An Analysis of the Value Added by Secondary Schools in England: Is the Value Added Indicator of Any Value? *

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Abstract

This paper argues that the value added score published for all publicly funded secondary schools in England is an unreliable indicator of school performance. A substantial proportion of the between-school variation in the value added score is accounted for by factors outside of the school's control. These factors include several pupil-related variables such as the proportion of pupils on free school meals, the authorised absence rate of pupils and the proportion of pupils from ethnic minority backgrounds. The value added score is also related to several school characteristics such as the school's admissions policy and its subject specialism. The main policy recommendation of this paper is that the value added score should not be used as a performance indicator, but should be used to gain a better understanding of why value added varies between schools.

JEL Classification numbers: H4 – Publicly-provided goods; I21 – Analysis of education; I28 - Government policy.

Key words: Value added, secondary schools, performance indicators, exam results

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I Introduction

Successive UK governments since the early 1990s have introduced a series of reforms that have led to the creation of a quasi-market in education (Le Grand, 1991; Glennerster, 1991). This quasi-market model has four main characteristics. First, parents have greater choice over which school their child attends. Second, schools are encouraged to compete for pupils and have an incentive to do so since funding is directly related to age-weighted pupil numbers. Third, the centralised model of educational finance based on local education authority control over funding has been replaced by a more decentralised approach. Schools have acquired much greater control over their budgets and how the available funds are allocated between competing uses. Fourth, schools have been encouraged to apply for specialist status, which allows them to bend their curricula in specific directions, such as languages, technology, science or sport whilst simultaneously meeting the requirements of the national curriculum. Recent policy statements make it clear that these policies are not only here to stay, but are to be reinforced. All secondary schools, for example, will ultimately have specialist status and schools are to gain even greater control over their budgets.[1]

The driving force behind this quasi-market policy is the assumption that competition for pupils will lead to improvements in educational outcomes. Good schools will be encouraged to grow while 'the worst schools will be closed or turned around' unless they can improve their performance relative to their competitors; and new academies are to be established in the most deprived areas, such as the inner cities, in order to improve educational outcomes.[2] Moreover, incentives are to be created to encourage more private sector funding of secondary education.

Since parents cannot make informed choices in the absence of information about how each school in their area is performing, a set of performance indicators is published annually in the School Performance Tables. This information is used not only by parents for finding an appropriate school for their child (supplemented by other available information such as school inspection reports) but is also used by the schools themselves in order to compare their performance with their local competitors and with their own past performance. A further user of the School Performance Tables is the government itself, which has made it clear that one of

[1] The Government's intention to reinforce the quasi-market was announced by the Secretary of State for Education on 4 July 2004.

the ways in which it intends to raise the quality of education is through setting targets for test and exam results (*Schools Achieving Success*, D*f*ES, 2001). Schools that fail to meet these targets can then be identified and appropriate action taken either by the school itself or by the school's local education authority, which has the responsibility for educational provision in their area of jurisdiction. In cases of persistent failure, the D*f*ES may intervene, perhaps closing a school or even contracting out the running of the school to the private sector.

The raw exam results, however, have serious weaknesses when used to measure school performance (Goldstein and Speigelhalter, 1996; Meyer, 1997; Wilson, 2003). The most serious weakness is that they fail to take into account prior attainment (Goldstein and Thomas, 1996). A new value added indicator was consequently published in 2002 based not on the raw exam results but on estimates of the additional knowledge gained during specific periods of schooling.

This paper challenges the view that the measure of value added published for state-maintained secondary schools in England is a reliable indicator of school performance. We argue that a substantial proportion of the variation in the value added score between schools is explained by factors outside of the school's control. Value added may therefore be a useful measure of the additional knowledge acquired by a school's pupils but may nevertheless be a poor indicator of the school's performance. Even though the value added measure may be unreliable as a performance indicator, however, we argue that it does have considerable secondary value since it permits investigation of the factors that determine the variation in value added between schools. These results have implications for education policy since they offer a more precise indication of where policy measures need to be focused in order to increase the value added to pupils.

The rest of this paper is organised as follows. Section 2 discusses the various published measures of school performance. Section 3 specifies a model of exam performance and identifies the variables likely to influence the educational attainment of a school's pupils. Section 4 describes the data and variables used in the statistical analysis of value added to pupils during secondary schooling. The results of this analysis are discussed in section 5 and section 7 concludes.

II. The measurement of school performance

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[2] See 'Excellence and Choice for All in Every Community', Department for Education and Skills, 4 July 2004.

The performance of secondary schools in England has been measured in various ways since the School Performance Tables were first published in 1992. National tests are taken by pupils in all state-maintained (publicly funded) schools at ages 7, 11, 14 and at the end of compulsory education at 16. (These ages refer to the age attained by pupils before the end of the relevant school year.) Although the primary purpose of these tests is to provide information about the academic performance of individual pupils, they are also used to construct performance indicators at school level.

Since 1992, the government has published School Performance Tables for all maintained secondary schools in England based on the GCSE[3] exams at 16. The proportion of pupils obtaining five or more GCSEs at grades A* to C is published for each school so that the exam performance of schools can be compared. Since 2000, this information has been supplemented by the average GCSE points score of each school's pupils. (The points allocated range from 1 for a G grade to 8 for an A* grade.) In practice, these two indicators of school performance in the GCSE exams are very highly correlated (e.g. R = 0.97 for 2003).

Although the raw exam scores may be useful for identifying those schools with poor exam results, they are fundamentally flawed as a performance indicator. The major weakness of using raw test scores to measure a school's performance is that they fail to allow for differences in the prior attainment of pupils. Schools that have an intake of high ability pupils can be expected to get higher exam scores than schools that have an intake of low ability pupils. There is a very high correlation, for example, between exam scores at Key Stage 2 (at the end of primary school) and Key Stage 4 (at the end of compulsory education). Figure 1 shows that 87% of the variation between schools in exam scores at Key Stage 4 can be 'explained' by the educational attainment achieved by pupils even before they entered secondary school. A school's exam score at Key Stage 4 is therefore predetermined to a very large extent by the initial attainment of pupils.

In other words, the raw test and exam scores tell us more about the prior academic ability of a school's pupils than about the performance of schools *per se*. There is therefore no justification for publishing these raw scores in the annual Performance Tables since they provide little, if any, information about a school's performance. Moreover, they may provide

[3] This is the General Certificate of Secondary Education, which is a set of subject-based exams taken by the majority of pupils at the end of compulsory education in Year 11 (at age 15/16). Some pupils also take the General National Vocational Qualification exams.

misleading information if they are used to indicate *changes* in a school's performance over time, since changes in exam performance may result from changes in the characteristics of the relevant pupil cohort and may be unrelated to how a school itself is performing. If a school can attract pupils with a higher level of prior attainment, it is very likely to improve its *exam results* but this does not mean that it has improved its *exam performance*.

The raw (unadjusted) exam score therefore measures the exam performance of *pupils* and not the performance of the *school* attended. This would not be a serious problem if it did not have potentially harmful consequences for schools achieving poor exam results. But as Ladd (2001) points out, schools with poor exam results get labelled as 'failing' schools even though they may be performing well given the prior attainment of their pupils. 'Failing' schools become unpopular, leading to a declining school roll and a subsequent loss of staff. Since the best teachers are likely to be the most mobile, this could lead to a downward spiral for unpopular schools. One of the possible consequences is the polarisation of pupils due to 'cream-skimming' by the most popular schools (Bradley and Taylor, 2002).

Recognition of the problems inherent in the raw exam score led the UK government to introduce value added indicators in 2002 for all state-maintained secondary schools in England ten years after the School Performance Tables were first published. A value added indicator has therefore been constructed by first calculating a pupil's *expected* exam score at the end of (say) Key Stage 3. This expected score is based on the pupil's *actual* score at the end of Key Stage 2. The difference between the actual score and the expected score is then assumed to measure the value added to each pupil's knowledge during Key Stage 3. The same procedure is used to calculate each pupil's value added score during Key Stage 4. Summing these calculations over all pupils in the relevant cohort provides a measure of value added to each school's cohort of pupils during each of the Key Stages (see Department for Education and Skills, *Value Added*, Technical Annex, 2001, for further details).

A comparison of the raw GCSE score (at the end of Key Stage 4) with the value added between Key Stages 3 and 4 clearly shows that these two measures provide different information about a school's performance (see Figure 2). Although there is a significant positive correlation between these two indicators across schools, the correlation is relatively low ($R = 0.46$). Schools achieving a high GCSE score at Key Stage 4, for example, do not necessarily achieve a high value added score; and schools achieving a low GCSE score at Key Stage 4 do not necessarily achieve a low value added score. Figure 2 also shows that schools selecting their pupils according to their academic ability (i.e. grammar schools) have a substantially lower value added score than could be expected from their GCSE score. [4]

Although the value added score has the merit that it takes prior attainment explicitly into account in its measurement, this does not mean that the published value added score is necessarily an efficient measure of a school's performance. The rationale behind the value added measure is that schools have far more influence over the *accumulation* of a pupil's knowledge over time than on the *stock* of a pupil's knowledge at any given point in time. By taking into account prior attainment, the value added indicator should in principle be a more reliable measure of a school's performance than the raw exam score. Indeed, it would be surprising if this were not the case given the inadequacy of the raw exam score as a performance indicator.

But there is a major problem in using the value added indicator to measure a school's performance. Specifically, it cannot be assumed that the knowledge gained by pupils during any of the Key Stages is due *solely* to the contribution of the school (Meyer, 1997; Ladd and Walsh, 2002). The published value added indicator should therefore be treated with considerable caution and suggests the need to investigate the extent to which factors outside of the school's control affect the value added of its pupils. Furthermore, it may be possible to construct policies that lead to an increase in value added if the major determinants can be found. Such an exercise could be particularly useful for improving the performance of schools with persistently low value added scores. The next section attempts to identify the variables that are likely to determine the value added to a school's pupils during their time at school.

3. Modelling value added

Educational output is multi-dimensional. It includes not only educational attainment but also the personal development of pupils and the inculcation of social and cultural values. We focus here, however, on estimating the potential determinants of the gains to knowledge as measured by the value added indicator discussed in section 2 above.

One approach to estimating the determinants of the value added to a school's pupils derives its rationale from production function theory. Following the seminal work of Hanushek (1979) and Hanushek and Taylor (1990), education can be treated as a production process in

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[4] The correlation coefficient increases marginally to 0.53 when selective schools are omitted.

which an individual's educational attainment is determined by their personal characteristics, family background and school inputs. Individual pupils have different levels of innate ability, different family backgrounds and receive different amounts and types of school inputs depending on the school they attend. Following Hanushek (1992), we can express the school's education production function as a linear model:

$$A_{i,t} = \alpha A_{i,t-1} + \mathbf{S}_{i,t}\boldsymbol{\beta} + \mathbf{P}_{i,t}\boldsymbol{\gamma} + \varepsilon_{i,t} \qquad (i = \text{school}) \qquad (1)$$

where $A_{i,t}$ is the level of educational attainment of a school's pupils at the end of a given period of schooling (t), $A_{i,t-1}$ is prior attainment, $\mathbf{S}_{i,t}$ are school-related factors and $\mathbf{P}_{i,t}$ are pupil-related factors (including family background) that determine educational attainment during period t. α, $\boldsymbol{\beta}$ and $\boldsymbol{\gamma}$ are parameters to be estimated and $\varepsilon_{i,t}$ is an error term.

The basic rationale for this formulation of the school's production function is that educational attainment is a cumulative process in which pupils gain knowledge over time. The inclusion of the previous level of attainment is therefore intended to capture the effects on the current level of knowledge of all historical inputs, including inherited endowments such as innate ability as well as family background and schooling. Subtracting prior attainment from both sides of equation (1), we obtain the value added formulation of the school's production function:

$$A_{i,t} - A_{i,t-1} = (\alpha - 1)\, A_{i,t-1} + \mathbf{S}_{i,t}\boldsymbol{\beta} + \mathbf{P}_{i,t}\boldsymbol{\gamma} + \varepsilon_{i,t}. \qquad (2)$$

The crucial feature of this value added formulation of the educational production function is that it focuses on the factors influencing the *gain* in knowledge during a specified time period.[5]

What factors are likely to influence the extent to which a school's pupils acquire knowledge during specific Key Stages? A large number of studies, particularly in the USA, have attempted to estimate the determinants of educational attainment. These studies range from analyses of longitudinal datasets based on large representative samples of individuals (e.g. High School and Beyond; and the National Educational Longitudinal Study) to those based on

[5] Todd and Wolpin (2002) warn that the estimated coefficients from regression equations based on this model (and similar models based on the educational attainment production function) need to be interpreted with great caution due to estimation problems arising from missing explanatory variables.

school level data (see Haveman and Wolfe (1995) for a review of earlier US studies.) Following the seminal work of Coleman (1966) in the USA, the most predominant finding from this research has been that an individual's family background is the primary influence on educational outcomes. Similar findings have been obtained from analyses of UK datasets, such as the Birth Cohort Study, the National Child Development Study and the Youth Cohort Study (Dolton and Vignoles, 1996; Dolton *et al.*1999; Dolton and Vignoles, 1999; Feinstein and Symons, 1999; Vignoles *et al*., 2000; Robertson and Symons, 2003; Bradley and Taylor, 2004).

Estimating the influence of the schools themselves on educational outcomes has not proved to be an easy task, both because of methodological shortcomings and because of a lack of appropriate data (Meyer, 1997; Ladd, 2001; Hanushek, 2004). Several school level analyses in the UK, however, have shown that school-related factors have had an impact on the exam performance of schools (Bradley *et al*., 2000; Bradley and Taylor, 1998, 2004). Schools can be classified, for example, by their admissions policies, their curriculum (subject to the conditions imposed by the National Curriculum[6]) and by the socio-economic mix of their pupils. Previous research has suggested that at least some of these factors have a role to play in determining the performance of a school's pupils in national tests and exams. However, the evidence that school-related factors (such as class size, pupil 'streaming' and expenditure per pupil) affect educational outcomes is considerably more controversial (Hanushek, 2003; Krueger, 2003) and there is still no consensus on the extent to which school inputs per pupil determine educational outcomes.

We argued earlier that a distinction needs to be made between the total value added to pupils and that part of the value added attributable to the schooling process. We therefore need to identify the determinants of the value added to pupils so that the influence of the school itself can be ascertained. An advantage of the production function approach to explaining why value added varies between schools is that it explicitly allows for the influence of school-related and pupil-related factors on value added to be estimated separately. In principle, this should provide a useful basis for estimating the specific influence of the school itself on its value added score. But this assumes that the factors identified as being school-related are under the school's control. This may not, however, be the case.

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[6] The National Curriculum is determined by the Department for Education and Skills following guidance provided by the Qualification and Curriculum Authority..

Schools can be categorised, for example, by their admissions policy. If those schools with a religious affiliation attract pupils whose parents are more committed to providing parental support to their child's education, this particular school-related factor will reflect the influence of family background rather than the influence of the school itself. Similarly, schools adopting a subject specialism may attract pupils from families with a higher level of commitment to their child's education than is the case for pupils attending schools with no subject specialism. A further example is that individual schools may have little direct influence over their pupil / teacher ratio. To the extent that these school-related factors are outside of the school's control, this should be taken into account in devising a performance indicator based on value added.

4. Data and variables

The dependent variable in the following statistical analysis is the value added score calculated for each maintained secondary school in England by the Department for Education and Skills and published annually in the School Performance Tables. ('Special schools' which admit only pupils with special educational needs are excluded from the analysis.) The dependent variable is expressed as a standard normal variable in order to make it easier to interpret the estimated impact of the individual explanatory variables. The explanatory variables were obtained from two sources. Information relating to the school itself as well as information about each school's pupils was obtained from the annual Schools' Census (Form 7); and data on teaching quality was obtained from OFSTED school inspection reports.

The explanatory variables divide into two broad groups (see Table 1): first, those that measure the characteristics of the school (referred to henceforth as *school-related* variables); and second, those that measure characteristics of the pupils and their families (*pupil-related* variables).

Schools can be categorised according to several characteristics. First, they are distinguished by their admissions policies. For example, schools may select pupils according to their religious affiliation (voluntary-aided or voluntary-controlled), their gender (boys-only or girls-only) and their academic ability (grammar schools and modern schools). A further aspect of school selection (by parents, pupils and schools) is the rapid expansion in the number of schools specialising in particular subject areas, a policy introduced in 1994.[7] In 2003, 45% of all state-maintained secondary schools had a subject specialism. This had risen to over 60% by 2004 and all secondary schools are expected to have a subject specialism by the end of the decade.

The second group of school-related variables is concerned with their operational characteristics (obtained from the annual Schools' Census). First, schools are distinguished according to whether or not they teach beyond the compulsory school leaving age of 16 (i.e. up to 18). This may affect a school's value added score in so far as the school's teaching staff will normally have higher qualifications if they teach up to A-level. The school may also have a different set of priorities and targets if they teach up to A-level. Second, the pupil-teacher ratio is included as a proxy for class size, which is expected to be negatively related to a school's value added score since smaller classes should mean more teaching inputs per pupil. Third, the ratio of part-time to full-time staff is included since it indicates the extent to which a school's managers can acquire extra teaching resources if needed. This variable may also indicate the extent of a school's willingness to be flexible in its hiring policies. Fourth, school size (and its squared value) is included in the model since earlier studies have indicated a non-linear (inverted-U) relationship between school size and exam results at the end of compulsory education.[8]

A school input that has so far proved to be elusive in empirical analyses of school outcomes is the quality of teaching. Although some previous US studies have investigated the relationship between the qualifications of teachers and educational outcomes, data measuring the quality of the teaching rather than the academic achievements of teachers has proved to be difficult to obtain. An estimate of the quality of teaching in each secondary school in England can be obtained, however, from school inspections undertaken by the Office for Standards in Education (OFSTED). One of the published quantitative variables from these inspections is the proportion of teaching rated as 'very good'. Since these judgments about teaching quality are made by independent and experienced inspectors, this variable can be regarded as being

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[7] See Levacic and Jenkins (2004) for a detailed statistical investigation into the impact of subject specialism on GCSE results.

[8] Several additional school-related variables were found to be statistically insignificant in all equations. These included the % of pupils with English as a second language, the support staff / pupil ratio and the % of pupils eligible for free school meals in the district (to reflect neighbourhood effects).

exogenous. In addition, lagged values of the teaching quality variable are used since inspections normally take place only once every five years.[9]

The pupil-related explanatory variables measure some potentially important characteristics of each school's pupils and their families. First, the proportion of pupils eligible for free school meals is included as an explanatory variable since the rate at which knowledge is accumulated may be determined in part by the family resources devoted to a child's education (including parental time as well as financial resources). Second, the proportion of a school's pupils with special educational needs is included since special needs pupils may learn at a slower rate than other pupils. Third, since cultural differences between pupils from different ethnic backgrounds may affect attitudes towards schooling, the proportion of pupils in each of five ethnic groups is included as an explanatory variable (Black, Bangladeshi, Indian, Pakistani and other ethnic groups). It may be the case that some ethnic minority pupils are held back by language or other difficulties at primary school and then catch up in later years. Their initial attainment score may therefore underestimate their true ability relative to whites.[10] Fourth, previous research has indicated that changing school in mid-stream can have a detrimental effect on pupil outcomes. The proportion of a school's pupils that joined a school 'late' is consequently included as an explanatory variable. Finally, since non-attendance at school due to illness is likely to have a detrimental effect on learning, the authorised absence rate (assumed to be exogenous since authorised absence is likely to be a consequence predominantly of illness) is included as an explanatory variable.

5. Empirical analysis

This section presents the results of an empirical analysis of the exam performance of secondary schools in England during 2003 based on the value added model specified in equation (2) above.

The statistical analysis divides into three parts. The first part investigates the determinants of value added over the entire period of secondary schooling. The dependent variable in this case is the value added between the end of primary school (Key Stage 2) and the end of compulsory education at age 16 (Key Stage 4). This part of the statistical analysis also

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[9] We assume that teaching quality is likely to remain reasonably stable over the medium term. The length of the lag, however, is likely to result in measurement error.

[10] Key Stage 2 scores in 2003 in maths, for example, were considerably lower for Black Caribbeans (50.1), Other Blacks (51.6), Bangladeshis (49.7) and Pakistanis (48.2) than for Whites (58.9). Source: National Pupil Database, Department for Education and Skills.

investigates how much of the variation in value added between schools can be accounted for by school-related factors alone compared to pupil-related factors alone. The second part of the statistical analysis splits the value added into two components: (i) value added during Key Stage 3; and (ii) value added during Key Stage 4. Since the correlation between value added at these two Key Stages is very low (R = 0.26, see Figure 3), this means that individual schools can perform well at one Key Stage and poorly at another. It is therefore useful to investigate the possibility that the impact of individual variables on value added differs between Key Stages. The third part of the statistical analysis reports the results of estimating a quantile regression model, following earlier work by Eide and Showalter (1998). Whereas OLS provides estimates of the relationship only at the conditional mean of the value added score, quantile regression allows us to investigate possible differences in the explanatory power of the determinants of value added across the entire conditional distribution.

The results in Table 2, in which the dependent variable is value added during Key Stages 3 and 4, show that the majority of school-related and pupil-related variables are statistically significant. An interesting finding for the school-related variables is that schools with a subject specialism are estimated to have a higher value added score than those without. The estimated coefficients are highly significantly positive for most of the school specialism variables, though the estimated effect on value added varies between specialisms. Specialising in technology or science, for example, is associated with a higher value added score than for other specialisms such as the arts. The estimated coefficients indicate that schools specialising in science or technology have a value added score that is one third of a standard deviation greater than the value added score for non-specialist schools (see Table 2).

The other main findings for the school-related variables are as follows. First, the estimated coefficient on selective (grammar) schools is not significantly different from zero, which implies that these schools do not offer any significant advantage over other schools as far as value added is concerned. (We return to this below.) Second, girls-only schools have higher value added scores than mixed schools. The opposite result is obtained for boys-only schools, which had substantially lower value added than mixed schools. Third, the estimated impact of teaching quality is positive and statistically significant but its estimated impact is relatively weak. An increase of one standard deviation in the teaching quality variable, for example, is associated with a 0.1 standard deviation increase in value added. The relatively weak effect of the teaching quality indicator may be a consequence of measurement error since teaching quality is only assessed intermittently (at approximately five-yearly intervals). The only other finding of note is that the ratio of part-time to full-time staff is positively associated with an increase in value added, which suggests that access to part-time staff is helpful to schools.

We turn now to pupil-related factors, several of which are highly significantly related to value added. Both the proportion of pupils eligible for free school meals and the authorised absence rate have highly significant negative coefficients. An increase in the percentage of pupils eligible for free school meals by 10 percentage points, for example, is associated with a reduction of 0.24 standard deviations in the value added score. Value added is also positively related to the proportion of ethnic minority pupils in a school. The estimated coefficients on the ethnic minority variables are highly statistically significant and are positive in all cases.

Since a primary purpose of this paper is to investigate the separate effects on value added of school-related and pupil-related factors, two parsimonious equations have been estimated that allow us to compare the explanatory power of the school-related and the pupil-related variables separately. The R^2 for the equation containing only school-related variables is 0.23 compared to 0.40 for the full model. By contrast, the inclusion in the model of only pupil-related variables results in an R^2 of 0.34. These two equations indicate that school-level variables add considerably less to the explanatory power of the regression model than pupil-level variables.

Earlier in this paper, we pointed out that the correlation between value added during Key Stages 3 and 4 was extremely low (R = 0.26), which suggests that the factors determining value added may have a different impact at different Key Stages. With this in mind, regression equations have been estimated separately for Key Stages 3 and 4 in order to investigate whether the impact of the explanatory variables does indeed vary between these two Key Stages. The results are given in Table 3.

The results in Table 3 indicate that there are several substantial differences in the impact of individual variables on value added during Key Stage 3 compared to Key Stage 4. The estimated impact of selective (i.e. grammar) schools on value added, for example, is estimated to be significantly positive at Key Stage 3 but (surprisingly) negative at Key Stage 4. These estimated coefficients suggest that selective schools are able to add considerable value to their pupils during their first three years of secondary schooling but consequently find that they cannot repeat this success during Key Stage 4. Indeed, the opposite is the case: selective schools do worse than comprehensives during Key Stage 4. This curious result is probably a consequence of the way in which value added is measured. Schools that achieve very high test scores at the end of Key Stage 3 may find it impossible to achieve a high value added score during Key Stage 4.

A further result of interest is that value added is significantly higher in girls-only schools than in mixed schools at both Key Stages 3 and 4, whereas value added in boys-only schools is significantly lower than in mixed schools at Key Stage 4. Separating girls from boys therefore appears to help girls to perform better but the opposite result is obtained for boys. Apparently, boys need girls more than girls need boys.

We earlier discovered that having a subject specialism is associated with a higher value added score. The only variation on this finding (see Table 3) is that the estimated impact of subject specialisation on value added is greater at Key Stage 4 than at Key Stage 3. The estimated impact of subject specialisation on value added therefore increases over the course of secondary schooling.

The results obtained for the pupil-related variables indicate a much stronger negative relationship between value added and the proportion of pupils eligible for free school meals at Key Stage 3 than at Key Stage 4. This suggests that the negative impact of poverty on value added is much greater during the first period of secondary education than during the second period. Table 3 also shows that ethnic minority pupils gain ground relative to white pupils and more so during the last two years of secondary education. This supports the view that any earlier disadvantages suffered by ethnic minority pupils are gradually eroded as they proceed through the education system.

The quantile regression estimates reported in Table 4 allow us to investigate the estimated relationship between value added and the explanatory variables over the conditional distribution of value added. The aim is to discover whether, and the extent to which, the impact of a variable varies over the conditional distribution of the value added score. Does the estimated impact of the explanatory variables differ, for example, between low and high value added schools? We focus here on just two explanatory variables: the quality of teaching and the proportion of pupils eligible for free school meals.

A result of particular interest is that the estimated (negative) impact of the proportion of pupils on free school meals on value added decreases substantially as we move up the value added distribution. The difference between the estimated coefficients at the 10th and 90th percentiles, for example, is highly statistically significant and indicates that the magnitude of the negative impact of this variable is less than half at the top end of the value added distribution than at the bottom end. A further result of interest is that the quality of teaching has a stronger positive impact on value added at the bottom end of the value added distribution than at the top end. This implies that more able pupils benefit less from high quality teaching than do less able pupils.

6. Conclusion

The purpose of this paper has been to examine the potential usefulness of the value added performance indicator published annually in the School Performance Tables. To be a useful indicator of a school's performance, the value added score would have to reflect the influence of the school itself on value added rather than the influence of factors outside of its control. Our main conclusion is that a substantial proportion of the variation between schools in their value added scores is accounted for by factors outside of the school's control. Using regression analysis, we find that several pupil-related factors (such as the proportion of pupils on free school meals, the authorised absence rate of pupils and the proportion of pupils from ethnic minority backgrounds) contribute substantially to 'explaining' the observed differences in value added between schools. Since schools have little control over many factors that are likely to affect their value added score, this implies that value added is an unreliable indicator of a school's performance.

Although we have argued that the value added score is not a useful performance indicator *per se*, this does not mean that it has no value. Specifically, it is important to know why value added varies between schools so that appropriate action can be taken to increase the value added to pupils in those schools where it is low. In view of this, we have estimated several regression models with the aim of identifying the factors that cause value added to vary between schools. Our main findings are as follows.

1. Specialising in particular subject areas such as science, technology or languages is associated with a higher value added score. What we do not know, however, is whether and the extent to which schools specialising in specific subject areas would have achieved higher value added scores even if they had not opted for specialist status. This requires further study.

2. The proportion of pupils eligible for free school meals is found to be strongly negatively related to a school's value added score, especially during Key Stage 3. This implies that pupils from poorer families are at a serious disadvantage compared to their better-off peers. Further analysis (using quantile regression techniques) indicates that this disadvantage is considerably more severe at the bottom end of the value added distribution than at the top end. Poverty reduction programmes may therefore be an important way of increasing value added, especially in schools with a large proportion of pupils from poor families.

3. A strong negative relationship is found between a school's value added score and its authorised absence rate. The variation in authorised absence between schools is substantial and this may be a fruitful area for policy intervention in order to increase value added. It should be noted that authorised absence (mean = 7.3% in terms of half-days lost) is far more serious in terms of non-attendance than unauthorised absence (mean = 1.2%).

4. The main policy recommendation of this paper is that the value added score should not be treated as a rod with which to beat 'under-performing' schools, but should rather be seen as an opportunity for gaining a better understanding of the determinants of educational attainment. There is clearly a lot that can be done to improve educational outcomes in schools with low (not necessarily 'poor') value added scores; and the statistical analysis of differences in value added between schools will help towards finding the most appropriate policy responses. This should be regarded, however, not as a one-off investigation that will 'reveal all', but rather as a continuous process of analysis and evaluation.

5. Finally, we have argued that if value added scores are to be used as performance indicators, it is essential to compare like with like. A school's actual value added score should not be compared with the mean score for all schools but with a benchmark calculated for each school separately.

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TABLE 1

Descriptive statistics, 2003

Variables	Mean	Standard deviation
School governance (%)		
Community (LEA controlled)*	63.7	
Voluntary aided / voluntary controlled	19.8	
Foundation	16.0	
City Technical College	0.5	
Selection policy (%)		
Comprehensive*	89.0	
Modern	5.8	
Selective (Grammar)	5.2	
Mixed gender*	86.9	
Boys-only	5.9	
Girls-only	7.2	
Non-conventional	1.0	
Subject specialism (%)		
Non-specialist*	54.2	
Arts	7.3	
Business studies	2.6	
Engineering	0.5	
Languages	6.0	
Maths & computing	2.5	
Sport	7.2	
Science	4.0	
Technology	15.7	
Other school characteristics		
Schools teaching up to A-level	57.9	49.4
Pupil/ teacher ratio	17.2	1.8
Teaching quality rated 'very good' (%)	18.2	9.6
Part-time / full-time teachers (x100)	14.5	8.7
Pupils on school roll	1018	341
Family background		
% pupils eligible for free meals	15.6	13.6
% pupils Afro-Caribbean	3.6	8.9
% pupils Bangladeshi	0.9	5.1
% pupils Indian	2.4	6.9
% pupils Pakistani	2.6	8.6
% pupils other ethnic origin	2.4	4.1
Pupils		
% pupils changing schools	2.9	10.4
% pupils with special needs	2.6	1.8
% authorised absence from school	7.3	1.7

Note: * indicates that a variable is included in the base group in the regression analysis. Special schools teaching only pupils with special needs are excluded from the data provided in this table.
Sources: School Performance Tables and Schools' Census (Form 7). The proportion of pupils changing schools (between Key Stages 3 and 4) was obtained from the National Pupil Database, Department for Education and Skills. The teaching quality variable was obtained from the Office for Standards in Education (OFSTED). This variable was available for the years 1996-2000 inclusive for 2046 secondary schools.

TABLE 2
Value added regressions

Explanatory variables	Dependent variable = combined value added during Key Stages 3 and 4		
Constant	1.285***	-1.105	1.288***
	(0.234)	(0.193)	(0.105)
School-related variables			
Voluntary assisted / controlled	0.085*	0.245***	
	(0.042)	(0.044)	
Foundation	0.100**	0.182***	
	(0.039)	(0.043)	
City technical college	0.789***	1.061***	
	(0.179)	(0.181)	
Modern	-0.123	-0.151*	
	(0.071)	(0.074)	
Selective (Grammar)	0.163	0.444***	
	(0.093)	(0.067)	
Boys-only	-0.352***	0.005	
	(0.067)	(0.069)	
Girls-only	0.562***	0.754***	
	(0.063)	(0.068)	
Arts	0.176**	0.231***	
	(0.056)	(0.060)	
Business	0.246**	0.345***	
	(0.088)	(0.091)	
Engineering	0.138	0.037	
	(0.133)	(0.129)	
Languages	0.254***	0.424***	
	(0.058)	(0.062)	
Maths & computing	0.277***	0.386***	
	(0.077)	(0.079)	
Sport	0.129*	0.102	
	(0.055)	(0.062)	
Science	0.357***	0.471***	
	(0.060)	(0.070)	
Technology	0.322***	0.381***	
	(0.042)	(0.047)	
11-18 school	-0.103**	-0.049	
	(0.036)	(0.040)	
Pupil/ teacher ratio	-0.022*	-0.001	
	(0.010)	(0.010)	
Proportion of teaching 'very good'	1.020***	1.598***	
	(0.189)	(0.197)	
Missing observations dummy	0.069*	0.079*	
	(0.030)	(0.034)	
Part-time / full-time teachers	0.828***	1.961***	
	(0.199)	(0.206)	
Pupils/100	-0.022	0.029	
	(0.023)	(0.025)	
Pupils/100-squared	0.001	0.000	
	(0.001)	(0.001)	
Pupil-related variables			
Initial attainment score	-0.024		0.086**
	(0.034)		(0.028)
Proportion joining school after KS3	-0.166		-0.166
	(0.289)		(0.312)
Proportion eligible for free meals	-2.434***		-2.335***
	(0.270)		(0.238)
Proportion with special needs	-1.169		-1.678
	(1.008)		(1.039)
Proportion Afro-Caribbean	1.560***		1.840***
	(0.276)		(0.275)

TABLE 2 continued

Proportion Bangladeshi	3.534***		3.583***
	(0.501)		(0.512)
Proportion Indian	0.939***		0.832***
	(0.237)		(0.249)
Proportion Pakistani	2.298***		2.495***
	(0.250)		(0.288)
Proportion other ethnic	1.829***		1.888**
	(0.546)		(0.589)
Proportion with authorised absence	-14.040***		-15.204***
	(1.298)		(1.377)
R-squared	0.40	0.23	0.33
n	2962	3051	2962

Notes: (i) The base group includes community schools, comprehensive schools, mixed gender schools, 11-16 schools and schools with no subject specialism. (ii) The initial attainment score (i.e. at the end of Key Stage 2) was calculated from the value added during Key Stage 3 and the points score at the end of Key Stage 3. (iii) The proportion of pupils changing schools is available only for those changing schools after Key Stage 3. (iv) Since 'teaching quality' is available for only two-thirds of secondary schools, the average value of this variable has been included for the missing schools and a dummy variable has been included in the regression equation which equals unity for the missing values. The results do not differ substantively from an equation estimated for those observations that do not have missing observations for teaching quality. The results for the full sample of schools (but excluding the teaching quality variable altogether) are also not substantively different from those in this Table (results available on request). (v) Special schools that teach only pupils with special needs are excluded from the analysis. (vii) * = significant at 0.05; ** = significant at 0.01; *** = significant at 0.001. Robust standard errors are in parentheses.

TABLE 3

Value added regressions for Key Stages 3 and 4 separately

Explanatory variables	Dependent variable = value added during Key Stage 3	Dependent variable = value added during Key Stage 4	Test for difference between coefficients (p-value)
Constant	1.186***	1.036***	
	(0.206)	(0.261)	
School-related variables			
Voluntary assisted / controlled	0.098**	0.087	0.706
	(0.036)	(0.045)	
Foundation	0.050	0.105*	0.278
	(0.036)	(0.042)	
City technical college	0.508***	0.816***	0.119
	(0.151)	(0.218)	
Modern	-0.117*	-0.134	0.524
	(0.055)	(0.077)	
Selective (Grammar)	1.294***	-0.345***	0.000
	(0.084)	(0.104)	
Boys-only	0.145*	-0.508***	0.000
	(0.057)	(0.072)	
Girls-only	0.378***	0.520***	0.028
	(0.052)	(0.070)	
Arts	0.050	0.193***	0.027
	(0.049)	(0.058)	
Business	-0.082	0.355***	0.000
	(0.069)	(0.095)	
Engineering	0.144	0.081	0.796
	(0.151)	(0.155)	
Languages	0.197***	0.215***	0.572
	(0.052)	(0.064)	
Maths & computing	0.188*	0.261***	0.408
	(0.085)	(0.079)	
Sport	0.099*	0.098	0.852
	(0.049)	(0.059)	
Science	0.258***	0.317***	0.350
	(0.063)	(0.066)	
Technology	0.144***	0.322***	0.000
	(0.036)	(0.045)	
11-18 school	0.005	-0.146***	0.000
	(0.031)	(0.039)	
Pupil/ teacher ratio	-0.007	-0.023*	0.058
	(0.008)	(0.010)	
Proportion of teaching 'very good'	1.071***	0.793***	0.463
	(0.166)	(0.210)	
Missing observations dummy	0.045	0.068*	0.562
	(0.027)	(0.032)	
Part-time / full-time teachers	0.771***	0.716***	0.940
	(0.169)	(0.213)	
Pupils/100	-0.027	-0.011	0.400
	(0.019)	(0.025)	
Pupils/100-squared	0.001	0.001	0.585
	(0.001)	(0.001)	
Pupil-related variables			
Initial attainment score	-0.192***	-0.026	0.340
	(0.030)	(0.040)	
Proportion joining school after KS3		-0.708***	
		(0.165)	
Proportion eligible for free meals	-4.083***	-1.078***	0.000
	(0.207)	(0.303)	

TABLE 3 continued

Proportion with special needs	-2.596**	-0.677	0.240
	(0.897)	(1.087)	
Proportion Afro-Caribbean	-0.134	1.900***	0.000
	(0.207)	(0.289)	
Proportion Bangladeshi	1.018***	3.883***	0.000
	(0.319)	(0.552)	
Proportion Indian	0.452*	0.886***	0.103
	(0.198)	(0.250)	
Proportion Pakistani	1.086***	2.261***	0.000
	(0.195)	(0.282)	
Proportion other ethnic	0.917*	1.915***	0.043
	(0.419)	(0.587)	
Proportion with authorised absence	-10.540***	-12.879***	0.013
	(1.065)	(1.439)	
R-squared	0.51	0.32	
n	2962	2984	

Note: See notes to Table 2 above. The p-values for the difference between the estimated parameters were calculated by first running a seemingly unrelated regression on the two dependent variables jointly. These jointly estimated equations were then used to test the hypothesis that the two parameters estimated for each variable are equal.

TABLE 4

Quantile regression estimates

Explanatory variables	Estimated coefficients at each quantile (standard errors)				
	0.10	0.25	0.50	0.75	0.90
Proportion of teaching 'very good'	1.54***	1.23***	0.98***	0.82***	0.69*
	(0.24)	(0.27)	(0.26)	(0.26)	(0.29)
Proportion of pupils eligible for free school meals	-3.52***	-2.96***	-2.72***	-2.07***	-1.50***
	(0.25)	(0.26)	(0.26)	(0.28)	(0.34)
Pseudo R-squared	0.27	0.26	0.23	0.22	0.21
n	2962	2962	2962	2962	2962

Note: The estimated equations at each quantile were estimated using all of the explanatory variables shown in Table 2. Only the estimated coefficients for teaching quality and the proportion of pupils on free schools meals are reported here.

Figure 1 Exam score: Key Stage 4 v. Key Stage 2

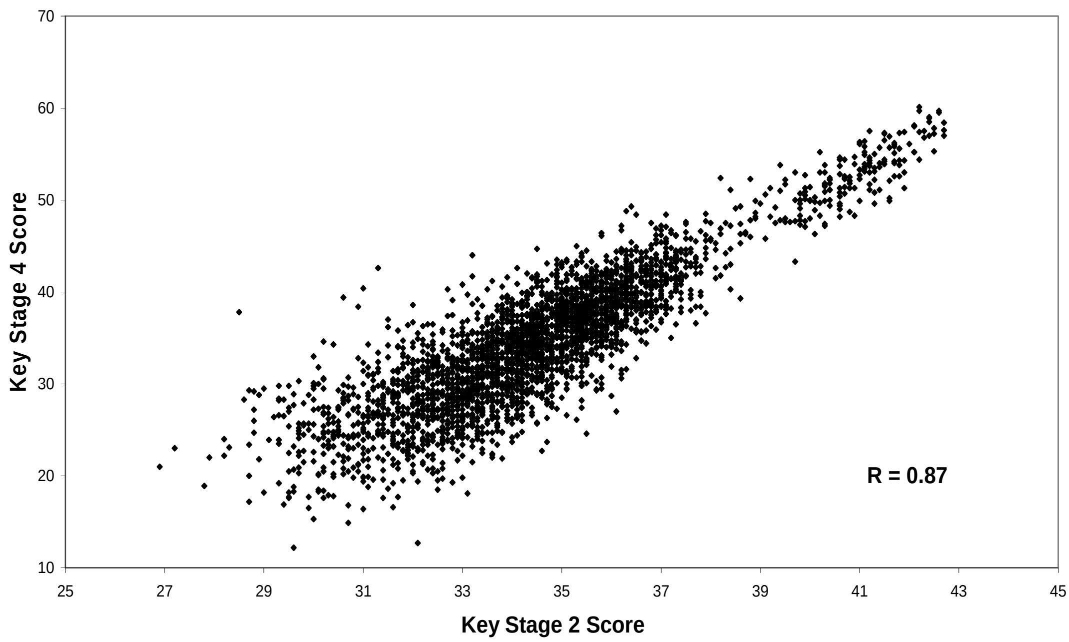

Figure 2 Value Added v. Exam Score at Key Stage 4

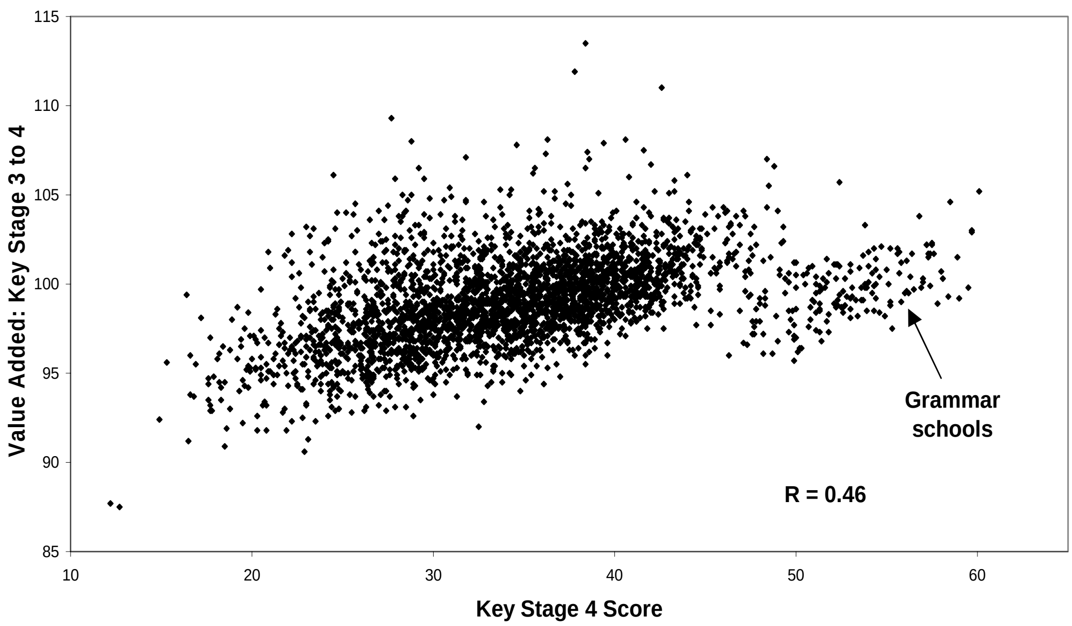

Figure 3 Value Added: Key Stage 4 v. Key Stage 3