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The Unintended Consequences of Quantifying Quality: Does Ranking School Performance Shape the Geographical Concentration of Advantage?[1]

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In this article we investigate whether quantifying school performance can have the unintended consequence of increasing the spatial concentration of advantage. Combining research on residential segregation with the sociology of quantification, we argue that ranking school performance may induce affluent parents to sort into areas with higher-ranked schools. We explore this hypothesis by analyzing linked decennial census data from 1981 to 2011 to examine whether the introduction of league tables measuring school performance in the early 1990s in England affected the spatial concentration of advantage. We find that the introduction of league tables was associated with an increase in the geographical concentration of occupational class. Advantaged households containing children became more likely to move to areas with better-performing schools after the introduction of league tables compared to less advantaged households. Quantifying school quality has the unintended consequence of increasing the geographical concentration of advantage, potentially entrenching inequalities.

INTRODUCTION

The composition of the communities in which we live can have a profound influence on our life chances (Galster 2012; van Ham et al. 2012; Sharkey

and Faber 2014). Growing up in a neighborhood where the majority of people are materially deprived can affect an individual's earnings, their occupation, and even how long they might live (Massey and Denton 1993; Galster 2012; Chetty and Hendren 2018). In the United States and other high-income countries, these detrimental patterns of residential segregation have primarily been examined through the lens of race (Charles 2003)[2] but are also connected with other forms of social stratification, including income inequality (Dorling and Rees 2003; Reardon and Bischoff 2011). Both forms of social inequality funnel disadvantaged households into deprived neighborhoods while their more advantaged peers end up elsewhere (Sharkey 2008; Allard and Small 2013), although the precise drivers of racial segregation differ from the drivers of socioeconomic segregation. In this article, we focus on how institutions that regulate the quality of local services may shape patterns of socioeconomic segregation over time (Allard and Small 2013).

Geographical variation in the quality of services, such as hospitals (Le Grand and Enthoven 2007) or schools (Figlio and Lucas 2004), can create segregation because people are willing to pay more to live in areas with better provision (Machin 2011). In both the United Kingdom and the United States, this competition pushes up house prices, making it more difficult for less affluent households to stay in areas with good services (Gingrich and Ansell 2014; Goldstein and Hastings 2019). Education is especially important

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[2] In the case of racial segregation in the United States, extensive attention has been paid to the role of legal segregation, zoning regulations, and discriminatory mortgage lending. Understanding causes, trends, and consequences of racial segregation within schools has of course been a central topic in U.S. sociology for well over half a century (Reardon and Owens 2014).

because school quality can have a major influence on adult life chances,[3] and British parents are willing to pay a substantial house price premium to gain access to good schools (Gibbons, Machin, and Silva 2013).

How people obtain information about the quality of these services, such as schools, is a crucial issue (Walsh 1991). Many governments (and other actors) have therefore created institutional rules that aim to measure service quality (e.g., performance on standardized tests or estimates of teacher value added) and then published the results in rankings or "league tables." Such rankings have proliferated in an effort to increase transparency and to allow citizens to make informed decisions about access to services (Figlio and Lucas 2004; Le Grand and Enthoven 2007; Bergman and Hill 2018; Hasan and Kumar 2018). Over the same period, schools have been central to increasing income segregation in the United States, particularly among families with children (Owens 2016; Goldstein and Hastings 2019). There are good reasons to suspect these trends might reinforce each other. Research in the sociology of quantification has revealed that rendering the social world quantifiable is rarely a neutral act (Strathern 2000): the creation of standardized metrics of quality can transform social relations, inducing competition, and entrenching inequalities between the entities being quantified (Espeland and Sauder 2007; Espeland and Stevens 2008; Mennicken and Espeland 2019; Rivera and Tilcsik 2019; Accominotti and Tadmon 2020). One problem with school league tables in particular is that measures of quality often merely reflect the social origins of those who attend a particular school. As a result, the act of measuring school quality has the potential to deepen the residential segregation of advantage and disadvantage.

We explore this possibility by using the introduction of school rankings to investigate whether the quantification of school performance shapes the geographical concentration of economic advantage. In the early 1990s, the U.K. government began publishing school league tables for England, ranking them according to the performance of their students on high-stakes examinations taken by 16-year-old pupils (Goldstein and Leckie 2008). (See app. A for additional details on the English education system.) These league tables made inequalities in performance between schools visible in new ways, changing the information parents of prospective students could obtain about school quality.

In two empirical studies we use decennial census data from 1981–2011 alongside school performance data to investigate how the introduction of these league tables shaped the spatial concentration of individuals by occupational class. Our first study uses school performance data from England

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[3] Including the quality of teaching as well as broader influences such as peer effects and the quality of the physical environment.

to show that areas with better-performing schools saw greater increases in their professional-managerial class share. This ecological analysis establishes that school performance is meaningfully correlated with changes in class composition in a given area. Our second study uses the ONS Longitudinal Study, a 1% sample of English and Welsh census records and life-events data that links individuals over time to study individual-level patterns of residential mobility. Using a difference-in-differences style design we find that people in professional or managerial occupations become more likely to move to areas with better schools after the introduction of school league tables. However, this only occurs if school-age children were present in the household, providing strong evidence that those who are most able and most incentivized to benefit from the introduction of league tables appeared to alter their patterns of residential mobility in response.

The data we use have some limitations: in particular we do not directly measure parents' reasons for moving to a different area and we cannot see exactly which schools are attended by the children of those who move. Nonetheless, our analysis does provide substantial indirect evidence that league tables drove a change in class-specific patterns of residential mobility. Moreover, we argue that alternative explanations are unlikely to explain the patterns we observe. In particular, we find little evidence that professional-managerial parents became more concerned about the educational prospects of their children over the analytic period.

Our findings make contributions to two distinct literatures. First, they contribute toward our understanding of the institutional drivers of socioeconomic segregation (Sampson and Sharkey 2008) by revealing the unintended consequences of whether and how the quality of public services are quantified. Second, our findings also open up new research questions related to how quantification can reinforce inequalities by remaking status hierarchies and bringing disparate entities into competition (O'Neil 2016; Mennicken and Espeland 2019; Rivera and Tilcsik 2019). Our results raise the possibility that processes of quantification can alter the geographical scale over which comparisons between organizations take place—a process illustrated by the way that school league tables situate the previously local reputations of schools within a wider geographical hierarchy of achievement. Our novel contribution is to bring these literatures together and show how political decisions to quantify and disseminate rankings of public services such as schools can have major implications for the long-term spatial concentration of advantage and disadvantage.

These findings also speak to school performance rankings in other contexts, in part because England is, in many respects, quite a conservative test case for our hypothesis. The English education system uses a centralized funding system to offset neighborhood disadvantage by redistributing from richer to poorer areas, and league tables were introduced alongside other

reforms designed to reduce disparities between schools by increasing centralized control and oversight over what teachers do in the classroom. The patterns we observe are thus likely to be stronger in contexts where school resources are shaped more strongly by area affluence.

Why and How Schools Are Quantified

Local and national governments in the United States (Hasan and Kumar 2018) and the United Kingdom (e.g., Goldstein and Leckie 2008) have frequently quantified school performance. This effort to render school quality numerically is rooted in the demands of administration and governance and by the desire to foster accountability and reveal inequalities (Mennicken and Espeland 2019). The acceleration of this trend within the education context in the 1980s, as Power (1999) documents, is part of a wider effort to extend the logic of markets to domains that were previously viewed as nonmarket goods or services (Le Grand and Enthoven 2007). In England, exam results were first published in league tables in 1992 (though the data we use run from 1994 onward; Goldstein and Leckie 2008), as part of a wider set of reforms instituted in the Education Reform Acts of 1988 and 1992, which increased centralized control and oversight of the education system. For further details on league tables and their role within the English education system see appendix A. These league tables reported the ranked position of every school in terms of the proportion of their students achieving five or more A*–C grades for the General Certificate of Secondary Education (GCSE),[4] which is a set of high-stakes exams taken by 16-year-olds at the end of compulsory schooling. This measure was the key indicator reported by government and was widely discussed in the national press (West and Pennell 2000; Francis and Hutchings 2013). The process of quantification turns school quality into a simple, unidimensional measure that reifies particular aspects of school quality as *the* dominant axis on which schools are to be ranked and compared (Rose 1991).

How Quantification of Schools Changes Educational Choices

Perceptions of school quality are strongly connected to exam performance (Hunter 1991), but the problem for parents is that this information is not always available. Before school league tables were published in the United Kingdom, parents would have necessarily relied on more informal indicators of school performance (Francis and Hutchings 2013) that they acquired

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[4] Here A* denotes the highest achievement.

through social networks as well as ad hoc publication of educational successes by schools or local education authorities (Hunter 1991). The quantification of school performance disrupts these evaluations (Mennicken and Espeland 2019) and, we argue, changes how parents think about their local schools in ways that may affect patterns of socioeconomic residential segregation. School league tables may reduce the importance of these more informal sources of information because rankings are alluring in their simplicity (Houston and Henig 2021). One of the virtues of league tables is their capacity to seemingly reduce the complexity of organizations, such as schools, to a single, manageable figure. Rankings are also attractive because they are presented as precise, definite, and accurate, even though their simplicity often obscures the messy reality that lies behind such metrics (Merry 2016; Pasquale 2016; Houston and Henig 2021). After school performance has been quantified, parents no longer need to rely on informal conversations (Francis and Hutchings 2013) because they can see for themselves how many children attending a certain school achieved good grades.

Quantifying quality in this way also does something else: it remakes the status hierarchies of school quality by potentially turning good schools into bad ones and vice versa. It reconfigures status hierarchies by explicitly situating local schools in a broader context. Informal sources of information regarding school quality are likely to be largely local. Parents reflect on the quality of any given school in the context of other schools in their area partly because most schools are simply unknown to parents. Publishing league tables changes the way parents assess local schools by allowing parents to directly compare performance with a wide range of other educational institutions (some near but others further away). What was once perceived to be a good local school may now find itself outperformed by other schools in the area. Moreover, an excellent school a bit further away may now become a family's first choice. In fact, on average, the distance children travel to school has almost doubled since the late 1980s (Parsons, Chalkley, and Jones 2000; Easton and Ferrari 2015) and children from more affluent families travel further to school (see our online supplement, sec. 3). The act of quantifying quality thus remakes the status hierarchy both by reconfiguring the standards of what is considered "good" (Espeland and Sauder 2016) and also by potentially extending the horizon of comparable schools.

Class-Specific Differences in Responses to League Tables

This reformulation of the status hierarchies of schools interacts with class position because the affluent are more concerned about these status hierarchies and because they are better placed to respond to their reconfiguration (Bergman and Hill 2018). Different social groups seem to use the information provided in rankings in quite different ways (Figlio and Lucas 2004). Only 20%

of British adults in semiroutine and routine manual occupations actually use league tables compared to over 55% among those in professional-managerial occupations (Montacute and Cullinane 2018). Few parents only consider performance metrics when choosing; they also reflect on specialisms and the distance between home and the school. However, the weight given to these different factors varies across social groups. Less affluent parents prioritize their children's happiness and preexisting relationships over school quality partly because children are given more say in schooling decisions in working-class households (Taylor 2002). As Ball and colleagues observe, there are two primary discourses in school choice in the United Kingdom: "a working-class discourse dominated by the practical and the immediate and a middle-class discourse dominated by the ideal and advantageous" (Ball, Bowe, and Gewirtz 1995, p. 74). In other words, working-class households are more concerned with finding well performing but conveniently situated local schools while professional-managerial households are more concerned with finding the best schools even if they are inconveniently located.

Professional-managerial parents are also more invested in ranking school quality because they are more attuned to the demands of the national competition for places at a small number of elite universities (Boliver 2013). Working-class families may be as equally invested in the value of higher education but are far less concerned about attending particular universities. In other words, when considering the location of a new home, discovering that the local school is merely average, according to this new metric, may prompt professional-managerial families to change their decision about where to live. League tables may have a less pronounced influence on how working-class families see the same local school. If professional-managerial parents typically respond to school league tables more strongly than working-class parents, then the introduction of league tables may lead professional-managerial parents to concentrate in areas with highly ranked schools, while working-class parents may spread more evenly across areas of varying school quality (Rhodes and De Luca 2014).

Class Differences in Ability to Respond to League Tables

Class differences in responsiveness to league tables are conditional on the resources available to different kinds of households. These economic constraints are central to the second mechanism through which quantifying school quality may lead to residential segregation. Schools with good reputations push up house prices in the surrounding area—a phenomena observed in the United Kingdom (Gibbons et al. 2013), France (Fack and Grenet 2010), and the United States (Black and Machin 2011). Parents are willing to pay more for a house if it increases their chances of getting their kids into a high-performing school. This implies that providing information about school quality may increase

house price differentials between areas near highly ranked and less highly ranked schools (Turnbull, Zahirovic-Herbert, and Zheng 2018), and hence make it more difficult for low-income individuals to move into areas with better schools. The set of affordable properties near a good school will be larger for wealthier parents than for poorer parents, and so wealthier parents will be more able to afford to buy (or rent) houses in areas with better schools (Black and Machin 2011). As house prices rise, poorer families already living in areas with high-performing schools may be incentivized to leave as a way of cashing in on the increasing value of their house, or they may no longer be able to afford to rent as costs increase (Machin 2011).

In other words, even if working-class households were as sensitive to league table rankings as professional-managerial households, economic constraints mean they would be far less able to respond to new information about school quality (Rhodes and De Luca 2014). Indeed, in the United Kingdom in 2013, around one-third of professional-managerial households reported moving to an area because it had good schools, compared to only 14% of (semi-) routine households (Francis and Hutchings 2013). We are not suggesting that league tables induced residential mobility among affluent parents but rather, given that an affluent household is moving, most likely because of employment (Niedomysl 2011), affluent parents are especially able to respond to this new signal about national school quality. These differential responses to quantifying school quality may potentially exacerbate social class segregation between communities.

Empirical Implications and the Ambiguity of Existing Evidence

This discussion suggests three testable predictions. At the community level, we expect the following:

Prediction 1.—After school league tables were introduced, areas with higher performing schools will see an increase in the share of more advantaged individuals, and a decrease in the share of less advantaged individuals, compared to areas with less well performing schools.

This prediction acts as an empirical baseline for the rest of our analysis, investigating whether changes in the class composition of areas are meaningfully associated with school performance at the aggregate level. At the individual level, we would expect patterns of residential mobility consistent with these community-level trends. In particular:

Prediction 2.—Individuals in more advantaged social classes will be more likely after school league tables are introduced, to move to areas with better-performing schools than individuals in less advantaged classes.

Prediction 3.—The association between social class and the likelihood of living in an area with high-performing schools will be stronger among individuals who are parents of children of school age or younger.

Surprisingly, the existing evidence on how the introduction of school rankings affects the concentration or segregation of economic advantage is rather mixed. Work on changes in school segregation after the introduction of school choice reforms in the United Kingdom has not arrived at a consensus, with some arguing these reforms had no detrimental effect (Fitz, Gorard, and Taylor 2003) while others observed increased school segregation, albeit rather small (Allen, Burgess, and Key 2010). Parents of young children do move house to live near highly ranked schools (Hansen 2014), but it is unclear whether these patterns are driven by school league tables in particular. Similar debates have been occurring in the U.S. context (Owens 2016; Hasan and Kumar 2018).

Our article builds on existing research in three ways. First, unlike some earlier work on how schools drive socioeconomic segregation, we focus on the presence of school rankings rather than other institutional features such as school district fragmentation (Owens 2018). Second, unlike much previous work on how school quality shapes parental choice (Allen et al. 2010; Hansen 2014), our analyses exploit comparison (or control) groups to help us identify a causal effect of the presence of league tables. These comparison groups include trends before and after the introduction of league tables, contrasting those in professional-managerial occupations with those in (semi-)routine occupations and, finally, contrasting parents of school-age children to households without children. Third, residential mobility is a relatively rare event (Champion and Shuttleworth 2017) that incurs substantial transaction costs for households. As a result, the introduction of school league tables is likely to affect patterns of residential mobility only over the relatively long term. Thus we build on existing literature (Fitz et al. 2003; Hasan and Kumar 2018; Goldstein and Hastings 2019) by using data that cover three decades, including almost 20 years following the introduction of league tables, in order to give adequate time for parents to reevaluate existing location decisions in light of new information about school performance.

In addition to providing a long time horizon, the United Kingdom is a fruitful context to study for several other reasons. First, the previous sections provide good evidence that the mechanisms motivating our study operate in the United Kingdom: professional-managerial parents pay greater attention to school league tables and there is a large house price premium in the vicinity of high-performing schools. Second, while existing research on how schools shape patterns of residential segregation generally uses data from the United States (Goldstein and Hastings 2019; Hasan and Kumar 2018; Owens 2018), there are important similarities between the two countries. Both are liberal market economies with high levels of income inequality. They also have largely comprehensive education systems without a strong vocational track (Andersen and Werfhorst 2010) and a highly competitive university system that is focused on a relatively small set of "elite" universities (Boliver 2013).

These affinities suggest our findings may have relevance to the U.S. context, as well as other similar contexts.

The United Kingdom is also interesting because it provides a conservative test case for the consequences of school quantification for residential sorting by occupational class. During the period we study, the British education system underwent substantial standardization designed to reduce disparities in performance across areas through introducing a national curriculum, increasing reliance on high-stakes testing, and creating a centralized inspection regime (Bagley 2006; Le Grand and Enthoven 2007; Children, Schools and Families and Committee 2009; Ball 2021). Furthermore, disparities in affluence between areas are not reflected in school funding patterns, due to a centralized funding system that explicitly corrects for disadvantaged intakes (Ball 2021). As a result, we would expect our results to be stronger in settings where geographical disparities in school funding can directly reinforce inequalities in school performance driven by the socioeconomic composition of the intake.

EMPIRICAL STRATEGY

We investigate our predictions across two distinct but related empirical analyses. First, we test prediction 1 using census data on administrative areas to establish the general pattern of change over time. This study aims to establish that the class composition of areas with highly ranked schools changed in ways consistent with our hypothesis. It uses an ecological analysis of population-level data to provide a baseline for our second study, which uses individual-level panel data from the ONS Longitudinal Study to test predictions 2 and 3. These latter predictions are concerned with patterns of residential mobility among different kinds of households. This second study allows us to construct control groups, giving us greater confidence in our causal inferences. Before introducing each empirical study we discuss some measurement issues common to all of them.

Occupational Class as Social Advantage

We use occupational class to measure socioeconomic advantage and disadvantage at the individual and area levels. Occupational class is operationalized through the National Statistics Socio-Economic Classification (NS-SEC). We are particularly interested in those employed in professional or managerial occupations (who experience high levels of earnings progression, job security, and control over their work) and those employed in semiroutine and routine occupations (who come from the working class and tend to work in low-paid and insecure occupations), which represent opposite ends of this

occupational class schema.[5] We focus on occupational class for three reasons: first, it is the only variable that can be used in U.K. census data over the long term to measure economic advantage and disadvantage; second, it clearly maps onto preferences and constraints that households face in residential choice; and third, it is a strong predictor of life chances—including lifetime earnings (McKnight and Goldthorpe 2006) and educational preferences (Erikson et al. 2005)—at both the individual and the community level (Galster 2012).

Geographical Areas

Schools in England do not have strictly defined district boundaries of the kind used in the United States. The most important variable predicting admission to a given school is the distance you live from it (Gibbons and Machin 2006), suggesting that location plays a major role in access to high-quality schools. As a result, in both our community-level and individual-level analyses we focus on the smallest administrative areas for which all our variables are available: local authority districts. These are the primary jurisdictions of local government and are analogous to U.S. counties, with an average population in 2011 of 152,691 (SD = 110, 693). Areas are heterogenous in size, demographics, and functions; for example, some of them have control of education (especially urban areas) and others do not (small rural areas).[6] These geographical areas are the analytical units in study 1. In study 2, by contrast, we are interested in the local authorities into which individuals move. One advantage of studying mobility between areas is a reduced likelihood that our analyses are confounded by word-of-mouth information transmitted across social networks (Burdick-Will et al. 2020), as such networks are likely to operate within fairly constrained geographical areas.

STUDY 1: AREA-LEVEL EVIDENCE

Do areas with higher performing schools experience increases in advantaged occupational classes, and decreases in disadvantaged occupational classes?[7] Our first empirical analysis explores whether—consistent with our first prediction—areas with higher performing schools observe an *increase* in the share of more advantaged individuals and a *decline* in the share of less advantaged individuals in the period after league tables became available.

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[5] The NS-SEC only started being used in official statistics in 2001. Hence, for the prior period we reconstruct it from preexisting occupational classifications.

[6] Areas are generally aggregated to 2011 boundaries. However, in a few cases we needed to combine separate local authorities into larger areas that are consistent over time.

[7] Sec. 1 of the online supplement contains additional analyses and robustness checks for this study.

Its purpose is to establish that, at the aggregate level, area performance on league tables is associated with changing class composition. As expected, we find that the professional-managerial share did increase faster in areas with high-performing schools than in areas with poor-performing schools, but the results for the share of semiroutine and routine occupations are more mixed.

We combine information on local authority characteristics from the decennial census with measures of school quality reported in the league tables. We do not claim that these metrics accurately capture school quality because they are in large part measuring the social origins of their pupils (Goldstein and Leckie 2008). However, we are interested in how parents respond to this signal of school performance. We therefore focus on the proportion of students achieving five or more A*–C grades in the General Certificate of Secondary Education (hereafter 5 + A*–C GCSEs) at age 16, which is the end of compulsory schooling in the United Kingdom. These are high-stakes exams that have been the major benchmark for tracking school performance and were extremely prominent in published tables.[8] For an individual student, achieving 5 + A*–C GCSEs is seen as an adequate baseline performance rather than excellence. However, at a school level, a large share of pupils achieving above this threshold is likely to be regarded as evidence of a high-performing institution, especially in the absence of direct measures of performance at the top of the distribution.

We use annual published results from the U.K. Department for Education (DfE) for all mainstream schools (state and private)[9] from league table introduction from 1994 to 2011. We link schools to local authorities through their addresses and then summarize their performance over time using the mean performance across schools in that local authority weighted by pupil numbers. School performance data are aggregated into two periods from 1994 to 2000 and 2002 to 2011 to fit the availability of census data. The school performance data are then linked with *changes* in class composition at the local authority level over two periods (1991–2001 and 2001–11). The school performance data from 1994 to 2000 are thus matched to data on changes in class composition between 1991 and 2001, and the same procedure is used for data between 2001 and 2011. This enables us to see whether change in the class composition of these areas between censuses is correlated with school performance over this same period.[10]

[8] Importantly, while house prices do respond to school performance according to this crude metric, there is little evidence house prices are influenced by more nuanced value-added measures of school performance (Imberman and Lovenheim 2016).

[9] We do not include specialist schools for children with learning difficulties or disabilities or those who have been excluded from mainstream schools.

[10] Decennial census data are the only data from this period capable of precisely measuring changes in the socioeconomic composition of local authorities. As a result we are unable to

We therefore estimate OLS regression models of the following form:

$$\Delta ClassShare_{it} = \beta_1 ClassShare_{it-1} + \beta_2 SchoolQuality_{it} + \beta_3 GDI_{it}$$
$$+ \beta_4 Selective_i + \gamma \Delta X_{it} + r_i + t + \alpha + \varepsilon_{itt}. \tag{1}$$

In this model i denotes local authorities, and t denotes time periods. Here, $\Delta ClassShare_{it}$ measures the change in the share of professional-managerial or routine/semiroutine occupations between 1991 and 2001, and 2001 and 2011; $\beta_2 SchoolQuality_{it}$ measures average school quality over the periods 1994–2000 and 2002–11; $\beta_1 ClassShare_{it-1}$ adjusts for class shares at baseline, providing a partial control for the possibility that areas with higher starting class shares have better school performance. We control for changes at the area level ($\gamma \Delta X_{it}$), which may affect school quality and class-specific patterns of migration using the following variables: ethnic/immigrant composition (% born outside the United Kingdom); the degree of poverty/presence of job opportunities (unemployment rate); the extent to which individuals can live in an area without paying market prices (% living in social/public housing); the presence of well-paying jobs for low-skilled individuals (% employed in manufacturing); and urbanization (logged population density). $\beta_3 GDI_{it}$ is a measure of gross disposable income per capita, measured in levels because it is not available prior to the mid-1990s.

We control for a binary measure of the presence of academically selective, publicly funded schools (known as grammar schools in the U.K. context) in the area, $\beta_4 Selective_i$. The process of detracking halted in the early 1980s, and as a result this variable is time invariant. We also add fixed effects for period t and nine broad geographic regions, r_i.[11] Standard errors are clustered by local authority. We have a balanced panel of 640 observations over 320 local authorities; descriptive statistics for all variables can be found in table A1.

Table 1 contains our results. In areas where the proportion of students obtaining 5 + A*–C GCSEs was 1 percentage point higher over each time period, we see a 5 percentage point (95% CI: 1, 9) increase in the professional-managerial share. This association is not diminished by including covariates; in fact, if anything, the association gets larger (11 percentage points; 95% CI: 8, 15). The results, however, are less straightforward for the semiroutine/routine share. With only time and region fixed effects we do not find a clear association between school performance and change in semiroutine/routine share. Once covariates are included, a 1 percentage point increase in GCSE performance across students is associated with a 7 percentage point decrease in the semiroutine/routine share (95% CI: −4, −9) over these two periods.

cleanly compare changes in class composition immediately before and after league table introduction. However, we expect the league tables to mainly affect parental behavior over the longer term, as parents are likely to take time to adjust their patterns of residential mobility.
[11] Government Office Regions.

TABLE 1
ASSOCIATION BETWEEN SCHOOL PERFORMANCE AND CHANGES
IN OCCUPATIONAL CLASS SHARES, ENGLAND 1991–2011

	CHANGE IN PROFESSIONAL-MANAGERIAL SHARE		CHANGE IN SEMIROUTINE/ROUTINE SHARE	
	(1)	(2)	(3)	(4)
School performance	.05*	.11***	−.02	−.07***
	(.01, .09)	(.08, .15)	(−.05, .01)	(−.09, −.04)
Change in % born in U.K.		.13**		−.17***
		(.03, .23)		(−.23, −.11)
Change in % unemployed		−1.23***		.90***
		(−1.53, −.93)		(.67, 1.14)
Change in % social housing		−.07		.06
		(−.17, .04)		(−.03, .15)
Change in % employed manufacturing		−.18***		.13**
		(−.25, −.11)		(.04, .22)
Change in log population density		.12***		−.06**
		(.07, .17)		(−.10, −.02)
Logged gross disposable income . . .		.04***		−.02**
		(.03, .06)		(−.03, −.01)
Selective schools in area		−.00		.00
		−.01, .00)		(−.00, .00)
Lagged professional-managerial share	.02	−.12***		
	(−.02, .06)	(−.17, −.07)		
Lagged semiroutine/routine share			−.06**	−.12***
R^2	.89	.92	.81	.86

NOTE.—OLS regression models with fixed effects for period and region and standard errors clustered by local authority. $N = 640$ in all models. School performance data are % of children in a local authority achieving 5 + A*−C grades at GCSE over the periods 1994−2000 and 2002−2011. Class composition and socioeconomic covariates from 1991−2011 censuses, school performance, and selectivity data are from the DfE, and gross disposable income is from Nomisweb. The 95% CIs are in parentheses.

  * $P < .05$.
  ** $P < .01$.
  *** $P < .001$.

We also conduct a series of robustness checks in the online supplement (see sec. 1). One concern with our results is that they might reflect reverse causation where areas with greater inflows of professional-managerial occupations have higher-performing schools because the population of students comes from more advantaged backgrounds. Without an exogenous source of variation in school quality we are unable to totally account for this possibility. However, we present a range of evidence suggesting it is unlikely to be the case.

First we adopt an alternative measurement strategy. Rather than measuring school performance averaged across the two periods 1994–2000 and

2002–11, we split our measure of school performance into two components. The first is school performance at baseline in each period (1994 or 2002), and the second is change in school performance within each period (i.e., 1994–2001 and 2002–11). While the second of these two components is clearly at risk of confounding by reverse causation, the first is less so because it is measured at the start of the period. We substitute these two measures into equation (2) in place of $\beta_2 SchoolQuality_{it}$. Results in table S1 in our online supplement suggest that while areas with greater increases in school performance saw (possibly endogenous) increases in professional-managerial share and decreases in semiroutine/routine share, areas with better-performing schools at baseline saw subsequent increases in professional-managerial share. Once again results for semiroutine/routine share are mixed.

Second, we show that our results are unchanged when adjusting for historical (lagged) changes in class composition (table S2). Third, we carry out a simple prediction exercise, comparing occupational class shares after league table introduction to counterfactual estimates of their value based on historical demographics or growth trajectories. We find that areas with higher-performing schools had higher than expected shares of professional-managerial workers and lower than expected shares of semiroutine/routine workers (fig. S1).

To understand the extent to which our results are dependent on the inclusion of specific control variables we produce model robustness analyses of the results presented in table 1 and table S1 in the online supplement. To do so we estimate models with all possible sets of control variables (Young and Holsteen 2017). All models contain measures of school performance at baseline averaged across the period, class share at baseline, year, and region. Specifications can potentially include all covariates as well as lagged changes in class share and lagged demographic covariates. Results from the specification curve analysis are reported in figure S2 and suggest that our results are highly robust to the precise choice of control variables.

We also show that our results are robust to an alternative measure of school quality—the proportion of schools in the top 20% of the national distribution—a measure that we also calculate for publicly funded schools only, to avoid results being influenced by private schools with exceptionally high performance (table S3). We then show that our results are not driven by any specific regions of the country. Our results hold within areas that do not have academically selective publicly funded schools, and when dropping any one of the nine regions from our data, as well as London and surrounding regions together (table S4).

We also consider, using both OLS and structural equation models, whether our results change after we control for average house prices. The results suggest that the positive correlation between school quality and house prices partially, but not entirely, accounts for the association we observe between school

quality and changes in the professional or managerial share (tables S5–S6). This is consistent with our theoretical model in which the association between school quality and changes in class composition is connected to house prices, but establishing causal mediation will require more detailed analysis.

Overall, in this first empirical analysis we found that areas in England with better-performing schools (according to league tables) saw larger increases in the share of those employed in professional-managerial occupations. Moreover, this is very robust to a large range of alternative model specifications. Our results are more mixed for those employed in semiroutine/routine occupations, in line with research showing that increases in income segregation in the United States have been concentrated at the top of the income distribution (Reardon and Bischoff 2011). This suggests that, at the aggregate level, changes in the class composition of areas are meaningfully associated with school performance in the way we would expect if school league tables shape patterns of residential mobility. While not conclusive, we have provided some evidence that these comparisons are not entirely driven by reverse causation. However, to substantiate our argument that these patterns are in fact shaped by class-specific responses to school league table introduction, we require data on individual-level patterns of residential mobility prior to the introduction of league tables.

STUDY 2: EVIDENCE FROM LONGITUDINAL MICRODATA

Are advantaged parents more likely to move to areas with better schools after the introduction of league tables?[12] So far we have shown that the share of advantaged occupations increased more in areas that contained schools that were consistently ranked high on league tables. However, it is not necessarily the case that these results are driven by patterns of residential mobility rather than, for example, changes in the occupational structure of local authorities. This problem is rooted in the fact that study 1 focuses entirely on aggregate-level relationships. In this second empirical study, we move to the individual level to investigate whether patterns of residential mobility are consistent with our second and third predictions, (i) whether professional-managerial households become more likely to move into areas where school performance is higher after the introduction of school league tables and (ii) whether this relationship is concentrated in households without children. We use patterns of residential mobility prior to the introduction of league tables and among those without school aged children to construct comparison/control groups to help us in identifying a causal effect of the presence of league tables.

For this component of the analysis, we use individual-level data from the Office for National Statistics (ONS) Longitudinal Study. The Longitudinal

[12] The online supplement, sec. 2, provides a wide range of supporting material and additional analyses for study 2.

Study links the records of a random 1% sample of the population of England and Wales, clustered by date of birth, across each decennial census since 1971. These records are linked to life-events data such as births and deaths. Individuals born on one of four selected dates in a calendar year were included in the sample in 1971, and these four dates were used to update the sample at the 1981, 1991, 2001, and 2011 censuses to ensure population representativeness. The long duration of the Longitudinal Study is ideal for studying long-term consequences of policy changes, and the large sample size (circa 500,000 individuals per wave) provides many respondents who are residentially mobile. Our analysis uses data from England over four waves between 1981 and 2011.

We are primarily concerned with residential mobility and so focus on individuals who moved local authority between any given wave (hereafter t) and the next wave (hereafter $t + 1$). We restrict our sample to those individuals who are most likely to be in a household with school-age or younger children—persons 20- to 50-years-old at t and hence 30- to 60-years-old at $t + 1$—because we want to account for patterns of residential mobility that vary across the life course.

School quality is the response variable and is measured for the local authority in which an individual lives at $t + 1$. School quality is again the average proportion of students attaining $5 + $ A*–C GCSEs across the period 1994–2011. Crucially, we also assign this measure of average school quality to areas in 1991, before the introduction of school league tables. We do this so that our response variable is essentially a counterfactual: Are advantaged parents more likely to move to areas that are revealed to possess good schools after the introduction of league tables than they were to move to the same areas before such information was available? This approach is justified by the very high correlation in exam results within areas over time ($r = .84$).

Besides variation over time, we have two main explanatory variables of interest: social class and the presence of children in the household. Social class is measured at t, using the three-class measure of NSSEC: (1) professional-managerial, (2) intermediate, self-employed, and lower supervisory, and (3) semiroutine and routine. We code families with school-age children (under 16) at t or $t + 1$ as 1, and everyone else as 0.[13] We are not primarily interested in whether league tables induce new moves. Instead, our basic

[13] This coding is designed to incorporate several distinct groups of parents into our analysis: (1) individuals who have children between t and $t + 1$, and move either prior to having children, or with young children to an area with better schools; (2) individuals who have children at t who are younger than secondary school age and move between t and $t + 1$ so that their child can attend a higher-quality secondary school than that available in their local area; and (3) individuals who have children of secondary school age and move between t and $t+ 1$ so that they can attend higher-quality schools when beginning to study for high-stakes exams such as GCSEs.

question is, given that households are moving, whether they are more likely to end up in areas with higher school quality at $t + 1$ after the introduction of school league tables. We then explore whether this association is stronger for professional-managerial households and households with children.

One challenge with this strategy is that we only focus on those individuals who change local authorities between t and $t + 1$ and this might lead to biased results because residential mobility is not randomly assigned to individuals (see supplementary table S9 for class differences in probability of moving area). To address this source of bias, we use a Heckman selection model to adjust our estimates for unequal probabilities of residential mobility.

The second stage of our model is the following linear regression model:

$$SchoolQuality_{it+1} = \beta_1 OccClass_{it} + \beta_2 year_t + \beta_3 children_{it}$$

$$+ \beta_4 OccClass_{it} * year_t + \beta_5 OccClass_{it} * children_{it}$$

$$+ \beta_6 year_t * children_{it} + \beta_7 OccClass_{it} * year_t * children_{it}$$

$$+ \gamma X_{it} + \lambda + \alpha + \varepsilon_{it}, \tag{2}$$

where $Schoolquality_{it+1}$ is average school performance in the area that an individual lives in at $t + 1$ and $OccClass_{it}$ and $children_{it}$ are dummy variables for occupational class and the presence of children in the household at t, while $year_t$ is a time dummy. The model interacts each of these variables with each other, and includes a three-way interaction ($OccClass_{it} * year_t * children_{it}$) that allows over time differences in the association between occupational class and school quality at $t + 1$ to vary based on the presence of children in the household. In effect, this model becomes a triple differences model (a difference-in-differences-in-differences). Here γX_{it} is a set of covariates including the housing tenure, household structure, and economic activity of the household observed at t, and the age group, gender, country of birth, education, and ethnicity of the individual whom we follow over time. λ is the nonselection hazard estimated in the first stage of the selection equation and used to adjust the estimates for sample selectivity. α is an overall intercept and ε_{it} an error term. Standard errors are clustered on individuals in the second-stage equation.

The first-stage equation is a probit regression with a binary indicator of mobility between local authorities as the outcome. It includes all of the variables in equation (1) alongside the following area-level variables at t: the share of the population that is professional-managerial, unemployed, in social housing, and employed in manufacturing, as well as the logged population density. In this equation we also control for school quality at t to capture the idea that individuals should be less likely to leave areas with good schools, all else equal. At an individual level we also control for a measure

of overcrowding, a well-known predictor of residential mobility. The area-level measures essentially act as instrumental variables, because by definition they can only be correlated with school quality at $t + 1$ through an individual's decision to stay in the same area or leave. We have 499,973 observations in total, 115,159 of which are moves across local authority boundaries. Table A2 displays descriptive statistics for all variables.[14]

Our predictions are concerned with how social class disparities in school quality at $t + 1$ change after the introduction of league tables, and whether this differs among those with and without children. To address these predictions we estimate contrasts of marginal means from the second stage of our Heckman selection equation. Equation (3) below illustrates our approach:

$$\hat{Y}_{Diff\text{-}in\text{-}diff} = \left(\hat{Y}_{ProfChild2011} - \hat{Y}_{RoutineChild2011} \right) - \left(\hat{Y}_{ProfChild1991} - \hat{Y}_{RoutineChild1991} \right). \tag{3}$$

In equation (3) we are interested in the difference in school performance at $t + 1$ between professional-managerial households with school age children and semiroutine and routine households with school age children. We also look at whether this difference changes over time. In other words, we consider school performance at $t + 1$ for professional-managerial households who moved house between 2001 and 2011 and compare it to school performance at $t + 1$ for semiroutine and routine households who also moved house between 2001 and 2011. We then examine whether this first difference is larger than the difference in school performance at $t + 1$ for professional-managerial compared to semiroutine and routine classes who moved between 1991 and 1981, essentially calculating a difference-in-differences of marginal means. These same quantities are calculated for individuals both with (as shown in eq. [3]), and without children (creating the triple difference). In all cases the reference occupational class is semiroutine and routine, and the reference time period is moves between 1981 and 1991, before the introduction of school league tables.

In figure 1 we display the central results from our Heckman sample selection model (coefficient estimates are found in supplementary table S10). The key message from this graph is that patterns of residential mobility change after the introduction of school league tables for people employed in professional-managerial occupations who also have children. We find that, among individuals in households with children, people in professional-managerial occupations who move between 1991 and 2001 become more likely to move

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[14] An advantage of using data from the ONS Longitudinal Study is the low level of sample attrition over periods as long as a decade. Of the individuals present at t, fewer than 15% are lost to follow-up at $t + 1$. Class differences in attrition are very small, though attrition is substantially more likely for individuals without children. See tables S7–S8 for details.

No school aged children   School aged children

Intermediate & self employed vs. Routine

Professional and managerial vs. Routine

-1   0   1   2 -1   0   1   2

Difference in average school performance at t+1
Contrasts of estimated marginal means

Comparing residential moves between: ○ 1991-2001 vs. 1981-1991   ✕ 2001-2011 vs. 1981-1991

Fig. 1.—Average school performance among residentially mobile households before and after the introduction of school league tables and comparing households with and without school-age children. The plot displays differences in average school performance at $t + 1$ among individuals who change area by occupational class (with semiroutine/routine as the reference category) over time (with 1981–91 as the reference period). These estimates are contrasts of estimated marginal means from Heckman sample selection model with controls for individual and household demographic variables in both selection and outcome equations and area-level predictors and measure of overcrowding in selection equation. See eqq. (2) and (3) for details, and table S10 for underlying coefficient estimates. Data are from the ONS Longitudinal Study, the census, and the DfE. Authors' calculations.

into areas with better schools in 2001 relative to those in routine manual occupations. This difference remains stable in successive waves: professional-managerial people who moved between 2001 and 2011 are still relatively more likely to move into areas with better schools than those professional-managerial people who moved between 1981 and 1991.

This pattern is not seen among all households, however. We find no evidence for differences over time in the average school performance of the areas that households without children move into, regardless of their class position. This observation is consistent with our claim that the changes we observe in residential mobility patterns over time are likely to be related to the introduction of school league tables, rather than some other change that may have occurred over the same period.

These results show that professional-managerial households with children become more likely to move into areas with better schools after the introduction of school leagues. We now investigate the implications of these changing patterns of residential mobility for occupational class concentration,

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the outcome in which we are ultimately interested. To do so we reestimate our Heckman selection model, but now the dependent variable is the share of the population employed in professional-managerial occupations. The results, displayed in figure 2, are very similar to those reported in figure 1. Professional-managerial parents who move between 1991 and 2001 or 2001 and 2011 are more likely than those who moved between 1981 and 1991 to end up in areas with a higher professional-managerial share of the population relative to those in routine manual occupations. Furthermore, coefficient estimates are larger among parents of school-age children, though the difference between parents and nonparents is smaller than reported in figure 1. This suggests that the introduction of school league tables was associated with an increased propensity for individuals in professional-managerial occupations to move to areas that already had high professional-managerial population shares, which should, all else equal, increase the geographical concentration of occupational class.

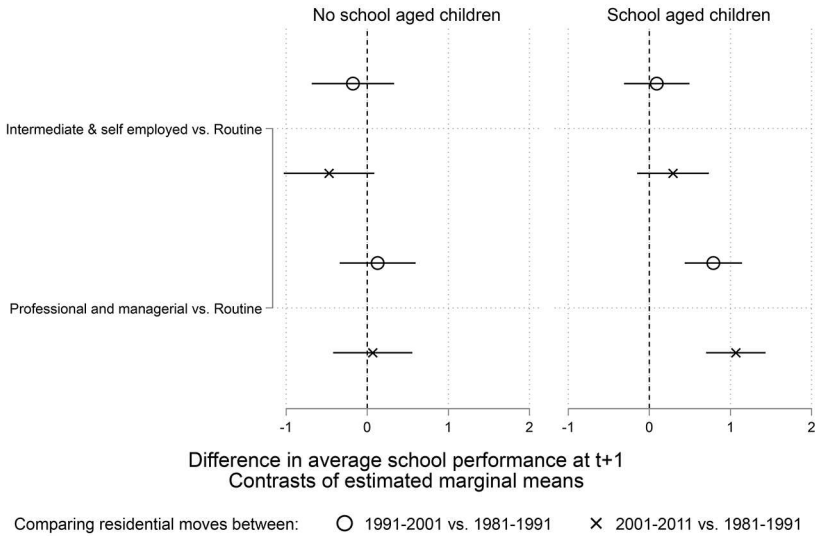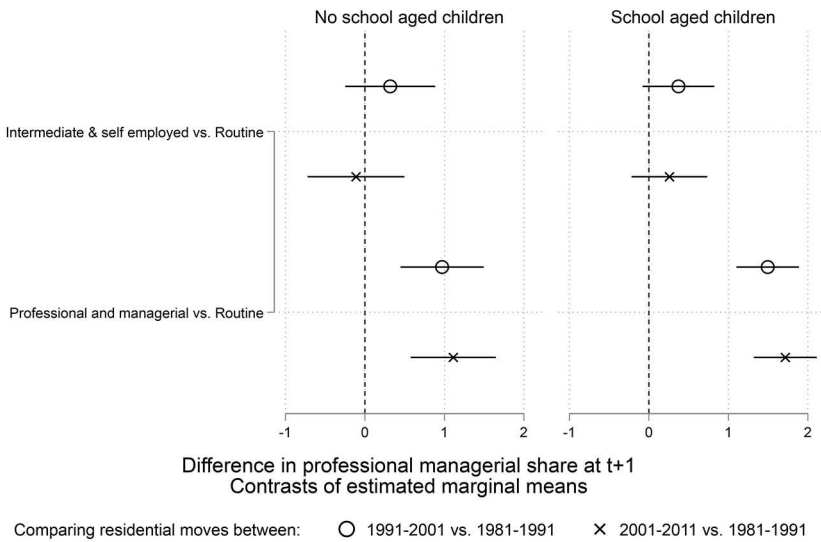FIG. 2.—Professional-managerial share among residentially mobile households before and after the introduction of school league tables and comparing households with and without school-age children. The plot displays differences in professional-managerial share at $t + 1$ among individuals who change area by occupational class (with semiroutine/routine as the reference category) over time (with 1981–91 as the reference period). These estimates are contrasts of estimated marginal means from a Heckman sample selection model with controls for individual and household demographic variables in both selection and outcome equations and area-level predictors and measure of overcrowding in selection equation. See eqq. (2) and (3) for details, and table S11 for underlying coefficient estimates. Data are from the ONS Longitudinal Study, the census, and the DfE. Authors' calculations.

Robustness Checks

In sections 2.6–2.7 of our online supplement, we report results from a number of robustness checks for our Heckman selection models. Broadly speaking, the regression coefficients in these models are consistent with previous research and theory, enhancing the plausibility of our modeling strategy. In particular, individuals living in areas with better-performing schools at t are less likely to leave their area (β: -0.27, CI: -0.18, -0.37). Our results change little when we include or exclude a variety of controls in both the outcome and selection equations of our Heckman selection model. We adjust for a source of potential endogeneity—that people in professional-managerial occupations are more likely to move to areas where professional-managerial jobs are expanding faster—by including controls of *changes* in area-level predictors in the area of residence at $t + 1$ in both selection and outcome equations.[15] We find that our results remain consistent in each instance.

In another robustness check (fig. S6) we focus on the distance moved by parents of school aged children, given that they moved areas between t and $t + 1$. Here, we find that class differences in school quality at $t + 1$ increased after the introduction of school league tables and that this is observed across moves ranging from the very short (> 1 km), to over 100 km. This provides us with additional confidence in our results by supporting two claims: (1) our results hold at larger spatial scales over which word-of-mouth influences are unlikely to be operative and (2) school league tables increase the propensity for parents to engage in short-distance residential sorting to live in the vicinity of better schools.

As with all difference-in-differences analyses, inferring a causal effect of league table introduction on residential mobility patterns rests on the assumption of parallel trends in the pretreatment period. We are unable to directly test this assumption given that we only have one pretreatment set of residential moves. However, the comparison between those with and without children (the triple difference) provides some reassurance. Since we find no evidence for a change in the association between social class and school quality of area among nonparents, our results are unlikely to be explained by a changing association between social class and location that is independent of the presence of children. It is, of course, possible that location and school choice became more important to professional-managerial parents during the period in which school league tables were introduced. However, qualitative evidence drawn from the late 1980s and early 1990s (before and after league tables were introduced) does not support this claim (Ball 2003; Hunter 1991; Noden et al. 1998; Woods, Bagley, and Glatter 2005). In the next section we discuss some candidate explanations in detail and conclude that

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[15] These variables are not included in our preferred specification because they are measured posttreatment.

major changes in the period were likely making the school quality of areas less salient to professional-managerial parents. Thus, to the extent to which our parallel trends assumption is violated, it is likely to be biasing our estimated effects downwards rather than upwards.

Alternative Explanations and Limitations

In this section we discuss several alternative explanations for our findings that cannot be directly addressed with the data available to us. First, increased class concentration around high-performing schools could be explained by rising levels of income inequality leading to increased anxiety among professional-managerial parents about ensuring their children's access to high quality education. We are not aware of any survey data that specifically addresses this anxiety but an analysis of data from the British Social Attitudes survey (see sec. 4 of the online supplement) does not suggest substantial increases in parental anxiety about social mobility over this period. Moreover, any anxieties generated among professional-managerial parents by rising income inequality during the 1980s (before league table introduction) were potentially offset by a number of countervailing forces. These include declining fertility rates among upper-middle-class households (Berrington, Stone, and Beaujouan 2015); stable relative rates of social mobility into professional and managerial occupations (Erikson, Goldthorpe, and Portocarero 2010); and the expansion of university places (Dearing Report 1997), which were disproportionately taken up by higher income parents (Lindley and Machin 2012), and did not reduce the returns to education (Blundell, Green, and Jin 2016). These trends are all consistent with professional-managerial parents having stable or declining levels of anxiety about their children's futures.

Second, the introduction of school league tables occurred alongside broader reforms that were intended to standardize secondary schooling in England by increasing centralized control and oversight of the education system. Concretely, this meant the creation of a national curriculum that would be taught in almost all schools, additional standardized testing, and a new school inspection regime. Did these reforms contribute to influence our results? As shown in figure 3, these reforms actually reduced disparities between areas, weakening material differences in school quality even if they did not affect relative position in the rankings.[16]

[16] It is possible that parents could respond differently to school league tables at the end of the period given dramatic improvements in average performance. Since we believe that parents are likely to be more interested in the relative performance of different schools than absolute performance, the most likely way in which this could happen would be if many areas had close to 100% 5 + A*–C at GCSE, reducing the ability of league tables to discriminate between areas. Fig. 3 shows that this was not the case, with areas at the
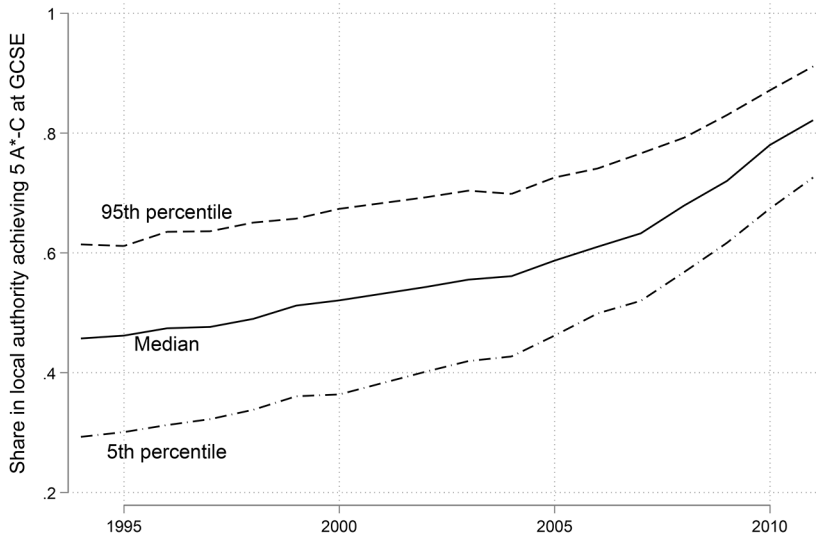
Fɪɢ. 3.—Share of pupils in local area achieving 5 + A*–C at GCSE. Data are from the DfE.

A third possible concern is that areas with greater population shares of professional-managerial parents will have better-performing schools simply as a mechanical consequence of having more advantaged and highly educated populations. However, our research design in study 2 is not affected by this kind of endogeneity. Our model examines changes in patterns of mobility relative to those that existed before the introduction of league tables. As a result, on the assumption that the association between parental occupational class and child educational attainment has not increased since the introduction of school league tables, our research design adjusts for the endogenous effect of occupational class on area-level school performance. Existing research confirms our assumption, finding that the association between parental occupational class and child educational attainment is either static or declining (Gregg and Macmillan 2010). Overall, therefore, these alternative explanations are inconsistent with underlying trends.

Reflecting on our empirical analysis as a whole, there are, of course, a number of limitations. First, we do not directly observe parents' school choices or their reasons for residential mobility decisions (Rhodes and De Luca

90th percentile of school performance only reaching 90% 5 + A*–C grades in 2011. Furthermore, parents may not necessarily have interpreted rising average performance as an indicator of improving school quality as in the later part of the period news stories containing allegations of grade inflation were widely reported.

2014). Second, our two-stage analytical strategy uses data from slightly different time periods. In analysis 1, for example, we do not have data before the reform, and this limits our ability to draw conclusions about the impact these reforms may have had at the aggregate level. Third, measuring school quality at the level of local authorities requires us to overlook important variation in school performance within local areas. However, the evidence from this more micro-scale reinforces our findings in two ways: (1) comparing parents who live in the same (very narrowly defined) area—poor parents send their children to lower performing schools (Burgess and Briggs 2010); (2) parents of young children will move short distances into areas with high-performing schools (Hansen 2014). Fourth, our analysis does not directly explain patterns of residential segregation by occupational class. Rather, we aim only to identify whether quantifying quality through school league tables leads professional-managerial people to concentrate in areas where they are already overrepresented, increasing class segregation, all else equal. Our results do not mean residential segregation has increased in absolute terms. Indeed, other countervailing forces are likely offsetting the influence of league tables on overall trends in residential segregation, such as the suburbanization of poverty.

DISCUSSION AND CONCLUSIONS

We use the publication of school league tables in England to examine the impact of quantifying school performance on the spatial concentration of advantage and disadvantage. Two key findings emerge from our analysis of English census data. First, we show that the professional-managerial share increased fastest in local authorities with the best-performing schools. Second, we find that those in more advantaged social classes became more likely to move to areas with higher performing schools after the introduction of school league tables, but only if school-age children were present in the household.

Our findings have implications for two sociological literatures. The first is the sociology of residential segregation. Our paper is part of a larger theoretical project aimed at understanding the causes and consequences of residential segregation (Sampson and Sharkey 2008) and, in particular, how sorting processes create the context in which neighborhood effects operate. We contribute to this project by showing how institutional rules governing whether and how the quality of schools are quantified influence the process of neighborhood sorting. The neighborhood effects literature often frames these "effects" in terms of the transmission of social norms, information, or other kinds of interpersonal transfers (Galster 2012). Yet such interpersonal transfers are the product of sorting processes that are, in turn, influenced by institutions. By allowing parents to make choices about where to

educate their children, school league tables also help create the environments in which these interpersonal transfers occur. School league tables could not only entrench the socioeconomic drivers of inequalities in school performance (Gingrich and Ansell 2014) but may also have spillover effects into other areas of social life, potentially exacerbating wealth inequality by depressing house prices in areas with low performing schools.

Our results do not necessarily imply that quantifying school quality will always generate greater geographical concentration of advantage. The effect of quantifying school quality will vary depending on background factors such as school funding policies and the level of house price inequality. If school funding is linked to property taxes then quantifying quality could have an even more marked effect on socioeconomic segregation because league tables will not only affect house prices but could also undermine funding for struggling schools. In this respect at least, the United Kingdom is quite a conservative case. By the same token, school league tables may have stronger consequences for socioeconomic segregation when introduced in contexts with greater initial geographical inequality in house prices (Goldstein and Hastings 2019). As such, the introduction of school league tables might exacerbate historical disparities in property value between areas based on historical legacies of racial segregation, thus contributing to racial wealth gaps (Taylor 2019; Faber 2020;). Our article is thus a call for greater attention to how the quantification of education interacts with and reinforces other institutional and economic background factors to produce residential segregation.

The second implication of our findings concerns how quantification can shape inequalities by "recreating social worlds" (Espeland and Sauder 2007) and speaks to research showing how rankings help to reproduce inequality (Rose 1991; Espeland and Sauder 2016; O'Neil 2016; Bergman and Hill 2018). Quantifying quality reveals inequalities in performance that were previously opaque but does so in a way that masks the social background of the school's intake. These metrics actually reward the geographical concentration of advantage, with school performance likely improving as their intake becomes wealthier.

Alongside reifying existing inequalities, quantifying school performance reconfigures parental standards of what is considered a "good" educational service (Espeland and Sauder 2016). Quantifying quality shifts the horizon of comparable schools by explicitly situating local schools in a national context. The meaning of these rankings will vary for parents in different situations. The introduction of school league tables does not imply that parents suddenly flock to Cheltenham in Gloucestershire simply because one of the highest performing schools in the country is located there. Rather, among parents who are not planning to move, league tables may allow them to identify high-performing schools that are outside the knowledge available to

them through social networks. Thus it is unsurprising to find that the children of professional-managerial parents travel further to get to school than they did in the 1980s—as parents are able to search for good schools that are slightly further away (Easton and Ferrari 2015; Parsons et al. 2000). By contrast, our analysis seeks to identify the effect of league tables on parents who are moving to new areas, where their ties to local knowledge are weaker. In this situation, league tables potentially perform a different function. Providing parents with information on how schools fit into a unidimensional national performance ranking may enable "mover" families to compare school quality over a much wider set of potential destination areas than was previously possible based on word-of-mouth and ad hoc data sources. These parents can thus proactively sort into areas with schools that are high performing nationally and not just locally.

School league tables potentially have the power to reshape the geographic comparisons that parents make because they rank schools according to performance on high-stakes exams, which play an important role in determining access to tertiary education.[17] Competition for places at elite universities is a national (or at least macro-regional) competition (Donnelly and Gamsu 2018). As a result, creating a national league table for schools based on measures of performance that are highly relevant for university admission alters the way that professional-managerial parents look at schools and areas. By abstracting away from other features of schools that may be less closely connected to exam performance, the area choices of professional-managerial parents become more aligned with one another, and with school performance as measured by league tables—all else equal leading to a greater spatial concentration of advantage. Future research should consider the ways in which quantification more broadly may alter status hierarchies by shifting the geographical scale over which comparisons occur and the behavioral responses of different groups of people.

These questions matter because precisely how quality is quantified is a political choice (Rose 1991), and in this article we have tried to uncover the unintended consequences of this choice. We show how rendering school quality as a league table reconfigured patterns of residential mobility and thereby increased social class concentration. Quantifying school performance allows parents to make informed decisions and may even improve teaching (Burgess, Wilson, and Worth 2013), but in doing so has deepened the geographical concentration of advantage and potentially affected the life chances of children whose parents were less able to benefit from this institutional change.

[17] While results on upper-secondary terminal examinations (A-Levels) are the primary mechanism for determining university admissions, GCSE results are important for admissions to upper-secondary education, and may be taken into account in university admissions.

APPENDIX A

The English Education System and the Role of League Tables

The English Education System

Over the period covered by our study, the English education system provided publicly funded and compulsory schooling from ages 5 to 16.[18] Children normally attend "primary schools" from ages 5 to 11 and then nonselective lower secondary schools from ages 11 to 16, though this varies somewhat over administrative subdivisions. Thereafter students may progress to an additional two years of upper-secondary education in preparation for university entry, vocational training, or employment.

Up to age 16, over 90% of children attend public (state-financed) schools. Private schools are included in our data set, though our calculations of school performance are weighted by pupil numbers so their influence on results will be minor. Some areas in England also have a small number of publicly funded selective schools (known as "grammar schools") for children 11 years old and older. These areas have a two-tiered schooling system in which grammar schools select students based on entrance exam results. Schools of this kind represent only about 5% of all secondary schools (150 out of approximately 3,000). Crucially, the process of detracking that created comprehensive schooling in most of the country had basically finished by 1981, so the presence of grammar schools in an area are time invariant in our study (Manning and Pischke 2006).

The main terminal qualification of compulsory education is known as the General Certificate of Secondary Education (GCSEs). These were introduced in 1988, replacing a similar qualification called O-Levels. GCSEs are taken at age 16, and good results are widely regarded as essential for progression to further study and employment.

Geography of Secondary Schooling

The relevant administrative area for education in England is called a local education authority (LEA). The boundaries of these LEAs correspond to the boundaries of local government in urban areas and some suburban areas, but in many rural/suburban areas several local authorities will be nested within an LEA. There have long been a variety of mechanisms by which

[18] This appendix draws on information recorded in the EU Eurydice database which provides detailed reports on national education systems for European countries. However, it is important to note that substantial reform to the English education system has occurred since the end of our study period in 2011. See in particular: https://eurydice .eacea.ec.europa.eu/national-education-systems/united-kingdom-england/secondary -and-post-secondary-non-tertiary

schools can opt out of local control (Machin and Vernoit 2011), but this was uncommon before 2011 (Eyles and Machin 2019).

School attendance does not have fixed boundaries like those in U.S. school districts, so children can attend schools outside their LEA (Gibbons et al. 2013). Parents can apply to any school. When schools are oversubscribed, they use a range of criteria used to determine entry, the most important of which is typically the distance from the family home to the school. Admissions policies do not generally allow selection directly on academic aptitude.

Pupils can receive free travel if they attend school more than three miles from their house, but there are no policies of deliberate desegregation. The average length of trips to school was 3.4 miles in 2014 in England (Department for Transport 2014). This has almost doubled since the 1980s (Easton and Ferrari 2015), but most of that increase was before the late 1990s (e.g., it was 2.9 miles in 1995–97). Over 75% of secondary school children travel less than five miles for school. By contrast, local authorities have an average area of 159 miles^2 and about 79% of local authorities are larger than 25 miles^2, which implies that most children will attend a school within their local authority.

League Tables

The U.K.'s Department for Education produces league tables—national rankings of almost every school in England—based on GCSE results from the previous academic year. They were introduced by the Education Reform Acts of 1988 and 1992 as part of an attempt to increase educational choice for parents and create markets in education. This effort to quantify quality was made possible by other concurrent changes, such as the creation of a national curriculum to be taught in almost all schools, additional standardized testing, and a new school inspection regime. These reforms would, if anything, be expected to reduce disparities between areas, and there has indeed been a reduction in geographical disparities in performance at GCSE level since then (see fig. 3 above).

The league tables report a number of indicators and some of these indicators have changed somewhat over time. We use the indicator that was most salient during the period of our study—the percentage of students in a given school achieving five or more A*–C grades (where A* denotes the highest achievement) for the GCSE. Students typically take GCSEs in at least five subjects. Grades of C or better were often regarded by governments as a benchmark for good performance (West 2010; West and Pennell 2000).[19]

[19] The grading system for GCSEs, and the content of league tables, was overhauled in a set of reforms from around 2017 onward. As a result, contemporary league tables no longer present the indicator we use. It has been replaced with various alternate measures of attainment at the GCSE level.

Value-added indicators were experimented with (as a supplementary indicator) toward the end of our study period (after 2001). These have frequently been updated and lack comparability with earlier periods and with each other. More importantly, value-added measures received far less attention from the national media, parents, and schools (Wilson, Croxson, and Atkinson 2006). League tables were widely discussed in national and local newspapers. They were published in four major national newspapers beginning in 1992 (the *Times*, *Telegraph*, the *Independent*, and the *Guardian*), and they were freely available in all public libraries (West and Pennell 2000). Since the internet has become widely available league tables are published online.

Funding for Schools

Across our study period the vast majority of funding for secondary schools in England ultimately comes from general taxation collected by the central government, rather than from local taxes. Over the period of our study, the role played by LEAs in distributing school funding has varied somewhat. While they are generally responsible for distributing funding received from central government to individual schools, some schools have always been funded directly by central government. There have always been constraints on LEA control of school funding, with spending on areas such as teacher salaries, and free school meals for children from low-income families set nationally.

The process of education reform set in motion by the Education Reform Act of 1988 further reduced local control of school funding by introducing formulas for LEAs to follow when allocating funding to schools (Levacic 1993; Sibieta 2015).[20] The precise formulas have varied over time and between LEAs, but the largest component has always been based on pupil numbers. Furthermore, across the late 1990s and 2000s, funding formulas, and additional grants from central government, were specifically designed to target additional funding to schools with deprived intakes and additional educational needs.

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[20] For example, details of the current funding formula can be found here: https://www.gov.uk/topic/schools-colleges-childrens-services/school-college-funding-finance

APPENDIX B

Descriptive Statistics

TABLE A1
DESCRIPTIVE STATISTICS FOR ALL VARIABLES IN STUDY 1

	Mean	SD	Min	Max
Change in professional-managerial share	.07	.07	−.06	.27
Change in semiroutine/routine share	−.05	.04	−.19	.02
Lagged professional-managerial share	.33	.10	.13	.67
Lagged semiroutine/routine share	.31	.08	.11	.51
School performance	.57	.12	.24	.87
Change in % born in U.K.	−.03	.03	−.19	.05
Change in % unemployed	−.01	.02	−.07	.03
Change in % social housing	−.02	.02	−.14	.01
Change in % employed manufacturing	−.04	.03	−.14	.12
Change in log population density	.07	.05	−.10	.29
Logged gross disposable income	9.51	.23	8.91	10.61
Selective schools in area	.20	.40	.00	1.00

NOTE.—$N = 640$ for all variables. School performance data are % of children in a local authority achieving 5+ A*–C grades at GCSE over the periods $1994−2000$ and $2002−11$. Class composition and socioeconomic covariates from the 1991–2011 censuses, school performance, and selectivity data are from the DfE; gross disposable income is from Nomisweb.

TABLE A2
DESCRIPTIVE STATISTICS FOR ALL VARIABLES IN STUDY 2

Variable	Mean	SD	Min	Max
Response variable:				
Average school performance at $t + 1$	55.92	7.37	38.06	77.49
Explanatory variable:				
Year:				
1981	.33			
1991	.36			
2001	.32			
Occupational class (3 category NSSEC):				
Semiroutine and routine	.33			
Lower technical and supervisory, self-employed/own				
account, and intermediate	.25			
Professional-managerial	.42			
Children present in household at t or $t + 1$:				
No	.34			
Yes	.66			
Demographic covariates:				
Housing tenure:				
Owner occupier	.74			
Social renter	.17			
Private renter	.09			
Age group:				
20–24	.13			
25–29	.16			

Variable	Mean	SD	Min	Max
30–34	.18			
35–39	.18			
40–44	.17			
45–50	.19			
Gender:				
Male	.49			
Female	.51			
Household structure and work status:				
Single: working	.24			
Single: unemployed	.02			
Single: not in labor force	.02			
Couple: both working	.46			
Couple: one working, one unemployed	.03			
Couple: one working, one looking after home	.19			
Couple: one working, one not in labor force	.02			
Couple: one unemployed, one looking after home ..	.02			
Couple: one unemployed, one not in labor force	.00			
Couple: both unemployed	.00			
Couple: both not in labor force	.01			
Born in U.K.:				
Yes	.91			
No	.09			
Degree education:				
No	.86			
Yes	.14			
Ethnicity:				
White	.93			
Black	.01			
Asian	.04			
Chinese	.00			
Mixed	.00			
Other	.00			
Overcrowding: persons per room:				
< .5	.25			
≥.5 to <1	.61			
≥1 to <1.5	.13			
> 1.5	.01			
Will move local authority between t and $t + 1$:				
No	.77			
Yes	.23			
Area-level covariates:				
% professional-managerial at $t + 1$	42.70	9.41	18.78	71.77
% professional-managerial at t	37.83	10.12	14.70	70.10
% unemployed	4.69	2.05	1.53	14.29
% social renter	22.75	11.39	5.04	86.67
% employed in manufacturing	26.37	16.86	5.15	84.87
Logged population density	6.75	1.34	2.98	9.48

Note.—Total sample size = 499,973 for all variables. Individual-level data from ONS Longitudinal Study 1981–2011, with local authority–level data on school performance from the DfE, and area-level demographic covariates from 1981–2011 censuses. Authors' calculations.

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