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House prices and the provision of local public services: capitalization under school choice programs

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Abstract

While the theoretical public finance literature argues that house prices should be influenced by the demand for local public services, there is little direct evidence concerning changes in house prices when these services are altered. Previous empirical studies have relied on cross-sectional identification of the relationship between house prices and variables that may proxy for the perceived quality of local public services. This paper instead examines a policy change, the adoption of a public school choice program, to identify the capitalization effects associated with the diminished importance of school district boundaries. Using data from inter-district choice in Minnesota, I find that residential properties appreciate significantly in school districts where students are able to transfer to preferred school districts, whereas residential property values decline in districts that accept transfer students. These general equilibrium effects also influence school districts' local property tax revenues, mitigating the incentive for schools to improve in order to attract or retain students.

> "Most real estate agents and builders must be generally conversant with school districts' reputations and what types of programs are offered by which one.... A particular district in Minnesota doesn't have to be the deciding factor on choosing a home, however.

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> Minnesota is nationally known for its open-enrollment program, wherein students may apply to attend schools in districts outside of their home district anywhere in the state"
>
> Ingrid Sundstrom [27].

1. Introduction

Theoretical research in local public finance often incorporates the Tiebout [28] model, in which households incorporate local tax rates and the quality of local public services into their residential location decision. Given this model, one would expect general equilibrium effects from any policy change that alters the relationship between residences and the availability of public services. Theoretical studies of the impact of the adoption of school choice programs have used computable general equilibrium models to show that these programs may affect residential location decisions and house prices (e.g., Nechyba [19,20], Epple and Romano [10], Ferreyra [11]).[1] For example, Nechyba [19,20] incorporates the Tiebout model into simulations of the effects of private school vouchers by allowing for migration across school districts, changes in the local tax base through changes in housing prices, and changes in the local tax rates due to shifts in the median voter. Under Nechyba's model [19, p. 31] (which also incorporates perceived peer effects on the quality of schooling), a private school voucher program "increases school-based stratification while it decreases residential stratification." This decrease in residential stratification is due to individuals moving into less expensive communities and sending their children to private schools. Property values in these communities increase, leading to a greater local tax base and higher per pupil spending in the local public schools.

While these types of general equilibrium effects seem plausible, there has previously been little empirical evidence concerning whether they occur. This paper identifies the capitalization effects of one type of school choice program, inter-district open enrollment in Minnesota. The findings strongly support the idea that the establishment of a school choice program can influence house prices and property tax bases. Since the adoption of inter-district open enrollment weakens the link between local school quality and property values, house prices rise in relatively unpopular districts. Controlling for new construction and improvements, the average house price within a district is more than three percent greater in districts where the fraction of students who are able to transfer to preferred districts is one standard deviation above the average rate. Conversely, house prices are about three percent lower given a one standard deviation increase in the fraction of students who transfer into a district. These capitalization effects are not fully realized until about eight years after the start of statewide open enrollment.

These estimates contribute to the empirical literature on the price elasticity of housing with respect to the demand for schooling. While previous studies (e.g., Bogart and Cromwell [5], Black [4], Barrow [2], Downes and Zabel [9], Figlio and Lucas [12]) focus on specific inputs or outputs, the adoption of a school choice program allows parents to respond to whatever aspect of schools that matter to them. In addition, since the identifi-

[1] See Nechyba [21] for an excellent summary of studies which use general equilibrium simulation models to examine school finance and school choice policies.

cation comes from a policy change rather than cross-sectional comparisons, one need not worry that neighborhood effects confound school quality effects. Another unique aspect of this paper's analysis is the nature of the dependent variable. This paper uses longitudinal data that measures average changes in the market value of all types of housing in a district, and this data does not rely on survey responses. A final, important difference is that this paper measures the house price premium associated with *some* residents gaining increased satisfaction with their children's schooling, as opposed to previous studies that examine the premium when a house is actually located in an area with "better" schooling. Whether the capitalization effects estimated in this paper are smaller or larger than previous estimates largely depends on whether house prices are more responsive to the average level of perceived school quality enjoyed by district residents or to the highest level of perceived school quality enjoyed by residents.

These estimated capitalization effects also have important implications for the welfare consequences of school choice programs. Previously, the debate over school choice programs has mostly revolved around two points of contention: whether increased competition improves the productivity of public schools (e.g., Hoxby [15], Belfield and Levin [3], Hsieh and Urquiola [16]), and how expanded choices influence student sorting (e.g., Cullen et al. [7,8], Rothstein [24], Urquiola [29], Reback [23]) and thus influence student outcomes. However, if the adoption of a school choice program also affects property values, then this changes homeowners' wealth and alters the local property tax base of school districts. In states such as Minnesota where schools rely heavily on local property tax revenues, this paper's findings suggest that public school districts with moderate declines in enrollments due to choice programs may not suffer much financially. Therefore, school choice programs may only mildly punish school districts that were unpopular prior to the adoption of the program. In terms of households' welfare, this paper's findings loosely suggest an aggregate welfare gain as a result of expanded school choice. Unless the school choice program adversely affects school quality, or unless the distributional consequences are undesirable and irreversible, states may benefit from adopting similar programs.

2. Related literature

Early studies of the relationship between house prices and the perceived quality of public schooling rely on hedonic regressions using static measures of school quality. Oates [22] and others find evidence that, holding the local tax burden constant, property values are positively related to measures of the quality of available public schooling. However, there are several challenges in interpreting how the demand for schooling is capitalized into house prices. First, it is not obvious which school characteristics are the relevant independent variables, since it is unclear which characteristics parents value. Second, it is often difficult to separate neighborhood effects from school quality effects. Third, since only a subset of the housing stock is actually sold within a given time period, it may not be feasible to have house-level panel data with actual sale prices for a wide range of housing. Finally, depending on whether the analysis is conducted at the school level or the school district level, estimates may only capture the effects of inter-district or intra-district differences in school quality.

Rather than simply estimating cross-sectional, hedonic regressions, authors have recently used a variety of techniques to attempt to separate neighborhood effects from school quality effects. Black [4] uses elementary school catchment area borders in Massachusetts to identify the premium placed on crossing from elementary schools with lower average test scores to schools with higher average test scores. She estimates a house price elasticity with respect to elementary school test scores equal to 0.5. The fine level of geography used to calculate this estimate likely disentangles the majority of neighborhood effects from school quality effects. This estimate may understate the overall valuation of better schools, because it only reflects capitalization due to intra-district differences in elementary school quality and thus does not capture inter-district differences in elementary and secondary school quality. Bogart and Cromwell [5] exploit school district boundaries within the Cleveland metropolitan area and find an average housing premium of about 20% for school districts that are "better."

Barrow [2] compares the housing choices in the Washington, DC area made by families with and without school-aged children, and she concludes that white households with children are willing to pay more than other white households for housing in areas where local public school students earn higher SAT scores. Downes and Zabel [9] find that school-level quality measures are much better than district-level quality measures for predicting house prices. Using randomly selected cross-sections of homeowner's estimates of the value of their homes in the Chicago area during 1987 and 1991, Downes and Zabel estimate a house price elasticity with respect to average school-level reading scores equal to about one. They also find that relying only on static measures of school quality leads to very different results.

One recent study that does not rely on static measures of school quality is Figlio and Lucas' [12] examination of the impact of school ratings in Florida on house prices. They compare house prices in two Florida counties before and after the state began assigning grades to schools based on students' test scores. They find that, even after controlling for the test scores that determine these grades, house prices in areas served by public schools with 'A' grades increased compared to house prices in areas served by 'B' schools. Interestingly, these capitalization effects appear to be short-lived, probably because parents soon become better informed of schools' test scores or observe the inter-temporal volatility of schools' grades and test scores.

By using the adoption of a school choice program to examine the effect of schooling on house prices, the analysis below takes a unique approach to handling the first three challenges listed above. The implied valuation of "better schooling" is unlikely to be biased by omitted neighborhood effects, and these valuations do not rely on specific measures of school quality that parents may or may not actually care about. Furthermore, the dependent variable captures average longitudinal changes in market valuations for all houses in the district.

Homeowners may already be quite aware of the potential capitalization effects of a school choice program. In states with inter-district public school choice programs, there is anecdotal evidence of real estate agents citing the qualities of neighboring school districts, rather than giving their more traditional sales pitch that the local schools are good. In addition, Brunner et al. [6] find a positive correlation between the percentage of people voting against a private school voucher initiative and housing price premiums related

to the quality of public education in their precinct. This relationship may indeed result from homeowners' recognition that the housing premium associated with the quality of the local public schools will diminish with the expansion of outside schooling options.

This paper uses data from Minnesota's inter-district open enrollment program to test predictions concerning the actual capitalization effects from the adoption of a school choice program. Property values should rise in districts in which the schooling market is strengthened by additional schooling options. Property values might also fall in districts that offer regionally popular public schools that admit transfer students. To the extent that housing in these districts and neighboring districts are close substitutes, the demand for local housing may decline because neighbors can attend the local schools without paying a premium to live there. After a brief description of Minnesota's program, I discuss these predictions more thoroughly.

3. Open enrollment in Minnesota

Minnesota currently has the oldest inter-district open enrollment program, in which students may transfer from their residential school district to another public school district.[2] The Minnesota Enrollment Options Program (Minn. Statute 120.062) began in the 1987–1988 school year on a voluntary basis for school districts. This meant that districts could decide whether or not to take students or allow them to leave. Transferring students were required to provide their own transportation beyond the border of their new district, and the new district could provide transportation from there to the school. When a student transfers, the losing district loses an amount equal to its own non-compensatory state aid per student, while the receiving district gains an amount equal to *its* non-compensatory state aid per pupil. In 1997–1998, non-compensatory state aid was close to $3000 per pupil for all districts, varying by a few hundred dollars per pupil. Thus, the change in total state aid for a district as a result of open enrollment would be roughly equal to $3000 times the net change in enrollment. Note that since average spending per pupil exceeds $3000 in all districts, per pupil revenue falls in districts that have net gains in transfer students, holding local revenues constant. However, in most cases, the marginal cost of serving a few more or a few less students is likely to be much less than $3000 per student.[3]

[2] Minnesota has also offered a variety of other types of school choice programs. These include charter schools, magnet schools in the twin cities (i.e., intra-district choice), alternative schools for students at-risk of failing to complete high school, and arrangements by which advanced high school students may take classes at local colleges. Participation in these programs would not likely affect this paper's estimates much, though it may have influenced participation in open enrollment several years after the adoption of open enrollment, especially in the twin city districts (Minneapolis and South St Paul). For example, while there were no charter schools in Minnesota in 1991, more than half of the charter schools that have emerged since then are located within these two districts.

[3] According to Ysseldyke et al. [30], only about five percent of 1990–1991 open enrollment transfer students were students with disabilities. This percentage is relatively low; during the same year, roughly 11% of all Minnesota public students were classified as special education students. Transfer students with disabilities are not necessarily associated with high marginal costs for the receiving district, since the residential district may be forced to finance the students' needs, such as special transportation arrangements (Lange et al. [17]).

In 1990–1991, the program became mandatory, meaning that districts could no longer prevent students from leaving. However, districts can still limit the number of students that they take in based on their capacity. The reason for the rejection may be a general lack of space in the schools, or a lack of space at the specific grade of a transfer applicant. The districts are not supposed to engage in discriminatory admissions; if more students would like to enter the district than are allowed to, students are randomly selected for the available spaces. Since districts are on their own to decide whether they have sufficient capacity to accept a transfer applicant, the overall qualities of the transfer applicant pool and the perceived benefit from admitting transfer students could marginally influence the supply of transfer spaces.

Unfortunately, the state agency does not maintain records of open enrollment applications. However, the agency did conduct a survey of all districts for the 1999–2000 school year, in which 304 districts reported that they did not reject any incoming transfer applications, 35 reported that they rejected at least one application, and 6 districts did not respond. While only about 10% of districts rejected any transfer applicants in 1999–2000, all of these rejecting districts also accepted some transfer students. Superintendents likely felt obliged to comply with the state policy by admitting at least a moderate fraction of transfer students. As Section 6 will discuss, the superintendents who actually depressed property values by admitting transfer students were not more likely to lose or leave their jobs. Interestingly, due to an out-of-court settlement in 2000 resulting from an adequacy lawsuit brought by the Minneapolis branch of the NAACP against the state of Minnesota, a group of suburban school districts now guarantees a minimum number of transfer spaces for urban students. However, this policy has had little impact on transfer rates, revealing that the supply of transfer spaces in these suburban districts was not previously binding.

Besides the district's own limit on the number of students it chooses to take, the only way in which a student may be prevented from transferring is if there are certain unfavorable desegregation consequences. The state education agency may prevent white students from transferring out of districts that have high percentages of minorities, particularly the urban districts of Minneapolis and St Paul. Recent changes in the open enrollment program include subsidization of transportation for students with need, and permission for school buses to cross district borders to provide transportation.

Participation in open enrollment has increased considerably. In 1990–1991, the first mandatory year, about 1.5 percent[4] of students transferred. This increased to 4.6 percent by the 1997–1998 school year. The average percentage of transfer students was higher than this, because some of the larger districts had relatively low rates of transferring. In 1990–1991, the average fraction of students transferring out of a district was 1.9 percent and by 1997–1998 it had risen to about 7 percent. Initial rates of student entrance and exit

[4] Due to the lack of availability of actual student transfer counts, percentages of students transferring are measured in pupil units throughout this paper. Pupil units are used for state funding purposes, so these measures are ideal for computing the direct financial impact of student exiting or entering. In 1990–1991, a kindergarten student counted for 0.5 pupil units, a 1st–6th grader counted for 1 pupil unit, a 7–12th grader counted for 1.35 pupil units, and a pre-kindergarten, handicapped student counted for 1 pupil unit. In 1997–1998, those weightings were 0.53, 1.06, 1.3, and 1 respectively.

are highly correlated with future rates of student entrance. Specifically, there is a 0.628 correlation between incoming transfer rates in 1990–1991 and incoming transfer rates in 1997–1998, while there is a 0.519 correlation between outgoing transfer rates during these two years.

Districts that initially experienced significant net losses or gains (equal to at least 5% of their residential student population), had smaller populations than others districts, but were fairly similar along other dimensions. On average, students transferred to districts with higher mean district test scores than their residential district.[5] Although it is impossible to know whether open enrollment itself affected these mean scores, this provides reassuring evidence that this paper's results are not due to some bizarre phenomenon in which students transfer to schools with lower average achievement than their residential schools. Analyzing transferring patterns and rejection rates in the program during 1999–2000, another study (Reback [23]) finds that mean student test scores of a district relative to neighboring districts are more powerful predictors of transfer demand than are relative values for socio-economic variables such as median household income, mean house value, and parental education levels. This other study is able to explain about half of the overall variation in transfer demand with variables controlling for population size, population density, and socio-economic and student achievement differences between neighboring districts.

4. Theoretical framework

The model is a simplified version of Nechyba's [19] model. Assume that all agents have one child. Let m_i be the residential community of agent i, h_i be the house type of agent i, s_i be the perceived quality of schooling received by the child of agent i, and c_i be the private good consumption of agent i. All agents maximize the utility function, $u_i(m_i, h_i, s_i, c_i)$,[6] which I assume to be increasing in s_i and c_i. Throughout this discussion, "school quality" is used in the loosest sense. School quality refers to any aspect of the school that might make a child's enrollment valuable, including the potential academic gains made by students, as well as the school's location, athletic programs, art programs, etc.

Consider all agents who initially send their child to public school. For these agents, prior to open enrollment, s simply equals the quality of the local public school district, which I call s_{ir}. Now allow for open enrollment, in which students may be able to transfer to a public school outside of their residential district. The value of s_i is a function of both the local public schools and nearby public schools, subject to access to and availability

[5] Although the data do not reveal the residential districts of incoming transfer students, one can compute average district-level characteristics, weighted by either the number of transfer students that enter or the number that exit. Beginning with the 1998–1999 school year, statewide district-level mean Reading and Math test scores are available separately for third grade, fifth grade, and eight grade exams. Tenth grade mean Writing scores are also available. For all seven of these exams, on average, a 1990–1991 transfer student's new district had a slightly higher 1998–1999 mean score than the student's residential district.

[6] Nechyba [19] provides a straightforward derivation of this reduced form function from an individual's maximization of her utility as a function of her consumption, her leisure, and her child's educational attainment.

of transfer spaces in these schools. Let s_{ij} be agent i's perceived "quality" of the jth school district other than the agent's residential district, where $j = 1$ to n. Note that agents may differ in their preferences for schools, so $s_{ay} > s_{az}$ does not imply $s_{by} > s_{bz}$. With open enrollment, $s_i = E[\max(s_{ir}, a_{i1}s_{i1}, a_{i2}s_{i2}, \ldots, a_{in}s_{in})]$, where $a_{ij} \in [0, 1]$ represents agent i's discounting factor to account for the convenience and availability of transfer spaces in the jth school district. For the time being, I ignore endogenous changes in school quality resulting from open enrollment.

After the adoption of open enrollment, there is an increase in the utility derived from living in a community where there is access to neighboring districts' schools which are perceived as higher quality than the local schools. For agents residing in these communities who would rather access the neighboring districts' schools than utilize the local schools, $s_i > s_{ir}$, so $u_i(m_i, h_i, s_i, c_i)$ increases. The utility derived from living in a community where the local public schools have higher perceived quality than nearby districts' schools does not increase under open enrollment. For agents in these communities who prefer their local schools, $s_i = s_{ir}$, so the level of utility remains unchanged (assuming that s_r remains unchanged under open enrollment, which will be relaxed later). On the other hand, the utility that these agents could derive from living in some of the other districts has increased, because they may reside in those districts, but transfer their child to a better school. These changes in relative valuations will serve to change the market prices of housing in school districts. Some agents may choose to relocate as a direct result of their new valuations. For example, they may move into a less expensive community and send their children as transfer students back to their original, more desirable public school. These arguments may be extended to agents who initially send their children to private schools;[7] they too will have new valuations and might alter their behavior as a result.

One would expect initial student transferring patterns under open enrollment to correspond directly with the changes in property values due to open enrollment. A high fraction of students transferring *out of* a district is an indication that many residents may now taking advantage of preferred schooling options in nearby districts. Some people will thus have increased valuations of residing in that district. As a result, one would expect housing values in that district to increase. A high fraction of students transferring *into* a district is an indication that parents in nearby districts are taking advantage of the higher "quality" of this district. This means that the value of residing in nearby districts has increased, causing less demand to live in this district and thus a negative effect on housing values. Put more simply, housing in a popular school district becomes less valuable when residents no longer have the exclusive right to attend the local schools. Some transfers may occur due to idio-

[7] An agent t who chooses to send her child to private school has chosen a residence such that $u_t(m_t, h_t, s_t, c_t)$ is maximized. Here $u_t = u_t(m_t, h_t, s_p, c - \tau)$, where s_p is the perceived quality of the private school and c is reduced by τ, the cost of private school tuition. After public school choice is introduced, agent t may change her residence and/or where she sends her child to school. She could decide to: (1) remain in the same residence but remove her child from private school and transfer the child to a non-residential public school, (2) relocate to a new district and transfer the child to another district, or (3) relocate to a new district and send the child to either the local public school or a private school. Changes in public school options and the market price of residences as a result of choice will affect whether the agent takes any of these actions. In any case, agent t will either have the same relative valuations for housing as before (if sending her child to private school remains optimal), or she will have changes in relative valuations similar to agents who initially sent their child to public school.

syncratic preferences of parents (e.g., geographic convenience, athletic programs, tastes for specific types of academic programs), and one would not expect strong capitalization effects in these cases. Section 5.4 below describes analyses that reveal capitalization effects are largest when transfers are likely related to differences in the perceived quality of schools that are shared by the vast majority of agents.

5. Empirical methods

The approach of this paper is to identify changes in district-level residential property values in Minnesota as a result of a regime change, the shift from local monopolies of public schooling to open enrollment. As in other event studies, one would ideally examine trends from shortly before the program was anticipated until a time when most of the impact of the program's adoption would be realized. Comparable property values prior to the partial adoption of the program are unavailable. As a result, the main analysis in this paper focuses on changes in property values after 1990 (one year before the program was fully adopted). However, using a different measure of property values, I directly control for district-level trends in property values prior to the adoption of the program. In particular, I control for the relative growth in districts' property tax bases between 1983–1984 and 1986–1987. This ensures that the key results are picking up a break in property growth trends rather than simply a persistence of trends.

For the main analysis, I examine the effect of transferring patterns in the first school year of statewide open enrollment (1990–1991) on changes in residential property values between 1989–1990 and 1997–1998. The data used here are at the district level and combine property value data from the Minnesota Department of Revenue, data from the Minnesota Department of Families, Children, and Learning's (MDFCL) School District Profiles [25,26], district-level student transferring data for the 1990–1991 school year provided by the MDFCL, and the 1990 School District Data Book based on the 1990 Census.

Transfer rates are ideal measures of people's appreciation of the transfer opportunities offered by the school choice program. Measures of school quality such as test scores, pupil–teacher ratios, or per pupil spending would not pick up whether residents are actually willing and able to transfer their children to another district. Furthermore, unlike these other measures, actual transfer rates capture competition that may occur when districts specialize in certain areas. Transfer rates pick up every possible component of the broad definition of school quality given in Section 4.

Transfer rates will equal the minimum of the supply and demand for transfer spaces. Transfer rates during the middle of the sample period are likely endogenous, since trends in property values unrelated to the adoption of open enrollment will affect the supply and demand for transfer spaces. For this reason, I focus on transfer rates during the baseline year. Although initial transfer rates may be correlated with longitudinal factors influencing supply and demand, such as anticipated construction or persistent property growth trends, one may directly control for these factors so that the initial transfer rates will exogenously measure transfer opportunities. On the other hand, later transfer rates are endogenous, so they are omitted from the analyses below. As mentioned in Section 3, initial and future rates are highly, positively correlated, so that the initial rates likely capture most of the transfer

opportunities related to initial differences in the perceived quality of school districts. Initial incoming transfer rates are positively correlated not only with 1996–1997 rates, but also with changes in transfer rates between 1991 and 1997, so that the estimated effect of initial incoming transferring on property values is likely related to both initial transfer opportunities and future transfer opportunities. Initial outgoing rates are positively correlated with 1997 rates but are not significantly correlated with the change in rates between 1991 and 1997. The latter relationship is encouraging, because it suggests that estimates below are not biased by any sort of systematic relationship between the initial loss of students and changes in the perceived quality of school districts. While some districts may respond to competitive pressures by improving or declining in quality, districts that initially lost students are not more or less likely to become more popular, as measured by changes in transfer rates. Furthermore, analyses below do not find any significant changes in capitalization effects when one adds control variables intended to capture changes in school quality over the sample period.

Given that the initial transfer rates will serve as exogenous measures of transfer opportunities, using these rates is a superior empirical strategy to using an instrumental variables approach to model the effect of later transferring. It is doubtful that any variable is an exogenous predictor of later-year transfer rates. In addition, since transfer rates reflect the minimum of the supply of and demand for transfer spaces, it is very difficult to find a variable that is very highly correlated with transfer rates; variables such as test score differences that are positively correlated with transfer space demand may be negatively correlated with the supply of transfer spaces (Reback [23]). Capitalization effects should only occur in cases where people are both willing and able to transfer.

Using initial rates also allows one to examine the effects of choice on property values several years later. The capitalization effects of school choice may occur gradually (Nechyba [21]). The sample period is sufficiently long for market transactions to occur so that the observed dependent variable actually reflects the changes in the market values of property. If one estimates similar models as those below, then the magnitudes of the results gradually increase in real terms as the end of the sample period is extended up until 1998. For example, the estimated capitalization effects between 1990 and 1994 associated with 1990–1991 outgoing and incoming transfers are respectively about 49 percent and 29 percent as large as those occurring between 1990 and 1998. Capitalization effects do not increase as the sample period is extended to 1999 or 2000, in fact they decrease very slightly, indicating that these effects are fully realized about eight years after the program began. It is also possible that some capitalization may have occurred when the program was anticipated but not yet in place, so that these estimates understate the total effects.

Section 5.1 presents the baseline regression analyses, including models with and without control variables capturing growth in property values related to construction or improvements. Section 5.2 tests whether these results are biased due to coincidental property growth trends related to the quality of public schools. Section 5.3 tests whether sample selection, caused by school district mergers during the 1990s, influenced the results. Finally, Section 5.4 tests whether the capitalization effects are heterogeneous among various types of districts.

5.1. Regression framework

The regression model here uses the percentage change in a district's residential property values between 1989–1990 and 1997–1998 as the dependent variable. The baseline model for estimating capitalization effects is:

$$Y_i = \beta_0 + \beta_1(\%\text{IN91}_i) + \beta_2(\%\text{OUT91}_i) + \beta_3(\text{NONE\_IN91}_i) + X_i\beta_4 + \varepsilon_i. \quad (1)$$

The dependent variable equals the percentage change in the equalized, assessed value of all residential property in a school district between 1989–1990 and 1997–1998. This measure should reflect actual market values very well, possibly more accurately than owner-reported survey responses used in previous studies. County assessors reassess the market values of each property at least once every four years, and these assessments are corrected annually for differences in assessors' behavior. Each year, the total assessed value is multiplied by a number equal to the actual sale prices of properties divided by the assessor's valuations of these properties. The resulting variable thus reflects annual changes in actual sale prices, while also controlling for the fixed effects of differences in assessment practices.

$\%\text{IN91}_i$ and $\%\text{OUT91}_i$ are the independent variables of most interest. $\%\text{IN91}_i$ equals the number of students who transfer into district i in 1990–1991 divided by the residential student population. Similarly, $\%\text{OUT91}_i$ equals the number of students who transfer from district i to another district in 1990–1991 divided by the residential student population. The denominator for both of these variables includes all residential students, so it is equal to the number of students who live in the district and attend school there plus the number of students who live in the district and transfer to another public school district. The transfer rates in this analysis are based on pupil units, rather than numbers of students (see footnote 4).

NONE_IN91_i is a dummy variable equal to one if district i did not have any incoming transfer students in 1990–1991. This controls for the fact that some people may not have been fully aware of their right to transfer in 1990–1991 and transfer rates of zero are probably related to districts' initial unwillingness to admit students when program participation was voluntary. A district's reluctance to participate may be an indicator of relatively strong schools.

X_i is a vector of other control variables from the baseline year that capture characteristics of district i's housing and residents. Table 1 provides definitions for these variables and Table 2 provides their summary statistics. Since the dependent variable captures changes in property values occurring *after* the initial transferring and since the models control for previous district-level trends in property growth, the estimated coefficients of the initial transfer rate variables should only reflect the effects of these transfer opportunities, unless some construction is anticipated. A district with a new apartment complex that will be completely finished in 1992 may anticipate a flood of students and be less likely to admit transfer students in 1991. In order to control for the potential impact of anticipated construction, some specifications include a control variable equal to the value of new construction during 1991 and 1992 divided by the total property value in the district in 1990. The final capitalization effect model adds a control variable equal to the percentage increase in non-residential property over the sample period, because this might help to

Table 1
Description of variables

Dependent variable	
%RESPROPΔ	The percent change in the district's residential property values between the 1989–1990 and 1997–1998 school years. These property values are equalized, assessed values derived from data from the Minnesota Department of Revenue. Each property is assessed at least once every four years, and assessed valuations are corrected annually for differences in assessment practices based on actual market sales.
Initial transfer rates	
%IN91	The number of students transferring into the district during the 1990–1991 school year divided by the total number of residential students (both retained and exiting) during that same year. Student counts are expressed in terms of pupil units. (MDCFL)
%OUT91	The number of students transferring out of the district during the 1990–1991 school year divided by the total number of residential students (both retained and exiting) during that same year. Student counts are expressed in terms of pupil units. (MDCFL)
District size	
RESPROP90	Total residential property value in the district during 1989–1990. (MDR)
ADULTS	Number of adults living in the district.
Housing characteristics	
%RES90	Percent of the district's equalized, assessed property value in 1990 composed of residential properties.
%VACANT	Percent of residential housing units in the district that were not occupied as a primary residence.
%RENTED	Percent of residential housing units in the district that were rented to an occupant other than the owner.
MEDIAN HOUSE VALUE	The median value of a house in the district.
%RURAL HOUSING	Percent of residential housing units in the district that are located in a rural area.
Prior property growth trend, 1984–1987	Captures district's relative rates of property growth prior to the start of the open enrollment program. Equals the z-score of a district's property tax base in 1987 minus the z-score of a district's property tax base in 1984. z-scores are used because the formula used to derive the property tax base changed over this time period. (MDCFL)
%NEW CONSTRUCTION: 1990–1992	The total market value derived from new construction and improvements to residential and non-residential land during 1991 and 1992, divided by the total market value of all land in 1990. (MDR)
%CHANGE in NON-RESIDENTIAL PROPERTY: 1990–1998	The value of non-residential land in 1999 minus the value of non-residential land in 1990, divided by the value of non-residential land in 1990. (MDR)
%NEW CONSTRUCTION: 1990–1998	The total market value derived from new construction and improvements to residential and non-residential land between 1990 and 1998, divided by the total market value of all land in 1990. (MDR)
Resident characteristics	
MEDIAN INCOME	The median income of adults living in the district.
%CHILDREN	Percent of district's population composed of children (ages 17 and under).
%ADULTS W/B.A.	Percent of adults living in the district who possess a Bachelor's Degree.
%ADULTS: H.S. DROPOUT	Percent of adults living in the district who dropped out of high school.
%ADULTS: POOR	Percent of adults living in the district who are classified as below the poverty line.

(*continued on next page*)

Table 1 (*Continued*)

Perceived school quality	
%POVERTY CHANGE, 1991–1998	A proxy for the change in the percentage of low-income students who attend a school in the district, equal to the percentage change in per pupil district expenditures on food between the 1990–1991 and 1997–1998 school years. This is highly correlated with the change in the poverty rate among students, because district expenditures on food are usually based almost entirely on subsidies for children of low-income households. (MDCFL)
TEST SCORE INDEX	Index with a standard deviation equal to one, base on factor analysis of seven district-level test score measures over four school years (see footnote 11 for more details). (MDCFL)

Notes. All variables are from the 1990 Census unless otherwise stated. MDCFL = data source is the Minnesota Department of Children, Families, and Learning; MDR = data sources is the Minnesota Department of Revenue.

capture unobserved factors that similarly influence residential and non-residential property value changes.

Open enrollment might affect residential properties, but would probably not affect non-residential properties. The hypothesis that non-residential property values are unaffected by the policy change is confirmed if one instead estimates similar models using non-residential property values as the dependent variable. The strict definition of capitalization includes any change in the value of land, regardless of whether this change is due to a change in the value of preexisting structures, improvements of preexisting structures, or construction of new structures. In order to investigate whether open enrollment leads to capitalization effects, I therefore initially examine the change in the total value of residential properties without controlling for construction and improvements. The magnitudes of the capitalization effects are particularly important, because these estimates reveal the impact of open enrollment on school districts' property tax bases.

Columns (1)–(3) of Table 3 shows the results of Huber–White heteroskedasticity-consistent OLS regressions of various forms of the model above. For ease of interpretation, except for the variable equal to the total value of residential property in 1990, all continuous variables that are not 'percent' are in log-form. Thus, the coefficients on these continuous variables should be interpreted as the change in the property growth rate associated with a one percent change in the independent variable. The coefficients on $\%IN91_i$ and $\%OUT91_i$ reflect the change in the property growth rate associated with a one *percentage point* change in the transfer rate. The estimated coefficient of $\%OUT91_i$ ranges from 1.50 to 1.63, suggesting that a one percentage point increase in the outgoing transfer rate is associated with an increase in residential property values of at least 1.5 percent. The estimated coefficient of $\%IN91_i$ ranges from -1.12 to -1.32, suggesting that a one percentage point increase in the incoming transfer rate is associated with a decrease in residential property values of at least 1.1 percent. These statistically significant results support the predictions of Section 4. Furthermore, the results remain qualitatively similar and statistically significant when various control variables are omitted from the analyses.[8]

[8] Using various combinations of independent variables and testing for the robustness of the results may be important here. Atkinson and Crocker [1] describe how collinearity issues often plague hedonic property value regressions. It is possible that property growth regressions could also suffer from this problem.

Table 2
Summary statistics

Variable	Districts in main analysis (existed in both 1990–1991 and 1998–1999)		Districts existing in 1990–1991	
	Mean	St. dev.	Mean	St. dev.
Dependent variable				
%RESPROPΔ	0.85	0.45	–	–
Initial transfer rates				
%IN91	0.020	0.030	0.017	0.029
%OUT91	0.017	0.021	0.022	0.034
District size				
RES90	$3.87 million	$10.3 million	$2.83 million	$8.87 million
ADULTS	5412	13,530	4131	11,581
Housing characteristics				
%RES90	0.29	0.15	0.26	0.15
%VACANT	0.15	0.15	0.15	0.14
%RENTED	0.20	0.07	0.20	0.06
MEDIAN HOUSE VALUE	$52,227	$23,960	$47,050	$22,724
%RURAL HOUSING	0.69	0.39	0.76	0.36
Prior property growth trend, 1984–1987	0.10	0.51	−0.01	0.55
%NEW CONSTRUCTION: 1990–1992	0.03	0.02	–	–
%CHANGE in NON-RESIDENTIAL PROPERTY: 1990–1998	0.04	0.16	–	–
%NEW CONSTRUCTION: 1990–1998	0.21	0.15	–	–
Resident characteristics				
MEDIAN INCOME	$26,557	$7967	$25,481	$7141
%CHILDREN	0.41	0.05	0.40	0.05
%ADULTS W/B.A.	0.14	0.08	0.13	0.08
%ADULTS: H.S. DROPOUT	0.27	0.09	0.28	0.09
%ADULTS: POOR	0.12	0.06	0.13	0.06
Perceived school quality				
%POVERTY CHANGE, 1991–1998	0.41	0.29	–	–
TEST SCORE INDEX	−0.04	1.03	–	–
Future transfer rates				
Incoming transfer rate during 1997–1998 school year	0.079	0.090	–	–
Outgoing transfer rate during the 1997–1998 school year	0.058	0.041	–	–
$N =$	272		383	

Next, in order to estimate the effects on homeowners' wealth and to find rough estimates of welfare effects and of parents' demand for public schooling options, I focus on changes in the values of preexisting homes. I use the same dependent variable, but add a control variable capturing changes in overall property values during the entire sample period that are due to either the construction of new structures or improvements of preexisting

Table 3
The capitalization effects of student transfer opportunities. OLS regressions with robust standard errors

	Capitalization effects			Capitalization effects controlling for any new construction	
	(1)	(2)	(3)	(4)	(5)
%IN91	−1.322*	−1.208**	−1.119*	−1.033**	−0.992**
	(0.686)	(0.596)	(0.581)	(0.501)	(0.499)
%OUT91	1.500**	1.498**	1.626**	1.627**	1.688**
	(0.757)	(0.735)	(0.713)	(0.669)	(0.668)
NONE_IN91	−0.054	−0.069	−0.048	−0.053	−0.043
	(0.063)	(0.057)	(0.052)	(0.053)	(0.050)
RES90	-3.79×10^{-9}	-1.51×10^{-9}	-1.84×10^{-9}	-6.23×10^{-11}	-2.48×10^{-10}
	(3.62×10^{-9})	(2.96×10^{-9})	(3.35×10^{-9})	(2.16×10^{-9})	(2.40×10^{-9})
%RES90	−0.626	−0.685	−0.774	−0.977	−1.005
	(0.418)	(0.437)	(0.448)*	(0.397)**	(0.410)**
LN(ADULTS)	−0.004	−0.047	−0.046	−0.053	−0.055
	(0.042)	(0.043)	(0.040)	(0.033)	(0.032)*
%VACANT	0.846***	0.646***	0.650***	0.198	0.229
	(0.229)	(0.218)	(0.195)	(0.198)	(0.187)
%RENTAL	−1.373***	−1.200**	−1.070**	−0.935**	−0.875**
	(0.504)	(0.480)	(0.438)	(0.406)	(0.384)
LN(MEDIAN_HOUSE)	0.443***	0.425***	0.440***	0.360***	0.374***
	(0.115)	(0.110)	(0.100)	(0.095)	(0.088)
%RURAL	0.048	0.067	0.022	0.181**	0.146
	(0.109)	(0.107)	(0.105)	(0.087)	(0.090)
LN(MEDIAN_INCOME)	−0.112	−0.280	−0.017	−0.431	−0.278
	(0.337)	(0.333)	(0.315)	(0.266)	(0.258)
%CHILDREN	1.438*	0.964	0.778	−0.101	−0.139
	(0.763)	(0.756)	(0.712)	(0.606)	(0.598)
%ADULTS W/B.A.	−1.791***	−1.653***	−1.628***	−1.117***	−1.142***
	(0.539)	(0.463)	(0.459)	(0.343)	(0.342)
%ADULTS:	−1.434***	−1.345***	−1.076**	−1.260***	−1.110***
H.S. DROPOUT	(0.506)	(0.507)	(0.504)	(0.412)	(0.427)
%ADULTS: POOR	−1.386*	−1.519**	−0.810	−1.445**	−1.057*
	(0.760)	(0.714)	(0.682)	(0.576)	(0.582)
Prior property growth trend,	0.179*	0.158	0.174	0.162	0.170
1984–1987	(0.105)	(0.118)	(0.123)	(0.110)	(0.113)
%NEW CONSTRUCTION:		5.046**	3.744**		
1991–1992		(2.156)	(1.868)		
%CHANGE in			0.590***		0.334***
NON-RESIDENTIAL			(0.137)		(0.127)
PROP: 1991–1999					
%NEW CONSTRUCTION:				1.778***	1.620***
1991–1999				(0.133)	(0.123)
Constant	−2.226	0.011	−2.879	2.387	0.667
	(3.063)	(3.069)	(2.945)	(2.448)	(2.381)
Observations	272	272	272	272	272
R-squared	0.57	0.60	0.63	0.72	0.73

Notes. Dependent variable: %CHANGE in residential property values between 1990 and 1998 (%RESPROPΔ). Robust standard errors in parentheses.

* Significance at the 10% level.

** Idem., 5%.

*** Idem., 1%.

structures.[9] These estimates are only rough estimates of welfare effects, because the magnitude of changes in house prices is influenced by the elasticity of supply and the elasticity of demand. In addition, these estimates might further understate welfare effects, because open enrollment may not only influence the values of preexisting structures, but possibly has similar effects on the values of new structures. For example, open enrollment could contribute to a developer's decision to build an apartment complex on a previously empty lot. Although this is a capitalization effect, one would not want to count the full value of the apartment complex as a welfare gain associated with open enrollment. By controlling for any such construction or improvement, one implicitly assumes that none of the value of this enhancement is related to open enrollment.

Columns (4) and (5) of Table 3 show estimates for the effect of open enrollment on the prices of preexisting homes. Unlike the previous columns, these models control for the portion of changes in property values due to new construction or improvements.[10] After controlling for construction, the effect associated with students utilizing exit opportunities increases only slightly. This implies that open enrollment exiting significantly affected the market values of preexisting homes. Exit opportunities associated with the adoption of open enrollment caused house prices to increase by at least 1.63 percent for a one percentage point increase in exiting. Controlling for new construction causes the estimated magnitude of the effects of incoming transfer students to decrease slightly. A one percentage point increase in the incoming transfer student rate caused about a one percent decline in house prices.

5.2. Controlling for changes in school quality

During the sample period, there may have been coincidental changes in the perceived quality of schools that were unrelated to the adoption of open enrollment, but were nonetheless correlated with initial transfer rates. For example, suppose that relatively unpopular districts happened to improve in quality relative to other districts, due to secular trends in school productivity or student composition. Suppose further that this trend was not captured by previous district-level trends in property values or by contemporaneous trends in non-residential property values. The positive relationship between initial exit transfer rates and residential property growth in the 1990s might then be a spurious result. To control

[9] I use this approach because data specifically concerning the construction of residential properties are not available. The control variable is thus only a proxy for the percentage of *residential* property growth due to construction and improvements, because the numerator and the denominator of this control variable are based on both residential and non-residential properties. To better ensure that the results accurately reflect house price effects, I also control for the initial fraction of the total district property wealth that is composed of residential property wealth. This way, the results will only be influenced by construction if districts receiving or losing transfer students tend to have disproportionate shares of residential versus non-residential construction, even after controlling for their initial share of property wealth that is residential.

[10] The control variable equals the total increase in the value of residential and non-residential property due to construction and improvements over the sample period divided by the value of residential and non-residential property in the baseline year (see footnote 9). As shown in Table 3, the coefficient on this control variable is greater than one, suggesting that districts with high rates of construction, on average, had a greater share of residential construction than non-residential construction.

for the effects of changes in student composition on perceived school quality, I include another independent variable that is a proxy for the change in the poverty rates of students between 1990–1991 and 1997–1998 (see Tables 1 and 2 for formal definitions and descriptive statistics). To control for potential changes in perceived school quality over the sample period, I also include a district-level test score measure as an additional independent variable. Although some changes in composition and test scores may be directly due to open enrollment, including these control variables is important to test whether the previous OLS results were simply driven by coincidental trends. Since test score measures prior to 1998 are unavailable, for each district, I derive an index of student achievement based on principle components analysis of seven annual test score measures between 1998 and 2001.[11] Including this control variable will ensure that the previous results were not due to an overall trend in the popularity of districts with relatively low or high achieving students.

Table 4 presents the results when these additional control variables are added to the models analogous to those displayed in Table 3. The test score measure is significantly, positively related to property value growth. The change in the poverty rate does not have much

Table 4
The capitalization effects of student transfer opportunities with added controls for coincidental changes in perceived school quality. OLS regressions with robust standard errors

	Capitalization effects			Capitalization effects controlling for any new construction	
	(1)	(2)	(3)	(4)	(5)
%IN91	−1.105*	−0.993*	−0.960*	−0.884*	−0.867*
	(0.623)	(0.555)	(0.552)	(0.476)	(0.480)
%OUT91	2.103*	2.067*	1.943*	1.824*	1.771*
	(1.201)	(1.110)	(1.045)	(0.946)	(0.918)
NONE_IN91	−0.065	−0.084	−0.064	−0.069	−0.060
	(0.062)	(0.056)	(0.052)	(0.054)	(0.050)
%POVERTY CHANGE	−0.046	−0.045	−0.004	−0.013	0.008
	(0.042)	(0.040)	(0.039)	(0.035)	(0.034)
TEST SCORE INDEX	0.077***	0.073***	0.056***	0.046**	0.038**
	(0.023)	(0.023)	(0.020)	(0.018)	(0.018)
Observations	267	267	267	267	267
R-squared	0.58	0.61	0.64	0.73	0.74

Notes. Dependent variable: %CHANGE in residential property values between 1990 and 1998 (%RESPROPΔ) Robust standard errors in parentheses.

* Significance at the 10% level.

** Idem., 5%.

*** Idem., 1%.

[11] For districts with the maximum set of test score outcomes, the factors used for principle components are (with corresponding score coefficients from earliest year to latest year in parentheses): 3rd grade mean Math score 1998–2000 (0.056, 0.032, 0.041), 3rd grade mean Reading score 1998–2000 (0.042, 0.055, 0.042), 5th grade mean Math score 1998–2000 (0.042, 0.062, 0.047), 5th grade mean Reading score 1998–2000 (0.077, 0.049, 0.057), 8th grade Math pass rate 1998–2001 (0.074, 0.068, 0.060, 0.062), 8th grade Reading pass rate 1998–2001 (0.044, 0.052, 0.045, 0.046), and 10th grade Writing pass rate 1998–2001 (0.027, 0.025, 0.031, 0.031).

of an effect on property values, especially for the models that control for new construction or for growth in non-residential property values. The transfer rate coefficient estimates remain qualitatively similar to those in Table 3. The magnitude of the outgoing transfer rate coefficient increases and the magnitude of the incoming transfer rate coefficient decreases slightly.

5.3. Controlling for sample selection

A complication of this paper's analysis is that a significant fraction of districts merged or dissolved over the eight year period. Of the 383 districts with data for both 1989–1990 and 1990–1991,[12] twenty-nine percent merged or dissolved by 1998, leaving only 272 districts with the same boundaries during this time span. When districts merge, they are entirely lost from the sample; the new district cannot be included, because the initial transfer rates of the original districts are no longer interpretable. The reason for the high rate of merging includes, but is not limited to, the presence of open enrollment. Open enrollment may have put added pressures on districts with high rates of student exit. Other reasons for district mergers include the presence of academic pairing agreements that may eventually lead to full consolidation, one-time financial subsidies to merging districts, and a continuing trend of rural districts merging in order to deal with declining rates of enrollment. District merging certainly imposes non-random sample selection for the districts that existed in the first and last year of this analysis. In particular, districts that avoid merging despite high transfer student exit rates may possess unobserved qualities correlated with property growth.

I use maximum-likelihood estimation of a Heckman [13] selection model to attempt to control for possible biases due to nonrandom sample attrition. The sole reason for sample attrition in this context is if a district merges. The probability that a district merges is related to district size and various district characteristics. The most telling indicator of whether a district merges is whether they previously had an academic pairing agreement with another district, an arrangement in which one district provides instruction for another district's students at some grade levels. Over two-thirds of all districts with pairing agreements in 1990–1991 merged by 1997–1998, and more than 70 percent of all districts that merged over this period had pairing agreements.

The first stage equation is the probability that a district remains in the sample (does not merge) across the years.[13] This selection equation contains all of the baseline variables from Eq. (1), because these variables may be associated with merger rates. In addition, a dummy variable for whether district i had an academic pairing agreement, (AC_PAIR_i),

[12] The district must have existed in both 1989–1990 and 1990–1991 in order to provide data on both 1989–1990 property values and on 1990–1991 student transfer rates. In addition, the Census data only presents 1989–1990 data for districts that still existed in 1990–1991.

[13] In other contexts, one might think of a conceptual difference between districts that "need" to merge and that are "induced" to merge. For example, if the state forced districts with certain qualities to merge with their struggling neighbors, then two types of selection equations would be appropriate. However, since mergers are voluntary, one selection equation will sufficiently characterize the incentive to merge for any district. Only one merger over this period resulted from a district dissolving and then becoming incorporated into two other districts. All other mergers were agreements between all participating districts.

is included. Since these agreements predate the existence of mandatory choice, this dummy is an instrument for merging that is unrelated to the adoption of choice. Furthermore, the presence of an academic agreement in the baseline year is plausibly exogenous to the percentage change in residential property values in the district.[14]

Table 5 shows estimates for both equations of a Heckman selection model estimating house price effects, where the main equation is analogous to the model estimated in column (5) of Table 3. The estimated coefficients of the transfer rate variables in the main equation are very close in magnitude to the OLS estimates. The presence of an academic pairing agreement was a strong predictor of whether the district would merge. The negative estimate of −0.05 for the coefficient of the inverse Mill's ratio suggests that districts likely to merge that do not actually merge have higher than expected rates of property growth. However, this estimated coefficient is relatively small in magnitude and is not statistically significant, suggesting that sample selection might not be a major cause for concern.

In order to confirm that the results of Table 5 are not dependent on the assumption of normality of the selection equation, I also found estimates that correct for sample selection based on a type of flexible functional form suggested by Lee [18].[15] This method produced very similar results: an estimated incoming transfer rate coefficient of −1.06 (0.60 standard error) and an estimated outgoing transfer rate coefficient of 1.75 (0.83 standard error).

As a final robustness check for sample selection, I re-estimated the regression models of Table 3 using only districts that did not have academic pairing agreements in 1990–1991. The sample selection issue among this subgroup is possibly less severe, because the merger rate (11%) is much lower. At the same time, this procedure removes districts that were most likely to merge, but for some unobserved reason, did not. The estimated coefficients of the incoming and outgoing transfer rates for this restricted sample using a model identical to column (5) of Table 3 are −1.14 (0.51 standard error) and 1.47 (0.82 standard error), respectively. Overall, sample selection does not appear to determine the qualitative results.

[14] Aside from this variable, there are not other, plausibly exogenous variables that influence the probability that a district merges. Though there were external financial incentives to encourage mergers, these incentives were not likely to be large enough to have differential effects on districts. In addition, I did not find a relationship between financial wellbeing and merging. According to one state official, the state education agency may encourage districts to merge if they have debts greater than 2 percent of their operational expenditures and do not have budget reserves. I created a dummy variable that identified the roughly 9 percent of all districts with this status in 1990–1991. However, this variable did not have a statistically significant effect on the likelihood of merging; in fact, the coefficient actually suggested a decreased chance of merging. Overall, the greater desire for these districts to merge was probably negated by other districts' desire not to merge with them, leading to no observable relationship between financial wellbeing and merging.

[15] This method consists of adding terms to the second stage regression which are based on the conditional expectation of the second stage regression's error term given the selection equation's error term assuming a Type AA distribution. As Lee [18] reports, this type of distribution has been shown to provide a good fit for regression curves with skewness and kurtosis. The second stage regression here includes the inverse Mill's ratio (referred to as $g_1(x)$) and two higher order terms based on the Type AA distribution: $g_2(x)$ and $g_3(x)$, where $g_2(x) = -x\phi(-x)/(2\Phi(-x))$, $g_3(x) = ((1-x^2)\phi(-x))/(6\Phi(-x))$, and x is the estimate of the likelihood of staying in the sample (not merging).

Table 5
Capitalization effects of transferring opportunities, maximum likelihood estimation to control for sample selection due to district mergers

Dependent variable	*Main Equation* %CHANGE in residential property values from 1991 to 1998	*Selection Equation* = 1 if remain in sample = 0 if lost from it due to merger
%IN91	-1.096^{**}	4.666
	(0.548)	(3.719)
%OUT91	1.828^{**}	−2.828
	(0.807)	(3.007)
NONE_IN91	−0.040	0.053
	(0.048)	(0.232)
RES90	6.88×10^{-11}	2.99×10^{-7}
	(2.27×10^{-9})	(2.33×10^{-7})
LN(ADULTS)	-0.067^{*}	0.263
	(0.036)	(0.243)
%RES90	-1.001^{***}	−1.385
	(0.171)	(1.248)
%VACANT	0.194	1.360
	(0.193)	(1.021)
%RENTAL	-0.876^{**}	3.610
	(0.403)	(2.850)
LN(MEDIAN_HOUSE)	0.368^{***}	−0.466
	(0.087)	(0.456)
%RURAL	0.145^{*}	0.387
	(0.085)	(0.529)
LN(MEDIAN_INCOME)	−0.249	0.039
	(0.259)	(1.367)
%CHILDREN	−0.328	6.656^{**}
	(0.580)	(3.082)
%ADULTS W/B.A.	-1.199^{***}	3.221
	(0.399)	(3.705)
%ADULTS; H.S. DROPOUT	-1.107^{***}	−0.064
	(0.394)	(2.146)
%ADULTS; POOR	−0.976	−1.876
	(0.614)	(3.484)
Prior property growth trend, 1984–1987	0.166^{***}	0.399
	(0.040)	(0.256)
%NEW CONSTRUCTION: 1990–1998	1.632^{***}	
	(0.150)	
%CHANGE in NON-RESIDENTIAL PROPERTY: 1991–1999	0.342^{***}	
	(0.100)	
Academic pairing agreement dummy		-1.514^{***}
		(0.199)
Inverse Mills' ratio	−0.055	
	0.047	
Constant	0.620	−0.148
	(2.402)	(13.018)
# of observations	272	383

Note. Robust standard errors in parentheses.
* Significance at the 10% level.
** Idem., 5%.
*** Idem., 1%.

5.4. Are capitalization effects related to test scores, net transfer rates, or geographic location?

Further support for the theory presented in Section 4 is found by focusing on districts likely to be most affected by the policy change. In particular, one would expect exiting transfer opportunities to be more valuable for districts with lower student achievement levels than neighboring districts and for districts with greater outgoing transfer rates than incoming transfer rates. Transferring out of these types of districts is likely related to perceived differences in school quality shared by the vast majority of residents, rather than the idiosyncratic preferences of some residents. This section investigates these predictions, and also tests whether capitalization effects vary between rural and non-rural areas and whether capitalization effects are robust to the inclusion of regional fixed effects.

First, consider a district with lower student achievement levels than neighboring districts. The value of a transfer opportunity for residents in this district may be particularly large, so that exiting from this district is associated with large increases in property values. Conversely, a district with higher achievement levels than the neighboring districts may have had large house premiums associated with school quality, so that open enrollment causes a sharp decline in property values in this district. In order to test these predictions, I divide the sample into two groups based on whether a district's achievement level is less than the achievement level of the neighboring school districts, where neighboring districts are defined as those sharing a border in at least one geographic location. For each district, I derive an index of student achievement based on principle components analysis of seven annual test score measures across four years (see footnote 11). The initial transfer rate coefficients from the split sample regressions, analogous to column (5) of Table 3, are presented in the first two columns of Table 6. As expected, the effect of open enrollment exiting is greater for districts with lower achievement levels than their neighboring districts. This evidence bolsters the claim that the initial exit rate coefficients are capturing capitalization effects related to the perceived value of alternative schooling opportunities. Surprisingly, the effect of incoming transfers is also stronger for these districts. Perhaps housing in these districts are relatively close substitutes for housing in neighboring districts.

There is additional supportive evidence of the causal effects of expanded school choice when one divides the sample by whether the district had a net inflow of transfer students. As expected, exiting transfer opportunities produce larger capitalization effects among districts experiencing net losses of transfers, where the local schools are less popular than those in nearby districts. Furthermore, incoming transfers are associated with larger declines in house prices among districts that experience net gains of transfers, where the local schools are more popular than those in nearby districts.

Since Minnesota consists of a large metropolitan area and many small, rural districts, it is important to determine whether these capitalization effects are limited to certain geographic areas. The fifth and sixth columns of Table 6 display the transfer rate coefficients dividing the sample into rural and non-rural groups. The rural group consists of districts with at least 96% of housing on rural land, as defined by the 1990 Census. This is a natural cutoff point, since all other districts have less than 70% of their housing on rural land. The impact of incoming transfer students is only significant for non-rural districts. This finding is consistent with the idea that the supply of housing within an entire district in rural

Table 6
Further evidence of capitalization: transfer rate coefficients dividing the sample based on district characteristics

	Test scores compared to scores of neighboring districts		Net transfer rate		Rural status	
	Below	Above	Negative	Positive	Rural	Non-rural
%IN91	−0.874	0.211	−0.487	−1.460	−0.129	−1.121
	(0.524)	(1.199)	(2.685)	(0.717)	(0.674)	(0.403)
%OUT91	2.104	0.857	2.097	1.635	1.871	0.601
	(0.891)	(2.174)	(0.695)	(2.667)	(0.833)	(0.858)
NONE_IN91	−0.039	−0.073	0.039	−0.240	0.011	−0.029
	(0.062)	(0.092)	(0.059)	(0.116)	(0.055)	(0.124)
$N =$	142	125	142	130	158	114
R-squared	0.79	0.74	0.80	0.68	0.71	0.89

Note. Capitalization effects controlling for construction: OLS regressions using same variables as column (5) of Table 3, with robust standard errors in parentheses.

areas is relatively elastic, so there are not large premiums related to local school quality.[16] The effect of exit opportunities in rural districts is significant and actually greater than the estimated impact for non-rural districts. Even if the supply of housing in rural areas is relatively elastic at the district level, it is likely that people locating in rural areas are fairly constrained when it comes to where they want to live (e.g., they would like to purchase a particular type of farm). Housing in one district that happens to be located next to another district with desirable schools might then become a valuable commodity, even though the demand for housing in the district with the desirable schools is unaffected. Overall, the evidence suggests that the capitalization resulting from the adoption of open enrollment affected both rural and non-rural districts in Minnesota.

Finally, to further ensure that the estimated capitalization effects are due to changes within local house markets rather than regional trends, I re-estimate the models of Table 3 with the addition of regional fixed effects. In Minnesota, school districts are located in thirteen economic development planning regions, used by the state for public finance purposes. The estimated transfer coefficients remain nearly identical to those in Table 3 when one controls for regional fixed effects. For example, the model analogous to column (3) of Table 3 yields a −1.12 incoming transfer rate coefficient (0.75 standard error) and a 1.65 outgoing transfer coefficient (0.76 standard error). The model analogous to column (5) of Table 3 yields a −0.78 incoming transfer rate coefficient (0.57 standard error) and a 1.733 outgoing transfer coefficient (0.72 standard error). School choice opportunities in local markets appear to be directly responsible for changes in house prices in nearby communities.

[16] Hilber and Mayer [14] find that the correlation between public school expenditures and the fraction of the population who are elderly is only negative in geographic areas with low residential density and in areas located outside of Metropolitan Statistical Areas. This finding suggests that citizens may recognize that capitalization effects related to school quality are only important in densely-populated areas, where the supply of housing is relatively inelastic.

6. Discussion of results

Both incoming and outgoing transfer rates have large, statistically significant effects on the future growth rate of a school district's residential property values. The estimated coefficients are in the direction predicted earlier in the paper. These results represent deviations from previous district-level property growth trends, and the results remain robust when controlling for coincidental changes in the perceived quality of schooling and for sample selection. A one standard deviation in initial outgoing transfer rates is associated with an increase in house prices of more than three percent, and a one standard deviation increase in initial incoming transfer rates is associated with a decrease in house prices of about three percent. These effects suggest non-trivial impacts on the wealth of homeowners resulting from the expansion of school choice.

The magnitudes of the house price effects are somewhat larger than one might expect based on the previous literature on the demand for schooling. For example, in comparison with Downes and Zabel [9] or Black's [4] house price elasticity estimates, a one percentage point increase in the amount of initial exiting from a district is respectively worth the equivalent of about a 1.7 percent or 3.4 percent average test score increase at the local school. Also, consider Bogart and Cromwell's [5] finding that "better" school districts in the Cleveland area translate into about a 20% increase in house prices. Since only a limited fraction of children actually end up attending a "better" district under open enrollment, the price elasticity of housing with respect to the average quality of schooling in a district would have to equal about eight in order for these open enrollment capitalization effects to correspond with Bogart and Cromwell's estimates. By raising house prices by more than three percent, a one standard deviation (e.g., 2 percentage point) increase in the amount of initial exit transferring led to similar capitalization as if 16% of the housing was redistricted to the "better" district. The key difference between previous studies' estimates and this paper's estimates is that house prices might be more easily affected by the "best" public schooling offered than by the "average" public schooling offered. For example, suppose that housing generally sells at prices slightly greater than the expected willingness to pay of the second-highest bidder within a certain amount of time. Even if they were not directly concerned with using transfer opportunities for their children, people may have expected an initial exit transfer rate equal to two percent to signal that, on average, the second-highest bidder was willing to pay about 3.4% more than in the absence of the open enrollment program.

As mentioned previously, these house price effects also provide very rough estimates of the welfare effects of the adoption of open enrollment. A one percentage point increase in initial outgoing transfer rates is associated with an increase in house prices of about 1.7 percent and a one percentage point increase in initial incoming transfer rates is associated with a decrease in house prices of about 1.0 percent. Weighting districts by their total residential property wealth, the average incoming transfer rate was about 14% higher than the average outgoing transfer rate. Since the estimated coefficient for the incoming transfer rate was about 40% smaller in magnitude than for the outgoing transfer rate, this means that the total impact of exiting transfers was greater in magnitude than the total impact of incoming transfers. Statewide average house price thus increased due to the adoption of open enrollment. This provides loose evidence of a positive aggregate welfare gain associ-

ated with the weakening of school district boundaries under Minnesota's open enrollment program. For a variety of reasons, one should apply this finding very cautiously when considering whether other states should adopt similar programs. House price effects are only rough approximations of welfare effects, because changes in house prices will depend on the elasticity of supply and the elasticity of demand. Furthermore, the difference between the magnitude of the incoming and outgoing transfer rate coefficients is not statistically significant. In addition, the open enrollment program could possibly have positive and/or negative effects on schools' quality. Finally, welfare effects may have undesirable, irreversible distributional consequences.

In addition to estimating changes in the average values of preexisting homes, this paper estimates capitalization effects that are directly relevant to changes in school district revenue in Minnesota. In 1998, the median district's property tax base was composed of about 40% residential property. The impact of transferring on residential property wealth may counteract the impact of the loss or gain of funding associated with losing or gaining students. For instance, consider a district that is at the median in terms of size. This median-sized district has approximately 1000 students and an adjusted tax base of about $2,000,000 (which is proportionally lower than the actual value because property is assessed at a fraction of market value). For each student who leaves, the district loses roughly $3000 in state revenue. However, they will also enjoy savings from not having to serve as many students. In addition, following the findings of this paper, the district will enjoy growth in property values due to student exit opportunities. This will increase the district's local tax revenue, though this effect will be mitigated by an increase in the district's financial obligations to the state. Districts must pay 26.3% of their adjusted tax base to the state every year. This median-sized district has a local adjusted tax rate of roughly 60%. So, the net gain in school revenue from capitalization for this district would be 33.7% (60% minus 26.3%) of the increase in the adjusted property tax base.[17]

Based on the estimated exit transfer rate coefficient in column (3) of Table 3, this district would gain approximately $440 in revenues from the capitalization effects associated with one additional student wanting to exit. The net cost to the district of student exit resulting from the adoption of the open enrollment policy equals $3000 minus $440 minus the average marginal cost of serving the transfer students. Therefore, plausible estimates of this average marginal cost suggest that a "losing" district may not actually lose much financially due to the open enrollment policy. If the average marginal cost of serving the exiting students equals $2000, then capitalization effects decrease the financial loss to a district by almost 50%, so that this loss equals only $560 per exiting student. Similarly, a "gaining" district may not gain much financially from the open enrollment policy. Based on the estimated entrance transfer rate coefficient in column (3) of Table 3, the district with median characteristics would expect to lose about $300 in revenues due to capitalization effects associated with one additional student transferring into their district. These estimates only reflect changes in tax bases due to the weakening of district borders. To obtain

[17] During the sample period, there was no observed relationship between transfer rates and changes in districts' property tax rates. Most Minnesota districts only hold property tax referenda about once every eight years. In the longer run, if local property tax rates are inversely related to changes in the property tax base, then this would diminish the effect of open enrollment on district revenues.

better estimates of the financial impact on individual districts due to all aspects of the policy change, one would want to also consider changes in student composition, changes in perceived quality, and changes in the preferences of the median voter (see footnote 17) as a result of open enrollment.

One would expect potential capitalization effects to influence people's attitudes towards school choice programs and schools' participation in them. It seems reasonable that a homeowner would vote against a school choice proposal that would reduce the value of her home. It also seems reasonable that some districts in Minnesota may be less willing to admit transfer students due to capitalization effects. The district administrators could face political pressure from district residents to limit transfer spaces. In addition, the administrators might fear that accepting transfers would eventually weaken their tax base. The relationship between schooling options and property values could thus prevent school choice proposals from being passed or could limit the size of established choice programs. Given the size of the house price declines in Minnesota, school district superintendents there may have felt compelled to comply with the state's law by admitting at least some students. Otherwise, it is hard to imagine why they would have taken action that would not significantly increase local revenues and would have a non-trivial, negative effect on the property wealth of their constituents. Actually, as shown in Table 7, admitting transfer students does not appear to weaken a superintendent's job security, even when this causes a non-trivial drop in local residents' house prices. One possible explanation is that local homeowners blame the state, rather than the local superintendent, for this policy that reduces their properties' values. Another possibility is that these superintendents who admit transfer students have built up sufficient political capital by running a popular school district in the first place. The entrance of transfer students will only partially erode the housing premium associated with popular schools.

Aside from open enrollment programs, other school choice programs, such as private school vouchers or charter schools, could also affect property values. To the extent that housing in popular and unpopular school districts are close substitutes, property values should rise in districts where students enjoy their new opportunities to attend charter or voucher schools. If an unpopular local public school is only losing a moderate fraction of

Table 7
The impact of house price changes due to incoming transfer students on the turnover rate of superintendents

	Coefficient	St. err.
Percentage point change in property values due to incoming transfer students[a]	1.6	2.9
Constant term	0.21	0.08

Notes. Probit model estimates, with the dependent variable equal to 1 if the district's superintendent changed between 1990–1991 and 1995–1996 and equal to 0 if the superintendent remained the same during this period. Number of observations = 259.

[a] The "percentage point decline in property values due to incoming transfer students" is calculated as follows: (i) Run the OLS regression identical to column (5) of Table 3; (ii) Run a similar OLS regression to column (5) of Table 3 in which the %IN91 variable is omitted; and (iii) Subtract the estimated error terms in step (i) from the estimated error terms in step (ii).

Interpretation of probit result above: A decrease in property values due to incoming transfer students does not have a statistically significant effect on superintendent turnover; in fact, this is associated with a statistically insignificant decrease in the probability of superintendent turnover.

students, then this school might not be much worse off after the policy change. This would depend on the details of the school finance system, the peer effects associated with the exiting students, and any potential reputation effects.

This paper's results do not discredit the idea that the adoption of a school choice program can create incentives that cause school districts to improve. Districts that are initially losing students might wish to recapture the lost state aid associated with these students. These districts might also fear that high exit rates lead residents and potential homebuyers to lower their opinion of the school district's quality. For these reasons, the district might wish to improve in order to retain more students. Similarly, under an inter-district open enrollment program, a district might wish to improve to attract transfer students and thus gain more state aid or prestige. However, the results here do cast doubt on whether the adoption of a school choice program imposes accountability by financially punishing or rewarding districts for *preexisting* differences in popularity. If only a moderate fraction of students exit, then the adoption of choice might have relatively small financial effects on unpopular schools.

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