Regional Science and Urban Economics 39 (2009) 523–529

Contents lists available at ScienceDirect

Regional Science and Urban Economics

journal homepage: www.elsevier.com/locate/regec

Parents, peers, or school inputs: Which components of school outcomes are capitalized into house value?

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ARTICLE INFO

Article history:
Received 3 July 2006
Received in revised form 26 December 2007
Accepted 5 May 2009
Available online 23 May 2009

JEL Classifications:
I2
N3
R21

Keywords:
House prices
Hedonic model
Capitalization
School quality
Peer effects
Parental inputs

ABSTRACT

Previous research has established that people bid more for houses in high-performing school districts. But what specific factors related to school outcomes influence house prices: the parents, the peers, or the school inputs? We study the extent that house values are affected by each of the components of an education production function. Based on 123 school districts and 26,000 house transactions, we find that parental inputs are the primary component of school outcomes that are capitalized into house prices. In the explanation of variations in house prices, variations in parental characteristics are at least seven times more important than similar variations in the influence of peer groups. We find no influence on house prices from variations in school inputs. This result suggests that land values in a particular community will be increased more by attention to zoning laws that influence the mix of renters to homeowners and the type of households entering a community compared to investing in additional public school inputs.

1. Introduction

A large body of evidence suggests that local public school outcomes are among the most highly valued of local amenities. Also, it is clear that within metropolitan areas the spatial variation in public school outcomes is large. This research has established that spatial variations in school outcomes often are capitalized into house prices, and thus variations in school quality often have been found to be one of the largest contributing components of spatial variations in house prices.

House values are of interest to multiple groups including city leaders and landowners. There is substantial potential for the capitalization of school quality variations to affect many U.S. households. In the fourth quarter of 2008, 67.5% of U.S. households were homeowners, and there were nearly 75.5 million owner-occupied housing units (U.S. HUD, 2009). Thus, spatial variations in school outcomes likely have a substantial impact on household wealth. However, school outcomes are not simply a function of the quantity of a school's inputs. Rather, they depend on parental inputs and peer group effects as well. Thus, city leaders and landowners should be interested in the relative contributions of the components contributing to educational outcomes.

We study whether house values are affected by the quantity of purchased school inputs, by students' peer groups, or by the level of parental inputs. Based on our study of 123 school districts and 26,000 house transactions, we find the most significant component of school outcomes that is capitalized into house prices is the level of parental inputs. All else constant, a two standard deviation change in parental inputs is associated with a 14% increase in house value. The parent component of school quality is seven times as important to house prices as the peer group component. Variations in purchased inputs across school districts have little impact on student performance and we find, correspondingly, that they have no effect on house prices.

A prediction derived from this finding is that homeowners, landowners, and perhaps community leaders will be more interested in controlling who enters their community rather than the amount invested in public school inputs. The mechanism of control would be through exclusionary zoning, which can influence the ratio of homeowners to renters and the type of households entering a community.

2. Literature

Rosen and Fullerton (1977) were among the first to use proficiency test scores as a measure of schooling outcomes. Subsequent research

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doi:10.1016/j.regsciurbeco.2009.05.002

generally uses K-12 student achievement measures in studies of house value capitalization and these studies almost always find that higher scores are positively correlated with house prices.[1]

An alternative measure of school outcomes that may be valued by households is the value-added of a school (Hayes and Taylor, 1996). However, a recent study by Brasington and Haurin (2006) finds no support for this hypothesis, nor do studies by Brasington (1999) or Downes and Zabel (2002). Their argument is that the market valuation of school outcomes is determined by the information available to households, and the most easily observed school outcome is proficiency test scores. The value added of a school is much more difficult to measure and observe.

Another large literature relevant for our study reports research about the production function for education. Studies in this area generally find that variations in school inputs and expenditures per pupil tend to have little effect on student outcomes (Hanushek, 1986, 1997). Instead, parental inputs are found to be the dominant factor in determining K-12 academic outcomes with the impact of peer group effects being smaller (Zimmer and Toma, 2000).[2] Parental inputs to school outcomes include the amount of time spent with their children in activities that are educational and also the provision of educational materials to their children. These materials include various types of books and workbooks, purchased educationally oriented pre-school or after-school activities, and the set of constraints set by parents for their children (for example, the amount and content of children's television viewing, amount of time set aside for study, etc.). Peer effects cover a wide range of possible influences of other children upon a particular child, his or her activities, behaviors, and attitudes. O'Sullivan (2006, p. 176) defines peer effects as follows: "A student learns more when he or she is surrounded by fellow students who are smart, motivated, and not disruptive."

3. House prices and K-12 public school outcomes with peer group effects

Our model assumes that house prices reflect the market values of structural attributes of housing, neighborhood characteristics, and aspects of a community's K-12 public education (Rosen, 1974). Thus house prices are:

$$\ln H_{ij} = c_{H0} + c_{HX}X_{ij} + c_{HA}A_j + c_{HN}N_j \quad (1)$$

where $\ln H_{ij}$ is the natural logarithm of house value for the i-th house and household in the j-th school district, X_{ij} represents house and neighborhood characteristics, A_j is the set of educational outcomes that are valued by households, and N_j are aggregated characteristics of the residents of the community.

Public school outputs such as academic achievement (A_{ij}) are produced by an education production function where inputs include parental inputs (P_i), school inputs (S_j), and peer effects (R_j). We assume the production function's form is additively separable, implying that parental inputs have the same impact on attainment no matter which school district is selected.[3]

$$A_{ij} = a_{A0} + a_{AP}P_i + a_{AS}S_j + a_{AR}R_j \quad (2)$$

When a household selects a school district, the set of peers in the district is exogenous, thus peers take on the attribute of a district-specific fixed effect.

Testing the hedonic price model requires observations of house prices, house and neighborhood characteristics, and a school district's educational outcomes, inputs, and peer effects. While our data set reports individual house prices and characteristics, we have only district-wide aggregated data on student outcomes, parent characteristics, and school inputs. Aggregating the educational production function to the district level implies:

$$A_j = a_{A0} + a_{AP}P_j + a_{AS}S_j + a_{AR}R_j + \varepsilon_j \quad (3)$$

where A_j is average student achievement, P_j is the average of parental inputs, and the error term represents unobserved factors affecting achievement.[4]

To test for the impact of the components of school outcomes on house values, we include them in the house value Eq. (1):

$$H_{ij} = c_{H0} + c_{HX}X_{ij} + c_{HP}P_j^* + c_{HS}S_j^* + c_{HR}R_j^* + c_{HN}N_j + \eta_{ij}. \quad (4)$$

The variables P_j^*, S_j^*, and R_j^* represent measures of the impact of P_j, S_j, and R_j on student achievement. That is, $P_j^* = \hat{a}_{AP}P_j$, $S_j^* = \hat{a}_{AS}S_j$, and $R_j^* = \hat{a}_{AR}R_j$.

Peer effects are difficult to observe but if R and R^* are omitted from (3) and (4) the remaining coefficients may be biased. The consequences are twofold. First, the expected values of the coefficients of P and S in the education production function when R is omitted are biased; specifically, $E(\hat{a}_{AS}) = a_{AS} + a_{AR}\, d_{RS}$ and $E(\hat{a}_{AP}) = a_{AP} + a_{AR}\, d_{RP}$ (Kmenta, 1986: 450). It is plausible that $a_{AR} > 0$, $d_{RS} > 0$, and $d_{RP} \geq 0$, implying upward bias in the coefficients of P and S in (3). This bias causes measurement errors in P^* and S^*, the key variables in the hedonic house price equation, because these variables are multiplied by the biased â coefficients. However, these measurement errors are the same multiple for all observations in the sample as only the coefficients $\hat{a}_{AS}$ and $\hat{a}_{AP}$ are affected and thus the t-statistics of the coefficients of P^* and S^* in (4) are unaffected by the omission of peer effects from (3).

The implications of the omission of peer group effects from (4) for interpretation of the house value estimation are more serious. Peer group effects may be correlated with other factors explaining student achievement; specifically, with average parental characteristics or with a school district's purchased inputs. This statistical relationship can be described by:

$$R_j = d_{R0} + d_{RP}P_j + d_{RS}S_j + e_{Rj} \quad (5)$$

where R_j measures peer effects and e_R is a mean zero random error. Omitting peer effects in (4) implies the parental and school input coefficients are: $E(\hat{c}_{HS}) = c_{HS} + c_{HR}d_{RS}$ and $E(\hat{c}_{HP}) = c_{HP} + c_{HR}d_{RP}$. This bias causes a potentially serious problem for separating the impact of the components of school outcomes.

We address the issue of unobserved peer effects through the use of multiple observations of each district's educational outcome at the same point in time t. This approach is feasible because the school districts administered multiple tests during the same school year. Let n designate the n-th test score observation in district j, $n = 1,\ldots,N$. Instead of (3) we estimate:

$$A_{jn} = a_{A0} + a_{AP}P_j + a_{AS}S_j + \varepsilon_{jn}. \quad (6)$$

Because all of the observations occur at the same time, the values of P_j and S_j do not vary over n. We next substitute (5) into (3), yielding an

[1] Haurin and Brasington (1996) use the pass rate on a ninth grade statewide proficiency test to measure student achievement. Brasington (1999) uses several sections of a proficiency test and finds that higher test scores increase house values. Figlio and Lucas (2004) find that both proficiency test scores and state-assigned grades are capitalized, and Hite et al. (2001) find a university admissions-created school competitiveness index is capitalized into house prices.

[2] Peer effects in educational outcomes are found in Henderson, Mieszkowski, and Sauvageau (1978), Betts and Morell (1999), and Robertson and Symons (2003).

[3] Another influential factor is a student's innate ability, this unobservable. It is likely positively correlated with parental characteristics.

[4] We assume that children are distributed equally among households in the district.