



# The impact of uncertainty on school quality capitalization using the border method

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## ABSTRACT

Hedonic valuation methods are commonly used to measure school quality capitalization to assess the value of school reforms and gain insight into how households choose schools and neighborhoods. These methods rely on observed school quality as a proxy for future school quality, but often ignore the potential for changes in people's expectations of future school quality. In particular, the border method is commonly used to measure school quality capitalization, as it differences out unobserved neighborhood characteristics that may be spatially correlated with school quality. However, it may produce estimates that are biased downwards since it relies on home sales near school borders, where residents' expectations of future school assignment may be different from contemporary expected school quality in the interior. I use 22,604 homes sales in DeKalb County, Georgia that occurred between 2003 and 2012 to investigate if information about potential school reassignment biases border method estimates downward. During this time, the school system sent differential signals to residents regarding their future school quality by announcing potential areas for reassignment long before the approval of final plans. Exploiting the variation between certain and uncertain borders, I find evidence that school assignment uncertainty reduces capitalization of school quality. The results provide evidence that residents' expectations of future school assignment are important factors contributing to the degree of school quality capitalization and suggest that future research should consider factors that influence people's expectations of school quality.

## 1. Introduction

Economists are interested in studying people's preferences for school characteristics such as academic quality and student body composition to assess the value of school reforms and to understand how households choose schools and neighborhoods. Two methodological strategies have emerged to study people's preferences for school attributes. The first strategy examines parents' school choice behavior when parents are given the option to choose which inputs enter into their children's education production function (Hastings et al., 2008; Burgess et al., 2015; Rothstein, 2006; Jacob and Lefgren, 2007). Empirical results indicate that parents have strong preferences for academic quality, socio-demographic composition and school proximity; however, studies also find significant variation in preferences across income levels (Hastings et al., 2008; Burgess et al., 2015). The second strategy employs hedonic valuation methods to examine the capitalization of school attributes into housing prices. The capitalization of school quality is well studied, and the general consensus is that people are willing to pay more for higher academic quality (Ross and Yinger, 1999; Nguyen-Hoang and Yinger, 2011). Empirical research using hedonic valuation methods has

also shown that measures of student body composition are capitalized into home sale prices (Clapp et al., 2008; Zahirovic-Herbert and Turnbull, 2009; Turnbull et al., 2017).

The standard approach for studying school quality capitalization is to use cross-sectional hedonics, which relates school quality measures to home sale prices; however, one concern with the standard approach is that omitted variables that are correlated in space with school quality bias estimates upwards. There are two solutions to correct for the omitted variables problem in the literature. The first approach assumes unobservables are constant across time and studies areas that experienced a recent change in school assignment. School quality is identified off differences in housing prices before and after reassignment, which cancels out unobserved neighborhood influences (Zahirovic-Herbert and Turnbull 2008, 2009). The second approach, the border method or boundary discontinuity design, uses neighborhood fixed effects encompassing both sides of school attendance zone border to control for unobservable neighborhood variables (Gill, 1983; Cushing, 1984; Black, 1999; Bayer et al., 2007; Dhar and Ross, 2012; Gibbons et al., 2013).

The border method assumes that unobserved attributes vary smoothly across space so that small neighborhoods around attendance zone

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boundaries have similar unobservable factors despite being located in separate school attendance zones. The inclusion of neighborhood fixed effects controls for the unobservable factors and school quality capitalization is identified off cross-border differences in school quality. Estimates using the border method are lower than estimates from standard cross sectional specifications, and the explanation is that the omitted variables are inflating estimates (Black, 1999; Bayer et al., 2007). An alternative explanation for the reduction in the magnitude of estimates is that people near attendance zone boundaries are less certain about their future school assignment, which leads to lower estimates since people near the border are discounting cross-border differences in school quality (Cheshire and Sheppard, 2004; Zahirovic-Herbert and Turnbull, 2008). Essentially, the border method may introduce a form of measurement error in school quality by focusing exclusively on those neighborhoods where perceived future school quality may be different from contemporary school quality observed in the interior. In this case, the border method would be biasing estimates downward, rather than correcting for the upward bias of unobservable factors.

The degree to which the border method estimates are biased downwards may depend on people's expectations of future border changes. Estimates across borders that people expect to remain relatively stable over time such as U.S. state, U.S. county and school district boundaries are potentially less influenced by uncertainty. For example, Dhar and Ross (2012) use school district boundaries to study the capitalization of school quality and cite that school district boundaries are subject to less uncertainty due to infrequent changes. Conversely, estimates across borders that people expect to change, such as school attendance zone borders, are potentially influenced more by uncertainty. School attendance zone boundaries may be subject to frequent changes as school districts adjust attendance zones to accommodate population changes. School districts experiencing population growth may increase enrollment capacity by opening new schools and redrawing attendance zones. School districts experiencing population decline may close schools and redraw or consolidate attendance zones to reduce costs. In either situation, residents in school districts with changing population demographics may expect periodic changes to school attendance zone borders.

Previous research links people's expectations of school quality to the degree of school quality capitalization. Cheshire and Sheppard (2004) observe that school quality is strongly discounted in areas where new home construction is concentrated and conclude that the source of the discount is people's expectations of future school reassignment due to expected increases in population. Turbnull et al. (2017) employs a theoretical model of urban consumer theory to demonstrate that school attendance zone instability decreases home sale prices, and empirically demonstrates that school attendance zone instability has a negative impact on home sale prices. Additionally, Turbnull et al. (2017) identifies the periodic reassignment of homes due to changes in the spatial distribution of school aged children as a main source of school quality uncertainty.

This paper investigates the impact of people's expectations of future school reassignment on the magnitude of the border method's school quality capitalization estimates by taking advantage of a natural experiment in DeKalb County, Georgia in which the DeKalb County School District (DCSD) announced potential areas for reassignment long before the school board approved final plans. The time between the initial announcements, which includes both potential school closure lists and realignment proposals, and the approval of final plans, together with some ambiguity about which proposal would be implemented, represents a period where residents received differential signals regarding their future school assignment. I exploit the differential signals by using a difference-in-difference (DID) specification within a hedonic regression analysis framework to determine if the announcement of potential changes to school attendance zone borders altered people's expectations of future school quality thereby influencing school quality capitalization.

The research makes two empirical contributions to the literature. First, it examines the relationship between people's expectations of

school quality and the magnitude of school quality capitalization estimates. This relationship is important given the emphasis placed on school quality and school reforms by the public and local government officials. Second, it addresses one of the primary criticisms of the border method – that people living near school attendance zone borders discount cross border differences in school quality relative to homes in the interior. Since the border method is widely used to estimate school quality capitalization, the research provides insights into a potential source of attenuation bias in border method estimates.

The empirical results indicate that a 5% increase in a school's academic quality is associated with a 3.1–3.5% increase in home sale price; however, in the presence of school assignment uncertainty, a 5% increase in a school's academic quality is associated with a 2.3–2.7% increase in home sale price, which represents a 25–30% decline. Extensions of the analysis investigate the capitalization of peer quality and if there are differential impacts for parental valuation of academic quality across income levels. I find that parents value peer quality but the valuation of peer quality is attenuated in the presence of school assignment uncertainty. I also find that higher income neighborhoods exhibit stronger capitalization effects and are more sensitive to potential school reassignment relative to low income neighborhoods. The results indicate the people's expectations of future school quality influence the degree of school quality capitalization. Additionally, the results suggest that uncertainty at school attendance zone borders matter, and if we accept the premise that neighborhoods around the border are inherently more uncertain than neighborhoods in the interior, we can infer that the border method's estimated are biased downwards.

The remainder of the paper is organized as follows. Section 2 provides background information on the DCSD's two rounds of school attendance zone rezoning between 2003 and 2012. Section 3 describes the empirical specification, while Section 4 discusses the data. Section 5 presents the estimation results and Section 6 discusses extensions to the analysis. Finally, Section 7 concludes.

## 2. Historical background

Between 2003 and 2012 the DCSD experienced two prolonged periods of school assignment uncertainty during which residents received differential signals regarding their future school assignment. The DCSD transmitted the potential realignment signals through the naming of candidate schools for closure and the release of realignment proposal plans. Table 1 displays dates on which residents received information concerning potential school attendance zone realignments. The first period began in January 2003 when the DCSD announced 16 candidate schools for closure (Gentry, 2003) and ended on May 14, 2007 when the school board approved the Proposed Consolidation and Redistricting Plan. The second period began on February 19, 2010 when the DCSD named twenty-three different candidate schools for closure (Cribbs, 2010a) and ended on March 7, 2011 when the DCSD approved the 2020 Redistricting and Consolidation Plan. During the second period, the DCSD fueled additional uncertainty by releasing five different realignment proposals, each of which designated different areas for reassignment.

The DCSD's selection of candidate schools was guided by Georgia's Quality Basic Education Act of 1985 (QBEA), which defined formulas for providing state funding to public school. Specifically, the QBEA states that elementary schools with less than 450 enrolled students are not eligible to receive state funds (Quality Basic Education Act. S. o. Georgia. 20-2). When faced with declining funding for public schools, the QBEA gave the DCSD financial incentives to redraw attendance zone boundaries to ensure school enrollment levels exceeded the 450 student threshold. The DCSD accomplished this goal by closing schools with low student capacity or enrollment levels are reassigning those students to nearby, underutilized schools. Table 3, which is discussed in Section 4.3, presents a difference in means test for total school enrollment for candidate and non-candidate schools. The average enrollment for a

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