Evaluating the Effectiveness of Specialist Schools

Rosalind Levacic

Andrew Jenkins

September 2004

Published by
Centre for the Economics of Education
London School of Economics and Political Science
Houghton Street
London WC2A 2AE

ISBN 07530 1732 6

Individual copy price: £5

The Centre for the Economics of Education is an independent research centre funded by the Department for Education and Skills. The view expressed in this work are those of the authors and do not necessarily reflect the views of the Department for Education and Skills. All errors and omissions remain the authors.

Executive Summary

Expanding the specialist school programme is a major plank in the government's strategy for improving and 'transforming' secondary schools. The distinguishing characteristic of specialist schools is that they are state schools which have successfully applied to the Department for Education and Skills (DfES) for a particular prescribed subject specialism, having raised the required private sponsorship money and submitted a development plan with agreed targets. If approved as worthy of specialist status the school receives from the DfES £100,000 in capital funding and £126 per pupil for four years – or longer if redesignated as specialist. Specialist status was introduced in 1994 by the previous government. The first specialist area was technology, followed the next year by languages. In 1997 sports and arts specialisms were introduced. The current government has added a further half dozen specialisms. By 2003 there were 1443 specialist schools out of 3173.

The government and the Specialist Schools Trust, drawing on commissioned research, present specialist status as a causal factor in school improvement. However, none of the research on specialist schools to date has used a research design that could test for causal impact of special status. Instead studies have estimated the relative effectiveness of specialist compare to non-specialist schools in any given year, finding that specialist schools in general add about 1-2 grades at GCSE. This could be explained by more effective schools having been selected to become specialist, since poorly performing schools have not been able to become specialist.

Previous studies are summarised in the paper, which then presents a more extensive analysis of the effectiveness of specialist compared to non-specialist schools for students who took GCSE/GNVQs in 2001 and for whom KS2 results in 1996 are also available. The data cover 2995 English secondary schools. A three level model (LEA, school and pupil) was estimated in MlwiN. Prior attainment, age and gender were controlled for at pupil level, as well as school type, size, presence of sixth form and composition (free school meals, SEN, ethnicity). Alternative measures of student attainment were used as the response variable – total GCSE/GNVQ score, probability of a student obtaining 5 or more A* to C grades at GCSE/GNVQ and grades in the individual specialist subjects. The specialist school 'effect' is defined as the additional grades or probability of 5 good GCSE/GNVQ grades that a pupil with given

characteristics obtained by attending a specialist school compared to a non-specialist school. A school was classified as specialist if it had been specialist at the beginning of the academic year 2000-2001. The various ‘effect’ sizes reported for different types of specialist school are descriptive of differential effectiveness and should not be given a causal interpretation.

Specialist schools on average are estimated to have added 1.4 grades to a student’s GCSE/GNVQ total score compared to non-specialists. When the sample is limited to the quintile of schools with the highest probabilities of being specialist, so that the non-specialist schools being compared are more similar to specialist schools than in the full sample, then the average value added is only reduced slightly to 1.29 grades. This estimate of specialist schools’ value added in terms of total GCSE score is slightly lower than the 2 grades in 2001 indicated by research commissioned by the Specialist Schools Trust but within the range found in the other studies. A boy pupil was 2.9 percent more likely to get 5+ A* to C grades at a specialist school and a girl 1.6 per cent more likely. This is less than the 4.2 per cent - 5.0 per cent range for 2001 to 2003 reported by the Specialist Schools Trust research.

Differentiating specialist schools by length of time they had been specialist and type of specialism shows considerable differences in their performance. Schools which had been specialist for 5-7 years added 3 more grades to boys’ total GCSE/GNVQ score (1.8 for girls) whereas schools that had been specialist for 1 to 4 years added only 1 grade for boys and 0.6 for girls. These differences could be due either to more effective schools having initially been selected to become specialist or to the raising of standards after becoming specialist taking several years to materialise.

Because sports and arts colleges have only been designated since 1997, to identify differential specialist school effectiveness in relation to specialism it is necessary to separate out the effects of length of time the schools had been specialist from the type of specialism. Technology specialist schools of 5-7 years standing were considerably more effective than language schools of the same duration (adding 3.25 grades to boys’ total GCSE/GNVQ score compared to 1.3). Language and arts schools of 1- 4 years standing were no more effective in overall GCSE performance than non-specialist schools. However, sports colleges, though only designated from 1-4 years, were found to be more effective, raising boys’ overall performance by 1 grade and girls by half a grade. This finding is in contrast to the other studies, which have reported poorer performance by sports colleges relative to the other specialisms. All specialist schools added value in their specialist subjects, apart from IT. Given the emphasis on ICT investment in specialist schools this result is surprising. Apart from PE, the estimated added value to the specialist subjects is modest – around 0.14 grades. Only technology and sports schools added value to specialist subjects other then their own, which is consistent with the better overall GCSE performance of these two specialisms.

More detailed analysis, from including interaction effects between specialist status and other factors, provides evidence about the relative effectiveness of specialist schools for different kinds of pupils. By and large the specialist schools narrowed the gap between boys' and girls' performance. This is the case for all specialist schools taken as a group and when differentiated by length of time specialist and type of specialism. In terms of total GCSE/GNVQ score, more able pupils did relatively better than less able pupils in specialist schools, though all ability levels had higher grades. Specialist schools therefore increased the differential at GCSE between high and low ability pupils. In terms of the probability of gaining 5 or more A* to C grades, average ability pupils gained most from attending a specialist school. While an average ability boy increased his chances of 5 or more good GCSE/GNVQS by 2.9 per cent a boy in the bottom 17 per cent of Key Stage 2 scores only increased his chances by 0.6 per cent. However, specialist schools with higher proportions of pupils eligible for free school meals were more effective than non-specialist schools with similar FSM proportions.

These findings, together with those from the other studies, show that some specialist schools, in particular those of long standing and the more recent technology and sports schools, are more effective than non-specialists. The most favourable of our findings for specialist schools is the additional value added of specialists with high proportions of pupils eligible for free school meals. Taken overall the superior effects of specialist schools are modest in size, not uniform across specialisms and dependent on the assumption of no selection bias in specialist school recruitment that is not controlled for by the observed pupil data.

Evaluating the Effectiveness of Specialist Schools

Rosalind Levacic
Andrew Jenkins

The Centre for the Economics of Education is an independent research centre funded by the Department for Education and Skills. The views expressed in this work are those of the author and do not reflect the views of the DfES. All errors and omissions remain the authors.

Acknowledgements

Rosalind Levacic is a Professor of Economics and Finance of Education at the Institute of Education, and a Principal Researcher at the Centre for the Economics of Education. Andrew Jenkins is a Research Officer for the Bedford Group for Lifecourse and Statistical Studies at the Institute of Education and a Principal Researcher at the Centre for the Economics of Education.

1 Specialist Schools Policy and its Evidence Base

The Labour Government, which came to power in May 1997, adopted many aspects of Conservative policy as part of its 'Third Way' politics (Blair, 1998; Giddens, 1998). Among these is the belief that greater diversity in state school provision would both improve parental satisfaction with schooling and raise educational standards. This can be seen as part of an international trend towards replacing common schooling by a plurality of school provision (Edwards et al., 1999). The Labour Government has promoted diversity vigorously through the specialist schools programme inherited from the Conservative government and turned it into a flagship policy. In 2003 the Secretary of State for Education reaffirmed the importance of 'creating a new specialist system' whereby all secondary schools ultimately become specialist as one of four key strategies for 'transforming secondary education' so that it becomes 'among the best in the world' (DfES, 2003).

However, as the House of Commons Education and Skills Committee concluded in its report on *Diversity of Provision*, the specialist schools policy has not been founded on a secure evidence base:

> It is a matter of concern the Government has made its decision to extend access to the specialist schools programme and associated funding to all schools, in the absence of clear evidence as to the alleged benefits of specialism, balanced against those of other initiatives. Evaluation of this initiative is essential so that the public and policy makers alike can be assured that policy is developed on the basis of sound evidence rather than wishful thinking (House of Commons Education and Skills Committee, 2003) para 125).

The main purpose of this paper is to provide a further assessment of the relative effectiveness of specialist schools. The paper starts by outlining the history of specialist schools policy since its inception in 1994, and then examines the methodological problems of evaluating the claim that specialist schools raise educational standards. We then summarise published research findings on the relative effectiveness of specialist schools and report a further evaluation that is more thorough than those published so far. This is because it applies multilevel modelling to the first available matched data set of pupils' Key Stage 2 results and GCSE/GNVQ results that includes most secondary schools in England. The other studies either use school level data with little school context data (Jesson, 2002b) or estimate value added from Key Stage 2 to Key Stage 3 and from Key Stage 3 to GCSE (Schagen et al., 2002). A better measure of the value added by secondary schools is that from the pupil's prior attainment on entry to secondary school to their performance in the school leaving examinations five years later.

Our study includes a range of attainment measures: GCSE/GNVQ total points score, GCSE grades in the specialist subjects and the probability of a student obtaining 5 or more A* to C GCSE/GNVQ grades. As extensive as possible set of school context variables, including resourcing and the proportion of students in the LEA educated in specialist schools, is controlled for. We report value added estimates for specialist schools as a whole and differentiated by type of specialism and length of time specialist. Tests of whether specialist school are differentially effective for boys or girls, pupils of low or high ability or for socially disadvantaged school communities are reported. We also examine whether the proportion of the LEA's pupils attending specialist schools has an effect on pupils' examination results in specialist and non-specialist schools.

2 The Evolution of Specialist Schools Policy

The distinguishing characteristic of specialist schools is that they are state schools which have successfully applied to the Department for Education and Skills (DfES) for a particular prescribed subject specialism, having raised the required private sponsorship money and submitted a development plan with agreed targets. If approved as worthy of specialist status the school receives from the DfES £100,000 in capital funding and £126 per pupil for four years[1] – or longer if redesignated as specialist.

Specialist schools originated from the Conservative Government's failure to induce

[1] Raised to £126 per pupil in 2003.

the private sector to invest on a large scale in newly founded independent secondary school specialising in technology - the City Technology Colleges, of which only 15 were created. Its successor programme, specialist technology colleges, was launched in 1994 to promote the preparation of young people for careers in science and technology and initially restricted to grant maintained and voluntary aided schools. Schools had to raise £100,000 in private sponsorship and provide evidence of academic success. In 1995 subject specialism was broadened to modern foreign languages and in 1997 to sports and arts. Specialist schools were permitted to select up to 10 per cent of their pupil intake according to 'aptitude' for the subject specialism.

The first Labour Green Paper on education, *Excellence in Schools* (DfEE, 1997), committed the government to continue the specialist schools programme, but added the criterion that these schools were to share their expertise with other schools and provide benefits to the local community. The School Standards and Framework Act (1998) enabled schools that were wholly or partially selective in 1997/98 to continue being so, and enabled new specialist schools to apply to select up to 10 per cent of pupils by 'aptitude'. A major boost to the specialist schools programme came in the White Paper *Schools: Achieving Success* (DfES, 2001) in which specialist schools were promoted as a major strategy for 'transforming secondary education'. This announced the aim of having 1000 (out of 3173[2]) secondary schools specialist by September 2003 rising to 1500 by 2005. The amount of sponsorship money to be raised in order to become specialist was reduced to £50,000 (less for schools with fewer than 500 pupils) and specialisms extended to science, engineering, business and mathematics & computing. In 2002 the government placed even greater emphasis on the specialist schools programme. 'Specialist schools are at the heart of the Government's drive to raise standards in secondary education and move beyond the old one-size-fits all system' declaimed the Secretary of State for Education (2002) announcing the ultimate aim of having all schools specialist. The intended number was raised to 2000 by 2006 and the specialisms extended to include humanities, music, a rural dimension and combined specialisms (DfES, 2003). From October 2003 schools which could demonstrate sustained but unsuccessful efforts to raise

[2] Excluding middle deemed secondary: from Statistics of Education Schools in England 2000.

sponsorship money could apply to a new £3m fund administered by the Specialist Schools Trust. The number and type of specialist schools are shown in Table 1. The annual designation rate has increased substantially since 2000 as has the number of specialisms since 2002.

Spending on specialist schools has risen annually under Labour as shown in Table 2. The annual recurrent cost to the DfES if all secondary schools were to become specialist would be around £358m (HC Education and Skills Committee, 2003 p. 25).

As the House of Commons Committee (2003) observed ‘ the emphasis of the programme has shifted over time from creating centres of excellence in a subject specialism, to its current mission which is explicitly aimed at school improvement’ (paragraph 36). In contrast to the importance accorded by the Conservative Government to competition as a means to raising standards, Labour specialist schools policy emphasises collaboration through specialist schools working in partnership with other schools to diffuse expertise and thereby spread improvements in student learning. As part of their four-year development plan submitted with the application to become specialist, schools have to demonstrate plans to improve teaching and learning that involve other local schools and the wider community.

According to official sources the means by which specialist schools raise standards is through developing a distinctive ethos and mission, using the subject specialism and the enhanced resourcing as a springboard for school improvement and innovation and thereby extending their expertise to other schools which consequently also improve (e.g. DfES 2001, 2003). According to the DfES (2003; p11):

> Specialist schools have been successful first and foremost because they have provided a means for inspirational head teachers to forge a distinctive mission and ethos which is right for their school. They have used the additional investment to support and enhance their specialist facilities, to develop excellence in their specialist subjects and to extend the insight it gives to best practice in teaching and learning to other areas of the curriculum. They have used their specialist status to raise achievement across the board.

The initial idea that a range of specialisms in a given locality would promote diversity through enabling parents to choose between different types of school has given way to seeing specialisation as a vehicle for improvement across all curriculum areas. The logic of treating curriculum specialisation as a major means to school improvement is not entirely compelling as this is not a major theme to emerge from the school effectiveness research literature (Sammons et al., 1995; Teddlie and Reynolds, 1999). As the Education and Skills Committee observed, there is a tension between an emphasis on a school's particular specialism as its unique selling point in the local school's market and on the quality of general education – to which all schools aspire - but which is to be secured via the specialism.

3 Methodology for Evaluating the Specialist Schools Programme

Clearly the specialist schools programme needs to be evaluated in relation to the aims intended for it. (OFSTED, 2001) listed these as being to:

1. raise standards of teaching and learning in the specialist subjects;
2. raise achievement for pupils of all abilities;
3. extend the curricular opportunities available to pupils;
4. develop a school character and ethos related to their specialism;
5. strengthen links between schools and private and charitable sponsors;
6. benefit other schools and the community in the local area.

The House of Commons Education and Skills Committee was critical of the lack of research evidence to support the intended benefits of the specialist schools programme and its universalisation. In part this is due both to the paucity of studies and the problems of developing a research design that could test whether there is a causal relationship between schools becoming specialist and subsequently achieving higher educational attainment for their own pupils and for those in neighbouring schools.

Our study concentrates on evaluating specialist schools in relation to aims 1 and 2 above which requires statistical analysis of the comparative value added by non-specialist and specialist schools. We also report a limited test of objective 6 in terms of whether specialist schools benefit pupils in non-specialist schools by including the proportion of pupils in the LEA attending specialist schools as an explanatory variable for pupil attainment.

In government thinking the specialist schools programme is a causal factor in improving student attainment both in the specialist school itself and in neighbouring schools. It is, however, difficult to devise a research design that could test whether giving schools specialist status is a causal factor in any subsequent improvements in the value added to student attainment by specialist schools relative to that of non-specialist schools. This is because specialist school status has not been randomly allocated to schools but has been given to selected schools that have been able through both internal and external factors to raise the required sponsorship money and produce convincing development plans for further improvement. 'Successful applications will have evidence of a stable or rising level of attainment overall and in all or most of the subjects associated with the specialism' (DFES, 2004)[3]. Any research design that attempts to test for causality would therefore need to find a group of non-specialist control schools which had similar features to those selected for specialist status. Given that the criteria for selection, in particular subject specialisms, have changed over time, the criteria for choosing matching non-specialist control schools would need to be revised for each year. None of the published studies has attempted this kind of research design. In our study we estimated the factors in our data set that explain the probability of a school being specialist but the predictive power was poor. This is not surprising when schools' internal management and local policy context factors that must affect the decision to apply for specialist status are not variables that appear in national data sets.

All the statistical studies comparing the performance of specialist schools with non-specialist schools, including ours, have estimated the relative effectiveness of schools using data on examination performance, controlling for students' prior attainment and other factors. After controlling for factors that affect student attainment but are determined externally to the school, a school is identified as more (or less) effective

[3] Schools in special measures or with serious weaknesses cannot become specialist.

than others if its students' examination results are higher (or lower) than those predicted from the students' characteristics and the school's contextual factors (such as proportion of students eligible for free school meals, who are girls or who have statements of special educational need). This difference between actual and predicted examination results – the residual – is referred to as 'value added'. If the differences in the estimated value added of two schools are statistically significantly different then we can say that one school is more effective than the other (Goldstein, 1997): (Goldstein, 1995).

The unknown factors that cause this value added residual are crucial for how one interprets it. If the statistical estimates have included all factors that systematically determine student attainment that are external to the school then the size of the residual can be attributed to the quality of the learning and teaching processes in the school. In this event we can say that a child of given prior attainment and other known characteristics would have achieved more highly in a school with greater estimated value added than one with less. However, if there are unobservable factors that affect student attainment but which have not been included in the regression analysis then one cannot reliably attribute the estimated value added to the quality of the school's teaching and learning. A well known example is that the value added of denominational (faith) schools is usually found to be higher than that of non-denominational schools (Schagen et al., 2002). This could be due to the ethos of these schools, as their advocates like to argue, or it could be due to these schools selecting pupils whose family background inclines them to be better motivated learners, a factor which is not fully reflected in the pupils' prior attainment scores.

Exactly the same issue arises in interpreting estimates of value added for specialist schools compared to non-specialist schools. If we are to infer from higher estimated value added that specialist schools as a group are educationally more effective than non-specialist schools then their higher value added must not be due to specialist schools selecting more motivated students, given their prior attainment, gender and other observed characteristics.

Specialist schools may be able to select better motivated students as they are able to select 10 per cent of their students by aptitude. However, only about 6 per cent of specialist schools actually select by aptitude (DfES data for 2000-01 reported in House of Commons, 2003: para 134). Parents who are effective in encouraging their children's academic attainment may also disproportionately select specialist schools. Covert selection of pupils according to motivational factors may occur especially by foundation and voluntary aided schools, which are their own admissions authorities (West and Hind, 2003). Specialist schools are slightly more likely to be in these two categories than non-specialists schools. In 2001 21.2 per cent of specialist schools had foundation status and 16.7 per cent were voluntary aided compared to 14.1 per cent and 15.6 per cent respectively of non-specialist schools[4].

If specialist schools deliberately or inadvertently cream off better motivated students and this characteristic is not observed in the data used for estimating value added, this poses two problems for evaluation. One is that estimated differences between specialist and non-specialists schools' value added could not be entirely or at all attributed to better educational processes in the former. Another possibility is that specialist schools could perform better and improve over time at the expense of other local schools. This was noted by the Education and Skills Committee, which commented that: 'the absence of data on the impact of initiatives on neighbouring schools is a serious weakness in existing analysis which should be addressed'.

Other questions of interest regarding the relative performance of specialist schools is whether they have differential effects on pupils who differ by gender, ability or other characteristics or whether specialist schools serving socially disadvantaged communities perform relatively better than non-specialist schools.

If it is found that specialist schools are more effective than non-specialist schools, then the interesting questions are whether this is due to the extra funding specialist schools receive, to the improvement processes that specialist schools are required to put in place (which are not unique to specialist schools) or to 'something inherent in the specialist schools policy itself' (House of Commons Education and Skills Committee, 2003: para 166).

---

[4] From LEASIS dataset for 2000-01.

Apart from the range of issues that evaluations of specialist schools need to address, there has been some disagreement amongst researchers about the best statistical methods to employ. The predominant view (Goldstein, 1997; Goldstein and Schagen, 2002; Paterson, 2002; Schagen and Goldstein, 2002) is that one should employ those methods most likely to produce unbiased estimates of the relationship between the explanatory variables and the dependent variable (student attainment in this instance) and then explain these simply for non-statistically literate audiences. Statistically robust methods require pupil level data, including as many control variables as possible and statistical modelling that takes into account the hierarchical nature of the data in which pupils are nested in schools. The contrary view has been put by Gorard,)2002; 2003) and Jesson (2002a; 2003b) who argue that because the evidence is important for school accountability and for policy making it has to be communicated clearly to non-statisticians. Therefore the simpler method, Ordinary Least Squares (OLS), should be used because its results can be more easily explained than those from a multilevel model. Jesson's reports on specialist schools' value added examination results ((Jesson, 2002b; 2003a)[5] use school level data and OLS estimation with very few controls. Jesson, like may researchers, uses OLS without correcting for the structure of the error term, which is likely to be correlated for pupils in the same school. Failure to correct for this serial correlation between the error terms leads to downward bias in the standard errors of the estimators and to the risk of accepting estimators as statistically significant when they are not (Goldstein, 1995). In addition, it may be the case that statistical relationships between variables at an aggregate level (e.g. the school) can be quite different from those at the unit level (i.e. pupils) (Goldstein 1995). The study reported here uses multilevel modelling which corrects for serial correlation and incorporates as many control variables as are available in the data and have some statistical significance. We argue that one should use the best statistical techniques available to minimise the probability of bias and then, if necessary for certain audiences, explain the findings simply.

---

[5] Jesson (2002) argues that because parents and LEAs know that schools' effectiveness differs and that LEA and school managers need value added analysis of examination results to help in improving results, then one should use simple statistical methods which provide easy to understand measures of differences in schools' value added. He criticises multilevel modelling from estimating school effects, which for many schools are not significantly different from average performance, and therefore for not providing indicators of school performance differences when this is what the clientele supposedly want.

4 Research Findings to Date on Specialist Schools' Relative Effectiveness

There have been four studies of specialist schools' comparative effectiveness measured in terms of value added. These are summarised in Table 3. Jesson in conjunction with Cyril Taylor (Jesson, 2000; 2001; 2002b; 2003a; 2004) has produced a series of annual reports commissioned and published by the Technology Colleges Trust (Specialist Schools Trust since 2003). The last three reports for examination results from 2001 to 2003 were the first of the series to use matched data sets from Key Stage 2 to GCSE/GNVQ. However, Jesson chose to forego some of the statistical advantages of this large matched pupil level data set by analysing the data at school level for the reasons given above. The other three studies (DfES, 2002; National Audit Office, 2003) used pupil level data but only across one key stage: the prior attainment measure for GCSE/GNVQ results was the average level at Key Stage 3 and Key Stage 2 average level was used as prior attainment for Key Stage 3 English, maths and science. The fuller version of the National Audit Office study (Benton et al., 2003) includes an extension in which schools' value added from Key Stage 2 to GCSE is estimated. The studies focused also on other school types, for example faith schools. The DfES study did not use multilevel modelling or control for other factors apart from prior attainment, whereas the other two studies did[6].

The outcome measure given prominence by Jesson is the percentage of students obtaining five or more A* to C grade GCSE/GNVQ passes on the grounds that this is the primary indicator used externally to judge secondary school performance. He fitted a simple equation with the school average Key Stage 2 score and the percentage of girls as the two explanatory variables. Each school's actual GCSE result was compared with its predicted results to obtain a value added measure. These were averaged for the specialist and non-specialist groups of schools. In 2001 specialist schools on average had a value added of 4 per cent and non-specialist schools a value added of –1 per cent making a net value added for specialist schools of 5 per cent. In the 2002 the net value added advantage to specialist schools was 4.5 per cent and in

[6] Both studies were conducted by the NFER.

2003 it was 4.2 per cent.

The percentage of students obtaining 5+ A* to C GCSE/GNVQ grades is not the best measure of the performance of a school's students (a view concurred with by the Education and Skills Committee) as it does not reflect student performance across the ability range and can be markedly affected by a few students – especially in smaller schools. The Jesson reports include a second value added equation for GCSE/GNVQ total points score in 2001 and GCSE/GNVQ points for the best 8 subjects in 2002 and 2003. In the report for 2001 students are placed into 5 groups according to their KS2 average scores and the GCSE/GNVQ total points scores of the specialist and non-specialist schools compared –those for specialist schools are higher in each ability group by around 2 grades. The net average value added to the capped GCSE/GNVQ capped points score was found to be 1.5 for specialist schools in 2002 and 1.1 in 2003.

Jesson and Taylor used these findings to support the government's specialist schools policy and the claim of a causal effect of specialist status on attainment:

> it (the additional value which specialist schools generate) indicates very powerfully the degree to which the process of both becoming and acting as a specialist school has delivered outstanding additional value to the nation (Jesson, 2003 p. 19)

Such causal claims cannot be validly made, as noted above, since all this evidence shows is that schools that were designated as specialist have higher value added (as estimated in this particular model). This observation could be explained by the fact that the more effective schools were selected to be specialist, rather than that these schools became more effective as a result of acquiring specialist status. This explanation is consistent with the Conservative Government's initial emphasis on creating centres of excellence for subject specialisms. Despite their methodological shortcomings, the Jesson studies have been used by the government to legitimate its policies in its White Paper and press releases (e.g. DfES 2001).

The DfES (2002) statistical study reports a 1 – 2 grade difference in the value added

GCSE/GNVQ total points scores of specialist compared to non-specialist (with Key Stage 3 as the measure of prior attainment). This report makes clear that no causal inferences can be made. Schagen et al (2002) report lower value added at GCSE from Key Stage 3 than DfES (2002) – in the region of 0 to 1.5 depending on the type of specialist school. This study uses more control variables, in particular the percentage of pupils eligible for FSM, which has a negative effect on attainment. The National Audit Office (2003) study used the first Pupil Level Annual Schools Census (PLASC) dataset and therefore included more pupil level variables, though again the prior attainment measure for GCSE/GNVQ was Key Stage 3 results. They estimated that from Key Stage 3 specialist schools on average added 0.84 grades to the GCSE/GNVQ capped score compared to non-specialist schools. Jesson reports that the value added at GCSE by Technology Colleges was the highest, followed by Languages, whereas in Schagen et al. Language Colleges performed slightly better (1.54 for GCSE total score) than Arts (1.15) and Technology (1.13) with Sports colleges having zero value added. Jesson and DfES found that specialist schools that had been designated longer performed better.

Differential impact on ability is investigated by Schagen et al. who report a slight tendency for more able pupils (as measured by Key Stage 3) to do relatively better in specialist schools compared to non-specialist schools than less able pupils (though the 'effect' of attending a specialist school was positive for all students on average). Jesson (2003) reports that pupils with average attainment at Key Stage 2 gained most advantage from attending a specialist school.

The only study to comment on specialist schools' relative performance for socially disadvantaged communities is Jesson (2002b 2003a, 2004) who examined schools with more than the average percentage of pupils eligible for FSM. He found that specialist schools' value added was relatively higher for this group of schools compared to specialist schools with lower FSM proportions.

The important issue of whether specialist schools have a negative impact on other schools' results is only addressed by Schagen et al. who placed LEAs into three categories – those with no specialist schools, those with up to 20 percent of pupils in specialist schools (about average) and those with more than 20 per cent. They found that non-specialist schools in LEAs with specialist schools had a lower average value added at GCSE and that this tends to be slightly more marked in LEAs with more than 20 per cent of pupils in specialist schools. However, this result was not replicated for value added at Key Stage 3.

In summary, the published research evidence shows that specialist schools are more effective at GCSE by a value of 1 – 2 grades. Schools that have been specialist for longer tend to be more effective and Sports colleges the least effective. Since technology and language colleges have been in operation longer this may account for their slightly higher value added. This could be interpreted as evidence that specialist status does have an effect and, as one would expect, it takes time to appear. Alternatively, it could be that more effective schools were selected earlier to become specialist. The findings on differential effects on pupils according to ability are not consistent and there is limited evidence from one study of a negative impact of specialist schools on others.

Researchers have also reported on improvements over time in raw examination results (OFSTED, 2001; West et al., 2000). Specialist schools are reported to have improved faster but one needs to control for changes in the characteristics of the pupil intake before being able to attribute such improvements to more effective educational practices. Gorard and Taylor (2002) produce evidence of a tendency for specialist schools to become relatively more socially segregated than non-specialist schools between 1999/00 and 1994/95[7]. A further set of case studies limited to 28 schools indicated that of the 10 which had increased social segregation all were their own admissions authorities. This study together with West and Hind (2003) on admissions practices provide some tentative evidence that comprehensive non-denominational specialist schools are more likely to select pupils on unobserved characteristics that are related to GCSE attainment than equivalent non-specialist schools.

[7] Between 1999/00 and 1994/95 29 per cent of secondary schools became more socially segregated (measured in terms of the change in the proportion of pupils eligible for free school meals that would have to be redistributed between schools in a LEA so ensure an equal distribution) compared to 37 per cent of specialist schools.

5 A Re-Analysis of the Relative Effectiveness of Specialist Schools

This study adds further to the research findings on the relative effectiveness of specialist schools by measuring value added at pupil level from KS2 to GCSE/GNVQ, which is the best measure of value added during the period of secondary education. It employs multilevel modelling to take into account variance at three levels - LEA, school and pupil. Two measures of overall GCSE results are used (see below) and as well as grades in the specialist subjects. The analysis attempts to discover whether pupils at specialist schools achieved better GCSE/GNVQ results than pupils at non-specialist schools after controlling for as many explanatory variables as it was possible to measure in the data sets available. By including interaction effects we are able to report on the differential effects of specialist schools for boys relative to girls, for more able relative to less able pupils and for schools with high concentrations of socially disadvantaged pupils. Differences in specialist schools by specialism and length of time specialist are distinguished.

6 Description of the Data

The data are drawn from five sources which could all be matched by school identity number.

1. The QCA matched data set of pupils whose Key Stage 2 scores in English, maths and science in 1996 are matched to their GCSE results in 2001. The other variables in the data set are the pupils' school identity number (LEA plus DfES code), gender and date of birth. Independent and special schools were removed, as were 123 records with 15 or more subject entries. All schools with fewer than 10 pupils in the data set were excluded (this included 156 pupils from a specialist schools).
2. The Annual Census of Schools (supplied as LEASIS) provided data for each of the years 1997 to 2001 on pupil numbers, percentage eligible for free school meals, with SEN, who were of white ethnic origin and type of school in terms of selection and age range.

3. The Registrar of Educational Establishments provided data on denominational affiliation, highest and lowest age of pupils, mixed, boys or girls school, governance type and schools in special measures.
4. A DfES file on specialist schools (DFES Press Notice 2001/0279)[8] supplied information on type of specialism and date of designation.
5. Section 52 statements gave data on school revenues and expenditure per pupil in 2000-2001.

The following measures of GCSE attainment at pupil level are used as the dependent variable in a series of regressions.

- GCSE/GNVQ total points
- Probability that a student obtains 5 or more A* to C GCSE./GNVQ grades
- GCSE grades in specialist subjects:

  technology
  IT
  art, and art and design
  modern foreign languages
  sports studies/PE

The following explanatory variables were included.

Pupil level variables:

- the pupil's total marks at Key Stage 2 English, maths and science scores in 1996;
- gender
- age.

School level categorical variables:

- School type (comprehensive, grammar, secondary modern school[9])
- Church of England, Roman Catholic or other faith school
- Lowest age of pupils (11, 12 or 13)[10]
- Highest age of pupils (age 16; i.e. schools without sixth form = 1)
- School specialist or not in September 2000 (used as a dummy variable)

---

[8] The REE designation of specialist status did not match that of the DfES so the latter was used.

[9] The definition of a secondary modern school in the DfES Autumn Package of school results was used.

[10] In the event lowest age was omitted from the regression results reported because it was consistently insignificant.

- Number of years school had been specialist by September 2001 (two sets of dummy variables were created and entered instead of the single specialist dummy)
- Type of specialism - none, arts, languages, sport, technology – (these were interacted with 5-7 years and 1-4 years as a specialist school to create 6 specialist dummy variables)
- School in special measures (these were omitted[11])

School level interval variables:

- Percentage of girl pupils
- Size of school (full time equivalent number of pupils)
- Percentage of pupils eligible for free school meals
- Percentage of pupils with statements of special educational need (SEN)
- Percentage of pupils of white ethnic origin[12]
- Pupil teacher ratio
- Proportion of pupils in the LEA in specialist schools in 2000-01
- Average Key Stage 2 English, maths and science scores of the year group taking GCSEs in 2001.

All the interval variables except the last two were averaged over the five year period between pupils' entry to secondary school after Key Stage 2 and GCSE[13] at the end of Year 11 (i.e. over the census years 1997 to 2001). The categorical variables (such as school type) are recorded at their values in 2000. The distribution of specialist and non-specialist schools in relation to selection categories is shown in Table 4.

7 Modelling and Statistical Analysis

The relative effectiveness of specialist schools was estimated using a number of different measures of GCSE/GNVQ attainment at pupil level as the dependent

[11] There were 74 schools in special measures of which 2 were specialist. They were omitted to increase comparability between specialist and non-specialists.

[12] Unfortunately LEASIS contained data on the percentage of ethnic minority students only for 1996-1999 but not for 2000 and 2001.

[13] Not all the pupils who take GCSEs in Year 11 will have been at their secondary school for the full five years. Jesson (2002) acknowledges that mobility cannot be accounted for in these data and cites OFSTED evidence that on average inward pupil mobility is 2.5 per cent annually. Like Jesson, we have not been able to account for differences in mobility between schools.

variable. Overall attainment was measured by total GCSE/GNVQ points and by the probability of a pupil achieving 5 or more A* to C grades at GCSE/GNVQ. The latter is the pupil level equivalent of the school level indicator of the percentage of pupils obtaining 5 or more A* to C grades. The former is a better measure of school performance as it focuses on whether a pupil of given ability has a greater chance of getting 5 good GCSE/GNVQs in a specialist school compared to a non-specialist school and how much bigger that probability is. The relationship at school level between a school average prior attainment score and school average examination results can give misleading estimates of the relationship at pupil level (Schagen and Goldstein, 2002). Further estimates were done using grades achieved by pupils in the specialist subjects as the dependent variable.

Different versions of the models were fitted for the different outcome measures and those reported had the best fit for each model as judged by the maximum likelihood estimator. Multilevel models were fitted in MlwiN including three levels – pupil. school and LEA. The models included the following features:

random coefficient on the Key Stage 2 prior attainment variable[14];
non-linear terms on Key Stage 2 attainment and percentage of pupils eligible for free school meals as their inclusion improved the proportion of variance explained[15];
interaction terms between specialist school status and Key Stage 2 attainment; percentage of students eligible for FSM and being a girl, were at first omitted and then included in the regressions– results of both versions are reported.

The peer group effect was captured by including the proportion of students eligible for free school meals and the school average for Key Stage 2 results for the year group. However, these two variables were highly correlated and in the presence of

---

[14] This means that the relationship between prior attainment at Key Stage 2 and GCSE/GNVQ is allowed to vary between schools.

[15] A linear term in Key Stage 2 attainment, as well as its squared and cubed values were all statistically significant in predicting GCSE total score: the GCSE rose slightly more than proportionally with Key Stage 2 average score. Linear, squared and cubed terms in the proportion of students with FSM show that attainment at GCSE declines more than proportionately at first as FSM increases and then the rate of decline tails off at high levels of FSM.

squared and cubed FSM the Key Stage 2 average for the year group took on a negative sign: it was therefore omitted from the final regressions.

The value added by specialist schools was estimated by including a dummy variable for specialist status in September 2000 so that schools had to be specialist for at least a year to be included as specialist in the analysis. Alternative specifications tested whether value added by specialist schools differed according to the number of years schools had been specialist or with the type of specialism. The interaction terms are important because they enable us to compare the average 'effect' of specialist schools on the attainment of a girls relative to girls in non-specialist schools and as well as on the attainment of pupils with differing prior attainment in the two school types. The interaction term between FSM and specialist status estimates how effective were specialist schools with a given proportion of FSM students compared to a non-specialist school with the same proportion of FSM. This provides a test of whether specialist schools were more effective for more socially disadvantaged school communities. The proportion of pupils in the LEA in specialist schools was included in some regression equations in order to test whether this had an effect on examination results.

8 The Estimated 'Effect' of Attending a Specialist School of Any Type

We use the term specialist school 'effect' to mean the difference in the predicted GCSE exam results of a pupil who attended a specialist as compared to pupil with the same gender, Key Stage 2 score and age who attended a non-specialist school[16]. Provided there are no unobserved pupil or school characteristics that exert a favourable influence on examination results, which are possessed to a greater extent by specialist schools and their pupils, then any statistically significant difference in

[16] The values of the interval variables used in the regressions were standardised. This means that the values of the interaction terms between specialist school and Key Stage 2 attainment and percentage of FSM pupils are zero for a pupil with mean Key Stage 2 attainment attending a school with mean FSM. If the pupil is a boy the interaction term between specialist and girl is zero. To convert from effect sizes measured in standardised units (i.e. standard deviations of GCSE points scores) to one measured in natural units (i.e actual grades) one has to multiply the coefficient of the dummy variables by the standard deviation of GCSE total exam scores. These are the effect sizes reported.

results between specialist and non-specialist pupils, after controlling for observed factors, can be attributed to a 'specialist school' effect'. However, as noted above, this effect cannot be validly interpreted as a causal effect of a school becoming specialist since the more effective schools may have been the ones selected to become specialist.

The findings on the value added by specialist schools compared to non-specialist schools are reported in Table 6. The first column reports value added as the size of the coefficient on the specialist school dummy in regressions with total GCSE/GNVQ points as the dependent variable. This effect is the additional number of GCSE grades due to a pupil attending a specialist school. Only statistically significant effect sizes[17] are reported. The full regression results are reported in Table A2 in the Appendix[18]. The overall value added on average by all specialist schools compared to non-specialist schools is 1.4 GCSE/GNVQ grades for both boys and girls of all abilities.

Adding interaction terms between specialist school and being a girl, between specialist school and Key Stage 2 score and specialist school and proportion of pupils eligible for free school meals enables us to test whether specialist schools are differentially effective for girls, for more or less able pupils and for schools with high or low FSM. The second and subsequent rows in Table 6 give the value added by specialist schools for girls compared to boys and for more and less able girls and boys and for girls and boys at schools with 1 standard deviation higher FSM percentage. All the value added estimates compare pupils with the same gender and prior attainment at a specialist and non-specialist school. Boys did relatively better on average at a specialist school compared with girls as their value added was 1.74 compared with the girls' 1.29. This indicates that specialist schools had a smaller gender gap than non-specialists. On average in non-specialist schools girls, obtained 3.45 grades more than boys but at specialist schools this was cut to 3.01 more grades than boys. More able pupils as measured by their Key Stage 2 scores did relatively

[17] At 90 per cent level of confidence

[18] The regression equations were fitted with the interval variables in standardised units. The effect size for natural units (i.e. for actual GCSE/GNVQ grades and not their standard deviation) are reported in Table 6. These are obtained by multiplying the estimated coefficient on the specialist dummy by the standard deviation of the pupil level GCSE/GNVQ score.

better at specialist schools. A boy with 1 standard deviation above the average Key Stage 2 score (i.e. the top 17 per cent) got slightly over 2 grades more at GCSE than his counterpart in a non-specialist school, whereas a boy with 1 standard deviation below the average Key Stage 2 score obtained only 1.41 grades more in a specialist school. More able girls similarly did relatively better in a specialist school than less able girls (1.62 grades better compared to 0.96). (The full results for the regression equations with interactions are given in Table A2 in the Appendix.)

The second overall performance measure is the probability that a pupil obtains 5 or more A* to C grades at GCSE/GNVQ. Since this has to be estimated with logistic regression (which is a non-linear equation) the marginal probabilities of getting 5+ good GCSE/GNVQs depend on the values of all the explanatory variables[19]. It was found that the only statistically significant interaction term was for girls at specialist schools. This was again negative, indicating the differential in value added for girls over boys was less in specialist schools.

For comparison the base case is a boy or girl with average Key Stage 2 attainment and age, at a bog standard comprehensive school (i.e.. non-denominational, mixed gender, with a sixth form) and which had average values for the proportion of pupils eligible for free school meals, with special educational needs or who are of white ethnicity. As shown in Table 6, a boy of average ability had a 2.9 per cent greater chance of getting 5+A* to C grades at a specialist school and a girl 1.6 per cent. If the boy or girl was in the top 17 per cent of the ability range (i.e. 1 standard deviation above average) they had a 2.2 per cent and 0.8 per cent higher probability respectively. Boys and girls in the lowest 17 per cent of the ability range had a slightly less than one percent probability of 5 or more higher grade GCSE/GNVQs at a specialist school. Hence it is middle ability pupils whose chance of getting 5 or more A* to Cs was most enhanced by attendance at a specialist school. This is not surprising since it is these pupils who are most likely to be shifted from D to C grades. For schools with 1 standard deviation above the average percent of pupils eligible for free school meals boys of average ability at specialist schools were 2.4 per cent more likely to gain five

---

[19] The marginal probability is the change in probability of getting 5+ good GCSEs given a change in the value of one of the explanatory variables.

or more good GCSEs and girls 1.5 per cent more likely than if they attended a non-specialist school.

The difference in probabilities of obtaining 5+A* to Cs is at the upper limit of the 95 per cent confidence limit is only 3 per cent for boys, which is well below the 4.2 per cent to 5 per cent value added differential for specialist schools found by Jesson (2002b, 2003a, 2004) using school level data. The probability for girls is well below 3 per cent[20].

9 Differential effects of types of specialist school and number of years specialist

In the school year 2000-2001 four types of specialist school were in operation - for Technology, Languages, Arts and Sports. In the first three years of operation from 1994 to 1996 only Technology and Languages specialisms existed. The distribution of specialist schools in our data set by specialism and number of years the school had been specialist is shown in Table 7.

We investigated whether schools that had been specialist for longer had higher value added. This was done by running two separate regressions first with two dummies for school being specialist for 5-7 years and for 1-4 years and a second one in which dummies were included for being specialist for 3 years or more or for only 1-3 years. The 'effect sizes' in terms of GCSE/GNVQ grades are shown in Table 8. Statistically significant values at 90 per cent are shown in bold.

Specialist schools had higher value added the longer they had been specialist. The value added varies from 2.98 for boys and 2.53 grades for girls in schools which had been specialist for 5-7 years to 0.75 and 0.25 grades for boys and girls respectively for those which had only had been specialist status for 1 to 3 years.

[20] Since Jesson does not report standard errors it is not known if the 95 per cent confidence interval around his estimates overlaps with ours. If his standard error were less than 0.006 then his lowest estimate of 4.2 per cent would be significantly different from our point estimate of 2.9 per cent.

The consistent decline in the specialist school 'effect' with time is consistent with two alternative explanations. One is that specialist status does have some causal effect that takes time to appear. This explanation is consistent with experience that school improvement measures take time to have an effect. However, an alternative explanation is that the most effective schools were selected for specialist status before the less effective. This is consistent with the initial government policy emphasis on selecting schools which would demonstrate excellence through their specialism compared to the later policy focus on specialisation as the route to school improvement. Differential effectiveness by specialism was estimated by including 6 interaction terms between type of specialism and whether the school had been specialist for 5-7 years or 1-4 years (only technology and language colleges could have existed long enough to have been specialist for more than 4 years). Two regression equations were fitted, one with the specialist school interaction term for all specialist schools and the second with interactions between girl and each specialist school type/years specialist . The second set of effect sizes are reported in parentheses in Table 8. Statistically significant values (at 90 per cent confidence) are in bold.

Technology schools stand out as the most effective with 3.25 grades value added for boys and 2.8 for girls if they had been specialist for 5-7 years and 1.28 and 0.83 for boys/girls if specialist for only 1 to 4 years. Language colleges of 5-7 years standing added 1.8 and 1.35 grades to boys and girls respectively (relative to non-specialist schools) but those of only 1 to 4 years standing did not have value added significantly different from non-specialist schools. Arts colleges, which had only been in existence for up to 4 years, had insignificant value added. However, in contrast to the findings of the other studies, sports colleges added 1 grade for boys and half a grade for girls compared to non-specialist schools. The differential between boys and girls compared to non-specialist schools is lower when interaction between girl and the four specialisms is included instead of the interaction term with specialist schools as a single group. (Only the latter results are reported in Tables 8 and 3A.) The differential effectiveness of schools of different specialisms, in particular Languages and Arts for which value added was not significantly different from non-specialist schools, casts doubt on curriculum specialisation as a general vehicle for school improvement as the curriculum area specialised in seems to matter[21].

The enhanced probabilities of students getting 5 or more good GCSE/GNVQs at specialist schools which had been designated for longer or shorter periods was also investigated. Table 9 reports ‘effect’ sizes for the probability of a student obtaining 5+ A*-C GCSE/GNVQs for specialist schools designated for 5-7 years. The value added by schools that had been specialist for 5-7 years was about twice that for all specialist schools (see Table 6). Only in the case of these specialist schools which had been in the initial three-year wave of designations did the estimated value added accord with the values of 5.0 per cent to 4.2 per cent found by Jesson for school level data. Specialist schools designated for 4 years or less were not significantly more effective than non-specialist schools. (The estimated regression coefficients for the fitted equation are given as Model 4d in Table A3 in the Appendix).

The interaction terms between the two dummies, specialist for 5-7 years and specialist for 1-4 years, and girl, while negative as in the other regressions, were not statistically significant. This is why the value added for girls is higher than that for boys in the estimates reported in Table 9. As with the regression with a single dummy for all specialist schools, pupils of average ability had higher value added in specialist schools than those 1 standard deviation above or below average ability. The older specialist schools also increased the probability of 5 or more good GCSE/GNVQs for pupils attending schools with 1 standard deviation above the average FSM percentage by 4.1 per cent for boys and 4.9 per cent for girls.

10 Effects on Specialist Subjects

Whether specialist schools are more effective for the specialist subjects was also investigated. The specialist subjects were restricted to those available in the data set. The following groups of subjects were tested separately, using the value of the grade as the response variable:

---

[21] Alternatively it may be that certain types of schools choose particular specialisms e.g. schools with high FSM percentage tend to chose sports as their specialism.

design and technology (includes food technology, graphics and resistant materials)
modern languages (includes French and German as these were the only language subjects in the matched pupil data set)
arts (includes art, design and drama)
IT (information technology)
PE (physical education).

Value added in terms of additional grades in specialist subjects obtained by pupils in specialist schools compared to those in non-specialist schools are recorded in Table 10. The results for all pupils are from regressions without interaction effects: the results for boys and girls are from regressions that included an interaction term between specialist school type and girl. The interaction terms between specialism and free school meals and average Key Stage 2 scores were not significant and were therefore dropped from the equation[22].

As shown in Table 10, all the specialist schools added value in their specialist subject, although in the case of arts specialist schools this was not statistically significant at the 10 per cent level. The stronger value added performance of technology and sports colleges found for the overall GCSE/GNVQ measures is mirrored in their adding positive value to specialist subjects other than their own. In some subjects specialist colleges added value to boys but very little to girls (Arts, Language and Technology schools in arts). Given the emphasis on ICT investment, especially in technology schools, it is interesting to note that only sports colleges did better in IT at GCSE than non-specialist schools. Over all the specialist subjects, the amount of value added was modest- at most it is 0.35 of a grade and often just over 10 per cent. Arts and Language schools are relatively more effective only in their specialist subject, a finding consistent with their poorer overall value added performance at GCSE shown in Table 8.

[22] When the dependent variable is a single subject it can take on only 9 values so the distribution of the residuals is unlikely to approximate a normal distribution. The results are therefore approximations.

11 Do Specialist Schools have Adverse or Positive Effect on Non-Specialist Schools?

A crucial issue in reaching a judgement about the impact of the specialist schools policy on raising standards is whether the greater effectiveness of specialist schools is achieved at the expense of neighbouring schools that have more able or better motivate pupils creamed off by the local specialist schools. The only variable available for testing this in the data sets used in this study is the proportion of students in a LEA which attends specialist schools. This is not correlated with LEA level exam results or percentage of students eligible for FSM in the LEA, therefore the data are not consistent with the hypothesis that poor examination results at LEA level encourage schools to become specialist.

When the proportion of students in the LEA enrolled in specialist schools and its interaction with the specialist school dummy were included in regressions of the total GCSE score in a two level (school and pupil) model estimated in SPSS the interaction term with specialist schools was significant and negative. However, when the regression was re-run in a 3 level MlwiN model the interaction term while still negative did not reach statistical significance (t= 1.36) though the proportion of pupils in a LEA attending specialist schools was negatively signed and significant at the 10 per cent level. (The results are reported in Table A5 in the Appendix.) The data are thus not consistent with a larger specialist school market share improving examination results in a LEA nor with a higher proportion harming non-specialist schools more than specialists. A tentative explanation is that a higher specialist market share may actually result in a smaller specialist school advantage due to each specialist school having less opportunity to cream off more able and better motivated students when in competition with a larger proportion of fellow specialists. A better test of the effect of specialist schools on neighbouring schools requires a finer measure of the number of specialist schools within the recruiting area of each school.

12 The Effect of Resources

The higher value added reported for specialist schools by Jesson in particular, has raised the question (e.g. Education and Skills Committee) of whether this is due to a 'specialist school effect' or to the additional resources that specialist schools receive. The problems of testing for a causal effect of resources on student outcomes are well known (Levacic and Vignoles, 2002; Todd and Wolpin, 2003). In England due to compensatory funding policies school level attainment and funding per pupil are inversely related and therefore the bias in OLS estimates is likely to be downward (Mayston, 2002 p. 26). In our study two resource variables were explored (but without correcting for endogeneity) – revenue per pupil from Section 52 statements for 2000-01 which include budget share and standards funding, into which specialist school funding is categorised. When revenue per pupil was included in regressions of GCSE/GNVQ total points score it was not statistically significant[23]. However, the pupil-teacher ratio (which was averaged over the five years 1997-2001) was both statistically significant and correctly signed: a higher pupil teacher ratio was related to a lower GCSE total score. A reduction in 5.65 pupils per teacher was associated with an increase of 1 GCSE/GNVQ grade (see Table A2). Given that teachers per pupil - the most important real resource variable in terms of proportion of school expenditure - is controlled for, a specialist 'effect' which is not accounted for by additional resources alone is indicated.

13 A Limited Attempt to Examine Causality

None of the studies so far published has investigated the issue of causality. Like ours they have all analysed a single year's data at a time and do not have data from the years before schools became specialist. As discussed earlier in the paper, these data are needed in order to test for causality by investigating whether schools that acquired specialist status differed in their effectiveness compared with schools that did not become specialist.

---

[23] The pupil-teacher ratio was not included in the same regression as revenue or expenditure per pupil.

As we are working with data from a single year, we estimated the probability of a school being specialist in order to select a sub-set of schools with the highest probabilities of being specialist, some of which were not selected for specialist status. The regressions were re-run on a sub-sample of schools that are more similar with respect to the characteristics possessed by specialist schools. The best model for predicting specialist status included the number of FTE pupils, proportion of pupils with SEN and voluntary, foundation and girls schools (see Table A6 in the Appendix)[24]. This confirms that specialist schools were not a random sample of all schools and so there is a clear problem of selection bias when comparing specialist and non-specialist schools.

The quintile of schools with the highest probability of being specialist was selected for re-running the regression for GCSE/GNVQ total subject score. These schools had a probability of 0.24 of being specialist compared to a mean of 0.173 and these probabilities were significantly different from the mean. This group consisted of 509 schools, of which 152 were specialist and 357 non-specialist (i.e. almost 30 per cent were specialist). When the regression for GCSE/GNVQ total points score was re-run in MlwN on this sub-sample the specialist school effect size was slightly reduced to 1.29 grades. When specialist schools are compared with non-specialist schools which they most closely resemble (as far as we can determine from the data available in this study), their value added to total GCSE is still positive but only slightly lower than when these specialists are compared with all other secondary schools. This evidence points to specialist schools being more effective as a consequence of being specialist but is by no means adequate for establishing causality. For a stronger test of this we would need to analyse the relative performance of specialist schools in the years before they became specialist to ensure that they were not better performing before becoming specialist.

14 Conclusion

This study used national data sets to investigate the relative effectiveness of specialist

[24] Grammar, secondary modern and denominational schools were excluded from the sub-sample.

compared to non-specialist schools, estimating regression equations for various measures of GCSE/GNVQ in 2001 in a multilevel model with three levels – LEA, school and pupil. Prior attainment was measured by the pupil's Key Stage 2 score taken 5 years earlier so the value added to the students over the main phase of their secondary schooling is estimated, controlling for their gender and age and a variety of school contextual, structural and governance variables. Thus a thorough analysis of the relative effectiveness of specialist schools has been undertaken with a variety of response variables - GCSE total score, grades in specialist subjects and the probability of the pupil obtaining 5 or more A* to C grades at GCSE/GNVQ, as well as differentiating specialist schools by type and number of years they had been specialist. The specialist school effect is defined as the additional grades at GCSCE/GNVQ that a pupil with particular characteristics obtained by attending a specialist compared to a non-specialist school.

Specialist schools on average are estimated to have added 1.4 grades to the GCSE/GNVQ total score compared to non-specialists. When the sample is limited to the quintile of schools with the highest probabilities of being specialist, so that the non-specialist schools being compared are more similar to specialist schools than in the full sample, then the average value added is only reduced slightly to 1.29 grades. Our estimate of specialist schools' value added in terms of total GCSE score is slightly lower than the 2 grades in 2001 indicated by Jesson (2002) but within the range found in the other studies. A boy pupil was 2.9 percent more likely to get 5+ A* to C grades at a specialist school. This is less impressive than the 4.2 per cent - 5.0 per cent range for 2001 to 2003 reported by Jesson from school level data and used has his main claim for 'these excellent results strongly vindicating the Government's decision to provide sufficient funds to designate every qualified bid for specialist status' (Jesson, 2004: iv). The increased probability of 5 or more good GCSE/GNVQ grades for girls was even less at 1.6 per cent.

Differentiating specialist schools by length of time they had been specialist and type of specialism shows considerable differences in their performance. Schools which had been specialist for 5-7 years added 3 more grades to boys' total GCSE/GNVQ score (1.8 to girls) whereas schools that had been specialist for 1 to 4 years added only 1 grade for boys and 0.6 for girls. These differences could be due either to more

effective schools having initially been selected to become specialist or to the raising of standards after becoming specialist taking several years to materialise.
Because sports and arts colleges have only been designated since 1997, to identify differential specialist school effectiveness in relation to specialism it is necessary to separate out the effects of length of time the schools had been specialist from the type of specialism. Technology specialist schools of 5-7 years standing were considerably more effective than language schools of the same duration (adding 3.25 grades to boys' total GCSE/GNVQ score compared to 1.3). Language and arts schools of 1- 4 years standing were no more effective in overall GCSE performance than non-specialist schools. However, sports colleges, though only designated from 1-4 years, were found to be more effective, raising boys' overall performance by 1 grade and girls by half a grade. This finding is in contrast to the other studies which have reported poorer performance by sports colleges relative to the other specialisms.

All specialist schools added value in their specialist subjects, apart from IT. Given the emphasis on ICT investment in specialist schools this result is surprising. Apart from PE, the estimated added value to the specialist subjects is modest – around 0.14 grades. Only technology and sports schools added value to specialist subjects other then their own, which is consistent with the better overall GCSE performance of these two specialisms.

More detailed analysis provides evidence about the relative effectiveness of specialist schools for different kinds of pupils. By and large the specialist schools narrowed the gap between boys' and girls' performance. This is the case for all specialist schools taken as a group and when differentiated by length of time specialist and type of specialism. In terms of total GCSE/GNVQ score, more able pupils did relatively better than less able pupils in specialist schools, though all ability levels had higher grades. Specialist schools therefore increased the differential at GCSE between high and low ability pupils. In terms of the probability of gaining 5 or more A* to C grades, average ability pupils gained most from attending a specialist school. While an average ability boy increased his chances of 5 or more good GCSE/GNVQS by 2.9 per cent a boy in the bottom 17 per cent of Key Stage 2 scores only increased his chances by 0.6 per cent. However, specialist schools with higher proportions of pupils eligible for free school meals were more effective than non-specialist schools with similar FSM proportions. This supports Jesson's findings on this aspect of specialist schools' performance.

The proportion of pupils in a LEA attending specialist schools was negatively and just significantly related to GCSE attainment thus giving no support to proposition that specialist schools benefit neighbouring schools. The sign of the interaction term between the proportion of specialist pupils in a LEA and specialist schools was negative (though not significant) indicating that specialist schools in areas saturated with other specialists are less effective or have less of an advantage. This could be because of less ability to cream off better motivated pupils when in competition with other specialists. Our test of the effect of the presence of specialists on other schools is relatively weak and more detailed measures of the market share of proximate specialist schools to each school are needed.

Our findings, together with those from the other studies, show that some specialist schools, in particular those of long standing and the more recent technology and sports schools, are more effective than non-specialists. On average a specialist school adds around one and half grades to GCSE total scores over the five years of a child's secondary schooling. However, arts and language schools of 1-4 years were no more effective than non-specialist schools. The greater effectiveness of specialists in their specialist subjects was modest at around 0.14 of a grade. The increased probability of a pupil obtaining 5 or more good GCSE/GNVQs was no more than 3 per cent for boys and less than 2 per cent for girls. This is considerably less than the 5.0 per cent to 4.2 per cent claimed by Jesson from analysing school level data and including far fewer control variables. The most favourable of our findings for specialist schools is the additional value added of specialists with high proportions of pupils eligible for free school meals. Taken overall the superior effects of specialist schools are modest in size, not uniform across specialisms and dependent on the assumption of no selection bias in specialist school recruitment that is not controlled for by the observed pupil data. There is no evidence as yet of specialist schools' adding value to pupils in non-specialist schools.

None of the studies undertaken so far has been able to test for a causal impact of schools becoming specialist on raising their students' subsequent GCSE/GNVQ results. Given the relatively modest ‘effect’ size of specialist schools on GCSE/GNVQ results and its variability with respect to type of specialism and length of time specialist, there is as yet little strong evidence that the specialist schools programme can be a major instrument for transforming the attainment levels of secondary school students.

Table 1 Specialist schools by specialism and year of designation

Year designated	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**Total**
Technology	43	36	43	41	46	40	53	58	79	61	**500**
Language	0	6	24	15	11	14	28	27	31	32	**188**
Arts	0	0	0	6	11	10	28	33	82	56	**226**
Sports	0	0	0	11	15	11	29	34	60	68	**228**
Business and Enterprise	0	0	0	0	0	0	0	0	18	63	**81**
Maths and Computing	0	0	0	0	0	0	0	0	12	64	**76**
Science	0	0	0	0	0	0	0	0	24	97	**121**
Engineering	0	0	0	0	0	0	0	0	4	10	**14**
Combined	0	0	0	0	0	0	0	0	0	9	**9**
Total designated	43	42	67	73	83	75	138	152	310	460	
Cumulative total	43	85	152	225	308	383	521	653	983	1443	**1443**

Source: DfES ‘Specialist Schools operational September 2003’ (www.dfes.gov.uk accessed November 2003)

Table 2 DfES Spending on specialist schools (current prices)

School Year	Number of schools	Expenditure by DfES including initial capital grant and recurrent funding
1998-99	327	£41.0m
1999-2000	403	£49.8m
2000-01	536	£71.9m
2001-02	685	£94.0m
2002-03	992	£145.3m

Source: House of Commons Education and Skills Committee (2003) para 12

Table 3 Summary of research findings on relative effectiveness of specialist schools

Study	Estimation method	Measure of attainment	Measure of prior attainment	Other variables controlled for	Data	Estimated Specialist 'effect' size (value added)	Variation in specialist 'effect'	Impact of specialist schools on other schools
Jesson (2002b; 2003a, 2004)	OLS School level data	per cent 5+A*-C GCSE passes 2001, 2002, 2003; GCSE/GNVQ points (2001) GCSE/GNVQ capped points (2002, 2003)	School average KS2 score of pupils who took GCSEs	Percentage of girls	Non-selective secondary schools matched data sets: 2001 430,000 pupils in 2700 schools 2002: 500,000 pupils in 2998 schools	2001 5per cent more students gaining 5+A*-C GCSE passes: 2002: 4.5per cent more: 2003: 4.2per cent GCSE/GNVQ total points 2001: 2 grades. GCSE/GNVQ capped points: 1.5 grades in 2002 and 1.1 grades in 2003.	Average ability pupils did better in specialist schools relative to others. Specialist schools in disadvantaged communities did relatively better.	Not considered
Schagen at al (2002) NFER	Multilevel modelling Pupil level data	GCSE point score Average GCSE point score Maths point score English language point score Double science point score. KS3 average level KS3 maths level KS3 Eng level KS3 science level	Average level attained in KS3 Average level attained in KS2	Pupils' gender and age School: per cent FSM, metropolitan LEA or not, type of specialism	National Value Added matched data sets for KS3 1998 to GCSE 2000. 482399 pupils, 3124 schools. and KS2 1997 to KS3 2000.	Four specialisms reported separately. Value added GCSE grades: 0 to 1.5. Av. GCSE grades: 0.02 to 0.11 Maths: 0.04 to 0.06 Eng: 0.03 – 0.09 Sci: -0.03 – 0.07. KS3 average level: 0.02 to 0.06. Technology and Arts Colleges more effective.	Slightly more effective for more able pupils both for GCSE grades and KS3 average level.	Attending a non-specialist school in LEAs with specialist schools compared to none had small negative effect on GCSE results but not on KS3.

Table 3 Continued

DFES (2002)	OLS Pupil level data	GCSE/GNVQ total points KS3 maths level KS3 Eng level KS3 science level	Average level attained in KS3 Average level attained in KS2	None	National Value Added matched data sets for KS3 1999 to GCSE 2001 and KS2 1998 to KS3 2001: all state secondary schools	1 –2 more GCSE/GNVQ grades KS3: one eighth of a level more progress. Schools specialist for 4 + years more effective by 1 grade.	Not considered	Not considered
Benton et al (2003)	Multilevel modelling Pupil level data	GCSE/GNVQ total points in best 8 subjects. Average 'points score' from KS3 tests in English, maths & science	KS2 Eng, maths & sci for KS3 KS3 Eng, maths & sci for GCSE	Pupil level: gender, FSM, ethnicity, EAL, SEN, age. School level: pupil mobility, per centFSM, per centEAL, per centSEN; grammar, denominational, single sex, beacon schools	National Pupil Database (version 2) 2002	One sixth of a level at KS3 0.84 grades at GCSE/GNVQ 1.1 grades at grades at GCSE/GNVQ (no differential effects for type of specialism found)	Not considered	Not considered

Table 4 Types of School in Data Set Analysed

Type of school	Number of schools	Percent
Specialist Comprehensive	450	15.0
Specialist Grammar	22	0.7
Specialist Secondary modern and other	29	1.0
TOTAL SPECIALIST	501	16.7
Non-specialist comprehensive	2152	71.9
Non specialist grammar	133	4.4
Non-specialist modern & other	209	7.0
TOTAL NON-SPECIALIST	2494	83.3
TOTAL all schools	**2995**	100

Table 6 'Effect' sizes of value added by specialist schools to total GCSE/GNVQ grades and to probability of student obtaining 5+ A*-C GCSE/GNVQ grades

	Total GCSE/GNVQ: additional grades	Increased in probability of 5+ A* to C grades at GCSE/GNVQ
Boy or girl (Model 1 with no interaction effects)	1.41	_
Boy	1.74	0.029
Girl	1.29	0.016
Boy: 1 standard deviation above average KS2 results	2.06	0.022
Girl: 1 standard deviation above average KS 2 results	1.62	0.008
Boy: 1 standard deviation below average KS2 results	1.41	0.007
Girl: 1 standard deviation below average KS 2 results	0.96	0.006
Boy: in school with FSM 1 standard deviation above average	2.18	0.024
Girl: in school with FSM 1 standard deviation above average	1.74	0.015

Note: The full regression results are reported in Table A2 in the Appendix as Models 1, 2 and 3. The 'effect' sizes for total GCSE/GNVQ, apart from the first row, are from Model 2 and those for 5+ A* to C grades at GCSE/GNVQ are from Model 3.

The comparisons of the probability of obtaining 5+ A*-C grades assume the pupil has average ability (KS2 score) unless otherwise specified and attends a non-denominational, mixed gender comprehensive school with a sixth form. The comparator school is non-specialist.

Table 7 Distribution of specialist schools by specialism and years specialist in data set

	5-7years	1-4 years	1-7 years
Technology	122	167	289
Arts	0	53	53
Sports	0	62	62
Language	30	67	97
All specialist schools	152	349	501

Table 8 'Effect' sizes of value added to total GSCE/GNVQ grades by specialist schools according to specialism and time specialist

	BOY	**GIRL**
Specialist 4-7 years (Model 4a)	***2.22***	**1.77**
Specialist 1-3 years (Model 4a)	***0.75***	**0.29**
Specialist 5-7 years (Model 4b)	***2.98***	**2.53**
Specialist 1-4 years (Model 4b)	***1.03***	**0.58**
Technology:5- 7 years specialist	***3.25***	**2.80**
(Model 4c)	***(3.42)***	**(2.85)**
Technology: 1-4 years specialist	***1.28***	**0.83**
(Model 4c)	***(1.17)***	(0.95)**
Language:5- 7 years specialist	***1.80***	**1.35**
(Model 4c)	***(2.02)***	**(1.28)**
Language: 1-4 years specialist	*0.67**	0.22*
(Model 4c)	*(0.91)*	(0.07)
Arts: 1-4 years specialist	*0.75**	0.30*
(Model 4c)	*(0.73)***	(0.31)**
Sports: 1-4 years specialist	***0.99***	**0.54**
(Model 4c)	***(1.06)***	**(0.44)**

Note: figures in bold indicate statistical significance at 90 per cent. t statistic is given in parentheses.

Full regression results are reported in Table A3 in the Appendix. The regression models in Table A3 from which the effect sizes are derived are indicated in the first column of Table 8. Girls' value added is obtained by adding the negative coefficient on the interaction term between girl and specialist school status. Note* Value added by Arts and Languages Schools of 1-4 years standing did not reach statistical significance (prob = 0.167). Note** Art Schools 1-4 years not significant: Technology Schools 1-4 years-girl interaction term not significant.

Table 9 'Effect' sizes of value added by schools which had been specialist for 5-7 years to the probability of student obtaining 5+ A*-C grades

Type of pupil by gender, ability and in school by percentage of pupils eligible for FSM	Total GCSE/GNVQ: additional grades
Boy	0.048
Girl	0.053
Boy: 1 standard deviation above average KS2 results	0.036
Girl: 1 standard deviation above average KS 2 results	0.026
Boy: 1 standard deviation below average KS2 results	0.014
Girl: 1 standard deviation below average KS 2 results	0.021
Boy: in school with FSM 1 standard deviation above average	0.041
Girl: in school with FSM 1 standard deviation above average	0.049

Note: the 'effect' sizes reported are derived from Table A3 Model 4d (in the Appendix). The comparisons of the probability of obtaining 5+ A*-C grades assume the pupil has average ability (KS2 score) unless otherwise specified.

Table 10 'Effect' sizes of value added of specialist schools on grades of the specialist subjects

Specialism	Design & technology	IT	Modern Languages	Arts	PE
Arts					
All pupils	ns	ns	ns	0.121 (t= 1.60)	ns
Boys	ns	ns	ns	0.217	ns
Girls	ns	ns	ns	0.076	ns
Languages					
All pupils	ns	ns	0.138	ns	ns
Boys	ns	ns	0.138	ns	ns
Girls	0.131	ns	0.138	-0.148	ns
Technology					
All pupils	0.143	ns	0.070	0.105	0.082
Boys	0.145	ns	0.092	0.145	0.080
Girls	0.145	ns	0.063	0.087	0.080
Sports					
All pupils	ns	0.282	0.124	ns	0.262
Boys	ns	0.353	0.165	ns	0.268
Girls	ns	0.353	0.088	ns	0.268

Note: 'ns' indicates 'not significant' at 90 per cent level: full regression results are reported in Table A4 in the Appendix.

Appendix

Table A1 Descriptive statistics of variable used in the analysis

Variable name	Mean	Standard deviation
GCSE/GNVQ total points score 2001 or constant	40.58	19.28
Proportion of pupils obtaining 5+ A* -C grades at GCSE/GNVQ	0.47	0.499
GCSE/ grade in design and technology	4.51	1.75
GCSE grade in ICT	4.53	1.91
GCSE grade in modern languages	4.40	1.7
GCSE grade in arts subjects	5.15	1.57
GCSE grade in PE	4.83	1.54
Key Stage 2 total for English, maths and science	154.8	38.6
Age (no. days between Aug 31 and birthday)	183.9	105.9
Percent of girls enrolled in 2000	49.82	16.73
FTE pupils: average 1997-2001	1059.8	322.1
Free School Meals (FSM): percentage of pupils eligible averaged 1997 –2001	16.13	12.93
SEN with statements: average percentage 1997-2001	2.44	1.68
White: average percentage 1997-2001	88.53	18.99
PTR average 1997-2001	16.95	1.09
Proportion of pupils in specialist schools	0.19	0.12

Table A2 Estimated regression coefficients for GCSE/GNVQ total score and probability of 5+ A* -C grades with a single dummy for all specialist schools

Dependent variable:	GCSE/GNVQ total score				Logit of 5+ A*-C	
(All interval variables are standardised)	Model 1		Model 2		Model 3 (logit)	
Explanatory variables	Estimate	t stat.	Estimate	t stat.	Estimate	t stat.
Constant	-.207	-20.70	-0.211	-21.10	-0.799	-28.32
KS2 total for English, maths & science	0.653	217.67	0.650	216.67	2.066	158.92
Age	0.052	52.00	0.052	52.00	0.135	27.00
Percentage of girl pupils: 2000	0.014	4.67	0.014	4.67	0.046	4.18
FTE pupils: average 1997-2001	0.002	0.40	0.002	0.40	0.001	0.07
FSM average percentage 1997 -2001	-0.202	-28.86	-0.205	-29.29	-0.589	-28.05
FSM average (1997-01) squared	0.048	8.00	0.050	8.33	0.174	9.16
FSM average (1997-01) cubed	-0.005	-2.50	-0.006	-3.00	-0.024	-4.80
KS2 Eng maths & science squared	0.034	34.00	0.034	34.00	-0.024	-3.00
KS2 Eng maths & science cubed	-0.003	-3.00	-0.003	-3.00	-0.006	-0.86
SEN with statements: average per cent 1997-2001	-0.008	-2.00	-0.008	-2.00	-0.038	-2.71
White: average percentage 1997-2001	-0.077	-15.40	-0.076	-15.20	-0.204	-14.57
PTR average 1997-2001	-0.010	-2.50	-0.010	-2.50	-0.021	-1.62
Proportion of pupils in specialist schools	-	-	-	-		
Specialist school 2000* KS2EMS96	-	-	0.017	3.40	-	-
Specialist school 2000*FSM average 1997-2001	-	-	0.023	2.56	-	-
Specialist school 2000* proportion of pupils at specialist schools	-	-	-	-	-	-
Girl	0.175	87.5	0.179	59.67	0.519	47.18
Girl at specialist school	-	-	-0.023	-3.83	-0.065	-2.60
Grammar	0.225	9.00	0.223	8.92	1.252	14.73
Secondary modern	-0.043	2.05	-0.042	-2.00	-0.164	-2.78
Highest age 16 (=1)	0.048	4.80	0.048	4.80	0.155	5.17
Church of England	0.032	1.78	0.032	1.78	0.039	0.74
Roman Catholic	0.056	4.67	0.057	4.75	0.088	2.51
Other religion	0.107	1.98	0.107	1.98	0.568	2.87
SPECIALIST	0.073	7.30	0.090	9.00	0.131	4.23
Specialist school 'effect' size	1.41		boy: 1.74 girl: 1.29		boy: 0.029 girl: 0.016	
Intra-school correlation	0.076		0.076		0.224	

Table A3 Note on calculation of 'effect' sizes.

The continuous variables in the regression equations were measured in standardised units. When examination results are GCSE scores then to convert from 'effect' sizes measured in standardised units (i.e. standard deviations of GCSE points scores) to ones measured in natural units (i.e. actual grades) the coefficient of the dummy variable for specialist schools is multiplied by the standard deviation of GCSE total exam scores. These are the 'effect' sizes reported in the tables in the main text.

When the outcome measure is whether a pupil obtained or did not obtain 5+ A*-C grades at GCSE/GNVQ logit regression is used. The dependent variable is the odds of obtaining 5+ A* to C grades. To calculate the 'effect size' of a specialist school dummy (including its interaction with other variables such as 'girl') the probabilities of 5+ A*-C grades of a boy or girl pupil of average age and given KS2 score attending (i) a specialist and (ii) a non specialist school are calculated. This requires assuming that the school level continuous variables are set at their mean value (which is 0 as they are in standardised units) and that the school is a non-denominational, mixed, comprehensive with a 6^{th} form. The probability of a boy/girl getting 5+ A*-C grades at a non-specialist school is subtracted from the probability of 5+ A*-C if attending a specialist school. The probability of 5+ A*-C is derived by working out the value of right hand side (RHS) of the estimated equation using the assumed values of the independent variables. The probability of getting 5+ A*- C grades is 1/(1+EXP(-value of RHS)). Hence the 'effect' sizes reported in terms of probabilities are conditional on the values assumed for the independent variables. If any of these values is changed (e.g. the student's KS2 score) the probability of 5+A*-C grades also changes. Tables 6 and 9 in the main text report 'effect' sizes in terms of the increased probability of attaining 5+ A* to C grades in a specialist school compared to a non-specialist. Tables A2 and A3 report the logit regression coefficients used to calculate the probabilities reported in Tables 6 and 9.

Table A3 Estimated regression coefficients including dummies for number of years specialist and type of specialism

Dependent variable:	GCSE/GNVQ total score						Logit of 5+ A*-C	
Explanatory variables	Model 4a		Model 4b		Model 4c		Model 4d	
(All interval variables are standardised)	Estimate	t stat	Estimate	t stat	Estimate	t stat	Estimate	t stat
Constant	-.201	-26.58	-.201	-26.47	-0.201	-26.50	-0.75	-27.81
KS2 total for English, maths and science	.650	228.28	0.650	228.29	0.650	228.27	1.95	149.9
Age	.052	43.73	0.052	43.73	0.052	43.73	0.13	25.6
Percentage of girl pupils: 2000	.013	3.75	0.014	3.84	0.014	3.92	0.04	4.4
FTE pupils: average 1997-2001	.008	1.77	0.009	1.85	0.009	1.85	0.001	0.08
FSM average percentage 1997 -2001	-.203	-30.71	-.203	-30.71	-0.204	-30.76	-0.56	-28
FSM average (1997-01) squared	.037	5.80	0.036	5.71	0.037	5.79	0.17	9.28
FSM average (1997-01) cubed	-.002	-1.46	-0.002	-1.37	-0.002	-1.42	-0.02	-4.6
KS2 English, maths & science squared	.033	28.42	0.034	28.44	0.034	28.44	0	0
KS2 English, maths & science cubed	-.003	-4.22	-0.003	-4.21	-0.003	-4.21	0	0
SEN statements 1997-2001	-.011	-2.72	-0.011	-2.69	-0.011	-2.69	-0.04	-2.70
White: average percentage 1997-2001	-.067	-15.55	-0.066	-0.067	-15.46	-15.53	-0.19	-13.71
PTR average 1997-2001	-.011	-2.70	-0.011	-2.72	-0.011	-2.72	-0.02	-1.46
Specialist school 2000* KS2EMS96	.017	3.28	0.017	3.25	0.17	3.27	0.48	48.20
Specialist school 2000*FSM	.029	3.12	0.030	3.30	0.028	3.01	-	-
Girl	.179	64.78	0.179	64.77	0.179	64.76	1.22	15.01
Girl at specialist school	-.023	-3.75	-0.023	-3.74	-0.023	-3.72	-	-
Grammar	.205	9.70	0.203	9.60	0.202	9.78	0.15	5.29
Secondary modern	-.065	-4.55	-0.067	-4.66	-0.068	-4.72	0.03	0.66
Highest age 16 (=1)	.056	6.23	0.056	6.19	0.056	6.19	0.08	2.45
Church of England	.028	1.58	0.027	1.48	0.027	1.46	0.54	2.89
Roman Catholic	.057	4.69	0.055	4.57	0.055	4.53	0.081	**2.45**
Other religion	.130	2.43	0.128	2.39	0.126	2.35	0.21	4.73

Table A3 Continued

Specialist: 1- 3 years	0.039	2.57	-	-	-	-	-	-
Specialist 1-4 years	-	-	0.054	4.46	-	-	0.04	1.42
Specialist: 4- 7 years	0.115	8.98			-	-		
Specialist: 5-7 years	-	-	-	9.02	-	-	0.213	4.73
Technology school 5-7 years	-	-	-	-	0.169	8.96	-	-
Technology school 1-4 years	-	-	-	-	0.066	4.09	-	-
Language school 5- 7 years	-	-	-	-	0.093	2.49	-	-
Language school 1- 4 years	-	-	-	-	0.035	1.38	-	-
Arts school 1- 4 years	-	-	-	-	0.039	1.38	-	-
Sports school 1- 4 years	-	-	-		0.051	1.98	-	-

Table A4 Estimated regression coefficients for specialist GCSE subjects (Models 5a to 5e)

(all interval variables are standardised)

Dependent variable: GCSE/GNVQ subject score	Design and technology		ICT		Modern languages		Arts		PE	
Explanatory variables	Est.	t	Est.	*t*	Est.	*t*	Est.	t	Est.	t
Constant	-0.289	24.08	-0.239	*8.85*	-0.432	*36.08*	-.346	*21.63*	-0.048	2.82
K2 total for English, maths, science	0.453	*113.2*	0.462	*57.75*	0.583	*48.58*	0.42	*84.00*	0.565	*80.71*
Age	0.02	*10.00*	0.029	*9.67*	0.05	*50.00*	-0.002	*-0.13*	-0.006	*-2.00*
Percent girls 2000	0.003	*0.60*	0.022	*2.00*	0.005	*1.00*	-0.004	*-0.67*	0.024	*3.00*
FTE pupils: average 1997-2001	0.001	*0.17*	0.014	*0.93*	0.013	*1.86*	0.028	*3.50*	0.006	*0.67*
FSM average percentage 1997 - 2001	-0.201	*-20.1*	-0.182	*-7.91*	-0.167	*-16.70*	-0.121	*-9.31*	-0.184	*-13.14*
FSM average (1997-01) squared	0.067	*7.44*	0.052	*2.48*	0.062	*6.89*	0.043	*3.58*	0.042	*3.23*
FSM average (1997-01) cubed	-0.009	*-4.50*	-0.01	*-2.00*	-0.01	*-5.00*	-0.003	*-1.00*	-0.003	*-1.00*
KS2 Eng, maths & science squared	0.043	*21.50*	0.045	*11.25*	0.066	*66.00*	0.024	*12.00*	0.023	*7.67*
KS2 Eng, maths & science cubed	0.004	*4.00*	0.004	*1.33*	0.008	*8.00*	-0.002	*-1.00*	-0.006	*-3.00*
SEN with statements: 1997-2001	-0.005	*-0.83*	-0.016	*-1.14*	-0.017	*-2.83*	-0.006	*-0.75*	-0.002	*-0.22*
White: average percentage 1997-2001	-0.035	*-5.83*	-0.087	*-5.80*	-0.064	*-9.14*	-0.027	*-3.38*	-0.019	*-2.11*
PTR average 1997-2001	-0.009	*-1.50*	-0.017	*-1.21*	-0.019	*-3.17*	-0.005	*-0.63*	-0.002	*-0.22*
Girl	0.334	*83.5*	0.131	*16.38*	0.338	*112.67*	0.387	*64.50*	-0.074	*-10.57*
Grammar	0.225	*7.03*	0.268	*3.72*	0.32	*10.32*	0.174	*4.24*	0.07	*1.273*
Secondary modern	-0.052	*-2.17*	-0.074	*-1.40*	-0.008	*-0.16*	0.003	*0.09*	-0.049	*-1.361*
Highest age 16 (=1)	0.039	*3.00*	0.078	*2.52*	0.049	*3.50*	0.058	*3.22*	0.031	*1.550*
Church of England	-0.013	*-0.52*	-0.008	*-0.13*	-0.017	*-0.65*	0.001	*0.03*	-0.001	*-0.028*
Roman Catholic	0.004	*0.25*	0.067	*1.72*	0.046	*2.71*	0.019	*0.86*	0.008	*0.333*

Table A4 Continued

Other religion	0.169	*2.32*	-0.102	*-0.45*	0.103	*1.41*	0.095	*1.03*	-0.005	*-0.042*
SPECIALIST Arts School	0.003	*0.08*	-0.027	*-0.28*	-0.018	*-0.43*	0.138	*2.60*	0.034	*0.596*
SPECIALIST Languages School	-0.014	*-0.45*	-0.097	*-1.33*	0.081	*2.45*	0.00	*0.00*	0.009	*0.191*
SPECIALIST Sports School	0.003	*0.08*	0.185	*1.99*	0.097	*2.55*	0.069	*1.44*	0.174	*3.625*
SPECIALIST Technology School	0.083	*4.88*	0.032	*0.80*	0.054	*3.00*	0.092	*3.83*	0.052	*2.080*
Girl* Arts School	0.017	*0.65*	-0.071	*-1.29*	-0.018	*-0.90*	-0.09	*-2.90*	-0.062	*-1.265*
Girl* Languages School	0.075	*3.75*	0.04	*0.85*	-0.006	*0.43*	-0.094	*-3.48*	0.038	*1.056*
Girl * Sports School	0.022	*0.92*	0.07	*1.43*	-0.05	*-2.78*	-0.041	*-1.28*	-0.049	*-1.441*
Girl* Technology School	-0.006	*-0.55*	0.009	*0.375*	-0.019	*-2.11*	-0.037	*-2.31*	0.004	*0.182*

Note: interactions between type of specialism and KS2 score, type of specialism and FSM were included in the regressions but are not reported as they were insignificant.

Table A5 Estimated regression coefficients including proportion of LEA pupils in specialist schools and restricting regression to top quintile of schools by probability of being specialist

Dependent variable: GCSE/GNVQ total score (all interval variables are standardised)	Model 6a proportion of LEA pupils in specialist schools		Model 6b proportion of LEA pupils in specialist schools		Model 7 20 per cent of schools most likely to be specialist	
	Estimate	t stat.	Estimate	t stat.	Estimate	t stat.
Constant	-0.211	*-21.10*	-0.21	-21.00	-0.209	-20.90
K2 total for English, maths and science	0.650	*216.67*	0.650	216.67	0.662	66.20
age	0.052	*52.00*	0.052	52.00	0.053	53.00
percent girls 2000	0.014	*4.67*	0.014	4.67	0.022	5.50
FTE pupils: average 1997-2001	0.003	*0.60*	0.003	0.60	0.002	0.40
FSM average percentage 1997 -2001	-0.205	*-29.29*	-0.205	-29.29	-0.202	-25.25
FSM average (1997-01) squared	0.050	*8.33*	0.050	8.33	0.047	6.71
FSM average (1997-01) cubed	-0.006	*-3.00*	-0.006	-3.00	-0.005	-2.50
KS2 Eng maths & science squared	0.034	*34*	0.034	34.00	0.037	37.00
KS2 Eng maths & science cubed	-0.003	*-3.00*	-0.003	-3.00	-0.003	-3.00
SEN with statements: average per cent 1997-2001	-0.008	*-2.00*	-0.008	-2.00	-0.008	-1.60
White: average percentage 1997-2001	-0.076	*-15.20*	-0.076	-15.20	-0.08	-16.00
PTR average 1997-2001	-0.010	*-2.50*	-0.010	-2.50	-0.01	-2.00
Proportion of pupils in specialist schools	-0.01	*-1.67*	-0.007	-1.00	-	-
Specialist school 2000* KS2EMS96	0.0170	*3.40*	0.017	3.40	-	-
Specialist school 2000*FSM average 1997-2001	0.0230	*2.56*	0.024	2.67	-	-

Table A5 Continued

Specialist school 2000* proportion of pupils at specialist schools	–	–	-0.015	-1.36	–	–
Girl	0.179	*59.67*	0.179	59.67	0.175	58.33
Girl at specialist school	-0.023	*-3.83*	-0.023	-3.83	-	-
Grammar	0.221	*8.84*	0.220	10.48	-	-
Secondary modern	-0.045	*-2.14*	-0.045	-2.14	-	-
Highest age 16 (=1)	0.047	*4.70*	0.047	4.70	0.057	5.18
Church of England	0.032	*1.78*	0.032	1.78	0.018	0.95
Roman Catholic	0.057	*4.75*	0.057	4.75	0.048	4.00
Other religion	0.107	*1.98*	0.108	2.00	0.135	1.48
SPECIALIST	0.092	*9.20*	0.099	9.00	0.067	6.7
Specialist school 'effect size' in GCSE grades	***1.77†***		**1.43†**		**1.29**	

† assumes mean proportion of LEA pupils in specialist schools (0.19)

Table A6 Logit regression of probability of being a specialist school

Dependent variable: logit (probability of being a specialist school)	Estimator	Wald
Constant	-1.658	576.88
Full time equivalent pupils (average 1997-2001)	0.508	81.19
Proportion of pupils with SEN	-0.079	0.064
Voluntary school	0.263	3.56
Foundation school	0.419	7.82
Girls' school	0.551	6.62

Note: Grammar schools, secondary modern schools, denominational schools omitted.

References

BENTON, T., HUTCHINSON, D., SCHAGEN, I. and SCOTT, E. (2003) *Study of the Performance of Maintained Secondary Schools in England: Report for National Audit Office* (Slough, NFER).

BLAIR, T. (1998) *The Third Way: New Politics for the New Century* (London, Fabian Society).

DFEE (1997) *Excellence in Schools* (London, Stationery Office).
DFES (2001) *Schools: Achieving Success* (London, DfES).

DFES (2002) Statistics of Education: Pupil progress in Secondary Schools by School Type in England: 2001, *National Statistics Bulletin*.

DFES (2003) *A New Specialist System: Transforming Secondary Education* (London, DfES).

DFES (2004) *Specialist Schools Programme 2003/04: Applications - A Guide for Schools* (London, DFES http://www.standards.dfes.gov.uk/specialistschools/guidance.

EDWARDS, T., WHITTY, G. and POWER, S. (1999) Moving Back from Comprehensive Education, in: J. DEMAINE (Ed) *Education Policy and Contemporary Politics* (Basingstoke, Palgrave).

GIDDENS, A. (1998) *The Third Way: The Renewal of Social Democracy* 1st edition (Cambridge, Polity Press).

GOLDSTEIN, H. (1995) *Multilevel Statistical Models* (London, Arnold).

GOLDSTEIN, H. (1997) Methods in school effectiveness research, *School Effectiveness and School Improvement*, 8: pp. 369-395.

GOLDSTEIN, H. and SCHAGEN, I. (2002) Serious reservations about the interpretation of what we said ..' *Research Intelligence,* 81: pp. 27.

GORARD, S. (2002) 'Let's keep it simple';: the multilevel model debate, *Research Intelligence,* 81: pp. 24.

GORARD, S. (2003) What is multilevel modelling for?, *British Journal of Educational Studies,* 51: pp.

GORARD, S. and TAYLOR, C. (2002) The composition of specialist schools in England: track record and future prospect, *School Leadership and Management,* 21: pp. 365-381.

HOUSE OF COMMONS EDUCATION AND SKILLS COMMITTEE (2003) *Secondary Education: Diversity of Provision, HC 94* (London, The Stationary Office).

JESSON, D. (2000) *Value added in specialist schools 1999* (London, Technology Colleges Trust (www.tctrust.org.uk)).

JESSON, D. (2001) *Educational outcomes and value added analysis of specialist schools for the year 2000* (London, Technology Colleges Trust (www.tctrust.org.uk).

JESSON, D. (2002a) 'Response to article by Schagen and Goldstein', *Research Intelligence,* 80: pp.

JESSON, D. (2002b) *Value added and the benefits of specialism* (London, Technology Colleges Trust (www.tctrust.org.uk)).

JESSON, D. (2003a) *Educational outcomes and value added by specialist schools* (London, Specialist Schools Trust) (www.specialistschoolstrust.org.uk).

JESSON, D. (2003b) 'Methods for evaluating school performance - a reply', *Research Intelligence,* 82: pp.

JESSON, D. (2004) *Educational outcomes and value added by specialist schools* (London, Specialist Schools Trust) (www.specialistschoolstrust.org.uk).

LEVACIC, R. and VIGNOLES, A. (2002) 'Researching the links between school resources and student outcomes in the UK: a review of issues and evidence', *Education Economics,* 10: pp. 312-331.

MAYSTON, D. (2002) *Tackling the endogeneity problem when estimating the relationship between school spending and student outcomes, Research Report 328* (London, DfEE).

NATIONAL AUDIT OFFICE (2003) *Making a Difference: Performance of maintained secondary schools in England* (London, The Stationery Office).

OFSTED (2001) *Specialist Schools: An Evaluation of Progress* (London, OFSED)

PATERSON, L. (2002) 'Jesson on Schagen and Goldstein confuses politics and science', *Research Intelligence,* 81: pp. 26.

SAMMONS, P., HILLMAN, J. and MORTIMORE, P. (1995) *Key Characteristics of Effective Schools: A Review of School Effectiveness Research* (London, London University Institute of Education and Ofsted).

SCHAGEN, I. and GOLDSTEIN, H. (2002) 'Do specialist schools add value? Some methodological problems', *Research Intelligence,* 80: pp.

SCHAGEN, S., DAVIES, D., RUDD, P. and SCHAGEN, I. (2002) *The Impact of Specialist and Faith Schools on Performance* (Slough, NFER).

TEDDLIE, C. and REYNOLDS, D. (Eds) (1999) *The International Handbook of School Effectiveness Research* (London, RoutledgeFalmer).

TODD, P. and WOLPIN, K. (2003) 'On the specification and estimation of the production function for cognitive achievement', *The Economic Journal*, 113.

WEST, A. and HIND, A. (2003) Secondary school admissions in England: Exploring the extent of overt and covert selection, *London School of Economics mimeo*.

WEST, A., NODEN, P., KLEINMAN, M. and WHITEHEAD, C. (2000) *Examining the Impact of the Specialist Schools Programme, Research Report RR196* (London, DfEE).