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MEASURING EFFICIENCY IN ENGLISH MAINTAINED SECONDARY SCHOOLS: *TECHNIQUES, POLICY IMPLICATIONS AND PRACTICALITIES*

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Abstract

This article describes the work that has been undertaken by the Department for Education and Skills in England to construct and utilise school level efficiency measures for all maintained secondary schools in England. The Department is using Data Envelopment Analysis techniques to generate efficiency estimates, to both identify where current best practice exists and also to bolster the ability of less efficient schools to benchmark themselves against other "similar" peer schools.

Key Words: Data Envelopment Analysis, School Efficiency, Policy Application.

1. INTRODUCTION

1.1. Context

The Department for Education and Skills (DfES) seeks to promote value for money within schools to ensure that they use the resources that they receive to best effect to assist them in realising the potential of all their pupils.

Figure 1 illustrates what is meant by the DfES when it talks about Value for Money. Essentially it can be partitioned into 3 different components - Economy, Efficiency and Effectiveness.

Much work has already been done with schools on trying to improve their economy with the inception of the Centre for Procurement Performance and the

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regional consortia all working with schools to try and both improve their own capacity to undertake good procurement practices, but also to use economies to try and secure best deals that schools can then directly buy into.

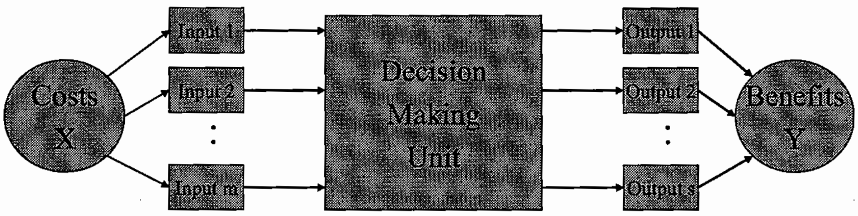
At the other end of figure 1 there is effectiveness, which in its conventional sense is concerned with ensuring that organisations choose the right output mix to have the maximum impact on outcomes. Applied to the schools sector one can equate this to whether schools are using the right teaching and learning techniques in order to allow their pupils to obtain their full potential.

Again, lots of work has been focussed on effectiveness within the Department with a whole wealth of initiatives being launched to try and improve teaching and learning practices, such as the national literacy strategy and so on.

Much more work remains to be done in taking forward the middle component "efficiency", which is all about how schools use the resources that they procure to best effect to produce their planned outputs.

FIGURE 1

Components of value for money



Economy	Efficiency	Effectiveness
Procurement of inputs at minimum costs	Use of resources to produce maximum output	Choice of output mix to produce maximum impact on outcomes

As part of the Gershon Review which fed into Spending Review 2004, the Department was set targets to realise a series of efficiency gains within schools. One of these targets was to realise £640 million worth of efficiency gains by 2007-08 from schools improving their strategic and financial management and hence improving their use of resources.

The Department had already begun work to improve efficiency in schools but with specific targets to meet, the task is now a high priority. In April 2002, to aid school accountability and to help schools benchmark their finances, the Department introduced the consistent financial reporting (CFR) framework regulations for all maintained schools in England. This required all schools to report their expenditure against 30 detailed expenditure headings as well as providing information on income and capital.

Much work has been done since, including the inception of the Schools Financial Management Benchmarking Website (November 2003), which allows schools to compare their income, expenditure and attainment records against other "similar" schools and hence begin to ask questions about why there expenditures look like they do and whether they could do anything to change them and hence realise efficiencies.

1.2 Why Develop Efficiency Estimates?

To assist schools in becoming ever more efficient the DfES has been developing school level efficiency measures for nearly every secondary school in England. It is important to note that these measures are still being developed and hence have not been formally published in any form, however schools have been consulted as the measures have gone through the various stages of development.

The measures have two purposes:

1. To highlight where best practice currently exists within the sector, to learn about the strategies, behaviours and practices that we should be aiming to disseminate throughout the sector to help all schools improve their efficiency.
2. To allow schools to benchmark themselves based directly on their efficiency scores. So less efficient schools can identify and learn from their efficient peers.

Section 2 of this paper gives an overview of the Data Envelopment Analysis (DEA) technique used to estimate school efficiencies. Section 3 then builds on this to describe the exact specification of the models in terms of the inputs and outputs that are used within the majority of the Departments models. Section 4 then discusses how these models are being used and the results of a piece of research looking at schools identified as being efficient, before Section 5 concludes the paper and identifies where this work is to be developed.

2. DEA TECHNIQUE

DEA is a non parametric technique that has been used widely in the literature on schools efficiency. It has the advantage of being specifically designed to model production processes using multiple inputs to produce multiple outputs. It also does not require one to predict the functional form linking inputs to outputs and it requires no judgement as to the relative importance of the inputs and outputs.

One of the great features of DEA that makes it so relevant to the public sector is that it automatically yields meaningful targets and identifies peer schools for less efficient schools.

The disadvantages of the technique is that it is not stochastic so it is therefore sensitive to errors in the data and also due to its non-parametric nature one cannot use standard statistical tests to check the quality of the DEA model.

The basic DEA model was introduced in the literature by Charnes, Cooper and Rhodes (1978). It is now referred to as the CCR model after its developers.

The measurement of technical output efficiency of a DMU by DEA involves two basic steps. First, one constructs the "Production Possibility Set" (PPS) and then one estimates the maximum feasible expansion of the output levels of the DMU within the PPS (Thanasoullis, 2001). The PPS is constructed using the observed input and output correspondences of all the DMUs in the sample. To do this we assume:

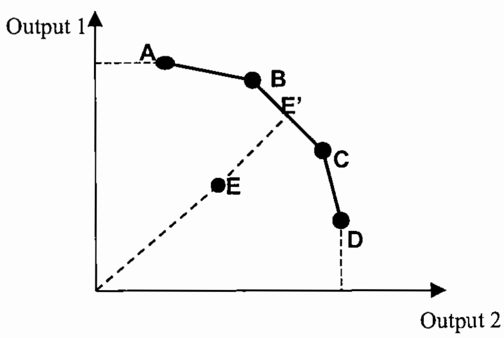
Interpolation: Points resulting from the interpolation of two feasible input-output correspondences lie on the line joining those correspondences, so using this assumption we deduce that all input-output correspondences lying between any of the units being assessed can in principle be observed. Thus in figure 2 below the input-output correspondences along the linear segments AB, BC etc. are feasible in principle;

Inefficient production is possible: So here we assume that it is possible to secure lower output levels than feasible for the given input levels;

The PPS represents the smallest containing set: This assumption means that the PPS contains all the observed DMUs, which implicitly infers that all the DMUs observed operate the same technology in the sense that they face the same production options in transforming input to output.

FIGURE 2

Graphical illustration of use of DEA in single input multi-output case (adapted from Thanassoulis, 2001)



From the diagram the PPS is bounded from above by the piece-wise linear boundary ABCD and by the broken horizontal line from A, and the broken vertical line from D. The Pareto-efficient output levels lie on the boundary ABCD while the output levels on the broken parts of the boundary are not Pareto efficient as they are dominated by the output levels at A and D respectively.

DMUs that are illustrated under the frontier are deemed inefficient; in Figure 1 the technical output efficiency of unit E is calculated by estimating the factor by which its output levels can be expanded radially, whilst holding its input level constant. The output mix of DMU E, defines the radial OEE' in Figure 1.The point E' represents the maximum output obtainable within the PPS for the output mix of unit E, therefore E' becomes the reference point for measuring the technical output efficiency of DMU E, which is given as:

Technical output efficiency of DMU E = OE/OE'

As already stated DEA, utilises linear programming techniques in order to construct efficiency scores for all of the DMUs in the dataset. The basic CCR model that we use to construct these scores is set out below:

Assume that we have N DMUs, (j=1,...,N), using m inputs to secure s outputs. Let individual inputs and outputs be referenced by i and r respectively. Let:

x_{ij} = Amount of input i used by DMU j.
y_{rj} = Amount of output r produced by DMU j.

The technical output efficiency of DMU_{j0} equals $1/h^*_{j0}$, where h^*_{j0} is the optimal value of h_{j0} in model (1).

$$\text{Max} \quad h_{j0} + \varepsilon\left[\sum_{i=1}^{m} I_i + \sum_{r=1}^{s} O_r\right] \qquad (1)$$

Subject to:

$$\sum_{j=1}^{N} \lambda_j x_{ij} = x_{ij0} - I_i, \qquad i = 1,\dots,m$$

$$\sum_{j=1}^{N} \lambda_j y_{rj} = O_r + h_{j0} y_{rj0}, \qquad r = 1,\dots,s$$

$$\lambda_j \geq 0, I_i, O_r \geq 0, \qquad \forall i,r,j$$

h_{j0} free, ε is a Non-Archimedean infinitesimal.

The model identifies a point within the production possibility set which offers output levels reflecting the maximal feasible radial expansion of the output levels of DMU j_0, without raising any one of its input levels (Thanassoulis, 2001). From the model the technical output efficiency of DMU j_0, is given by $1/h^*_{j0}$.

The variables I_i and O_r in model M1 are slack variables and are constrained to be non-negative. The purpose of the ε term in the objective function is such that its value is defined to be so small that no multiple of ε can compensate for a reduction in the value of h^*j_0 (Banker *et al*, 1989). So in practice the model is effectively solved by a two stage process. The first stage consists of maximising the value of h_{j0} to yield the maximum value of h^*_{j0}. The second phase in solving the model involves setting $h_{j0}=h^*_{j0}$, and solving the model such that the sum of the slack variables is maximised. If any of these variables are positive at the optimal solution to the model, it means the corresponding input or output of DMU j_0, can improve further after the radial expansion of its output level by the factor h^*_{j0}.

The variables λ_j which are also constrained to be non-negative are the weights used to identify a group of peer units for each DMU, that is a group of units that a DMU can emulate (by a linear combination) to increase its efficiency. The peer units are weighted by the λ_j's to construct a composite (virtual) DMU that will portray the best practice for the DMU being assessed and will serve as a target for the DMU.

Model M1 does not as it currently stands allow for variable returns to scale (VRS), that is it implicitly assumes constant returns to scale (CRS). By assuming CRS, one implicitly assumes that the scale of operation of a DMU has no impact on its productivity, which is quite a strong assumption to make. In order to incorporate VRS, one must include an additional constraint to the model. This constraint is known as the convexity constraint and adopts the following form:

$$\sum_{j=1}^{N} \lambda_j = 1 \tag{2}$$

The convexity constraint ensures that an inefficient DMU will only be benchmarked against DMUs of a similar size. That is the projected point on the DEA frontier will be a convex combination of observed DMUs. The restriction is not imposed in the CRS case so a DMU may be benchmarked against DMUs that are substantially larger (smaller) than itself. In this instance the λ_j-weights will sum to a value greater than (less than) one (Coelli *et al*, 1998).

Model (1), when augmented by the convexity constraint is known as the BCC model, after its developers Banker, Charnes and Cooper (1984).

3. DATA AND MODEL SPECIFICATION

3.1. Data

Before any models can be constructed it is necessary to construct a large dataset for all secondary schools in the maintained sector in England. This analysis has initially focused on secondary schools as they have larger budgets, there are less of them and they are more likely to have an individual within their schools that is specifically responsible for financial management, which should mean that they have greater capacity to generate and push through change in their strategic and financial management process.

In concentrating on secondary schools, a further distinction has been made between those with sixth forms and those without. This distinction is important since a major source of difference is that those with a sixth form attract a totally separate funding stream from the LSC for the provision of post 16 learning, which will not necessarily be allocated exclusively to post 16 learners as there is likely to be a degree of cross subsidisation.

Our initial focus has been on the provision of education in secondary schools between key stages 3 (KS3) and 4 (KS4). A pupil spends two years in school during the phase between KS3 and KS4, therefore all variables considered for inclusion within the model will be two year averages to reflect the total resource that the pupils received within a school during this phase of the curriculum.

The only data not averaged over two years is the consistent financial reporting data. This is purely because we only have CFR data going back to financial year 2002-2003. Because we are interested in resources utilised by schools in specific academic years we must convert the financial year data into academic years. To do this for academic year 2002/03 for example we would use the standard 7:5 apportionment rule for expenditures in financial year 2002-2003 and 2003-2004 respectively. So given the data available it is only possible to calculate 2 academic years worth of data for 2002-03 and 2003-04.

This is a limitation of the models constructed at this stage, because of the limited time frame for which we have consistent financial data (CFR) it cannot be averaged across the whole period that pupils have been engaged within the key stage. For this reason we only include the financial data relevant to the year in which the pupils take their KS4 qualifications.

All CFR data was also adjusted by the relevant area cost adjustment factor (ACA). ACAs allow one to make allowance for the fact that providing a common level of service differs between areas due to the difference in the cost of inputs that schools must purchase.

CFR data was matched with Pupil Level Annual Schools Census (PLASC) data on staffing numbers and pupils contextual information, which was further complemented by Edubase data, which provided school contextual variables all averaged over the appropriate years.

The final dataset therefore contains information on school characteristics, school expenditure, pupil characteristics and policy variables.

3.2. Model Specification

The choice of variables to be included within the model is pivotal and in this section we look at the choice of both outputs and inputs that we include within the model.

Outputs

In these initial models, the output variable to be used is the uncapped value added) attainment results (in this instance value added between KS3 and GCSE's). Value added measures, mean pupils progress is mapped against an average expected level of improvement given their prior attainment. The uncapped term means that the measures take account of all the subjects that the pupil takes. Capped measures on the other hand only concentrate on the pupils 8 best subjects. The Department no longer produces uncapped measures as they are trying encourage schools to focus on achieving better results in fewer subjects. However for efficiency modelling purposes it is important that the models capture the total sum of the output that the school is producing in terms of the number of subjects taught and the attainment of pupils within these subjects. Table 2 shows the summary statistics for the GCSE uncapped value added.

TABLE 2

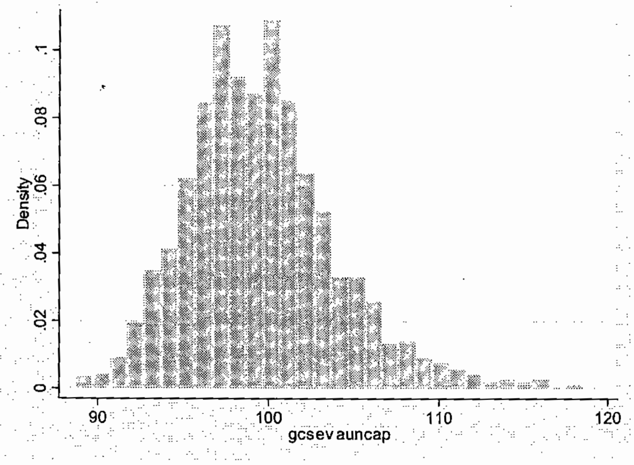
Summary statistics for the GCSE uncapped value added

Outputs	Mean	Std. Deviation	Minimum	Maximum
GCSE Uncapped Value Added	99.61	4.33	88.8	118.6

The distribution of the uncapped value added GCSE scores is presented in figure 3:

FIGURE 3

Distribution of the GCSE uncapped value added



As can be seen from the chart there is a reasonable amount of variation in the output variable between schools and hence the initial modelling work that we shall perform will attempt to explain this variation.

Inputs

Models of educational production functions tend to depict the achievement of a given student at a particular point in time as a function of the cumulative influence of family background, peers and school inputs, (Hanushek 1986).

DEA as already mentioned is a non-parametric technique, which means that we cannot perform standard statistical tests of significance on the variables included within the model. Therefore initial choices must be firmly based on the education production function literature and also other analysis that has been performed by the Department looking at the impact of resources on attainment. Our modelling problem is to select the combination of available input variables that most accurately capture the production process.

When utilising DEA there is an incentive to minimise the number of input variables included in the model as the more inputs you include the more likely it is that schools will use a unique bundle of these inputs and hence in the absence of any peers the school will be deemed efficient.

Another justification for trying to minimise the number of variables contained within the model arises as DEA is a technique based on linear programming, where the software package is asked to solve numerous simultaneous equations subject to specific constraints. As more variables are added the number of calculations that need to be solved in order to complete the model grow exponentially and hence become much more computationally demanding, which with current software takes a considerably long time.

Counter to this argument we obviously wish to include all the variables that we believe to be important in the production process. This is required as to capture efficiency gains associated with better strategic and financial management in schools we must be adequately catering for all the important inputs that schools have to manage or can manipulate and use in different quantities to ensure that we are capturing the whole production process.

Because of the requirement to minimise the number of variables the initial model specifications did not include both expenditure on teaching staff and expenditure on education support staff as well as variables on the physical number of these people that are present in schools. This decision was taken as these variables are obviously highly correlated so the inclusion of both is not likely to explain much more of the variation in attainment. Secondly the expenditure data does not allow us to disaggregate the different types of staff into as finer categories as the schools census data and thirdly the actual physical staff numbers are likely to be more reliable than the CFR records as schools find it much easier to accurately record the number of staff they employ rather than the expenditure devoted to such resource.

For these reasons the staffing variables were chosen to be considered for the favoured model. One counter argument for using expenditure rather than raw headcount numbers of teaching staff is that expenditure may also allow us to capture some impact of teacher quality, if it is believed that teachers pay is related to their quality. However to counter this, one could argue that pay in the maintained teaching profession is currently much more closely linked with experience and time on the job, which is not necessarily directly linked to quality.

Given that the models are to include staffing figures it is necessary to analyse these a little more closely. Firstly all staffing figures were converted to a per-pupil basis[1], to cater for scale within the model, as a large school may have many more teachers when compared to a small school but this does not necessarily mean that each pupil within the school receives more teacher time.

The dataset allows us to distinguish between three different types of teaching staff; qualified teachers, unqualified teachers and others. The "Other" teachers category predominantly constitute those people who are working within schools whilst at the same time embarking on some form of training that will lead them to obtaining qualified teacher status. Table 3 provides summary statistics for these different teacher types.

[1] On conversion all staffing figures were also multiplied by 1000 in order to make their values more discernable from one another with limited decimal places.

TABLE 3

Summary statistics for teaching variables

Teaching Variable	Mean	Std. Deviation	Minimum	Maximum
Qualified Teachers Per-Pupil	59.22	6.26	40.99	155.61
Unqualified Teachers Per-Pupil	0.72	1.48	0	15.62
Other Teachers	1.78	2.59	0	34.48

From the table it can be seen that most schools do not have many unqualified or other teachers. This warrants further investigation since if we include all of these variables separately then it is likely that we would identify significant numbers of schools utilising a unique bundle of teaching staff and therefore these schools would automatically be deemed efficient within the DEA methodology as they lack any comparable peers. Figures 4 and 5 confirm this suspicion showing the frequency of unqualified teachers and other teachers respectively.

FIGURE 4

Distribution of unqualified teachers

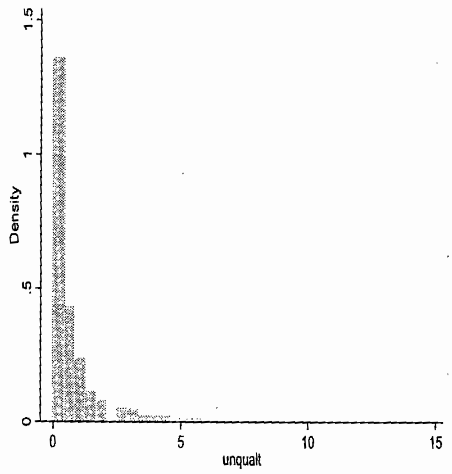
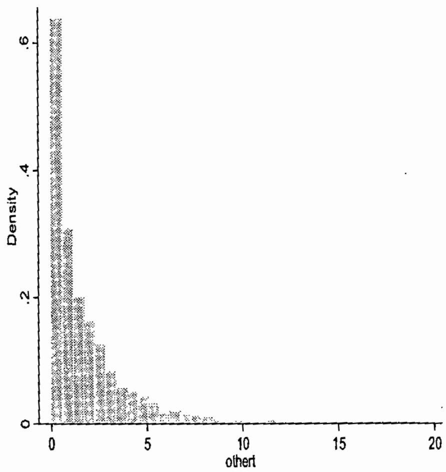


FIGURE 5

Distribution of other teachers



From the charts it can be confirmed that many schools do not use any unqualified or other teachers and yet some outlier schools rely quite heavily on them. Therefore inclusion of these variables separately within the model is likely to lead to some onerous findings of efficient schools. For this reason and also because of the desire to keep the number of input variables to a minimum it was decided to combine all the teaching staff variables (so qualified, unqualified and other) into one input that then captures the number of teachers per pupil.

Variables to capture the number of learning support staff per pupil and the number of administrative and clerical staff per pupil were also added as these are integral to analysing how a school manages its human resource and these are all likely to have an impact on the efficacy of a school.

The variable capturing expenditure on learning resources and ICT learning resources was also included in the model as the provision of such resources are likely to have an impact on a child's subsequent attainment. By including all these variables one can observe how different schools choose to allocate their resources to deliver their curriculum, through both human and physical learning resources.

Any model of the school production function also has to adequately control for the intake of pupils that the school faces. The characteristics of the pupils within a school are in effect the raw materials that schools have to work with. By opting for the value added output measure our model already caters for the average prior attainment of the pupils within a school. However there are other factors that may determine the ease of imparting knowledge to a child.

The first of these is the level of deprivation a pupil faces. Relating this to the literature on education production functions it has been shown that pupil attainment is dependent on a child's family background and peer group effects. One measure of a child's family background is family income and hence levels of deprivation. Our proxy measure of deprivation is the proportion of pupils eligible for free school meals (FSM). FSM are a means tested benefit given to those pupils from low income families. By looking at the proportion of pupils eligible for FSM within a school we also may begin to identify peer group effects as those pupils who are in schools with a high proportion of pupils eligible for free school meals are obviously surrounded and mixing with other children from relatively deprived backgrounds.

Previous modelling work carried out by the department has shown that eligibility for FSM has a negative effect on attainment. In order for a variable to be included within a DEA model it must satisfy a condition called the positive isotonicity constraint, which means that all the input variables within the model must be positively correlated with the stipulated outputs. For this reason to include a FSM variable in a DEA model we must convert it so it captures the proportion of pupils who are **not** eligible for FSM and hence is positively correlated with the attainment output variable.

Also included within our initial modelling work were variables capturing the proportion of pupils that are not special education needs (SEN) and are not statemented, and the proportion of pupils who are not SEN and statemented. Whether a pupil is statemented or not is dependent on how severe there special need is deemed to be, with those pupils who are statemented being deemed the most in need.

Based on the decisions detailed above some initial regression modelling was performed to analyse the relationships that exist between uncapped value added

GCSE scores and the different inputs that we wish to include. The results are given in table 4.

TABLE 4

Results of the regression analysis

GCSE VA Uncapped	Coefficient	Std. Error	t-stat	P>t
Number of fte Teachers pp	-0.02884	0.02093	-1.38	0.169
Number of fte Learning Support Staff pp	0.032397	0.022015	1.47	0.141
Number of fte admin & clerical staff pp	0.011298	0.03708	0.3	0.761
% Not Eligible for FSM	0.03954*	0.011171	3.54	0
% Not SEN with Statements	0.150267*	0.06858	2.19	0.029
% Not SEN without statements	0.039374*	0.015691	2.51	0.012
% Not English as Additional Language	-0.09351*	0.007373	-12.68	0
Expenditure on Learning Resources	0.005583*	0.001159	4.82	0
Constant	86.94882*	7.273067	11.95	0

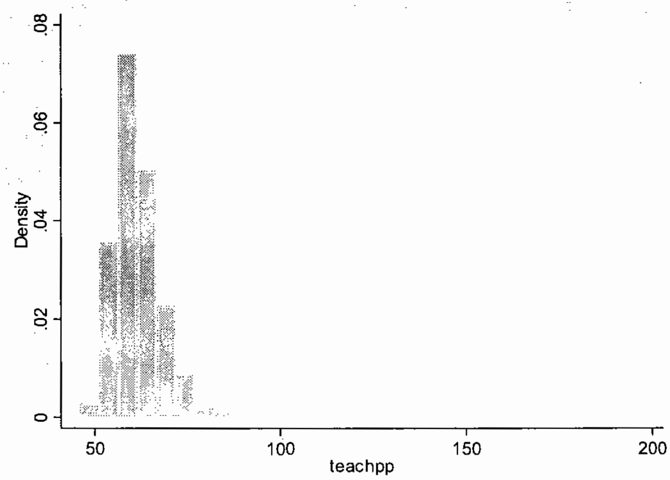
* Indicates significant at the 5 percent level

A surprising result of table 4 is that the number of full time equivalent (fte) teachers per pupil and the number of fte learning support staff per pupil do not appear to have a statistically significant effect on pupils subsequent value added attainment at GSCE.

In terms of the number of teachers this can be explained to some extent by the relatively similar way that schools do structure themselves in terms of teacher to pupil ratios, which results in little variation between schools in this variable. This is shown in the histogram (figure 6) below.

FIGURE 6

Distribution of the number of teachers per pupil



This graph shows the number of full time equivalent teachers per pupil multiplied by 1000, to make the numbers more manageable. One can clearly see that most schools opt to resource themselves such as their teachers to pupil ratios are very similar to all other schools. This is likely to be a result of previous Departmental guidance to schools aiming to ensure that class sizes did not exceed certain limits.

Rather less surprising is the finding that the number of FTE administrative and clerical staff does not have a statistically significant impact on pupils' attainment. This could be expected as such staff have no direct contact with the children and hence are less likely to directly influence their subsequent attainment levels. All the contextual variables are statistically significant at the 5 percent level and have the expected sign. One result that at first appears surprising is the negative coefficient on pupils who do not have English as an additional language (EAL). What this means is that having English as an additional language is actually associated with better value added attainment results at GCSE. This finding is however consistent with other research which has found that initially those with EAL do worse than their peers, however later in their school life there value added attainment scores improve to the extent that they overtake their English speaking peers.[2]

This does make intuitive sense as early in their school days, those who have EAL are likely to be constrained by the language barrier, however once grasped and overcome they go on to make larger gains than their peers with English as their first language.

This does however have quite a serious connotation for the DEA models as all input variables must be positively associated with the outputs. Therefore in the final model this variable should be inverted again to represent the proportion of pupils that have EAL.

Another interesting finding discovered whist conducting some of the initial modelling work is that if you omit expenditure on learning resources from the model, then the number of learning support staff per pupil become significant, as shown in table 5, but when you put this variable back in as table 4 shows the effect of the number of learning support staff per pupil becomes insignificant.

To investigate this a little further an interaction term was generated and included within the model and the results are presented in Table 6.

The table shows that the interaction term itself is not significant however its inclusion does have the effect of making the learning and support staff per pupil variable significant at the five percent level. The combination of these results infers that the number of learning support staff and the amount spent on learning resources are highly correlated, however it is not that these variables are

[2] Statistics of Education, Pupil Progress by Pupil Characteristics. ONS

TABLE 5

Results of regression analysis without expenditure as independent variable

GCSE VA Uncapped	Coefficient	Std. Error	t-stat	P>t
Number of fte Teachers pp	0.003287	0.020017	0.16	0.87
Number of fte Learning Support Staff pp	0.049905*	0.021907	2.28	0.023
Number of fte admin & clerical staff pp	0.029617	0.037213	0.8	0.426
% Not Eligible for FSM	0.031793*	0.011153	2.85	0.004
% Not SEN with Statements	0.172323*	0.069037	2.5	0.013
% Not SEN without statements	0.041247*	0.015826	2.61	0.009
% Not English as Additional Language	-0.09201*	0.007432	-12.38	0
Constant	84.03622*	7.312461	11.49	0

*Indicates significant at the 5 percent level.

TABLE 6

Results of regression analysis with interaction term between expenditure and support staff

GCSE VA Uncapped	Coefficient	Std. Error	t-stat	P>t
Number of fte Teachers pp	-0.00959	0.023851	-0.4	0.688
Number of fte Learning Support Staff pp	0.050457*	0.024488	2.06	0.04
Number of fte admin & clerical staff pp	0.011194	0.037053	0.3	0.763
% Not Eligible for FSM	0.043266*	0.011381	3.8	0
% Not SEN with Statements	0.160642*	0.068808	2.33	0.02
% Not SEN without statements	0.043547*	0.015875	2.74	0.006
% Not English as Additional Language	-0.09232*	0.007402	-12.47	0
Expenditure on Learning Resources	0.007565*	0.001654	4.57	0
Interaction Term: Learning support staff * Exp. on Learning Resources	-6.1E-05	3.64E-05	-1.68	0.093
Constant	83.50342*	7.551982	11.06	0

*Indicates significant at the 5 percent level.

complimentary rather it would appear to be the case that they are substitutes for one another.

The final specification for the chosen model is presented in table 7.

4. RESULTS

4.1. DEA assessment

Table 8 presents the results obtained from using an output orientated VRS model and running separate models for both schools with sixth forms and those without using 2003-04 data.

Table 8 shows that the average efficiency and minimum and maximum efficiency levels for schools with and without sixth forms are very similar, centred around 91 percent efficient.

TABLE 7

DEA model specification

Output
GCSE Value Added Uncapped
Inputs
Number of Teachers Per Pupil
Number of Learning Support Staff per pupil
Number of Administrative and Clerical Staff per pupil
Expenditure on Learning Resources and ICT Learning Resources per pupil
Proportion of Pupils **not** eligible for Free School Meals
Proportion of Pupils **not** Special Educational Needs without Statements
Proportions of Pupils **not** Special Educational Needs with Statements
Proportion of Pupils with English as an Additional Language

TABLE 8

Results of the DEA assessment

School Type	Number of Schools	Average Efficiency	Minimum	Maximum
With Sixth Forms	1676	90.8%	76.4%	100%
Without Sixth Form	1254	91.1%	76.1%	100%

One must remember however that these are relative efficiencies so just because the average efficiencies are similar this does not directly imply that the two different types of schools share the same average absolute efficiency rather they just exhibit a similar distribution of efficiencies around the most effective school boundary.

4.2. Implications of the Results

As these measures cover nearly all secondary schools they can be used as a tool for identifying where the most efficient practice currently exists within the sector. In order to be confident that we are identifying schools that are truly efficient we adopted 2 selection criteria.

Firstly attention was focussed only on those schools that lay on the efficient boundary so only schools that were identified as being relatively efficient by the techniques were selected for further analysis.

This sample was then further reduced to focus on just those schools that acted as efficient peers to 100 or more less-effective schools. This additional selection criteria was included to ensure that the final sample of identified schools were relatively efficient and also faced similar resource constraints and contextual challenges to lots of other schools in the sector. By doing this it also removes the danger that we are just identifying schools as being efficient solely because they use a unique bundle of inputs.

After applying these two criteria a final sample of 38 relatively effective schools were identified. Other performance indicators for these schools were then analysed to add further reassurance that they were indeed efficient.

A project was then commissioned to visit a selection of these effective schools. This was necessary as the measurement techniques can only act as a signpost as to where the most efficient practice currently exists. What it cannot do is provide information on how the school is acting efficiently. What process, practices and procedures are being employed at the school level to make it appear efficient via our methods.

To gather this kind of information it is necessary to compliment the quantitative analysis with more qualitative research, conducting structured interviews with key members of the efficient school staff.

The qualitative analysis had the dual aim of firstly validating whether the schools that the models had identified as efficient were indeed truly efficient in the researchers opinions and secondly based on the premise that the first aim was met, to identify the best practice that these efficient schools exhibit to allow the Department to attempt to disseminate the practice wider around the sector and hence improve all schools efficiencies.

4.3. Research Findings

The research project[3] concluded that the schools identified by the models as efficient were indeed so. This provides further evidence that the Departments efficiency models are robust and hence are producing sensible results.

Because only schools on the boundary of the production possibility set were chosen to be included in the final sample they all necessarily faced different resource constraints and different contextual challenges. Therefore it was no surprise that the researchers found "no single path to efficiency", that is that the efficient schools given their differing circumstances followed different approaches to deal with them.

However having said that the sample of efficient schools shared many common characteristics and these are detailed in table 9.

[3] "Investigating the Effective Use of Resources in Secondary Schools", DfES Research Report 779, 2006.

TABLE 9

Characteristics of efficiency schools

Characteristic	Definition
Strong, positive Ethos	Founded on principle that a school is a place to learn and achieve. Parents, pupils and staff all share the common objective of maximising learning and achievement.
Strong Leadership	Personalised in the head teacher but extending throughout the senior leadership team. Most common characteristic is the unwillingness to accept any limits to a pupils potential.
Rigorous and focussed use of student performance data.	Data used to set attainment targets, measure progress and devise responses to under-performance.
Culture of Accountability	Dissemination of a culture of accountability for performance to all staff, summarised as 'good teaching is about good outcomes'.
Willingness amongst staff to make additional input of time and effort	To offer pupils a range of support measures to help all pupils achieve their potential.
Inclusive Approach	Development of an inclusive curriculum to meet the needs of all pupils.
Proactive in seeking out additional funding	Proactive in seeking additional funding and also deploying such funding to improve the school.
Strong commitment to planning, use of and investment in ICT.	Strong commitment to planning evidenced by very comprehensive school improvement plans.[4]

5. CONCLUSIONS AND FUTURE DIRECTION

From this paper it can be seen that much work has already been conducted within the Department to develop reliable and accurate measures of efficiency and using these measures it has been possible for the Department to identify and conduct extra analysis on schools that are exhibiting current best practice within the sector. Schools are always asking for examples of efficient schools and this latest research work allows us to begin to point schools in the right direction.

The strength of DEA is in its ability to identify peer schools and contrast with the less efficient schools. Schools are always concerned that they are unique and therefore any form of benchmarking activity is ineffective as they have no real comparator schools. DEA overcomes this problem by automatically identifying peers for all schools.

There is now much more work to be done in terms of both developing the models and considering how the Department can best deliver the measures to schools to allow them to use them in the most constructive manner to improve their own performance.

[4] Findings from: "Investigating the Effective Use of Resources in Secondary Schools", DfES Research Report 779, 2006.

Priority work to be conducted on the model specification involves trying to bolster the outputs to capture the many wider outputs that schools are asked to produce and provide that are not necessarily directly related to attainment. With the Department placing increasing importance on the every child matters (ECM) outcomes (be healthy, stay safe, enjoys and achieve, make a positive contribution and achieve economic well being)[4] it is important that the models if possible reflect and capture this.

The second strand of work involves working closely with local authorities to investigate exactly how schools will be able to use the measures to facilitate improved benchmarking activities. The overall aim is to include the efficiency measures on the existing Schools Financial Benchmarking Website[5] so that schools can directly compare their efficiency scores against other similar schools.

5 http://www.everychildmatters.gov.uk/aims/
6 https://sfb.teachernet.gov.uk/login.aspx

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Resumo

Este artigo descreve o trabalho que tem sido desenvolvido no Department for Education and Skills em Inglaterra na construção e utilização de medidas de eficiência de todas as escolas secundárias Inglesas. O departamento tem vindo a utilizar a técnica de data envelopment analysis (DEA) para gerar estimativas de eficiência com o propósito de identificar as melhores práticas e reforçar a capacidade das escolas menos eficientes para melhorar, emulando as práticas de escolas similares que possam ser consideradas suas benchmarks.

Palavras-chave: Data Envelopment Analysis; eficiência nas escolas, aplicação de políticas.