Journal of Urban Economics 75 (2013) 15–28

Contents lists available at SciVerse ScienceDirect

Journal of Urban Economics

www.elsevier.com/locate/jue

Valuing school quality using boundary discontinuities

Stephen Gibbons [a], Stephen Machin [b], Olmo Silva [a,*]

[a] Department of Geography and Environment and Centre for Economic Performance, London School of Economics, UK
[b] Department of Economics, University College London and Centre for Economic Performance, London School of Economics, UK

ARTICLE INFO

Article history:
Received 28 March 2012
Revised 2 November 2012
Available online 16 November 2012

JEL classification:
C21
I20
H75
R21

Keywords:
House prices
School quality
Boundary discontinuities

ABSTRACT

Existing research shows that house prices respond to local school quality as measured by average test scores. However, higher test scores could signal higher academic value-added or higher ability, more sought-after intakes. In our research, we show that both school value-added and student prior achievement – linked to the background of children in schools – affect households' demand for education. In order to identify these effects, we improve the boundary discontinuity regression methodology by matching identical properties across admissions authority boundaries; by allowing for boundary effects and spatial trends; by re-weighting our data towards transactions that are closest to district boundaries; by eliminating boundaries that coincide with major geographical features; and by submitting our estimates to a number of novel falsification tests. Our results survive this battery of tests and show that a one-standard deviation change in either school average value-added or prior achievement raises prices by around 3%.

1. Introduction

Good schooling is frequently upheld as decisive in life, but empirical evidence remains quite ambiguous when it comes to pinning down what makes a 'good' school and what people value in education. Parents making school choices seem well aware of their preferences and go to great lengths to secure places for their children at their preferred schools. However, social scientists have had mixed success in eliciting general conclusions about the nature of these preferences.

Researchers in education have regularly used survey responses to learn about preferences for schools (e.g. Coldron and Boulton, 1991; Flatley et al., 2001; Schneider and Buckley, 2002). The evidence from this field shows that parents rank academic outcomes highly among the reasons for choosing a school, but other factors play an important role, such as distance from home, school composition, safety and wellbeing. More recently, parents' actual choices of schools and teachers have been used as an alternative way to uncover preferences for school attributes (e.g. Hastings et al., 2005; Jacob and Lefgren, 2007).

Apart from these examples, other research has looked for evidence of the value of schools in the capitalisation of their benefits into housing prices – i.e. using the hedonic valuation method. This wide-ranging international literature has shown that the demand for school quality is at least partly revealed in housing prices whenever school places are assigned to neighbouring homes. Gibbons and Machin (2008), Black and Machin (2010), Nguyen-Hoang and Yinger (2011) and Machin (2011) provide summaries of recent evidence, all suggesting a consensus estimate of around 3–4% house price premium for one standard deviation increase in school average test scores.

One limitation of previous work is that – with a few exceptions – it is confined to showing that prices follow headline school performance as measured by school average test scores. However, better test scores could occur through improvements in enrolment quality or through greater pupil progress – potentially driven by teaching quality, school resources, peer effects and school effectiveness. One possibility is that parents pay for school 'value-added' that represents the expected academic *gains* for their children. A second possibility is that parents pay for good peers and favourable school composition – i.e. school inputs – irrespective of the contribution of these factors to their own child's achievements.[1] While the first perspective is interesting from a policy point

* Corresponding author. Address: Department of Geography and Environment, London School of Economics, Houghton Street, London WC2A 2AE, UK.
E-mail address: o.silva@lse.ac.uk (O. Silva).

[1] Kramarz et al. (2009) provide empirical tests of the relative importance of pupil, school and peer effects in determining test scores. Their findings suggest that a large part of the variation in test scores is explained by pupil attributes, followed by school quality differentials, while peers' characteristics matter less. This is consistent with Gibbons and Telhaj (2008), Lavy et al. (2012) and most other studies of peer effects.

0094-1190/$ - see front matter © 2012 Elsevier Inc. All rights reserved.
http://dx.doi.org/10.1016/j.jue.2012.11.001

of view because it puts a price on interventions that raise academic standards, the second one is relevant because of its implications for school segregation (e.g. Epple and Romano, 2000).

A handful of papers have taken steps to disentangle these two channels of influence. Brasington and Haurin's (2006) results show that that school value-added and initial achievements both have positive effects on prices, although this point is somewhat lost in their conclusions. Kane et al. (2005) also consider value-added and average test scores as alternative indicators of school performance. However, they do not present specifications that include both indicators and do not aim to provide evidence on the importance of value-added. In contrast, Clapp et al. (2008) show that pupil ethnicity seems more important than test scores to home buyers around Connecticut schools, although the authors do not have access to data on pupils' academic progress.

Other papers have looked at the importance of school expenditure relative to test score outputs. For example, Downes and Zabel (2002) find that test scores are capitalised into local house prices, whereas measures of school expenditures are not. Cellini et al. (2010) use referenda outcomes in California's school finance system to suggest that house prices respond to the level of capital expenditure per pupil and that this cannot be fully explained by changes in test scores. Occasionally other school attributes have been considered. For example, Figlio and Lucas (2004) find that state-assigned school ratings have a transient effect on prices, over and above test scores, suggesting that householders draw additional information about achievement from these grades, or else value the ratings in their own right. Finally, Gibbons and Machin (2006) suggest that popularity in itself raises prices, given that over-capacity schools command an additional premium relative to under-capacity schools with equal performance.

Our paper moves this literature forward in a number of important ways. Our first contribution is to use a convincing strategy to show that house prices respond causally to school age-7 to age-11 test score gains (value-added), indicating that parents value school educational output. Our results suggest that parents also value the average age-7 test score component of this value-added measure, which we interpret as a marker for students' background characteristics. We argue that this result arises from parental demand for good school composition, rather than demand for school quality in the early years, even if school composition is not a productive input in the educational production function. This interpretation is supported by further evidence showing that the price effects from age-7 achievements are completely explained by students' background characteristics, especially their eligibility for free meals (a proxy for low family income).

Our second contribution is to further refine, improve and test the boundary discontinuity regression method, which is the 'state-of-the-art' approach used in this field to mitigate potential biases induced by neighbourhood unobservables. We present several innovations and refinements, which can be summarised as follows: (a) We combine matching methods with the regression-discontinuity design to allow for flexibility in the way in which housing observables affect price differentials across boundaries; (b) We incorporate in our models a variety of boundary fixed effects and spatial trends to account semi-parametrically for between-district unobserved heterogeneity and trends in amenities across boundaries; (c) We inverse-distance weight our regressions such that identification comes from variation at the admission zone boundaries where neighbourhood heterogeneity is minimised; this refines previous studies which used samples restricted to fixed buffer-zones close to boundaries (e.g. 1/4 mile); (e) We perform a number of falsification exercises and a compelling placebo test which uses the quality of autonomous state schools that do *not* admit on the basis of residential location, but administer the same standard tests as the mainstream schools that prioritise admission on place of residence.

A final advantage of our work is that we establish these findings using large scale administrative data for the whole of England, and not just for one city (e.g. Boston or San Francisco) as done by much of the previous research. The size and coverage of our data makes the above strategies feasible and the findings more representative.

To preview our results, we find that a one-standard deviation change in either age-7 to age-11 school average value-added or prior (age 7) achievement raises prices by around 3% for schools that prioritise students who live close by. Conversely, we show that there is no house price premium attached to properties close to high quality schools that do *not* prioritise local students. This finding – alongside other falsification exercises – demonstrates that our findings are causal and not spurious.[2] Finally, various back-of-the envelope calculations show that the magnitude of this house price response to school quality is plausible as a parental investment decision given the expected return in terms of future earnings of their children.

The remainder of the paper has the following structure. Section 2 explains our methods. Section 3 discusses the context in which we apply our approach and the data setup. Section 4 presents our results and discussion. Finally, Section 5 concludes.

2. Empirical strategy

2.1. Methodological framework

Our empirical work uses a geographical boundary-based regression discontinuity design. This approach was initially popularised by the work of Black (1999), with several more recent examples (e.g. Bogart and Cromwell, 2000; Gibbons and Machin, 2003, 2006; Bayer and McMillan, 2005; Kane et al., 2005; Davidoff and Leigh, 2006; Fack and Grenet, 2010; Bayer et al., 2007; Ries and Somerville, 2010). Closely related studies investigate the effects of local taxes (Cushing, 1984; Duranton et al., 2006; Holmes, 1998) and market access when there are changes in national borders and their permeability (Redding and Sturm, 2008; Hanson, 2004).

The standard hedonic property value model (Sheppard, 1999) represents property market prices (usually log prices) as a linear combination of observable property attributes and the implicit market price of these attributes. The implicit prices can be estimated by standard least squares regression techniques, but researchers usually do not observe all salient property and neighbourhood characteristics, leading to omitted variable biases. This problem is particularly acute for amenities – e.g. school performance – that depend on the distribution of characteristics in the local population, and hence on sorting in relation to unobserved area effects.

A way to mitigate this problem is to difference the data between close-neighbouring houses to eliminate area-specific unobservables, but this strategy only works for school quality if there is a sharp discontinuity in its supply between close-neighbouring homes. This condition holds when admissions involve contiguous pre-defined admission zones such that residents on each side of the boundary have access to different sets of schools. Regression specifications can then include attendance district boundary dummy variables, or be estimated on data that is differenced between matched pairs of neighbouring houses on either side of

[2] Note that this is different from the exercise of Fack and Grenet (2010), who show that house prices respond less to the quality of local non-autonomous schools if there are autonomous schools in the area. The authors cannot perform a similar falsification test because their autonomous schools are private schools and are not ranked using comparable performance tables as state schools (unlike ours).