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ABSTRACT

Choice, Competition and Pupil Achievement*

Choice and competition in education have found growing support from both policy makers and academics in the recent past. Yet, evidence on the actual benefits of market-oriented reforms is at best mixed. Moreover, while the economic rationale for choice and competition is clear, in existing work there is rarely an attempt to distinguish between the two concepts. In this paper, we study whether pupils in Primary schools in England with a wider range of school choices achieve better academic outcomes than those whose choice is more limited; and whether Primary schools facing more competition perform better than those in a more monopolistic situation. In simple least squares regression models, we find little evidence of a link between choice and achievement, but uncover a small positive association between competition and school performance. Yet, this could be related to endogenous school location or pupil sorting. In fact, an instrumental variable strategy based on discontinuities generated by admissions district boundaries suggests that the performance gains from greater school competition are limited. Only when we restrict our attention to Faith autonomous schools, which have more freedom in managing their admission practices and governance, do we find evidence of a positive causal link between competition and pupil achievement.

JEL Classification: I20, H70, R5

Keywords: choice, competition, primary schools, pupil achievement

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1. Introduction

Choice has been the big policy idea in education for quite some time, and it is an idea that is increasingly being pushed hard in the UK. Choice may be a good thing in itself because people value their freedom. Yet, most proponents stress that it leads educational providers to compete for pupils by improving their technology, thus raising educational standards. Additionally, it is argued that gains may directly arise from choice through better matching of pupils with schools according to personal tastes and needs. These issues have been widely researched in the US, with an extensive literature in the education and economics of education fields (Hoxby, 2000, 2003, 2004). However, it seems only fair to say that the existing evidence is mixed, and at best offers a shaky foundation for policy.

Despite this, a quasi-market in education has political currency[1]. In this paper we study school choice and competition, with the aim of uncovering empirical evidence for the hypothesised performance advantages that advocates of choice and competition say underpin these policy ideas. We focus explicitly on two conceptually distinct questions: 1) Do pupils perform better if they had more schools from which to choose, conditional on where they live; 2) Do pupils perform better if they are enrolled in schools that have to compete with many other schools to attract pupils, given where pupils live? We consider these questions to be the most relevant when evaluating the likely impacts of policies designed to expand the choice set available to families, without requiring them to move home. As such, we abstract from the kind of choice that can by exercised by choice of residential location (Tiebout, 1956, choice), which

[1] See Le Grand (1991, 1993) and the more recent discussion in Machin and Vignoles (2005). In the recent 2005 UK government election, the two leading parties both supported it in their manifestos. Labour's pledged was that 'good schools will be able to expand their size and also their influence – by taking over less successful schools' (Labour Party, 2005a). The Conservatives pledged a right to choose that 'will give real autonomy to all schools, and real choice to parents', with the claim that 'choice drives up standards in every field of human endeavour [and]… put pressure on underperforming schools to raise their standards' (Conservative Party, 2005).

has been studied elsewhere (e.g. Hoxby, 2000). Our analysis using rich administrative data on Primary school pupils in the South East of England allows us to improve on the existing (largely US-based) literature, since the data contains detailed information on pupil and school addresses, which we will use to construct separate choice and competition indices.

We also make use of the fact that only a small percentage of pupils in England attend Primary schools outside their home Local Education Authority (LEA) because there are institutional barriers to doing so. This allows us to derive credible instrumental variables for the competition and choice indices, based on the boundary discontinuity that these barriers generate. We use this empirical strategy to solve the difficult issues of endogeneity that are inextricably associated with studying connections between pupil performance and choice/competition.

In the empirical analysis, simple least squares regressions show no link between choice and achievement, but a small positive association between school competition and performance. However, this seems to be related to endogenous school location or pupil sorting, since instrumental variable estimates show that there are no general benefits to be had from increasing school competition. It is only a minority of schools, namely Faith schools with autonomous governance and admission procedures, which seem to respond positively to a greater degree of competition with local schools.

The rest of the paper has the following structure. The next section outlines the ideas surrounding debates on choice and competition and provides a short guide to the (vast) empirical evidence from the US and the (scant) empirical evidence from the UK. Next, we discuss how choice and competition relate to the current admissions system in England. Following that, in Section 4 we explain our empirical methods. Section 5 describes the data and Section 6 presents our results. Finally, Section 7 concludes.

2. Choice and School Competition: Theoretical Background and Previous Research

Theoretical discussions of the benefits of school choice and competition, and on its less desirable consequences, are wide ranging and often highly politicised. Although broad philosophical issues are often involved (Brighouse, 2000), we will here mainly attend to the narrower claims about the potential productivity and performance benefits, which have been the prime focus of applied work in the field. The arguments are fairly well rehearsed, and there are many theoretical expositions that focus on different aspects[2]; here we present a brief summary to motivate our empirical work based on two 'ideal' modes of school provision:

1) The *community-school* model, in which schools serve local communities only, and only those who live nearby or within the relevant jurisdiction are allowed in.

2) The *parental-choice* model, in which schools admit pupils regardless of where they live, and parental preference is the deciding factor.

Broadly speaking, (1) has traditionally been the most dominant form of provision in most parts of the world. However, comparison of the relatively weak performance of state-sector schools operating under mode (1), with respect to schools in the private sector which operate largely on mode (2), has led many (following on from Friedman, 1962) to advocate expansion of choice as the road to better schooling.

Advocates of mode (2) tend to base their claims on standard efficiency arguments from economic theory. These claims fall into two categories: those based on market discipline incentives, and those based on better matching of pupil needs and school provision. The main claims are predicated on the assumption that Tiebout choice, in which families vote with their feet and make residential and schooling choices simultaneously, has not led to an efficient allocation of resources under the community-based model (1).

[2] See, *inter alia*, Epple and Romano (1998), Epple, Newlon and Romano (2002), McMillan (2004) and Nechyba (2000, 2003).

Indeed, community-based schools serving single neighbourhoods work in a relatively monopolistic market, and the incentives for improvement or adoption of new teaching technologies may be weak. Incentives need to come from good governance, supported by strong institutional arrangements including training, monitoring, mechanisms for self-evaluation and performance-related pay; yet, these may not be effective. Allowing parents free choice, instead, and linking school finance to school popularity, creates a direct market incentive mechanism: unpopular schools lose pupils and money, popular schools gain pupils additional funding; head-teachers and staff are rewarded accordingly; schools must adapt to meet parental demands – which may include provision of high educational standards – or fail and close. We refer to this mechanism as a *school competition* effect stemming from greater parental choice in education markets.

Gains may also arise through reallocation of pupils to schools according to personal tastes and pedagogic needs. In fact, consider a move from a community-based to choice-based system. If every pupil can find a school that they prefer at least as much as what was available under the old system, the new system must be welfare improving. If every pupil can find a school that offers a teaching technology that educates them at least as effectively as under the community-based system, then academic achievement improves. We refer to this second mechanism as a *direct choice* effect of school provision operating under mode (2).

In defence of mode (1) it has been argued that teaching proceeds better in a stable environment, where teachers are not under undue competitive pressures. Also, classes in a choice-based system may suffer higher pupil turnover linked to search, which can further disrupt teaching (Hanushek, Kain and Rivkin, 2004). Moreover, schools facing demand from families with heterogeneous preferences over school quality may respond to an increase in competition by reducing costly effort and going down-market to serve those with weak

preferences for school performance (McMillan, 2004). Finally, a further disadvantage of the choice based system is that pupil travel distances might be greater than under the community school model; this may have a detrimental effect on achievement because of lateness or stress.

Given these counterbalancing arguments, what is the available evidence on the effects of school competition and choice? A lot has been written on the issue in the past few decades. Over the years, various countries have adapted their institutional arrangements to accommodate greater freedom of choice for families and, implicitly at least, greater competition between schools. The literature is rich in descriptions of these institutional arrangements and, sometimes, changes in aggregate achievements that accompanied them (e.g. Plank and Sykes, 2003; Gorard, Taylor and Fitz, 2003). Following different approaches, a substantial volume of quantitative evidence on the effects of school choice and competition on pupil outcomes has been produced (particularly for the US setting). Belfield and Levin (2003) provide a broad survey.

The first and most common approach is to explore the effects of implicit variation in the level of choice available in different school markets (e.g. some of the work reviewed in Belfield and Levin, 2003, Hoxby, 2000, and Rothstein, 2006a, for recent examples) to derive some indicators of market competitiveness, and then measure to what extent these are associated with pupil outcomes in the cross-section. The first empirical problem, and one to which we will return later, is the definition of the competition indicator. In most research, the market in which a school is located is broadly defined by the admissions district in which it is located, whilst the level of competition is based on the number of schools that seem to be available to any pupil in that district. Studies adopting this approach are mixed in their findings. Belfield and Levin (2003) suggest 'the gains from competition are modest in scope with respect to realistic changes in levels of competition' and that many results are statistically

insignificant. Hoxby (2000) does find that pupils perform better in metropolitan areas where there seem to be more schooling choices (assuming choice is exercised through Tiebout mechanisms). However, this is only true once the number of school districts is predicted (instrumented) from information on the number of natural boundaries (rivers and streams) and the validity of these instruments and the robustness of Hoxby's results have been recently contested (Rothstein, 2006b; Hoxby, 2006). In none of these studies is there an attempt to distinguish between a direct effect of parental choice, and improvements due to increased competition among schools.

A second approach evaluates the effects of private schooling. This has two strands. One body of work looks at the outcome of private sector pupils relative to public (state) schooling, or more specifically at whether pupils offered vouchers for access to the private sector perform better (Rouse, 1998; Mizala and Romaguera, 2005). In fact, this approach cannot directly assess whether increased choice itself is effective at raising standards, or whether schooling in the private sector offers advantages over schooling in the state sector[3]. If it is the latter, then giving families more freedom to choose private schools (by vouchers or similar schemes) could lead to aggregate improvements in educational standards, but neither choice nor competition are directly responsible[4]. The second strand looks at the competition effects directly by measuring the effects of private school enrolment on state school performance, on the basis that private schools provide competition for state schools (Hoxby, 1994, 2004). This strategy is complicated by the notion that the location of private schools is endogenous to neighbourhood

[3] See some of the arguments in Nechyba (2005), who provides a theoretical overview of issues related to bringing aspects of the private sector to the state sector.

[4] The *assumption* here is that private schools are competitive, and that this is the source of their technological advantage.

status, and such schools are likely to skim off the higher-achievement pupils from the state sector (Epple and Romano, 1998).

Finally, another body of research evaluates the impact of policy changes introducing greater choice into geographically localised educational markets. In some cases, policies allow constructing research designs that directly exploit random assignment to choice programs: Cullen et al. (2003) find that students randomized into supposedly better high-schools experience little academic benefit (and Cullen et al., 2005, come to similar conclusions). On the other hand, Hoxby's work (Hoxby and Rockoff, 2004; Hoxby, 2003) finds benefits from choice-increasing programs, as do Holmes et al. (2003) on school choice in North Carolina, and Lavy (2005) on choice in school districts in Tel Aviv. These findings are often difficult to generalize, given the highly localized and peculiar settings under analysis. Moreover, it is difficult to infer whether any benefits occur because choice improves the match of pupils with educational providers, or because it increases competitive pressure.

All in all, then, it has to be said that the evidence from the US is voluminous, but 'mixed' in findings. In contrast, evidence for Britain is almost non-existent. On the one hand, Levacic (2004) finds that Secondary school head-teachers' of self-reports of perceived competition are linked to school performance indicators; this probably means that the best head-teachers are more aware of their competitors, since her structural measures of competition are unrelated to academic performance. Bradley et al. (2000) show a number of 'market' type effects in Secondary education following admissions reforms in the late 1980s – for example, schools that performed better than their neighbours attracted more pupils. Further, Bradley et al. (2001) find that schools with close neighbours are more efficient in their use of resources. On the other hand, Clark (2005) reports that reforms that handed more power to schools (in late 1980s) only exerted modest efficiency gains through competition effects.

Otherwise, most research effort in Britain has been directed at the effects of competition on segregation (e.g. Gorard, Taylor and Fitz, 2003, Goldstein and Noden, 2003, Burgess et al., 2004), which we do not pursue here. An overarching concern about wider school choice (model (2)) is that even if choice itself, or the competition it engenders, has the potential to boost pupil achievements, this may come at the cost of increased segregation across schools, and that gains may not be equally distributed[5]. Indeed, whether there are improvements on average depends on whether the gains to the winners outweigh the costs to those who lose out. Hoxby (2003) argues that school competition is a 'tide to lift all boats'. However, the general weight of evidence in the literature (and the results we present below) suggests this to be rather bold a claim.

The empirical work we present here is, then, the first pupil-level analysis of the effects of choice and competition on academic achievement in Primary schools in England, and the first distinguishing these two concepts empirically[6]. Moreover, our analysis is based on a large pupil census for a sizable part of the South of England, and therefore generally representative. Finally, exploiting some institutional features of school admissions across school district boundaries, we devise a solid instrumental variable (IV) strategy, which we describe in more detail below.

3. School Choice and Competition in English Primary Schools

The current state-school system in England is something of a hybrid of a community-based model and a parental-choice setting (i.e., models (1) and (2) discussed above). Traditionally neighbourhood-based, the principle of choice has been extended to a greater or lesser extent in

[5] Although the theoretical argument for the link between choice, competition and stratification is not clear, and points to either direction.

[6] Bayer and McMillan (2005) is the only other work conceptually distinguishing the two ideas. Yet, the authors' structural modelling approach only allows estimating the effect of school competition.

different areas, since the Education Reform Act of 1988 (see e.g. Glennerster, 1991). The trend has continued recently, with further expansion of choice being advocated in many quarters[7].

Although choice at the *Secondary* education phase tends to dominate the political rhetoric and policy discussion, in this paper we will consider the effects of choice and competition among *Primary* state-schools only[8]. The reasons for this are two-fold. Firstly, we believe that choices made at Primary age are critical for later educational success (see Heckman, 2000, and Dearden et al., 2004), and that parents are very active in exercising choice at the Primary level (as evidenced by research on the house price effects of Primary school performance in Gibbons and Machin, 2003, 2006). Next, travel distances have a greater role to play in Primary school choice because children of this age are not independent travellers. This means that geographical criteria are likely to be more relevant in deciding which school to attend, so that the availability of schools can be more confidently inferred from geographical measures of accessibility.

All state schools in England are funded largely by central government, through Local Education Authorities (LEA) that are responsible for schools in their geographical domain, and, crucially, funding is linked to the number of pupils enrolled in schools. Primary schools in the state-sector fall into a number of different categories, and differ in terms of the way they are governed, who controls pupil admissions, and finally their religious affiliation (if any). In addition there is a small private, fee-paying sector, which we do not consider here[9]. The key differences between the various types of state school – Community, Foundation, Voluntary

[7] For example the UK Government's October 2005 White Paper: "Higher Standards, Better Schools for All: More choice for parents and pupils".

[8] The UK Labour party, for example, has proposals to make all Secondary schools 'Specialist' schools with their own curriculum specialisations and to allow popular schools to expand in response to demand (Labour Party 2005b).

[9] Private schools educate around 6-7% of pupils in England as a whole.

Aided and Voluntary Controlled – are set out in Appendix Table A1. About 60% of the 14500 (or so) Primary schools in England are classified as Community schools, with a further 15% being Voluntary Controlled schools (predominantly Faith schools). Next, Voluntary Aided account for about 23% of the state-Primary sector (97% of which religiously affiliated), while Foundation schools account for about 2% (86% of which are not connected to a particular Faith).

All schools are run by a Governing Body composed of members elected from amongst parents and staff (Parent Governors and Staff Governors), appointed by the LEA (LEA Governors), appointed by the church or charitable foundation that owns the school premises (where relevant – Foundation Governors), and appointed from the community (e.g. local businesses) by the Governing Body. The Governing Body sets the strategic direction of the school, draws up school policies, sets targets and monitors performance, although day-to-day running is down to the head-teacher and his or her leadership team. The constitution of the Governing Body is important because it determines how much influence various 'stakeholders' have in the way the school is run – in particular, the balance between control by the LEA and control by the church or charitable foundation. Importantly, for Voluntary Aided and Foundation schools, it is the Governing body of the school that is responsible for managing admissions, and therefore, *via* number of pupils, its own funding. In the other cases, it is the LEA that handles admissions centrally. These distinctions are important when considering the different incentives that competition may have for different school types.

Overall, all LEAs and schools must organise their admissions arrangements in accordance with the current (statutory) Department of Education and Skills School Admissions Code of Practice. The guiding principle of this document is that parental *choice* should be the first consideration when ranking applications to a Primary school. Yet, if the number of

applicants exceeds the number of available places, almost any criterion – which is not discriminatory, does not involve selection by ability and can be clearly assessed by parents – can be used to prioritise applicants[10]. These vary in detail, but preference is usually given first to children with special educational needs, next to children with siblings in the school and to those children who live closest. For faith-schools, regular attendance at designated local churches (or other expression of religious commitment) is foremost. Note that less than 50% of pupils attend their closest Community school, which shows that there is not a one-to-one mapping between where a child lives and where they go to school and suggests that parents have some scope to exercise their 'right to choose'.

One important restriction applies, though. Families are allowed to apply to schools in LEAs other than their LEA of residence. However, parents must make separate applications to other LEAs, and, more importantly, LEAs do not have a statutory requirement to find a school for pupils from other LEAs: the law only requires that they provide enough schools for pupils in 'their area'[11]. As a result, banking on admission to a popular school in another LEA is a high-risk strategy, and cross-LEA attendance is not commonplace in Primary schools. In our study area in and around London only 4.7% of Community school pupils, 3% of Voluntary Controlled pupils and 6% of Foundation school pupils attend a school located outside their home LEA. For Voluntary Aided schools, the rate of LEA crossing is slightly higher, but is still only about 10%.

[10] LEAs now publish their admissions policy, complete with information on historical patterns of admission in each school in their jurisdiction (for example Barnet, 2005; Enfield, 2005)

[11] The Education Act 1996 section 14 reads: "(1)A local education authority shall secure that sufficient schools for providing (a) Primary education, and (b) education that is Secondary education by virtue of section 2(2)(a), are available for their area. (2) The schools available for an area shall not be regarded as sufficient for the purposes of subsection (1) unless they are sufficient in number, character and equipment to provide for all pupils the opportunity of appropriate education"

As to the actual extent of competition faced by Primary schools, it is important to notice that Primary schools are universally non-selective, do not have explicit curriculum specialisations, and are mixed gender. Yet, there is quite a lot of heterogeneity in terms of their performance, and enrolment rates are likely to be quite elastic with respect to 'quality' measures, as evidenced by research on the house price effects of Primary school performance in England (Gibbons and Machin, 2003, 2006; Cheshire and Sheppard 2004). Given that Primary institutions are mainly funded according to pupil numbers, schools face strong incentives in their drive to attract pupils by improving educational standards[12]: failing schools are under threat of falling enrolment, funding and personnel and could eventually be closed; popular schools on the other hand receive growing numbers of applications, more resources and are be able to expand. Additional, high-flying schools can receive extra resources and recognition for their excellence (e.g. so called "Beacon schools") and head-teacher pay schemes are explicitly linked to performance.

One final remark is worth making: we expect these 'competition' incentives to be stronger in 'autonomous' schools, such as Voluntary Aided schools, that manage their own admission systems and so are directly responsible for attracting pupils and funding. Numbers in undersubscribed 'Controlled' schools, such as Community schools, where the Local Education Authority handles admissions centrally, are often topped up with pupils who could not be accommodated in their school(s) of choice. This undoubtedly weakens the potential link between parental choice and school competition in Controlled schools[13].

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[12] As already mentioned, schools are funded on a per-pupil basis (with adjustments for special needs and economic deprivation); yet, the marginal costs of teaching extra children within a class group are small in purely financial terms. Schools are also evaluated on the basis of pupil pass rates in national tests (the league tables). For these reasons it is not hard to believe that these incentives are real.

[13] Unfortunately, we do not have access to data about how families ranked their school choices.

4. Empirical Methods

4.1. Defining and measuring choice and competition

The concept of competition we will invoke in this study is one of spatial competition conditional on pupils' residence: schools compete with other schools for students in a community in order to maximise their revenues and minimise the costs associated with disruptive and hard-to-teach pupils. Even under a parental-choice regime of school provision (model (2) above), a family's set of available schools is constrained by the distance between home and school, in part because of commuting costs and in part because school admission rules have historically favoured residents who live nearby. Because of this, residential locations differ in terms of numbers and accessibility of alternative schools, which in turn means that some schools face greater competition from alternatives than do others. Since state schools cannot easily change location or vary their price, they can only increase their market share by offering a higher quality; these are the competition effects we seek out in this paper.

One thing should be clear from the outset: there must be variation in the structure of school markets for these ideas to be meaningful empirically. Our empirical work considers a large metropolitan area in which there are few explicit differences in institutional arrangements that could give rise to different competitive configurations[14]. However, our claim is that it is the spatial arrangement of schools in relation to each other, and in relation to residential housing, to give rise to *de-facto* variation in school accessibility and market structure[15].

The purpose of this empirical work is to assess separately the effect of greater school choice, and greater inter-school competition, on pupil academic performance. Though these

[14] This is unlike the markets studied by Hoxby (2000), who considers the number of school attendance zones in a jurisdiction.

[15] For sure, this spatial arrangement may be endogenous to pupil performance and this is something we consider in our empirical work.

two ideas are conceptually distinct, they can be quite difficult to separate. At the school level, these go hand in hand: markets in which parents have a wider choice of schools are markets in which schools face greater competition from other schools. Yet, for the family, the two concepts are distinct. Our definitions are then as follows: *Choice* is a property of residential location, and is dependent on the number of alternative schools from which a family can choose. *Competition* is a property of school location, and depends on the number of alternatives available to enrolled pupils. So, our measurements of parental choice are based on the number of schools that, according to our data, are available to families living in a given location; while, our measurements of competition are based on the range of alternatives that are available to pupils attending each school.

Competition/choice indices generally suffer from a number of problems. Firstly they can also capture urban density and school size effects, rather than competition and choice. We try and carefully design our measures to avoid this. Secondly, different market configurations can arise through processes of parental choice and school location, which may be endogenous to pupil performance. For example, if school places are rationed by place of residence, then parents have good reason to move close to popular schools. Schools may then appear monopolistic, even though it is parental choice that has compressed the geographical spread of their intake. Additionally, although new school openings are rare, it is not implausible that the current spatial distribution of schools is related to the socioeconomic characteristics of an area and, consequently, its level of pupil achievement. We address the endogeneity of the competition and choice indices using an instrumental variables approach based upon a boundary discontinuity, as described below (in Section 4.3).

To construct our indices (which are described diagrammatically in Figure 1), we start by taking advantage of the fact that our data contains information on school location and pupil

residential location, identified by 6 digit (1 metre) coordinates derived from full address postcodes. For each school *s* we define its *travel zone* to encompass all residential postcode units that are: a) within the same LEA as school *s*; *and* b) contained within the perimeter of a circle drawn around school *s* at the median of the distribution of the home-school distances for pupils who attend school *s*[16].

Our index of school *choice* availability is derived using our knowledge of a pupil's residential postcode and the travel zones of nearby schools. This index is defined as: the number of schools accessible to a pupil – i.e. the number of school travel zones that encompass the pupil's residential postcode, excluding the school the pupil actually attends.

Next, the *competition* index is school-based and assesses the extent to which pupils attending school *s*, have the option of attending other schools. This information is obtained as: the average number of schools accessible to pupils in the school – i.e. the average of our school choice index across pupils actually *attending* school *s*[17].

Notice that we have experimented with a number of alternative choice and competition measures, including the number of alternative schools and number of 'competitors' within a fixed radius, and a Herfindahl index of pupil shares in schools available within travel zones. These alternatives gave qualitatively similar result; yet, we think our number-of-school indices are conceptually easier to interpret and avoid imposing *a priori* restrictions on travel patterns.

Finally, the way we define the travel-zones used to construct these indices means that they are not purely dependent on school density, and hence on urbanisation effects. For example, semi-rural and low-density suburban areas can (in principle) appear competitive

[16] Using the median means that we are focussing on competition amongst the pupils who live nearest to schools. Our results are similar if we use a wider or narrower travel zone, e.g. the 25th or 75th percentiles.

[17] In all cases, when we consider pupil numbers, we count all pupils in the age 10-11 cohort who are finishing Primary school and taking their Key Stage 2 tests.

because our definition of school accessibility is based on observed pupil travel behaviour; less dense places may exhibit low school density, but still be competitive school markets because families can travel longer distances more easily. Essentially, the fact that our travel zones are defined by 'revealed preferences' allows us to account for heterogeneous travel modes and time, and other features of choice patterns that would be obscured by more restrictive assumptions such as common travel distances or common travel modes in different urban, suburban and semi-rural settings.

4.2. Modelling school performance

Our focus is on the influence of these competition indices on pupil achievements, where these are measured in terms of standard test results. One can think of this as the effects of choice and/or competition on school productivity (Hoxby, 2003), though we make no attempt to evaluate achievements per pound spent[18]. As discussed above, more competition with other schools and greater exercise of choice amongst potential pupils may raise a school's productivity, because it forces schools to use a more efficient teaching technology, or because reallocation of pupils to schools results in more efficient pupil-school matches.

We look for these types of influence by estimating pupil-level educational production functions that use information for the extended London metropolitan area (described below). The data available to us are rich in geographical detail, with information on pupil residential addresses, which makes computation of these choice and competition indices feasible. However, it is only available for two years to date, leaving us with little useful time-series variation in the indices and forcing us to adopt an essentially cross-sectional approach.

[18] Expenditure information at school level is not available to us.

The inputs into the education production functions include the choice and competition indices, alongside a wide range of pupil, school and neighbourhood characteristics. The full details of each specification are described in the Results section below. The outputs of the production function are measures of pupil achievement relating to standard tests taken at the end of the Primary phase in English education, at age 10/11. There is little doubt the outputs of a good education amount to more then good results in academic tests. However, tests remain the simplest metric on which to judge pupil abilities, and average achievement in schools is the most common, if the most basic, means by which school performance is assessed. So, we use test scores as the main measure of pupil achievement, and focus on the *gain* in pupil achievement from age 6/7 to age 10/11: what is referred to as Key Stage 2 in the English National Curriculum.

Summing up, all our empirical models are more or less restricted versions of the following specification:

$$KS2_{irst} = \alpha KS1_{irst} + \beta_1 c_{rt} + \beta_2 c_{st} + \mathbf{x}'_{\mathbf{irst}}\boldsymbol{\gamma} + \varepsilon_{irst} \qquad (1)$$

where $KS2_{irst}$ is the age-10/11 test score for pupil *i*, who lives in postcode *r* and attends school *s* in year *t*; $KS1_{irst}$ is the age-6/7 test score for pupil *i*, who lives in postcode *r* and attends school *s* in year *t*; c_{st} is a competition index for school *s* in year *t*; c_{rt} is a choice index for residents of postcode *r* in year *t*; and finally $\mathbf{x}'_{\mathbf{irst}}$ is a vector of pupil, school, neighbourhood characteristics (and a year dummy).

4.3. Accounting for residential sorting: instrumental variables strategy

Families choose where to live, and schools are one thing they consider when making that choice. As a consequence, the market structures we observe in our data – which are based on the spatial configuration of school and pupil residential locations – may be endogenous in the

production of pupil achievements. This would be true if, for example, families crowd around a high-performing school, reducing its apparent competitiveness; it would also be true if the competitive structure is indicative of market penetration by a specific school type in areas with specific socioeconomic characteristics. Because of these concerns, we need to adopt an instrumental variable strategy and look for credible instruments for our competition and choice indices.

Our indices all assume that residence-school distance is an important factor in school choice because of travel costs. The general assumption is that the probability of family i attending school j decreases with distance to the school d_{ij}. Given this, families are (under most conditions) more likely to choose their nearest school, as the average distance to alternatives increases (other things equal). To see this, consider the following simple exposition. Suppose family utility from attending school j depends on distance d_{ij} and the school quality q_j, with $u_{ij} = aq_j - bd_{ij}$. Family i attends the nearest school k if $aq_j - bd_{ij} < aq_k - bd_{ik}$ for all j, or $a(q_j - q_k) < b(d_{ij} - d_{ik})$. Clearly, for given values of q_j, q_k and d_{ik}, the probability of i attending k increases as d_{ij} increases, for any j. An increase in d_{ik} for any j implies an increase in the average distance to all alternatives to k (assuming the choice set is finite).

Our instrumentation strategy uses this intuition, exploiting the notion that families living near LEA boundaries face longer journeys to schools other than the nearest, than families living in locations interior to the LEA. The idea is best illustrated in Figure 3. The figure shows a linear district with 5 schools k, m, n, p, q spaced at equal intervals. Schools k and q are located at the district boundaries at the left and right ends of the district respectively. The dashed lines show the cost of reaching each school, from each point i along the linear district. The bold line shows the average cost of reaching schools other than the nearest school, at any point i along the linear district. As can be seen, the average costs of travel to schools other than

the nearest is higher for residents near the edge than the centre. This means that residents near boundaries are more likely to attend their local school, i.e. travel costs restrict choice for residents near the district boundary relative to those in the centre. A further implication is that probability that school *j* recruits from the set of families who have *j* as the nearest school decreases with the distance of *j* from the LEA boundary; so, schools nearby LEA boundaries will mainly enrol pupils from of local families, who have that school as the nearest choice.

In conclusion, schools in locations close to LEA boundaries face less competition because: a) the catchment area shrinks in radius and land area closer to LEA boundaries due to local pupils (who face a more restricted choice set) crowding out those who would have travelled from further a-field; b) the catchment area may be partially truncated on one side, which is a restriction we impose by excluding the few pupils who cross LEA boundaries in the calculation of our choice and competition indices[19]. From these arguments, we propose to use the distance between a pupil's home and the LEA boundary as an instrument for school choice, and the distance between a school and the LEA boundary as an instrument for its level of competitiveness.

The validity of this strategy rests on a set of assumptions. First, it requires that the administrative boundary increases the costs associated with access to services on the opposite side of the boundary, so that they actually restrict parental choice and school competition[20]. Next, we need the distribution of schools and school types, as well as families, not to follow systematic patterns with respect to LEA boundaries; for example, schools (or Voluntary Aided schools) and households should not be more densely distributed around the LEA perimeters

[19] As it turns out, a) is most important in terms of driving variation in our indices.

[20] It also assumes that LEA boundaries are exogenously fixed and stable; this seems to be the case, as LEA boundaries were last re-drawn in 1997/1998, and even then very few boundaries in the area we study were affected.

than the centre. A further assumption is that these LEA-boundary distance instruments do not have a direct influence on school or pupil performance other than through their effects on the choice set available to families and that they are otherwise uncorrelated with the outcomes that are being analysed[21]. These are empirical issues regarding power and balancing properties of our instruments which we will investigate in detail below when we assess the validity of our instruments; in doing so, we will borrow from the methodology used in Cullen et al. (2005).

5. Data Sources and Sample Construction

The empirical analysis employs a number of large and complex data sets, which we now describe. The central sources of data for the empirical analysis are the combined National Pupil Database (NPD) for 1996 to 2003, the Annual School Census (ASC) from 1996 to 2003, and the Pupil Level Annual Census (PLASC) for 2002 and 2003. These are administrative datasets made available by the Department of Education and Skills (DfES) of the UK Government.

The first (NPD) is a pupil-level dataset that records test results obtained by pupils at various stages in their school careers. The first set of assessments is administered at age 6/7, at the end of what is called Key Stage 1 (KS1) in the National Curriculum. The assessment comprises Reading, English and Maths tests and tasks. Pupils are awarded a 'Level' of 0,1,2,3 in each subject (with +/- subcategories), and these Levels can be translated into point scores according to predetermined DfES rules. The second set of assessments takes place at age 10/11, at the end of Key Stage 2 (KS2). The assessment comprises English, Maths and Science tests and pupils are awarded percentage marks in each of these; marks translate into KS2 Levels 2,3,4,5 (with some +/- subcategories), which in turn translate into point scores, again

[21] Similarly, we are assuming that families do not decide to move away from LEA boundaries just because they value competition in itself (they just want a good school). Hence, from the parental perspective, there is no reason to reside far from LEA boundaries, unless this has a direct impact on pupils' performance.

using standard DfES rules. We will use KS2 and KS1 point score information to compute a value added measure of educational progress between age 6/7 and 10/11.

The second data set (ASC) collects information on pupil and teacher characteristics at school-level and is used for resource allocation and other administrative purposes by central government. It was augmented from 2002 onwards by PLASC, which collects characteristics of pupils individually, including their residential postcodes. These pupil characteristics can be linked to the pupil test results in the NPD and to school characteristics in the ASC. So, the basis for our composite dataset is all pupils in PLASC who took KS2 tests in the school years 2001/2002 and 2002/2003, and sat their KS1 tests in 1997/1998 and 1998/1999.

This information can be linked to additional school information, in particular school addresses and institution types using the DfES Record of Educational Establishments ('REE') and 'Edubase' files. Moreover, to compute measures of spatial competition using Euclidian distances, we need geographic coordinates for both schools and pupils. These are derived from the full address postcodes using Ordnance Survey Codepoint data, which provides 1 metre grid references for postcode unit centroids. For some of our analyses we also include information on pupil residential neighbourhood and family background, which we obtained by matching the residential address to Census data for 2001[22]. Finally, we derive LEA boundaries from the County and District boundaries obtainable from the 'UK Borders' service for Geographical Information Systems, which we will use in our instrumental variable analysis.

As stated above, the pupil data we use relates to age-10/11 pupils sitting KS2 tests in 2001/2-2002/3. The sample is further restricted to pupils living in a geographical zone within a 45km radius of central London, defined here as Bank tube station in the City of London, and to

[22] We identify pupil residential neighbourhoods using postcode sectors; these include a handful of postcode tracts and are well designed to represent the community where individuals live.

schools within the same radius[23]. Our purpose in restricting the data is to focus on primarily urban school markets. Moreover, reducing the sample also reduces the computational burden substantially. One further restriction is to eliminate partial LEAs (Luton, Bracknell) at the margins of our geographical zone, and in the City of London (which has a very low pupil population).

6. Results

6.1. Sample description

Table 1 summarises the most important variables in the dataset, namely the pupil achievement indicators and competition/choice indices. One key question concerns the amount of variation in our competition measures. Clearly if all schools serve only the local community, or if any school within an LEA is easily accessible from any residence within an LEA, then there is no variation in the level of competition. Our methods assume that a mix of neighbourhood-school and parental-choice structures exists, and that this will be reflected in our measures. Table 1 tabulates the summary statistics for our indices, Figure 3 graphs their distributions and Figure 4 provides a map (for part of our study area). These all show there to be substantial variation in the indices we have at hand.

Row 1 of Table 1 shows that, on average, every 10 pupils could quite easily reach 14 schools from their home address – in addition to the school they actually attend. Remember that this index is based on whether the median travel distance of pupils in neighbouring schools encompasses each home address, so that the feasible choice set could be quite a lot larger. Averaging this choice index at the level of the school in which pupils are enrolled, we derive

[23] We start with a sample within 50km in order to construct our choice and competition indices, but base estimation on the sub-sample within 45 km. This avoids us mistakenly inferring lack of competition, at the boundaries of our geographical zone.

our competition index (Row 4, Table 1). The difference between the pupil and un-weighted school mean implies that pupils in larger schools tend to be those with more choices. Obviously, the choice and competition indices are highly correlated (with a pair-wise correlation of about 0.60); yet, they display sufficient independent variation, from which we will separately identify the effects of school availability and competition[24]. Looking at Figure 3, we see that around 1 in 4 pupils have no school (other than the one they attend) within a short travel distance, but only 1 in 10 schools have all pupils with no local alternatives. It is also worth noting that only 48% of Community school pupils and 27% of Faith school pupils in our study area actually attend their nearest school within their LEA, so there is clearly considerable exercise of choice (see also Burgess et al., 2004). Finally, from the map of Figure 4, we can also deduce that the competition indices are only partly related to urban centrality and density: Some of the highest values of our index occur in suburban districts such as Barnet and Brent, whilst inner city zones like south Hackney or Southwark exhibit low levels of competition.

Further down Table 1 are other interesting features of the data. The median travel distance of Primary school pupils in our study area is 743 metres, and this travel zone is home to an average of 80 pupils, though the number ranges widely[25]. We have also computed a cohort density measure centred on each pupil residential postcode, using a count of the number of pupils aged 10/11 within a 564m radius of each pupil address (a $1km^2$ circle). The mean pupil density is $64.1km^{-2}$, but ranges between 1 and 256. These inter-school distance and population density variables do not feature in our competition or choice indices, but are used as

[24] This is because, for example, pupils coming from an areas with little available choice, may travel long distances and enrol in a school which faces a highly competitive market.

[25] The average distance between a school and other schools in its travel zone is about 600 metres, ranging from zero (i.e. two or more schools are in the same postcode) up to 4.4 km.

controls for more general urban density factors in our regression models. Additionally, we will include a number of variables in these regressions, at four levels of aggregation: pupil, school, residential postcode sector, and LEA level. These are described in Appendix Table A2.

6.2. Choice, competition and performance: regression results

Our first results are ordinary least squares (OLS) estimates of the model in Equation (1) and appear in Table 2. This shows the coefficients of interest only, and is divided into three panels. The top panel shows estimates of the association between choice availability and pupil achievement, unconditional on the index of competition at the pupil's school (β_1 in Equation 1, with β_2 restricted to zero). The next panel shows the association between school competition and pupil achievement (β_2 in Equation 1, with β_1 restricted to zero). The third panel reports the coefficients with both choice and competition indices included together (β_1 and β_2 unrestricted). All columns report results where the dependent variable is the pupil's change in points between KS1 and KS2, a direct measure of value added through the National Curriculum stages. Table A3 in the Appendix reports results for KS2 English and Maths test marks separately. As we did not find different patterns for the two subjects, we decided to focus on the overall value added measures[26]. Finally, notice that it is difficult to establish a priori at which level one should cluster standard errors; therefore, we report both standard errors clustered at school and LEA level (respectively in round and square brackets).

[26] Controlling for prior achievement, or using achievement growth, risks underestimating the effect of fixed school characteristics, because prior achievement is determined by school characteristics too. Unfortunately the coefficient on prior achievement is also endogenous (see Todd and Wolpin, 2003) and potentially downward biased. Nevertheless such specifications are commonplace and we follow tradition. Since we have no instruments for prior achievement which would allow us to correct the specification we simply note here that the coefficients on our competition and choice indices are almost unchanged if we use age-11 test scores unconditional on age-7 test scores. See Table A2 in the Appendix.

Looking at the OLS results in the first panel of Table 2, it seems clear that there is an association between the number of choices a pupil has available locally and their achievement at school between age 7 and 11. This is true, regardless of whether we include the full set control described in Appendix Table A1. However, the association is very small in magnitude: one extra school in the pupil choice set relates to about 0.1 value-added points. These results are qualitatively similar when we look at the school competition index on its own in the next panel. This is unsurprising, since the choice and competition indices are positively correlated. Finally, when the choice and competition indices are included together, we find that pupils in schools facing more competition do marginally better; yet, we find that choice is not associated with higher pupil performance[27].

Taken at face value, these estimates suggest small but significant gains for pupils in schools facing more competitive markets. However, we find it hard to trust these findings, because the choice and competition indices we use are likely to be endogenous to pupil and school performance. To address this, we employ the instrumental variables (IV) strategy described above, using the pupil residence-LEA boundary distance as an instrument for choice, and the school-LEA boundary distance as an instrument for competition.

The IV coefficient estimates are presented in Columns (3) and (4) of Table 2, and tell a different story. The signs on all the coefficients become negative, but statistically insignificant[28]. There is no evidence here to suggest that an increase in the number of schools available near a pupil's home (as we move away from an LEA boundary) improves pupil

[27] We also assessed whether the impact of competition/choice mainly comes from under- or over-capacity schools. Our results suggest that: a-Competition always matters more than choice; b-Most of the action comes from schools that have a potential for expansion (under-capacity). This "threat effect" is in line with predictions from the empirical IO literature.

[28] Notice that the results are similar whether we include the full set of controls or not; this is reassuring about the validity of our instrumental variable approach.

achievement. Notice that this coefficient identifies an average effect of school availability, i.e. both for individuals who exercise choice and opt out of their local schools, and for individuals who are 'left' in the local institution; without further assumptions, we can not disentangle a pure pupil-school 'matching' effect from indirect 'spill-over' effects. Additionally, we do not find evidence that attendance at a school that faces more competition further away from an LEA boundary improves achievement. These point estimates suggest that these changes could have small adverse effects on achievement, though they are imprecisely determined.

6.3. Assessing the instrumental variables strategy

It is reasonable to ask whether, given these results, LEA boundary distance measures are good instruments for the choice and competition indices. An important assumption for the instrument to determine choice and competition is that cross-LEA Primary school attendance is not wide-spread. From the Pupil Census data we have established that the proportion of entry-age children (age-4) attending schools in an LEA outside their home LEA is only around 5.5%, and slightly lower for Community schools at around 4.7%. Moreover, of the 10% of pupils who live closest to the LEA boundaries, well over 80% attend Primary schools within their own LEA. This is particularly reassuring, as these pupils are typically in postcodes that are immediately adjacent to the boundary and would seem equally likely to attend a school in the adjacent LEA as in their own LEA if the boundary imposed no barrier.

Ultimately, the deciding factor is whether the first stages of the IV regressions are effective. These are tabulated in Table 3, where we report results for specifications including and excluding controls, and with standard errors clustered at school or LEA level. The instruments – the log of boundary distances – are always very powerful. A 10% increase in the distance from LEA boundary to pupil residence increases the number of schools in the pupil's choice set by 0.027, or about 2% relative to the mean (0.027/1.404). A 10% increase in LEA

boundary-school distance increases the average number of alternative schools for pupils in that school by about 0.02. The instruments are individually significant and the F-statistic for the joint test of the instruments is always high (Staiger and Stock, 1997). In a nutshell, the instruments are indeed strong predictors of choice availability and school competition.

Further results (not tabulated) show that the instrument for choice (and indirectly competition) also works in line with the theoretical reasoning we used to justify its use. Firstly, for each 1% increase in distance between a pupil's residence and the nearest LEA boundary there is a 1.4 percentage point decrease in the probability that the pupil attends the nearest school (controlling for the average pupil-boundary distance within the LEA). Secondly, the average distance between a pupil's residence and the nearest 4 schools (other than the one he or she actually attends) decreases by 0.06% for each 1% increase in the distance between their home and the boundary. In other words pupils near admissions district boundaries seem to be more constrained in their choice of school. Finally, we dropped the restriction of no-LEA-crossing to compute our indices, and re-performed the IV analysis; results are presented in Appendix Table A4. First stage results show that distances to LEA boundaries are still strong predictors of competition and choice. As explained before, we expect the instruments to work if boundaries are effective barriers, even if we include boundary-crossers in our indices. This is because the composition of the intake in a less-competitive school close to an LEA boundary will be weighted towards restricted-choice pupils living in the immediate vicinity. This shrinks the catchment area radius relative to schools located more centrally within the LEA, and so influences the choice and competition indices in the surrounding area.

Another crucial assumption behind our strategy is that school or residence distance from LEA boundaries are uncorrelated with unobserved pupil and school characteristics that may influence educational outcomes. This assumption might be violated if, for example, there are

geographical differences between places close to LEA boundaries and places further away, and residential sorting leads to differences in the distributions of pupil characteristics in these areas. Although this assumption is ultimately un-testable, we can provide some evidence in support of it by demonstrating that our instruments are not strongly correlated with observable school and residential neighbourhood characteristics . To do so, we borrow from the methodology in Cullen et al. (2005) and perform balancing tests for the two instruments separately. Results are reported in Tables 4 and 5.

In the first of the two Tables, we deal with the instrument for school choice and test whether the logarithm of pupil residence-LEA boundary distance is correlated with neighbourhood characteristics not included in our specifications. Columns 1 and 2 report descriptive statistics for these variables. Column 3 reports coefficients from separate regressions of these characteristics on the instrument and the usual set of controls. The variables that we use to test the properties of our instrument include, among others, average school achievement of peers in the neighbourhood, and its dispersion (average and standard deviation of KS1 grades), number of private schools, average and standard deviation of log house prices, fraction of adult individuals working, and a measure for the homogeneity of educational attainment of adult individuals in the neighbourhood (i.e., a Herfindhal index). In no case find a significant and sizable relation between these measures and pupil residence-LEA boundary distance.

In Table 5, we deal with the instrument for school competition and test whether the school-LEA boundary distance is correlated with school level characteristics; these include the average achievement of peers in the school, and its dispersion (average and standard deviation of KS1 grades in school), distance to main roads, number of schools within 1km (controlling

for the average LEA density), and fraction of schools religiously affiliated. Once more, we find no evidence for a significant association between these measures and our instrument.

Everything here indicates that choice and competition in Primary schooling increase exogenously as pupils and schools move away from LEA boundaries. In support of the assumption discussed above, we find that our distance measures do not simply capture features of the school or school type distribution next to LEA boundaries; nor do they reflect other neighbourhood characteristics which may have a direct influence on school or pupil performance. However, results in Table 2 show *no* systematic impact of choice and competition on pupil performance. The natural interpretation of this is that the positive, but small, association between pupil performance and competition indices seen in the ordinary least squares estimates is attributable to endogenous school location or pupil sorting.

6.4. Autonomous schools and controlled schools

The difference between the OLS and IV estimates in Table 2 clearly warrants further exploration, and it is to this that we now turn. As we discussed in Section 3, there are important institutional differences among state-funded Primary schools in England, especially in terms of governance and admissions procedures. These distinctions may be important when considering how different schools types react to school competition incentives. At one extreme, 'autonomous' Voluntary Aided schools are likely to be highly responsive to competition because they are directly responsible for their own pupil admissions, and, therefore, closely connected to the process of attracting pupils and funding. At the other extreme, admissions to Community 'controlled' schools are handled centrally by the Local Education Authority, which may re-allocate some pupils whose preferred schools are over-subscribed to schools that are under-subscribed. This clearly has the potential to weaken the link between parental choice,

school competition and pupil achievement, although unpopular schools do remain under-capacity and under-resourced than those that are popular.

Another important characteristic that distinguishes Community schools from Voluntary Aided schools is their religious affiliation and governance structure. Whilst the former are secular institutions, the latter are predominantly Faith-based[29]. In these Voluntary Aided schools, the church or charitable institution that owns the school premises has a majority representation on the Governing Body and so has a strong influence on its running. In Community and other 'controlled' schools, instead, governance is shared more equally amongst LEA representatives, teaching staff and parents. We suspect that the arrangement in Voluntary Aided schools is more conducive to a focussed, competitive ethos in which the setting of targets, drawing of strategies, adoption of technologies and monitoring of performance will be seen more explicitly as a way to attract pupils through the promise of excellence. In Community schools, on the other hand, there is greater need to balance the objective of high standards for high-achieving children, with appropriate education for children from diverse backgrounds, including those with English as and additional language and those with special educational needs.

Given these considerations, we now go on to examine pupils in Faith autonomous (Voluntary Aided) schools and pupils in secular controlled (Community) schools separately, and to study whether choice and competition have different effects for these two subgroups. Results are reported in Table 6. Columns (1) and (3) present OLS results for Faith autonomous schools and secular controlled institutions respectively. For both school types, we still find that choice is not significantly associated with pupil achievement. More interesting, we find that

[29] In fact all Voluntary Aided schools in our sample are religiously affiliated.

competition is positively related to performance in Faith autonomous schools, but this is not the case for schools under LEA control.

While this suggests that competition may improve average achievement for pupils in schools that, we have argued, are likely more responsive to incentives, it may also be driven by the endogeneity of the choice and competition indices to pupil and school performance. To address this issue, we reproduce our IV strategy for these two groups; results are presented in Column (2) and (5) of Table 6. First stage statistics reported at the bottom of the Table show that our instruments based on school and residence distance to LEA boundaries are still effective for the two groups separately. Yet, the IV coefficients for the effect of school competition on pupil achievement are remarkably different for autonomous and controlled schools. While for the latter, we still find a negative non-significant association between competition and average achievement, for the former we find a sizeable and positive impact. While this is only significant at the 10% level, the effect is quite large: the competition threat associated with one extra school available to pupils (about one standard deviation of the competition index) increases the value-added by 1.6 points, accounting for about 20% of its standard deviation.

To gain precision in our IV estimates, we further split our sample in high and low school density areas (and concentrate on the former); these are defined in terms of number of other institutions within 1km from the school under analysis, relative to the average LEA school density[30]. We expect competition among schools to be fiercer in more dense areas: pupils have more alternatives within travel distance, and travel arrangements (i.e. public transport) makes it easier for families to exercise choice; as a result schools will face more competitors for the same pool of pupils.

[30] This is the measure used in Table 5 to test the balancing properties of our instrument for the school competition.

IV results for high school density areas are reported in Columns (3) and (6) of Table 6[31]. While we still fail to find any positive effect of competition for secular controlled schools, we find a large, positive and significant coefficient for Faith autonomous schools: one additional 'competitor' raises value added by about 1.7 points during Primary education[32].

These findings lend support to a causal effect of competition on pupil achievement in this setting: for schools that combine more responsive governance (via institutional arrangements or individual ethos and involvement) with greater autonomy in the admission procedures, competition leads to significant performance improvements. It has to be emphasized that these schools are a relatively big group in the state Primary education system, enrolling more than 20% of the pupils. A more conservative interpretation, focusing on Faith autonomous schools in more dense areas only, would still lead us to conclude that for approximately one in seven schools, competition is causally linked to increased pupil achievement.

7. Concluding Remarks

In this paper we have attempted to identify the causal links between choice and competition and the academic achievement of Primary school pupils. To do so we have carefully constructed measures of the choices of Primary school available to pupils based on the equilibrium accessibility of schools to their homes. From this, we also derived competition measures for the schools at which these pupils are enrolled. Choice and competition indices were related to pupil achievements in Primary schools, first in a simple least squares setting

[31] OLS results are not reported for space reasons; yet, they confirm the patterns of Columns (1) and (3).

[32] Importantly, high school density areas in our sample are regions where a larger fraction of pupils from poorer backgrounds and entitled to Free-School-Meals are concentrated. The positive and significant IV findings for denser areas suggest that competition may have larger beneficial effects for pupils in disadvantaged areas. These results are consistent with US findings reported in Neal (1997), Grogger and Neal (2000) and Altonji, Elder and Taber (2005) suggesting that urban disadvantaged pupils may benefit more from Faith school availability, because their local communities offer poor state school alternatives.

and second using an instrumental variables approach based on a boundary discontinuity affecting school attendance.

Simple least squares results show a (small) positive association between school competition and achievement: pupils tend to do better if they are enrolled in schools that serve more competitive markets. Yet, we found little evidence that it is competition that drives the gain in achievement; pupil sorting and endogenous travel patterns and school location provide more likely explanations for these findings. Once endogeneity issues are controlled for, achievement for pupils at Community schools – the standard state Primary in the English system, fully controlled by the Local Education Authority– are unrelated to the competitive pressures a school faces. It is only in Faith autonomous schools – which have more freedom in managing their admission practices and governance – that competition seems linked to performance. This seems likely to be attributable to their more responsive institutional arrangements and possibly to factors like religious fervour and more proactive governance.

These findings matter for the often heated debate about whether choice and competition are good things for pupil performance. There is some comfort here for advocates of choice and competition as a pathway to higher educational standards: our evidence suggests that competition may improve school performance for some of the one-in-five students who attend Faith autonomous schools. On the other hand, though, our results cast some doubt on the general effectiveness of choice and competition in the school context; our results point to such pressures only operating in a specific sub-set of the Primary school market. There are, of course, a number of other issues that could usefully be studied here. For example, we do not consider competition from private schools (largely for data reasons); nor can we study parental preferences in any direct way. Building these factors into future work (theoretical and applied) would seem to be a useful direction in which to go.

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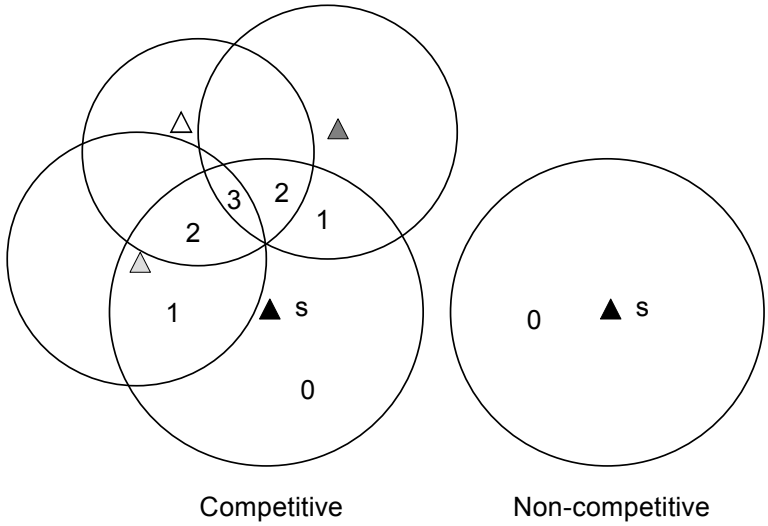
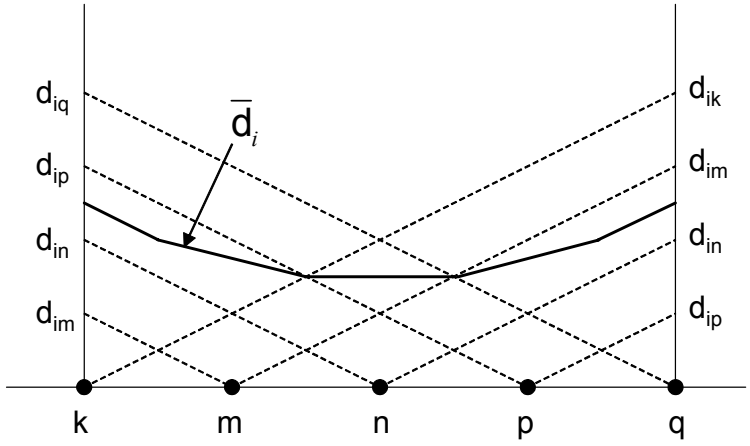
8. Figures

Figure 1: Schematic presentation of the choice and competition measures



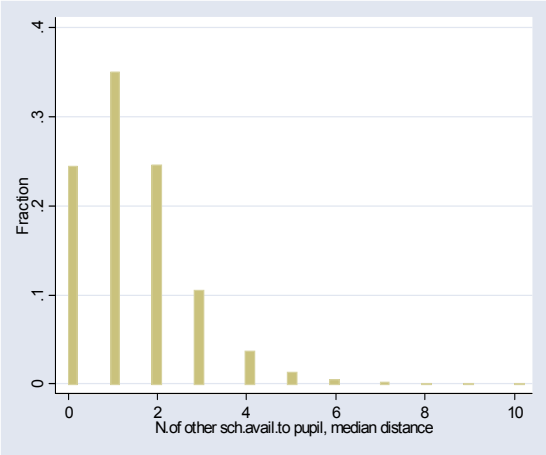
Note: Numbers 0,1,2,3 indicate the choice index that would be assigned to pupils living in each area (assuming they attend school s)

Figure 2**:** Illustration of the instrumentation strategy

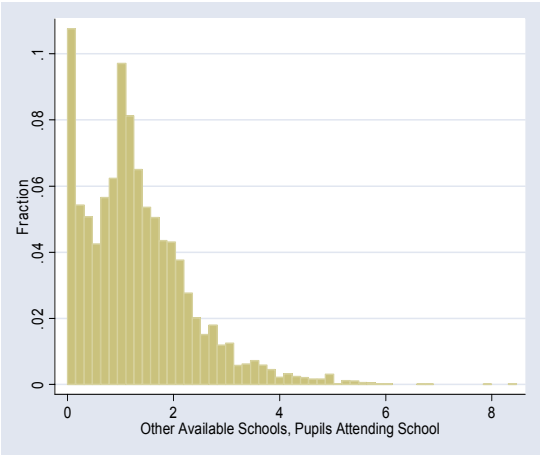


Note: Figure shows a linear district with 5 schools, k,m,n,p,q; d_{ij} is the distance to each school; $\overline{d}_i$ is the average distance to schools *other than* the nearest.

Figure 3: Distributions of the choice and competition indices

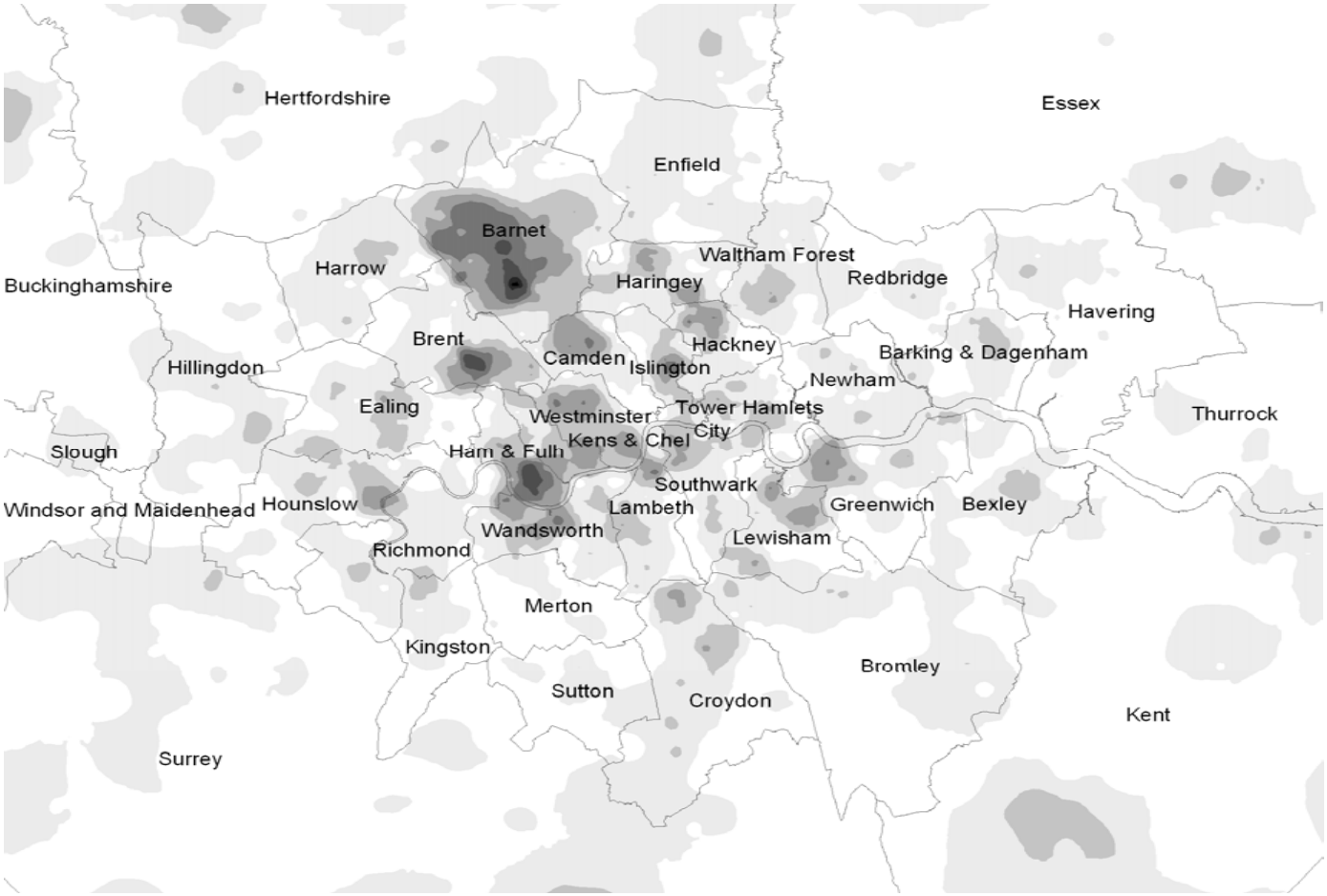


Pupil choice index: Number of schools accessible to pupil's home



School competition index: Number of schools accessible to pupils, average in school attended

Figure 4: Primary school competition in the Greater London Area



Note: Figure shows local averages of the school-level competition index (Inverse Distance Weighted means of the nearest 6 schools on a 250m raster). Each shading class corresponds to intervals [0,1], (1,2], …(6,7] from lighter to darker.

9. Tables

Table 1: Choice, competition and pupil achievement; summary statistics

Variable	Observations	Mean	Std. Dev.	Min, Max
Number of schools accessible to pupil	201034	1.40	1.21	0, 10
Number of schools accessible to pupils enrolled in faith autonomous schools	42993	1.58	1.29	0, 10
Number of schools accessible to pupils enrolled in secular controlled schools	144002	1.38	1.18	0, 10
Average number of schools accessible to pupils in school	201034	1.31	0.99	0, 8.31
Average number of schools accessible to pupils enrolled in faith autonomous schools	42993	1.57	1.03	0, 6.73
Average number of schools accessible to pupils enrolled in secular controlled schools	144002	1.27	0.97	0, 8.31
Median travel distance all schools	201034	743.71	455.37	102, 6157
Median travel distance, faith autonomous schools	42993	1093.87	601.53	146, 6157
Median travel distance, secular controlled schools	144002	624.63	305.11	102, 4303
Number of pupils in the travel area	201034	79.81	71.83	2, 1015
Pupil density (Number of pupils per hectare)	201034	0.64	0.37	0.01, 2.56
KS2-1 Value Added	201034	38.61	8.17	-4, 90
KS2-1 Value Added, faith autonomous schools	42993	39.15	7.66	2, 84
KS2-1 Value Added, secular controlled schools	144002	38.45	8.33	-4, 90

Note: Faith autonomous schools are religiously affiliated Voluntary Aided schools; secular controlled schools are non-religiously affiliated community schools.

Table 2: Primary school choice, competition and pupil achievement; Key Stage 2, 2001/2-2002/3

	Total Value Added Points			
	(1)	(2)	(3)	(4)
	OLS	OLS	IV	IV
Choice index entered separately				
Number of schools accessible to pupil's home	0.103	0.098	-0.244	-0.305
	(0.038)**	(0.036)**	(0.195)	(0.196)
	[0.060]	*[0.035]*	*[0.257]*	*[0.266]*
Competition index entered separately				
Average number of schools accessible to pupils in the school	0.195	0.172	-0.386	-0.488
	(0.066)**	(0.070)*	(0.325)	(0.341)
	[0.087]	*[0.066]*	*[0.390]*	*[0.417]*
Choice and competition together				
Number of schools accessible to pupil's home	0.011	0.036	-0.036	-0.065
	(0.025)	(0.024)	(0.168)	(0.176)
	[0.040]	*[0.032]*	*[0.172]*	*[0.187]*
Average number of schools accessible to pupils in the school	0.186	0.147	-0.361	-0.463
	(0.066)**	(0.070)*	(0.350)	(0.373)
	[0.083]	*[0.073]*	*[0.390]*	*[0.417]*
Controls	No	Yes	No	Yes
Number of schools	2412	2412	2412	2412
Observations	201034	201034	201034	201034

Note: Regressions at the pupil level. Standard errors clustered on schools in round parenthesis: *, significant at 5%; **, significant at 1%. Standard errors clustered at the LEA level in square brackets (there are 42 LEA in the area under analysis). Controls include pupil median travel distance and number of pupils in travel area (Table 1) and variables listed in Appendix Table A2. Missing Postcode Sector Level and LEA Level variables recoded to zeros; dummies for missing Postcode Sector Level and LEA Level observations included in the specifications. Instruments in Columns (3) and (4) are as follows. Top panel, *choice only*: log of distance between pupil home and LEA boundary, controlling for LEA average of log distance between pupil home and LEA boundary. Central panel, *competition only*: log of distance between school and LEA boundary, controlling for LEA average of log distance between school and LEA boundary. Bottom panel, *choice and competition*: log of distance between school and LEA boundary and pupil home and LEA boundary, controlling for LEA average of log distance between school and LEA boundary and LEA average of log distance between pupil home and LEA boundary.

Table 3: First stage results:
Primary school choice and competition, and distance to LEA boundaries.

	Models without controls		*Models with controls*	
	School level clustered S.E.	LEA level clustered S.E.	School level clustered S.E.	LEA level clustered S.E.
Choice index entered separately				
Coeff. on log. of pupil residence-LEA boundary distance	0.253 (0.012)**	0.253 (0.036)**	0.249 (0.011)**	0.249 (0.034)**
F-Statistics	426.91	48.55	523.77	54.06
[P-Value]	*[0.0000]*	*[0.0000]*	*[0.0000]*	*[0.0000]*
Partial R^2 on excluded instrument	0.0421	0.0421	0.0442	0.0442
Competition index entered separately				
Coeff on log. of school-LEA boundary distance	0.212 (0.022)**	0.212 (0.031)**	0.205 (0.020)**	0.205 (0.032)**
F-Statistics	95.27	46.42	101.20	41.96
[P-Value]	*[0.0000]*	*[0.0000]*	*[0.0000]*	*[0.0000]*
Partial R^2 on excluded instrument	0.0411	0.0411	0.0437	0.0440
Competition and choice indices together				
Choice index first stage equation				
Coeff. on log. of pupil residence-LEA boundary distance *(Own)*	0.282 (0.011)**	0.282 (0.030)**	0.270 (0.009)**	0.270 (0.028)**
Coeff. on log. of school-LEA boundary distance *(Cross)*	-0.048 (0.015)**	-0.048 (0.015)**	-0.036 (0.014)*	-0.036 (0.015)*
F-Statistics	350.99	83.53	407.21	72.63
[P-Value]	*[0.0000]*	*[0.0000]*	*[0.0000]*	*[0.0000]*
Partial R^2 on excluded instruments	0.0436	0.0436	0.0448	0.0448
Competition index first stage equation				
Coeff. on log. of school-LEA boundary distance *(Own)*	0.198 (0.024)**	0.198 (0.029)**	0.191 (0.022)**	0.191 (0.032)**
Coeff. on log. of pupil residence-LEA boundary distance *(Cross)*	0.023 (0.013)*	0.023 (0.013)	0.021 (0.011)*	0.021 (0.011)
F-Statistics	55.01	23.19	57.47	*21.55*
[P-Value]	*[0.0000]*	*[0.0000]*	*[0.0000]*	*[0.0001]*
Partial R^2 on excluded instruments	0.0420	0.0420	0.0439	0.0441

Note: Regressions at the pupil level. Standard errors clustered on schools in round parenthesis in Columns (1) and (3); standard errors clustered at the LEA level in round parenthesis in Columns (2) and (4). *, significant at 5%; **, significant at 1%. Controls include pupil median travel distance and number of pupils in travel area (Table 1) and variables listed in Appendix Table A2. Missing Postcode Sector Level and LEA Level variables recoded to zeros; dummies for missing Postcode Sector Level and LEA Level observations included in the specifications. Top panel (*choice only*) also controls for LEA average of log distance between pupil home and LEA boundary. Central panel (*competition only*) also controls for LEA average of log distance between school and LEA boundary. Bottom panel (*choice and competition*) also controls for LEA average of log distance between school and LEA boundary and LEA average of log distance between pupil home and LEA boundary. Number of observations: 201034; number of school 2412.

Table 4: Pupil home-LEA boundary distance and neighbourhood characteristics

Variable List:	Mean	Std.Dev	Reg.Coefficients
Average KS1 grades, within postcode sector	44.710	3.126	-0.040 (0.037)
Std.Dev of KS1 grades, within postcode sector	10.730	1.315	0.038 (0.023)
Fraction of FSME pupils, within postcode sector	0.198	0.154	0.001 (0.001)
Fraction of SEN pupils, within postcode sector	0.245	0.086	0.001 (0.001)
Number of independent (Private) schools, within postcode sector	0.379	0.823	0.016 (0.013)
Average house prices, within postcode sector	0.095	0.286	-0.009 (0.005)
Std.Dev. house prices, within postcode sector	0.371	0.088	-0.002 (0.002)
Fraction of individuals economically active, within postcode sector	0.678	0.051	-0.001 (0.001)
Fraction of individuals working full time, within postcode sector	0.422	0.052	-0.000 (0.001)
Fraction of individuals retired from work, within postcode sector	0.111	0.053	0.001 (0.001)
Fraction of sick and disabled individuals, within postcode sector	0.045	0.030	0.000 (0.000)
Fraction of individuals enrolled in education, within postcode sector	0.053	0.030	0.000 (0.000)
Education homogeneity (Herfindhal index), within postcode sector	0.221	0.033	0.001 (0.001)

Note: Regression coefficients obtained from separate regressions of listed variable on log of distance of between pupil home and LEA boundary, regressions at the pupil level. Standard errors clustered on LEA in round parenthesis; no regression coefficients significant at conventional levels. Controls include pupil median travel distance and number of pupils in travel area (Table 1), variables listed in Appendix Table A2 and LEA average of log distance between pupil home and LEA boundary. Missing Postcode Sector Level and LEA Level variables recoded to zeros; dummies for missing Postcode Sector Level and LEA Level observations included in the specifications. Herindahl Index constructed over the following 6 categories: missing qualification; no qualification, Level-1 qualifications; Level-2 qualifications; Level-3 qualifications; Level -4 or -5 qualifications. Number of observations varying according to variables used. Row 1 to 5: 201034 observations; 1458 postcode sectors. Rows 6 and 7: 200568 observations; 1429 postcode sectors. Rows 8 to 13: 199693 observations; 1421 postcode sectors.

Table 5: School-LEA boundary distance and school characteristics

Variable List:	Mean	Std.Dev	Reg.Coefficients
Average KS1 grades, within school	44.710	4.242	0.027 (0.061)
Std.Dev. of KS1 grades, within school	10.322	1.751	0.040 (0.028)
SEN support teacher to pupil ratio	0.593	0.639	0.006 (0.013)
Ethnic minorities support teacher to pupil ratio	0.053	0.155	-0.000 (0.002)
Log distance to main roads	6.661	1.113	0.033 (0.027)
School religiously affiliated	0.241	0.428	0.000 (0.001)
Number of other schools within 1km, controlling for LEA school density	3.094	2.944	0.020 (0.039)

Note: Regression coefficients obtained from separate regressions of listed variable on log of distance of between school and LEA boundary; regressions at the pupil level. Standard errors clustered on school in round parenthesis; no regression coefficients significant at conventional levels. Controls include pupil median travel distance and number of pupils in travel area (Table 1), variables listed in Appendix Table A2 and LEA average of log distance between school and LEA boundary. Missing Postcode Sector Level and LEA Level variables recoded to zeros; dummies for missing Postcode Sector Level and LEA Level observations included in the specifications. Number of observations: 201034; number of schools: 2412.

Table 6: Primary school choice, competition and pupil achievement; Key Stage 2, 2001/2-2002/3; pupils in faith autonomous schools and secular controlled schools separately

	Pupils in faith autonomous schools			*Pupils in secular controlled schools*		
	(1)	(2)	(3)	(4)	(5)	(6)
	OLS- All Schools	IV- All Schools	IV- High Density Areas	OLS- All Schools	IV- All Schools	IV- High Density Areas
Number of schools accessible to pupil's home	0.030	0.057	0.056	0.030	0.005	0.059
	(0.044)	(0.249)	(0.387)	(0.031)	(0.221)	(0.324)
	[0.044]	*[0.250]*	*[0.340]*	*[0.042]*	*[0.220]*	*[0.361]*
Average n. of schools accessible to pupils in the school	0.378	1.624	1.709	0.113	-0.808	-0.568
	(0.120)**	(0.963)	(0.808)*	(0.090)	(0.479)	(0.587)
	[0.143]	*[1.070]*	*[0.714]*	*[0.086]*	*[0.618]*	*[0.655]*
First Stage Statistics						
F-Statistics						
[P-Value]						
Choice equation	--	136.12	68.22	--	285.44	138.68
		[0.0000]	*[0.0000]*		*[0.0000]*	*[0.0000]*
Competition equation	--	6.07	12.73	--	40.86	30.73
		[0.0024]	*[0.0000]*		*[0.0000]*	*[0.0000]*
Partial-R^2						
Choice equation	--	0.0393	0.0345	--	0.0482	0.0483
Competition equation	--	0.0187	0.0450	--	0.0416	0.0550
Controls	Yes	Yes		Yes	Yes	
Number of schools	638	638	351	1613	1613	836
Observations	42993	42993	24158	144002	144002	72701

Note: Regressions at the pupil level. Standard errors clustered on school in round parenthesis: *, significant at 5%; **, significant at 1%. Standard errors clustered at the LEA level in square brackets (there are 42 LEA in the area under analysis). First stage statistics for models with standard errors clustered at the school level. Controls include pupil median travel distance and number of pupils in travel area (Table 1) and variables listed in Appendix Table A2. Missing Postcode Sector Level and LEA Level variables recoded to zeros; dummies for missing Postcode Sector Level and LEA Level observations included in the specifications. Instruments in Columns (2) and (4) are log of distance between school and LEA boundary and pupil home and LEA boundary, controlling for LEA average of log distance between school and LEA boundary and LEA average of log distance between pupil home and LEA boundary. Faith autonomous schools are religiously affiliated Voluntary Aided schools; secular controlled schools are non-religiously affiliated community schools. Area density defined in terns of number of other schools within 1km from school under analysis, relative to average LEA school density. High density areas include schools in areas where density is above the median of the density distribution across all schools.

10. Appendix A

Table A1: Primary school categories in England

Type	Faith	Governors	Admissions authority	Assets owned by	Employer
Community	Secular	Parents >30% Staff <30% LEA 20% Community 20%	LEA	LEA	LEA
Foundation	Mostly secular, some C. of E.,	Parents >30% Staff <30% Foundation <25% LEA <20% Community 10%	Governors	Church or charity	Governors
Voluntary Aided	Mostly C. of E. or Catholic, some secular	Foundation >50% Parents >30% LEA <10% Staff (<30%)	Governors	Church or charity	Governors
Voluntary Controlled	Mostly C. of E., some other faith, some secular	Parents >30% Staff <30% Foundation <25% LEA <20% Community 10%	LEA	LEA	LEA

Note: C. of E. means Church of England.

Table A2: Controls; summary statistics

Variable	Observations	Mean	Std. Dev.	Min, Max
Pupil level variables				
English as first language	201034	0.795	0.403	0, 1
Female	201034	0.497	0.500	0, 1
Pupil with special education needs (SEN), with and without statements	201034	0.245	0.430	0, 1
Free school meal eligible (FSME) pupil	201034	0.198	0.399	0, 1
School level variables				
Pupil/qualified teacher ratio	201034	23.641	3.936	11.2, 108.3
Total school size	201034	367.055	138.207	52, 1373
Fraction of pupils with SEN	201034	0.209	0.090	0, 0.652
Fraction of pupils with FSME	201034	0.198	0.158	0, 0.771
Postcode sector level variables				
Fraction of lone parents	199693	0.260	0.116	0.035, 0.606
Fraction of unemployed	199693	0.037	0.018	0.007, 0.097
Fraction with no school qualifications	199693	0.259	0.076	0.037, 0.535
Fraction with Black ethnicity	199693	0.077	0.094	0, 0.536
Fraction with Asian ethnicities	199693	0.116	0.134	0.001, 0.795
Fraction on individuals ages 16 or below	199693	0.222	0.032	0.018, 0.431
LEA Level Controls				
Total LEA expenditure in 2000 (in £1000)	201034	2170.823	1691.547	493, 5983
LEA area (in 1,000,000 squared metres)	201034	680.349	1076.473	12, 3451
LEA deprivation score in 2000	198770	24.140	13.569	7.5, 61.34

Table A3: Primary school choice, competition and pupil achievement;
Key Stage 2, 2001/2-2002/3; percentiles of English and Mathematics test scores

	KS2 English percentiles				*KS2 Maths percentiles*			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	OLS	OLS	IV	IV	OLS	OLS	IV	IV
Competition and choice together								
N. of schools accessible to pupil's home	0.081	0.115	0.080	-0.086	-0.038	0.024	0.156	0.136
	(0.069)	(0.057)*	(0.435)	(0.380)	(0.071)	(0.060)	(0.414)	(0.402)
Av. N of schools accessible to pupils in the school	0.568	0.360	-0.505	-0.753	0.691	0.538	-0.570	-1.067
	(0.166)**	(0.154)*	(0.857)	(0.787)	(0.171)**	(0.168)**	(0.811)	(0.851)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
KS1 controls	No	Writing Reading	No	Writing Reading	No	Maths	No	Maths
Number of schools	2412	2412	2412	2412	2412	2412	2412	2412
Observations	196706	196706	196706	197829	197829	197829	201034	201034

Note: Regressions at the pupil level. Standard errors clustered on school in round parenthesis: *, significant at 5%; **, significant at 1%. Controls include pupil median travel distance and number of pupils in travel area (Table 1) and variables listed in Appendix Table A2. Missing Postcode Sector Level and LEA Level variables recoded to zeros; dummies for missing Postcode Sector Level and LEA Level observations included in the specifications. Instruments in Columns (3), (4), (7) and (8) are log of distance between school and LEA boundary and pupil home and LEA boundary, controlling for LEA average of log distance between school and LEA boundary and LEA average of log distance between pupil home and LEA boundary.

Table A4: Primary school choice, competition and pupil achievement; Key Stage 2, 2001/2-2002/3; competition and choice indices, without 'no-LEA boundary crossing' restriction

	Total value added points			
	(1)	(2)	(3)	(4)
	OLS	OLS	IV	IV
N. of schools accessible to pupil	0.026	0.042	-0.090	-0.182
	(0.025)	(0.024)	(0.457)	(0.518)
Av. N. of schools accessible to pupils in school	0.190	0.134	-0.858	-1.016
	(0.061)**	(0.067)*	(0.887)	(0.950)
First Stage Statistics				
F-Statistics *[P-Value]*				
Choice equation	--	--	41.75	44.19
			[0.0000]	*[0.0000]*
Competition equation	--	--	8.83	10.11
			[0.0002]	*[0.0000]*
Partial-R^2				
Choice equation	--	--	*0.0061*	*0.0064*
Competition equation	--	--	*0.0067*	*0.0077*
Controls	No	Yes	No	Yes
Number of schools	2412	2412	2412	2412
Observations	201034	201034	201034	201034

Note: Regressions at the pupil level. Standard errors clustered on school in round parenthesis: *, significant at 5%; **, significant at 1%. Standard errors clustered at the LEA level in square brackets (there are 42 LEA in the area under analysis). First stage statistics for models with standard errors clustered at the school level. Controls include pupil median travel distance and number of pupils in travel area (Table 1) and variables listed in Appendix Table A2. Missing Postcode Sector Level and LEA Level variables recoded to zeros; dummies for missing Postcode Sector Level and LEA Level observations included in the specifications. Instruments in Columns (3) and (4) are log of distance between school and LEA boundary and pupil home and LEA boundary, controlling for LEA average of log distance between school and LEA boundary and LEA average of log distance between pupil home and LEA boundary. Choice index (no restrictions) descriptive statistics: mean=1.566; std.dev.=1.299. Competition index (no restrictions) descriptive statistics: mean=1.475; std.dev.= 1.084.