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An Economic Appraisal on Efficiency, Institutional Restructuring and Reform in English State Primary Schools

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A dissertation submitted in partial fulfilment of the requirements for the degree of Master of Philosophy, University of London.
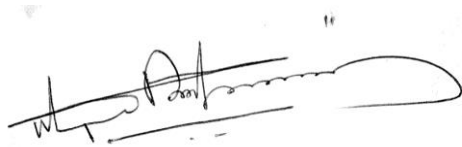
2021

Declaration

I, Margaret Antony, hereby declare that this thesis and the work presented in it is entirely my own. Where I have consulted the work of others, this is always clearly stated.

Signed   (Margaret Antony)

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Abstract

This thesis is an economic appraisal on the primary education sector of England. The research is undertaken on all state primary schools in the country for the period 2002 – 2014. The period is noteworthy with regard to observed trends in primary education spending as well as for major policy reform associated with the Academies Act 2010. The study provides economic insights on educational attainment at the school level in these two different contexts.

First, the aspect of efficiency in resource utilisation is examined against the backdrop of the economic recession with imminent and actual cuts on education spending – the second largest area of public spending. An econometric estimation of the production frontier, defined by the most efficient schools, is undertaken using data on school inputs and *test-score* output for the period 2002 – 2010. The empirical evidence suggests considerable scope for improving efficiency in state schooling in England. Mean-efficiency levels vary between 0.5 and 0.95 on both inter-school and intra-school variations in pupil attainment and progress. Schools are seen to be capitalising on pupils with higher learning aptitude, with prior attainment being the single most dominant factor that has a positive effect on efficiency based on test-score measures. The frontier schools are evidently more judicious in the employment of school resources in maximising the educational output. In terms of school finance, the 'best-practice' schools are able to translate every percentage increase in per pupil real expenditure in to a 0.1 percent rise in english and maths test results, unlike the average school.

The latter part of the thesis is a policy evaluation on the Academies Act 2010. The 2010 Act heralded the ongoing academisation process of English primary schools, whereby schools converting to academy status gained autonomy from local education authority control. As a contextual prelude to the empirical research, a chapter of the thesis documents the changes brought about by the 2010 reform and examines its policy implications. The causal effects of

institutional restructuring on academic achievement and school composition is then examined through a comparative analysis of academy schools vis-à-vis maintained schools. The school level analysis over the years 2002 – 2014, adopts the standard difference-in-differences model for a time (period) and yearly event estimation of the academy effect in this sector. The average test performance of pupils in academy schools is observed to have increased by almost a unit, in the post-academisation years, for standardised tests in english reading and maths, over that of maintained schools. The estimates indicate intake quality enhancing changes in academy schools in the post-reform period relative to maintained schools, which is accompanied by increasing pupil numbers in these schools.

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Introduction

The primary education sector caters to the largest number of pupils in compulsory education in the UK. The vast majority of primary school pupils, that is over 93 per cent (around 4.7 million pupils), are educated in state schools with the remaining 7 per cent attending independent schools. State schools are non-fee paying schools, which are funded by the central government either through the local education authority or directly. Currently, a third of public spending in education[1] goes to the state primary school sector (Bolton, 2020). Improving school performance and pupil outcomes in state primary schools has received priority under successive governments. In recent years, there have also been growing concerns over the persistence of a long tail of underachievers in the state school sector. Policy reforms and programmes, including priority spending for disadvantaged students, intended to improve schools, have been implemented with varying degrees of success overtime. This thesis, 'An Economic Appraisal on Efficiency, Institutional Restructuring and Reform in English State Primary Schools', looks at two important aspects in the economics of schooling in England, within this context, that have to do with efficiency in the utilisation of school resources and the implications of 'market-oriented' policy reforms involving institutional changes in state primary schools.

The aspect of efficiency is an under researched area in the economic literature on English schools. The most commonly used criteria for evaluating school performance is pupil achievement, measured mainly by test scores. Education policy, in the UK, has also been centred on improving pupil performance in standardised tests and increasing the numbers of pupils attaining expected levels of attainment by the end of each phase of schooling. The school league

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[1] "Education spending is the second-largest element of public service spending in the UK behind health, representing about £95 billion in 2019–20 in today's prices or about 4.2% of national income." (Britton et al, 2020).

tables, published since 1992, also rank schools on the basis of standardised test results/pupil attainment. School performance measures again form the main criteria on which failing schools are identified by the schools' inspections authority, the Office for Standards in Education, Children's Services and Skills (Ofsted). This emphasis on high-stake performance indicators can, however, be counter-productive and result in sub-optimal outcomes. Schools are known to game the system for their benefit through practices, such as, selective intake and streamlining. Schools may compete to attract pupils with higher aptitude in learning and prioritise improving their rankings in the school league tables by 'teaching to test' and focusing on potential borderline pupils so as to improve test results within short time-frames. Measures based on school efficiency – on how well schools utilise their resources in achieving desired outcomes – may be offered as a meaningful alternative to 'test-centred' performance indicators. Efficiency measures enable greater accountability and transparency within the system of state schooling and also provide an incentive for schools to improve standards at minimum costs.

An efficiency analysis is undertaken as part of this research, using data on school inputs and test-score output. The empirical estimation of school-level efficiency uses the econometric approach, known as the stochastic production frontier methodology, to identify the frontier, comprised by the most efficient schools in the dataset. In other words, the production frontier function depicts the maximum attainable educational outcome with the minimal use of school resources. The empirical evidence from this research shows the most efficient schools to be more effective in the utilisation of school inputs compared to the average school. It identifies some of the idiosyncratic factors, with respect to school inputs, in the education production process of the best practice schools. The analysis undertaken analyses efficiency both with respect to inter-school variations in pupil performance as well as intra-school variations in educational outcomes. The findings throw light on the scope for school improvement by optimising the use of valuable resources and through the emulation of best-practice.

The latter part of this thesis is a policy evaluation on the Academy Act 2010. The reform paved the way for the institutional restructuring of the state

primary school sector through the introduction of academy schools. Academy schools are non-fee paying autonomous schools, funded directly by the central government. Academies epitomise the influence of neo-liberal thinking on education policy reforms over the last quarter of a century. They are an extension of the quasi-market in the state education sector, where both public and private agents meet in the efficient delivery of public services. A critical review of the academy reforms is undertaken in this study, tracing the path to academisation of state primary schools and the later expansion of the programme. The review undertaken examines the legislative and organisation features of the new system of schooling and elaborates on the implications of the school restructuring exercise. This is followed by a policy evaluation on the impact of the 2010 reform in the state school sector, through the empirical estimation of the 'academy effect'. The analysis is undertaken by specifying a difference-in-differences model that compares between academy schools and a comparable control group of maintained schools on school test results and intake quality. The estimates from the so specified period and yearly event models show a significant and positive 'academy effect' on maths and english test scores in the post-academisation period. The results on school intake quality are, however, not as vivid, but indicate performance enhancing changes in the intake composition of academy schools relative to maintained schools.

Chapter 1

Efficiency in Primary Education in England

1.1 Introduction

The allocation of resources to schools and within schools is central in education decision-making. In allocating resources and in the design and implementation of education policy, schools and state agencies, as rational agents, are engaged in optimising behaviour. Such optimising behaviour involves making choices, the nature of which is crucial in determining the effectiveness of resources and of education policy, per se. The interplay of political and behavioural choices made by the state, schools and households (parents and students), as optimising agents in the education production process results in differing outcomes. Assuming a common educational objective, analysing the variation in outcomes would enable the identification and emulation of 'best-practice' within the sector. This forms the core of an efficiency analysis in education as is undertaken in the current study.

Specifically the study examines relative efficiency in primary education in England for the period 2002-2010 using pupil-level data from the National Pupil Database (NPD) that has been aggregated to the school-level for the purpose of the analysis. Efficiency, as used here, refers to the aspect of technical efficiency, defined a la Farrell (1957) as the ability of an economic

unit to increase its output without increasing the use of its resources[2]. In the context of primary education, it reflects the ability of a school to maximise its educational output (where, measured by test scores) with the minimal use of its resources. Thus within the framework of education production function analysis, the study aims to quantify where inefficiencies in resource allocation are originating, through the identification of best practice within the primary school sector. The hypothesis is that relative inefficiencies exist in resource use and allocation between schools and there exists the scope of maximizing output further (that is, the educational output/s or desired educational outcome) by learning from best practice and through the judicious allocation of resources.

The identification of best practice and measurement of efficiency is made possible using the production frontier methodology. The study exploits the developments in the econometric approach to efficiency measurement to obtain efficiency scores for individual schools based on the data on inputs (covering various school and pupil characteristics) and `test-scores' output. Adopting the stochastic production frontier methodology, developed by Aigner et al (1977), a time-varying fixed effects model is specified that allows for both cross-sectional as well as temporal variation in efficiency levels a la Cornwell et al (1990). Two different specifications of the production frontier are used. One examines efficiency in terms of test-score production, while the second specification is based on measures of variance in test scores. The study further identifies the determinants of teaching efficiency in primary education, on how schools differ with regard to the inputs that go into the education production process.

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[2] The term 'efficiency' is used interchangeably with 'technical efficiency' in the study. It may be noted that technical efficiency is just one component of overall economic efficiency. The other component of economic efficiency is allocative efficiency, which refers to the ability and willingness of an economic unit to equate its specific marginal value product with its marginal cost. Taken together, overall economic efficiency is defined as the ability of an economic unit to allocate resources in such a way as to derive maximum returns against the minimum sacrifice. Farell (1957) provides a clear distinction between these three different measures of efficiency. In the absence of data on input prices, the current study focuses on the technical aspect of economic efficiency alone. Moreover, the measurement of technical efficiency assumes greater significance, given the higher probability that where technical inefficiency exists, it is likely to exert an influence on allocative efficiency, thereby, resulting in a cumulative negative effect on overall efficiency (Kalirajan and Shand, 1994).

This study puts into perspective the link between efficiency in resource use and educational achievement in the context of resource availability and between school variations in school expenditure patterns. An efficiency study of this nature is particularly warranted in the UK context in light of the observed sharp increase in the overall spending on education[3] as well as on schools, particularly after the late-nineties, prior to the onset of the recession circa 2008. The overall increase in the recurrent expenditure by the central and local government on schools in England in real terms for the ten year period since 1997/98 has been to the tune of 34 per cent, with spending on under 5s, primary and secondary schools increasing by 59 per cent, 25 per cent and 29 per cent, respectively. Whether the increase in resources has translated in terms of improved performance and whether more resources mean better outcomes can be effectively addressed through an efficiency analysis of schools, which is unprecedented. An analysis on how effectively schools have employed resources in improving performance during this relevant period would also shed light on the possible implications of the austerity measures that have ensued. The specification of a time-varying efficiency model enables one to undertake a trend analysis of the relative-efficiency of schools and observe how these have responded to exogenous changes in public spending on schools and changes in education policy per se. The economic aspect of school performance in terms of efficiency in resource use and the judicious allocation of resources have received little attention to date. A common criterion used for judging school performance, in the education literature, has been pupil achievement measured mainly through test scores (Hanushek, 1986; Gibbons, 2011). Much of educational policy, in the UK, has also been centred on the objective of improving performance and increasing the numbers of those attaining the expected levels of achievement at the end of their school year. This has been a main criterion in ranking

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[3] Public spending on education constitutes about 5 per cent of the National Income in the UK (OECD, 2004), with spending on school education accounting for the largest proportion of total education spending (Sibieta et al, 2008). The main elements in overall education spending, it may be noted, include spending on schools, higher education and further education.

schools in the School League tables as well[4]. The success of education policy and the success of schools are, thus, mainly judged on the criteria of performance measured in terms of test scores/attainment levels as different from attaining the maximum outcome through the optimal utilisation of resources. The Schools' White Paper – *The Importance of Teaching,* published in November 2010, officially recognises the importance of efficiency in improving the effectiveness of schooling in the UK. Learning from best practice and the judicious allocation of resources are spelt out as important factors in a bid to improving the efficiency of the system. In the absence of any comprehensive study on efficiency in resource use in schooling in the UK, this study aims to fill the void in the existing literature through a systematic evaluation of relative efficiency in primary schooling in England. Comparing school performance in terms of optimizing resource use would contribute to a better understanding of the economic aspect of performance in schooling. Moreover, identification of the idiosyncratic factors in the education production process of the best performing schools enables the emulation of `best-practice' and thereby the more effective utilization of resources in the primary school sector.

The contribution of school resources to pupils' performance is an issue that is widely contended upon (Hanushek, 1986; Vignoles et al, 2000; Hanushek, 2003; Hageland et al, 2005). Studies examining the link between school resources and performance, in the UK context, observe a small but positive association between educational expenditure and performance (Gibbons et al, 2011a; Nicoletti et al, 2012). The analysis in these studies has been mainly undertaken following the traditional production function approach through OLS estimation. The current study deviates from this trend, examining the link between resource allocation and performance from a production frontier framework. Through the econometric estimation of the production frontier, the parameters of which reflect the association between school inputs and the school output for the best performing schools, the deviations from the

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[4] The School League tables have been published since 1992 as an informative source catering towards enhancing choice and inducing competition in schooling in the UK.

estimated frontier are quantified to arrive at measures of efficiency (inefficiency) for those schools below the frontier. The parameters of the estimated frontier are also compared with that of the average production function estimated via OLS to gain a better understanding of differences between the best practice and average school. The findings clearly exhibit the frontier schools as having a greater effect on performance compared to the average school, besides being more effective in the use of its resources. The estimated efficiency scores vary between 0.3 and 1, between the least efficient (0.3) and most efficient (1) schools in the dataset. Primary schools in England, in the state school sector, could, thus, improve their efficiency by up to 70% by using resources more effectively.

This study, further, examines how schools compare in terms of intra-school variations in test results in the context of efficiency. Tincani (2017) establishes that the variance of peer types can have a negative effect on performance depending on the ability of students, with a differential impact observed across subjects. By specifying the variance in test scores as an outcome variable, this study looks into the association between efficiency and intra-school variation in test-scores: Higher variance in test results being indicative of greater 'intra-school' inequality in performance and hence undesirable[5]. The patterns of association between the different factor inputs and variance in test-scores is also closely examined. There is observed to be little consonance between inter-school variations in performance and intra-school variation in test results with regard to technical efficiency, implying a trade-off between the two when it comes to the efficient utilisation of resources.

The estimated production frontier model also controls for inequities stemming from location-specific and school-specific factors as well as temporal factors determining the school/pupil profile, through a school-by-year fixed effects estimation of the production frontier. Besides this, the

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[5] Inequality in UK primary education has been a major area of concern, particularly in recent years, with evidence of widening disparity and poor performance of some schools. According to the Equality and Human Rights Commission (EHRC) Report 'How Fair is Britain' (2010), children are being failed by Britain's schools because of inequalities relating to gender, race and cultural issues despite decades of reform.

education production function has been specified to include variables that control for the differences in the pupil profile and neighbourhood characteristics. These control variables include the ethnicity of pupils, free school meal status, mother tongue, special educational needs and gender. Again, relevant in this context are the inequalities stemming from the nature of differential funding to schools based on location-specific characteristics. Under the current system of funding, schools in disadvantaged areas receive more funding through a system of compensatory resource allocation to and from local authorities. This allowance in the current funding formulae has led to discrepancies in school funding as neighbouring schools with similar socio-economic profiles receive different levels of funding, on grounds of falling under the jurisdiction of different local authorities (Gibbons, 2011a). As to how the non-random allocation of pupils and funding to schools impact upon variations in efficiency-levels further expands the analytical scope of this study.

Comparison of efficiency scores across schools is of considerable interest from a policy as well as academic perspective. Efficiency studies on the education sector of the UK are relatively few and pertain mainly to secondary and higher education (Bates, 1997). There is observed to be a dearth of efficiency studies at the primary or elementary school level in England, which accounts for the largest proportion of pupils in the education sector of the country. Furthermore, primary education being a crucial determinant of further educational attainment, a comprehensive study of efficiency in primary education, assumes importance. This is particularly so considering the possible spill over effects of improved primary school performance on overall educational outcomes.

The following sections of this paper are organised thus: Section 1.2 provides an overview of the institutional setting and of educational policies pertaining to UK primary education relevant to the period of study. Section 1.3 contains a critical review of the relevant literature. The methodological framework and results of the current study from the empirical estimation of school technical efficiency are presented in Sections 1.4 and 1.5, respectively. Section 1.6

outlines the policy implications, while Section 1.7 concludes on the main findings and policy recommendations that emerge from the study.

1.2 Institutional Structure and Policy Environment

Primary education in England accounts for the largest proportion of pupils in compulsory education in the country. As per the latest School Census (2013), there are $24,328$ schools in England[6]. These include schools in the state sector (maintained schools) as well as independent/private schools. The private sector caters to the education of only around 6-7% of pupils in England, with maintained schools in the state sector containing the vast majority of the pupil population in the country[7]. Maintained schools differ in the way they are governed, on who controls pupil admissions, and their religious affiliation (Gibbons et al, 2008). Under the DfE classification, these schools are categorised as[8]: Academy schools, Community schools, Foundation schools, Voluntary Aided schools and Voluntary Controlled schools[9]. About 60% of Primary schools in England are classified as Community schools, with 15% comprised by Voluntary Controlled schools that are predominantly Faith schools. Foundation schools account for about 2%, of which 86% are not connected to a particular faith, while Voluntary Aided schools account for about 23% of the state primary school sector, the majority of which are religiously affiliated (97%)[10]. The formation of Academy schools is a fairly

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[6] Schools, pupils and their characteristics, Academic Year 2020/21 – Explore education statistics – GOV.UK (explore-education-statistics.service.gov.uk)

[7] As per the Statistical First Release (DfE), there were 4.3 million pupils in state-funded primary schools in England in 2013.

[8] Table A1.8 in the Appendix lists the main types of Primary Schools in the country and their fundamental characteristics.

[9] This list excludes Community Special schools and Foundation Special schools that cater to the education requirements of Special Needs (SEN) children and Pupil Referral Units (PRUs).

[10] Gibbons, 2008.

recent phenomenon that came into effect with the Academies Act 2010[11]. An Academy school is a publicly funded independent school offering free education to pupils of all abilities, established by sponsors from business, faith or voluntary groups working in partnership with the central Government and local education partners[12]. There has been the further addition of what are known as free schools and trust schools in recent years. Similar to Academies and funded directly from the central government, these schools are to be set up by groups of parents, teachers, charities, trusts, religious and voluntary groups[13].

Maintained schools are mainly funded by the central government and follow a *National Curriculum[14]*. The national curriculum is organised into blocks of years called 'key stages' (KS). Key stages were introduced to the UK education system in 1988, to ensure that all children cover specific content during these particular stages of their school career. For each subject, teachers guide their pupils through the requirements of the National Curriculum, in preparation for Standard Assessment Tests (SATs) at the end of Key Stages 1, 2 and 3. Thus, at the end of each key stage, pupils are formally assessed to measure progress. Primary schooling comprises of two key stages: Key Stage 1 (KS1) and Key Stage 2 (KS2). Key Stage 1 tasks and tests are taken at the end of the Key Stage 1 program of study, normally in Year 2, when children are 7 years old. The tests cover reading, writing and mathematics. Key Stage 2 tests are taken at the end of the Key Stage 2 program of study, normally in Year 6, when children are 11 years old. Children have to be assessed at working at level 3 or above to take Key Stage 2 tests. The subjects covered in these tests are english and

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[11] The first schools converted to academy status in September 2010. On 1 September 2015 a total of 3,420 schools had done so. The majority of converters (54%) were primary schools. The 1,861 primary academy converters were 11% of all state funded primary schools (Bolton, 2015).

[12] Types of school: Academies - GOV.UK (www.gov.uk)

[13] Latest figures released by the Department for Education show that almost nine-in-ten of the schools established by parents' groups and charities received more applications than places for September, showing the growing popularity of the schools (Paton, 2013).

[14] The only exception to this are Academy schools and Free schools, which are publicly-funded independent schools that can follow their own curriculum.

mathematics. Every year the government publishes data on attainment, progress and absence in all primary schools in the country based on the SAT tests results. Media organisations use the information provided in compiling the School league tables as an informative source in widening choice and enhancing competition in state schooling.

1.2.1 *School Funding and Governance*

All maintained schools, except Academies and Free schools, come under the jurisdiction of the local authority, which are mostly local government districts that organise schooling. The local authorities act as intermediaries in the transfer of funds from the central government to schools, besides offering a number of educational services to schools under their jurisdiction. In matters of school funding, the local authorities play a decisive role, determining the allocation of funding to schools. Each local authority, has its own fair-funding formula for the schools they maintain, based on school characteristics. The adoption of differing funding formulae across local authorities resulted in schools with similar characteristics receiving different levels of funding, being located in different local authorities. In recent years, initiatives to rectify these discrepancies associated with school funding, have led to the development of a National Funding formulae for schools (Chowdry et al, 2011).

Schools receive funding for three years at a time. There are two major types of school funding: revenue funding and capital funding[15]. Revenue funding pays for the day-to-day running costs of the school: staff salaries and heating/light bills. The funding is received by the school from their local authority (LA) and is known as delegated budget. The majority of funding for schools is provided by a central government grant to the local authority, known as the Dedicated Schools Grant (DSG). The local authority can spend more than the DSG on schools, but may not spend less. The DSG plus any funding the LA receives from the Learning and Skills Council is called the

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[15] A Handbook for New School Governors 2009-2010; Chowdry et al, 2011

Schools Budget. The LA can retain part of the Schools Budget to fund central services, e.g. to fund pupil referral units and high cost special educational needs. It is the local schools forum (Governing Body), which decides how much of the Schools Budget can be retained centrally. On average, local authorities retain about 13% of their Schools Budget for central services; while 10% of LAs retain less than 9% and 10% retain more than 17% of their schools budget[16]. The remainder of the Schools Budget is delegated directly to individual schools through the local authority's spending formula that distribute the majority of funds on the basis of the number of pupils in schools. More recently, local authorities have been constrained on how they set their formulae on school funding and have to adhere to rules such as the Central Expenditure Limit that restricts the growth in spending on central services and the Minimum Funding Guarantee (MFG) whereby, each school is guaranteed a minimum increase in funding per pupil each year (Chowdry et al 2011).

Overall, the most common aspects of the fair-funding formulae that determines the allocation of funding to schools are:

- The number of pupils at each Key Stage;

- Indicators of social deprivation, such as the number of pupils eligible for free school meals (FSM);

- Individually Assigned Resources for pupils with a statement of special educational needs (SEN);

- Number of pupils with SEN without a statement[17];

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[16] Chowdry et al, 2011.

[17] A Statement is a document, which sets out a child's SEN and any additional help that the child should receive. The aim of the Statement is to make sure that the child gets the right support to enable them to make progress in school. A Statement is normally made when all the educational provision required to meet a child's needs cannot reasonably be met by the resources within a child's school at School Action or School Action Plus after proper assessment.

- Number of pupils with English as an additional language (EAL);

- Site and school factors (the school's business rates bill, an amount per square metre of the school's site, and many other factors), technically referred to as the Area Cost Adjustment Index (ACA).

The other major type of funding is capital funding, that is, money provided for spending on school buildings. This funding may not be spent on the day-to-day running costs of the school or on routine maintenance. Every school receives a devolved formula capital allocation, calculated on a formulaic basis. In addition to formula capital, schools can also apply for other forms of capital funding.

Schools may also receive grants for specific purposes. These include the School Development Grant, received from the respective LEA, which may be used to support teaching and learning, and the School Standard Grant. The School Standard Grant is calculated as an amount per primary school plus a per pupil amount and is allocated to schools at the same time as their delegated budget. Schools have discretion on how to use the School Standard Grant, such as for funding community facilities to support the school's extended services.

The resources that a school has at its disposal vary between schools and are largely determined by the amount of funding received from the central government. Schools also mobilise money from the local community, mainly through charitable gifts and donations, as well as from other sources such as school trips and school fairs. Schools receiving delegated budgets from local authorities are subject to local authority auditing procedures. Schools are subject to regular internal audits carried out on behalf of the local authority by their internal auditor. They may also be subject to external audits as part of the Audit Commission review of the local authority[18].

The school has decisive power on how to spend its funds. The bulk of the expenditure predominantly covers teacher pay that follows national pay

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[18] A Handbook for New School Governors 2009-2010.

scales. Besides this are the expenses mainly on support staff or other staff, building and maintenance and on learning resources/IT. How well a school uses its resources and how these are linked to educational priorities is part of the inspection process undertaken by the Office for Standards in Education, Children's services and Skills (Ofsted), the regulatory body that takes responsibility for the inspection of education in all schools in England[19].

1.2.2 *Policy Initiatives: 1997-2010*

A child-centred and progressive system of education[20] with better access and greater choice of provision are, currently, some of the prominent features of the state school sector in the UK. Education policy reforms have played a crucial part in, thus, transforming school education in the country, overtime. In recent years, particularly since the late eighties[21], these have centred on deregulating and modernising the UK education sector. In this section, some of the major policy reforms relevant to English schools are reviewed for the period 1997-2010 on different aspects of schooling that include the curriculum, the structure of schooling, performance and spending.

The aims, purposes and values of primary education, particularly in the latter half of the nineties, were set to raise pupil performance in the core subjects of literacy, numeracy and science. A number of pilot schemes and interventionist programmes, starting with the formation of the National curriculum and its delivery, have since taken shape. Among the noteworthy initiatives of the time

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[19] Ofsted inspectors work to government legislation and statutory guidance, which is based on the Department for Education's Safeguarding children and safer recruitment in education (*www.ofsted.gov.uk*)

[20] The two most noteworthy Acts in this context are the Elementary Education Act of 1880 and that of 1891. The former made school attendance compulsory and the latter made elementary education free.

[21] In 1988 the British parliament passed the Education Reform Act intended to bring about far-reaching changes in the education sector of the country by allowing the operation of a market economy in the provision of education. These changes, however, contain only some elements of an internal market for education within the state education system (Glennerster, 1991). Hence the term quasi-market is used to refer to the still evolving market-oriented system of state schooling in England.

are the National Literacy Strategy and the setting up of national learning targets, the inclusion of a compulsory literacy and numeracy hour in primary schools, the wider use of non-qualified teachers to support classroom teaching and secure improved student outcomes and the reduction in the amount of compulsory content in the National Curriculum. Policy evaluation studies highlight the importance of these programmes and reforms to improvements in schooling. Machin et al (2004), examining the effectiveness of the compulsory literacy and numeracy hour in primary schools, observe reading scores to have risen by 0.09 of a standard deviation, as a result. Johnson (2004) also credits the literacy and numeracy strategies in support of KS2 performance with a significant part of the remarkable improvements in results between 1997 and 2001. According to Johnson (2004), "these strategies set out very clear guidelines for teachers, with clearly structured lessons and daily 'literacy hours', in part responding to significant criticism of practices common in some primary schools." Similarly, Coughlan (2007) observes a sharp rise in the number of 11 year olds who reach the expected levels in English, Maths and Science between 1997 and 2006.

Also noteworthy are programmes promoting educational inclusion. Following the 1997 white paper *Excellence in Schools,* two major initiatives, addressing the persistent problem of a long tail of underachievers in UK education, were launched. These were the Excellence in Cities (EiC) and Education Action Zones (EAZs). EAZs were set up in 1998 in inner city areas with underperforming schools. They consisted of clusters of schools in deprived areas working together with government grants and sponsorship from local businesses, assuming some of the functions of the LEA[22]. Eventually, in 1999, the most successful EAZs were merged into a new programme called Excellence in Cities. This was a three-year programme aimed at improving the education of inner city children, to enable them to achieve better education and labour-market outcomes (Emmerson et al, 2005; Johnson, 2004). An evaluation of the programme by Emmerson et al (2005) shows it to have had

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[22] Gillard, 2018.

the intended effect with a significant and positive EiC effect observed on the performance of inner city schools.

Another direct policy intervention by the government, with the objective of improving the urban primary school, is the Improving Schools Programme (ISP), previously called the Intensive Support for Primary Schools Programme. Schools that made little progress in raising standards and with low achievement in literacy and mathematics were to receive support from local authority (LA) advisors or consultants as part of the ISP. It involved a process of streamlining, whereby, these schools, helped by their advisers/consultants, were to select out the children in each class who can be supported to make 'accelerated progress'. The initiative had the added advantage of enhancing the schools' position in the league tables (Macguire, 2009). More recently, there has been the introduction of a pupil premium, which is money provided to schools towards the support of disadvantaged children and meant to improve their educational outcomes.

Performance enhancing policy initiatives, aimed at improving the quality of teaching, have also been pursued by successive governments. Under New Labour, head teachers were specifically 'identified as in need of higher status and training as school leaders' (Gunter, 2009). A National College for School Leadership (NCSL) was established in 2000 in order to train and support aspiring and serving head teachers. The National Professional Qualification for Head Teacher (NPQH), was, further, made mandatory from 1 April, 2009 and the qualified teacher status (QTS) requirement to be a head teacher removed. Subsequently, the Tory government, on similar lines, oversaw the setting up of `Teaching Schools', whereby outstanding schools were to lead the training and professional development of teachers and head teachers. In addition to this, 'School Direct', an initiative allowing schools to train top graduates as teachers in the subjects and phases they need has been set up. It has also been made compulsory for teacher trainers to pass literacy and numeracy tests before starting training. Besides this, there have been new regulations on teacher appraisal. *The Education (School Teachers' Appraisal) (England) Regulations 2012* make the regulations on teacher appraisal mandatory for maintained schools and local authorities, while providing

schools and local authorities greater freedom to design appraisal policies that suit their own individual circumstances. This policy initiative has been followed by a more recent move to relate teachers' performance to pay, based on the recommendations of the School Teachers' Review Body (STRB). The initiative equips head teachers with the freedom to decide pay and is intended to reward good staff. The scheme also helps schools in disadvantaged areas recruit and keep the best teachers (Walker, 2013).

In the area of institutional reform, the deregulation and modernisation of the UK education sector received much headway with the enactment of the Education Act 2002. Following the proposals of the white paper '*Schools – Achieving Success,*' the legislation relegated the role of Local Education Authorities (LEAs) in the provision of education while encouraging greater private sector participation. There has since been greater diversity in the provision of educational services in the country as seen in the establishment of trust schools, academies and free schools. These initiatives on greater school autonomy and the diversification of schooling has received further impetus with the Academies Act 2010. The implications of the market oriented changes have been evaluated in different contexts, portraying the opportunities and challenges embedded in the new system of schooling (Chevalier, 2005; Wilson, 2011).

Public policy measures on school finance have particular relevance in the current context. The efficient and fair allocation of funding to schools has received priority in school funding reforms in recent years. Among the noteworthy policy initiatives in this direction have been the introduction of the Central Expenditure Limit and the Minimum Funding Guarantee (MFG). While the latter restricts the growth in spending on central services, the MFG ensures each school a minimum increase in funding per pupil each year. In addition to this, major reforms towards the formulation of a National Funding formula that ensures school funding is fair and flexible to changing needs have taken root (Chowdry et al, 2011). The period 1997-2008 also witnessed a steep rise in both overall education spending and school spending.

The above review on the policy environment throws light on the various aspects of school reforms that shape the character of the public provision of schooling in the UK, on which the current study focuses.

1.3 Education Production Function Analysis: A Review

A proper appreciation of the input-output relations prevalent in education becomes pertinent in the context of an efficiency analysis on schools. There has been a plethora of studies, mainly of an empirical nature, that examine the input-output relations in education in various dimensions and contexts (Scheerens et al, 1989; Hanushek, 2003; Vignoles et al, 2000). The empirical research, however, remains equivocal in determining the factors critical to 'school effectiveness'; the generalisation of findings is also made difficult given the different methodological approaches in these studies (Vignoles et al, 2000). Empirical research in this subject area has also been greatly limited by the lack of adequate theoretical models and the unavailability of reliable data (Scheerens et al, 1989; Vignoles et al, 2000; Levacic et al, 2002). Taking note of this, the empirical and theoretical underpinnings in the literature on the effectiveness of school resources, specifically in the context of primary education in the UK, is examined in this section.

A pioneering study on the effectiveness of school resources on pupil outcomes is the Coleman Congressional Report of 1966. The report highlighted the role of family circumstances, ability and socioeconomic background in determining pupil outcomes over and above that of school resources. The publication of the Coleman report initiated a flow of studies focusing on the link between school resources and performance. However, there has been little consensus regarding the school's contribution to pupil outcomes (Hanushek, 1997; Scheerens et al, 1989; Vignoles et al, 2000; Hanushek, 2003; Haegeland et al, 2005, 2008; Das et al, 2011; Gibbons et al, 2011a; Nicoletti et al, 2012; Cobb-Clark, 2013). For instance, Grissmer et al (1994) focusing on various family factors that influence children's achievement at a point in time

show that black students performed better overtime compared to white students, despite unfavourable family factors.   Unlike Coleman, they therefore, conclude that schools matter, attributing the better performance among black students to improvements in schooling. Though, there have been efforts to map educational inputs to attainment through major surveys, involving meta-analysis and vote counting, on the empirical literature, the evidence drawn remains inconclusive (Hanushek, 1986; Hedges et al, 1994). While Hedges et al (1994) point to a significant relationship between various factor inputs and achievement, according to Hanushek (2003) resources in general contribute little to student achievement and what matters more are incentive policies designed to make improvements. Vignoles et al (2000), examining the relevance of meta-analysis on the literature on school effectiveness, sums up that "the 'positive' results of some meta-studies can at best be taken as indicative, rather than conclusive."

From a theoretical lens, school effectiveness[23] is generally perceived in terms of input-output relations and refers to the processes that lead to the realisation of educational outcomes/goals. Though the education production process involves the multi-level generation of multiple outputs, standardised tests/examination results are the most commonly used measures of output in empirical research (Gibbons, 2011a; Hanushek, 1986). Of these, measures on value-added or pupil progress are being increasingly relied on in education production function studies, since their introduction (Hanushek, 1971). Value-added measures are particularly useful in accounting for non-randomness in the nature of allocation of pupils to schools - a typical feature of schooling systems around the world (Vignoles et al, 2000; Gibbons, 2008, 2013). School inputs, on the other hand, refer to school-specific features that may affect educational outcomes. Coleman (1966) placed emphasis on compositional factors, identifying family circumstances, individual ability and socio-economic background as important determinants of educational

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[23] See Vignoles, 2002 for an elaborate discussion on the distinction between school effectiveness research and education production function studies. In the current context, however, the term school effectiveness is used very broadly as in Hanushek (1979; 1981; 1986), incorporating education production function research as well.

outcomes. The decomposition of school inputs so as to provide a more holistic approach in incorporating various determinants of educational outcomes in education production function analysis has since ensued. Some of the factors used in the empirical research are total expenditure/expenditure per pupil, class-size/pupil-teacher ratio and the qualifications and experience of teaching staff. Variables defining school composition include the free school meal status of pupils taken as a proxy for the socio-economic background, ethnicity, the education of parents and innate ability/aptitude measured by pupil performance in the early years of schooling. The analysis that follows models the education production function on some of these output and school input measures commonly found in the literature.

1.3.1 *Empirical Studies on English Primary Schools*

The empirical evidence on English primary schools is reviewed here from the literature on the effectiveness of school resources, the class-size debate and policy evaluations[24].

Gibbons et al (2011a), exploiting differences in funding patterns between local education authorities arising from differences in the Area Cost Adjustment index (ACA)[25], investigate the causal link between educational expenditure and pupil outcomes at the end of primary schooling in England. Using a regression discontinuity approach with Area Cost adjustment differences taken as an appropriate source of exogenous variation in funding between schools, the study shows large effects of expenditure on attainment. An additional expenditure of £1,000 per student in urban schools was estimated to raise student test scores at the end of primary school by around 0.25 standard deviations. Nicoletti et al (2012) adopting a production function approach, also find a positive effect of school finance on pupil outcomes. They estimate that a £1,000 increase in annual spending per pupil in schools would

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[24] Machin et al (2005) provide a comprehensive review of some of these studies.

[25] See section on school funding in Section 3 below.

increase the average of the test scores in Mathematics, English and Science by about 1%, 0.75% and 0.5%, respectively.

The contribution of factors, other than school finance, to school quality, has also been examined. Gibbons et al (2007) consider the effect of pupil mobility on performance. They establish that immobile pupils who experience high pupil entry rates in their year groups progress less well academically between ages 7 and 11 than pupils who experience low mobility in the same school. Gibbons et al (2008), on the other hand, examine the association between competition and school performance. The performance gains from greater school competition is shown to be limited, with a positive causal link observed only in the case of Voluntary Aided schools. Here, autonomy in administrative and admission practices is noted as an important factor where competition has an effect on schooling outcomes. In another study, Gibbons et al (2011b) provide insights on the role of institutional factors on school performance. Estimating the causal effect of attending a state Faith school on attainment in English primary schools, the authors show that pupils who attend Faith schools progress faster compared to their counterparts in other state schools. Among other aspects examined in the literature are school size and teaching quality. Chevalier et al (2005) highlight the importance of teaching quality and effort on pupil outcomes, with the pupil-teacher ratio observed to have only a limited impact. Analysis on the class-size indicator from other sources also show any effects it has on pupil attainment to be small and declining overtime (The Department for Education, 2012). The report 'Class Size and Education in England' (DofE, 2012), thereby, concludes that class size reduction policies need to be assessed against other factors, such as, teacher effectiveness when it comes to improving school quality.

An understanding of the economics of schooling in the UK is also got through evaluation studies on targeted programmes and policy reforms in English schools. Machin et al (2004) undertake an evaluation on the National Literacy Project (NLP) that covered about 400 primary schools in England in 1997 and 1998. They observe that reading scores rose by around 0.09 of a standard deviation following the introduction of the literacy hour. In a review of the Intensive Support for Primary schools Programme (ISP), Maguire et al (2009)

point to the need for "a policy approach that takes account of 'political, social and economic contexts' in working towards a better way of 'doing school' in the urban setting "(characterised by 'challenging' schools). Johnson (2004) reviews education policy reforms in England and also notes significant improvements in KS2 results attained between 1997 and 2001 since the introduction of the literacy and numeracy strategies in support of KS2 performance. According to the author, "these very big increases in performance suggest substantial initial levels of inefficiency in converting resources into the particular outcome – success at KS2 tests – and a significant failure of information or incentives within the school sector itself." These observations are relevant in the current context and highlight the scope of an efficiency analysis on schools in informing policy as well as contributing to the discourse on improving school effectiveness.

1.4 Methodological Framework and Data Analysis

The conceptualisation and measurement of efficiency using the production frontier methodology stems from neo-classical production function analysis. Theoretically, the concept of a production frontier corresponds to the neo-classical notion of a production function as the maximum possible output attainable with any given set of inputs. Any deviation from the frontier, thus, indicates the extent of an economic unit's inability to produce the maximum output using its available inputs. The extent of (in) efficiency is given by an index, which is the ratio between the actual and potential output. Whereas the conventional production function approach assumes all economic units to be efficient and thus, operating on the frontier, efficiency analysis using the production frontier deviates from the conventional notion in recognising the existence of relative inefficiencies in production.

The conventional production function may be seen as an average function, statistically estimated using Ordinary Least Squares (OLS) regression as different from the frontier technique developed by Farrell (1957). Under the

production frontier methodology, the maximum possible output/production frontier, not being observable, must be estimated. Empirically, the production frontier is estimated from the observation of inputs and outputs of a number of economic units. There are two competing paradigms on how to estimate production frontiers under this methodology. One uses mathematical programming techniques (deterministic) while the other employs statistical methods (stochastic).

In the deterministic approach to efficiency measurement all variation in performance is attributed to variations in efficiency alone. The deterministic approach consists of parametric and non-parametric techniques. In the nonparametric programming technique the frontier is constructed as a free disposal convex hull based on the input-output ratios through linear programming techniques (Farrell, 1957). The method consists of linear segments connecting the best technically efficient economic units against which the actual output of each sample observation is measured. The advantage of this approach is that no functional form needs to be imposed on the data. However, the approach suffers from the limitation that the frontier is computed from a supporting subset of observations from the sample, and is therefore particularly susceptible to extreme observations and measurement error (Forsund et al, 1980). It also doesn't make allowance for statistical noise or measurement error.

Aigner et al (1968), following Farrell's suggestion, specified a homogeneous Cobb-Douglas production frontier with all observations required to lie on or beneath the frontier. Technical efficiency is, then, computed directly from the vector of residuals, using either the linear programming or quadratic programming technique with the error term in the specified functional form assumed to be one-sided (Forsund et al, 1980). The difference in this approach with the non-parametric programming technique is that the parametric frontier is smooth, while its non-parametric counterpart is piecewise linear. However, as with the non-parametric methodology, the 'estimated' frontier in the parametric approach is sensitive to outliers. Afriat (1972) further developed upon the deterministic models so as to make them amenable to statistical analysis. He proposed a two-parameter gamma

distribution for the error term and proposed that the model be estimated using maximum likelihood method. This method still suffers from the drawback that it does not take into consideration the influence of random events and statistical noise in estimating efficiency. These drawbacks in the deterministic models are overcome in the stochastic production frontier methodology (econometric approach) to efficiency measurement.

The stochastic frontier method being better amenable to statistical testing makes it a better choice over other models for the current analysis. Inefficiency is modelled by a 'composed' error term, under this approach, consisting of statistical noise and a one sided disturbance to allow for inefficiency. In the stochastic production frontier framework developed by Aigner et al (1977), the best practice or frontier production function takes the following generic form:

$$y = f(x) + u + v \quad\quad\quad\quad\quad (1.1)$$

where, y is the observed outcome (test scores). As is unique to the stochastic production frontier methodology, the error term is decomposed into two parts: *u + v*; where *v* captures the influence of other random factors, such as differences in location, institutional setting and measurement errors and is assumed to be normally distributed, i.e., $v \sim N[0, \sigma_u^2]$. Technical (in) efficiency is captured by the one-sided component of the error term in the above equation, that is, '*u'*[26]. The deterministic part f(x) and the stochastic part, `v' together makes up the frontier for each observation (i.e., f(x) + v), unlike in the deterministic approach, where any deviation from the frontier is attributed solely to technical efficiency with no allowance made for statistical noise in the data (i.e., y=f(x) +u) [27].

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[26] Conventionally, the efficiency component of the error term ('*u'*) can take either the form of a truncated normal distribution, a half-normal distribution, an exponential distribution of a gamma distribution.

[27] Figure A1.1 in the Appendix illustrates the difference between the three main approaches in the estimation of the production function – the average production function estimated via OLS and the production frontier estimated through the deterministic approach and that

The above function (eq. 1.1) can be estimated empirically, through either maximum likelihood estimation, modified ordinary least squares (as used in the current study) or generalised method of moments. Jondrow et al (1982) enabled the calculation of observation-specific (school-specific) efficiency levels, based on the strong distributional assumptions made on the components of the error term. Observation specific estimates of efficiency are obtained by considering the expected value of *u*, conditional on *(v-u),* by using either the mean or mode of the conditional distribution. Where the technical efficiency component of the error term follows a half-normal distribution this is calculated as:

$$E[u_{it}/\varepsilon_{it}] = [\frac{\sigma\lambda}{1+\lambda^2}][\mu_{it} + \frac{\phi(\mu_{it})}{\Phi(\mu_{it})}], \mu_{it} = -\lambda\varepsilon_{it}/\sigma \qquad (1.2)$$

or

$$E[u_{it}/\varepsilon_{it}] = \frac{-\lambda(y_{it}-\beta x_{it})}{\sigma} \qquad (1.3)$$

here;

$\lambda = \frac{\sigma u}{\sigma v} > 0; \sigma = \sqrt{\sigma v^2 + \sigma u^2} > 0$; ϕ (.) is the probability density function and Φ (.) is the cumulative distribution function.

From the point estimates of u, thus, obtained, estimates of technical efficiency (TE) are derived as:

$$TE = exp(-\hat{u}) \qquad (1.4)$$

In the extension of the above model to the panel-data case, Cornwall et al (1990) estimate technical efficiency, allowing for temporal variation without invoking strong distributional assumptions on the components of the error

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estimated through the econometric approach, also known as stochastic production frontier analysis (SFA).

term. This is done by including in the production function a flexible function of time with parameters that vary over individual units.

The basic model in the panel data case is specified as:

$$y_{it} = \alpha + \beta x_{it} + Υ_l + v_{it} + u_i \qquad\qquad i = 1, \ldots, N; \; t = 1, \ldots, T \qquad\qquad (1.5)$$

Defining $\alpha i = \alpha - ui$ gives the standard panel data model:

$$y_{it} = \alpha_i + \beta x_{it} + v_{it} \qquad\qquad\qquad (1.6)$$

It is assumed that v are independently and identically (i.i.d) distributed and uncorrelated with the inputs x. This last assumptions is made for the consistency of the within and generalised estimators of the parameter vector β, which are derived from the OLS estimation of equation 1.5 - a fixed effects model, where $Υ_l$ is the parameter representing local authority fixed effects. Cornwell et al (1990) replace the firm effect (αi) in equation 1.5 above by a flexibly parameterised function of time. A quadratic functional form is chosen, whereby:

$$\alpha_{it} = \theta_{i1} + \theta_{i2t} + \theta_{i3t} \qquad\qquad\qquad (1.7)$$

Defining $W'_{it} = [1, t, t^2]$ and $\delta_I = [\theta_{i1}, \theta_{i2}, \theta_{i3}]$, eq. 1.6 is written as:

$$y_{it} = X'_{it}\beta + W'_{it}\delta_I + v_{it} \qquad\qquad\qquad (1.8)$$

The specification (1.8) implies that output levels vary both over firms and over time. Efficiency measurement focuses on the cross-sectional variation and the model allows efficiency levels to vary over time (Cornwell et al, 1990). Time varying productivity and efficiency levels for each observation are then derived from the residuals based on the within estimator. Here, δ_I is estimated by regressing the residuals $(y_{it} - X'_{it}\beta)$ for observation *I* on W_{it}; on a constant, time and time squared. The fitted values from this regression provide an

estimate of α_{it} in eq. 1.7, which is consistent (for all i and t) as T $\rightarrow \propto$. The frontier intercept at time t and the firm-specific level of technical inefficiency of firm I at time t is then estimated as follows:

$$\hat{\alpha}_t = \max_j (\hat{\alpha}_{jt}) \text{ and } \hat{u}_{it} = \alpha_t - \hat{\alpha}_{it} \tag{1.9}$$

Efficiency analysis on the UK education sector, using production frontier models, is very limited and is mainly on higher education (Iziad et al, 2002; Bates, 1997). The deterministic production frontier methodology is more commonly used in these studies in the calculation of efficiency levels (Worthington, 2001). The imposition of a functional form and the inability to account for 'economies of scale' in the econometric model, make it the less preferred option in conducting efficiency studies. Bates (1997) adopts both approaches in the context of English secondary schools. The study concludes that there is much agreement between the deterministic and stochastic frontier results with high correlation observed on the relative estimates of efficiency obtained using both methods.

1.4.1 *Empirical Estimation*

The efficiency analysis is undertaken for all maintained primary schools in 151 local educational authorities across all nine regions of England for the period 2002-2010. Pupil level data on KS1 and KS2 performance and socio-economic characteristics is collapsed to the school level to undertake the stochastic production frontier (SF) analysis. The specified model allows for both cross-sectional and temporal variation in efficiency levels across schools, a la Cornwall et al (1990). The estimates from the SF model are compared with the OLS estimates for varied specifications on the educational output and the differential effects of school inputs in the 'best-practice' and 'average' school examined.

1.4.2 *The Data*

Data used for the empirical analysis is mainly from the National Pupil Database (NPD) made available by the Department for Education. The data held in the NPD is collected from a range of sources including schools, Local Authorities and awarding bodies. The data covers all maintained primary schools in England as well as independent and special schools that submit results on Standard Assessment Tests (SAT) taken at age 7 and 11 (Key Stages 1 & 2, respectively). It includes detailed information about pupils' test and exam results, prior attainment and progression at each key stage. The NPD also includes information about the characteristics of pupils such as their gender, ethnicity, first language, eligibility for free school meals, information about special educational needs and detailed information about any absences and exclusions.

The study covers the period 2002-2010. KS2 data on SAT (Standard Assessment Test) results for the relevant period (2002-2009) has been matched with KS1 data for the period 1998-2006 - the period for which cohorts who sat the KS2 tests between the years 2002-2010 had taken the KS1 tests. This is done to calculate the value-added score, measuring a pupil's progress between the two key stages[28]. The input measure for each pupil, in the computation of the value-added score, is the average point score achieved in the reading, writing and mathematics tests at KS1. The output measure for each pupil is the average point score achieved in the english, mathematics and science KS2 tests. A pupil's value added score is calculated by taking the difference between a pupil's APS at the KS2 SAT tests (actual) and the median value of KS2 results of other pupils with the same, or similar, prior attainment at KS1 (expected). A school's value added score is a simple average (arithmetic mean) of the value added measures for all pupils in the school and

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[28] The value-added accounts for differences in innate ability and the influence of the socio-economic environment and family background on a pupil's achievement and is a useful measure to circumvent any selection bias in estimation where school and pupil allocation is non-random. In other words, it captures the school's effect on performance net of other effects that include innate ability and family background, capturing the contribution a school makes to a pupil's progress/attainment.

is taken as a measure centred on 100[29]. The value-added score enables comparison between schools, where school and pupil allocation is non-random.

The NPD data comprises of performance data on all schools that take the KS1 and KS2 SATs and census data from the Pupil-Level Annual School Census (PLASC) that covers all maintained and special schools (non-maintained) in England. This data has been merged with data of the Department for Education from other sources. This includes the Annual School Census data of the LEASIS (Local Education Authority and School Information Service) on school characteristics and school finance data from the Outrun Detailed tables. The merged dataset comprises of 145,987 observations that include all maintained schools in England as well as independent and special schools that take the SAT tests. After imputing for missing values and inconsistent/implausible values through replacement with school-specific mean values of the respective variable, **the outlier values on the class-size variable and all other relevant variables were identified and flagged using dummies that take the value of one where an observation is identified as an outlier and zero, otherwise**[30]. The bottom five and top five percentile of observations on the class-size variable have then been deleted, thus eliminating the very small and very large schools in the dataset. Schools with less than than three outliers (flags) on any of the selected variables are noted as having inconsistent data. The flagged (outlier) values in each of these

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[29] The procedure followed in the calculation of the VA score has been adopted from the technical note on the calculation of a school's value added on the Department of Education's website: [ARCHIVED CONTENT] Value added technical information (nationalarchives.gov.uk). However, in the calculation of the value added score in this paper, the median value-added score in KS1 tests are based on the ability group to which a pupil belongs to within the same school the pupil attends. In the official data, it is important to note, the ability group of a pupil is determined nationally. There could, thus, be some degree of measurement error in using the value-added or progress measure as calculated in this study, in the comparative analysis across schools using the so constructed progress measure.
 In recent years, there have been significant changes in the methodology applied to calculate a school's value added by accounting for the effect of school size on value-added through the incorporation of a 'shrinkage factor'   in   the   formula used for calculating school value-added.

[30] The thus treated values have been accounted for in the estimation model with dummies that take the value of 1, indicating that the value has been imputed, and zero, otherwise. The effect of the imputed values in the estimation is seen to be negligible.

cases are, therefore, replaced by the mean value of the respective variable for the school. Given the large variation and discrepancies observed in the total real resources variable, within-school observations in the panel data with more than 3 outlier values on this variable have been dropped to minimise the effect of extreme observations on the data. The list-wise deletion of missing data and outlier observations on class-size and total real resources, including the dropping of independent and special schools from the analysis account for 24 per cent of the data. A complete case analysis is opted for on the thus treated panel dataset on 111, 289 maintained primary schools that covers the period 2002-2010, with data for all the nine years not being available for some of the schools (unbalanced panel).

The summary statistics on the selected variables in the model are shown in Table 1.1 below. These include the different specifications on the outcome variable based on test scores and the variance in test scores: the school value added score, the average percentage marks attained in english (reading and writing), the average percentage marks attained in maths (numerical ability and mental maths) and the average point score at Key Stage 2[31]. The latter three measure attainment, while the school value-added score shows the average progress pupils make between Key Stages 1 and 2. Attainment, it may be clarified, is a static concept measuring performance at a single point of time, while progress is a dynamic concept that requires longitudinal data (Plewis, 1977).

The progress measure can be operationalised either by looking at attainment at the second occasion conditional on attainment at the first occasion or in terms of a difference score, referred to here as the value-added (VA) score. The value added score indicates the extent to which pupils exceed their expected level of progress or whether they fall short of the expected levels of progress. Schools with VA scores above 100 are those where pupils on average make greater progress than their counterparts nationally and schools

[31] The average point score is derived from the average of the point scores attained in the English and Maths SAT tests and teacher assessments. The point scores are derived from the national curriculum levels pupils attain, given the percentage of marks they receive in the relevant tests. Pupils in Key Stage 1 are assigned national curriculum levels between 1 and 4+ and the national curriculum levels assigned to pupils at Key Stage 2 are between 2 and 5.

with scores below 100 are those where the average progress of pupils is lagging behind their equally able counterparts in other schools nationally[32]. The mean level of the value-added score in Table 1.1 is seen to be 99.55, indicating that the actual level of attainment at KS2 is almost equal to the predicted level of attainment based on KS1 results. The maximum value-added score among schools in the dataset is 106.75, implying that the average pupil in the school with the maximum value added score has progressed at least six terms ahead of other pupils in the same ability group for the same school. Conversely, the school with the minimum value added score of 79.7 indicates the average pupil in the school is about twenty terms behind other pupils of equal ability (with the same average point score at key stage 1) in the same cohort of the school.

On average schools seem to fare better and possibly more efficiently in maths compared to English. The average attained marks in maths tests is 66% and for English tests 60%. The extent of variation in Maths and English tests results across schools are not very different, indicating consistency in performance across these subjects in the average school. This is in contrast to the within-school variation in maths test scores that shows greater variance (inequality) in maths test results for the average school compared to the within-school variation observed for English test results. The variation around mean values for the value-added score and the average point score, on the other hand, is quite low, for schools in general.

The maximum attainable point score at KS1 is 27, which is equivalent to level 4+ and the expected level of attainment 2, with a minimum point score of 13. At Key Stage 2, the maximum attainable point score is 33, equivalent to level 5. Pupils are expected to make at least two levels of progress between KS1 and KS2, with the majority expected to attain a level of 4 and above at the end of KS2. A requirement for sitting the KS2 SAT tests is that pupils are at least at

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[32] For KS1 to KS2 value added, a measure of 101 means that on average each of the school's pupils made one term's more progress between KS1 and KS2 than the median - or middle value - for pupils with similar KS1 attainment. Conversely, a score of 99 means that the school's pupils made a term's less progress ([ARCHIVED CONTENT] KS1 to KS2 Value Added (nationalarchives.gov.uk)).

level 3a[33]. The mean and maximum values on both these indicators, as seen in Table 1.1, show a greater chance of attaining the maximum point score at key stage 2 than at key stage 1. Comparing the variance of the APS at KS2 with that at KS1, further, shows both within and between school variations to be greater in the case of the former and could arise as result of a widening gap between high performing and low performing pupils over-time.

The average cohort-size for the school leaving cohort is 35 with a maximum number of pupils of 168 and a minimum number of 1 among the largest and smallest schools[34] in the dataset. The proportion of boys and girls is almost equal in the average school while some schools in the dataset are all boys' schools or all girls' schools.

The socio-economic characteristics of pupils in the school may now be examined through the indicators on free school meal status (FSM), ethnicity, mother tongue and special educational needs. The free school meal indicator is normally taken as a proxy variable on socio-economic status (disadvantage) of pupils. While all pupils qualify for free school meals under the Universal Infant Free School Meals programme, eligibility in later years of primary schooling is means-tested. Pupils from low income backgrounds qualify for free school meals if they satisfy the criteria for eligibility (see Table A1.1). The information on free school meals is readily available in school administrative datasets and has been widely used as an indicator capturing educational disadvantage among pupils. The appropriateness of this indicator in accurately representing socio-economically disadvantaged pupils is, however, disputed (Kounali et al, 2008; Taylor, 2017; Couglan, 2017). Kounali et al (2008) show that reliance on the free school meal indicator alone underestimates the pool of disadvantaged pupils considerably and results in a downward bias on the effect of socio-economic status (SES) in standard value-

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[33] It may be noted that if any pupil is assessed to be working lower than level 3, they are disapplied from the test and only a teacher assessment level will be reported.
[34] The very small size of the school, despite dropping the lowest and highest five percentile of the data based on school size, maybe explained for as exceptional for some years for schools that otherwise fall above the lower five percentile and may be data suppressed for reasons of anonymity when the number of pupils in any given year is very low.

added analysis[35]. Measurement error and selection bias associated with the use of the FSM indicator as the sole measure of socio-economic disadvantage may arise for a number of reasons. The measurement of free school meal pupils being based on take up, rather than eligibility, results in underreporting on the numbers of economically disadvantaged pupils where parents are reluctant to claim free school meals for their children. The indicator also fails to account for changes in the labour market and differences in the nature of work among low income earning parents (Couglan, 2017). Moreover, where family income is at the upper threshold of the income cut-off levels, which determine whether a pupil qualifies for free school meals, the measure will not reflect the actual extent of deprivation among pupils within the dataset. Despite its limitations, the free school meal indicator is a useful proxy on socio-economic deprivation and as the only source of information on the income/wealth status of a pupil's household provided by the NPD. The summary statistics on the FSM indicator in Table 1.1 shows on average 16 per cent of pupils claim free school meals (FSM). The variance on this indicator is observed to be considerably large indicating wide variation in the distribution of FSM pupils across schools. In a small number of schools (6 schools), there are some cohort groups where all pupils are observed to be on free school meals.

An examination of the` variables on ethnicity and mother tongue reveal the majority of students in a class to be whites and English speaking (87%). On average, around 3 per cent and 5 per cent of the pupils are of African and Asian origin, respectively, while the average proportion of other ethnic minorities is 5 per cent. Pupils of Asian origin, thus, outnumber those from other ethnic

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[35] Specifically, the use of the FSM indicator is used as a proxy measure of economic disadvantage is associated with a large error in estimates at 10%. "It was also found to lead to underestimation of the proportion of children who consistently remain below the income thresholds implied by the FSM-eligibility criteria, by 50%. The income cut-off imposed is seen to characterise a significant proportion (61%) of low-income families with low-capital assets as "non-disadvantaged". The "non-disadvantaged" families which are close to the threshold will then be averaged with those from more privileged backgrounds, driving the mean test performance of the truly non disadvantaged towards lower values. The resulting comparisons between the groups formed in this way will lead to estimates of difference which are smaller" (Kounali et al, 2008).

minority groups. There is also observed to be greater variation in the proportions of pupils of Asian descent, compared to other ethnic minorities. On special education needs (SEN), the mean proportion of SEN pupils at 23% is close to the national average figures of pupils with SEN at 20% (2013). These include pupils who have been identified with some learning disability, irrespective of whether they have a statement of SEN or not. A small number of schools (15) are seen to cater only to SEN pupils. On closer inspection, it is seen that these are mostly very small schools with class sizes less than 18[36].

The composition with regard to some of the main categories of school staff shows that on average schools have at least 11 full–time qualified teachers, 4 teaching assistants and at least 1 staff for admin/secretarial work with wide variation between schools on the number of staff employed, largely determined by school size.

Wide variation is also observed in the distribution of school finance in the dataset with the average school receiving around £25,000 per pupil as revenue expenditure[37]. The total financial resources of schools has been converted to real terms using the Consumer Price Index (CPI) from the National Accounts Statistics with the year 2005 as the base year. The minimum and maximum values on total real school finance per pupil is seen to vary widely between £3,183 and £352, 425. These figures are noted to be much above the per pupil expenditure in official statistics since they are per pupil figures for the school leaving cohort, while the official records on the same are per the total number of pupils in a school.

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[36] This is again exceptional to some years for maintained schools without specialist status, in the absence of any special schools in the dataset.

[37] This comprises of expenditure under the following headings: Opening pupil focused revenue balance, opening community focused extended school revenue balance, delegated funds (including pupil focused school standard grant and learning and skills council funding), SEN funding (including some Standards Fund), minority ethnic pupils funding, standards fund residue, other government grants, income generated by schools, pupil focused extended school funding/grants and community focused extended school facilities income.

Table 1.1: Summary Statistics on Key Variables

Variables	Mean	Standard Deviation	Min.	Max.
Average Total Marks in English	60.38	7.64	13	96.67
Average Total Marks in Maths	66.33	8.77	21	99.88
Average Point Score (APS) – KS1	15.22	1.33	2.75	19.62
APS (KS2)	26.74	2.87	10	32.87
School Value-Added (VA) Score	99.55	2.42	79.7	106.75
Average Marks in English (Variance)	3.10	1.06	0.5	25.5
Average Marks in Maths (Variance)	4.03	1.29	0.99	42.5
Variance in APS (KS1)	0.62	0.22	0.1	6.33
Variance in APS (KS2)	0.74	0.28	0.09	8.67
Variance in School VA Score	0.53	0.20	0.16	7.02
Total Real Resources/Pupil	25233.28	10362.51	3183.38	352425.1
No. of Pupils	35.11	17.38	1	168
% of Girls	49.14	10.16	0	100
% FSM	16.41	16.22	0	100
% Whites	86.62	21.02	0	100
% African Origin	2.99	9.17	0	100
% Asian	4.98	13.43	0	100
% Indian	1.47	5.73	0	100
% Chinese	0.26	1.04	0	28
% Pakistani	2.82	10.55	0	100
% Other Asians	0.43	1.70	0	60
% Other Minorities	5.33	8.41	0	100
% Minorities	0.45	0.82	0	25
% English as an Additional Language (EAL)	7.15	16.58	0	100
% SEN	23.17	13.29	0	100
Full-time Equivalent (Fte) of Qualified Teachers	10.73	4.35	1	33
Fte of Teaching Assistants (ta's)	4.08	3.24	0	33
Fte of Admin Officers/Secretaries	1.27	0.72	0	18
N	111284			

1.4.3 *Empirical Model*

A log linear Cobb-Douglas production function is specified here for the frontier and OLS analysis (eqs. 1.10 & 1.11). This functional form is preferred over less restrictive and more flexible options, such as, the Translog production function, since it permits the simple decomposition of educational inputs and outputs that define the production function. The Cobb-Douglas education production function is tested for constant returns to scale (CRS). The F-test on the coefficients of the school factor inputs, however, fails to support the assumption of CRS (see Table A1.2). In other words, the input-output relation in the specified model may exhibit increasing or decreasing returns to scale. The interpretation of the results from the estimation of the average and frontier production functions, therefore, needs to be evaluated bearing this in mind.

Additionally, the average production function (eq. 1.12) is tested to check the significance of within group (school) variation to between group variations. The results of the Wu-Hausman test are presented in Table A1.3. The test validates fixed-effects estimation for all the outcome specifications, **the variation in resources and pupil composition between schools not being systematic.** An F-test on the significance of the effect of year-specific factors on the outcome variable (time-fixed effects), further, supports the hypothesis that the relationship between the factor inputs and output do not remain constant overtime (Table A1.4). The average production function and the frontier function models estimated, therefore, control for both school-specific and year-specific factors.

Equation 1.10 below specifies the input-output relationship for frontier schools as modelled by Cornwall et al (1990). The parameters in the specified function are obtained through Modified Ordinary Least Squares (MOLS) estimation. The model controls for cross sectional as well as temporal variation in technical efficiency by allowing for heterogeneity in the slopes and intercepts. Equations 1.10 and 1.12 depict the Cornwell et al (1990) time-varying fixed effects frontier model and the average production function, respectively:

$$\ln y_{it} = \beta_{ot} + \sum_{n=1}^{N} \beta_n \ln X_{nit} + v_{it} - u_{it} = \beta_{it} + + \sum_{n=1}^{N} \beta_n \ln X_{nit} + v_{it} \qquad (1.10)$$

In the above function β_{ot} indicates the common production frontier intercept to all cross-sectional productive units in period t and $\beta_{it} = \beta_{ot} - u_{it}$ is the intercept of unit 'i' in period t; v_{it} is the technical efficiency component of the error term, and u_{it} the random component. The intercept parameters for different cross-sectional school observations over different time periods, in the above specification (eq. 1.10), are modelled as a quadratic function in time as depicted in equation 1.7 above. The time variables are associated to each observation's specific parameters as in the logarithmic function below:

$$\log y_{it} = \beta \log X'_{it} + W'_{it}\delta_I + v_{it} \qquad (1.11)$$

The input coefficients from the above frontier production function estimation are compared with that of the average production function, given by:

$$\ln y_{it} = \alpha + \mu_i + \tau_t + \beta \ln X_{it} + \varepsilon_{it} \qquad (1.12)$$

where,

μ_I is the fixed-effect term, capturing school-specific fixed effects;

τ_t indicates time fixed–effects, and

ε_{it} is the error term capturing statistical noise.

The constitution of the output and input variables in both the above specifications are as follows:

y_{it} –the educational output is the log of the value-added score, the average marks obtained in english, the average marks obtained in maths and the average point score (APS) obtained at Key Stage 2, alternatively. y_{it} is also specified as the variance for each of the performance indicators, separately.

x_i – is an orthogonal matrix of various school and pupil characteristics: the cohort-size; the average point score at KS1 to control for the innate ability of pupils; the total real finance available to schools; the full-time equivalent of

qualified teachers; the full-time equivalent of teaching assistants; the full-time equivalent of administrative officers and secretaries – all in logs, as well as controls on the percentage of girl pupils; the percentage of pupils claiming free school meals (FSM); the ethnicity of pupils; the percentage of pupils with english as an additional language (EAL) and the percentage of pupils with SEN support.

1.5 Efficiency Estimates

The results from the stochastic production frontier and OLS estimation clearly exhibit the distinction between the average school and the frontier school. The co-efficient estimates of both the average production function and the frontier function are shown in Tables 1.2 and 1.3 below, for the four alternative specifications of the outcome variable and the corresponding specifications in terms of their variance.

The first two columns in the tables below show the coefficients and efficiency estimates for the value-added/progress measures for the frontier school and average school, respectively. In the average school every percentage rise in real financial resources is associated with a 0.01 percent reduction in value-added/progress. The OLS estimate on the co-efficient of the total real resources variable is both negative and significant at the 1 per cent level. The corresponding figure for the frontier function is seen to be positive, though insignificant. The class size (the cohort size) indicator is also seen to be negatively associated with the value-added score for the average school with every percentage increase in the number of pupils reducing pupils' progress by 0.01 percent. The co-efficient on the class-size variable is insignificant though positive for the most efficient schools under the value-added specification. The distinction between the best practice and average school is more vivid where the outcome variable measures the attainment level in english and maths tests. Test scores in english and maths SAT tests fall by 0.1 percent, in the average school, for every percentage increase in the total real

resources available to schools. The most efficient schools, on the other hand, are able to translate every percentage increase in real resources to a 0.1 percentage rise in attainment levels in english and maths. Where the average point score (APS), is the outcome indicator, a percentage increase in real resources in the average school lowers the APS by 0.01 percent. The co-efficient estimate on the frontier function is positive and insignificant. School-size is found to be negatively associated with output for the measures on attainment in the average production function. English and maths test scores fall by 0.1 percent with every percentage rise in the number of pupils, while the APS falls by 0.02 percent. The frontier schools, however, function more effectively with every percentage increase in the number of pupils. Test scores rise by 0.1 and 0.2 percent in the case of english and maths test results, respectively, for the most efficient schools, while the co-efficient on the APS specification is positive, but insignificant.

Both the average school and the frontier school are seen to benefit considerably from the employment of more teaching assistants. The effect of teaching assistants (TAs) on attainment is particularly high in english and maths with every percentage increase in the number of teaching assistants resulting in a 0.2 and 0.3 percent rise in english and maths test scores, respectively. The VA score and APS at KS2 increases by 0.01 and 0.03 percent, respectively with every percentage rise in the employment of teaching assistants. These effects are seen to be higher for the frontier schools compared to the average school. Schools in general are seen to benefit from the employment of teaching assistants.

The effect other school support staff have on the education output is quite different. An increase in the number of full-time equivalent of administrative officers and secretaries is observed to lower test scores in english and maths by 0.34 and 0.21 percent, respectively. The negative effect is much higher in the case of the most efficient schools (-0.65 in english and -0.45 in maths). In contrast the employment of additional administrative staff increases the value-added score and APS (KS2), by 0.01 per cent and 0.1 percent, respectively for both the average school and the frontier school.

Furthermore, the average school is observed to benefit from the employment of additional teachers who are fully qualified with test scores rising by 0.1 and 0.03 percent in english and maths tests, respectively. The same variable is, however, negatively associated with the education output for the frontier schools with test scores in english and maths declining by 0.02 and 0.1 percent with every percentage increase in the employment of qualified teachers; the estimate on english test scores being negative and insignificant for the frontier school. A similar effect is seen on the value-added and average point score with the employment of fully qualified teachers. Both the VA score and APS (KS2) drop by 0.01 and 0.1 percent with the additional employment of fully qualified teaching staff in the frontier schools. The coefficient estimates on this factor input for the average school is found to be positive, but not significant.

The effect of the indicators that define the socio-economic profile of pupils on the education output, in each of these cases, may now be examined. Among these indicators, previous attainment that determines the innate ability of pupils is seen to have a dominant effect on all outcome measures on attainment. The estimated effects are significant at the one per cent level and range from a 0.2 to 0.4 percent increase on each of the outcome variables on attainment. Schools are very clearly capitalising on the ability/aptitude of pupils, determined by factors outside the control of the school, such as socioeconomic characteristics and family background.

Other variables on the demographic composition of schools do not explain much on the observed variation in outcomes in both sets of schools. Though significant, the effects of factors, such as, ethnicity, eligibility for free school meals, special educational needs (SEN), mother tongue and gender are very low. The significant and positive sign on the variable showing the proportion of pupils with english as an additional language, under most of the specifications, prompted the analysis to be undertaken at a more decomposed level on the ethnicity variable. Since the groups classified as whites and those of African origin are more homogeneous compared to those classifed as Asian, the ethnic composition of those within this latter group are taken separately. Interestingly, compared to all other ethnic groups, Chinese pupils are

observed to have a significant positive effect on attainment by 0.1 percent in english and maths tests scores. This conforms to the other similar findings in the literature showing that Chinese pupils are among the best performers in primary school tests. The results from the frontier and OLS estimation also conform to the existing evidence that girls generally do not perform well in maths. An increase in the proportion of girls is associated with a significant negative effect on maths test results by 0.1 percent for both the average and frontier schools. Further, as is generally the case, attainment and progress are shown to be negatively associated with the proportion of pupils on free school meals and those with special educational needs in the current analysis as well. The coefficient estimates on these two variables are significant and consistent across all specifications of the education output. The estimates project a minor decline in the attainment and progress measures with every percentage rise in the numbers of pupils on FSM and with SEN. In line with similar analysis on the education sector, the results from this study also show systematic variation of efficiency in the utilisation of school inputs with the socio-economic factors that determine pupil composition (Ray, 1991; Deller et al, 1993, Bates, 1997).

Table A1.5 in the appendix presents the standardised regression coefficients for each of the specifications of the education output, where the co-efficient estimates turn out significant at the one percent level for some of the factor inputs in the estimated model in either case (average or frontier production function). As can be seen from the table a standard deviation (SD) unit change in total real resources results in a 0.2 SD change in value-added, a 0.5 SD change in both english and maths test results and a 0.1 SD change in the APS in the case of the average production function. With regard to the frontier schools a SD unit change in total real resources is associated with a 0.62 SD change in English test results and 0.8 SD change in maths test results. These estimates for the average school are of the same magnitude as the estimates in Gibbons (2011a) on the effect of school expenditure on pupil test scores. The higher figures for frontier schools in the current analysis clearly indicates the scope of making efficiency improvements through the emulation of best practice schools. Similarly a SD unit change in the number of pupils results in

a 0.2 SD change in value-added, a 0.4 SD change in English test results, a 0.04 SD change in maths test results and a 0.1 SD change in the APS for the average school. With regard to the frontier schools a SD unit change in the number of pupils is associated with a 0.4 SD change in english test results and a 0.5 SD change in maths test results. **The standardised regression coefficients clearly exhibit the frontier schools to be having a greater and positive effect on performance compared to the average school, besides being more effective in the use of its resources.** The importance of learning from best practice may be reiterated here through the more judicious allocation/utilisation of resources and by improving the efficiency of schools operating below the frontier.

1.5.1 *Intra-School Variation in Test Results and Efficiency*

The pattern of behaviour between the factor inputs and intra-school variation in performance may now be examined. Table 1.3 shows the estimates of the frontier and average production function based on measures of variance in test scores. The picture that emerges is quite different from the estimates in Table 1.2. A rise in the variance indicator, in this case, projects greater levels of 'intra-school' inequality or variation in marks among students. School size is observed to be negatively associated with the variance in test scores and the value-added in both the average school and the frontier school. The effect is noticeably higher in the average production function, varying between 0.2 and 0.3 percent for every percentage rise in the variance in test scores. The association between total real resources and variance in the progress measure and test score measures is mixed. In the frontier as well as the average school, a percentage increase in total real resources reduces intra-school variation in the value-added score by 0.01 percent and 0.1 percent, respectively. The estimate is negative and significant at the one per cent level for the average school, and negative, but insignificant for the frontier school. The total real resources also have a negative effect on the variance in english test scores and that of the average point score (KS2) in the average school with the variances in both measures falling by 0.03 and 0.1 percent, respectively. A percentage

rise in total real resources, on the other hand, raises the variance in english and maths test scores for the frontier schools by 0.1 percent and the APS at key stage 2 by 0.02 percent. The variance of average test scores in maths are also seen to be positively associated with total real resources for the average school.

A varied effect is similarly observed for school staff on the 'intra-school' variance in progress/attainment. Teaching assistants are seen to lower the variance in pupils' progress for the average school and frontier schools, However, with regard to the variance in other test score measures, a percentage increase in the number of teaching assistants is associated with an increase of 0.2 percentage in the 'intra-school' variance in english test results and a 0.1 percentage increase in the variance in maths test results for both the average and the best-practice schools. The coefficient estimates on the APS (KS2) also turn out positive for both production functions, though insignificant. An increase in the number of administrative officers and secretaries is associated with a significant negative effect, ranging between 0.1 and 0.3 percentage, on the variance in test score measures in english and maths, for both the average and frontier production functions. This contrasts with the negative association observed earlier (Table 1.2) between the number of office staff and test results in english and maths and is indicative of a trade-off between equity and performance in the employment of additional office staff. The average production function and the frontier function project a negative association between the variance in marks with the employment of qualified teachers. The same is the case with respect to the association between intra-school variation in pupils' progress and the employment of qualified teachers for the most efficient schools on the frontier. The variance in marks in english and maths display a 0.2 percent fall following a percentage rise in the numbers of full time equivalent (fte) of qualified teachers. The variance in the APS (KS2), likewise, falls by 0.01 percentage for the frontier schools as the number of qualified teachers employed by the school increases by a percent.

Innate ability is again observed to have a significant and notable impact on the intra-school variance in marks and value-added. The two are negatively

correlated and the coefficient estimates vary between 0.2 and 0.4, a greater effect being observed in the case of the frontier schools. The proportion of pupils on free school meals and with special education needs is associated with an almost negligible, but, significant positive effect on variance raising both intra-school variance in marks/progress measures. The proportion of girls is also observed to have a positive effect on the variance in marks for maths in both the average and frontier school and a fall in the intra-school variation in value-added scores. The impact of ethnicity on the intra-school variation in marks/progress measures differs with the proportion of pupils of African origin and those of Pakistani/Bangladeshi origin associated with a negative effect on the intra-school variation in progress and performance. Chinese students, in contrast, are seen to have a significant positive effect on the intra-school variation in English and maths marks for both the average and frontier school, while the proportion of Indian pupils has a significant positive effect on the within school variation in marks in maths and of the average point score (KS2) in the average school. In general, the proportion of pupils with English as an additional language is associated with a negative impact on the variation in marks and the APS (KS2). In the case of the variance of the VA score, the proportion of EAL pupils has a positive significant effect on the intra-school variance both for the average production function and the frontier function[38].

Furthermore, it may be noted that a greater degree of inter-school variation in the variance measures presented in Table 1.3 is explained by the technical efficiency component of the error term than by random variation. This is compared to the extent of deviation from the frontier function, with regard to test scores as explained by the technical efficiency component of the error term, shown in Table 1.2. There appears to be greater scope for reducing intra-school variation in marks between schools through the more efficient

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[38] Noteworthy in both table 1.2 and 1.3 are the estimates on the dummy variables for imputed values in the dataset, which turns out significant in most cases. Undertaking the analysis by dropping observations with imputed values may throw more light on the actual extent to which the coefficient estimates are changed upon imputation.

utilisation of resources compared to raising performance. The correlation matrix on technical efficiency estimates (Table A1.6), it may further be noted, shows little correlation between the estimates based on test scores and those based on variance measures. Better performance and lesser intra-school variation in marks/progress measures do not seem to move together when it comes to the efficient utilisation of resources.

1.5.2 *Mean Levels of Efficiency and Time-Trends*

The mean levels of efficiency are seen to be higher under the test-score measures compared to the measures on variance (see table A1.7). On average, efficiency is seen to vary between 0.6 and 0.95, projecting the scope for the more efficient utilisation of resources. The time-trends on efficiency (shown in Figures 1.2a and 1.2b) indicate efficiency levels to be higher in the mid-2000s compared to the earlier period in the case of test-score measures. For english test results, there is a steep rise in technical efficiency between 2002 and 2007. Thereafter, the level of technical efficiency increases gradually and is close to 70 percent by 2010. Though efficiency levels in maths are similar to those in english in the early period (2002), at slightly above 60 percent, the rise in technical efficiency is more gradual and there is a slight dip observed after 2009. Technical efficiency levels are relatively much higher on the average point score (KS2) and the progress measure (VA score). It rises steadily after 2003 for the APS (KS2), while it declines slightly in the progress measure post-2004. With respect to the Value-Added score, the large majority of schools have efficiency levels close to 95 per cent and operate very close to the frontier. Technical efficiency trends with respect to the variance on these measures are more homogenous. The starting levels of efficiency, in 2002, are all between 0.5 and 0.6. The levels of technical efficiency also appear to be consistent and steady over time with a slight dip observed after 2008, while the technical efficiency with respect to the variance in the VA score appears to be gradually falling overtime. Overall, in agreement with the observations made in section 1.5.1 above, there appears to be greater potential for improvements in technical efficiency that have to do with intra-school

variation in performance and progress compared to inter-school variation in the same measures. The gradual decline in technical efficiency levels during the period of study suggests greater dispersion (intra-school variation), in performance and progress measures, overtime, among pupils in general. The higher levels of technical efficiency observed after mid-2000 on attainment levels and progress and the lower figures in terms of the variance in these measures around the same time are particularly noteworthy features in the trend analysis. It suggests any improvements in pupil outcomes over this time period and any corresponding improvements in schools' efficiency may be occurring at the cost of educational inclusion, such that, schools may be failing educationally disadvantaged students. Looking back at the review in section 1.2.2 on the policy framework, some of the relevant policy initiatives, around this time, that are potentially associated with the observed improvements in technical efficiency, may be identified. The introduction of a compulsory literacy and numeracy hour in schools (1997/98), the Every Child a Reader programme (2001) and the Minimum Funding Guarantee and Central Expendiure Limit reforms (2004/2005) are some of the policy measures of the time, particularly noteworthy in this context. Finally, the improvements in technical efficiency levels, observed here, are in line with the improvements in school performance outcomes observed in other studies over the same time period (Machin et al, 2004; Johnson, 2004; Couglan, 2007). The findings from the trend analysis open the scope for further research exploring the effectiveness of policy measures on the technical efficiency of schools.

Table 1.2: Coefficients of the Production Function – OLS vis-à-vis Frontier

Variables	Value-Added Score		English Test Results		Maths Test Results		APS – KS2	
Estimation	**SFA**	**OLS**	**SFA**	**OLS**	**SFA**	**OLS**	**SFA**	**OLS**
No. of Pupils	0.0001 (0.002)	-0.01*** (0.002)	0.1*** (0.01)	-0.1*** (0.01)	0.13*** (0.01)	-0.1*** (0.01)	0.01 (0.01)	-0.02*** (0.01)
Total Real Resources	0.003 (0.002)	-0.01*** (0.002)	0.12*** (0.01)	-0.1*** (0.01)	0.17*** (0.01)	-0.1*** (0.005)	0.02** (0.01)	-0.02*** (0.0)
Fte. TA's	0.01** (0.002)	0.004** (0.002)	0.27*** (0.01)	0.22*** (0.03)	0.32*** (0.01)	0.26*** (0.01)	0.03*** (0.01)	0.03*** (0.01)
Fte. Admin. Officers/ Secretaries	0.01 (0.004)	0.01*** (0.001)	-0.65*** (0.03)	-0.34*** (0.02)	-0.45*** (0.02)	-0.21*** (0.02)	.05* (0.02)	0.1*** (0.03)
Fte. of qualified teachers	-0.012** (0.005)	0.003 (0.003)	-0.02 (0.03)	0.05*** (0.01)	-0.14*** (0.02)	0.03** (0.02)	-0.06** (0.02)	0.01 (0.01)
Average Point Score (KS1)			0.32*** (0.01)	0.26*** (0.01)	0.43*** (0.01)	0.31*** (0.01)	0.30*** (0.01)	0.22*** (0.01)
% Girls	-0.00002 (0.00001)	-0.00002* (0.00001)	0.0004*** (0.00005)	0.0004*** (0.00003)	-0.001*** (0.00005)	-0.001*** (0.00004)	-0.00004 (0.0001)	-0.000002 (0.00004)
% Eligible for FSM	-0.00004* (0.00002)	-0.00001 (0.00001)	-0.0002*** (0.0001)	-0.0003*** (0.0001)	-0.0004*** (0.0001)	-0.0004*** (0.0001)	-0.0003*** (0.0001)	-0.0003*** (0.0001)
% African Origin	-0.00004 (0.00004)	-0.00005 (0.00003)	-0.001*** (0.0002)	-0.001*** (0.0001)	-0.001*** (0.0002)	-0.001*** (0.0001)	-0.0004 (0.0002)	-0.0003* (0.0001)
% Indian Origin	-0.00002 (0.0001)	-0.00002 (0.00005)	0.0003 (0.0003)	0.0004* (0.0002)	0.0004 (0.0002)	0.0004* (0.0002)	-0.0001 (0.0003)	-0.0002 (0.0002)
% Chinese Origin	-0.0001 (0.0001)	-0.0002 (0.0001)	0.001 (0.001)	0.001** (0.0003)	0.00002 (0.001)	0.0004 (0.0004)	-0.001 (0.001)	-0.001 (0.0004)
% Pak/Bagladeshi Origin	0.0001 (0.0001)	0.00004 (0.00004)	-0.00002 (0.0003)	-0.001*** (0.0001)	0.0001 (0.0002)	-0.0003* (0.0001)	0.0001 (0.0003)	-0.00001 (0.0002)
% Other Asian	0.000003 (0.0001)	0.00001 (0.0001)	0.001* (0.0004)	-0.0003 (0.0003)	0.002*** (0.0004)	0.001*** (0.0003)	0.0004 (0.0004)	0.0004 (0.0003)
% Other Minorities	0.0001** (0.00002)	0.00002 (0.00001)	0..001*** (0.0001)	0.0004*** (0.0001)	0.001*** (0.0001)	0.001*** (0.0001)	0.0003*** (0.0001)	0.0001 (0.0001)
% With EAL	0.00002 (0.00003)	0.0001* (0.00002)	0.0002 (0.0001)	-0.0001 (0.0001)	0.0003* (0.0001)	0.0002** (0.0001)	0.0001 (0.0001)	0.0004*** (0.0001)
% SEN	-0.0001*** (0.00001)	-0.0001*** (0.00001)	-0.001*** (0.0001)	-0.001*** (0.00005)	-0.001*** (0.0001)	-0.001*** (0.00005)	-0.001*** (0.0001)	-0.001*** (0.00004)
Constant		4.74*** (0.02)		4.43*** (0.1)		4.32*** (0.1)		3.04*** (0.11)
R²		0.21		0.27		0.28		0.15
σ v	0.02		0.11		0.12		0.07	
σ u	0.02		0.10		0.09		0.10	
Total				111284				

* significant at the 10% level ** significant at the 5% level *** significant at the 1% level

σ v is the variance of the random component of the error term;

σ u is the variance of the technical efficiency component of the error term

Figures in parenthesis are the standard errors clustered at the local authority level

Table1.3: Coefficients of the Production Function (Variance Measures) – OLS vis-à-vis Frontier

Variables	Variance in Value-Added Score		Variance in English Test Scores		Variance in Maths Test Scores		Variance in Average Point Score – KS2	
Estimation	SFA	OLS	SFA	OLS	SFA	OLS	SFA	OLS
No. of Pupils	-0.16***	-0.17***	-0.26***	-0.34***	-0.31***	-0.33***	-0.17***	-0.20***
	(0.01)	(0.004)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Total Real Resources	-0.01	-0.1***	0.09***	-0.03***	0.05***	0.01***	0.02	-0.1***
	(0.01)	(0.003)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.004)
Ftc. TA's	-0.003	-0.01***	0.19***	0.15***	0.12***	0.1***	0.01	0.0004
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Ftc. Admin. Officers/ Secretaries	-0.02	0.03**	-0.27***	-0.16***	-0.16***	-0.13***	0.01	0.07***
	(0.03)	(0.02)	(0.04)	(0.03)	(0.04)	(0.03)	(0.03)	(0.02)
Ftc. of qualified teachers	-0.001	0.07***	-0.17***	-0.16***	-0.17***	-0.16***	-0.01*	-0.004
	(0.02)	(0.01)	(0.04)	(0.02)	(0.03)	(0.03)	(0.02)	(0.02)
Average Point Score (KS1)			-0.35***	-0.30***	-0.26***	-0.20***	-0.29***	-0.28***
			(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
% Girls	-0.0001*	-0.0002***	0.0001	-0.0001	0.0002**	0.0001*	0.0001	-0.00002
	(0.0001)	(0.00003)	(0.0001)	(0.00004)	(0.0001)	(0.00001)	(0.0001)	(0.00004)
% Eligible for FSM	0.001***	0.001***	0.001***	0.001***	0.001***	0.001***	0.0004***	0.001***
	(0.0001)	(0.00005)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
% African Origin	-0.0002	-0.0001	-0.001***	-0.002***	-0.0001	-0.0004**	-0.0001	-0.0004***
	(0.0002)	(0.0001)	(0.0002)	(0.0002)	(0.0002)	(0.0001)	(0.0002)	(0.0001)
% Indian Origin	-0.0003	-0.0002	-0.001	0.0003	0.0003	0.001*	0.0001	0.0004*
	(0.0002)	(0.0002)	(0.0003)	(0.0002)	(0.0003)	(0.0002)	(0.0003)	(0.0002)
% Chinese Origin	0.0003	0.0001	0.001*	0.002***	0.002**	0.002***	-0.0001	-0.0004
	(0.001)	(0.0003)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.0004)
% Pak/Bagladeshi Origin	-0.001*	-0.001***	-0.001**	-0.001***	0.0003	-0.0001	-0.0001	-0.0004**
	(0.0002)	(0.0001)	(0.0003)	(0.0003)	(0.0003)	(0.0002)	(0.0002)	(0.0002)
% Other Asian	0.0003	0.0001	0.001	0.0001	0.001	0.0004	-0.0001	-0.001*
	(0.0004)	(0.0003)	(0.001)	(0.0004)	(0.001)	(0.0003)	(0.0004)	(0.0003)
% Other Minorities	0.0001	0.0001***	0.001***	0.0004***	0.001***	0.0003***	0.0002*	0.0001
	(0.0001)	(0.00004)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
% With EAL	0.0004***	0.0003***	0.0001	-0.001***	-0.0002	-0.001***	-0.0002	-0.0004***
	(0.0001)	(0.0001)	(0.0002)	(0.0001)	(0.0002)	(0.0001)	(0.0001)	(0.0001)
% SEN	0.001***	0.001***	0.003***	0.002***	0.002***	0.002***	0.001***	0.001***
	(0.0001)	(0.00004)	(0.0001)	(0.0001)	(0.0001)	(0.00001)	(0.0001)	(0.00001)
Constant		1.62***		3.65***		3.18***		2.59***
		(0.04)		(0.05)		(0.06)		(0.05)
R^2		0.1		0.2		0.2		0.12
Sigma v	0.06		0.11		0.10		0.08	
Sigma u	0.09		0.13		0.12		0.09	
Total	111284							

* significant at the 10% level ** significant at the 5% level *** significant at the 1% level ;

σ v is the variance of the random component of the error term;
σ u is the variance of the technical efficiency component of the error term
Figures in parenthesis are the standard errors clustered at the local authority level

1.6 Policy Implications

The efficiency analysis on English primary schools undertaken, here, provides empirical evidence of resource-use inefficiency in primary schools in the country. The mean levels of efficiency vary between 0.6 and 0.95 for the different specifications of the educational output (see table A1.7). The efficiency estimates are observed to be sensitive to the specification of the educational output. The degree of inter-school variation in the efficiency levels under the value-added specification is much lesser compared to the other outcome indicators and may be explained by the relatively low variation across schools on value added, in general (see table 1.1). Again, contrary to what has been observed for the average school (table 1.1), mean levels of efficiency are seen to be higher with respect to test scores obtained in english tests compared to maths. The higher average test scores observed in maths, it may, therefore, be concluded does not seem to stem from the more effective utilisation of resources in this subject area. Again, the variation in efficiency levels is slightly higher in maths compared to english, indicating a greater degree of dispersion in efficiency scores among schools in this subject area.

The findings from this study carry important policy implications. The estimated school efficiency levels vary between 0.3 and 1, showing considerable scope for improving efficiency in the primary school sector of England. In light of the finding that frontier schools are able to use inputs more effectively in attaining higher output/test scores compared to the average school, English primary schools would be able to function more efficiently through the emulation of 'best practice'. The negative association observed between efficiency levels/performance and the proportion of SEN and FSM pupils and of girl pupils in maths may be addressed so as to help the most efficient schools to be further pushed up the education production frontier. In line with previous studies (Coleman, 1966; Ray, 1991; Deller et al, 1993; Bates, 1997) the importance of the socio-economic background/innate ability of pupils in determining performance is again made evident through the frontier analysis undertaken. These finding reiterate the predominance of

the socio-economic background of pupils over schools in determining pupil performance. The liaising of schools and families in improving pupil outcomes may be, put forward, as a policy solution for improving pupil outcomes and educational inclusion.

Intra-school variations in efficiency for the average school and the frontier school are seen to be more similar. Cohort size and prior attainment have a substantial negative effect on the variance in marks. The number of full time qualified teachers is also associated with a negative effect on pupil performance for both sets of schools. Again, a favourable negative effect is observed on the intra-school variation in maths test results with the employment of additional administrative and support staff. Educational disadvantage experienced by FSM pupils, SEN pupils and of girls on performance in maths is also evident from the analysis, which shows intra-school variance in marks and pupils' progress to be positively associated with the numbers of educationally disadvantaged students.

The significance of the coefficient estimates on prior attainment shows that schools are clearly capitalising on pupils with higher innate ability/aptitude, as determined by socio-economic factors and family background that are outside the control of the school. The analysis further indicates that better performance and lesser intra-school variation in marks/progress measures do not move in the same direction when it comes to the efficient utilisation of resources. Overall, there is observed to be greater scope in reducing intra-school variation in marks through the more efficient utilisation of resources, compared to raising performance; the mean-levels of efficiency being lower on the variance measures compared to test scores. The differential impact of factor resources on the efficiency of schools is a noteworthy feature of the production frontier analysis undertaken. In a policy context, studying these differential effects is important for framing policies that are conducive to the more effective allocation and utilisation of resources in order to maximise the educational outcome/s.

1.7 Conclusion

This paper analyses school performance in terms of how efficient schools are in maximising educational output/s with their given resources. The study identifies 'best-practice' or the 'frontier schools' that relatively maximise output with the minimal use of inputs. The study applies the stochastic production frontier methodology in measuring school efficiency using data on school output/s and factor inputs. A fixed-effects time-varying model, developed by Cornwell et al (1990), is specified for the estimation. Any deviation from the so constructed production frontier of the 'best-practice' schools is quantified as school-specific estimates of efficiency that also show temporal variation.

The study provides empirical evidence on the existence of considerable inter-school variation in efficiency levels and the scope for improving schools through the judicious allocation of resources and by learning from best practice. The efficiency estimates are observed to be sensitive to the specification of the education output/s with mean levels of efficiency being higher under the value-added specification compared to other output measures. On average, efficiency levels are higher for test performance measures compared to indicators on intra-school dispersion in test results. In line with other studies (Ray, 1991; Bates, 1997), there is observed to be systematic variation in the efficiency estimates with the socio-economic background of the pupils. Innate ability, as shown by prior attainment, is seen to be the most important contributory factor that determines school performance and the intra-school variation in marks as well as the relative efficiency of schools. Policy initiatives targeted at improving the performance of disadvantaged pupils could, therefore, further push up the production frontier and enable schools to perform better. The liaising between schools and families in improving school and pupil outcome/s, which has received much attention in recent years, could also potentially contribute to raising standards and improving efficiency. Further, recognition of the differential effects of school resources on pupil performance and the variance in

marks/progress is important when designing policy measures that are effective in achieving better educational outcomes.

Chapter 2

The Academisation Programme in England's Primary Schools

2.1 Introduction

This chapter focuses on the transition of previously state-managed schools (maintained schools) to academy status. Academy schools are publicly funded independent schools, free from local authority control. The academy school model was introduced in the UK secondary school sector in 2002, under the New Labour government (1997-2010) and were designed to replace failing schools. These were relaunched or new schools and, as per the provisions of the Learning and Skills Act 2000, were to be established in some of the most deprived areas of inner-city London, to improve performance. Originally referred to as 'city-academies', they were renamed as 'academies' following the Education Act 2002, and the programme was further extended to rural areas as well (Gorard, 2005; Parkinson, 2005; Long, 2015). Academy schools retain some of the organisational features of pre-existing autonomous institutions, that is, City Technology Colleges (CTCs) and grant-maintained schools. Academies, likewise, are independent from local authority control and receive funds directly from the Central government. In addition to this, academies, similar to CTCs, can be funded and run by external sponsors from among businesses, individuals, charities and the voluntary sector. The idea was to revamp schools needing intervention through organisational changes

and by involving the private sector in the efficient delivery of public education. Schools deemed as failing were mandatorily made academies under a willing sponsor. The new 'business-model' of schooling won popular appeal and has, since, been continued and expanded under successive governments. The appeal lay in its neoliberal character, a defining feature of education policy reforms in the last quarter of a century and reminiscent of a post-Keynesian era. The new school system received impetus under the Conservative led Coalition government (2010-2015) with the enactment of the Academies Act 2010, a sequel to the Learning and Skills Act 2000 and Education Act 2002. The new legislation makes provision for the academisation of all maintained schools and includes the primary school sector as well. The pace of academisation in the country has considerably increased since the implementation of this bespoke reform. As of February, 2018, 72% of secondary schools, including free schools, and 27% of primary schools are academies (NAO, 2018). The numbers are set to increase even further with all schools being encouraged to become academies by the year 2022 (Long et al, 2016). The implications of this, unprecedented, large scale transition in the schooling system are far reaching (Maisuria, 2014; West et al, 2018). The 2010 reform, therefore, provides a vital platform for studying about '*market-oriented*' policy reform and the impact of associated institutional restructuring on the education sector. This is pursued here, with focus on the transition process in the primary school sector of the country.

The rest of this chapter is organised as follows: Section 2.2 traces the history of the reforms, leading to the formation of academies. Section 2.3 provides a critical review of the academisation programme - its dominant features and the academisation experience to date. Section 2.4 examines the pace and character of the reform process. Section 2.5 concludes on the review undertaken and summarises on the policy implications.

2.2 The Path to School Autonomy and Academisation

An overarching aim of education policy reforms in the UK has been on improving 'standards'. The transition from what was a national 'state-managed' system to a locally managed 'market-oriented' one has accordingly witnessed a shift in focus from 'standards and basics'[39] to one on 'standards and choices'. The main policy changes associated with this transition, leading to the formation of academies are outlined here in the context of schools.

Among the early pieces of legislation, the Education Reform Act 1944[40] is noteworthy for the formal changes it brought about to the institutional structure of schools. The Board of Education was reconstituted as a new Ministry of Education. Schools were nationalised and local education authorities (LEAs) given the responsibility to establish and maintain schools (Batteson, 1999; West et al, 2013; Blatchford, 2014). Local education authorities were held responsible to the Minister of Education who was to provide direction and guidance to the LEAs and thereby ensure a more even standard of education throughout England and Wales (Blatchford, 2014). Three progressive stages were introduced in schooling: primary, secondary and further education, replacing the previous classification between elementary and higher education. In the secondary school sector, there was the further tripartite division of schools into grammar, secondary modern and technical schools and the school leaving age was raised from 14 to 15. Schools were assigned professional responsibilities with considerable teacher autonomy and little accountability to parents. Local education authorities, on the other hand, looked after basic school operations and administered school

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[39] Beauvallet, 2015.

[40] The Education Reform Act 1944 is also referred to as the Butler Act, named after its chief architect, Rab Butler who was then President of the Board of Education (Blatchford, 2014).

finances, primarily through government grants and local property taxes[41]. Discontent with the functioning of local education authorities and concerns over falling standards in education[42], however, steered the need for change.

The Education Act 1980 and the Education Reform Act 1988 are two important pieces of legislation associated with subsequent overhaul of the existing educational set-up. The role of local education authorities in the schools' administration was considerably diminished. Schools were made legal entities in their own right with decision-making powers over matters of finance and appointments (West et al, 2018). The 1988 legislation was particularly noteworthy in its elision of traditional elements with new approaches. It heralded neoliberal thinking in education policy making and has since set the scene for radical change in the education sector. Greater choice, diversity, autonomy and accountability were some of the hallmarks of the new reforms. Parents were granted the right to choose schools[43] and representation in school governing bodies. The first autonomous public institutions also came to the fore in the form of City Technology Colleges (CTCs). The school sector became more diversified with the establishment of specialised schools and grant maintained schools (West et al, 2013). These institutions were to receive their funds directly from the central government while CTCs and specialised schools also required financial contributions from external sponsors (West et al, 2013). Local management of schools became the norm, but schools were at the same time held accountable through a centralised steering system (Kauko et al, 2015). The National Curriculum and

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[41] https://www.britannica.com/topic/education

[42] These concerns effectively gained attention through the publication of five *Black Papers* between 1969 and 1977, reflecting right-wing critique on the English education system and a related publication, the *Crisis in Education*, by one of its editors, Rhodes Boyson, in 1975 (Beauvallet, 2015). Also noteworthy at the time was the announcement of *The Great Education Debate* by Prime Minister James Callaghan at Ruskin College Oxford in 1976, expressing the Labour Government's concerns "about progressive tendencies in education and of education's poor performance in meeting the needs of industry" (Whitty et al, 1989; Marshall, 1997; Beauvallet, 2015). There was also the concern that achievement had stagnated in English schools, particularly in the post-compulsory phase – the proportions succeeding in examinations at age 16 being stagnant from around 1970 to 1980 (Machin et al, 2006).

[43] Parental choice, however, was limited within the catchment areas of schools as drawn by the local education authority.

standardised assessment practices were introduced and made mandatory for all state schools. A system of public accountability was also put in place with the publication of school league tables and the establishment of the Office for Standards in Education, Children's Services and Skills (Ofsted) in 1992. The private sector was more involved in a newly created 'quasi-market' for education in the public sector, so called as it included only some elements of the market.

Academies further extend the scope of the quasi-market in the UK education sector. They emerged as part of the New Labour Government (1997–2010) initiatives to tackle the problem of persistent underachievement in English schools (Simkins, 2015; Gorard, 2005; Black et al, 2019). The commitment to social inclusion was in consonance with international policy trends, around the same time period, towards greater inclusive education as contained in the Salamanca Declaration (UNESCO, 1994). The 1997 White Paper *Excellence in Schools* led to the development of two well noted interventionist policy measures in this direction: Education Action Zones (EAZs) and Excellence in Cities (EiC) [44]. EAZs were set up in 1998 in inner city areas with underperforming schools. Schools in Education Action Zones enjoyed higher rates of pay with freedom to change the curriculum and the staffing structure. In 1999, the most successful EAZs were merged into a new programme called Excellence in Cities. The focus of this latter programme being on standards, to be pursued through varied schemes: learning mentors, learning support units, gifted and talent programme, city learning centres and beacon schools (Gunter, 2011). These developments eventually led to the re-launching of City Technology Colleges in the form of city academies. The legislation (the Learning and Skills Act 2000) that introduced city academies was, in fact, an extension of the rubric on CTCs. Subsequently, the Education Act 2002 dropped the word 'City' and renamed these new schools as Academies with provision for the establishment of these schools outside of cities as well.

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[44] Other complementary programmes of the period that addressed the issue of social inequality in education include the City Challenge, Every Child Matters, the Improving Schools Programme and the creation of 'Fresh Start' schools.

Similar to CTCs, academies are autonomous institutions that operate outside local authority control and receive funding directly from the central government. However, unlike CTCs, city academies were not restricted to technology, but could specialise in any subject specified by order of the Secretary of State (Walford, 2014). The scale of the academisation programme is also much bigger. Of the 15 CTCs established before the onset of academisation, all but three, subsequently became academies (Curtis, 2008; West et al, 2013). The academy programme supposedly gained greater support among local education authorities compared to CTCs (Curtis, 2008). The 2010 reform further validates the operation of academies with its provision for the expansion of the new schooling system, in which school autonomy is central.

The introduction of market mechanisms that include choice, competition and autonomy in education policy reforms is a radical approach that has been widely adopted in diverse settings. The US has been among the forerunners in implementing market oriented education policy in the provision of public education. A striking example lies in the formation of charter schools or magnet schools on which CTCs and academies have been partly modelled (Curtis, 2008). Introduced in 1992, charter schools are autonomous schools that are publicly funded and set up by a legal 'charter'. They were 'aimed at improving the quality of education and enabling greater choice' (West et al, 2013). Similarly, Sweden has undertaken a massive programme in decentralising schooling in the early nineties. New Zealand, South Korea and Australia are other countries where market oriented education policy reforms are being implemented with varying levels of success. Common policy goals in these reforms include freedom of choice, providing quality education and achieving greater cost-effectiveness (West et al, 2013).

In the UK, the 2010 White Paper spelt out the need for radical change in an education sector that is lagging behind[45] so as to meet world standards. The document recognises the initiatives taken by countries at the forefront of

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[45]The OECD PISA survey in 2006 shows that the country had fallen from 4th in the world in the 2000 survey to 14th in science, 7th to 17th in literacy, and 8th to 24th in mathematics (The White Paper 2010).

education: "improving teacher quality, granting greater autonomy to the front line, modernising curricula, making schools more accountable to their communities, harnessing detailed performance data and encouraging professional collaboration" (The White Paper 2010)[46]. The 2010 legislation, thereby, aims for system-wide change that would raise standards and alleviate inequities in the education sector. To this end, the 2010 reform extends the provision for the academisation of schools to include all maintained schools and the primary school sector as well.

2.3 Deregulation and the Academy Model

The Academy model employs the precepts of the neo-classical market model in the public provision of schooling. It exemplifies neoliberal ideology[47] and its emphasis on entrepreneurism and competitiveness for the efficient provision of public services (Ball, 2011; Maisuria, 2014). Competition, consumerism and the domination of private interests permeate this 'market-state' in education, where the role of the 'welfare' state is receded (Maisuria, 2014; Ball, 2011; Gunter, 2011). New public management (NPM) policies have come into play, underpinning the reforming structures (Maisuria, 2014; Hogan, 2014). These policy reforms have to do with the deregulation of markets and the commodification and privatisation of state assets. In

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[46] To quote the then Secretary of State for Education, Michael Gove, "These regions and nations – from Alberta to Singapore, Finland to Hong Kong, Harlem to South Korea – have been our inspiration. While each of these exemplars has their own unique and individual approach to aspects of education, their successful systems all share certain common features…It is only through such whole-system reform that education can be transformed to make a nation one of the world's top performers" (The White Paper 2010).

[47] The political economic practice of neoliberalism originated in Chile in 1973 as an experiment by a group of economists, called the 'Chicago Brothers'. It since became the preface to the rapid restructuring of global economies, by taking capitalism to a new phase. In Britain, neoliberalism, as a political and economic ideology, took roots following the 'Washington Consensus' between the prime minister of Great Britain, Margaret Thatcher and U.S President Ronald Reagan. The agreement paved the way for radical reforms initiated so as to revive the economies of the UK and USA from a state of severe recession and involved the deregulation of markets and the commodification and marketization of state assets (Maisuria, 2014).

schooling, the process entails the deconstruction of previously state-managed institutions to allow for private partnerships in the organisation and delivery of learning in state schools. It features, in particular, increasing school autonomy, dismantling bureaucratic control and enhancing managerial capacity at the school-level (Kauko, 2015). The NPM policy design as embedded in the academy model purports to have 'innovative approaches' to one or more areas of schooling, as in governance, curriculum, staffing structures and pay, teaching and learning (Black et al, 2019). Edu-businesses play an important role as legitimate contributors in the new policy environment and are being used to shape and implement education policy (Ball, 2011; Hogan, 2014). The organisational nature of schooling that ensues is best identified as heterarchical [48], characterised by 'polycentric' and 'strategic' governance structures, whereby, stakeholders, both public and private, collaborate and or compete in the policy process (Ball, 2011; Hogan, 2014).

In the pluralistic and complex setting shaped by NPM reforms and networked governance, school autonomy is paramount. As with other public-sector enterprises in the 'post-welfare' state, academy schools are self-organising units (Kauko, 2015). Schools that become academies are freed from local authority control and operate under the domain of the market. The dissolution of local control, means that these schools enjoy a greater degree of freedom compared to local authority 'maintained' schools. These freedoms mainly have to do with governance, finance, management of staff (pay and conditions), in the delivery of the curriculum, deciding the length of the school day and year and to a certain extent admissions. It is perceived that schools entrusted with greater autonomy and decision-making power are better equipped to use their local know-how in meeting the needs of the local population. Besides, school autonomy is considered essential to enable innovative management and teaching practices, catered to raise educational standards. Survey evidence on UK academy schools shows that schools have

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[48] "Heterarchy is an organisational form somewhere between hierarchy and network that draws upon diverse horizontal and vertical links that permit different elements of the policy process to co-operate (and/or compete)" (Ball, 2011, pp147).

utilised their autonomy to make various changes[49] (Eyles et al, 2017; Neri et al, 2018; Black et al, 2019). Academy schools that had been open for a longer period are observed to have made more changes (Black et al, 2019). School autonomy forms the cornerstone of the academisation policy with freedom from local authority control and bureaucracy cited as the main reason for academy conversion (Cirin, 2014; Thornton, 2018; West et al, 2018).

The English educational setting has changed in a major way with the introduction of academy schools. The school restructuring programme posits to increase the diversity of supply in schooling and enhance choice of schools in a location (Curtis, 2008; Thornton, 2018). Parental choice is the focus in the realisation of this objective, which rests on the presumption that "academies are significantly different and employ innovative approaches to particular aspects of schooling" (Curtis et al, 2008). The emphasis on parental choice is justified for reasons of promoting diversity, as a parental right, or as a means of increasing efficiency and accountability (Fiske et al, 2000). Central to this argument is the notion that "public schools are inefficient local monopolies and that educational quality would improve dramatically if only parents were allowed to freely choose between schools" (Hsieh et al, 2003). Following academisation, parents can exercise their right to choose schools outside the control of the local authority. It is argued that "if individual schools can no longer treat parents and students as captive customers, teachers and school administrators will be forced to become responsive to the needs of their students, and they will deliver education that is both higher quality and more cost-effective" (Fiske et al, 2000).

The introduction of private enterprise and the diversification of the state school sector propels competition among schools. Self-management in academy schools means that they can no longer rely on the support/intervention of the local education authority. These schools, therefore, need to be resourceful in order to survive and compete in the schooling market. Competition can be fierce and "thus should develop high

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[49] Common changes made in academy schools are: externally procuring services previously supplied by the local authorities (90% of academies); linking pay to performance (84%); and changing, or planning to change, the curriculum (79%) (Black et al, 2019).

standards as each enterprise aims to provide a better product than the next to entice customers (parents) to choose their establishment within which to educate their children" (Thornton, 2018). Furthermore, individuals are given the freedom to propose the establishment of new schools in any one area and "as the doctrine of competition underpins academies, the best proposal is likely to be selected by the Local Authority" (Thornton, 2018). Competition also extends to providers of educational services, previously provided by the local education authority. In brief, competition, as conceived in the academy model, is a non-zero sum game and mutually non-exclusive with all players benefiting in some way.

While the establishment of academies and the service provided is driven by private entities, the state input still prevails as a steering mechanism to which academies are held accountable (Thornton, 2018). In theory, the academy model incorporates the multifarious nature of accountability in education, by "using political processes to assure democratic accountability, introducing market-based reforms to increase accountability to parents and children, or developing peer-based accountability systems to increase the professional accountability of teachers" (Figlio et al, 2011). However, in practice, academy freedoms are constrained by the national policy of steering by evaluation through inspection and testing, besides the managerial practices of sponsors (Kauko, 2015).   The former falls within the lines of accountability of centralised governance patterns within which the decentralised academy model sits. Fiske et Ladd (2000), in the context of the Tomorrow's Schools Programme in New Zealand, refer to a tight-loose-tight governance structure that best summarises the governance structure of the academy model, as one "in which the central authority *tightly* specifies schools' missions and outcome standards, *loosely* allows schools to use whatever methods they choose to achieve those standards, and then *tightly* holds schools accountable for results."

2.3.1 Legislative and Organisational Framework

Academies are companies limited by guarantee, which have charitable status and are contracted by the government through a funding agreement between an 'academy trust' and the Secretary of State for Education (Wolfe, 2011; Bassett et al, 2012; West, 2019). They are subject to company law[50] and some statutory education law, and controlled and funded directly by the central government (Curtis, 2008; West et al, 2013).

An Academy school can be set up through either of two processes: (i) a competitive process as applies to the establishment of maintained schools (Section 7 of the Education and Inspections Act), or, (ii) through consultation by the Secretary of State with the concerned local authority[51] (Section 482(3) of the Education Act 1996). In the case of the former, The Local Authority selects from among the proposals submitted by persons interested in establishing a new school in the area. If the Local Authority is itself a contender, the decision is made by an adjudicator. Governing bodies of schools applying for academy status are bound by a duty to consult potential stakeholders on the proposed conversion. Where the Secretary of State is involved in the establishment of the school, the process is simplified with no statutory consultation or other procedures to follow (London Councils, 2011).

An academy project begins with what is referred to as 'expressions of interest', or EOI. The Department of Education (DfE) publishes guidance on completing an EOI form that provides important information on the proposed academy project. Signatures from the sponsor, co-sponsor(s) and LA are mandatorily required on the final version of the EOI, before the project moves to the next phase, called the Feasibility Stage. During the Feasibility Stage, a Local Authority may consult locally on the Academy proposal and study the EOI in

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[50] Academy schools are different from maintained schools, which are operated by governing bodies that are statutory corporations.

[51] Where a significant proportion of pupils at the school are likely to be resident within the area of another local education authority, it is required to involve that local authority in the consultation process (Wolfe, 2011).

greater detail[52]. The EOI forms the basis on which Funding Agreements are finally made between an academy and the Secretary of State for Education. Since 2014, these powers vested with the Secretary of State have been delegated to eight Regional School Commissioners (RSCs), who were appointed as DfE civil servants (West et al, 2018). These School Commissioners exercise significant powers and responsibility with respect to both academies and maintained schools.

In order to qualify for academy status, schools had to meet the eligibility criteria. The criteria governing conversion has changed overtime with more recent revisions allowing for the fast-track conversion of schools. The process in the primary school sector has been notably different to that in the secondary school sector where initially only failing schools were made to convert with the help of a private sponsor. At the outset of the 2010 reform (from September 2010), only primary schools judged 'outstanding', in their most recent inspection by Ofsted, were invited to assume academy status. Not much later, in November 2010, all good schools with outstanding features were allowed to convert with provision made for schools to apply for academy status provided it joined an academy trust with an outstanding school or entered into an educational partnership with a school having a proven record of improvement. In April 2011, schools considered as performing well, based on most recent test results, Ofsted rankings and financial management were included in the process (Eyles et al, 2017). To facilitate the conversion of all schools to academy status, new academies are now being encouraged to "support at least one faltering or coasting school to improve"[53].

Academies are "sponsored" and run by businesses, individuals, churches or voluntary bodies and public sector organisations that include local authorities (only as co-sponsors), universities and schools. Sponsors originally contributed to the capital costs of schools while revenue costs were met

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[52] Where academies replace existing maintained schools, as is generally the case, extensive statutory procedures involved in the 'discontinuance' of the maintained schools in question must be followed with the concerned Local Authority required to first consult and then publish formal proposals on which representations may be made, before considering whether to approve the proposals (Wolfe, 2011).

[53] London Councils (2011) quoting former Education Secretary, Michael Gove.

directly by the central government and set at a comparable level to maintained schools in the area. Sponsors are no longer required by law to make a £2 million investment for new academies and since September 2011, sponsorship is not a pre-requisite for conversion (Gunter, 2011; West, 2019). The central government also provides additional funds to cover the cost of services for which the academy would be directly responsible once it was no longer "maintained" by the local authority (West, 2019). The DfE provides funds to assist with the costs of conversion, when a maintained school becomes an academy. In 2016/17 the total value of funds amounted to £81 million. An estimated £745 million alone has been spend on conversions since 2010/11 as one-off costs and includes conversion grants at a flat-rate of £25,000 to schools that converted, and larger grants to the bodies sponsoring new academies (West, 2019). Schools, therefore, get a significant budget increase following conversion. This is a dominant reason for becoming an academy school, particularly so, in the face of austerity measures facing schools during a period of economic recession at the time the 2010 reform was enacted (Bassett, 2012; Cirin, 2014).

The Funding Agreement

The funding agreement is a legal contract that sets out the requirements of academies. These regulations vary between schools with flexibility given to individual academies to negotiate the terms and conditions of their contract. Any changes can be made only by agreement between the academy trust and the Secretary of State, or if overridden by statute (West et al, 2018)[54].

The flexibility given to academies in negotiating their funding agreement has given rise to considerable variation in schooling 'standards' across academies. Flexibility and the lack of consistency, further, carries implications for the

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[54] Instances of statutory overriding include new provisions on SEN and exclusions. All pupils with a Statement of SEN or an Education, Health and Care (EHC) Plan have to be admitted to an academy if the school is named in the Statement or Plan. Similarly, academy schools have to mandatorily admit pupils excluded from other school in the local authority within which it falls.

quality of education that pupils receive in the absence of 'standardisation' (West et al, 2018; Thornton, 2018). In recent years, attempts have been made by the Department of Education to create a Model Funding Agreement (Wolfe, 2011; West et al, 2018; Thornton et al, 2018). The aim was to eliminate inequality and create consistency across academies by providing an example that all academies can follow (Thornton, 2018). However, frequent changes in the model funding agreement, due to litigation and political influences and the lack of retrospective effects (that is, the inability to make similar changes in existing contracts), renders it ineffective to the original purpose (Thornton, 2018; West et al, 2018).

The funding agreement provides the framework within which an academy school operates. Its terms and conditions are distinct for the various freedoms that academy schools enjoy. In general, academies are required to offer a "broad and balanced" curriculum and are not obliged to follow the national curriculum. Academies are also exempted from following the School Teachers National Pay and Conditions statutory guidance. Teachers in academies are not required to have qualified teacher status in more recent funding agreements. Academies are also responsible for their own admissions with freedom to select up to 10% of their student intake based on aptitude (West, 2019). The freedoms that academy schools enjoy is still bound by general legal requirements such as the equality/discrimination law, the Human Rights Act and the Freedom of Information law, observance of which, though, is not strictly enforced as for schools directly under the jurisdiction of the Local Authority (Wolfe, 2011).

Types of Academies and Academy Trusts

Academies are broadly classified as sponsored academies and converter academies. Converter academies comprise of schools with a strong record of performance who voluntarily opt to convert to an academy. On the other hand, sponsored academies are generally underperforming schools, mandatorily made to convert under a sponsor (Coldron et al, 2014). Sponsors come from a range of backgrounds and include successful schools, businesses,

universities, charities and faith bodies and hold responsibility for improving the performance of their respective schools. Sponsors play a large role in Academies and are a particularly distinctive aspect of the Academies programme (Curtis, 2008).

Academies are run by academy trusts. Academy trusts vary according to the structure of governance and are broadly classified as: Single Academy Trust (SAT)/'standalone' academies with individual contracts and Multi-Academy Trust (MAT) with a number of academies under a single contract. From both these groups, some academies have also grouped themselves into an 'umbrella trust', while some stand-alone academies enter into 'collaborative partnerships' with other trusts. MATs, umbrella trusts and collaborative partnerships are also collectively referred to as a 'chain'. Most academies, particularly sponsored academies, are part of a chain, though some stand-alone academies exist (Simkins, 2015; Thornton, 2018; West et al, 2018).

2.3.2 Policy Evaluation

The academy model of schooling has been offered as a panacea for the ills of a state-managed system. It was intended to replicate the perceived success of CTCs and act as an engine for social mobility. The programme has made much headway since its inception in the English primary school sector with the enactment of the Academy Act 2010. The reforms being implemented touch upon almost every aspect of schooling, the implications of which are far reaching. An evaluation is undertaken here on the academisation policy and on its effectiveness as a school improvement programme.

An original aim of the academy programme has been to raise standards, particularly so in underperforming schools. Over a decade since the reforms were initiated in the country's primary schools, the association between school improvement and academisation, however, remains a contentious issue (Gunter, 2011; Thornton, 2018). Eyles et al (2017) study the exogenous effects of academisation on primary school pupils by focusing on 'legacy' pupils, enrolled in the school prior to the decision to convert to academy status. Their analysis shows zero-effects on performance following academy

conversion. Their finding is consistent both for average test results in english (reading) and maths. In a subsequent study, Neri et al (2018), using a grandfathering instrument, also referring to students enrolled in an academy school a year prior to conversion, examine the performance effects of academisation in English primary schools. They estimate a significant positive effect on test results, both in english language and maths (by about 0.9 – 1% of the average), in the immediate period post-conversion for schools that come under a Multi-Academy Trust (MAT). Single Academy Trust (SAT) schools, however, exhibit a negative effect on pupil performance, following academy conversion. Their study suggests the importance of governance structures and associated changes, made upon conversion, for improvements in performance. In general, comparisons between academies and mainstream schools show performance improvements in both groups of schools over time and hence the evidence is inconclusive with regard to the 'relative' effectiveness of academy schools (Gunter, 2011). According to Curtis (2008), the absence of a uniform 'academy effect' may be explained by variations in attainment levels between academies that average figures mask.

Another important point of evaluation concerns the impact that the academisation programme has had on the performance of those at the bottom end of the ability distribution. The programme as implemented in the primary school sector, while remaining an inclusive education policy, widened its focus to 'system-wide' change, thus deviating from its sole focus on reviving failing schools, originally. Initially, only schools judged 'outstanding' by Ofsted were allowed to become academies. Not long after, provision was made for all schools to convert provided it joined an academy trust with an outstanding school or entered into an educational partnership with a school having a proven record of improvement. This defeats the original purpose of the academy policy, which was to raise standards in underperforming schools (Thornton, 2018). It has also been observed that the existing gulf between schools has widened since the option for conversion was extended to all schools (Thorton, 2018). The widening gap is conceivable when all schools that convert receive the same amount of resources and or inputs.

Wilson (2011), in the context of secondary schools, further show that academisation has exacerbated "educational inequalities and schooling stratification along the lines of ability and social background." This is explained by "compositional changes that Academy schools have made" – a practice referred to as gaming[55]. Black et al (2019) look at compositional changes with regard to special needs pupils in schools post-academisation. Sponsored academies are observed to be more likely to reduce the proportion of pupils with special needs and remove additional support to them. Schools changing the nature of their intake, through sleight-of-hand school improvement, to produce good test results raises concerns about creating socially imbalanced schools down the road (Fiske et al, 2000; Gorard, 2005; Curtis, 2008; Wilson, 2011). Improved performance may be achieved at the expense of socially disadvantaged children, and children with disabilities, who may be directly or indirectly excluded from the new types of school (Black et al, 2019).

Also of concern are the very high rates of exclusions and half-day unauthorised absences in academy schools. Academies, in 2007, had a higher rate of half-day unauthorised absences than the national average. With regard to exclusions, the rate has been three times that of neighbouring schools. The latter can have damaging effects on neighbouring schools if academy schools exclude more pupils than the number of excluded pupils they would take in from elsewhere in the local authority (Curtis, 2008).

Machin et al (2017) examining the causal effect of academisation on performance, on the other hand, observe no changes to primary schools' pupil composition following academisation. There is also some evidence from the secondary school sector, which shows greater improvements among disadvantaged students in academy schools relative to those in local authority maintained schools (Gunter, 2011). Academies, in general, remain "inclusive" with twice the national average of pupils eligible for Free School Meals (FSM),

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[55] "Sleight-of-hand school improvement involves schools changing the nature of their intake, often as an unintended outcome of a change in admission procedures, and then claiming that an ensuing rise in test scores is due to an improvement in teaching or management." (Gorard, 2007)

though overall the proportion of FSM pupils has fallen since the programme started by 16.36 percentage points (Curtis, 2008).

The freedom that academy schools enjoy, has been brought under scrutiny. As already seen, with respect to admission procedures, it could mean less social inclusion (Wilson, 2011; Black, 2019). Flexibility over how the curriculum is taught may be compromising on the standard, quality and content of the education pupils receive and their ability to compete nationally (Thornton, 2018). Teaching standards may be further jeopardised by the freedom given to academy schools to recruit teaching staff who do not possess qualified teacher status (QTS). OECD (2011) highlights the importance of accountability in the context of school autonomy. Though, autonomy is proven to raise student performance, schools, in countries that do not have proper accountability arrangements in place, tend to perform worse (OECD, 2011). In the UK, academy schools fall under the scrutiny of the school inspections authority, Ofsted, similar to maintained schools. They are, however, exempt from inspection in the first few years of their inception as an academy school. Questions are also raised on the appropriateness of subjecting academy schools to Ofsted inspections under the same set of guidelines as maintained schools. For instance, the role of the sponsor continues to remain unchecked, though they play a very important part in the organisation of an academy school (Thornton, 2018). It is also noted, from a different perspective, that the use of centralised steering mechanisms, such as, standardised tests and Ofsted inspections contradicts the fundamentals of the decentralised model for academy schools (Kauko, 2015).

The hollowing out of local authority responsibility and the undue reliance placed on sponsors, who may be acting on their own self-interests; the undemocratic manner in which academy schools are being established through the evasion of proper consultation procedures; the lack of transparency and or opaqueness in the selection of sponsors and in financial operations; potential detrimental effects of academies on neighbourhood schools, such as, in admissions and staff retention[56]; the fragmented nature of

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[56] Academies are not bound by the National Teachers Pay and Conditions, which means they are able to attract better teachers and the most talented head teachers from other state

schooling, which the creation of academies has resulted in; the absence of provision for reversing the process once a school becomes an academy; the very loss of autonomy for schools managed by multi-academy trusts and the financial viability of academy schools, especially so when academy trusts function as not-for-profit companies (as different from the school decentralisation models adopted in the US and Sweden that operate for profit) are among other concerns raised about the operation of academy schools that deserve attention (Cirin, 2008; Gunter, 2011; Thornton, 2018; West, 2019). Nevertheless, academy schools are, generally, oversubscribed. This is so both for sponsored and converter academies, which have reported a substantial increase in first-choice applications since becoming an academy, with the increase being greater in sponsored academies (Black et al, 2019).

2.4 Expansion of the Academisation Programme

Academies were introduced in early 2000, to replace underperforming schools in the secondary school sector, under the initiative of the 1997-2010 Labour government. The first three academies opened in 2002/2003 and their numbers gradually increased in the following years. By 2008/09, the number of secondary school academies was 50 (Eyles et al, 2018). The Academies Act 2010 paved the way for the rapid expansion of the programme by enabling all schools to become academies and extending the programme to include primary schools and specialist schools as well. By 2017, 69% of secondary schools and over a fifth of primary schools were academies (West, 2019).

Academies currently constitute about 33 per cent of schools in the primary school sector of England[57]. The proportion of academies in the primary school sector is notably less than half the proportion of secondary academies (see

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schools. As per the National Audit Office records, academy principals are paid on average between £18,000 and £32,000 more than those in the maintained sector (Cirin, 2008).

[57] Open academies, free schools, studio schools and UTCs - GOV.UK (www.gov.uk)

Figure A2.1). In absolute numbers, however, the number of primary academies is about twice their number in the secondary school sector, given the larger number of primary schools (16, 769) in the country compared to the secondary schools (3, 448)[58]. Keddie (2017) explains for the disparity in the rate at which academisation has proceeded in both these phases of education:

"This disparity between secondary and primary has been attributed in large part to the relative lack of material resources primary schools can draw on to effectively take up the responsibilities of academisation. As generally small schools with a lack of leadership density, primary schools have tended not to see conversion as of benefit to them economically and managerial. Given their limited resources and size, primary schools do not have the capacity to convert to sole academy status. Rather, they would need to join an academy network or chain. There is concern amongst primary school heads that such an arrangement would undermine the individual autonomy of their school (Hill et al. 2012). For these reasons, many primary schools have opted to remain attached to the local authority." (Keddie, 2017)

The pace and character of the academisation programme varies across the country, a closer examination of which reveals noteworthy patterns. Figures 2.1 and 2.2, borrowed from Black et al (2019) shows the composition of schools by type and the rate of academisation in England, respectively.

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[58]   https://www.gov.uk/government/statistics/schools-pupils-and-theircharacteristics-january-2019

Figure 2.1: School Composition in the State School Sector (2011 – 2017)
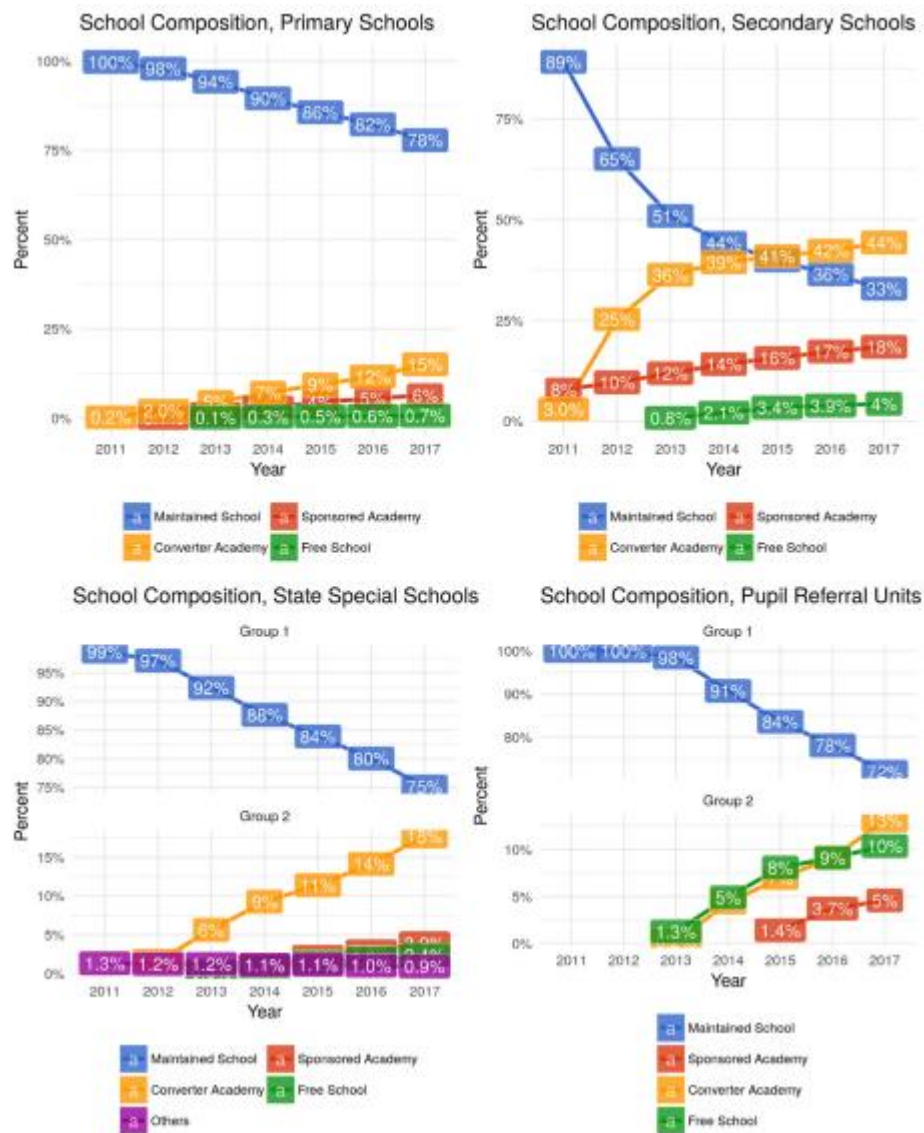
FIGURE 1 | Distributions of schools in England by types and sector. 2011–2017.

Source: Black et al (2017)

The figure above (Figure 2.1) shows the rate of change by school type: Maintained, Sponsored Academies, Converter Academies, Free schools and others, separately for primary schools, secondary schools, special schools and pupil referral units in England in 2011–2017. The rate of change is notably steeper for secondary schools, where academisation proceeded at a faster rate, compared to primary schools. The pattern of change for special schools and pupil referral units (PRUs), on the other hand, is seen to be similar to that of the primary school sector.

Figure 2.2 exhibits the regional differences in academisation over the period 2011 to 2017. Regions/areas with relatively higher concentrations of academy schools are shown in darker shade. The proportion of academies among primary schools is noticeably lower relative to that in the secondary school sector. In the primary school sector, the five most academised local authorities in 2017 are Poole, North-East Lincolnshire, Bromley, Bournemouth and Darlington.

Figure 2.2: Percentage of Academies by Local Authority

FIGURE 2 | Percentage of academies among English primary schools by local authority in 2011, 2014, and 2017.

FIGURE 3 | Percentage of academies among English secondary schools by local authority in 2011, 2014, and 2017.
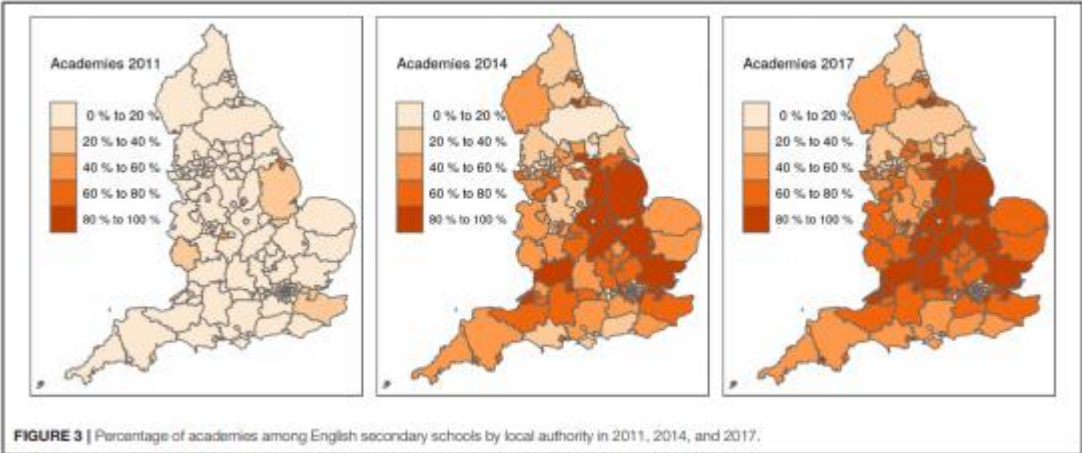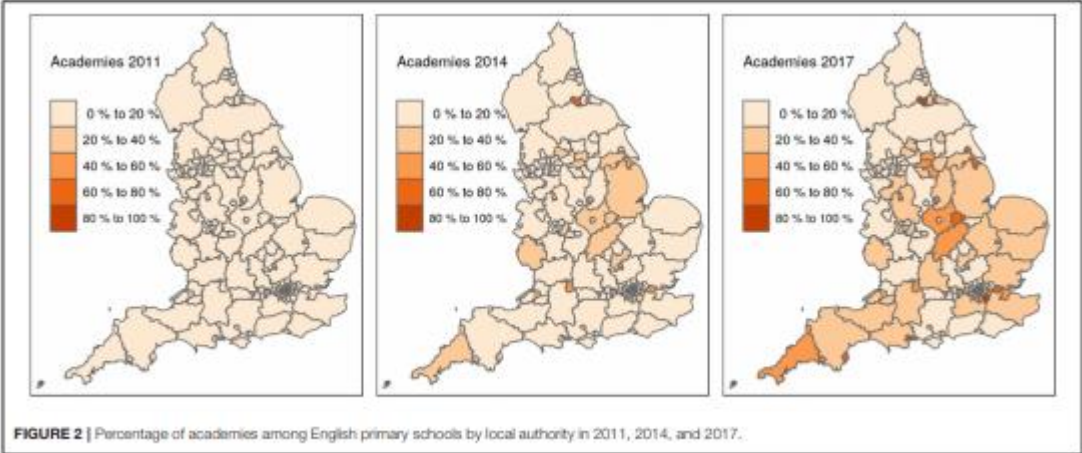
Source: Black et al (2017)

Tables 2.1 and 2.2 corroborate the observations made above on the primary school sector. Of the 16, 769 state-funded primary schools in the country, 5, 802 schools became academies by the year 2019 (Table 2.1). Of these 4,095 are converter academies, 1,509 are sponsored academies and 198 free

schools. The pace of academisation in the primary school sector has steadily risen after 2010/11, with the largest number of schools becoming academies in 2017.

Table 2.2, shows the regional dispersion of open academies for the primary school sector. The majority of academy converters are located in East-Midlands and Humber (16.5%) and the South West (16.01%), while the lowest numbers are found in the North (6.46%).

Table 2.1: Pace of Academy Conversion for Primary Schools (2010 – 2019)

Period of Conversion	Number of Converting Schools
01.09.2010 – 01.12.2010	24
01.01.2012 – 01.12.2011	319
01.01.2013 – 01.12.2013	716
01.01.2014 – 01.12.2014	660
01.01.2015 – 01.12.2015	572
01.01.2016 – 01.12.2016	729
01.01.2017 – 01.12.2017	848
01.01.2018 – 01.12.2018	836
01.01.2019 – 01.12.2019	526
Total	**5802**

Source: Department for Education data on Open Academies, Free Schools, UTCs and Academy Projects in Development, 2019

Table 2.2: Academy Schools by Area of Regional School Commissioners, 2019

Area of Regional School Commisioner	Number of Academy Converters	Proportion of Academy Converters
East Midlands & Humber	957	16.5%
East of England & North East London	819	14.12%
Lancashire & West Yorkshire	532	9.17%
North	375	6.46%
North West London & South Central	652	11.24%
South-East & South London	769	13.3%
South-West	929	16.01%
West-Midlands	769	13.3%

Source: Department for Education data on Open Academies, Free Schools, UTCs and Academy Projects in Development, 2019

Further comparison between academy concentration and school performance in the primary school sector shows some interesting patterns (Figure A2.2). Areas with low concentration of primary academies, the lighter shaded area, are where the average school performance levels are above the national average. On the other hand, areas where the density of primary academies is the highest are those where the average levels of school performance are below the national average. These figures are apparently driven by later conversions considering the fact that the criteria governing academy conversion in the primary school sector initially favoured only schools with outstanding performance and well performing schools.

2.5 Conclusion

The academisation programme, being undertaken in the UK state school sector, is one of the largest experiments in UK education policy. It involves the reconfiguration of the governance structures of schools to allow for private enterprise and the self-organisation of schools. The 2010 reform has

accelerated the process of academisation in the country and this has far reaching implications. The review undertaken in this chapter lays out the opportunities and challenges the programme poses to the UK education sector. It portrays the policy processes where political, ideological and economic factors play a major role in shaping the provisions, enactment and implementation of the programme. It identifies the gaps where policy and practice fail to meet and sometimes contradict each other. The empirical evidence, reviewed, provides a mixed picture on the effectiveness of the academisation reforms in raising standards and improving school performance. Concerns are raised about any performance gains in academies being at the cost of educational inclusion. Other challenges include the rectification of a very fragmented system of operation, having appropriate accountability systems in place that ensures uniformity in the quality of teaching across academy schools and proper management practices, enabling schools under multi-academy trusts to function without compromising on their autonomous status and ensuring a financially viable system. There are wide variations observed between academy schools with respect to performance, practices, type, location and composition, a proper understanding of which is important for policy purposes.

Chapter 3

The School-Level Effects of Institutional Restructuring

3.1 Introduction

A central feature of Education Policy Reform in the UK, in recent years, has been the establishment of 'quasi-autonomous' institutions, commonly referred to as 'academies', within the system of state schooling. Greater school autonomy, it is perceived, would positively impact upon performance and improve overall school effectiveness[59]. To this end, under the *Academies Act 2010*, the academisation programme initiated in secondary schools has been extended to include maintained primary as well as special schools[60]. Of the 16,766 primary schools in England, 2,440 now have academy status, which

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[59] "The OECD has shown that countries which give the most autonomy to head teachers and teachers are the ones that do best. Finland and South Korea – the highest performing countries in PISA – have clearly defined and challenging universal standards, along with individual school autonomy" (The Schools White Paper, 2010).

[60] The first schools converted to academy status in September, 2010. The majority of converters (59%) were secondary schools. The 772 primary academy converters in January 2013 were 5% of all state funded primary schools (Bolton, 2015).

include Academy schools, Trust schools and Free schools[61]. These schools are state-funded, non-fee paying schools, free from local authority control. Academies and maintained schools, currently, constitute the majority of schools in England, with the former having more freedom and control over their finances, the curriculum and over staff recruitment and pay compared to maintained schools.

The redesign of the educational landscape through the introduction of alternative school structures diversifies the system of state schooling in the country and broadens the spectrum of schooling choices. Where schools previously fell under local authority control, following the national curriculum and national teacher pay and conditions, there is now greater heterogeneity. The decisive power that schools converting to academy status have over their finances, curriculum, staff recruitment and admission policy enables a range of organisational options best suited to individual schools and to meeting the needs of students. While such differences are more vivid in the secondary school sector mainly through subject specialisation, there are a growing number of primary academies offering a varied curriculum and catering to the needs of a wide range of pupils, which are gaining in popularity (Brundett et al, 2010). This de facto variation in institutional arrangements provides a rich context for analysing the effects of school restructuring and forms the focus of the current paper.

Autonomy coupled with greater accountability, choice and competition further expands the scope of the quasi-market in the provision of schooling. In line with other market-oriented reforms in the education sector, greater school autonomy is envisaged to improve efficacy in the system of state schooling. The rationale here is that schools granted with more decision-making power would be incentivised to better performance and raise overall standards. Under the principal-agent relationship that characterises

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[61] An Academy school is a publicly funded independent school offering free education to pupils of all abilities, established by sponsors from business, faith or voluntary groups working in partnership with the Central Government and local education partners (**www.education.gov.uk**). Free schools and Trust schools, on the other hand, are newly established schools set up by groups of parents, teachers, charities, trusts, religious and voluntary groups that also receive funds directly from the central government.

maintained schools, voters (principals) have little control over the activities of school boards (agents), as a result of which school boards may be captured by vested interests[62]. This may result in sub-optimal outcomes, owing to the inefficient operation of the educational marketplace. The academy model, being offered as a panacea for the ills of the conventional school model, operates differently in that it realigns authority between the primary stake holders in the state school sector and emphasises up on more effective management practices at the school-level. As to whether such restructuring effectively works in practice, however, remains a contested issue (Fiske et al, 2000; Hoxby et al, 2004; Eyles et al, 2015; Eyles et al, 2016; Wilson, 2011; Machin et al, 2013).

The academy model introduced in the UK secondary school sector in 2002 is largely shaped after the free school model introduced in Sweden in the early nineties. Other similar initiatives in school restructuring include the introduction of Charter schools in the US and the Tomorrow's School Reforms in New Zealand[63]. These attempts at revamping the state school sector involves the creation of new schools or the conversion of existing schools into semi-autonomous institutions – a central aim being to decentralise authority to individual schools. These institutional changes in conjunction with other market oriented policies promoting greater choice and competition in the state school sector were intended to: 1) raise attainment levels in state schools 2) enable more effective ways of delivering the curriculum by encouraging greater diversity and innovative approaches to learning 3) lead to better matching between pupils and schools, mainly by widening the range of choices in the state school sector 4) support schools in serving the educational needs of the local student population by harnessing the local knowledge that schools have to more effectively meet the needs of the local

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[62] Clark (2009)

[63] Another dimension to the school restructuring experience of these countries is the voucher scheme. This provision entails the distribution of vouchers to pupils from disadvantaged backgrounds enabling them to study in a private school setting of their choice.

education market 5) act as "a tide that lifts all boats"[64] by improving the performance of low-performing schools and raising attainments levels of pupils at the lower tail of the student distribution and 6) improve efficiency in the state school sector by enabling the more effective utilisation of school resources.

The underlying objectives in the school restructuring programme encompasses three broad areas in economic decision-making: performance, equity and efficiency. As to whether the new school model has been effective in delivering these broad goals is, however, a contended issue. The experiences of nations partaking in the reform process have been varied and the empirical evidence provides a mixed picture on the effectiveness of the reforms. Sandstorm et al (2005) find large positive gains on educational attainment following the free school reforms in the Swedish education sector. However, the study relies on a weak instrument in estimating the effect of the reforms and fails to control for most social factors that influence the educational decisions of households in the municipalities covered in the study, limiting the scope for generalisation. In a more recent study, Bohlmark and Lindahl (2007) consistently estimate positive test gains associated with the growth of free schools in Sweden using a long panel of data from 1988/89 to 2002/03. Bjorklund et al (2004), on the other hand, show no positive gains associated with the share of free schools in the Swedish context in their study, which is confined to a short period of time with little variation in the parameter of interest. In the US context, Hoxby et al, 2004 show positive effects on attainment for pupils who join a Charter school from the lower elementary grades. Eyles et al (2016) focusing on primary school academies in England between 2010 and 2012, show a zero-effect of autonomy on pupil performance. Other studies based on the UK and New Zealand experiment in school restructuring (Machin et al, 2013; Wilson, 2011; Fiske et al, 2000) indicate improvement in test score results for students, which is confined to the top-half of the ability distribution. The lack of percolation of any performance gains to the persistent lower tail of the ability distribution, as

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[64] Hoxby, 2003

observed in the UK and New Zealand, is a pertinent issue that prods closer examination.

In most, if not all cases, school restructuring reforms were targeted at bettering low performing schools and addressing inequalities within the system. In the UK, especially, the first schools to be granted academy status were, in fact, low performing schools within the secondary school sector (Wilson, 2011). The idea of rejuvenating schools by delegating authority to private sponsors receives credence from the US experiment with Charter schools where it is seen that 'in some situations, autonomous schools can improve the performance of disadvantaged students, and narrow some of the most persistent educational disparities[65]" (Hoxby et al, 2009; Dobbie et al, 2011). Eyles et al (2016) observe these gains in performance to be most pronounced for charter schools located in urban areas, serving less-privileged pupils.

The effectiveness of US Charter schools in narrowing educational disparities, however, doesn't, seem to hold in other similar settings where 'school autonomy' became the norm. In New Zealand, the lowest decile schools that catered largely to the education of students from disadvantaged backgrounds experienced a downward spiralling effect following the reforms (Fiske et al, 2000). The country also experienced an ethnic divide in student-school sorting, after the implementation of the Tomorrow's School Programme, not explained by changes in ethnic or demographic residential patterns (Fiske et al, 2000). In the UK, too, there's been little evidence that the 'academy model' introduced in the secondary school sector of the country in 2002 has had any positive impact on the bottom tail of the student population (Machin et al, 2013). Wilson (2011), examining the effectiveness of institutional transformation on school performance, concludes that "education inequalities and schooling stratification along the lines of ability and social background have increased" owing to the "compositional changes that Academy schools have made" – an aspect further examined later in this paper.

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[65] Machin and Silva (2013)

Machin (2013) explains the differential impact of UK academies vis-à-vis that of US charters on the lower tail of the student distribution in terms of differences in the institutional setting. Charter schools operate on a charter or contract and are held accountable to their sponsor, unlike UK schools. This "generates sharp incentives for the schools to perform and achieve their contractual aims" (Machin, 2013). English academy schools, on the other hand, cater to a mix of students of different abilities and are held accountable with publicly available performance tables. Educational 'equity' within the academy model in the UK context may, thus, be a 'constrained' choice for schools, requiring remedial policy interventions.

Another aspect of the school restructuring exercise, recognised in the Academies Act 2010, concerns the efficiency gains that may be attained through the provision of greater school autonomy. This argument receives validity from "the inconclusive evidence on the effectiveness of resource-based interventions (Hanushek, 2003)" in economics literature. [66] The interplay of greater choice, competition and autonomy, together with the establishment of a quasi-market in the education sector, is perceived as conducive to school performance. The Academies Act 2010 specifically spells out the aim of reaping efficiency gains through 'the more judicious allocation of resources' and 'learning from best practice'. Besides this are quality improvements that may accrue from the adoption of more innovative and diverse curriculums when schools cater to the needs of a wider range of pupils. Fiske et al (2000) note that schools in New Zealand began to offer a very diverse choice of subjects and adopt innovative teaching practices, better suited to the needs of its students, following the Tomorrow's Schools initiative. On the downside, however, these benefits offered by the new educational marketplace also appear to have been lopsided. The New Zealand experience also shows that better performing schools often had an advantage, under the new system, and at the expense of the lowest decile of schools. For example, the successful operation of an autonomous school, largely depended

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[66] Machin et al (2013). The findings of early period empirical studies on the returns to education, as observed in Jackson et al (2016), are, however, greatly limited by the simplicity of methods used in the econometric and statistical estimation of the effects of school spending.

on managerial expertise[67] at the school-level, which all schools could not afford to have (Fiske et al, 2000). Failure to balance the interest of the various stake holders eventually led to the polarisation of schools and of the student population in the country, accompanied by associated 'efficiency' loses.

The aforementioned review on the nature of school restructuring reforms and its implementation highlights the opportunities and challenges facing schools in the new educational marketplace. It is against this setting that the current research documents the changes brought about by the Academy Act 2010 on the English primary school sector. The analysis that follows provides a logical examination of the effects of academisation on schools that convert to academy status. Such an analysis is best undertaken within a standard difference-in-differences framework. The methodology adopted allows for a yearly and event history analysis, comparing between academy schools and maintained schools over the two distinct periods of interest, that is, the pre-conversion (pre-treatment) period and the post conversion (post-treatment) period. The key identifying assumption, here, is that in the absence of treatment, there exists no difference in trends (parallel trends) between to-be-academies and maintained schools. The identifying strategy involves defining a control group of schools, from among the pooled sample of maintained schools, which best resemble academy schools pre-conversion. This is determined, here, using the propensity score matching (PSM) technique. The propensity score is estimated through a probit regression of the binary variable, that identifies 'to-be-academies' (1) and 'non-academies' (0), on a set of school and pupil characteristics, aggregated over the pre-policy time period. The propensity score exhibits the likelihood of conversion for all schools in the sample - a higher propensity score implying a higher chance

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[67] The importance of good management practices in the academy model of schooling is also empirically investigated by Neri et al (2018) in the UK context. Their findings show schools run by Multi Academy Trusts (MAT), with pooled resources and expertise, to have improved performance to a greater extent, following academisation, compared to schools run by Single Academy Trusts (SAT) or Stand-Alone Academies. The authors explain for the differential effects on performance on both sets of schools in terms of more efficient managerial practices in MAT schools.

that a school becomes an academy. The difference-in-differences estimator or 'academy effect' is then obtained as the deviation from the secular trend for treated schools in the post-treatment period vis-à-vis the selected group of control schools. The empirical model and selection procedure used are more elaborately discussed in section 3.5 below. The rest of the paper is organised as follows: Section 3.2 spells out the motivation for undertaking the research, outlining its key objectives; Section 3.3 provides an overview on the features of the Academy Act 2010 and of English primary schools; Section 3.4 presents the data and the ocular statistics; Section 3.5 elaborates on the research methodology while the empirical results are discussed in section 3.6; Section 3.7 concludes on the findings of the study and its policy implications.

3.2 Motivation and Aim of the Study

This research is motivated by the radical change brought about on the institutional setting of English primary schools following the implementation of the Academies Act 2010. The Act, which heralded the establishment of academies in the primary school sector of the country, oversees a process of transition whereby schools converting to academy status gain more autonomy over their decision-making in matters, such as, school finance, admissions, staff recruitment and curriculum. The autonomous status and decision-making power opted for by some schools alters the existent trajectory of schools in a major way. The current study exploits this exogenous variation in the institutional setting to study about the performance effects and compositional changes associated with the school restructuring exercise.

A study of this nature gains added relevance following the accelerated roll-out of the 2010 reform across English primary schools in recent years. Academies, currently, constitute over a third (37%[68]) of all maintained primary schools in

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[68]   https://explore-education-statistics.service.gov.uk/find-statistics/school-pupils-and-their-characteristics (last accessed on 18/08/2021 at 03:39)

the country. Evidence on the impact this school reform has had on already existing academies is crucial to making informed policy decisions on the same. Whether academisation acts as a panacea for the ills of a hitherto largely state-controlled school system or, on the other hand, exacerbates already existing inequities in state schools may be ascertained through an analysis on the observed effects of academisation.

The analysis, undertaken in this study, centres on the estimation of the academy effect across state primary schools in England, using observational data at the school level. A period and event analysis model is applied within a difference-in-differences framework, differentiating between treatment (academy) and control (maintained) schools and between the pre-treatment and post-treatment period. While the aggregated effect following academisation is obtained through the period analysis, associated time trajectories, prior to and accompanying academisation, are accounted for in the event analysis model. This latter model also allows for heterogeneity in treatment timing as is the case in the sample of academy schools studied, where the timing of academy conversion differs.

Economic analysis of the academy model in the primary school sector of England remains an under researched area. The sector accounts for the largest proportion of the student population in the country and of schools. Pupil outcomes at this phase of education are important for the spill-over effects it has on later years of education. Policy reforms in this sector also carry far reaching implications on overall educational outcomes. The paucity of studies in the economic literature on primary education in the UK is another motivational factor that has necessitated the current research. The study, thereby, makes an important contribution, particularly with its focus on the Academy Act 2010, empirical evidence on which is again scanty for the primary school sector.

The only two other existent studies, that evaluate the impact of academisation in the same context, are worth mention here. Eyles et al (2017) and Neri et al (2018) examine the causal relationship between academisation and pupil performance. Both studies use a combined difference-in-differences and instrumental variable (IV) approach to examine the effects of the 2010 reform

on primary school pupils' performance. Eyles et al (2017) estimate an overall zero-effect on pupil performance, following academisation with the observed lack of effects hypothetically assigned to the nature of governance, Neri et al (2018) examine the heterogeneous performance effects of academisation, dstingushing between two main governance-models in academy schools: Multi Academy Trusts and Single Academy Trusts. The study establishes that schools run by Multi Academy Trusts (MATs), where multiple schools are governed under the same academy trust, experience performance gains, following academisation. The effects, on the other hand, are negative in Stand-alone Academies/Single Academy Trust (SATs) schools where individual schools are governed by their own trust. The authors explain for the positive differential effect on MAT schools by the more efficient management practices in these schools where resources and skills are pooled together and shared by all schools under the trust,

This research differs with its examination of the aggregated effects of academisation at the school level, considering both school performance and school compositional changes. The analysis that follows is broadly defined by the following set of objectives:

1. To estimate the 'academy' effect on English primary schools, following the introduction of the academy model in 2010.

2. To examine the period and yearly event trends on pupil performance and school composition associated with the academisation process.

3. To draw out the policy implications of the academisation programme from the empirical findings of the study.

3.3 The Academies Act 2010 & Primary Schools in England

The Academies Act, passed by the UK Parliament in July 2010, has paved the way for the establishment of autonomous state primary schools in the country. These schools are publicly funded and fall outside local authority control with the majority of their funds coming directly from the central government through the Educational Funding Agency (EFA). Being autonomous means that 'academy' schools enjoy greater discretion, compared to mainstream schools, on how they chose to spend their funds as well as in matters of school governance. Some of the ways this discretion is applied have to do with the delivery of the curriculum, staff recruitment and pay and decisions on the structure and length of the school day as well as school admissions.

Schools converting to academy status are broadly classified as Converter Academies and Sponsor-led-Academies. Converter academies initially comprised those schools deemed as Outstanding by Ofsted[69] and were among the early stream of converters. This group of schools voluntarily opt to convert. Sponsor led academies, on the other hand, are generally constituted by underperforming schools that were mandatorily made to convert under a sponsor. Academy sponsors hold the responsibility for improving the performance of their respective schools and come from a wide range of backgrounds that include successful schools, businesses, universities, charities and faith bodies.

Both converter academies and sponsor-led-academies are managed by a trust, comprised of governors/trustees/directors with the head teacher as the chief executive. However, the nature of governance may differ. Converter academies can choose to function as either Stand-Alone-Academies (SAT) or be part of a Multi-Academy Trust (MAT). Sponsor-led-academies have to

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[69] The Office for Standards in Education (Ofsted) visits schools every 3-5 years and conducts school inspections. Schools are rated on a four point scale that ranges from 'outstanding' to 'inadequate', following these inspections.

convert as part of chains or partnerships. Academies that convert as part of chains or partnerships can opt to work as a multi-academy trust (MAT) with all schools governed by one trust and board of directors; as an umbrella trust, in which schools work together, but also retain a certain level of independence; or, as a collaborative partnership with no shared trust or formalised governance structure (Eyles et al, 2016). Schools, in general, are encouraged to convert in a chain or partnership to reap the benefits of the economies of scale from pooling resources, skills and ideas.

The process of academisation as it occurs in the English primary school sector has been different from that of the secondary school sector that saw the inception of the reforms in early 2000. The Department of Education adopted a phased and staggered approach to the programme in the primary school sector, gradually relaxing the criteria by which primary schools could convert, so as to minimise risks. Better performing schools that were ranked as Outstanding by Ofsted initially received priority for conversion[70]. Two months later, in November 2010, the criteria was extended to include all good schools, with outstanding features. In this latter phase, provision was also made for any school to convert, regardless of their Ofsted grade, as long as it either joined an academy trust with an excellent school or entered into an educational partnership with a school having a proven record of improvement. In April 2011, schools considered as performing well, based on most recent test results, Ofsted rankings and financial management, were also included in the process (Eyles et al, 2016). The number of primary schools becoming academies, thus, gradually increased over time with the largest spurt in numbers occurring in 2013 among early period converters and subsequently in 2017 in more recent years (see table 2.1).

Prior to the enactment of the Academies Bill, 2010, schools in the UK were mainly categorised as – Community schools, Voluntary Controlled Schools, Foundation Schools and Voluntary Aided Schools. Community schools accounted for 60% of all state schools, followed by Voluntary Aided schools

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[70] In the secondary school sector, on the other hand, the first converters were poorer performing schools that were forced to convert to academy status.

(23%), Voluntary Controlled schools (15%) and Foundation schools (2%). The implementation of the 2010 reform has altered the existing educational landscape in a major way. Academies now constitute over a third of primary schools in England with the numbers deemed to increase in the foreseeable future[71].

A common yardstick of school performance in the two notably different institutional settings of an academy school and maintained school is pupil assessment. Pupils enrolled at academy schools are also registered for the national curriculum tests and assessed along with pupils from mainstream schools[72]. A more vivid examination of the nature of school assessment, in English primary schools is, therefore, provided in this context.

3.3.1 *National Assessments and Test Score based Measures of Performance*

Schooling in the UK comprises of four 'key stages'. Key Stage 1 (KS1) and Key Stage 2 (KS2) complete the phase of primary schooling. At the end of KS1 and KS2, pupils take Standard Assessment Tests (SATs) in core subjects. Children sit for KS 1 tests in english and mathematics normally at the age of 7. These tests are externally set, but internally assessed by teachers. National curriculum levels, ranging between the values of 1 and 3, with an unrestricted upper limit, are assigned to pupils, based on performance. This classification is normally taken as an indicator of a pupil's ability as opposed to achievement. Key Stage 2 tests are at the end of primary schooling (Year 6) when pupils are aged around 11. These assessments are also standardised, but, are marked externally. In order to sit the tests, students are expected to

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[71] The former Education Secretary, George Osborne has proposed a forced academisation plan for all schools in England to convert by 2020 or be committed to converting by 2022. This policy proposal was later withdrawn following large outcry against its implementation (Adams, 2016; http://www.bbc.co.uk/news/education-13274090).

[72] This includes pupils working below the standard of the tests and ultimately don't take them and pupils working at the standard but can't access the tests. Pupils in their final year of KS2 attending a pupil referral unit (PRU) or hospital school while still on the register of a maintained school or academy must also participate in the tests (www.gov.uk).

be working at level 3 and above. Until recently, the expected level of achievement at the end of KS2 has been a level 4c[73] with the maximum obtainable level being a 6a. Recent revisions to the assessment procedure in 2014 replace the levels with scores[74] . Students are now expected to attain a score of at least 100 in the SAT assessments on english grammar, punctuation and spelling, english reading tests and maths tests. The attainable scores are between 100 and 120 with a score below 100 meaning a fail.

School performance measures, as noted above, can be on levels of pupil performance and are, commonly, referred to as "status" measures (Figlio et al, 2011). Alternatively, there are "growth or "progress" measures, also called "gain scores" or "value-added" measures (Plewis, 1997; Figlio et al, 2010). The latter is an economic measure of performance and shows the extent of improvement in pupils' performance between different stages or years. The value-added measure is a useful tool in determining a school's contribution to pupils' achievement. The input measure for each pupil, in the computation of the value-added score, is the average point score (APS) achieved in the reading, writing and mathematics tests at KS1. The output measure for each pupil is the average point score achieved in the english, mathematics and science KS2 tests. A pupil's value added score is calculated as the difference between a pupil's APS at the KS2 SAT tests (actual) and the median value of KS2 results of other pupils with the same, or similar, prior attainment at KS1 (expected), nationally[75]. The school's value added score is given as the simple average (arithmetic mean) of the value added measures for all pupils in the school and is a measure centred on 100. A value above 100 for a school's value-added score indicates a positive contribution by a school to pupils' progress. The value-added score allows for differences in intake composition

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[73] Since 2014, with revisions to the nature of assessments at KS2, the expected level of attainment is currently equivalent to a 4b.

[74] http://www.bbc.co.uk/news/education-36682743

[75] **http://www.education.gov.uk/schools/performance/archive/primary_04/p8.shtml**. The referred technical note on the calculation of value-added score, mentioned here, doesn't include major changes that have since been introduced in its calculation. Among these changes is the incorporation of a 'shrinkage factor' that accommodates for differences in school size.

and captures the 'school effect' in attainment/performance net of other effects that include innate ability and family background. It is, therefore, used as a standard measure of comparison for schools and accounts for non-randomness in the process of school allocation and pupil admissions. Educational progress between ages 6-7 (end of Key Stage1) and 10-11 (end of Key Stage2) are among the school performance indicators annually published in the school league tables in the UK.

Test-score based measures of performance are currently, the most widely used and commonly accepted indicator of school performance.   Gibbons (2011c) shows that test-score based measures of school quality tend to dominate parental satisfaction with the learning environment.   Test based performance indicators are also at the core of school accountability systems in the UK and elsewhere.   The school league tables, published in the UK since 1992, hold schools publicly accountable through the publication of school performance tables that display pupils' academic outcomes based on standard assessment tests (SATs). An overwhelming majority of empirical studies on schools rely on test-score outcomes as a measure of school performance since these are readily available and in the absence of other alternative indicators. Standardised test results provide common ground for comparing between academy schools and mainstream schools. This feature has been exploited here to study the school-level effects of school restructuring.

3.4 Data Preparation and Summary Statistics

 Data covering all primary schools in England over the period 2002 – 2014 is used in the analysis that follows. This data has been compiled from different sources. The main source of data is the National Pupil Database (NPD) of the Department for Education. The NPD data is a collation of both pupil-level and school-level administrative data from the Pupil-level Annual School Census (PLASC) and School Performance tables. The data from the NPD has been

merged with publicly available School Census data that contains school-level information on various school-specific characteristics.

Schools in the dataset are identified by their respective local education authority and establishment number. General information on schools include the school address and type of school. Schools are classified as one of the following school types: Voluntary Aided Schools, Voluntary Controlled Schools, Community Schools, Foundation Schools, City Technology Colleges (CTCs), City Academies, Independent Schools, Special Schools, Pupil Referral Units, Free Schools, Converter Academies and Sponsored Academies. Other basic school-specific information available are the number of pupils (school size), cohort-size of the school leaving age group, the opening date of a school and, where relevant, the closing date for both maintained and academy schools.

The pupil-level data covers information on the socio-economic characteristics of pupils and pupil assessments. Information on the gender, ethnicity and mother tongue of pupils as well as indicators on free school meal (FSM) status and special educational needs (SEN) are provided in the data. Pupils in the data set are assigned a Unique Reference Number (URN) that remains the same throughout their school years. Pupils can, therefore, be identified across school years and tracked on a number of time-variant factors as well, such as, their record on exclusions, mobility and progress.

Pupil performance data is drawn from the attainment tables on teacher assessments and SAT test results. The information content here includes pupils' test scores and the national curriculum levels attained in teacher assessments and SATs in core subjects at both KS1 and KS2. The availability of this data at both phases of primary schooling is useful in keeping track of the progress a pupil makes through their years of schooling.

The pupil-level data for each school has been aggregated/collapsed to the school level for the current analysis. The original dataset consists of 222, 570 school year observations on all 'open' state primary schools located in 154 local authorities. The panel data runs from 2002 to 2014. City Technology Colleges, Pupil Referral Units, Special Schools, City Academies and Independent schools, where the organisation of schooling is vastly different

from mainstream schools, constitute about 16.73 per cent of the schools and these are dropped from the dataset. Very large schools, that is, schools that form the top 1 per cent of the distribution on school size (number of pupils), and very small schools, at the bottom 1 per cent of the school-size distribution, are also dropped from the original dataset. This is done to eliminate the effect of outlier observations that could potentially distort the data analysis. About 2 per cent of the observations (2, 549) have been thus dropped.

A further issue encountered in the data preparation has to do with missing and implausible values on some of the variables. This is remedied by replacing missing and implausible values with the mean values for these variables. The mean replacement value used is the average of the non-missing values in the preceding and succeeding years for a school. Observations with missing/implausible values for the top and bottom observations of a school, sorted by year, which are not sandwiched between non-missing values, have been replaced with the data available in the immediate preceding and succeeding years of the same school. Overall, 3 per cent of the observations have been so replaced. Observations that are still left with missing values on any of the variables, relevant to the data analysis, have been dropped and these constitute about 2.1 per cent of the data.

Finally, the data set was prepared to avoid possible attrition bias arising from missing school year observations in the unbalanced panel data. This is done by including only schools that are observed throughout the 13 year period. **This process also ensures that the same set of schools are observed in the pre-reform and post-reform period in the analysis that follows.** The dataset is also further narrowed down to a comparable sample of maintained schools and academy schools after dropping all local authorities that do not contain any academy schools. There are 30 local authorities in total that do not have even one academy school. Dropping these local authorities leaves a strongly balanced panel dataset of 139,867 school year observations with data from 2002 – 2014, of which 128, 661 are on maintained schools and the rest, 11, 206, on academies.

Table 3.1 presents the preliminary statistics that summarises the data on relevant school and pupil characteristics in the aggregated dataset. The

figures show the mean, standard deviation, minimum and maximum values for indicators on school performance and school composition.

Table 3.1: Summary Statistics on Primary Schools in England (2002 – 2014)

VARIABLES	MEAN	S.D	MIN	MAX
Test Scores				
Reading Test (%)	60.64	7.933	12	96
Maths Test (%)	66.65	8.63	11	97.5
APS (KS2)	18.02	2.80	5	27
APS (KS1)	15.33	1.34	3	21
School Characteristics				
Cohort Size	36.30	22.88	1	223
% of Girls	49.14	10.88	0	100
% of FSM Eligible	15.37	15.44	0	100
% Whites	84.78	23.31	0	100
% African Origin	3.28	9.69	0	100
% Asian Origin	6.32	15.92	0	100
% EAL Pupils	9.04	19.23	0	100
% SEN Pupils	22.66	13.06	0	100
Total	139867			

Starting with the average cohort size, it is observed that the mean number of pupils in a cohort is around 36 with an almost equal proportion of boys (50.86%) and girls (49.14%). A very low minimum value of one on the number of pupils, after having cleaned the data of outliers on school size, is explained for by very few observations in the dataset that have records for just one pupil for a single year in the school. These, in other words, are outliers on cohort-size within a school and may be examples of suppressed data, when the number of pupils in any given year in a school is very low, data records on which can compromise the anonymity of pupils in the respective schools. Since there are only 5 school year observations, where information on cohort size is far from the average for the school and this is unlikely to have a major effect on the main data analysis, these observations have not been removed or the figures altered. White pupils constitute the majority and form around 85 per cent of a cohort, followed by pupils of Asian origin (6.4%), while pupils of African origin account for around 4 per cent of the average cohort size.

The performance statistics show that pupils score relatively more marks on average in mathematics tests compared to reading tests[76]. The table also shows the average point scores (APS) obtained at Key Stage 1 (15.33) and Key Stage 2 (18.02), respectively. As mentioned earlier, these scores at KS1 exhibit the ability level of pupils as opposed to achievement. The APS at both phases of primary education are scores assigned to pupils that broadly classifies them on the basis of their tests performance. The variance for these indicators is, therefore, noticeably low compared to other test score measures of performance.

The APS at KS1 and the indicators on free school meal (FSM), special educational needs (SEN) and mother tongue (EAL), define the intake quality of a school. It is seen that about 15 per cent of pupils on average come from poor economic backgrounds, being eligible for free school meals, and over a fifth have special educational needs, with or without a statement. On average, 9 per cent of pupils have english as an additional language.

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[76] Reading tests are marked out of 50 and have been converted to percentages for purposes of comparison. Maths test scores, on the other hand, are recorded out of 100 in the original dataset.

The information above is further disaggregated by school type and the period of interest. The figures presented in table 3.2 below provide a general profile for both maintained schools and academies in the pre-policy and post-policy years.

There is noticeable difference between both school types in the pre-reform as well as post-reform periods, at the ocular level. Pupils in academy schools on average earn higher grades in english and maths compared to their counterparts in maintained schools. The relatively low APS at KS2 for academy schools and higher APS at KS1 suggests that the excess scores these schools display in english and maths over that of maintained schools may have to do with higher ability levels among pupils attending academy schools. It could also imply that pupils in academy schools may be performing below their potential, despite the relatively higher average grades they attain in english and maths.

On school size, academies appear to be considerably larger schools than maintained schools. The proportion of white pupils in academies is also relatively higher, corresponding to which are lower numbers of ethnic minorities and pupils with english as an additional language. This difference is seen to hold in both time periods. Further, academies seem to have a higher intake quality both before and after conversion, with lower proportions of pupils on free school meals and of those with special educational needs.

Table 3.2: School and Pupil Profile: Pre and Post Academisation (2002 – 2014)

VARIABLES	Maintained (Pre-2010)	Maintained (Post-2010)	Academy (Pre-2010)	Academy (Post-2010)	t-test (Pre-2010)	Ha: diff≠0
Scores	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)		Pr(|T| > |t|) = 0
Reading Test (%)	59.18 (7.6)	62.84 (7.7)	60.22 (7.5)	64.58 (7.1)	11.58	0
Maths Test (%)	64.99 (8.5)	69.41 (7.9)	66.52 (8.3)	71.56 (7.4)	15.25	0
APS (KS2)	18.31 (2.7)	17.61 (2.9)	17.86 (2.8)	16.91 (2.9)	13.84	0
APS (KS1)	15.34 (1.3)	15.25 (1.4)	15.51 (1.3)	15.47 (1.3)	10.71	0
Cohort Size	36.27 (22.3)	34.03 (21.2)	45.89 (30.2)	44.19 (29)	35.22	0
% of Girls	49.14 (10.8)	49.17 (11.3)	49.04 (9.5)	49.12 (9.9)	0.78	0.44
% of FSM Pupils	14.99 (15.5)	16.59 (15.5)	13.31 (14.8)	14.53 (14.6)	9.23	0
% Whites	85.51 (22.9)	83.07 (24.5)	86.97 (20.7)	84.57 (22.8)	5.44	0
% African	3.04 (9.4)	3.88 (10.4)	2.62 (8.7)	3.43 (9.4)	3.81	0
% Asian	5.89 (15.6)	7.33 (17)	5.15 (13.4)	6.63 (15)	4.07	0
% EAL Pupils	8.08 (18.6)	11.23 (20.8)	6.71 (16)	9.63 (18.2)	6.32	0
% SEN Pupils	22.56 (13.2)	23.58 (13.1)	21.37 (12.6)	22.17 (12.5)	7.68	0
Total	89073	49485	7758	4310	96831 (combined)	96831 (combined)

The above noted differences between academies and maintained schools are further tested for statistical significance. The results of the two tailed t-tests are shown in the last two columns of the above table (Table 3.2). The mean values on almost all selected variables, except that on the number of girl pupils, are seen to be statistically different for both groups of schools. The null hypothesis that there exists no significant difference in the mean values between both groups of schools is, therefore, rejected, in each of these cases. The statistical significance of the difference-in-means tests, in the pre-policy period, carries implications for the empirical estimation that is to be undertaken. It indicates non-randomness in selection into academy status, as is the case with the academisation process taking place in the English primary school sector, which could potentially yield biased estimates in the difference-in-differences analysis.

In light of the above, correcting for non-random selection and possible endogeneous effects, associated with the academy conversion process, is a fundamental part of the estimation procedure. The earlier mentioned studies in the same context have approached these issues in different ways. Eyles et al (2017) and Neri et al (2018), studying the effects of academisation on pupil performance, opt for an instrumental variable (IV) analysis. In both these

studies, only pupils who are already enrolled in the school prior to academisation, referred to as Intent to Treat (ITT) or grandfathered pupils, are included in the data analysis. This is done to isolate the *pure* academy effects, considering that pupils acting up on the knowledge of a school becoming an academy may select in or out of schools. As a result, any effects identified, post-reform could be endogenous and not independent of the outcome measure. Eyles et al (2017), further, circumvent the issue of selection bias by focusing only on schools that convert to academy status. For each group of schools that are treated (become academies) in a given year, the control group of schools (comparison group) is defined by the set of to-be-academies of the following year, so as to ensure comparison between similar sets of schools. The method adopted in this study, it may be noted, is for analysis at the school-level. **The study proceeds, making use of the procedure of propensity score matching, to avert the implications of the non-random nature of academy conversion and of endogeneity, in the estimation process.** This is done by specifying a control group (comparison) of schools from among the sample of maintained schools that are most similar to academy schools in pre-reform characteristics. The identification strategy and selection process adopted is examined in greater detail in the following section, where the empirical models are presented.

3.5 The Difference-in-Differences Methodology and Empirical Models

The difference-in-differences methodology is commonly used for comparative analysis in observational studies, using longitudinal data. It is used for the estimation of the effect of a treatment (intervention) and may involve comparison overtime of the same set of observations that are treated or two different groups of observations, that is, the treated and not treated (control group). The methodology is widely used in different fields of study and for undertaking policy evaluations, as in the current context. The quasi-

experimental design of the difference-in-differences model is particularly suitable for observational studies where treatment or policy-interventions do not take place under controlled settings (as in experimental studies) and selection into treatment is not randomized.

The academisation process in the English primary school sector is a typical example of a quasi-experimental policy study. Conversion into academy status has been a selective (non-random) exercise, where the criteria governing conversion also changed over time. Comparison of the outcome trajectories for treated schools (academies) with schools that are not treated (maintained schools) is possible within the difference-in-differences framework with the employment of an appropriate identification strategy that allows for comparison between similar groups of observations. Similarity in time invariant and time varying (due to other causes of the outcome, other than the treatment) observables between the treated and control group of schools is needed in order to obtain unbiased estimates on the causal effects, as provided by the difference-in-differences estimator. Known as the common trends/parallel trends assumption, it implies that in the absence of treatment both treated and control schools have similar outcome trajectories. Any differences/deviation from the 'common trend' in the post-reform period will, therefore, capture the effect of the treatment.

The difference-in-differences analysis is undertaken by specifying a model that correlates the policy change to the outcome variable of interest. Two specifications of the model are estimated, here, for a period and yearly event analysis. The former approach estimates the 'academy effect' that is the aggregated effect over the post-reform period while the latter traces the associated time trajectories over the pre-policy and post-policy years.

Equations 3.1 and 3.2 below specify the linear reduced form model for the period analysis, where Y_{it} depicts the outcome variable of interest for school i in period t, with t taking the value of 1 in the pre-reform period and 0 in the post-reform period. The output measure (Y_{it}) has been specified to determine the causal effects of academy conversion on school performance and intake quality. School performance measures used are the average test scores in english and maths and the average point score at Key Stage 2. Intake

quality/compositional changes for the school are measured using the indicators on free school meal status (FSM), special educational needs (SEN), innate ability of pupils as determined by the average point scores at Key Stage 1 and the proportion of pupils with english as an additional language (EAL) as well as the cohort size.

$$Y_{it} = \alpha_{it} + \beta_1 ACD_{it} + \beta_2 TIME + \beta_3 ACD_{it}*TIME + \varepsilon_{it} \qquad (3.1)$$

Equation 3.1 models the causal effect of academisation on each of the above mentioned indicators on the outcome variable (Y_{it}). ACD_{it} in the above equation is a dummy variable, indicating 'academy stauts' and takes the value of '1' for schools that become academies and '0', otherwise. The adjacent co-efficient β_1 is interpreted as the estimated mean difference in the outcome variable (Y_{it}) between the treated group and the control group prior to the 2010 policy intervention. In other words, β_1 shows the baseline differences between both groups of schools, prior to academisation.

The TIME variable represents the two distinct periods of interest: the pre-policy (pre-reform) period and the post-policy (post-reform) period. Since the academy reforms were initiated in the primary school sector in 2010, with the first primary schools converting as academies the same year, the post-policy period is specified from 2010 onwards in this analysis. The TIME dummy, accordingly, assumes the value of 1 for the post-reform period (post-2010) and 0, otherwise. The co-efficient on this variable, β_2, captures the expected mean change in the outcome variable (Y_{it}) for the control group between the pre and post-treatment periods.

The main co-efficient of interest in the above equation is, β_3, referred to as the difference-in-differences estimator. β_3 indicates whether the expected mean change in the outcome between the pre (0) and post-policy (1) periods is significantly different for both groups of schools (treated and control). Any difference in outcomes is the average treatment effect (ATE) and is more explicitly summarised in equation (3.1.1) below, where G_i, in the equation,

indicates the status of the school as an academy converter (G_i=1) or non-converter (G_i=0):

$$ATE = \{\, E[Y_{i1}|G_i = 1] - E[Y_{i1}|G_i = 0] \,\} - \{\, E[Y_{i0}|G_i = 1] - E[Y_{i0}|G_i = 0] \,\} \quad (3.1.1)$$

Where the common trend assumption holds, the mean difference in the outcome variable between the treatment and control group for the post-intervention period can be obtained from the sum of the estimates $\beta_1 + \beta_3$. ε_{it} in equation 3.1 is the random error component that captures unexplained variation in the outcome variable.

The period analysis model in equation 3.1 is further extended to control for school-specific observables and other confounders in the data as in equation 3.2 below:

$$Y_{it} = \alpha_{it} + \beta_1 ACD_{it} + \beta_2 TIME + \beta_3 ACD_{it}*TIME + \beta_4 X_{it} + \delta_d + \Upsilon_t + \varepsilon_{it} \quad (3.2)$$

The right hand side (RHS) of the above equation (3.2) includes the covariates (X_{it}), the dummies denoting academy status (ACD_{it}) and the time period (TIME), the coefficients on local authority fixed effects (δ_d) and time fixed effects (Υ_t) and an error term (ε_{it}) to capture random variation, assumed to be independently and identically distributed (i.i.d).

X_{it} is the set of orthogonal variables that control for both time varying and time-invariant observables independent of the outcome. These are the number of pupils of school leaving age, the ability level of the pupils given by the average point scores at Key Stage 1, the percentage of pupils on free school meals, the percentage of pupils with special educational needs, the percentage of white pupils and the cohort size of the school leaving age group.

Time invariant unobservables that may affect the outcome variable are controlled for with fixed effects at the local authority level (δ_d). The model also controls for time-varying year-specific (cross-sectional) factors, which may affect the outcome, with Υ_t. - the time fixed effects factor,

The difference-in-differences estimation on the 'academy effect' also includes a yearly event analysis that examines the linear time trends on the policy change as modelled in equation 3.3:

$$Y_{it} = \alpha_{it} + \beta_1 ACD_{it} + \beta_2 Year + \sum_{t=t-k}^{t=t+k} \beta_3 ACD_{it}*Year + \beta_4 X_{it} + \delta_d + \varepsilon_{it} \qquad (3.3)$$

In the above equation, β_1 provides the mean estimate of the outcome variable for the treated group of schools in the absence of treatment and β_2 the change in outcome overtime. $\sum_{t=t-k}^{t=t+k} \beta_3$ summarises the difference in the mean estimates of the outcome variable between the pre-reform period (t=t-k) and the post-reform period (t=t+k). The reference period, here, is t=0 - the year when the policy intervention takes place. The conversion year (t=0), not being observed for the control group of schools, has to be randomly assigned. The random assignment of the reference period (intervention year) among schools in the control group has been done so as to replicate the observed distribution pattern of the conversion year among treated schools. The model also conditions for time-invariant exogenous factors (X_{it}) likely to affect output and includes local authority fixed effects to control for time invariant unobservables that are common for schools within the same local education authority (δ_d) and random variation (ε_{it}). The event analysis model is particularly useful to detect the presence of endogeneity associated with academy conversion. It enables comparison of pre-trends in the outcome variable with trends in the post–policy (post-trends) years. **The absence of noticeable pre-trends validates the model for the estimation of the exogenous effects of academisation on the outcome variables of interest.** The results from the estimation of the period and event analysis models are presented in Section 3.6. The identification strategy that precedes the difference-in-differences estimation may now be discussed.

3.5 .1 *Identification Strategy: Propensity Score Matching and the Common Trends Assumption*

The identification strategy adopted here has been designed to address the issue of non-randomness in the selection process of academisation. A peculiarity of the 'bespoke' reforms in the English primary school sector is the staggered manner in which they have been implemented. The criteria by which schools could convert to academy status changed and was relaxed over time. The first schools that gained eligibility to convert were the better performing schools, deemed as outstanding by Ofsted. This was followed by all good schools, with outstanding features, regardless of their Ofsted grade. Later, schools considered as performing well, on the basis of recent test results, Ofsted rankings and financial management, were eligible to convert. Besides this, are schools funded by the local authority, judged as 'inadequate' by Ofsted, which are mandatorily made to convert. The non-random and varied nature of selection into academy status poses issues in the data analysis, mainly to do with selection bias. The problem is circumvented, here, by adopting an appropriate identification strategy to enable comparison of like-with-like, called the propensity score matching technique.

Propensity score matching involves selection of a control group of maintained schools, which best resemble academy converters (treated schools) in their pre-treatment characteristics. The assumption is that in the absence of treatment there exist no significant difference between academy schools and maintained schools, in both observable and unobservable features. The assumption of common-trends or parallel trends is more clearly illustrated in Figure 3.1. Satisfaction of the criteria enables comparison between similar sets of observations for academy schools and maintained schools and is an essential condition in obtaining unbiased estimates of the treatment (academisation) effect in the difference-in-differences analysis.

Figure 3.1: Difference-in-Differences Estimation and the Common Trends Assumption
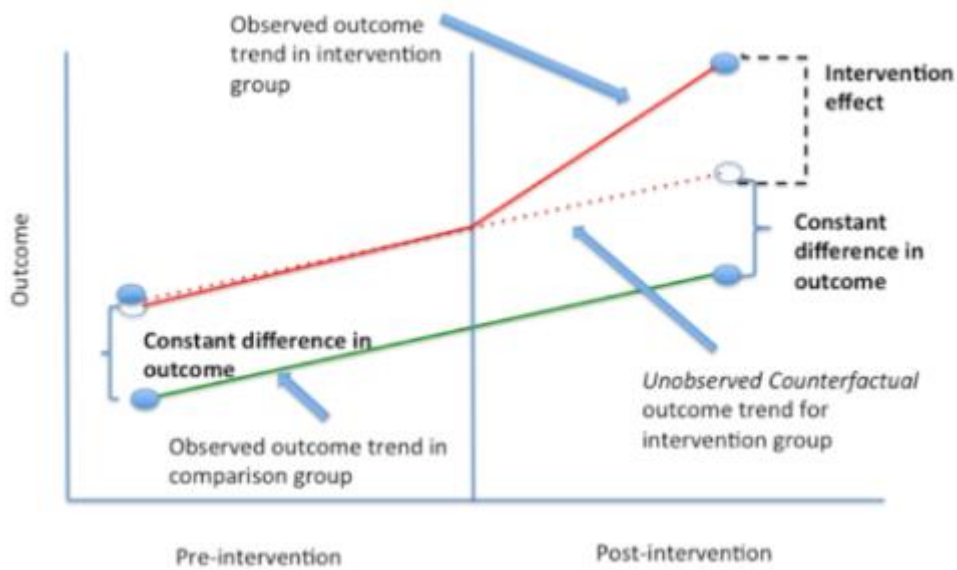
Source: Mailman School of Public Health, Colombia University (2017)

Figure 3.1 above depicts the common trends assumption within the framework of the difference-in-differences model. The trend lines on the outcome measure for the control (comparison) and treatment (intervention) groups, on the left side of the panel, display parallel trends, in the pre-intervention (pre-treatment) period. Any deviation from this trend for the treated group in the post-reform period is the effect of the treatment (intervention) on the treated group. The magnitude of the deviation is derived from the difference-in-differences estimator. Here, the assumption of common trends, as illustrated in figure 3.1, is vital for the internal validity of the difference-in-differences model.

In order to select the control group of maintained schools for the difference-in-differences analysis, on the basis of similarity in pre-treatment trends, the panel data, running from 2002-2014, is collapsed on key variables for the pre-reform period. Data for this period (2002-2010) has been aggregated to an individual observation for all schools in the dataset so as to obtain a single estimate of the propensity score for each school (10,759 observations or schools). The estimation of the propensity score is done through a non-linear probit regression of the binary dependent variable depicting treatment (academy) status on potential confounders/determinants in the data,

including local authority fixed effects. The probit analysis maps the likelihood of academy conversion to the incremental effects of time-invariant observables and unobservables that are common to both treated and untreated schools (Table 3.3). All covariates included in the model are seen to have a significant effect on the likelihood of academy conversion.

Propensity scores are calculated on the basis of the incremental effects that the selected school-specific factors have on the likelihood of academy conversion. A higher propensity score implies a higher chance/probability of a school becoming an academy and likewise the lower the propensity score the less likely a school converts to academy status. The range of the propensity scores estimated to be above 0, vary between 0.004 and 0.8 with a long tail of school observations at the higher end of the propensity score distribution (see table A3.1). Most school observations are clustered within the range where the likelihood of academy conversion varies between 5 per cent and 20 percent (see figure 3.2). Within the different blocks of the estimated propensity score, it is important to note, the distribution of covariates included in the probit model is the same (balanced) for treated schools and control schools. Satisfaction of the balancing property, in other words, ensures common trends between the schools within the same block of estimated propensity scores.

Given the distributions on propensity scores for 'treated schools' and 'schools-not-treated', the common support region (CSR) may be defined. This is the area of overlap between the distributions of both sets of schools as can be seen in figure 3.3 below. The final step involves selecting schools within the CSR for the difference-in-differences analysis. Any schools that fall outside this region is discarded from the analysis. 478 maintained schools that fall outside the Common Support Region have, thus, been discarded bringing down the total number of schools in the final data set from 10,759 to 10,281. It is noteworthy that the discarded set of schools doesn't contain any academy schools meaning that the model specified correctly predicts the probability of academy conversion among schools in the dataset.

Table 3.3: Marginal and Percentage Effects (2002 – 2010: Averages)

Variables	% Effect on Pr (Academy)=1	Marginal Effects
Reading Test (%)	0.1*** (0.01)	59.33
Maths Test (%)	0.05*** (0.01)	65.18
APS (KS2)	0.1*** (0.03)	18.26
APS (KS1)	-0.17*** (0.04)	15.35
Cohort Size	0.01*** (0.001)	37.01
FSM Pupils (%)	0.02*** (0.003)	14.88
SEN Pupils (%)	0.01*** (0.003)	22.48
Pseudo R^2	0.17	

* significant at the 10% level ** significant at the 5% level *** significant at the 1% level

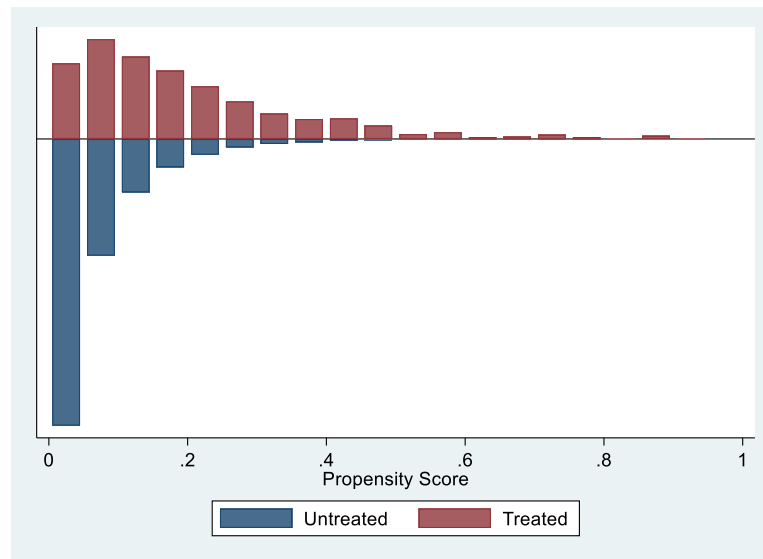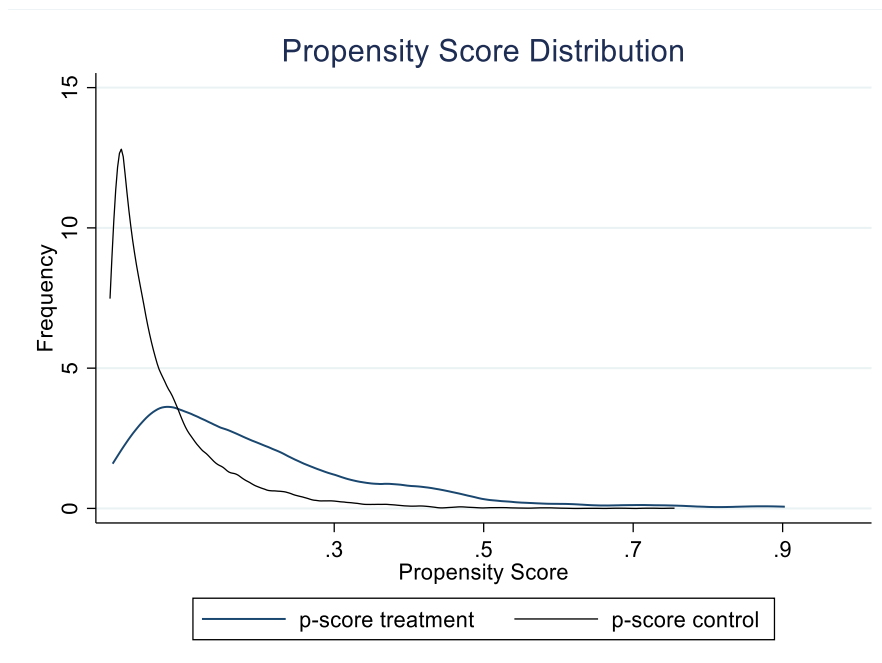Figure 3.2: Bar Diagram on the Propensity Score Distribution

Figure 3.3: Identification of the Common Support Region

3.6 Empirical Analysis & Falsification Test

The results from the estimation of the aggregated effects (period model) and dynamic effects (yearly event model) of academy conversion pertaining to school performance outcomes and intake quality are analysed here. Table 3.4 presents the estimates from the period analysis on school performance outcomes as in maths test results, reading test results and the Average Point Score at Key Stage 2. The difference-in-differences estimate, β_3, is the average treatment effect (ATE) and indicates whether the expected mean change in the outcome between the pre (0) and post-policy (1) periods is significantly different for both groups of schools (treated and control).

Comparison of the performance indicators on english reading and maths show a positive and significant change in test results in both subjects in the post-policy period for academy schools compared to the counterfactual outcome. The estimates are significant and positive even when controlling for time invariant observables and unobservables and year- specific factors that could potentially affect the outcome variables. The average increase in reading and maths test results over the post-policy period for academy schools is higher by almost a unit compared to maintained schools. The ATE is, however, seen to be moving in the opposite direction on Average Point Scores at Key Stage 2. The Average Point Score (KS2) is a combination of the average test results in Standard Assessment Tests (SAT) in reading, maths and grammar, punctuation and spelling and of teacher assessments in writing and science. The discrepancy with the observed effect on standardised test results in reading and maths, taken separately, may have to do with differences in the assessment procedure or may be due to the effects of aggregating test scores across different subjects and different assessment procedures - considering the possibility that teacher assessments could be subjective in nature (Burgess, 2009). The APS (KS2) falls by 0.3 for academy schools relative to maintained schools in the post-reform period.

School intake quality is examined through the indicators on innate ability/aptitude (APS-KS1), the percentages of pupils on free school meals,

special educational needs and with English as an additional language and the cohort size. The results presented in Tables 3.5a and 3.5b provide a mixed picture. The difference-in-differences estimator is not significant in each of these cases except on cohort size. With respect to this latter variable, academisation is seen to have a positive impact, with the average size of the school leaving cohort increasing by 0.5 to 0.6 for academy schools over that of maintained schools. The estimate on this indicator is significant at the ten per cent level. The baseline indicator, β_1, for the outcome variable on cohort size is significant and positive for academy schools, indicating that academisation generally involved bigger sized schools. The baseline indicator on innate ability is also positive and significant and retains the positive sign in the post-policy period, though not showing a significant increase over maintained schools in admitting pupils of higher ability. Intake quality with respect to socially, economically and educationally disadvantaged pupils (FSM, SEN and EAL pupils) are all observed to be higher in the baseline period for academy schools – the baseline indicator coefficient is significant and negative for academy schools on each of these variables. The academy effect is, however, not significant in the post-policy period, but indicates continued lower intake of pupils from these three categories of disadvantaged pupils. The counterfactual mean outcome on each of these indicators on intake quality is, interestingly, seen to be moving in the opposite direction in all cases.

Examination of the dynamic effects of academisation (see figure 3.4), reveal a positive effect on maths test scores and reading test scores for the later and early group of academy converters combined. The effect is significant at the 10 per cent level and wanes off in later lags as well as turning negative. This may be explained by the very low numbers of academy schools in the data set among the early period converters. There are no noteworthy differences in school intake quality with respect to most indicators between the pre-policy and post-policy period. The cohort size, on the other hand, shows significant systematic variation in the pre-reform and post-reform period suggesting that this variable may be endogeneous to academisation.

Table 3.4: The Academy Effect on School Performance Outcomes

Estimates/Controls	Outcome Variables (Coefficients)					
	Maths	Maths	Reading	Reading	APS(KS2)	APS(KS2)
Post-2010	4.805*** (0.133)	6.543*** (0.174)	4.313*** (0.0871)	1.292*** (0.135)	-0.783*** (0.0305)	-2.015*** (0.0596)
Academy (β_1)	1.226*** (0.300)	-0.605*** (0.147)	0.795*** (0.264)	0.852*** (0.125)	-0.375*** (0.0863)	-0.455*** (0.0589)
Diff (β_3)	0.806*** (0.217)	0.676*** (0.219)	0.866*** (0.175)	0.707*** (0.182)	-0.281*** (0.0619)	-0.248*** (0.0602)
No. of Pupils		-0.0836*** (0.00266)		-0.0332*** (0.00184)		0.00638*** (0.000933)
APS (KS1)		2.323*** (0.0431)		2.314*** (0.0354)		
Girls (%)		-0.0412*** (0.00185)		0.0161*** (0.00158)		0.000245 (0.000708)
Whites (%)		-0.00634*** (0.00198)		0.00448 (0.00324)		-0.00500*** (0.00134)
FSM (%)		-0.111*** (0.00337)		-0.123*** (0.00361)		0.0693*** (0.00183)
SEN (%)		-0.102*** (0.00309)		-0.0798*** (0.00308)		0.0443*** (0.00146)
Constant	65.29*** (0.219)	35.25*** (0.683)	59.43*** (0.225)	29.02*** (0.615)	18.24*** (0.0677)	17.60*** (0.153)
Observations	133,653	133,653	133,653	133,653	133,648	133,648
R-squared	0.073	0.547	0.068	0.549	0.020	0.285
Mean control $t(0)$	65.29	35.25	59.43	29.02	18.24	17.60
Mean treated $t(0)$	66.52	34.64	60.22	29.87	17.86	17.14
Diff $t(0)$	1.226	-0.605	0.795	0.852	-0.375	-0.455

* significant at the 10% level ** significant at the 5% level *** significant at the 1% level

Table 3.5a: The Academy Effect on School Intake Quality

| Estimates/ Controls	Outcome Variables (Coefficients)			
	APS (KS1)	APS (KS1)	FSM	FSM
Post-2010	-0.0713*** (0.0232)	0.0412 (0.0252)	1.619*** (0.198)	-0.815** (0.402)
Academy (β_1)	0.147*** (0.0511)	0.108*** (0.0222)	1.552** (0.683)	0.203 (0.296)
Diff (β_3)	0.0485 (0.0370)	0.0236 (0.0345)	-0.333 (0.220)	-0.0558 (0.300)
No. of Pupils		0.00192*** (0.000350)		0.00233 (0.00587)
APS (KS1)				-4.454*** (0.172)
Girls (%)		0.00403*** (0.000322)		0.0512*** (0.00396)
Whites (%)		0.00713*** (0.000487)		-0.102*** (0.00888)
FSM (%)		-0.0390*** (0.0000915)		
SEN (%)		-0.0323*** (0.000675)		0.189*** (0.00897)
Constant	15.36*** (0.0426)	15.82*** (0.0584)	14.86*** (0.945)	80.20*** (2.836)
Observations	133,653	133,653	133,653	133,653
R-squared	0.002	0.480	0.003	0.557
Mean control $t(0)$	15.36	15.82	14.86	80.20
Mean treated $t(0)$	15.51	15.92	13.31	80.40
Diff $t(0)$	0.147	0.108	-1.552	0.203
Mean control $t(1)$ label	15.29	15.86	16.48	79.38

* significant at the 10% level ** significant at the 5% level *** significant at the 1% level;

Table 3.5b: The Academy Effect on School Intake Quality

Estimates/ Controls	Outcome Variables (Coefficients)					
	SEN	SEN	EAL	EAL	No. of Pupils	No. of Pupils
Post-2010	0.65*** (0.22)	5.002*** (0.413)	3.55*** (0.28)	1.05*** (0.22)	-2.45*** (0.18)	-1.30*** (0.25)
Academy (β_1)	-1.02** (0.45)	0.10 (0.22)	-1.41* (0.73)	0.05 (0.20)	8.91*** (1.48)	9.36*** (1.45)
Diff (β_1)	-0.32 (0.37)	-0.04 (0.36)	-0.25 (0.31)	-0.21 (0.21)	0.61* (0.32)	0.52* (0.29)
No. of Pupils		-0.04*** (0.003)		0.023*** (0.01)		
APS (KS1)		-3.83*** (0.08)		-0.69*** (0.07)		0.92*** (0.17)
Girls (%)		-0.08*** (0.004)		0.001 (0.002)		-0.04*** (0.01)
Whites (%)		0.03*** (0.004)		-0.71*** (0.03)		-0.12*** (0.02)
FSM (%)		0.20*** (0.01)		0.03*** (0.01)		0.01 (0.03)
SEN (%)				-0.03*** (0.01)		-0.18*** (0.01)
Constant	22.39*** (0.37)	77.86*** (1.27)	8.12*** (1.12)	77.86*** (3.28)	36.97*** (0.91)	43.33*** (3.33)
Observations	133,653	133,653	133,653	133,653	133,653	133,653
R-squared	0.001	0.35	0.01	0.82	0.01	0.17
Mean control t(0)	22.39	77.86	8.12	77.86	36.97	43.33
Mean treated t(0)	21.37	77.96	6.71	77.91	45.89	52.70
Diff t(0)	-1.015	0.10	-1.41	0.05	8.912	9.363
Mean control t(1) label	23.03	82.87	11.67	78.91	34.52	42.03

* significant at the 10% level ** significant at the 5% level *** significant at the 1% level

Figure 3.4: Yearly Event Trends (Academies vis-à-vis Maintained Schools)
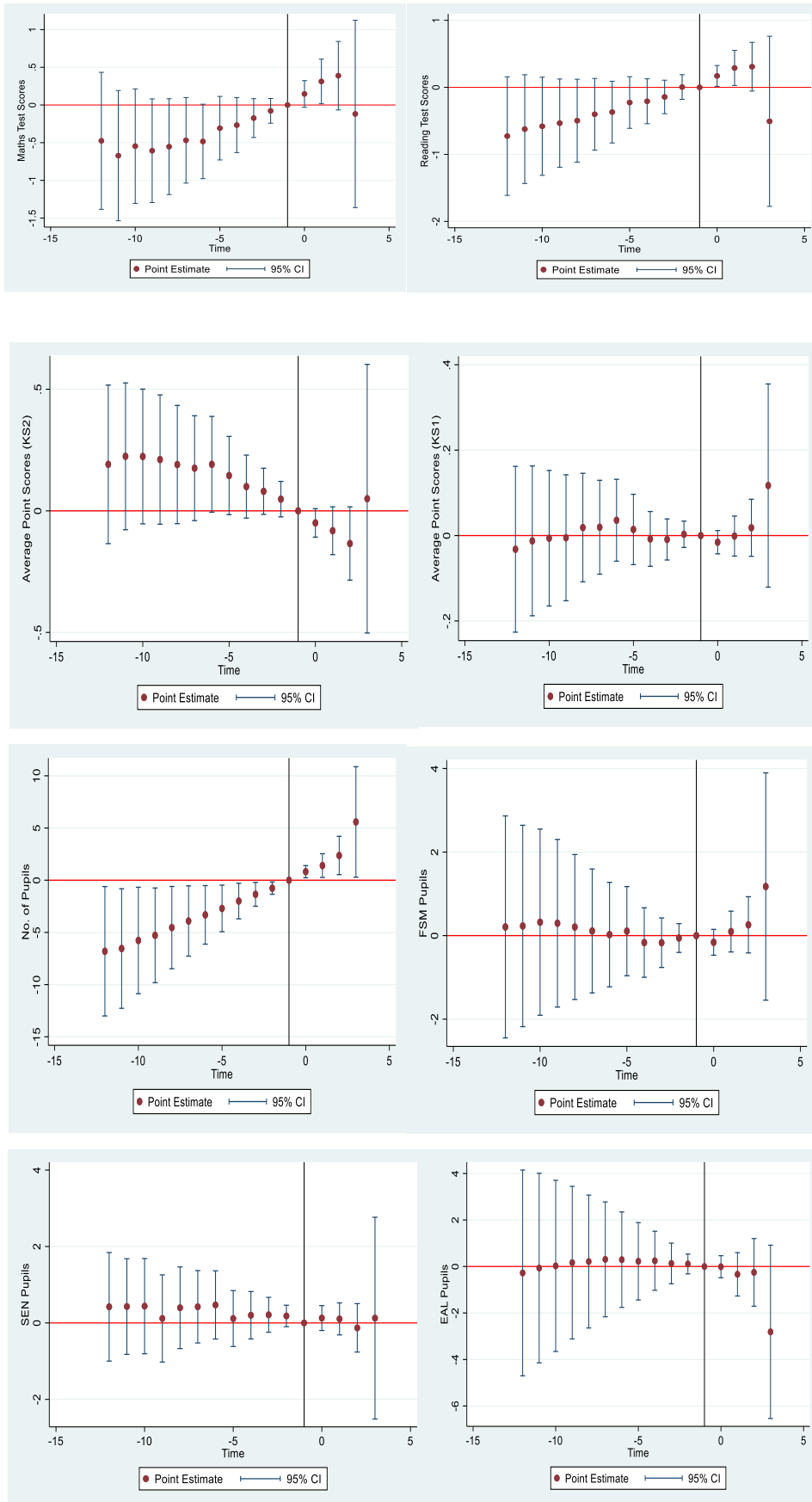
<u>Robustness Checks: Falsification Test</u>

The validity of the results from the period and event analysis is further checked through a falsification test (results are not presented here). In order to verify that the estimated effect from both models is the true 'academy effect', the analysis has been undertaken on a selected sample from within the dataset within which school observations have been randomly grouped as academy schools and maintained schools. The post-reform period remains the same and is defined from 2010 onwards.

The results from both the period and event analysis models show no significant observable difference between the so classified academy schools and maintained schools on any of the outcome indicators following the policy change, except on the average point score at key stage 2 in the specification using full controls. The effect observed on the latter outcome is negative with a 10 per cent level of significance. Overall, the results from the falsification test validates the findings of this research and it can, thus, be concluded that the estimated 'academy effect' on school performance and intake quality is the true effect.

3.7 Conclusion

The implementation of the 2010 reform in the English primary school sector has been a large scale experimental exercise linking institutional restructuring to educational outcomes. The analysis undertaken in this chapter examines this association at the school level with respect to its effect on school performance and school composition. In line with previous studies (Machin et al, 2009; Neri et al, 2018), the findings from this research indicate a significant positive policy-effect on schools that become academies for standardised test results in reading and maths. This is supported by the observed trends in standardised test outcomes over the post-policy period for academy schools in the event study model. The results on intake composition indicate a quality enhancing selection process in academy schools with

baseline estimates indicating the same trend to have been prevalent in these schools even prior to academisation. These compositional changes are observed to be accompanied by systematic increases in pupil numbers for the school leaving age group. The higher intake quality observed in academy schools in the post-reform period may, therefore, not be at the expense of pupils from disadvantaged backgrounds. The findings from this study are particularly useful from a policy perspective in designing measures for inclusive education and understanding the performance enhancing mechanisms that work within the academy school model.

Conclusion

This thesis is an analytical study on the economics of state primary schools in England. It examines the aspect of efficiency in English primary schools, in terms of maximising school/pupil outcomes through the judicious employment of school resources. School-level estimates of efficiency are obtained using a time-varying fixed effects frontier production function model, as developed by Cornwell et al (1990), in the econometric measurement of efficiency. The analysis is undertaken both with respect to test-score measures on pupil attainment and progress and on intra-school variation in test-scores as well as progress. There is observed to be wide variation in efficiency levels across schools, with efficiency scores ranging from 0.5 to 0.95. There is, thus, considerable scope for improving efficiency in the state school sector through the more judicious allocation of resources and by emulating the best-practice schools, which constitute the frontier. The frontier schools are evidently able to translate every net addition to key factor inputs, such as, total real resources, teaching assistants and school size, more effectively into improvements in test results and pupil progress. There is also seen to be greater scope for improving/reducing intra-school variation in marks and progress measures through the more efficient utilisation of resources. The estimated model shows factor inputs to be responding differently with regard to tests scores and progress measures compared to the variance in these measures. There seems to be a trade-off between efficiency improvements involving tests-scores/pupils progress and reducing intra-school variations in tests performance/pupil progress. The trend analysis also shows technical efficiency to be gradually rising after mid-2000 on the attainment/progress measures, but declining over almost the same time period on the variance in these measures. The study highlights the importance of measures based on efficiency in judging school performance. It calls for greater recognition of efficiency indicators in informing policy and, for optimising the use of valuable resources within the state school sector.

The study also undertakes a policy-evaluation on the Academy Act 2010. The legislation heralded the onset of the academisation process in the English state primary school sector. The process oversaw the institutional restructuring of schools that convert into academies among state schools. Academy schools were given greater freedom over the school curriculum, deciding the length of the school day and term, governance, school finance, staff pay and employment and in setting their own admissions policy. The review undertaken on the nature of the reforms and its implementation portray the strengths and weaknesses in the programme. The review elaborates on the policy implications of the academisation process, which in recent years, has been proceeding at an accelerated rate. The empirical analysis that follows, estimates the 'academy effect' in the primary school sector of the country, through a period and yearly event difference-in-differences analysis. Academisation is seen to raise pupil performance in standardised test results in english and maths by almost a unit in excess of pupil performance in local authority maintained schools. Differences in school intake quality of a performance enhancing nature is also observed in academy schools as compared to maintained schools.

The findings from this study are particularly useful from a policy point of view as well as academically. It draws attention to the scope of applying efficiency models in determining school performance and informing policy. The research puts into perspective the association between pupil performance and efficiency in resource-use, while accounting for differences in how schools utilise the resources at its disposal for maximising (minimising) the educational output. The empirical evidence on the 'academy effect' among state primary schools is another noteworthy contribution of this research. The observations made with regards to changes in intake quality and on the different outcome trajectories of academy and maintained schools both prior to and following academisation are particularly informative and contributes to the discourse on school effectiveness. Understanding the performance enhancing mechanisms that work within the academy school model and the need to design education policy measures to ensure greater inclusion within

the system of state schooling and especially, in the context of academisation are among other key policy imperatives that emerge from this study.

Appendix

A1.1: Eligibility Criteria for Free School Meals

Who is eligible for free school meals?

Free school meals are available to pupils in receipt of, or whose parents are in receipt of, one or more of the following benefits:

- Universal Credit (provided you have an annual net earned income of no more than £7,400, as assessed by earnings from up to three of your most recent assessment periods)
- Income Support
- Income-based Jobseeker's Allowance
- Income-related Employment and Support Allowance
- Support under Part VI of the Immigration and Asylum Act 1999
- The guarantee element of Pension Credit
- Child Tax Credit (provided you're not also entitled to Working Tax Credit and have an annual gross income of no more than £16,190)
- Working Tax Credit run-on – paid for four weeks after you stop qualifying for Working Tax Credit

In addition, the following pupils will be protected against losing their free school meals as follows (please see page 10 for further details):

- From 1 April 2018, all existing free school meals claimants will continue to receive free school meals whilst Universal Credit is rolled out. This will apply even if their earnings rise above the new threshold during that time.

- In addition, any child gaining eligibility for free school meals after 1 April 2018 will be protected against losing free school meals during the Universal Credit rollout period.

- Once Universal Credit is fully rolled out, any existing claimants that no longer meet the eligibility criteria at that point (because they are earning above the threshold or are no longer a recipient of Universal Credit) will continue to receive free school meals until the end of their current phase of education (i.e. primary or secondary).

The Universal Credit rollout is currently expected to complete in March 2022.

Note: A pupil is only eligible to receive a free school meal when a claim for the meal has been made on their behalf, and their eligibility has been verified by the school where they are enrolled or by the local authority.

Source: Department for Education, 2018

Table A1.2: F-Test on Constant Returns to Scale

F(8, 93099)	3304.05
Prob > F	0.00

Table A1.3: Wu Hausman Test on Fixed or Random Effects & Test on Time Fixed-Effects

Outcome Variable	Wu-Hausman Test Statistic	Time Fixed Effect Test Statistic
Value-Added Score	$\chi 2\ (12)= 424$ $\rho > \chi 2 = 0$	F (8, 97880) = 371.81 $\rho > $ F = 0
English Test Results	$\chi 2\ (13)= 5595.24$ $\rho > \chi 2 = 0$	F (8, 97879) = 7264.35 $\rho > $ F = 0
Maths Test Results	$\chi 2\ (13)= 4479.05$ $\rho > \chi 2 = 0$	F (8, 97879) = 4816.09 $\rho > $ F = 0
APS – KS2	$\chi 2\ (13)= 1306.94$ $\rho > \chi 2 = 0$	F (8, 97879) = 694.74 $\rho > $ F = 0
Variance in Value-Added Score	$\chi 2\ (12)= 993.84$ $\rho > \chi 2 = 0$	F (8, 978870) = 148.78 $\rho > $ F = 0
Variance in English Test Marks	$\chi 2\ (13)= 421.46$ $\rho > \chi 2 = 0$	F (8, 97879) = 107.32 $\rho > $ F = 0
Variance in Maths Test Marks	$\chi 2\ (13)= 957.76$ $\rho > \chi 2 = 0$	F (8, 97879) = 555.92 $\rho > $ F = 0
Variance in APS – KS2	$\chi 2\ (13)= 753.94$ $\rho > \chi 2 = 0$	F (8, 97879) = 229.20 $\rho > $ F = 0

Table A1.4: Summary Statistics of Log-transformed Variables

Variable	Mean	Standard Deviation
Number of Pupils	3.44	0.60
Total Resources in real terms	10.05	0.72
Average Point Score (APS) at KS1	2.80	0.08
APS at KS2	3.33	0.11
School Value-Added Score	4.62	0.03
Average Total Marks in English Test	4.11	0.14
Average Total Marks in Maths Test	4.20	0.15
Technical Efficiency (Value-Added)	0.67	0.01
Technical Efficiency (English Test)	0.50	0.04
Technical Efficiency (Maths Test)	0.50	0.05
Technical Efficiency (APS KS2)	0.84	0.05
Total	1	07,587

Table A1.5: Standardised Regression Coefficients

| Variables	Value-Added Score		English Test Results		Maths Test Results		APS (KS2)	
	SFA	OLS	SFA	OLS	SFA	OLS	SFA	OLS
Total Real Resources	0.10 (0.002)	-0.24 (0.002)	0.62 (0.01)	-0.51 (0.01)	0.82 (0.01)	-0.50 (0.01)	0.13 (0.01)	-0.13 (0)
No. of Pupils	0.002 (0.002)	-0.20 (0.002)	043 (0.01)	-0.43 (0.01)	0.52 (0.01)	-04 (0.01)	0.10 (0.01)	-0.11 (0.01)
APS – KS1			0.20 (0.01)	0.15 (0.01)	0..23 (0.01)	0.20 (0.01)	0.22 (0.01)	0.20 (0.01)

Table A1.6: Correlation Matrix of Efficiency Estimates

	TE (VA)	TE (Eng)	TE (Maths)	TE (APS)	TE (SE in VA)	TE (SE in Eng)	TE (SE in Maths)	TE (SE in APS)
TE(VA)	1.00							
TE(Eng)	-0.09	1.00						
TE(Maths)	0.03	0.71	1.00					
TE(APS)	0.39	0.25	-0.12	1.00				
TE(SE in VA)	0.20	-0.03	0.06	-0.33	1.00			
TE(SE in Eng)	0.65	0.22	0.40	0.18	0.31	1.00		
TE(SE in Maths)	0.24	-0.05	-0.30	0.06	-0.48	-0.21	1.00	
TE(SE in APS)	0.44	-0.04	-0.28	-0.11	0.15	-0.01	0.75	1.00

Table A1.7: Mean Levels of Technical Efficiency

Educational Output	Mean	Standard Deviation	Minimum	Maximum
Value-Added	0.95	0.02	0.83	1
English Test Scores	0.65	0.07	0.40	1
Maths Test Scores	0.60	0.08	0.33	1
Average Point Score	0.84	0.05	0.48	1

Figure A1.1: Distinction between OLS, the Deterministic and Stochastic Production Functions
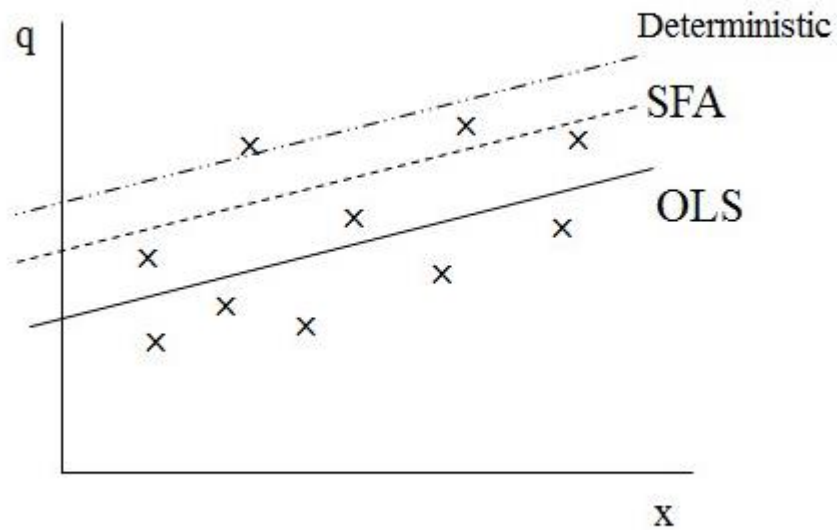
Deterministic frontier: where, any deviation from the frontier determined by the input-output mapping of the most productive units is attributed to technical efficiency alone.

SFA (Stochastic Frontier Approach): where, the frontier is determined by a deterministic component mapping inputs and output and a random error component to account for statistical noise. Any unit that lies below the thus determined frontier is technically inefficient with the extent of deviation from the frontier capturing the degree of inefficiency.

OLS (Ordinary Least Squares): This is the average production function mapping inputs and outputs for the average unit after accounting for noise in the data.

Table A1.8: Main Types of Primary Schools and Characteristics

Type of School	Organisation	Funding
Community Schools	Run by the Local Authority (LA)	LA Funded
Foundation & Trust Schools	Managed by the Governing Body (GB); The GB employs the staff and sets the admissions policy.	LA Funded
Voluntary Aided Schools	Are Religious/Faith Schools; GB employs the staff and sets the admissions policy; School Buildings and land are usually owned by a Charity, often a church.	LA Funded
Voluntary Controlled Schools	LA employs the staff and sets the admission policy. School land and buildings owned by a charity, often a church.	LA funded
Academies	Publicly funded independent schools set up by sponsors for business, faith or voluntary groups in partnership with the LA and the government Department for Children, Schools and families; Run by a GB/Academy Trust; Don't have to follow the National Curriculum and can set their own term times; Have to follow the same rules on admission, special educational needs and exclusions as other state schools.	Funded directly from the Central Government
Free Schools	Set up by teachers, community or faith groups, Universities and groups of parents where there is parent demand; Greater control over finances, the curriculum and teachers' pay and conditions; Can change the length of school terms and the school day.	Funded directly from the Central Government
Independent Schools	Private Management; Independent of LA Control; Pupils don't have to follow the National Curriculum.	Parents pay fees towards the cost of running an independent school.

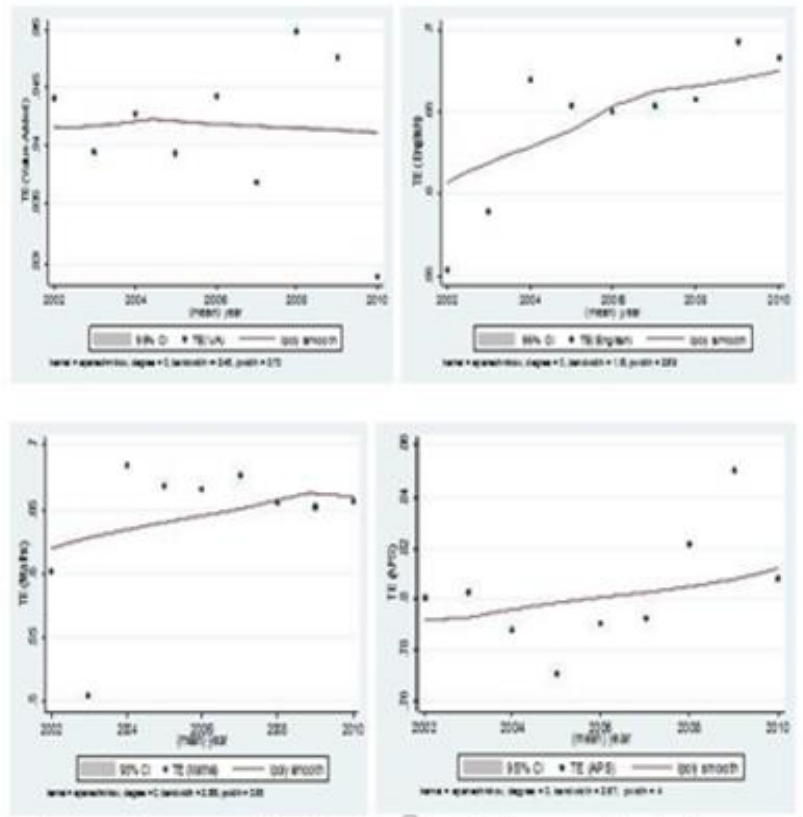Figure A1.2a: Time Trends in Technical Efficiency

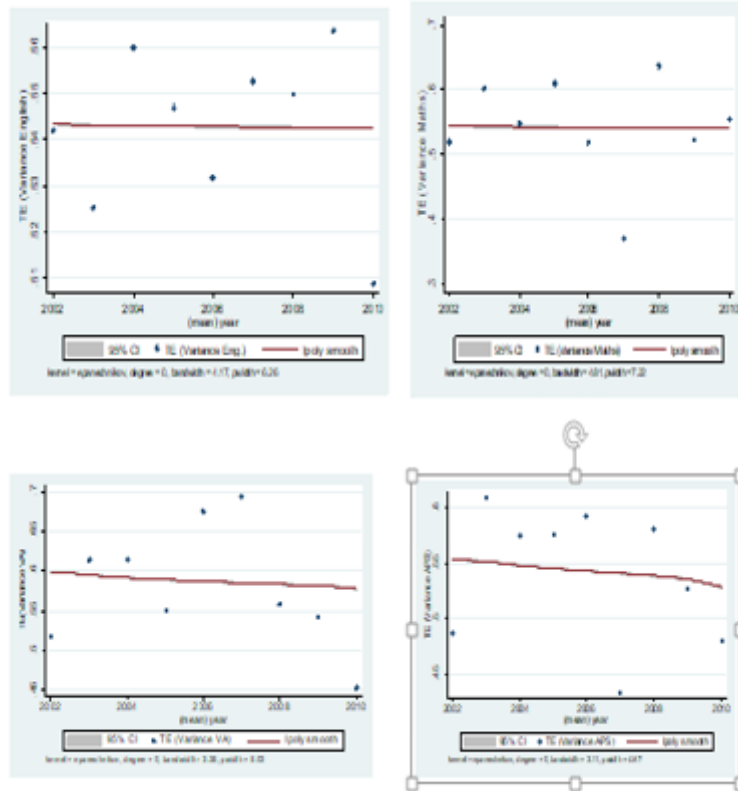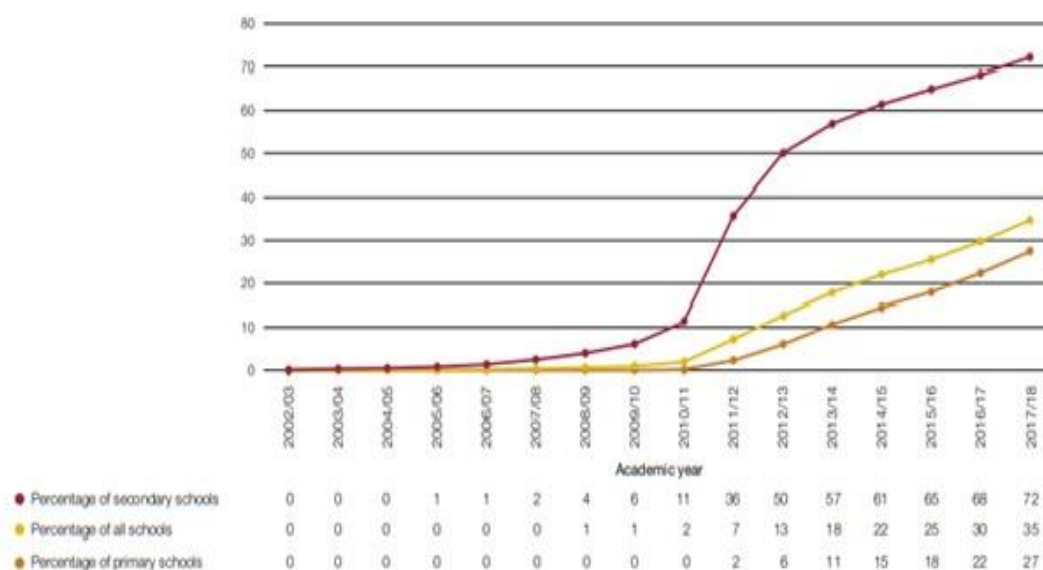Figure A1.2b: Time Trends in Technical Efficiency (Continued)

Table A2.1: Autonomy in the English School System

	Systemic changes	Peripheral changes
1980	Governing bodies established for all schools, heralding the introduction of school accountability	
1986	Governors given greater freedom over headteacher and staffing decisions	
1988	National Curriculum introduced for all schools	City Technology Colleges (CTCs) introduced
	Schools given greater autonomy over budgets, management and staffing under Local Management of Schools (LMS)	Grant-maintained status introduced, enabling schools to opt-out of LEA control and receive funding from central government
1990		300-pupil threshold on grant maintained (GM) applications removed
1992	Ofsted established to regulate and inspect schools	
	The Parent's Charter introduces school league tables and greater parent information	
	Further education and sixth-form colleges removed from LEA control	
1993		Sponsored GM schools introduced
		Funding Agency for Schools established to coordinate central government payments to GM schools
		Specialist Schools programme introduced
1997	School Standards and Framework Act reconstitutes schools as foundation, voluntary or community schools	Grant-maintained schools brought back under control of the LEA
2000	National "floor targets" of five A* to C GCSE grades introduced	City academies, modelled on CTCs, introduced to address failure in disadvantaged urban areas through a mix of autonomy and strong governance
2002		Eligibility rules for academies relaxed to include all-age, primary and sixth-form colleges in disadvantaged rural (as well as urban) areas
2004	School Improvement Partners (SIPs) introduced	
2007		All future academies required to follow the National Curriculum programme of study in English, maths, science and ICT
2009	All schools obliged to meet the "21st Century School Pupil Guarantee", imposing curriculum requirements on primary and secondary schools	Removal of funding requirement for academy sponsors
2010	The Academies Act allows all maintained schools to apply to become an academy and removed the need for local authority consultation	Introduction of free schools announced
	Underperforming primary schools are replaced with academies for the first time	Abolition of requirement for new academies to follow National Curriculum in core subjects

Source: Bassett et al, 2012

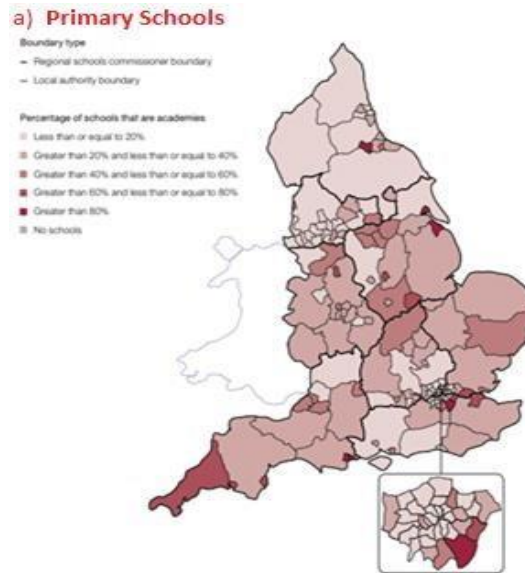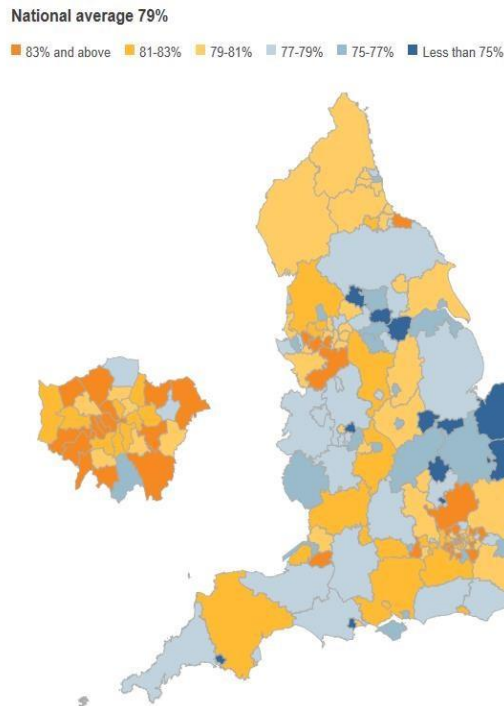Figure A2.1: Academies in England, 2002/03 to 2017/18

	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18
Percentage of secondary schools	0	0	0	1	1	2	4	6	11	36	50	57	61	65	68	72
Percentage of all schools	0	0	0	0	0	0	1	1	2	7	13	18	22	25	30	35
Percentage of primary schools	0	0	0	0	0	0	0	0	0	2	6	11	15	18	22	27

Notes:

1. Percentages are calculated using data collected in the January of each academic year. Percentages for 2002/03 to 2016/17 are based on published national statistics. The percentage for 2017/18 is an estimate based on our analysis of the Department's published database of schools.

2. In total, 21, 538 state-funded schools were open at January 2018. Of these, 14, 066 (65%) were maintained schools and 7, 472 (35%) were academies. The number of academies comprised 6, 996 converted academies, and 476 free schools, including university technical colleges and studio schools.

3. In addition to 16, 768 primary and 3, 434 secondary schools, 'all schools' includes 984 special schools and 352 alternative providers. At January 2018, 29% of statefunded special schools and 34% of alternative providers were academies.

Source: National Audit Office Analysis of Department for Education data (2018)

Figure A2.2: Proportion of Primary Schools that are Academies & Primary
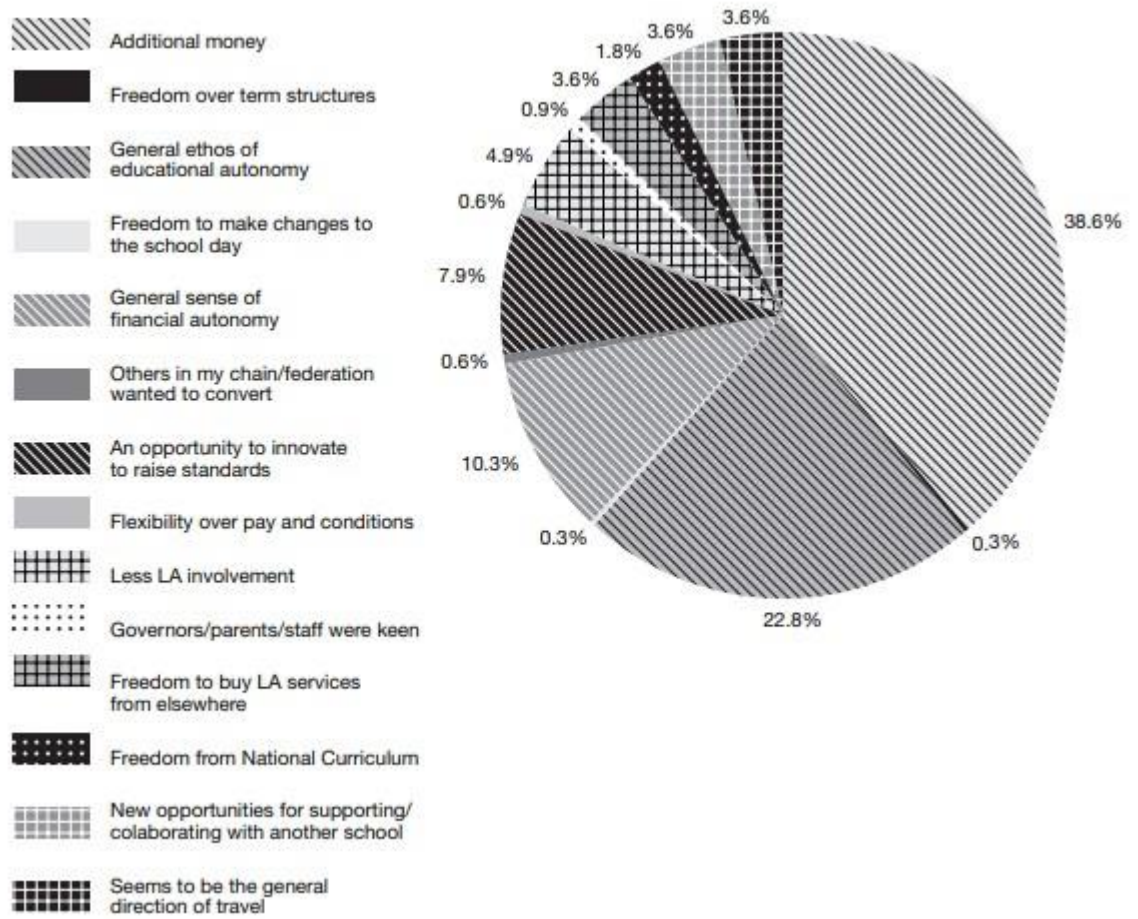School Performance in England's Local Authorities

a) **Primary Schools**

Source: National Audit Office Analysis of Department for Education data, 2018

National average 79%

■ 83% and above ■ 81-83% ■ 79-81% ■ 77-79% ■ 75-77% ■ Less than 75%

Source: **https://www.bbc.co.uk/news/education-30410097**

Figure A2.3: What is the primary reason for becoming an academy?

Legend:
- Additional money
- Freedom over term structures
- General ethos of educational autonomy
- Freedom to make changes to the school day
- General sense of financial autonomy
- Others in my chain/federation wanted to convert
- An opportunity to innovate to raise standards
- Flexibility over pay and conditions
- Less LA involvement
- Governors/parents/staff were keen
- Freedom to buy LA services from elsewhere
- Freedom from National Curriculum
- New opportunities for supporting/colaborating with another school
- Seems to be the general direction of travel

Pie chart values: 3.6%, 3.6%, 1.8%, 3.6%, 0.9%, 4.9%, 0.6%, 7.9%, 0.6%, 10.3%, 0.3%, 22.8%, 0.3%, 38.6%

Source: Bassett et al, 2012

Figure A3.1: Number of Primary Academies in England
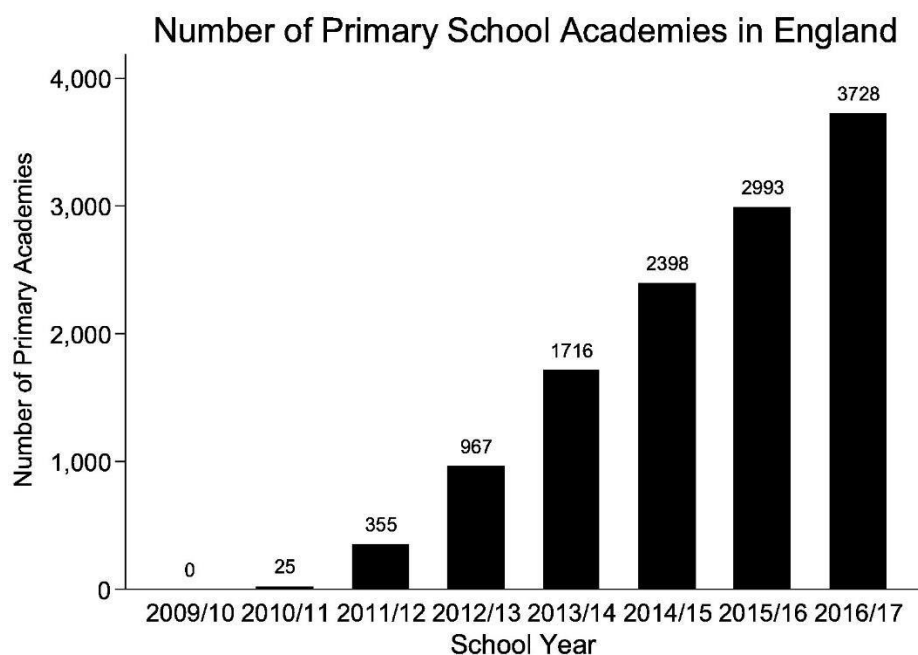
Source: Eyles et al, 2017

Table A3.1: Table of Inferior Bound (Showing the number of treated and the number of controls for each block)

```
 Inferior |
 of block |      (mean) acdever
of pscore |        0          1 |     Total
----------+----------------------+----------
.0035769 |    1,387         13 |     1,400
   .0125 |    1,496         29 |     1,525
    .025 |    2,082         83 |     2,165
     .05 |    2,215        165 |     2,380
      .1 |    1,013        136 |     1,149
     .15 |      536        113 |       649
      .2 |      457        149 |       606
      .3 |      156         75 |       231
      .4 |       68         75 |       143 |
      .6 |        9         17 |        26
      .8 |        0          7 |         7
----------+----------------------+----------
   Total |    9,419        862 |    10,281
```

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