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The effect of educational test scores on house prices in a model with spatial dependence ☆

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ABSTRACT

The hedonic modeling literature is rich with analyses of the importance of public school quality on real estate markets. In this paper, spatial dependency is incorporated in a hedonic model based on housing, neighborhood, demographic, and school quality attributes readily available on the Internet for home sales in Howard County, Maryland. The importance of using readily available measures is that perceptions in the public are formed by them. The study also addresses potential omitted variable bias by incorporating school assessment measures over the K-12 grade range. The consideration of spatial dependency in hedonic models is imperative since the findings are sensitive to appropriately modeling the spatial component of home prices. The results indicate that there is consistent and significant evidence of the capitalization of 8th grade test scores and SAT scores in home prices, and inconsistent evidence of the capitalization of 3rd grade test scores. The elasticities of house price with respect to test scores are all in the inelastic range and smaller than those found in other studies. This study provides clear guidance on how to test for spatial heterogeneity and non-normality of error terms before proceeding with hedonic analysis.

1. Introduction

A familiar real estate adage is that "location, location, and location" are the three most important determinants of house prices. Public school quality is perceived as being one of the crucial factors underlying location (Ferrechio, 2002; Max, 2004). If prices are influenced by buyer and seller quality perceptions, the use of input measures when output measures are difficult to obtain may be necessary. Thus, early approaches for incorporating school quality focused on input measures such as school expenditures, expenditures per student, and student–teacher ratios. Rosen and Fullerton (1977) criticized the use of inputs and suggested that output measures such as proficiency scores are more appropriate measures of quality. Most recent work is consistent with Rosen and Fullerton's critique and employs proficiency test scores. The formation of buyer and seller perceptions of school quality based on proficiency scores is a reasonable supposition given the broad discussion of educational assessment and outcomes in the public forum. The outcome assessment measures show considerable variation both within and across school districts.

This study investigates the impact of intra-school district variation in assessment measures on house prices using a hedonic pricing model testing for spatial dependence.[2] By analyzing the impact within a single countywide

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[2] Explaining the reasons for this variation within the school district is not the purpose of this paper. However, it may be due to differences in parental and student inputs or due to differences in production functions across schools given the distribution in the teacher quality.

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school system, control variables for educational expenditures per student and other educational inputs are not needed. The study uses data on 3164 home sales in Howard County, Maryland in 2002. The perceived quality of the school addresses one location attribute of the home and is measured by passage rates on the Maryland State Performance Assessment Program (MSPAP), a series of tests given to all students in the elementary and middle schools. MSPAP measures how well a student performs on the basics, critical thinking, and problem solving skills. At the high school, the mean SAT score is used as an alternative measure of school quality. While different percentages of students at each high school may take the SAT, selection bias is not an issue since the perception of school quality, the variable of interest, is influenced by the publicly available and reported scores. The incorporation of assessment scores for all levels, the primary grades, middle school, and high school addresses potential omitted variable bias in prior studies.[3]

The specification of the hedonic pricing model also incorporates publicly and readily available specific characteristics of the social environment with specific emphasis on location and housing characteristics. As consumers increasingly utilize the Internet to search for information on their purchases, the incorporation of variables in the hedonic model that are accessible to the public is desirable. The advantage of the school quality and crime level variables in this study is that both are readily available on the Internet for buyers to consider before buying a house. Similar to the control for school input measures, measures of the provision of social services, such as fire and police, are not necessary in our model as these services are provided by the county as a single tax entity. The standard deviation of test scores intra-district is quite small compared to inter-district studies. Our findings demonstrate a significant impact of small variations in test scores on housing prices. The price elasticities with respect to school test scores found in this study are also smaller than those computed in other studies and indicate that there may be less capitalization of school quality in housing prices than anticipated. In any event, the very low cost of finding data to make comparisons within a school district suggests that homebuyers can afford to be very discriminating in terms of assessing school quality when purchasing a home.

When assessing the impact of school quality on home prices, it is important to test for spatial dependence and carefully specify spatial econometric models when the evidence suggests they are warranted. This study provides clear guidance on how to test for spatial heterogeneity and non-normality of error terms before proceeding with hedonic analysis. The analysis herein is initially performed with OLS regression on the hedonic pricing model, and Moran's I (Moran, 1948) and Geary's C (Geary, 1954), are used to test for spatial autocorrelation. The results indicate that spatial autocorrelation is present, and the hedonic pricing model is expanded to include the spatial structure using two alternative model specifications. Our detection of spatial dependence is in agreement with Bowen et al. (2002), and highlights the need to include carefully crafted spatial testing in all modeling of attributes of house prices using hedonic regression. Results are shown to be sensitive to spatial model specification. This implies that careful diagnostic testing is necessary to specify the model correctly.

The paper is organized as follows: Section 2 provides a review of the literature that is relevant to our thesis, and the hedonic model is presented in Section 3. In Sections 4 and 5, the data set is described and the construction of the spatial variables explained, respectively. Section 6 develops the estimation process and Section 7 reviews the results. Section 8 concludes the paper.

2. Literature review

Hedonic housing price studies have not always incorporated school quality variables (see, for instance, Benjamin and Sirmans, 1996 or Des Rosiers and Theriault, 1996), but there is now a growing literature focusing on which school quality variables to include. Early approaches for including school quality focused on input measures such as school expenditures (Oates, 1969), expenditures per student (e.g., Sonstelie and Portney, 1980), and student–teacher ratios (e.g., Harrison and Rubinfeld, 1978). Rosen and Fullerton (1977) criticized the use of inputs and suggested the use of proficiency scores since output measures are more appropriate measures of quality. Soon thereafter, Li and Brown (1980) found that fourth graders' test scores have a positive and significant effect on housing prices in Boston. In a larger study, Haurin and Brasington (1996) found that school quality, measured by the pass rate of ninth grade students on a statewide proficiency exam, is the most important explanatory variable in the variation of house prices among communities in the six largest Ohio metropolitan areas. Hayes and Taylor (1996) obtained similar results using sixth grade standardized mathematics test scores in Dallas, Texas. Weimer and Wolkoff (2001) validated the importance of elementary school outputs in Monroe County, New York, while controlling for student body composition.

Most recent work is consistent with Rosen and Fullerton's critique and employ proficiency tests (see, for instance, Brasington, 1999 or Goodman and Thibodeau, 1998), but a fourth measure, value-added, has also been tested in the literature. This approach looks at the change in outcome measures over time. Hayes and Taylor (1996) and Brasington (1999, 2006) compare value-added measures of school quality with outcomes measures, among other comparisons. Hayes and Taylor claim that only value-added measures are critical, while Brasington's results indicate that housing values are impacted by proficiency test passage rates and expenditures per pupil but not value-added by school districts. Downes and Zabel (2002) argue that the school quality variable that households value is the relevant measure and find that the housing market

[3] Magnet schools are available in Howard County for middle and high school. However, the competitive entry requirements imply that parents may be concerned with the quality of the middle and high schools in their neighborhood. If parents of potential magnet students place less emphasis on middle and high school quality, one may find that the capitalization of elementary school quality is more important. Furthermore, school quality at all levels if capitalized also impacts resale values.