to the pursuit of detailed manpower planning, monitoring carefully from year to year student demand and the prospective needs for new graduates by industry, commerce and public services. The government, the White Paper indicated, "will in particular, be concerned to see that the UFC's arrangements for making funds available to universities properly reward success in developing co-operation with and meeting the needs of industry and commerce." (para. 4.43)

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[4]. Higher Education: Meeting the Challenge, Cm.114, London: HMSO, April 1987.

5.2.1. The University Management

Traditionally, management in HEIs played a passive role in initiating changes, it was always imposed on them. They had little choice but to respond rather than initiate change. Managers in HEIs as leaders can only have some flexibility in selecting those appropriate strategies to achieve the objectives being set for them and have no say in determining the objectives of their institutions. Pack and Pack (1988) regard education as a process from which individuals experience to achieve various goals. Thus, the university can be seen as a system that makes it possible for this process to take place and consequently enables the individuals to achieve their objectives. Furthermore, Pack and Pack (1988) consider managers to be the ultimate agents for change. To some extent, this statement may be true in independent organisations. Commercial and profit oriented organisations can shift from one segment of the market to another, from one category of clients to another, they can eliminate unprofitable products/services or introduce new ones. The managers in profit oriented organisation can choose to initiate dramatic (or revolutionary) changes and They must do so to ensure success and achieve their goals. However, managers of less independent organisations cannot behave in any similar ways, simply because they are tightly dependent on other factors in the global system in which they operate. Their decisions are crucial with regard to the relationships within the system and their role in it. Therefore, it may be fair to conclude that, managers in higher education institutions are only 'junior' managers in the political hierarchy and have no upper hand in formulating those strategies which may achieve the objectives which they have not set in the first place.

The university management is further complicated by the interplay between a bureaucratic structure of senior and middle managers and the participatory model of committees and

committee consideration, etc. Furthermore, policy decisions are more concerned with the marginal decision consistent with a very broad loose framework rather than the grand fixed strategy of a development plan. Points of specificity in planning may be possible only on particular issues due to the political and environmental uncertainties. Hence, Joint policy decisions are slow and problematic to make, and decisions which are carried through are usually, short-ranged and based on compromise.

The Government White Paper, HE: Meeting the Challenge (1987) lays stress in its introduction on improvements in efficiency by: (a) improving and strengthening of institutional management, (b) changes in the management of the system and (c) the development and use of performance indicators. The intention is to steer up the entire system via the mechanisms of performance assessment. That is, to achieve better results economically and otherwise, the system must be made more responsible and accountable.

5.3. Organisational Change

Significant organisational changes originate with higher levels of management, and are 'pushed through' in one way or another. Resistance from the 'lower levels' is usually expected and plans are made to overcome it. Management attempts either to convince those affected that they are likely to gain as a result, or promises them that they will be compensated for any loss of job or status. Whatever the kind of change to take place is, it is managed from the 'top-down'. Because it is, above all, the senior management to be held responsible for what happens to the organisation, to the clients, to the government or whoever else might be part of it. It is up to the senior managers, in discharging that responsibility, to see that at the very least the organisation survives and at the most grows and develops.

They must therefore keep an eye on the competitors, the clients, the unions, the state of technical know-how, the government etc., and make what changes they judge necessary to deal with the situation as they see it.

McGregor, Blake, Likert and others are concerned to point out that, if organisations are to be effective and efficient, managers must combine technical and formal administrative competence with skill in getting their subordinates to commit themselves to the goals of the organisation or at least to subgoals that are consistent with those general goals. This managerial skill is based on understanding of the needs of subordinates and expresses itself in a willingness to what they have to say by way of criticism and suggestion for improvement. They need either to act on these or to be prepared to explain patiently why it is impossible or impractical to do so. Commitment may also be won by management if it makes subordinates jobs more interesting, more demanding, or more satisfying.

McGregor's Theory Y, Likert's System 4, Blake's 9/9 management style are all variations on a simple and familiar theme. They all assume that high organisation efficiency and human enjoyment of work may be brought about by careful attention on the part of superiors to the needs of subordinates. Theory Y and 9/9 management style indicate that if subordinates' behaviour is to be altered in directions that are consistent with the interests and aims of superiors the leader must be participatory. When the leader's behaviour moves along the scale from X to Y then the subordinates' attitudes change and for the better.

5.3.1. Understanding Organisational Change

In order to understand organisational change, some general principles[6] and procedures must be understood and complied with by managers. Then changes become possible and can be carried out successfully. Here follows some of these principles:
Firstly, organisations are organisms and not mechanisms which can be taken apart and reassembled differently as required. They can be changed, but the change must be approached carefully with the implications for the various groupings thought out and the participants convinced of the worthiness of the change. They must be given time to understand the change proposals, and to 'digest' the changes after they have been made. Changes must not be made too frequent. They are too hard to digest and will become dysfunctional and cosmetic.

Secondly, organisations are occupational and political systems as well as rational resource-allocation ones. Every reaction to a change proposal must be interpreted in its own merits and not only in terms of the rational arguments of what is best for the organisation. The reactions must also be understood in relation to the occupational system. For instance, how will it affect the ways of working, number of jobs, career prospects, motivation, of the particular person or group whose arguments are being heard?. It must also be understood in relation to the political system and how will it affect the power, status, and prestige of the group?.

Thirdly, all members of an organisation are parts of the rational, occupational and political system. Therefore, it is important not to be too simplistic and think that the

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[6]. See for example, Pugh, D. (1986), and Lupton T. (1986), both in Mayon-White, B. (Ed.), (1988).

occupational and political aspects are all that matter, and that rational arguments are merely rationalisations to defend a particular position.

Fourthly, change is most likely to be acceptable and effective in those groups who are basically successful in their tasks but who are experiencing tension or failure in some particular part of their work. They will have the two basic ingredients of confidence in their ability and motivation to change. The next most likely to change are the successful. They will have the confidence but must be interested in developing the motivation. The least likely to understand and accept change are the unsuccessful, who might attempt to protect themselves by rigidity.

For effective change to take place, Pugh (1986) argues that the managers must anticipate the need for change so that the time is available. Then they can manage the process over that time so that the two relevant characteristics of the people involved, their confidence in their ability and, their motivation to change, can be maintained and developed.

5.3.2. Managing Change Effectively

It is understood by many[7] that, for change to be managed effectively, there are some principles must be taken seriously into consideration; firstly, there must be a need for the change: this may not seem to be necessary for the change proposers, but what may be an obvious need to them may not be seen as such by the others involved. The reasons for changes must appeal to many of the interest groups and people who will be involved. Only after a decade since the changes in the higher education system were proposed, the need for these changes becomes clear to senior managers in HEIs.

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[7]. See for example, Pugh (1986); Lupton (1986); and Mayon-White (1988).

Secondly, thinking through the change: It is not enough to think out what the change will be and calculate the benefits and costs from the proposer's point of view. The others involved will almost inevitably see the benefits as less and the costs as greater. there is a need to consider consciously and systematically what the change will mean for all the parties involved, or what they will see as their costs and benefits.

Thirdly, initiating change through informal discussions is an effective way of pushing change through and getting some feedback and participation. It is important to get discussion going with key figures involved to get feedback to enable the manager to evaluate the proposal fully from all points of view (pilot testing). It is necessary to discover whether the change is correct in principle or not, and what modifications, if any, will improve it.

Fourthly, the leader should invite criticisms from those affected. This is because, (a) people who have a change imposed on them without taking account of their objections may lose some confidence in their abilities, this leads to rigidity. Flexibility is encouraged by people seeing that they can contribute and make an impact. (b) Any current situation is the outcomes of a balance of forces. If the forces pressing for change are increased, the forces resisting change do not go away even if they are not brought out into the open. The resisting forces should be identified and dealt with in their own right.

Fifthly, the proposer of change must be prepared for it, a manager who possesses to initiate change must join in the process and be prepared to change. It is advised that not to 'fall in love with your own idea'. It may be good, but it could well be improved after the discussions and objections are taken into account. Over commitment by the manager in an early stage could lead to rigidity. It is essential to split

a proposal into its general and specific aspects, starting the discussion on the more general aspects of principles and approach. The details need not be planned at an early stage, this may be left until the feedback has shown that the direction is accepted as appropriate. The detailed planning may then take account of the information generated by the whole process.

The change maybe 'bottom-up' as well as 'top-down', it does not always have to be initiated from above. A manager who is prepared to change may well consider ideas initiated from below. A very good way of obtaining ideas for improvement is to carry out a survey of subordinates views. Many managers have been surprised at the quality of proposals which can be unlocked by this method (Pugh 1986). Finally, When the change has been carried through, it must be checked after a suitable time to see if it is working well and giving the benefits that were argued. If it does not, minor modifications will be in order. If the change is working well and the benefits can be demonstrated in, for example, improved efficiency, more satisfaction, then everyone must be informed. This is most important as it gives reinforcement to those involved and for others help to set up an organisational climate in which change can be seen to be beneficial.

5.3.3. Institutional Arrangement for Responsiveness

The status and history of HEIs play an important role in responding to external pressures. The high status institutions are concerned with maintaining academic positions. Less confident but well esteemed HEIs, by the same token, are more likely to assess their present and potential sources of support and make changes accordingly. The hypothesis is that the lower the status, the more the change is concerned with recruiting external, industrial or commercial recognition or support.

During the 1980's the changes in the environment were enormous. That is, severe cuts in funding, and great pressure for improved efficiency. These changes without any doubt affect the ways in which HEIs operated. The reduction in public subsidy, the pressure to be more self-sufficient and entrepreneurial, more efficient and, at the same time, to enhance academic standing all converged on institutions and upon their units. Their responses varied, according to their status and their histories as well as to the style of leadership and its relationship with the other powerful groups present within HEIs. This complex combination of factors makes generalisations about the responds to induced changes very difficult, but in general some points may be made as follows: First, the institution's leader succeeded in promoting change. This was due to severe threat from outside. Such conditions opened the way for determined leadership, or allowed a consensus to build up between leadership and the basic units. Second, responsiveness was initiated by institutional leaders rather than councillors and governors. This is not to deny their role in the appointment of institutional leaders in the first place who in turn critically affect the overall style and responsiveness of the institution. Finally, as a result of the response to external pressure, centralisation of power increased. The choice of means was associated with the size of the whole institution, and with other factors which might affect its vulnerability and its need to respond to external influence.

It is emphasised that institutional leadership is a key factor in ensuring the wellbeing and survival in times of constraint and challenge[8]. The question which may be asked here is that, what can institutional leaders do?. Departments should be encouraged to remain true to the quality demands of their subject areas. Also each subject of the curriculum could well benefit from institutional scrutiny of the extent

[8]. See for example, Boys et al. (1988); Sizer (1987b); and Pratt and Silverman (1986).

to which teachers ensure that effective teaching is delivered to produce quality students. They are to be competent in the job market, and have some awareness of the relationship of their subjects to wider concerns of the economy and society.

Institutional leaders should therefore encourage faculties and departments to engage in a thorough study of how far their educational patterns are consistent with the development of working skills for purposes of both academic study and transfer to employment. It is teachers in the subject areas who have the expertise in what is possible and how to make real and effective arrangement so ends can meet. But leaders can encourage, reward and monitor teachers' work in these areas of development. However, the problem with HEIs may be seen as that for most part, the institution does not concern itself with these matters. The institution and the faculty have been concerned with overriding issues resulting from the reduction in funds, and in making decisions on changes in patterns of staffing and the associate provision of courses.

There has been a shift in power from academics in the departments to those who run institutions. the framework of resources is tighter. The response of those more vulnerable institutions to what they believe the government and the economy want has concentrated on promoting what they think the market and ministers want.

5.4. HEIs and Business Organisations

Business organisations should aim to take advantage of what HEIs have to offer through research, technology transfer, business start-up facilities and consultancy. HEIs, too, stands to gain from this involvement: staff can gain breadth and expertise, can keep up-to-date with the latest developments in industry and can enhance their earnings.

Institutions themselves may claim a share of accruing income. HEIs can be vital partners in product innovation, consultancy and other activities. Institutional attitudes and action are important. The government, through its White Paper (The Development of HE into the 1990, May 1985) encourages[9] and indeed hopes that all institutions with something to offer in the areas described will themselves adopt, and encourage all relevant departments to follow, the good practices now to be found in many, such as: (a) in applied fields taking consultancy and other beneficial industrial work fully into account when assessing candidates for promotion; (b) granting permission to engage in business activity on the basis of an assessment of the effect of this on an academic's overall contribution to the objectives of this institution; (c) offering first rate academics who have particularly strong links with business a part-time contract or seeking to make joint appointments with industry; (d) striking reasonable deals with staff over the sharing of income earned from involvement with business and, operating industrial liaison services;

[9]. For more on government encouragement to universities to collaborate with business, the cited reference may be consulted. White Paper: The Development of HE into the 1990, May 1985, HMSO, Cmnd. 9524, London.

5.5. Leadership in Higher Education Institutions

The leadership role is one of the key functions that managers perform for their organisations. However, managing and leading are two different activities. In managing, the emphasis is on rationally analysing situations, devising strategies, organising resources, coordinating activities, and directing and controlling the behaviour of employees towards achieving a set of goals. Leading is about setting objectives and formulating strategies, and creating visions for employees to believe in. Leaders must inspire trust and loyalty, and they must understand and have the skills in directing the talents of others towards achieving a desired end. Thus effective leaders must have strong interpersonal skills, including the ability to communicate, to motivate, and to convince others to follow willingly. Hellriegel and Slocum (1989) point to the distinction between leader and manager indicating that a good leader doesn't necessarily possess managerial skills, but most successful managers have the ability to lead. Furthermore, Cartwright and Zander (1953) viewed leadership as the performance of those acts which help the group achieve its objectives. Finally, studies of leadership in an educational context also ascertain the importance of the leader roles in the success of their institutions. Courses on business and public administration continue to assign special interests to this topic.

5.5.1. Leadership Skills

It is to some extent agreed among management authors in the topic of leadership that there are some skills that are required and indispensable to the effective leader, because the leader holds responsibility for motivating and inspiring the "troops" in his charge (Evarard 1984). Most important of

these skills are[10]: first, empowerment: the leader's sharing of power with subordinates. In doing so, the leader involves subordinates in setting objectives and planning. Leaders spend time with subordinates, unlocking motivation to serve the purposes of the group in pursuing common objectives. Second, intuition: it involves the scanning of the situation, anticipating changes, taking risks and building trusts. Leaders have a feel for changes that are occurring. They must move quickly to serve new customers, find new competitive advantages, and exploit new organisation strengths. Third, self-understanding: the leader's ability to recognise his/her strengths and compensate for their weaknesses. It requires a willingness to receive feedback both positive and negative, and grow in the job. Fourth, vision: it involves imagining a different and better environment and a way to achieve it. Employees are likely to make a commitment to a vision when they are actively involved in creating it. Finally, value congruence: the knowing and understanding of the organisation's guiding beliefs, as well as the subordinates values, and thus, reconciling the two.

5.5.2. Sources of Power

Power is central to the leadership process. The bases of a leader's power tell us why subordinates will follow the leader. One of the most useful frameworks for understanding leader power was developed by French and Raven (1960), This framework may be summarised as follows: legitimate power, which is based on the leader's position in a hierarchy, that is, the person's formal authority; rewards power, which depends on the leader's ability to reward subordinates for

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[10]. See for example, Byrd R.E. (Summer 1987), "Corporate Leadership Skills: A New synthesis," Organisational Dynamics, pp.34-43; and Block P. (1987) The Empowered Manager, San Francisco, Jossey-Bass, pp. 99-129.

compliance; coercion power, this is the leader's ability to obtain compliance through fear of punishment in whichever form; referent power, it is the leader's influence on others because of their personal identification with the leader. Often based on personal admiration, referent power is associated with leaders who possess admirable personal characteristics, charisma, or excellent reputations; and finally, expertise power, which is the leader's influence on others because of the leader's specialised knowledge. Expertise power is narrow in scope because a leader's expertise generally is limited to specific task areas.

Power ultimately comes from subordinates' willingness to follow the manager's direction and the manager's ability to satisfy subordinates needs[11]. Access to resources, information, and key decision makers, as well as the ability to act quickly, give some managers an edge in influencing events and passing on information and rewards to subordinates. Thus, the manager's power does not come from style and skill, so much as from the manager's position in the formal hierarchy of the organisation. Subordinates cooperate with such managers partly because they believe that the manger has the power to make things happen.

5.6. Leadership and Institutional Success

The performance of institutional leader considered by Kogan and Youll (1988) as a key factor in determining how well institutions sustained their position during the period of growth. The quality of leadership is seen as one of the most effective factors for institutional success (Sizer, 1987). Leaders must be able decisively to initiate change, and their

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[11]. Kanter, R.M. (1979), "Power Failure in Management Circuits", Harvard Business Review, July-August, p.67.

power to influence or steer the work of their institutions is unlimited. This goes in line with the expectation that leaders are 'powerful agents for change' (Campbell et al. 1966, and Pack and Pack 1988). This in contrast to administrators who are seen to be primarily concerned with maintaining rather than changing the established structures, procedures or goals (Lipham 1964).

It is generally agreed that a primary task of leadership was to protect and strengthen the institution as a whole; that is, leading it from one phase of success to another. Leaders define the institutional identity, and they are to maintain and promote the external interests and relationships of the institution. Hence, the trend now in HEIs is to favour those with effective executive styles of leadership. HEIs are complex and basic units are strong; resistance to central management is not difficult to generate. However, Wedgwood and Devies (1985) indicated to the growing challenge for leadership in the need to manage changes and reduce uncertainty within a 'turbulent' environment.

In HEIs, there were moves to establish external relationships in which the leader took a high profile in representing the institution as negotiator, boundary keeper, and ambassador. The political activity of forming and maintaining networks of friends and contacts was recognised as key function of the leader. Strong institutional leaders are also expected to be able to interpret and translate environmental changes so to be accommodated within the objectives of their institutions. Sizer (1987b); Lockwood and Davies (1985); and Kogan et al. (1988), tend to confirm the views that management of change is one of the key functions of leadership in HEIs. It is the strong leader who can hold a sense of institutional cohesion and continuity through the processes of change and the management of external relationships.

5.6.1. Faculties and Departments

Relationships between the institution, faculty and department have changed in those institutions which have tried to systematise policy making. As institutions have been forced to make reductions, the faculty has become a stronger locus of decision making (Davies, 1985). It is sufficiently removed from departments to be able to override specific interests at a time when they are to be given a lower profile. It is the only level where there is sufficient expertise with which to challenge the defences mounted by constituent groups. With contraction and the government's emphasis on efficiency, the sovereignty of individual disciplines has come under challenge and it is at the faculty level that proposals for the combination of teaching or research disciplines can be considered. Traditionally, faculties are seen as a grouping of departments on the basis of academic kinship: they are as Moodie and Eustace (1974), describe 'the embodiment of the larger view'; they are the constituency for elections to Senate or Academic Board. They are the channel of communication between departments and central management. Large and strong faculties provide safeguards to their institutions against those conflicts which they can resolve at their own level. At the same time, faculties are academics collectives and their deans are in place to represent the academic dimensions to the centre.

Lockwood and Davies (1985) introduce a new terminology into HEIs as communities of scholars, in their view deans are middle managers. They are expected to be both credible academics as well as credible administrators. Senior management expects them to be the general officers of their units who are able to implement institutional policies. They are middle men in a complicated communication network. These mid-institution posts represent the executive central initiatives. If power becomes more centralised and the senior officers more influential, middle managers can be expected to

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become more managerial. It is however unlikely that deans think of themselves in these terms: many are appointed for a fixed term, and are unlikely to lose touch with their own disciplinary and academic base.

5.6.2. Executive Style and Institutional Culture

HEIs in many parts of the world including the UK are mostly sponsored by government. Hence, their management style cannot be considered in isolation from the influence of their sponsor. In the midst of a world wide squeeze on resources, HEIs are expected to increase entrepreneurial and market oriented focus, and therefore build up alternative sources of funds. Sizer (1988b) indicated to the fact that there are pressures on HEIs to change their 'culture' from a free, oligarchic and consensus model, supported by administrative styles of management, to an entrepreneurial and free market like model with executive styles of management. That is, operating towards securing value for money in terms of economy, efficiency and in particular effectiveness. In terms of effectiveness, not only good quality of teaching and research is required but also responsiveness and relevance to the changing needs of society in general and the economy in particular, selectivity in allocation of limited resources available for teaching and research. In these circumstances it may be difficult to equate executive management with consensus management.

In professionally staffed organisations, institutional heads usually have a strong professional background in the relevant area of expertise. Such practice may be regarded as co-opting devices designed to defuse tensions between practising professionals and their superiors. Hall (1968)[12] provided

[12]. A comprehensive research included doctors, nurses, lawyers, accountants, social workers and teachers.

support for the proposition that the professional's quest for autonomy is the professional value which causes most difficulty in organisations. Furthermore, there is a general belief that professionals are unlike other employees, they have a strong tendency to face outwards and away from the bureaucratic structure of their organisation. These views supported by Moore (1970) who indicated that the manager who has some basis for understanding the problems inherent to the professional role and its organisational setting is likely to have greater confidence than would be accorded to a layman.

Moore also observed that there is representative as well as an internal co-ordinating function to be performed and that a similar point applies. Thus, representation by a professional is more acceptable than anyone viewed as an outsider. The role of the professional-as- manager may thus be presented, in structural-functional terms, as the ultimate accommodating technique: its legitimised hierarchy helps to ensure that bureaucratic formalisation does not restrict professional autonomy, and provides external representation which expresses a professional standpoint. Whether it works like that in practice is another matter.

It would be unwise to draw general conclusions, particularly as it has been noted earlier that little reliance can be placed on a trait or 'great man' theory of leadership. There is however, as Kogan and Youll (1988) indicated, at least one significant characteristic that they identified to be common to many leaders[13] in educational institutions. It seems that each had a strong commitment to the education of those in their charge, and not simply carrying out the managerial

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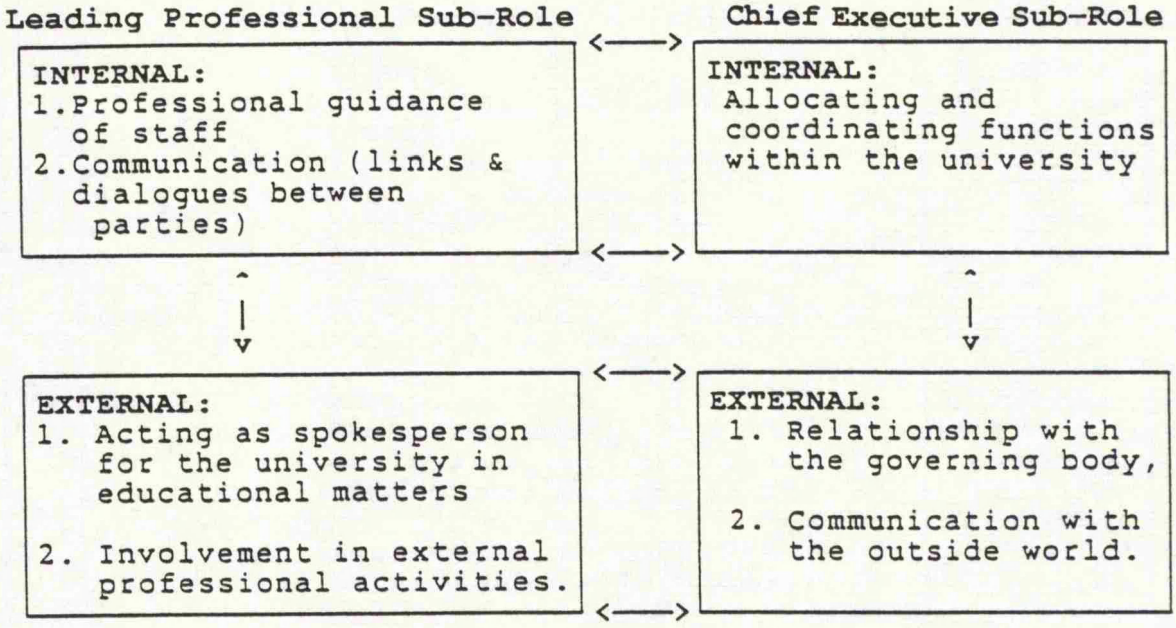
[13]. They give examples: Hetherington, V.C. of Liverpool and then of Glasgow; Irvine, V.C. of St. Andrews; Arnold, (of Rugby); and Thring (of Uppingham).

duties of their office. In line with what Hall (1982) considered to be a necessary condition for the leader's behaviour. The leader is expected to have a great deal to do with what goes on in the organisation. For those successful leaders, it is not only they have effective role within their institutions, but more importantly, they are committed to the objectives of their institutions and also have the ability to exert influence externally on behalf of their institutions.

5.6.3. The Dual Role Model

In order to examine more closely the professional-as-manager phenomenon at the headship level, it has been conceptualised by Hughes (1972), as the simultaneous activation of two sub-roles which deeply inter penetrate each other: the role of leading professional (LP) and the role of chief executive (CE). As a provisional first approximation one can then visualise the two sub-roles as distinct entities. This involves differentiating between professional and executive types of activities, while also explicitly recognising that there are internal and external aspects to both role conceptions. Handy (1984) argued that schools should have both leaders, senior professionals and administrators, and it is inappropriate to combine the two roles in one person. However, in this circumstances the term administration is used to refer solely to subordinates' regulatory activities, as is common usage in commercial management, whereas leadership includes the direction of the institution, the setting of its vision and its standards, and the oversight of its working. Which effectively includes both the LP and the CE sub-roles, as conceptualised in the dual (LP-CE) role model of headship in Figure (5.1) below:



See Hughes et al. (1987), pp. 278-279; and Hughes (1976).

5.6.4. The Domain of Professional Leadership

Professional leadership is concerned with; (a) task achievement, (b) group maintenance and development, and (c) the external domain.

(a) Task Achievement: heads of departments in universities attach importance to their teaching role as a form of leadership by example. This would not normally apply, however, to university vice-chancellors. The most significant professional contribution of the positional leader to task achievement will be indirect. The opportunities for leader participation may conveniently be expressed in terms of a classical management cycle, as applied to education in a number of management by objectives formulation. Davies (1975) indicated that the leader is likely to be involved in: firstly, setting the objectives for the organisation. Secondly, choosing the best available course of actions by which the resulting decisions are to be implemented. Thirdly, making clear to others the measures adopted, whether formally or informally, to judge the extent to which agreed objectives

are being achieved. Finally, the actions which are to be taken as a result of the assessment made.

Additionally, the leader inevitably will be involved in a critical appraisal of the contributions of the others and in the use of professional and political judgement in coordinating activities, reconciling and integrating those contributions. It is, of course, not only at the summit of the organisational hierarchy that the professional-as-manager concept is relevant to task achievement. The initiation of structure within universities by deans of faculties, heads of departments, and individual lecturers, gives rise to issues of both professional and organisational significance, the consideration of which typically takes place within a well developed committee structure.

(b) Group Maintenance and Development: the appointment of professional persons as heads of professionally staffed organisations has mainly been advocated, not in terms of their contribution to task achievement but on the grounds that such persons are well placed to have the confidence, and to elicit the cooperation, of professional staff. Etzioni (1964) for instance, observed that having a professional at the head of the authority structure will mean that the professionals will expect to find the organisational head sympathetic to their viewpoint and welfare. This fulfil an important need for them, for this reason professional head is more likely to be followed, other things being equal, than a lay manager.

Human relations theorists have maintained that a rigid hierarchal emphasis can make the achievement of a genuine colleague relationship very difficult. Hoyle (1975) made a distinction within the teacher group between restricted professionality, confined to work in the class room, and extended professionality which additionally includes an

awareness of wider dimensions. Sensitivity to such differences in attitudes is clearly advisable for heads of department who wish to obtain the cooperation of their colleagues in planning for change and in working together to achieve it. Innovative school heads, Hughes (1975) indicated, are particularly aware that informal contacts with staff colleagues, such as over a cup of coffee in the common room, are highly political occasions, providing opportunities for influence to be exerted in both directions, through 'dropping hints, 'sowing the seed' 'deliberate kite flying', and the skilful manipulative task of all, making it appear that the new idea has come from someone else.

A parallel case study of teacher principals interaction in American schools by Hanson (1976) reported examples of manipulative behavioural management by both teachers and principals, both parties relying on common commitment to professional values. Principals, through their control over awkward structures of teachers, have an additional organisational power at their disposal. This is the democratic procedures and informal bargaining which can serve as mechanisms to reduce conflict.

Both studies thus provide examples in the domains of group maintenance and development of inter penetration of the LP and CE sub-roles, as previously described. The effective head relies partly on exerting influence on staff colleagues as a fellow professional; equally, however, he accepts his position as chief executive, and uses the organisational controls which are available to him to get things moving. Hughes (1976) noted that professional and executive concerns reinforce each other as complementary aspects of a coherent and unified strategy.

In a discussion of the management of HEIs in a period of contraction and uncertainty, Davies and Morgan (1983) discuss policy formation in terms of four successive phases: an

ambiguous stage, a political stage, a collegial stage and an executive stage. Davies and Morgan suggested that each phase must be given enough time. They referred to the significant role of the university head in creating communication links and dialogues between parties who may have the capability to develop new perspectives. The vice-chancellor's or administrator's most sophisticated role involves coalition building between potentially like-minded groups.

(c) The External Domain: Mosher (1978) mentioned a number of major social changes which significantly add to the complexity of the role of the professional leadership. He drew particular attention to the erosion of the conventionally drawn line between the roles of the professional expert and the politician acting as the people's representative, which he coupled with a growing demand for public involvement in making and executing public policy. Other significant factors, he suggested, were the greater concern in society for equal rights and opportunities wherever disadvantage could be perceived. Shipman (1984) viewed the education service as a net, which depends for its shape on the various pressure groups pulling away at the corners. On the one hand there are influences through national and local government; while on the other hand there are varied professional and academic pressures. Development, he suggested, is the result of interaction between these two groups of factors within the education service, but taking account also of pressures from a disparate set of other influences, the external forces. Among these he included not only other government departments, the Manpower Services Commission, the Racial Equality and Equal Opportunities Commissions, etc., but also parents, employers, trade unions and others acting through interest groups both to affect the legal and financial basis of the service and to influence professional practices.

5.7. Leadership Development in Universities

It is important at this stage to consider some recent development on the part of strategic leadership in universities and other HEIs. The concept of management and leadership training for academics is relatively new with respect to universities. There is, thus, no tradition of a training culture in this field. The emergence of management/ leadership development in universities is associated with unprecedented external attack on the system. The economic and political climate in which the task of university management is undertaken contributes formidable difficulties to this task and continues to change its characters.

The need to provide management or leadership training for academics is viewed as representative of the pressure imposed on universities during the last decade. For some, it is seen as contributing to the imposition of an ill-suited model of management on universities. The transformation of universities from administrative to management systems is a recent phenomenon. Restructuring has been a rapid rather than gradual process in response to external pressures for greater accountability from central government, in a context where the university lecturer had historically enjoyed greater autonomy from administrative regulations. Within this process, it has been difficult to derive harmonious models of management. Managers in universities are trying to accommodate political pressure. Doing so in a climate where academic staff accustomed to a considerable independency, may well be perceived as power coercion. It is therefore hardly surprising to see that many university lecturers view 'management' as an alien concept.

This view is represented by Waton (1987) that it became very clear from early responses to Jarratt that many vice chancellors and other senior managers either believed in the vision of the hierarchical university or were willing to

implement such structures in the belief that it might lighten future treatment by government. Foe both groups, the end result would be the same. Thus, more rigid hierarchies, greater managerial control of staff, with appraisal as a key element in achieving these goals.

Jarratt Report (1985) aimed to encourage the simplifying of managerial systems in universities. It is intended that they become tighter, clearer and more explicit, quicker to respond to outside stimuli, incorporating greater internal and external accountability. Its emphasis is on altering university structures and procedures. The report has considerable implication for senior academics and their role within the management of their institution. Heads of departments are the most severely affected. They must still be eminent academics but should also be 'good managers'. In other words: they are to be budget-holders, capable of managing and budgeting resources, in accordance with an agreed academic and financial plan and with responsibility for the plan's outcomes. They are to undertake major personnel functions, including staff management, appraisal and selection. They are in addition to continue their traditional roles representing the department internally and externally, promoting disciplines, teaching and research as well as assuming their share of committee responsibility on behalf of the university. The tasks and activities which must be undertaken by the head of department as identified by a group of twenty academic heads of department participating in leadership course at Farnham Castle in Surrey are portrayed in Table (5.1) in the appendix to this chapter. They also listed the skills which they considered to be necessary in order to perform these tasks and activities. These skills rage from teaching, research, communications, public relation to objective setting, planning, finance, controlling and counselling. The full list is shown in table (5.2) in the appendix.

Pro-Vice Chancellors at present have a variety of roles, ranging from executive action with delegated responsibility through policy-making and co-ordination to 'trouble shooting'. They should possess, therefore, a variety of skills: those of politicians and negotiators, planners, initiators and coordinators of policy, with a detailed understanding of university structures, constraints and procedures.

Jarratt Report gave the vice chancellor the position of both academic leader and chief executive responsible for the effective management of the institution. The postholder is required to be a skilful negotiator and politician both internally and externally, to be able to initiate, promote and gain consensus for strategic academic and financial plans, to make and implement hard decisions, while maintaining high morale and to consult, inform and communicate as widely as possible. In short, the VC must possess high quality executive manager of change and be capable of overcoming institutional inertia.

As a response to Jarratt's Report, some institutions have established or are planning internal management development programmes. Some of these, for example at the universities of Exeter, Sheffield and Liverpool, have been conceived with the intention of improving managerial skills and awareness, as well as developing corporate spirit within the institution. The advantage of such internal courses is that they can be linked to a range of optional topics and can provide detailed information on local procedures. Feedback and support can be built in. As experience at the University of Exeter is beginning to show, such programmes can also have a very positive impact on inter departmental communication and collaboration.

Other universities are employing outside consultants to

organise programmes for them[14]. The field of education consultancy is fastly growing, for instance, management development programmes, appraisal schemes, new curricula, and departmental reviews can be bought and tailor-made to universities' requirement. Furthermore, the University of Surry's national leadership course for heads of academic departments has provided a training opportunity. This takes the form of a two-day introduction to leadership theory, practice and techniques. The industrial Society also offers an 'off-the-shelf' course of this kind. Experience of the Surry courses and seminars for more senior staff indicates that the major reported benefits include awareness raising in relation to leadership role and responsibilities; techniques for effective management (such as time-management, delegation, planning, and so on); and the sharing of common experiences and problems amongst peers.

5.8. Higher Education for the Future

Throughout HE the normal pattern in major institutions is to have a two headed system of government; the first is a council or board of governors or their equivalent. This holds to final legal responsibility for finance, assets, and employment. The second is a senate or academic board or their equivalent with whom the academic decisions rest. The academic staff are represented on the council or board of directors in most places, and so are the students. Whereas, it is rare for non-academic interests to have any voice on the senate or academic board. The predominant pattern is to have 'lay' majority on the council, but the ancient universities of Oxford and Cambridge are in practice controlled by their academic staff for most purposes; they

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[14]. For example, The Scottish Universities are approaching Henley, the Management College to contribute to a regional programme, while the Industrial Society is used by others.

are described as 'workers cooperatives'.

There are historical reasons for two headed government, and it is often seen by academics as enabling them to decide that matters which interest them without interference. But that freedom may not be justifiable since academic decisions should not be made in an isolated vacuum from the views of the wider community which pays the bills, employs the graduates and uses the research. In fact, 'lay' members would probably have a much useful contribution to make to the design of courses, and it seems to be impossible to think of a reputable reason why this contribution should be prevented. Furthermore, there is no proper line of division between an academic decision and one which relates to finance, or buildings, or personnel, they are related parts of a single whole, and the body which ought to govern an institution should be enabled to oversee and, so far as possible, have under control the full implications of each decision.

The powerful argument in favour of two headed system is related to the conservative principle that it is safer proposing that 'foolish measures' which go unchecked in the senate or academic board can be defeated, perhaps on financial grounds, in the council or board of governors. There is substance in this point, HEIs are sometimes tempted to take very foolish decisions, perhaps under the influence of a passing fashion. There are alternative ways of providing for a delaying or revising function, and it should be noted that a less desirable effect of the two-headed system is to increase greatly the power of the chief executive of the institution. The vice chancellor or principal can easily learn how to use divided control in order to get their own way, arranging that when something which they dislikes passes in one body it will be questioned in the other.

Another line of argument in favour of the 'status quo' is that the agenda of the academic body is too long and detailed

to be understood by lay members. This is often true, but what it means is that the supreme academic body, which ought to give itself time to debate issues of principle, is allowing itself to be submerged by a mass of details which ought to be done by sub-committees. However, the widespread support for the two-headed system derives almost entirely as Carter (1980) argued, not from rational argument, but from the belief of academics that they know best. They tend to stick to their belief even on issues where, it is very evident that they could benefit by listening to the voice of those with a different experience.

HEIs may stand to benefit from a system of unitary government which could be assisted by a number of committees for specific purposes. These will prepare major businesses and have delegated power on minor matters. In this system the members external and internal to the institution should be divided equally. Thus, neither group could safely act without considering the views of the other. This would provide the internal members with an ultimate safeguard against being overridden on a point of principle on which they are agreed, but without sacrificing the advantage of getting the view of external people on academic matters. On the ordinary run of business, however, the danger of deadlock due to the balanced composition of the governing council would not be great, because there would be a variety of participants in both the internal and the external group, and a regular 'voting pattern' is not likely.

Finally, there is a number of groups with evident competence to make a significant contribution to the decision making process in HEIs. These are as follows: firstly, education experts and managers including experienced administrators from within the institution and from other similar places. Secondly, employers of graduates, and users of research or other services. Thirdly, professional consultants who can advise on the management of the institution's affairs.

Fourthly, the students, despite their lack of experience, they may have relevant things to say about the needs and aspirations of their successors.

Appendix to Chapter Five

Table (5.1):
Tasks and Activities Undertaken in the Role of Academic Head of Department.

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*. Monitoring teaching
*. Monitoring research
*. Effective and efficient leadership of the department
*. Communication with staff
*. Discipline: carrot and stick
*. Policy and planning: the department's direction
*. Resources development: finding the money
*. Academic leadership: professional commitments
*. Personnel management
*. Financial management
*. Representation of the department: internal adversarial role
*. Selection of staff
*. Link between central management and the department
*. Stimulating research activity
*. Attending Committees
*. Teaching and research.

Source: Compiled by participants in a course on leadership for heads of university departments, held at Farnham Castle in January 1987. In Eggins H. (Ed.) 1988, p.140.

Table (5.2):
Skills Required for Academic Leadership and Management

Communication	Listening
Presentation	Coaching
Negotiation	Decision-making
Committee work	Delegation
Judging/assessing	Political
Interpersonal	Research/scholarship
Planning/objective setting	Catalyst in motivating
Controlling	Public relations
Financial	Teaching
Counselling	Holding a group together
Setting an example	

Source: as Table (5.1) above.

Chapter Six

PERFORMANCE ASSESSMENT IN UNIVERSITIES: AN APPLICATION OF DEA

Introduction

Universities fall within our defined category of NPOs which produce multiple non-homogeneous outputs using multiple inputs. The same prominent problem that is common to all NPOs as discussed in chapter two is that of the performance assessment. No matter how difficult the issue of concerns is, the efficient use of resources must be reviewed, high achievement should be rewarded and low levels of attainment must be subjected to further investigations. The fundamental trouble is with the evaluation of outputs produced and their relationships with the inputs used to produce them. A 'by-problem' is that the various inputs are often used to produce more than one output and therefore, the attribution of specific inputs to specific outputs is a major difficulty.

To elaborate more, one output may affect another output(s) indirectly[1] by affecting the inputs which determine that output. Hence, the difficulty arises when setting to identify and measure any kind of relationship between the outputs and inputs in the higher education sector. That is, using the production function theory as a way to either establish

[1]. Jones and Taylor (1990), point to the simultaneity problem which arise from the fact that universities or departments with high reputation for their research outputs are often able to attract students of higher academic ability than those with poor research record. They provide support for this hypothesis as by the highly significant positive correlation between 'A' level score and the UGC/UFC's research rating across universities (r=0.66), (p. 67).

relationships between inputs and outputs, or measure performance in HEIs seems to be rather an 'ad hoc' and may be inappropriate.

This chapter focuses on the information that can be obtained from a DEA application to universities in England. The aims are to disclose the importance of DEA in identifyin g the relatively efficient and inefficient universities (or exchangebly referred to as DMUs), and to show how the results obtained from DEA application can be very useful in practice, with the possibility of setting targets for those inefficient DMUs so to achieve technical efficiency (TE). Moreover, a reference set is identified for each inefficient DMU. In order to do so, we first examine the overall efficiency (OE) of universities, we identify inefficient ones and establish how much savings can be achieved for each DMU with respect to inputs and the level of increase in outputs for them to become efficient.

Section one explores the problem of efficiency measurement in the university context and identifies the difficulties involved in that respect. It also outlines the specification of objectives for those institutions to be assessed and lightly discusses the performance indicators which have been suggested by the UGC (and UFC). Section two outlines the specification of the DEA model, the inputs and outputs which are chosen for this assessment are considered. Section three examines the results for the overall performance of universities. The fourth section considers the nature, interpretation and usefulness of the information obtained from this experiment. Finally, the three sets of OE, TE, and scale efficiency (SE) are discussed and targets are identified with respect to input savings and output increase. The level of SE and its significance to university is examined.

6.1. University Outputs and Performance Measurement

It is the norm for any organisation to have a defined set of objectives which it strives to achieve. Therefore, before carrying out an assessment process of the university activities, it is necessary to find out what their objectives are and what outputs should they produce in order to reach the established goals. Unless objectives are set in an unambiguous way, performance measures would be hard to establish. In the HE context, however, the setting of clear objectives is rarely the case, and does not comply with what theorists suppose.

The goals of HE may be left deliberately ambiguous in order to maximise support and serve as means of diversity for achieving a common goal in the sector. The pursuit of 'excellence' is always found in the literature as the proper goal for HE, but this is a hard term to define and cannot readily be translated into quantitative measure. It can be argued that it is highly ambiguous, but at the same time, it also allows priority at the level of institution to be given to the apparent objectives while very different private goals are pursued. However, unless goals can be made specific, it is hard to judge efficiency. Even though specificity is hard to reach in higher education, attempts have been made to identify a set of objectives for the sector. Blaug (1968), for example, suggested that the purpose of higher education is that to select the most able for leadership in industry and government, to cultivate talent for the sake of self enrichment, to promote scholarship and research and t o preserve and disseminate cultural values.

From the literature on the objectives of higher education (HE), a much longer list could be drawn. Some of which are as follows: (a) to provide skills which will be valuable both to person acquiring those skills and to society more generally

and to promote the notion of public service[2]; (b) to provide greater equality of opportunity (Brandl 1970); (c) to provide an independent source of social and political comment (Layard and Varry 1975) and; (d) to undertake applied research of relevance to increase the productive efficiency of the economy and to improve the well-being of humankind (Johnes and Taylor 1990). A further objective was dictated by the need to reduce dependency on public funds is that; to increase income generated from other than government sources such as short courses, overseas students, consultancy to industry and government, etc. Furthermore, the UFC (1989a) has set out several specific aims. Thus, Universities will be expected: (a) to provide an expanding range of services to cater for the growing needs of society; (b) to provide more opportunities for people to participate in university education, thereby raising the participation rate of under-represented groups; (c) to maintain and enhance scholarship and research of high quality and to make this more accessible to the public at large; (d) to participate more fully in local and regional activities as centres of expertise; and (e) to obtain a greater proportion of their income from non- government sources, develop more efficient management systems, and become more outward-looking by expanding their activities at local, regional and international levels. Finally, universities will be encouraged "to exercise their autonomy to the maximum degree with full accountability for their use of [public] funds" (UFC 1989a: Annex B).

The above attempts plus many others to specify the objectives of universities can be considered to offer four different categories of outputs resulting from the processing of the different inputs used by the university. These are:

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[2]. Robbins, (1963); and Jarratt, (1985).

1) the teaching process,
2) research activities,
3) consultancy and similar activities and,
4) outputs in the form of cultural and social contributions to society.

The resources used by universities and the different processes or functions performed to produce the outputs are portrayed in Figure (6.1). However, the problem arises when attempting to quantify these different inputs and outputs. For example, how can such statements as 'cultivate talent for the sake of self-enrichment' or 'preserve and disseminate cultural values' be quantified ?, similar thing can be asked about the benefits accruing to the society at large from higher education. Further example, research output, since there exists no monetary measure for academic research because this becomes public property as soon as it is published in article journals and books. A suggested alternative would be the quantity of research that is produced by a university, but what about the quality?. One piece of research could be worth many articles and books to the society at large as well as to humankind.

Similar things can be said with respect to measuring outputs which result from the teaching process in universities. Although a detailed information exists on the number of graduates, the degrees they have obtained, and their first destinations, employment and others. Exactly how this information should be assembled to produce a measure of the teaching output is not, however, entirely satisfactory as yet.

Under these circumstances, 'any process of evaluation is on shifting sands'. Since any of the above factors relate not only to teaching but also to the student's own motivation and circumstances. There is no universally agreed standards, nor any methods of teaching styles, and no hard evidence which

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shows how they relate to effectiveness in different sizes and types of teaching arrangement, and no insight into how teaching and research interact. Hence, measuring teaching performance is another ordeal.

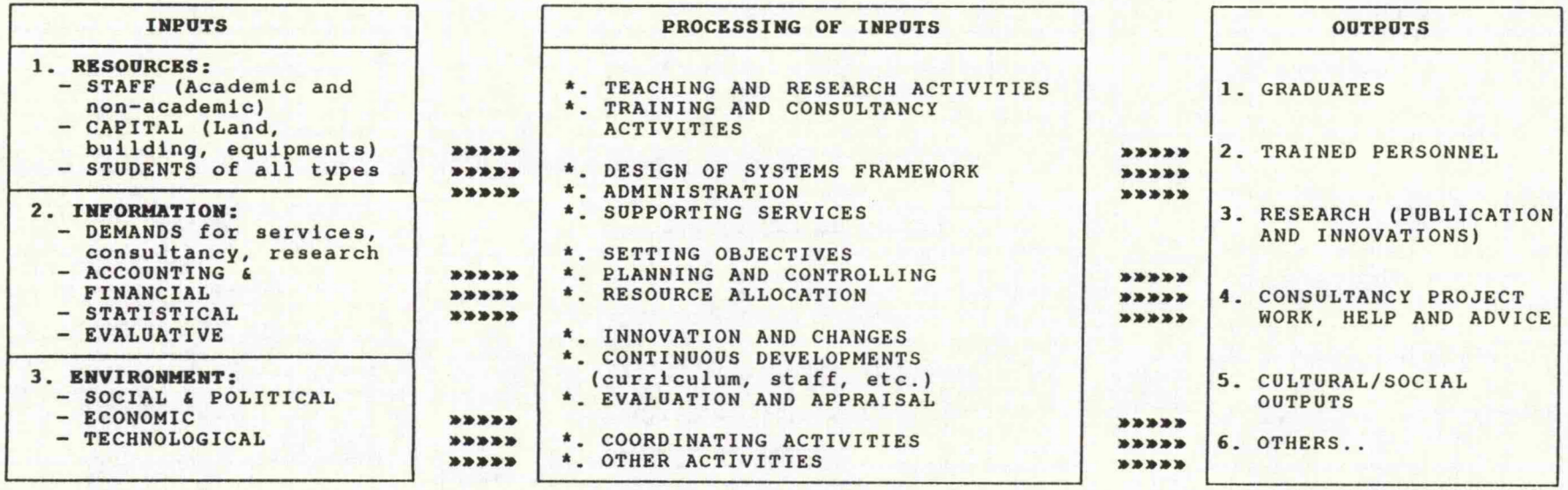
Measuring the outputs of universities is therefore a complex matter. This does not mean however, that the HE sector should not attempt to control their operations and measure the outputs they produce, hence performance evaluation. There can be little hope for progress towards developing appropriate methodologies of evaluation unless satisfactory measures of output can be constructed. During a time of squeezed resources and amounting pressures, HE sector has no alternative but to develop such measures. The funding agencies together with the government are committed to impose more rigorous methods of evaluation on the sector, unless HEIs themselves come out with a set of 'acceptable' measures of performance.

There is much pressure on the HE sector to construct and use performance indicators (PIs), hence, the need to examine what kinds of output measures actually exist. Among the measures available are annual output of graduates, degree results, the first destination of graduates after leaving university and the research output. This relates in some way to the success or otherwise of each university's graduates and ability to produce quality research. Since it is the aim of each university to produce as many successful students as possible from any given 'entry cohort', these various measures can consequently be used as indicators of each university's output. It is very much the case in measuring other types of outputs which are produced by universities.

Measurement problems associated with teaching and research activities, as we have seen, motivate the search for simple performance indicators. There can be no objections to such indicators in principle, providing that the user has a good

sense of their context and the problems attached to the measures themselves as well as the things they do not take into account. If, however, the measures are taken as surrogates for overall performance by those unaware of their weaknesses, they can be dangerous. They must be seriously questioned when used as part of a complex mechanism for the allocation of funds. Some of the PIs are ambiguous and others measure nothing, examples are the telephone bills, library, computer and careers services and student societies expenditure. It is by no means clear without further information whether it is good or bad to have a high or low level of any of the above elements; yet the above indicated are amongst the current PIs. Nor is it always clear where the balance of advantage lies: secretarial hours are easy to cut back, but the price paid by the academic community is hard to quantify. Some well-paid professionals will have to engage in routine work for long hours, which hardly seems an efficient use of resources. Therefore, inappropriate indicators may well give incorrect signals, which can be the very root cause of inefficiency. The problem is that PIs very rarely observe genuine performance; instead they only measure what it can be quantified. Judging an institution's performance by the class of degree awarded to its students is an incentive to 'grade inflation'; basing efficiency on the level of expenditure is an incentive to reduce it at the cost of the quality of services provided. Finally, counting the number of publications or references to them gives incentives to publish early results, and later a revised and expanded versions.

Figure (6.1): INPUTS, PROCESSES AND OUTPUTS OF UNIVERSITIES.



6.2. Consideration of the Inputs and Outputs Used

The inputs (**Is**) and outputs (**Os**) which are to be used in DEA provide the cornerstone of the experiment and its reliability. DEA results' depend crucially on the Is and Os that are chosen. The selection process should normally be carried out by persons who are well informed about the DMUs being assessed, to determine what they see as constituting the outputs of the functions of those units to be assessed and what factors and inputs contribute to those outputs. This is because when an output is omitted, the relative efficiencies obtained will not reflect the actual performance of the units being assessed. Similarly, the omission of an input would mean the assessment ignores the contributions of that particular input. This process may be an advantage or disadvantage to any particular unit.

Therefore, all the relevant Is and Os should be included. However, as Thanassoulis et al., (1987) observed that the larger the number of Is and Os in relation to the number of DMUs being assessed, the less accurate DEA is. In fact the number of (Is + Os) should not exceed half the number of the units being assessed. This is considered as a rule of thumb for maintaining an adequate number of degrees of freedom (Bowlin, 1987).

This was clear in our case, from several assessments, when using 35 universities and a total of ten Is & Os, the number of units with relative efficiency of 1.00 was found to be 17 and the rest with efficiencies ranging from as low as 0.815 scored by DMU20 to 0.979 for DMU10. However, when input number three (student/staff ratio) was omitted, the number of units with relative efficiency of 1.00 dropped to 13 and the efficiency scores of the rest decreased substantially (see table (6.7), below).

This tendency is evident, because the larger the number of Is and Os for a given number of DMUs being assessed, the greater

the chance that a unit can find weights for some subsets of the inputs and/or outputs of which it has absolute advantages that show it efficient. Hence, the number of Is + Os of which to be used in DEA application should be kept to a minimum. That is, aggregating some Is and/or Os whenever possible, providing that the set used adequately reflects the resources and outcomes that being used and produced respectively by the set of DMUs to be appraised.

The number of inputs and outputs may be reduced by testing for correlations. For the pairs of Is and Os that are perfectly positively correlated, one of them may be omitted without significantly affecting the DEA efficiency results[3]. This view was formalised and made explicit by Lewin et al. (1981) who suggested the use of regression and correlation techniques for identifying the relevant set of Is and Os. In the case of highly correlated pairs of Is and/or Os, (but not exact multiples of each other), then one of them may be omitted again, but this time the effect may be to reduce the efficiency rating for some of the inefficient units. Efficient units would not be affected. Addition of highly correlated Is and/or Os with existing ones, would slightly increase the efficiency rating of those inefficient DMUs. Addition of perfectly positively correlated Is and/or Os can only increase or leave unchanged the H_o^* rating for inefficient DMUs.

DEA assumes that any increase in the levels of inputs, all else being equal, leads to higher levels of outputs. However, if some input is of the nature that an increase in its value leads to decreases in the output value, then, the inverse of the values of that input should be used in the analysis (Thanassoulis, 1987).

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[3]. See Charnes el al., 1981.

The universities chosen for this experiment are only those of England (34 plus an artificial one which is made up from the averages of the data). The only reason for this being to minimise variations such as regional, length of degrees offered, institution structure, etc. Most of the data covers three year period 1985/86 to 1987/88 except for research output and research income the data is for two years and one year respectively. Using the average data over three year period brings any variations in the data with the same institution to a minimum. In order to preserve confidentiality, the universities are not named, instead they are given numbers from 1 to 35.

Table (6.1) provides a list of the variables used in this study. A longer list of inputs and outputs were considered in the first instance, but many of them were observed to have no effect on the results obtained from DEA assessments and therefore were excluded.

The inputs and outputs selected are considered to represent the university activities adequately (see Kogan et al., 1989). As indicated before, it is DEA's exclusive property which allows us to use ten variables, each in its own physical unit. These inputs and outputs do not only provide quantitative measures of university activities, they also observe qualitative factors as well. The latter is present in variables such as completion rate, first destination of graduates and the average of 'A' Level scores for students intake. Some of the variables such as non-completion rate (NCR), 'A' Level scores and student/staff ratio have to be inverted because the model maximises outputs and minimises inputs respectively. Whereas in the case of these three variables, the objective would be to minimise the former and maximise the latter.

As indicated in the first section, the inputs that used by the university sector can be broadly classified into four

main groups: labour, capital services, consumables (i.e. heating, telephone, etc.), and raw materials of students and others. Technical knowledge is assumed to be embodied in labour and capital services. One of the most crucial input of university is the quality of its students. Universities have to operate in a competitive environment as far as acquiring students is concerned. They attempt to attract students of the highest academic calibre, a characteristic which can be expected to have an effect on university outputs. The academic ability of students may be expected to affect their exam performance as well as their success in finding a suitable job after graduation. The only feasible measure is the average 'A' level score of each university's entrants.

6.3. Inputs and Outputs Explained

Before proceeding to study the implication of DEA results', we first look at each of the set of Inputs (Is) and Outputs (Os) that have been chosen. The consideration of each of the I and O will be kept to a minimum, since they are not an objective here, they are rather a mean to accomplish the main aims of this study. However, for deeper details in their concerns, reference may be made to their original sources. The set of Is and Os used in this study, presented in table (6.1) below, and the corresponding data for these Is & Os was derived from three main sources:

1) University Management Statistics and Performance Indicators in the UK, 1988 and 1989, published by The Committee of Vice-Chancellors and Principals (CVCP) and the University Grants Committee (UGC), (thereafter, CVCP/UGC).

2) University Statistics, published by the Universities Statistical Records, previously on behalf of the UGC, and currently for the Universities Funding Council (UFC).

3) Two assessment of research strengths and weaknesses were conducted by the UGC (1986) and UFC (1989). The results were published in The Times Higher Education Supplement (THES), May 30, 1986 and Septembre 1, 1989 respectively.

The inputs and outputs are selected from a long list of 'performance indicators' (PIs), 54 PIs published by the CVCP/UGC (1988). A wide range of Indicators were carefully considered for this study, but several were found to be redundant, hence they were excluded from the assessment, among those excluded were; central administration expenditure per full-time equivalent student (FTES), expenditure on books and periodicals per FTES, and attendance as percentage of expectation. The set of Is and Os which remained to be used in this study compares well with a recommended set of performance indicators by Cave et al. (1989).

6.3.1. Measuring Unit costs

Average expenditure per full-time equivalent student (FTES) over a three-year period. This input covers the expenditure per FTES across all cost centres within each university. This figure is affected by the nature, level and intensity of research activity. There are also differences and inconsistencies arising between universities, mainly due to the variations of methods of calculation of all figures that affect this particular variable. Further difficulties are those which arise in assigning departments to the cost centres they ought to belong to. However, despite all these differing variations among universities, taking an average of all cost centres should account for most (if not all) of these differences and produces similar and comparable figures throughout all institutions.

Nevin (1985) used or cost per student for the purpose of measuring output. He used a weighted combination of staff,

postgraduates and undergraduates as an index of output in his attempt to calculate cost per unit of output for UK universities. His argument was that staff produce research output and so should be included in the calculation of unit costs. This approach is criticised on the basis that weights which are attached to staff and students are entirely arbitrary (see for example Johnes, J. 1990b; Johnes and Taylor 1990; and Cave et al. 1988).

In addition, there are other problems that arise from different accounting practices in calculating cost per student for instance, some elements of expenditure are included in one institution while excluded in another. Total university expenditure is split into two main components: recurrent and capital expenditure since the latter can vary considerably from one year to another, then it is excluded from the measure of university costs. Moreover, within the recurrent component of expenditure, many of the items cover expenditure which does not relate directly to the output of graduates such as expenditure on research activities, short courses, etc. Hence, in order to focus specifically on the teaching aspects of a university's activities, total general expenditure on academic departments is used as the measure of costs. This comprised over 40% of the total recurrent expenditure of all English Universities in 1987/88 (CVCP, 1989). Other recurrent cost items which are also important in the teaching function of universities such as administration, central services, academic services and maintenance costs were not included in the measure of costs which are also important for the university functions. If these cost items were to be included in the measure of cost per student, it would be necessary to find ways of allocating these costs between the various outputs produced by universities. This has recently been done for each 'cost centre' in the university sector as a whole but not yet for individual institutions (UFC 1989a). Thus, the definition used by the CVCP (1989) to calculate unit cost (UC) is therefore defined

as follows:

$$UC = \frac{\text{General expenditure on academic departments}}{\text{FTE students}}$$

where, FTE means full-time equivalent which includes, taught postgraduates and research postgraduates. The number of students registered for courses during any one year is used for calculating unit cost. Variations in cost per student throughout English Universities are very high, during the period 1985/86 to 1987/88, In average, they vary from less than £2600 per student at DMUs 11, 13, 15 and 34 to over £3600 at DMUs 5, 17, 19, 20 and 23. The difference between the highest and lowest cost per student is about £2000, (see table 6.3). There are factors which may affect inter-university differences in cost per student some of these are: the subject mix, mix of students, type of degrees awarded, staff inputs and student/staff ratio, the level of research activities and the size of each institution (economies of scales). Therefore, one can conclude that a certain level of the inter university variations in cost per student is due to some of these suggested variables, while the rest is accounted for by inefficient operations and the use of relatively excessive level of inputs.

6.3.2. Degree Results

This was proposed amongst the performance indicators and it was further made clear in the 1987 White Paper that academic standards and the quality of teaching in higher education is to be judged by reference to students' achievement. Also the numbers and class distribution of degrees awarded is to provide some measure of good performance and conversely, do NCRs.

It is important to know why degree results differ among

institutions. If the reasons are due to innate ability of student entrants, any comparisons in degree results among institutions will be worthless unless such factors are taken into account. Ideally, this means that any performance indicator based on degree results will have to be corrected to allow for inter-university differences in degree results which are due to factors unrelated to the teaching process, since it is the effectiveness of the teaching process which degree results are ought to measure.

A long list of factors[4] is suggested to affect the inter-university differences in degree results, among these factors are: the 'A' level scores, student/staff ratio, subject Mix, the percentage of students who live at home, the type of university, and others such as the age and size of the university, and library expenditure as a percentage of total expenditure.

Johnes and Taylor (1990) suggest that 80 percent of the variation in degree results is explained by six variables. These are: the mean 'A' Level score of entrants, the percentage of students who live at home, library expenditure as percentage of total expenditure, wether or not a university is an ex-college of advanced technology (ex-CAT) and wether or not a university is one of the new greenfield universities of the 1960s. However, trying to estimate the attributions of the above factors to the degree results is not as simple as it might be taken and it is no less complex than measuring the university outputs.

[4]. For a comprehensive account on this issue, see Johnes and Taylor (1990).

6.3.3. Non-completion Rates (NCRs)

Since 1988, the CVCP has included a measure of the success of each university's students (by cost centre) in its annual publication, University Management Statistics and Performance Indicators, from which it is easy to calculate the percentage of leavers who did not complete their courses. This is defined as the proportion of any given leaving cohort of undergraduates who had not completed their degree course (and obtained qualifications) in any one year to the total number of leavers in that year. This is calculated for year t0 leaving cohort, as follows:

$$\text{Non-completion rate for leaving cohort year t0} = \frac{\text{Total number of leavers in year t0} - \text{Number of leavers who successfully obtained a qualification in year t0}}{\text{Total Number of leavers in year t0}}$$

In practice, the CVCP has produced a success rate based on leavers over a three-year period in order to reduce the influence of temporary fluctuations in this variable.
Table (6.5) provides the NCRs for three-year leaving cohorts (1986-88). The two important features of these rates are first, the large differences in the NCRs between universities during any given year and second, the high stability of NCRs within each university over time.

6.3.4. Research Rating and Allocation Of Resources

Research performance, up to a point, is sensitive to quantitative measures, because quality is a significant factor in this respect. The most effective measure of quality is peer group, but it is a highly subjective measure (see for example, Martin and Irvine 1983; and Webster 1981). In addition, the overall reputation of an institution would affect the dis-aggregated parts like the departments (Anderson et al. 1978; and Cave et al. 1988). Moreover, some

outstanding pieces of research can easily be missed at the time of writing, because their usefulness and relevance could not be realised cannot be determined 'ex ante'. There are additional problems of comparability within a subject across universities and across subjects within a university.

Measuring research output is a difficult task both in theory and in practice (Lloyd 1987, G. Johnes 1988). In addition to peer review, there are some alternative measures to serve this end: number of publications, citations, and research income. Similar problems are associated with measurement such as the number of publications (see for example, R. Smith and Fielder 1971; G. Johnes 1988 and 1990; King 1987; Martin and Irvine 1983; Hogan 1984; and Hirsch et al. 1984). Citations are objectives and only reflects quality, (MacRoberts and MacRoberts 1987a and 1987b; Phillimore 1989).

The Research Selectivity Exercises of UK Universities

The first exercise was performed by the UGC in 1986, and it was based upon peer review with little emphasis placed on the actual research output that was produced by universities. Subject pannels consulted well known academics in each subject area and research councils provided information about research grants awarded during the previous five years. In addition each university or cost centre was asked to submit a brief account of its research performance and future research plans and to select five recent publications which accurately reflected the research work being undertaken in each cost centre or department in many cases.

The very limited approach adopted in 1986 exercise was heavily criticised on many grounds. The criteria used were not made clear, the identity of the assessors was not disclosed, large departments seemed to have been favoured to smaller ones, and different assessment standards were used for different subjects (for further details see for example, Moore 1987; Gillet 1987a, and 1987b; Gillet and Aitkenhead

1987; P.K. Johnes 1989; and DES 1987c).

The UFC responded to the criticisms and attacks on the UGC by preparing the 1989 selectivity exercise. Evaluation, as previously with the UGC, was based upon informed peer review, but more comprehensive and more formal approach was adopted. In particular, more data describing research output was collected and used. Around 70 advisory groups and panels were set involving 300 members and covering 152 subject units of assessment. In addition, 100 outside advisers were consulted in confidence.

Information about research output for each institution was provided over the period 1984-88 inclusive. Then panels of experts were asked to rate each department using five point scale (explained in chapter six) common to all subject areas. The same as with the UGC exercise, the UFC exercise has also invited much criticism. These critiques centred around issues such as the length of time that given to the advisory groups and panels as being too short (only three months), the definition of the unit which was assessed for instance, research output was based upon all FTE academic staff and finally, problems associated with the definition of research output and the five-point rating scale and comparisons among different subjects due to the wide variation in mean scores across subject areas. However, the UFC has a plan to repeat the same exercise again in 1993/94 which should take into account some of these criticisms (see P.K. Jones 1989).

6.3.5. Research Income

This measure is unlike citation and publication, it does not require a time lag over which to perform the count. It gives more up-to-date picture of the research output of units (see Webster 1981). The research grants and contracts can be used to reflect the market and social values of the research being

undertaken. Applied research would most probably be advantaged at the cost of theoretical research, but this is no different from any other measures, there are always some problems with whichever measure is chosen. The criticism to this method is that research income is an input into the research production process rather than an output and those fields of research where grants are in short supply would be discriminated against (see for example, D.M. Smith 1986; Gillet 1987b; and Harris 1989). The final thing to say is about the correlation between research rating per cost centre and research income per FTE member of staff with (r^2 = 45) giving some credibility to both measures of research. The data for both variables are presented in table (6.6).

Research income per FTE member of staff as indicated by the CVCP/UGC, covers all specific income for the purpose of research receivable in the year, whether receivable by the university, by a department, or by an individual within a department[5]. In short, this includes all research income from any source except for that income which comes from university companies. It should be made clear that a low level of research income cannot be taken to mean low performance or low quality of research, the CVCP/UGC warned. Universities with high concentrations of subjects in humanities and other theoretical branches of scientific disciplines are likely to have significantly lower levels of research incom than others.

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[5]. For more details on research incom, please see CVCP/UGC 1988, definition 8, pp. 24-25.

Table (6.1):
The set of inputs and outputs that used in DEA assessment:

I. Inputs:

1. Research expenditure per FTE academic. The average of two years is used 1986/87 and 1987/88.

2. Cost per student, the average of three years, 1985/86 to 1987/88 is used.

3. Student/staff ratio. The ratio of FTES to FTE teaching and research staff (excluding research only staff) in 1984/85 and 1985/86.

4. Average 'A' Level score of 1985/86 entrants. As was explained, the data for this input is to be inverted.

II. Outputs:

1. Degree results, first and upper second class degrees awarded using the average of three years 1986-88.

2. The non-completion rates for three years 1986-88. The average is used and data for this output is to be inverted for the reason explained above.

3. Destination of graduates in full-time employment for a period of three-year 1985/86 to 1987/88, we take the average.

4. Destination of graduates who are in further education and training for a three-year period 1985/86 to 1987/88.

5. Research output, the average research output per each cost centre as rated by the UGC/UFC in 1986 and 1989.

6. Research income per FTE academic. The average research income per FTE academic is taken for the year 1987/88.

Table (6.2): The Data for the 35 DMUs.

Us/	I1	I2	I3	I4	O1	O2	O3	O4	O5	O6
	£'000	£'000								£'000
1	7.6	2.6	13.2	11.4	51.5	16.8	82.4	10.4	2.6	11.9
2	8.6	2.9	10.5	12.4	58.6	13.3	79.7	13.7	2.8	14.2
3	8.9	3.3	9.0	11.4	40.3	10.6	66.2	22.8	3.1	14.8
4	6.0	2.8	10.7	10.0	43.3	15.7	77.6	11.4	2.4	10.0
5	9.7	3.7	9.5	12.7	51.2	8.4	64.6	24.5	3.8	16.3
6	11.9	3.0	13.0	10.6	46.1	21.0	79.8	15.0	2.1	16.1
7	11.8	3.1	11.5	14.1	67.5	5.4	55.3	36.2	4.7	31.6
8	6.4	3.3	10.9	10.0	44.4	19.0	87.2	7.3	2.0	8.9
9	6.5	2.6	11.2	12.5	47.7	5.7	62.1	32.0	3.2	13.0
10	5.8	2.8	11.0	10.0	46.2	10.8	55.0	27.7	3.1	9.8
11	6.7	2.3	8.7	8.8	46.3	15.0	55.7	32.6	3.4	14.9
12	4.5	2.6	10.9	11.1	45.4	9.3	63.7	25.2	2.9	12.2
13	5.0	2.5	12.2	10.0	42.1	12.5	61.9	28.2	2.5	9.8
14	6.2	2.5	10.3	9.1	43.1	17.2	54.9	30.7	2.0	5.9
15	7.4	2.2	11.7	10.2	44.7	13.0	62.2	25.6	2.7	22.1
16	5.5	2.8	10.6	10.0	46.8	10.2	66.1	24.3	3.2	10.0
17	7.2	3.5	9.4	10.7	38.2	11.4	62.4	24.8	3.1	12.0
18	8.7	3.1	9.4	10.4	42.2	11.0	59.0	31.0	2.8	17.9
19	9.0	3.5	9.0	10.7	35.9	14.1	61.1	23.4	3.3	16.5
20	15.5	4.1	8.2	10.9	42.4	17.4	65.0	23.5	3.5	24.2
21	11.1	3.0	10.4	11.3	49.0	10.1	77.3	11.9	2.6	17.0
22	7.9	3.4	8.7	11.6	43.3	14.3	64.1	23.7	3.6	10.1
23	14.4	3.9	10.0	10.7	41.6	16.6	76.6	13.4	3.7	22.2
24	8.8	3.4	9.2	10.2	37.3	17.9	71.1	20.8	3.1	13.0
25	9.1	3.1	10.3	11.6	49.7	9.3	66.6	22.8	3.1	14.1
26	14.8	3.0	10.6	13.5	58.1	7.1	55.8	36.0	4.6	31.6
27	8.3	3.1	10.3	10.1	48.6	12.1	69.6	20.7	2.9	14.4
28	6.5	2.9	12.3	10.1	43.7	19.7	75.3	14.5	2.0	10.6
29	7.9	3.2	10.5	11.4	43.4	11.3	62.7	23.5	3.2	13.4
30	12.2	3.4	9.6	12.0	44.2	10.2	69.2	23.1	3.3	21.3
31	12.2	3.4	10.6	10.8	45.1	15.0	75.3	15.7	3.0	26.8
32	9.5	2.9	10.6	10.2	44.2	12.5	57.4	28.9	3.4	16.3
33	10.6	2.6	11.4	11.0	46.3	10.8	65.6	22.2	4.1	22.0
34	10.0	2.5	12.2	11.7	55.5	8.8	59.2	28.2	3.7	15.7
35	8.9	3.0	10.5	11.0	46.3	12.7	66.7	22.8	3.1	15.9

6.4. Assumptions about the Experiment

Two computer programmes were used in performing DEA assessments, the first was written by Green and Davis of The University of Bath. The results obtained from this programme are presented in Tables (6.7), (6.8) and (6.9). The set of results obtained from this programme includes the efficiency ratings, a reference set for each inefficient unit and the weights attached to each inputs and outputs. It assumes constant returns to scale with input minimisation and output maximisation. The second computer programme used was written by J. Cubbin of Queen Mary College[6], this programme is more advanced and capable of handling both, constant returns to scale (CRS) and variable returns to scale (VRS) technologies. That is, the production function may take increasing, constant, or decreasing returns to scale form. It also provides additional set of results (the targeted inputs and outputs which if achieved would enable those DMUs which are rated inefficient to become efficient). The results obtained from using Cubbin's programme are presented in the appendix to this chapter for illustrative purposes only; the reason is that the results were obtained from an incorrect use of set of inputs and outputs (input three, student/staff ratio was incorrectly used. It was used as it stands, when in fact, it should have benn inverted). Since we no longer have access to that programme which provides additional results and insight into DEA analysis, we wish to present the early obtained results in the appendix to this chapter.

The assumptions we make here are those; all DMUs must maximise the outputs they produce using the least possible of the resources available to them simultaneously. Hence, minimise the inputs used. The universities are pressed hard by the government and the UFC to operate efficiently. That is observing the 'value for money' principle introduced by the Government in the 1980s. Therefore, both assumptions are employed, input minimisation (IM) and output maximisation

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[6]. I would like to acknowledge that, it is my colleague Michael Doble who performed the running of the data on the computer programme. My gratitude goes to both, Cubbin and Doble.

(OM).

Banker and Morey (1986) and Smullen (1989) distinguished between two types of inputs and outputs. The first is the controllable inputs and outputs, which refer to those under direct management control. The second type refers to those inputs and outputs which cannot be directly affected by management. Cubbin's Programme allows for such distinction to be made. The first type is of more importance to us since it is possible for the management of relatively inefficient DMUs to attempt to achieve the identified targets which enable them to become efficient. However, the second type can still be affected, but only indirectly by the management practices at least in the long term. Examples of the non-controllable variables are the destination of graduates and the NCRs.

As indicated earlier, the choice of inputs and outputs in a DEA application is very important to the results obtained and should always be done through consultations with those to be evaluated. Regarding this study, however, the DEA assessment is not so much for producing a value judgement that indicates the universities which are efficient and those which are not. The aim here is to shed light on the potential usefulness of DEA in comparative efficiency assessments in higher education institutions as well as in other organisations of similar missions. Having said that, however, every effort has been made to assess as fairly as possible those universities selected for this exercise to enable us to draw some comparisons between the results of this study and judgements that have been passed by other bodies like the UGC and UFC with regard to the same universities. It is important to indicate to the deficiencies and shortcomings of the Is and Os chosen to represent accurately the entire resources and complete set of outcomes used and produced respectively by universities. There is much larger set of Is and Os required to fairly reflect the wide ranging activities of the universities. An additional set of Is and Os to this used here could well be incorporated into the study and may well alter the details of the results obtained and those universities identified as relatively efficient or inefficient, but it would not alter the nature of the

information obtained and their usefulness. Which are the main objective of this study.

6.5. Results and Conclusions Discussed

Having identified the set of inputs and outputs to be used, DEA was performed on the 35 DMUs employing the assumptions of input minimisation (IM) and output maximisation (OM) with constant returns to scale (CRS). This obtains a measure for overall technical efficiency (**OTE**). Two sets of efficiency ratings were produced; the first assessment used all inputs and outputs of Table (6.2), (the data for inputs three, and four and output two is inverted). The results obtained from this assessment are presented in table (6.7), column **EFF** (a) and table (6.8). The second assessment excluded input three (student/staff ratio). The results presented in Table (6.7), column **EFF** (b) and Table (6.9).

The efficiency scores of the first assessment which used all Is and Os of Table (6.2) are reported under column **EFF**(a) in table (6.7), yields 17 DMUs with technical efficiency scores of **ONE** under constant returns technology. Hence, 18 DMUs are technically inefficient with the lowest efficiency score being **0.815** for DMU20. Although, this may not seem to be very poor performance, the possible improvement if it were to becomes 100 % efficient is highly significant. For example, the research income per FTE academic will have to be increased by about £5500 (about 23 % increase in the current level). Its research rating would put it well above the average (4.3 point per cost centre against its current level of 3.5). The percentage of its graduates who are either in full-time employment will have to increase from the current level of 65% to about 80% (an increase of 23%). The percentage of its students who leave without any qualifications will be reduced to from 17.4 % to a new low of 13.6%. The percentage of its graduates with first and upper second class honours will have to become 52 % against 42.4 % currently an increase by more than 22 %. Moreover, the reductions in inputs will be as follows: research expenditures per FTE academic will have to be reduced by

about £2860, a reduction of about 18.5 %, and over £760 a reduction in the cost per student (about 18.5 % reduction), also student/staff ratio could be improved to become 10.1 against 8.2, and with the possibility of increasing the average 'A' Level score of its students intake to 13.37 against 10.9. It can be seen that the possible improvement in the level of outputs are substantial. Still with these levels of improvement a significant reduction in the amounts of resources can be achieved when an inefficient DMU is to become efficient.

The optimal weights selected by each university in computing its efficiency may incorporate some weights so small or even zero as to exclude from consideration the corresponding input(s) and/or output(s) on which the university may be very inefficient. This indicates that the efficiency rankings produced by DEA offer an initial classification of universities in relative efficiency terms only. Hence, any correction action that is to be based on DEA results must be taken only after some further investigations outside the DEA results to gain a better understanding of the relatively inefficient university and the reasons behind its inefficient performance.

In addition to the efficiency rating, DEA also yields a reference set for each inefficient unit. This reference set provides each inefficient unit with a model that enables the unit in question to draw some useful comparison with. It is also possible that this model can be copied (after thorough investigation of course); this may include organisational structure and practices such as resource allocation and other similar tasks. Tables (6.8) and (6.9) provide the reference sets of those inefficient DMUs.

Drake and Weyman-Jones (1992) and Field (1990) decomposed TE into PTE and SE, we follow their path to calculate a measure for scale efficiency (SE) from the obtained OTE and PTE. Scale efficiency is calculated as follows; Scale Efficiency = OTE/PTE. Since we no longer have access to the computer programme which can handel variable returns to scales, we include in the appendix to this chapter the results obtained

earlier[7]. **This inclusion is for illustrative purposes only.** Therefore, to calculate the degree of SE in universities, constant and variable returns versions of DEA were performed on the data. Tables (A: 6.3) and (A: 6.4) each displays the three measures of efficiency, the first table displays the results obtained from using output maximisation and the second table displays the results obtained from using input minimisation. SE provides a means by which the scale of operation can be adjusted to correct the loss of output. Take for example, DMU 6 with scale efficiency equal to 95.8 %, output will have to be increased by 4.2 % to make DMU 6 a best-practice unit.

The high level of average scale efficiency rating (over 99 % in the case of OM and over 98 % in the case of IM)[8] indicates that most of the universities in the sample are operating at, or close to their optimal scale. Given that the mean PTE is slightly lower (98 %) would justify the concentration on PTE improvement for universities and that scale efficiency is of little importance to universities. Rangan et al. (1988) explain how it is possible to find out whether a DMU has CRS, DRS or IRS by re-estimating the frontier under non-increasing returns to scale assumption. This facility is not available in Cubbin's Programme, and neither it is of any significance to our study especially when it is found that the average SE is very high across the sample of DMUs.

Figure (6.2), illustrates the TE and SE. Point A represents the DMU being evaluated. The choice of reference set and thus the efficiency of a DMU depends upon whether we assume input minimisation or output maximisation. If we take the first course of action, then efficiency is measured horizontally in relation to input axis. However, if the latter was to be assumed, then efficiency would be measured vertically in relation to the output axis.

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[7]. These results are obtained from the same set of data. the only difference from those presented in the main body of this chapter is that input three (student/staff ratio) was incorrectly used (i.e. was not inverted, when it should have been).

[8]. These obtained from tables (7.A5) and (7.A6) of the Appendix to this chapter.

Using the VRS programme, the efficiency frontier generated will be BCD. For DMU A, TE = MB/MA, B having the same scale size as A. Overall scale and technical efficiency is measured in relation to a CRS frontier OQ by the ratio ME/MA, Comparing point A to the point E which reflects the average productivity attainable at the MPSS represented by C. Finally, the SE of A is measured by the ratio MB/MA, so that the overall scale and technical efficiency ME/MA is less than the PTE measure of MB/MA. The relationship between the two efficiency measures holds also for the general case of multiple inputs and outputs.

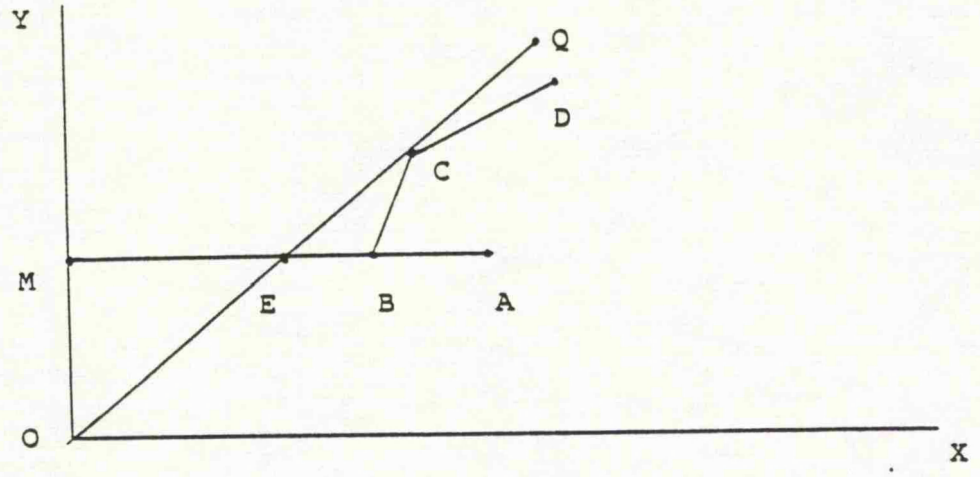

Figure (6.2): Technical and Scale Efficiencies.

A is the DMU being evaluated, B represents a technically efficient reference unit with the same scale size, and C represents a technically and scale efficient reference unit at the MPSS.

T and SE = ME/MA
PTE = MB/MA
PSE = ME/MB

6.6. The Relatively Least and Most Efficient DMUs

As it can be noticed from tables (6.8) and (6.9), DEA identifies the reference set of efficient universities to each inefficient university. In other words, performance targets are set for each inefficient university, so by achieving these targets it can become efficient. Hence, a 'model' is identified for the inefficient units to consider and this can be very useful in practice, so the inefficient university may adopt strategies and policies from those efficient ones to become efficient.

Using the weights produced by the model, it is possible to identify comparable efficient and inefficient universities, and show the areas in which the inefficient DMUs are weak in comparison with the efficient DMUs. Therefore, the usefulness of such information stems from two important aspects; (a) it helps in setting performance targets for the inefficient DMUs, and (b) it gains clear understanding into the performance of the DMUs concerned and identifies their merited dimensions of performance. Moreover, efficient DMUs may reveal good operating practices for other DMUs to adopt. Before the most efficient DMUs can be taken to represent a 'model' for the inefficient ones, some deeper investigations and cautions should be carried out and taken respectively in the following areas:

Since it is possible to identify the volume or proportion of contribution by each input and output to the overall efficiency of each university. It is crucial to establish the importance of the different Is and Os to each DMU's efficiency. As the DEA technique permits each unit to select the weighting which gives it the highest possible relative efficiency score, this could lead to a situation where a unit assigns high weights to those inputs and outputs which have a high performance and very low, or even zero weights, to those Is and Os in which it performs badly in their sphere. Consequently, this can be misleading if no caution is taken.

The relative importance of each DMU's input and output in determining its efficiency rating can be ascertained by

multiplying each weight by the corresponding input and output. Only then it is possible to discover by how much each input and output contributes to the overall efficiency. This information is important in respect to: Firstly, an efficient unit with relatively high weighting associated with its most important inputs and outputs[9] is efficient and effective compared to another unit with low weighting associated with the same Is and Os, and relatively high weighting assigned to the much less important Is and Os. In the case of the former, this means, priorities are given to the most important objectives (what is required) of that unit, while in the case of the latter, priorities are given to secondary objectives rather than primary ones. Hence, comparisons with the latter unit are likely to be misleading. Secondly, the weights obtained determine the aspects of performance of which efficient DMUs may be best at. That is, a DMU is clearly performing best in respect with that output with the highest contributory proportion to its performance in the set.

6.7. Some Limitations of DEA

The strengths of the DEA as well as the potential usefulness of the information obtained from DEA assessments were discussed. However, it is important to report some of the weaknesses associated with the technique. DEA focuses on the technical output/input efficiency and says nothing about the optimal cost of producing a particular good or service, nor does it indicate as to the optimum level of outputs for a given level of inputs. Furthermore, although, DEA addresses the efficiency issue, it does not attempt to evaluate effectiveness. However, this is rather a difficult task which requires other techniques and managerial judgement. Furthermore, any variations among the set of units being studied would violate the results obtained. Such variations may arise from operating constraints, capacity, different environment. Hence, we would be comparing non-comparable units.

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[9]. The importance of the inputs and outputs is to be based on the experts judgement.

DEA only makes statements about relative efficiency. Hence, DMUs with relative efficiencies of 1.00 may or may not be efficient in absolute terms. The DEA merely establishes that they are efficient in comparison with the other DMUs in the set. Therefore, a potential for further improvement is always a probability, with the aid of investigation outside the DEA assessment.

Finally, it may be said that DEA does not take into account the quality of the output. In fact, this can easily be incorporated into the different inputs/outputs used. This study for example, selected few outputs (O1, O2 and O4) which possess some quality of the outputs produced by the different universities. However, there are other Is/Os could be used to achieve better quality results (e.g. position of academic staff, classes of degrees awarded, value added, salaries earned by graduates over a particular period of time, etc.). Furthermore, DEA capabilities may be strengthened by assigning relative prices or priority weights to outputs and inputs if they are available.

Conclusion

This study in line with previous studies and empirical applications of DEA showed the reliability of the technique in efficiency assessment in the context of NPOs. The use of DEA in this study has generated 'a wealth of information' that may not be obtainable via any other means. Without the needs for either production or cost functions for the university sector to be known, nor the market prices for the inputs and outputs, or the variables need to be in a unified measure like pounds. It was possible (with the aid of DEA) to combine the multi-input/ output variables of universities into a single summary measure which indicates the relative efficiency for each university. The overall technical efficiency (OTE) for the 35 DMUs was obtained. The average OTE was found to be fairly high (about 0.94). 17 DMUs obtained efficiency rating of one and the rest, 18 DMUs, have lower efficiency rating with (the lowest being DMU20, efficiency equal to 0.815). Enormous improvement can be made when considering the scale and magnitude of potentially

achievable results.

DEA identifies those relatively efficient and inefficient universities. It also identifies a reference set for each of those inefficient ones. An inefficient university could consider its reference set's codes of practice which may prove to be very useful for it to adopt, so it can become efficient. That is, the target inputs and outputs for each relatively inefficient DMU is identified, alas the level of improvements required. Moreover, DEA establishes a solid foundation for the transfer of strategies, policies, or techniques from the relatively efficient universities to the relatively inefficient ones.

Finally, DEA capability may be improved by assigning priority weights to the different outputs and inputs. These weights can then be constraint so no DMU can assign very low or zero weights to those inputs and/or outputs of which it does not perform well in their respect. Nor any DMU could assign very high weights to only few of its inputs and/or outputs. It is worth mentioning that, DEA is most suited to those areas where there is a large number of organisations to compare.

Table (6.3): Cost per Student 1985/86 to 1987/88.

DMUs	85/86	86/87	87/88	Average
DMU 1	2636	2617	2807	2687
DMU 2	2869	3002	3242	3038
DMU 3	3305	3335	3549	3396
DMU 4	2681	2789	3150	2873
DMU 5	3544	3797	4001	3781
DMU 6	2885	2926	3286	3032
DMU 7	3036	3201	3419	3219
DMU 8	3150	3466	3489	3368
DMU 9	2529	2641	2832	2667
DMU10	2787	2853	2959	2866
DMU11	2305	2372	2511	2396
DMU12	2534	2661	2855	2683
DMU13	2507	2598	2692	2599
DMU14	2487	2580	2780	2616
DMU15	2148	2310	2512	2323
DMU16	2776	2927	2982	2895
DMU17	3381	3613	3809	3601
DMU18	3045	3132	3336	3171
DMU19	3342	3596	3892	3610
DMU20	3979	4293	4525	4266
DMU21	2819	3139	3276	3078
DMU22	3310	3519	3785	3538
DMU23	4006	3963	4233	4067
DMU24	3274	3430	3723	3476
DMU25	3036	3183	3448	3222
DMU26	2910	3083	3233	3075
DMU27	3048	3172	3446	3222
DMU28	2786	2972	3068	2942
DMU29	3248	3162	3431	3280
DMU30	3206	3436	3783	3475
DMU31	3325	3454	3516	3432
DMU32	2652	2827	3132	2870
DMU33	2573	2749	2817	2713
DMU34	2387	2566	2745	2566
DMU35	2956	3099	3302	3031

Source: University Statistics, Finance, 1985/86 to 1987/88

Table (6.4): Degree Results, the Percentage of Graduates with First and Upper Second Class Honours Degree, 1986-1988.

DMUs	1986	1987	1988	Average
DMU 1	48.1	55.4	58.7	51.5
DMU 2	57.7	60.3	59.8	58.6
DMU 3	43.3	41.6	39.5	40.3
DMU 4	41.9	46.1	45.6	43.3
DMU 5	52.1	51.9	53.2	51.2
DMU 6	45.9	47.3	45.6	46.1
DMU 7	66.2	68.6	69.3	67.5
DMU 8	45.3	42.8	48.1	44.4
DMU 9	47.8	45.9	49.0	47.7
DMU10	42.9	51.1	48.8	46.2
DMU11	43.5	48.9	48.2	46.3
DMU12	45.1	43.7	47.4	45.4
DMU13	41.9	44.5	44.4	42.1
DMU14	42.5	45.2	46.4	43.1
DMU15	43.6	47.3	51.1	44.7
DMU16	43.5	49.0	53.6	46.8
DMU17	37.8	37.0	41.6	38.2
DMU18	42.4	41.9	45.4	42.2
DMU19	35.0	37.4	37.4	35.9
DMU20	43.2	42.2	43.3	42.4
DMU21	47.2	50.4	51.1	49.0
DMU22	40.7	43.9	45.8	43.3
DMU23	42.3	41.2	43.0	41.6
DMU24	35.2	37.8	40.2	37.3
DMU25	47.3	51.8	52.5	49.7
DMU26	56.8	58.6	58.8	58.1
DMU27	51.1	48.3	52.6	48.6
DMU28	43.9	42.4	50.5	43.7
DMU29	41.4	44.5	46.4	43.4
DMU30	43.4	43.7	45.4	44.2
DMU31	43.6	44.2	47.4	45.1
DMU32	44.1	44.9	44.8	44.2
DMU33	47.7	47.1	48.9	46.3
DMU34	54.0	56.4	58.5	55.5
DMU35	45.5	47.2	48.9	46.3

Source: Universities' Statistical Record, Cheltenham.

Table (6.5): : Non-completion Rates based upon leaving cohorts 1986-1988.

DMUs	1986	1987	1988	Average
DMU 1	17.1	16.8	16.4	16.8
DMU 2	11.4	14.1	14.3	13.3
DMU 3	11.5	10.5	9.8	10.6
DMU 4	15.2	16.0	15.9	15.7
DMU 5	8.3	7.3	9.7	8.4
DMU 6	22.5	21.8	18.6	21.0
DMU 7	3.6	3.4	9.2	5.4
DMU 8	19.1	19.3	18.5	19.0
DMU 9	5.9	5.2	6.1	5.7
DMU10	12.8	9.6	9.9	10.8
DMU11	14.4	14.6	16.0	15.0
DMU12	10.3	8.8	8.9	9.3
DMU13	12.8	12.3	12.4	12.5
DMU14	16.6	16.3	18.6	17.2
DMU15	11.9	13.3	13.8	13.0
DMU16	11.4	8.7	10.4	10.2
DMU17	11.7	10.9	11.5	11.4
DMU18	12.2	9.7	11.1	11.0
DMU19	14.7	14.3	13.4	14.1
DMU20	15.7	16.5	20.0	17.4
DMU21	11.8	10.3	8.1	10.1
DMU22	13.9	12.8	16.1	14.3
DMU23	18.6	14.8	16.5	16.6
DMU24	18.2	16.9	18.5	17.9
DMU25	9.4	9.2	9.3	9.3
DMU26	6.3	7.0	7.9	7.1
DMU27	13.3	12.0	11.1	12.1
DMU28	20.8	19.5	18.9	19.7
DMU29	11.2	9.9	12.8	11.3
DMU30	10.9	9.1	10.5	10.2
DMU31	14.7	14.7	15.5	15.0
DMU32	12.7	12.2	12.7	12.5
DMU33	10.2	11.5	10.8	10.8
DMU34	9.0	8.7	8.6	8.8
DMU35	12.9	12.3	13.0	12.7

Source: Calculated from data in CVCP, 1989.

Table (6.6): Research output per cost centre and Research income per FTE academic.

DMUs	Res. Output	Res. Income
DMU 1	2.6	11870
DMU 2	2.8	14190
DMU 3	3.1	14830
DMU 4	2.4	10030
DMU 5	3.8	16290
DMU 6	2.1	16110
DMU 7	4.7	31620
DMU 8	2.0	8930
DMU 9	3.2	12970
DMU10	3.1	9770
DMU11	3.4	14900
DMU12	2.9	12200
DMU13	2.5	9830
DMU14	2.0	5880
DMU15	2.7	22100
DMU16	3.2	10010
DMU17	3.1	12000
DMU18	2.8	17890
DMU19	3.3	16500
DMU20	3.5	24190
DMU21	2.6	17020
DMU22	3.6	10060
DMU23	3.7	22240
DMU24	3.1	12990
DMU25	3.1	14120
DMU26	4.6	31610
DMU27	2.9	14410
DMU28	2.0	10570
DMU29	3.2	13400
DMU30	3.3	21250
DMU31	3.0	26760
DMU32	3.4	16260
DMU33	4.1	22030
DMU34	3.7	15740
DMU35	3.1	15899

Table (6.7): Overall Technical Efficiency.

DMUs	EFF(a)	EFF (b)	Changes
1	1.000	1.000	--
2	1.000	1.000	--
3	0.854	0.854	--
4	1.000	1.000	--
5	0.966	0.966	--
6	1.000	0.958**	-0.042
7	1.000	1.000	--
8	1.000	1.000	--
9	1.000	1.000	--
10	0.979	0.922 *	-0.057
11	1.000	1.000	--
12	1.000	1.000	--
13	1.000	1.000	--
14	0.963	0.960 *	-0.003
15	1.000	1.000	--
16	1.000	0.966**	-0.034
17	0.887	0.887	--
18	0.850	0.850	--
19	0.840	0.840	--
20	0.815	0.815	--
21	0.959	0.959	--
22	0.940	0.940	--
23	0.956	0.916 *	-0.040
24	0.841	0.835 *	-0.006
25	0.861	0.856 *	-0.005
26	1.000	1.000	--
27	0.847	0.844 *	-0.003
28	1.000	0.940**	-0.060
29	0.880	0.876 *	-0.004
30	0.946	0.942 *	-0.004
31	1.000	0.978**	-0.022
32	0.895	0.869 *	-0.026
33	1.000	1.000	--
34	1.000	1.000	--
35	0.877	0.877	--
Average:	**0.947**	**0.938**	**-0.024**

EFF(a): The relative efficiency scores using all 10 inputs and outputs of Table (7.2), with inputs 3 and 4, and Output 2 are being inverted.
EFF(b): Same as EFF(a) except input 3 is excluded.

*: Those units were inefficient under EFF(a).
**: Those units were efficient under EFF(a)

Table (6.8): The Reference Sets of each inefficient DMU that obtained from assessment **EFF(a)**.

DMUs	Eff(a)	Reference Sets
DMU 3	0.854	2 7 9 12
DMU 5	0.966	2 7 9
DMU10	0.979	7 9 12
DMU14	0.963	9 11 13
DMU17	0.877	2 9 12
DMU18	0.850	7 9 11 12 15
DMU19	0.840	2 7 9 12
DMU20	0.815	2 26
DMU21	0.959	1 2 7 9
DMU22	0.940	7 9 12
DMU23	0.956	1 2 26 31
DMU24	0.841	1 2 7 9
DMU25	0.861	1 2 7 9
DMU27	0.847	1 2 7 9 12
DMU29	0.880	1 2 7 9
DMU30	0.946	2 6 26
DMU32	0.895	7 9 13 26 34
DMU35	0.877	1 2 7 9 12 15

Five Units: 1, 2, 7, 9 and, 12 are the most to appear in reference sets to those inefficient DMUs. They appeared 7, 13, 13, 15 and 8 times each respectively. Of these five units there are two small, two medium size and one large.

Table (6.9): The Reference Sets of each inefficient DMU obtained from Assessment **EFF(b)**.

DMUs	Eff(b)	Reference Sets
DMU 3	0.854	2 7 9 12
DMU 5	0.966	2 7 9
DMU 6	0.958	1 2 26
DMU10	0.922	7 9 11 12
DMU14	0.960	9 11 13
DMU16	0.966	7 11 12
DMU17	0.877	2 9 12
DMU18	0.850	7 9 11 12 15
DMU19	0.840	2 7 9 12
DMU20	0.815	2 26
DMU21	0.959	1 2 7 9
DMU22	0.940	7 9 12
DMU23	0.916	2 26
DMU24	0.835	1 2 9 12
DMU25	0.856	1 2 7 9
DMU27	0.844	1 2 7 9 12 15
DMU28	0.940	1 4 8 12
DMU29	0.876	2 7 9
DMU30	0.942	2 26
DMU31	0.978	1 2 7 26
DMU32	0.869	9 11 15 26 33 34
DMU35	0.877	1 2 7 9 12 15

Five Units: 1, 2, 7, 9 and, 12 are the most to appear in reference sets to those inefficient DMUs. They appeared 7, 13, 13, 15 and 8 times each respectively. Of these five units there are two small, two medium size and one large.

APPENDIX TO CHAPTER SIX

Table (A: 6.1a):

Constant Returns to scale:

Output Maximisation Approach

Unit		EFF.	I1	I2	I3	I4	O1	O2	O3	O4	O5	O6
U6	A	0.96	11911	2988	13.0	0.09	46.1	0.05	79.8	15.0	2.1	16110
	T	1.00	9837	2988	12.8	0.09	59.0	0.08	83.3	16.5	3.2	16820
U10	A	0.93	5808	2816	11.0	0.10	46.2	0.09	55.0	27.7	3.1	9770
	T	1.00	5808	2712	11.0	0.10	49.6	0.11	65.0	29.7	3.3	14650
U14	A	0.97	6232	2528	10.3	0.11	43.1	0.06	54.9	30.7	2.0	5880
	T	1.00	6232	2487	10.3	0.11	45.9	0.08	59.6	31.8	3.1	13330
U17	A	0.99	7179	3483	9.4	0.09	38.2	0.09	62.4	24.8	3.1	12000
	T	1.00	7179	2849	9.4	0.09	45.9	0.09	63.3	25.2	3.2	12180
U18	A	0.99	8692	3082	9.4	0.10	42.2	0.09	59.0	31.0	2.8	17890
	T	1.00	8692	2691	9.4	0.10	48.4	0.09	59.9	31.5	3.6	18150
U25	A	0.96	9103	3128	10.3	0.09	49.7	0.11	66.6	22.8	3.1	14120
	T	1.00	9011	3128	10.3	0.08	52.0	0.11	69.6	23.8	3.3	15890
U27	A	0.94	8338	3131	10.3	0.10	48.6	0.08	69.6	20.7	2.9	14410
	T	1.00	8338	3093	10.3	0.10	51.5	0.08	73.7	21.9	3.1	15260
U28	A	0.94	6476	2869	12.3	0.10	43.7	0.05	75.3	14.5	2.0	10570
	T	1.00	6476	2869	12.1	0.10	48.9	0.08	80.1	15.4	2.7	11720
U29	A	0.91	7852	3205	10.5	0.09	43.4	0.09	62.7	23.5	3.2	13400
	T	1.00	7852	3116	10.5	0.09	52.0	0.11	68.6	25.7	3.5	14650
U32	A	0.89	9492	2785	10.6	0.1	44.2	0.08	57.4	28.9	3.4	16260
	T	1.00	9270	2785	10.6	0.1	53.8	0.11	64.7	32.6	3.8	19340
U35	A	0.94	8887	3031	10.5	0.09	46.3	0.08	66.7	22.8	3.1	15900
	T	1.00	8887	3031	10.5	0.09	54.6	0.11	71.2	24.5	3.4	16979

A: ACTUAL INPUT/OUTPUT
T: TARGET INPUT/OUTPUT
EFF.: EFFICIENCY SCORE

Table (A: 6.1b): VARIABLE RETURNS, OUTPUT MAXIMISATION APPROACH.

UNIT		EEF.	I1	I2	I3	I4	O1	O2	O3	O4	O5	O6
U10	A	0.97	5808	2816	11.0	0.10	46.2	0.09	55.0	27.7	3.1	9770
	T	1.00	5808	2578	10.4	0.09	47.6	0.11	60.9	28.5	3.2	14480
U14	A	0.98	6232	2528	10.3	0.11	43.1	0.06	54.9	30.7	2.0	5880
	T	1.00	6232	2403	9.7	0.11	45.1	0.07	57.5	31.4	3.1	13450
U18	A	0.998	8692	3082	9.4	0.10	42.2	0.09	59.0	31.0	2.8	17890
	T	1.00	8692	2656	9.4	0.10	47.6	0.10	59.1	31.1	3.5	17920
U25	A	0.97	9103	3128	10.3	0.09	49.7	0.11	66.6	22.8	3.1	14120
	T	1.00	9103	2977	10.3	0.08	51.5	0.11	69.0	23.6	3.2	16700
U27	A	0.97	8338	3131	10.3	0.10	48.6	0.08	69.6	20.7	2.9	14410
	T	1.00	8338	3016	10.3	0.09	50.0	0.10	71.5	21.3	3.1	14810
U28	A	0.97	6476	2869	12.3	0.10	43.7	0.05	75.3	14.5	2.0	10570
	T	1.00	6476	2869	11.6	0.09	47.1	0.08	77.9	15.0	2.5	10940
U29	A	0.94	7852	3205	10.5	0.09	43.4	0.09	62.7	23.5	3.2	13400
	T	1.00	7852	2999	10.5	0.09	50.3	0.11	66.7	25.0	3.4	15420
U32	A	0.93	9492	2785	10.6	0.10	44.2	0.08	57.4	28.9	3.4	16260
	T	1.00	9492	2785	10.6	0.08	51.9	0.14	61.5	31.0	3.7	19480
U35	A	0.96	8887	3031	10.5	0.09	46.3	0.08	66.7	22.8	3.1	15900
	T	1.00	8887	2992	10.5	0.08	51.0	0.12	69.3	23.7	3.2	16528

A: ACTUAL INPUT/OUTPUT
T: TARGET INPUT/OUTPUT
EFF.: EFFICIENCY SCORE

Table (A: 6.2a):

CONSTANT RETURNS, INPUT MINIMISATION APPROACH

UNIT		EFF.	I1	I2	I3	I4	O1	O2	O3	O4	O5	O6
U6	A	0.96	11911	2988	13.0	0.09	46.1	0.05	79.8	15.0	2.1	16110
	T	1.00	9422	2862	12.3	0.09	56.5	0.08	79.8	15.9	3.1	16110
U10	A	0.93	5808	2816	11.0	0.10	46.2	0.09	55.0	27.7	3.10	9770
	T	1.00	5427	2534	10.3	0.09	46.4	0.10	60.7	27.7	3.10	13690
U14	A	0.97	6232	2528	10.3	0.11	43.1	0.06	54.9	30.7	2.0	5880
	T	1.00	6020	2403	10.0	0.11	44.4	0.07	57.6	30.7	3.0	12880
U17	A	0.99	7179	3483	9.4	0.09	38.2	0.09	62.4	24.8	3.1	12000
	T	1.00	7074	2807	9.3	0.09	45.2	0.09	62.4	24.8	3.2	12000
U18	A	0.99	8692	3082	9.4	0.10	42.2	0.09	59.0	31.0	2.8	17890
	T	1.00	8569	2653	9.3	0.10	47.7	0.09	59.0	31.0	3.5	17890
U25	A	0.96	9103	3128	10.3	0.09	49.7	0.11	66.6	22.8	3.1	14120
	T	1.00	8619	2992	9.9	0.08	49.7	0.11	66.6	22.8	3.2	15200
U27	A	0.94	8338	3131	10.3	0.10	48.6	0.08	69.6	20.7	2.9	14410
	T	1.00	7872	2920	9.7	0.09	48.6	0.08	69.6	20.7	3.0	14410
U28	A	0.94	6476	2869	12.3	0.10	43.7	0.05	75.3	14.5	2.0	10570
	T	1.00	6085	2696	11.4	0.09	46.0	0.07	75.3	14.5	2.6	11015
U29	A	0.96	7852	3205	10.5	0.09	43.4	0.09	62.7	23.5	3.2	13400
	T	1.00	7180	2849	9.6	0.08	47.6	0.10	62.7	23.5	3.2	13400
U32	A	0.89	9492	2785	10.6	0.10	44.2	0.08	57.4	28.9	3.4	16260
	T	1.00	8224	2471	9.4	0.09	47.7	0.10	57.4	28.9	3.4	17160
U35	A	0.98	8887	3031	10.5	0.09	46.3	0.08	66.7	22.8	3.1	15900
	T	1.00	8322	2838	9.8	0.08	51.1	0.10	66.7	22.8	3.1	15900

A: ACTUAL INPUT/OUTPUT
T: TARGET INPUT/OUTPUT
EFF.: EFFICIENCY SCORE

Table (A: 6.2b):

VARIABLE RETURNS, INPUT MINIMISATION APPROACH:

UNIT		EFF.	I1	I2	I3	I4	O1	O2	O3	O4	O5	O6
U10	A	0.94	5808	2816	11.0	0.10	46.2	0.09	55.0	27.7	3.1	9770
	T	1.00	5448	2573	10.3	0.09	46.2	0.10	61.4	27.7	3.1	13280
U14	A	0.97	6232	2528	10.3	0.11	43.1	0.06	54.9	30.7	2.0	5880
	T	1.00	6022	2426	10.0	0.11	44.9	0.08	58.2	30.7	3.1	13120
U18	A	0.99	8692	3082	9.4	0.10	42.2	0.09	59.0	31.0	2.8	17890
	T	1.00	8639	2652	9.3	0.10	47.6	0.09	59.0	31.0	3.5	17890
U25	A	0.96	9103	3128	10.3	0.09	49.7	0.11	66.6	22.8	3.1	14120
	T	1.00	8394	3012	9.9	0.09	49.7	0.11	66.6	24.2	3.3	14900
U27	A	0.94	8338	3131	10.3	0.10	48.6	0.08	69.6	21.7	2.9	14410
	T	1.00	7878	2906	9.7	0.09	48.6	0.08	69.6	21.1	3.0	14410
U28	A	0.94	6476	2869	12.3	0.10	43.7	0.05	75.3	14.5	2.0	10570
	T	1.00	6094	2700	11.5	0.09	46.4	0.07	75.3	15.0	2.6	11170
U29	A	0.95	7852	3205	10.5	0.09	43.4	0.09	62.7	23.5	3.2	13400
	T	1.00	7456	3043	10.0	0.09	47.0	0.11	62.7	27.2	3.5	13400
U32	A	0.92	9492	2785	10.6	0.10	44.2	0.08	57.4	28.9	3.4	16260
	T	1.00	8751	2574	9.8	0.09	49.7	0.11	57.4	33.2	3.7	18690
U35	A	0.95	8887	3031	10.5	0.09	46.3	0.08	66.7	22.8	3.1	15900
	T	1.00	8482	2893	10.0	0.09	51.6	0.09	66.7	24.1	3.3	15900

A: ACTUAL INPUT/OUTPUT
T: TARGET INPUT/OUTPUT
EFF.: EFFICIENCY SCORE

Table (A: 6.3): [OM]: Overall, Pure and Scale Efficiencies.

DMUs	OTE:OM	PTE:OM	SE:OM
DMU 1	1.000	1.000	1.000
DMU 2	1.000	1.000	1.000
DMU 3	1.000	1.000	1.000
DMU 4	1.000	1.000	1.000
DMU 5	1.000	1.000	1.000
DMU 6	0.958	1.000	0.958
DMU 7	1.000	1.000	1.000
DMU 8	1.000	1.000	1.000
DMU 9	1.000	1.000	1.000
DMU10	0.934	0.970	0.963
DMU11	1.000	1.000	1.000
DMU12	1.000	1.000	1.000
DMU13	1.000	1.000	1.000
DMU14	0.966	0.979	0.987
DMU15	1.000	1.000	1.000
DMU16	1.000	1.000	1.000
DMU17	0.985	1.000	0.985
DMU18	0.986	0.998	0.988
DMU19	1.000	1.000	1.000
DMU20	1.000	1.000	1.000
DMU21	1.000	1.000	1.000
DMU22	1.000	1.000	1.000
DMU23	1.000	1.000	1.000
DMU24	1.000	1.000	1.000
DMU25	0.957	0.966	0.991
DMU26	1.000	1.000	1.000
DMU27	0.944	0.973	0.970
DMU28	0.940	0.967	0.972
DMU29	0.914	0.941	0.971
DMU30	1.000	1.000	1.000
DMU31	1.000	1.000	1.000
DMU32	0.887	0.933	0.951
DMU33	1.000	1.000	1.000
DMU34	1.000	1.000	1.000
DMU35	0.936	0.962	0.973
Average	0.983	0.991	0.983
Minimum	0.887	0.933	0.951
St. Dev.	0.030	0.018	0.014

Table (A: 6.4):[IM]: Overall, Pure and Scale Efficiencies.

DMUs	OTE:IM	PTE:IM	SE:IM
DMU 1	1.000	1.000	1.000
DMU 2	1.000	1.000	1.000
DMU 3	1.000	1.000	1.000
DMU 4	1.000	1.000	1.000
DMU 5	1.000	1.000	1.000
DMU 6	0.958	1.000	0.958
DMU 7	1.000	1.000	1.000
DMU 8	1.000	1.000	1.000
DMU 9	1.000	1.000	1.000
DMU10	0.934	0.938	0.996
DMU11	1.000	1.000	1.000
DMU12	1.000	1.000	1.000
DMU13	1.000	1.000	1.000
DMU14	0.966	0.966	1.000
DMU15	1.000	1.000	1.000
DMU16	1.000	1.000	1.000
DMU17	0.985	1.000	0.985
DMU18	0.986	0.994	0.992
DMU19	1.000	1.000	1.000
DMU20	1.000	1.000	1.000
DMU21	1.000	1.000	1.000
DMU22	1.000	1.000	1.000
DMU23	1.000	1.000	1.000
DMU24	1.000	1.000	1.000
DMU25	0.957	0.963	0.994
DMU26	1.000	1.000	1.000
DMU27	0.944	0.945	0.999
DMU28	0.940	0.941	0.999
DMU29	0.914	0.950	0.962
DMU30	1.000	1.000	1.000
DMU31	1.000	1.000	1.000
DMU32	0.887	0.924	0.960
DMU33	1.000	1.000	1.000
DMU34	1.000	1.000	1.000
DMU35	0.936	0.954	0.981
Average	0.983	0.988	0.995
Minimum	0.887	0.924	0.958
St. Dev.	0.030	0.023	0.012

Table (A: 6.5): Input Minimisation Approach, (VRS).

UNIT	EFF.SCORE	REFERENCE SETS
U8	0.965	9(0.127) 12(0.009) 16(0.736) 24(0.084) 30(0.044)
U10	0.936	7(0.016) 9(0.058) 11(0.224) 12(0.638) 22(0.064)
U13	0.951	4(0.114) 11(0.039) 12(0.847)
U21	0.986	2(0.046) 9(0.129) 11(0.123) 19(0.359) 26(0.097) 34(0.246)
U23	0.915	5(0.378) 20(0.430) 26(0.192)
U28	0.915	1(0.209) 4(0.698) 11(0.093)
U29	0.968	2(0.198) 7(0.033) 9(0.387) 11(0.181) 19(0.159) 22(0.043)
U31	0.989	7(0.301) 15(0.027) 18(0.197) 26(0.292) 30(0.183)
U32	0.949	2(0.198) 9(0.036) 11(0.185) 15(0.160) 24(0.315) 26(0.058) 34(0.048)
U33	0.976	7(0.266) 12(0.349) 26(0.379) 34(0.007)
U35	0.956	2(0.462) 5(0.030) 7(0.043) 9(0.020) 11(0.157) 12(0.087) 19(0.093) 30(0.108)

Table (A: 6.6): Output Maximisation Approach, (VRS).

UNIT	EFF.	REFERENCE SETS
U8	0.943	9(0.082) 16(0.918)
U10	0.958	7(0.036) 11(0.473) 12(0.490)
U13	0.835	11(0.222) 12(0.778)
U21	0.868	7(0.140) 9(0.101) 11(0.326) 19(0.076) 26(0.136) 34(0.222)
U23	0.831	11(0.276) 20(0.031) 26(0.692)
U28	0.777	1(0.107) 4(0.458) 11(0.172) 12(0.065) 15(0.199)
U29	0.848	7(0.337) 9(0.047) 11(0.360) 12(0.257)
U31	0.980	7(0.316) 15(0.057) 18(0.125) 26(0.305) 30(0.197)
U32	0.865	7(0.085) 11(0.066) 12(0.329) 24(0.124) 26(0.320) 34(0.077)
U33	0.985	7(0.293) 12(0.178) 16(0.156) 26(0.373)
U35	0.805	7(0.208) 11(0.203) 12(0.326) 16(0.030) 26(0.233)

Chapter Seven

Summary of Study Findings and Avenues for Further Research

Up to this stage, we have covered DEA and its uses in universities as a test for similar applications in many other Nonprofit organisations (NPOs). In this final chapter, we shall draw some major conclusions from what has been done throughout the thesis. Then we shall indicate possible extensions for other uses such as in the planning and budgeting aspects of management that might be derived from the results of DEA as an evaluation and control criterion. In this way we can indicate not only possible new managerial uses and extensions, but also move on to pointing issues for more scientific research in both theory and methodology.

The way we shall proceed to do this is as follows: first, we shall summarise our main conclusions and indicate possible extensions for DEA. Then we shall turn to consider the possibility of DEA being combined with goal programming in an overall budgetary model. This combination raises a variety of issues both for managerial use and scientific research which will then be pointed up.

The objectives of this thesis were to review, validate, and extend the present state of knowledge of performance evaluation in nonprofit organisations in general with a specific reference to universities. In doing this, we provided an illustration based on university data which was abstracted from, University Management Statistics and Performance Indicators in the UK, University Statistics, and two research assessment exercises by the UGC (1986) and UFC

(1989).

Specifically, we were concerned with the development of methods for measuring efficiency in NPOs such as health care organisations, higher education institutions, social and charitable organisations etc. In this sense we were very much after something very much like the standard cost accounting controls used in manufacturing and other private sector enterprises. Other methods of performance evaluation such as propriety and effectiveness were beyond the scope of this research.

Our validation and extension of efficiency evaluation was accomplished in two stages. In the first stage we evaluated and compared DEA and other efficiency measures (including variants of DEA) in an abstract way. This was basically done to obtain a better understanding of the properties and characteristics of each of the methodologies so that we could make a determination as to which method was best suited to our research. The second stage involved the testing of DEA in a higher education institutions prototype to see if it was suitable and applicable for that environment.

Over the last decade, performance evaluation methodologies have been continuously evolving. We examined several of these alternatives to determine which best suited our research. Our hypothetical consideration of the different methods (with the support of previous research) indicated that DEA offered the best alternative of all when it comes to measuring efficiency in those organisations with multiple inputs and outputs where no common unit of measurement is available. It is common for NPOs to have ambiguous objectives which may be left intentionally so. For this particular reason, DEA serves as the best technique for efficiency measurement. This is due to one of the characteristics of DEA, which treats the inputs and outputs of each DMU as equally important. Therefore, avoiding the problem of attaching weights or importance to

the various objectives of the concerned DMUs.

The other efficiency evaluation methodologies we reviewed were either inferior or not appropriate for our research. Traditional techniques such as regression analysis were unsatisfactory because they involved "a priori" weighting schemes and/or explicit specification of functional relations with accompanying assumptions that are difficult to justify and test in a programmatic contexts such as are involved in universities activities.

Other alternatives were also examined. One devised by Byrnes, Fare, and Groskopf (BFG) (1984) deals with these problems in a manner analogous to DEA. However, their model cannot handle multiple outputs and hence was not suited for our research. Constrained Facet Analysis (CFA), a variant of DEA, as developed by Bessent, Bessent, Clark, and Elam (1986) provided yet another alternative, but its estimates were proved by Banker et al. (1986) to be inferior to DEA, and could be challenged in other ways. A final alternative was examined in the form of Measure of Efficiency Dominance (MED). We concluded that MED was not appropriate for our situation since we had no reason to believe that DEA's convexity property did not hold for our data. Thus we concluded that DEA was the best suited for our research but of course, this still does not mean that DEA will always performs better than every other methodology in actual applications simply because it proved abstractly better than other alternatives.

In the second part of our testing, we used university data and analysed through DEA to check issues such as usability and relevance of our concept in a real world environment. A key ingredient in this stage of our study was the numerous applications we carried out using different sets and different combinations of inputs and outputs. This was done to insure the relevance and validity of the variables used as

well as the validity of our work. This is a process used to checking managerial control techniques. Furthermore, The use of constant and varying returns to scale technologies enabled us to make distinction between the different types of efficiencies (technical, pure and scale efficiencies).

The many applications we conducted enabled us to select the most appropriate input and output variables and dropped out those which were proved to have been redundant.

We conducted two major experiments; the first, for which we selected only 21 universities from the total number of 34 in England alone. The choice of these universities was based solely on their size, taking into account both the number of students and the number of cost centres in each of them. And they were made into three groups (large, medium and small size). we settled on nine inputs and outputs which were identified to capture the resources consumed and the outputs produced by the universities. The inputs were: the average expenditure per FTE student, the average expenditure per FTE academic, and the ratio of FTE students to FTE academic staff. Outputs included: average research income per FTE academic, average research score per FTE academic, successful leavers as percentage of those ending their studies, the percentage difference between those graduates with destinations "unemployed" or "short-term" and the calculated expected values of the latter based on a national average, the average first degree graduates per FTE academic, and finally average higher degree graduates per FTE academic.

The second major experiment was conducted using the total number of universities in England (34) plus one artificial unit for which the data was the averages of the data for the 34 universities. In this experiment, the set of inputs and outputs used was slightly different from that used in the first experiment. We used ten inputs and outputs. The inputs were as follows: research expenditure per FTE academic, cost

per FTE student, student/staff ratio, and average 'A' Level score. And the outputs were: degree results (first and upper second class), the non-completion rate, the destination of graduates (those in full-time employment), graduates in further education and training, research output as per cost centre and research income as per FTE academic.

Appendix A contains a long and controversial list of performance indicators for universities. DEA offers an alternative criterion for efficiency measurement that yields more consistent and reliable assessment of the operations of universities, hence funds can be allocated more objectively. In the analysis of the 35 DMUs, the efficiency was reduced to a single scalar measure reflecting their productivity and indicating to the possible saving in resources and increase in productivity that each inefficient university has to make before it can achieve best-practice.

Of the 35 DMUs in the cross section in chapter six, 24 obtained a score of unity and thus are relatively efficient in managing the resouces available to them in order to achieve their objectives. However, The remaining 11 are relatively inefficient with respect to the inputs used and the outputs produced. Althoough, the majority of them achieved levels of efficiency over 90 %, there is significant levels of reduction in inputs and increase in outputs to be achieved before these DMUs could be rated efficient.

In summary, we tested DEA with reference to variations in the number of inputs and outputs used as well as the number of DMUs. The latter was done by taking to total number of universities in England rather than a sample. In all uses, DEA performed very well, up to and including returns to scale and inefficiency identification which appeared reasonable to us compared with other results from various sources.

Extensions

Only recently it become possible to use DEA in a time series as well as cross-section application. The DEA applications enhanced with the possible use of multiple year or multi-quarter data to detect trends in relative efficiency over time which provides a powerful tool for managerial audit applications. That is, this development made it feasable to identify DMUs that were relatively efficient and which become relatively inefficient, for instance as a result of introducing new technology or any other organisational changes. The same thing could be detected with respect to previously inefficient DMUs which become efficient. This would allow the audit to focus on dynamic as well as static source of inefficiencies. Nevertheless, DEA is a still evolving methodology with advancement in its use and theory still possible and likely. Some suggested advancement follows:

1. One possible extension is the use of DEA in conjunction with goal programming to aid management's decision making in the areas of planning, budgeting, and resource allocation,

2. DEA could also be used for the evaluation of programmes in a manner similar to that used by Charnes, Cooper, and Rhodes (1981), in evaluating the programme efficiency of Program Follow Through relative to Non-Follow Through,

3. a third area of possible future research is to assign weights to the inputs and outputs to be used. Hence, explore the performance of DEA, then it becomes more useful for both, business enterprises and NPOs and

4. finally, the introduction of relative price constraints in the linear programming model may extend the results to evaluate price efficiency as well as the already encompassed technical efficiency. This would expand the capabilities of DEA substantially, hence it becomes more powerful and

attractive for business application where information about relative competitive market prices is readily available.

We should note that DEA results are not an end in themselves. They are better regarded as providing guidance to auditors or persons concerned with budgetary and programme reviews in identifying the possible presence of inefficiencies.

In summary, DEA appears to be relevant and beneficial for evaluating the efficiency of university activities. Not only does it identify efficient and less efficient activities, it also identifies the sources and magnitude of inefficiencies along with other managerial information. It does this without requiring "a priori" specification of a production function and is able to handle multiple inputs and outputs simultaneously. These properties, perhaps, are the most attractive for uses in NPOs activities such as those of the universities where usual control such as prices and costs can have only limited applicability for measuring output benefits.

Appendix A.[1]

A list of Performance Indicators and some of their definitions that were provided by The UGC/UFC.

INPUT VARIABLES.

1. Expenditure per FTE student and FTE staf:

1a. Exp. per FTE students,
1b. Exp. per FTE academic,
1c. Exp. on support staff per FTE academic, And
1d. Equipment Exp. FTE academic.

2. Postgraduate Indicator:

2a. Research Postgraduate as a % of FTE students,
2b. Taught Postgraduates as a % of FTE students,
2c. All Postgraduates as a % of FTE students, and
2d. Ratio FTE students to FTE staff with teaching duties.

3. Central Administration Expenditure:

3a. Central admin. Exp. as a % of grand total exp.,
3b. Central admin. pay exp. as a % of central admin. exp.,
3c. Central admin. exp. per FTE student, and
3d. Central admin. exp. per FTE academic staff.

4. Library Expenditure:

4a. Library exp. as % of total general exp.,
4b. Publication exp. as a % of library exp.,
4c. Library pay exp. as a % of library exp.,
4d. Library exp. per FTE student,
4e. Library exp. per FTE academic staff,
4f. Book exp. per FTE student, and
4g. Periodical exp. per FTE student.

5. Computer Services Expenditure:

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[1]. Appendix A has been abstracted from CVCP (1989).

5a. Computer services exp. as a % of total general exp.,
5b. Computer services pay exp. as a % of computer services exp.,
5c. Computer services exp. per FTE student, and
5d. Computer services exp. per FTE academic staff.

6. Premises Expenditure:
6a. Total premises exp. as a % of total general exp.,
- . premisews pay exp. as a % of premises exp.,
- . Heat, water and electricity exp. as a % of total general exp.,
- . cleaning and custodial services exp. as a % of total general exp.,
- . Repair and maintenance as a % of total general exp.,
- . Telephone exp. as a % of total general exp.,

6b. Total premises exp. per FTE student,
- . Premises pay exp. per FTE student,
- . Heat, water and electricity exp. per FTE student,
- . Repair and maintenance exp. per FTE student, and
- . Telephone exp. per FTE student.

7. Careers Services and Student Societies Expenditure:
7a. Careers services exp. per FTE student,
7b. Grants to Student Unions and Societies per FTE student.

8. Entry Qualifications of Undergraduates:
8a. Students with 3+ GCE "A" levels,
8b. "A" level Scores (Averages), and
8c. Other entry qualifications.

OUTPUT VARIABLES:

1. Destinations of first degree graduates 1985 to 1987.
1a. Total graduates with known destinations,
1b. Graduates with known destinations "unemployed" or "short term",

1c. Calculated expected value of 1b,
1d. Percentage, by subject, of unemployed and short term.

2. Undergraduate Success*; Terms of Attendance:
2a. Number of successful leavers,
2b. As percent of those ending their studies,
2c. Length of courses: % on 3-year courses,
2d. Length of courses: % on 4-year courses,
2e. Terms of attendance per success, and
2f. Attendance as percent of expectation.

3. Research Income per FTE Academic.
1c: A figure for each institution is calculated which gives the number of graduates "unemployed" or on "short-term" contracts that would be expected if, in each subject, it conformed to the national distribution. Thus for each institution the number of graduates in the population for each of the 112 subject head is multiplied by the proportion vision in all destinations for that subject. The results are added to give an overall predicted figure as would be shown in 1c.

2. Undergraduate Success:
The expected attendance of a student on a course nominally of 'n' years is taken as 3 'n' terms. This is multiplied by the number of students who were successful at the end of an "n year course". The sum of these products for all lengths of course gives the total attendance expected to be required in order to produce the number of successful graduates given in 2a.

The actual total attendance is calculated for all students - including those who fail at the end or those who leave earlier. This is divided by the number of successful graduates to give a number of terms per graduate (variable 2e.) and by the expectation described above to give variable 2f. (which is expressed as a percentage).

INPUT VARIABLES:

DEF. 1.

I) Full-time Equivalent (FTE) Student Load:

1) Headcounts of students registered on 31 December are derived from USR's individual undergraduate and Postgraduate student records. These headcounts are converted to a return of the student load for the academic year in two stages. First, the headcounts are converted to a full-time equivalence of students in attendance throughout the year and supported from general funds, by adjustment for part-time students, student in attwendance for only part of the year and students on self- financing courses. Secondly, the resulting FTE student numbers are apportioned accross the academic departmental cost centres according to the cost centres' contribution to teaching each student, so as to give the "student load" carried by each centre.

2) Postgraduate students are those studying on courses for which the holding for a qualification at degree level is a normal requirement at entry. Postgraduates are divided between "taught" courses, where the cost consists mainly in formal teaching (though a dissertation may form a part) and "research" courses, mainly consisting in research leading to a thesis, even though some formal teaching may be provided.

DEF. 2.

II) Full-time Equivalent (FTE) Academic Staff:

Staff numbers are derived from the staff record of the USR, being those departmental staff recorded as having "function of employment" code 11 (teaching or teaching and research) or code 12 (research only). Each is weighted by the factor "percentage academic effort", which allows for the reduced contribution of certain staff who are employed in part on other than academic duties, as well as be giving an equivalence for part-time staff.

In all tables (except tables 2 and 2a) staff on code 12 are weighted by the factor "proportion on salary from general funds". This is in contrast to past practice in which only those wholly paid from general funds were included: it reduces some anomalies which arise where many of the staff of a particular department receive part of their pay from other sources.

Variables Nos.1&2
Expenditure per FTE student and FTE Staff.
Caveats:

(i) It is particularly important that these statistics should not be used as the sole indicator by which a cost centre's performance is judged.

(ii) Unit costs should be interpreted in the light of the proportion of different categories of student, for example, research or taught pstgraduates.

(iii) Unit costs will also be affected by the nature, level and intensity of research activity.

(iv) A high unit cost could indicate an institution's success attracting endowment and other external income.

(v) Inconsistencies may arise from variations between universities' methods of calculating student load for part-time students.

(vi) The variation in NHS contributions to medical and dental schools means that clinical medicine (01) and clinical dentistry (02) cost centres should be treated with great caution.

(vii) Variations in proportion of service teaching in subjects such as mathematics may affect unit costs.

(viii) The extent of devolution of central administration shifts the balance of costs between "Central administration" and departments. Similar considerations may apply elsewhere (e.g. telephone).

(ix) Often departments are difficult to assign to cost centres in a consistent unambiguous way. This means that the content of certain cost centres (notibaly "other technology") is variable.

(x) In particular, departments in some subjects, such as biochemistry, serve in part to teach students on preclinical medical courses as well as to teach the subject in its own right. Where such teaching is exclusively for pre-clinical courses, and the work is brought together as "pre-clinical medicine", it will be shown in that cost centre.

(xi) A table giving the aggregate of all teaching department has been omitted because of the distortion caused by subject mix.

VARIABLE NO.4.

Ratio of FTE Student to FTE Staff with Teaching Duties.

(i) FTE staff with teaching duties includes all teachers however funded.

(ii) In table 2, an aggregate table of staff student ratio **(SSR)** by institution has been omitted because of the distortion caused by subject mix.

(iii) In medical disciplines variations in NHS funding and formal employment practices may affect SSR's substancially.

(iv) Indicator C9a must be read in conjunction with indicators C6, C7, and C8.

(v) Table 2a gives a time series of staff student ratios

(SSR's) for 1984-85 to 1986-87 for each cost centre. An institution aggregate table for all cost centres by institutions is not given because of the distortion caused by student mix.

VARIABLE No.5.

Central Administration Expenditure per FTE Student.

This covers only expenditure on central administration and includes:

(i) Salaries of central administrative staff (see Def. 10).

(ii) Running costs of administrative computers and charges for the administrative use of central computer.

(iii) Other expenditure covered includes:
(a) Public relations.
(b) Advertising of and recruitment to all vacancies.
(c) Removal expenses of all staff.
(d) Postage, unless specifically charged elsewhere, for example, to departments.
(e) Publications, excluding educational publications.
(f) Rating advisers.
(h) Security of wages.
(i) Bank charges, excluding interest on overdrafts.
(j) Calender, prospectuses, regulations etc.
(k) General advertising, unless specifically charged elsewhere.
(l) Other costs of faculty offices in respect of central admininstrative work.
(m) Legal and audit fees.
(n) Superannuation management.

The heading excludes:
(i) The costs of departmental administration.
(ii) The direct cost of examinations and premises expenditure.

(iii) Recoverable rates.
(iv) Capital-in-recurrent.
(v) Transfers to furniture and equipment grants.
(vi) Re-imbursable lump sum and other premature retirement payments.

(vii) The following are subtracted in order to derive universities' net expenditure:

Income from the university health service,
Income from use of athletic facilities.
Income from extra-mural courses.

Caveats:

(i) Some universities include departmental administrative support in cost centre expenditure on support staff. This may reduce their costs under central administrative costs and increase them under the cost centre tabulation.

(ii) Universities have discretion to charge certain experndiTure, e.g. postage and stationary either via departments or centrally and the practice chosen will affect the figures given.

(iii) Some administrative costs are related more to students numbers than to the actual expenditure per student. A given administrative cost per student may be a high percentage of the total expenditure in a university with a low science component.

(iv) Attention is drawn to the fact that grand total expenditure rather than general expenditure is used in indicators C10 because other centres of expenditure consume administrative resources.

DEF.3.
Variable No.6.

Library Expenditure

This covers expenditure in all libraries (central or departmental) excluding premises, whether they are under the control of the university library or not. Expenditure in binderies is included.

Library expenditure is made of the following items:

(i) Operating costs, including salaries and wages, include the pay of all employees wholly or mainly engaged in recognised library duties, except that of binderies staff. All non-pay expenditure including consumables, on the operation of the library is included.

(ii) Books expenditure.

(iii) Periodicals expenditure. A periodical is defined as a publication issued in a continuous series, with a consecutive numeration and with no predetermined end. (Items (ii) and (iv) include expenditure on books and periodical as microforms).

(iv) "Other documents" cover expenditure on all documents other than books and periodicals, such as other microforms, audio-visual materials, maps, photographs etc.

(v) Binding includes the cost of binding including the pay of the bindery staff. Work done for bodies outside the university is excluded.

Caveats:

(i) There are differences in the structure of individual libraries which have implications for expenditure on acquisitions and on staff pay in relation to each other.

(ii) Costs may be affected by differing practices in individual libraries with regard to non printed materials,

e.g. microfilm and databases.

(iii) Subject mix in istitutions will affect the kind of books and materials purchased.

(iv) Expenditure on acquisitions, operations and staffing varies between individual libraries according to several factors.

(a) Structure, whether on one site or several.
(b) Size and costs of maintaining collections.
(c) Subject mix and the coverage of specialist subjects e.g. more or less science and technology, specialist languages.
(d) Student mix, e.g. more or fewer research postgraduates.
(e) Special collections of rare and valuable materials and the demands for conservation.
(f) Location and proximity or otherwise of other relevant library resources.
(g) Coverage of non-print materials, e.g. media, microforms. and databases.
(h) Binding: the few libraries which operate their own binderies have the staff costs counted here.

Variable No.7.
Entry Qualifications:
The USR undergraduate record contains data on students' careers.

(i) Table 11 gives figures, for major groups of subjects, on the qualifications of undergraduates entering to study for full time degrees in the three years 1985, 1986, and 1987. They are divided on the basis of their "main qualification"; either 3 or more GCE "A Level", 5 or more SCE "Highers" or other qualification e.g. BTEC, HND, HNC etc.

(ii) Candidates holding BTEC national certificates or diplomas or kindered qualifications, are seen as having been

admitted on the basis of that qualification, and are included in "other qualifications" even though they may also hold "A" levels or "Highers". Also a candidate with "Highers" may also hold "A" levels: he or she is recorded as having main qualification whichever is in the greater number.

(iii) For universities outside Scotland, "Highers" are included in "other qualifications".

(iv) Data on qualifications is correrct as at 14.7.88.

Entry Qualification Scores:

The scores of GCE Advanced level and SCE Higher grade passes take account of the best three or five passes respectively (whenever obtained). Duplicate Subjects are discounted and scores are calculated as follows"

(i) GCE "A" level- for entrants with three passes the following scores are allocated: A = 5, B = 4, C = 3, D = 2, E = 1.

(ii) SCE "H' grade- for entramnts with three or more passes up to a maximum of five, the following scores are allocated: A = 3, B = 2, C = 1.

(iii) Both examinations are scored out of 15: it is important to realise that this is coicidental and that the very different structures of the two examinations systems precludes any comparison between them. It is also invalid to assume that similar grades in different subjects are necessarily comparable.

(iv) Data have not been shown where the number of entrants is less than five. Total for countries may, therefore, not appear to reconcile with the figures for individual universities.

(v) A zero number of entrants is indicated by "-"
One to four entrants are indicarted by ".".

Caveats:

(i) Due to inherent differences in the General Certificate of Education and the Scottish Certificate of Education, direct comparisons between "A" Level and "H" grade score are not valid.

(ii) University selectors choose their students on their personal qualities and potential as well as on their intellectual achievements at entry. "A" Levels are now not the only qualifications that gain students a place on a course.

OUTPUT VARIABLES:

1. Graduates of known destination with long-term employment as percentage of total graduates.

data on the first destinations of graduates have often been used as an indicator of relative performance of university. although some criticisms have been made about the quality of some of the data, or that it is collected too soon after graduation, the FDR remains the only source of information about graduates available.

subject mix in universities has always been regarded as one of the key factors in explaining the variations of employability. table 9 attempts to take account of the influence of subject mix. Data are based on UK domiciled graduates of two years 1985-86 and 1986-87. It is intended in the future work to increase this to three years and calculate a three year moving average. Graduates whose destinations are recorded as "not known" or as "not available for wemployment" are excluded as having indeterminate employability- the

latter group are usually homemakers or are taking time off to travel.

The total number of graduates with known destinations is given in Col 40. Of these graduates, those with destinations of "known to be unemployed" or as "in short-term" (i.e. 3 months or less) are shown in Col 41. In Col 42 a figure for each institution is calculated which gives the number of graduates "Unemployed" or "on short-term" contracts that would be expected if, in each subject, it conformed to the national distribution. Thus for each institution the number of graduates in the population for each of the 112 subjects head is multiplied by the proportion vision in all destinations for that subject. The results are added to give an overall predicted figure as shown in Col 42. The actual number (Col 41) is Subtracted and the difference is shown in Col 43. Col 43 is then divided by the total number of graduates for each university (ie. Col 40) to give a rate of excess per hundred graduates, shown in Col 44. Thus a negative figure indicates more than the predicted proportion of unemployed destinations or in short-term employmnet and a positive figure less than predicted.

Caveats:

(i) Discrepancies between some figures arise because of calculating fractions and whole numbers.

(ii) Very little of the variation indicated between universities of any statistical significance.

(iii) There may be distortions because of small numbers of students in certain subjects.

(iv) It is important that caution is exercised in making value judgements about the suitability of some forms of permanent employment.

(v) Some short term destinations may be appropriate for students intending to undertake certain vocational training courses or gain work experience.

*** Table 9a gives the proportions of unemployed and short-term destinations for all UK universities for each of the 112 subjects and academic groups. The larger subject group contributions are for illustration only and are not used in the calculations.

Variables 2&3.

Undergraduate Success: Terms of Attendance.

Table 10 presents, for major groups of subjects, data which relate to the degree of success of undergraduates. It is based on those leaving during the three academic years 1984-85 to 1986-87, who, at the time they left, were studying full-time for first degrees or diplomas at degree level (Col 45). For these students it is possible to assess the total number of terms in which they were in formal attendance (excluding optional time away from the university, "sabbaticals" etc). It is also possible to count the numbers who successfully completed their courses (C46), and hence deduce the number of terms of attendance required to produce a graduate (C48): this may be seen as a cost in terms of human resourses.

There will be variations between universities arising from the balance between courses of three-years duration, four-years duration and some of even longer. To allow for this, a calculation is made for each student of the percentage excess or deficit of attendance over expectation (C49).

Table 10 also shows the number of successful leavers, and the number successful as a proportion of those who left on completion of their studies (ie. excluding those known to be continuing study elsewhere).

Undergraduate Success.

The expected attendance of a student on a course nominally of "n" years is taken as 3 "n" terms. This is multiplied by the number of students who where successful at the end of an "n year course". The sum of these products for all lengths of course gives the total attendance expected to be required in order to produce the number of sduccessful graduates given in the first column.

The actual total attendance is calculated for all students- including those who fail at the end or those who leave earlier. This is divided by the number of successful graduates to give a number of terms per graduate (indicator C48) and by the expectation described above to give indicator C49 (which is expressed as a percentage).

Caveats:

(i) Data in table 10 is based on a three year average combining the years 1984-85 and 1986-87. Anomalies which might have arisen in one particular year are ironed out by the average.

(ii) Some universities admit some students to the second or later year of course. These will, of course, contribute less than the attendance expected (eg. 6 terms if admitted to the second year of a three year course).

(iii) Some courses recorded as four years are in fact of only ten terms. Both these cosiderations may give rise to attendance less than 100% of calculated expectation.

(iv) Changes in the way courses in medicine and dentisry are handled, with the complexities arising from inter-university transfers and intercalation of courses, making it impossible to present a meaningful analysis for this subject group.

Research Income.

This covers all specific income for the purpose of research receivable in the year, whether receivable by the university, by a department, or by an individual within a department, and includes:

(i) All research grant income received from research councils covered by the Advisory Board for Research Councils.

(ii) Contracts income from Research Councils covered by the Advisory Board for Research Councils.

(iii) Income from all UK Central Government bodies except Research Councils, and hence includes Government Departments, The Scottish Office, The Northern Ireland departments and other organisations financed from Central Government funds, such as the National Health Service.

(iv) Income from UK Local Authorities, which covers elected local councils including Local Education Authorities, Police Authorities and some other bodies controlled by councils jointly.

(v) Income from UK Corporations, which are publicly owned trading bodies, usually statutary corporations, with a substantial degree of financial independence. They include the Nationalised Industries and bodies such as the British Technology Group, The Ordnance Survey and the Housing Corporation.

(vi) Income from other UK industry and Commerce, which includes industrial and Commercial Companies operating in the United Kingdom, except those covered under Public Corporations (see (v)).

(vii) Income from all charitable foundations, trusts etc., based in the United Kingdom.

(viii) Overseas income relates to all overseas bodies.

(ix) Other sources which include all research income not covered by sub-heads (i) to (viii).

Income from university companies is excluded.

Caveats:

(i) A low level of research income does not necessarily mean a low level (or low quality) of research (for instance in the humanities or theoretical branches of scientific dispilines).

(ii) Variations of costs between universities for a given cost centre may be affected by different types of research within the same cost centre.

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