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Edited by Gregory K. Ingram and Daphne A. Kenyon



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Education, Land, and Location

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School Quality, School Choice, and Residential Mobility

Eric J. Brunner

For households with children, perhaps the most important service provided by local governments is public education. Thus, it is not surprising that if one asked parents why they chose to live where they do, their responses would likely include (among other things) the quality of schooling offered in their community. For example, among parents who responded to the 1993 National Household Education Survey (NHES), 47 percent stated that their residential location choice was influenced by where their child would go to school (McArthur, Colopy, and Schlaline, 1995), and in the 2007 NHES, the parents of 27 percent of public school students responded that they specifically moved to their current neighborhood to gain access to their desired public school (Grady and Bielick, 2010).

While the notion that households base their residential location decisions at least in part on the quality and variety of services offered by local governments now seems rather self-evident, that was not always the case. As noted by Fischel (2006), it was not until after the publication of Charles Tiebout's (1956) seminal paper on local public expenditures that scholars began "connecting mobility with demand for the services of local government" (6). Since that time, Tiebout's central insight that mobile households "vote with their feet" by choosing the community that provides the bundle of public services that best matches their preferences has become a central feature of much of the theoretical and empirical local public finance literature. The central aim of this chapter is to lay out what that literature has to say about the link between residential location decisions and the quality of public education, one of the most important services offered by local governments.

Over the past four decades, an extensive body of literature documenting the link between school quality and residential location decisions has emerged. Most of that literature focuses on settings where students are assigned to schools based on a strict residential-based assignment system. Under such a system, a family wishing to send their child to a particular public school must establish residency within the boundaries of the school's assignment zone. Residential-based assignment systems were nearly universal in the United States prior to the early 1990s and remain the dominant form of school assignment in most of the country.

The first section of this chapter explores the literature that examines the link between school quality and household location decisions under a residential-based assignment system. In particular, the results of three broad classes of studies are surveyed: (1) those that examine how school quality affects the ways in which households are distributed across schools and communities; (2) those that employ discrete choice models to examine the extent to which school quality influences residential mobility patterns; and (3) those that exploit natural policy experiments such as school desegregation, school assignment zone changes, and school finance reform to examine how changes in school quality affect residential mobility patterns.

While residential-based assignment systems are still the primary method used to assign students to schools, the school choice options available to families have expanded dramatically since the early 1990s. As an alternative to their residentially zoned public schools, parents in many states can now take advantage of charter schools, magnet schools, inter- and intradistrict choice plans, and vouchers to attend private schools. A common feature of all school choice policies is that they decouple (at least to some extent) the strict link between residential location and the quality of education available to families. As a result, such policies have the potential to affect the residential location decisions of households and thus housing values. The second part of this chapter surveys the emerging theoretical and empirical literature that examines how school choice policies that decouple the link between school quality and residential location affect housing markets and residential mobility.

School Quality and Mobility with Residential-Based Assignment Systems

As noted by Nechyba (2006), because residential-based assignment systems explicitly link access to high-quality schools to a household's residential location decision, such systems create a strong link between school and housing markets, with housing markets acting as a substitute "for a public school tuition market by pricing or 'rationing' access to most public schools" (10). Specifically, homes located in areas with high-quality schools tend to command a significant price premium over identical homes located in areas with lower-quality schools,

making the price of a home the implicit price of access to a high-quality public education.

Oates (1969) was the first to recognize the link between school and housing markets that is implicit in Tiebout's (1956) assertion that households vote with their feet. In his seminal paper on capitalization, Oates (1969) reasoned that if households sort across communities in the manner suggested by Tiebout (1956), homes located in communities offering higher-quality public services or lower taxes (all else being equal) should be more attractive to potential residents and thus command a price premium over similar homes located in less desirable communities. Based on a sample of 53 New Jersey municipalities, Oates found evidence consistent with his predictions: homes located in municipalities with higher expenditures per pupil or lower property tax rates had higher housing values.

Since Oates (1969), a large and growing body of literature has emerged that examines the extent to which school quality is capitalized into housing values. Ross and Yinger (1999) surveyed early (pre-2000) studies in this literature and concluded that the vast majority found that school quality was capitalized into housing values. More recently, Nguyen-Hoang and Yinger (2011) provided a comprehensive review of 50 school quality capitalization studies conducted since 1999 and concluded that while studies have employed different data and different methodologies, "these studies provide remarkably similar results, namely that house values rise by 1–4% for a one-standard-deviation increase in student test scores" (46).¹

SCHOOL DISTRICT CHOICE AND RESIDENTIAL STRATIFICATION

While the capitalization of school quality into housing values provides evidence consistent with Tiebout's (1956) hypothesis that households vote with their feet, that evidence is nevertheless rather indirect. In particular, capitalization studies tell us very little about how school quality affects residential sorting patterns or the stratification of households across communities. In light of that fact, a number of scholars have proposed alternative approaches to testing Tiebout's hypothesis that households sort across communities based on their demands for public services.

One alternative test is to examine whether households with similar demands for public services cluster together in the same communities, or more specifically, whether there is evidence that households stratify across communities based on their demands for public services. Eberts and Gronberg (1981) conducted such a test by examining whether the positive correlation between income and demand for local public services leads to income stratification across communities.

1. In one of the most recent and comprehensive capitalization studies to date, Gibbons, Machin, and Silva (2013) found that a one-standard-deviation increase in student achievement raised home prices by approximately 3 percent, an estimate that is quite robust to a wide array of specification and falsification tests.

Specifically, they hypothesized that if households sort across communities in the manner suggested by Tiebout (1956), metropolitan areas that contain a greater number of school districts should also exhibit a greater degree of income stratification. Using data from the 1970 census on the distribution of income within school districts located in 34 metropolitan areas, they found evidence consistent with that hypothesis: as the number of school districts in a metropolitan area increased, the degree of income heterogeneity (as measured by a Theil index) within districts declined.²

Several studies have also examined whether Tiebout sorting leads to stratification along dimensions other than income. For example, Clotfelter (1999) used data on the racial and ethnic composition of public schools located in 331 metropolitan areas in 1994–1995 to examine the extent of racial segregation across school districts. His results suggest that metropolitan areas that contain a greater number of school districts tend to be more racially segregated.³ More recently, Urquiola (2005) examined how the number of school districts in a metropolitan area affected both racial and educational attainment stratification across school districts. As he noted, isolating the effect that district choice (i.e., the number of districts) has on household sorting patterns is difficult because the number of districts in a metropolitan area is likely correlated with other unobservable factors that also affect the extent to which households sort across communities. To address that issue, Urquiola exploited the fact that many metropolitan areas actually contain two types of school districts—elementary and high school districts. By exploiting variation across metropolitan areas in the difference in the number of elementary and high school districts, his identification strategy effectively differenced out any metropolitan area unobservables that might otherwise have confounded his findings. His results suggest that the degree of racial and educational attainment stratification across school districts tends to be more pronounced in metropolitan areas that contain a larger number of school districts.

In an important contribution to the literature, Epple and Sieg (1999) developed a structural model of residential sorting in which households differ in

2. Hamilton, Mills, and Puryear (1975) found similar results using a Gini index to measure income inequality at the census-tract level. Using data from New York on voter demand for school spending, Munley (1982) found that as the number of school districts within New York counties increased, within-district heterogeneity in the demand for school spending declined. Gramlich and Rubinfeld (1982) used individual survey data from Michigan to compare the variance in public spending demands within local communities to the variance in spending demands for the state of Michigan as a whole. Consistent with Tiebout sorting, they found that households with similar preferences for local spending (both observed and unobserved) tended to cluster together in the same communities. See Oates (2006) for a more general review of studies that attempt to test the Tiebout hypothesis.

3. Bischoff (2008) reached a similar conclusion using data from the 2000 census on the racial and ethnic composition of school districts located in 304 metropolitan areas.

terms of both income and their “tastes” for public services. The model predicts that in equilibrium, households will be stratified across communities on the basis of both income and tastes for public services⁴ and that the ranking of communities should satisfy an “ascending bundles” property, whereby household income (measured by the median, mean, or any other percentile) and housing values ascend in the same order as the quality of public services. Using data from 92 municipalities in the Boston metropolitan area in 1980, Epple and Sieg found evidence consistent with those predictions. Specifically, they found that the observed distribution of households across communities matched quite closely the distribution predicted by their model and that, consistent with the ascending bundles property, both income and housing values ascended in the same order as school quality. Perhaps more important, however, their results also revealed a significant degree of income heterogeneity within communities: 89 percent of the variation in income within the Boston metropolitan area was due to within-school-district variation rather than across-district variation. Thus, their results suggest that while Tiebout sorting leads to income stratification, “unobserved heterogeneity in preferences for public goods is quite substantial” (673).⁵

EVIDENCE ON RESIDENTIAL MOBILITY FROM DISCRETE CHOICE STUDIES

Perhaps the most obvious way of testing Tiebout’s (1956) hypothesis that households sort across communities based on their demand for publicly provided services is to directly examine whether the residential location decisions of households are influenced by the quality of public services offered in different communities. Studies that take this approach typically analyze sorting patterns by modeling a household’s residential location decision as a discrete choice. Nechyba and Strauss (1998) used this approach to examine how school quality affected the residential location decisions of households in Camden County, New Jersey. Using data on approximately 90 percent of all homeowners living in six school districts, they found evidence consistent with the notion that public school quality (as measured by spending per pupil) influences household residential choices: a 1 percent increase in spending per pupil is estimated to increase the probability

4. In particular, while Tiebout sorting leads to income stratification, such stratification is not complete. A community providing high-quality public services may contain both high-income households with relatively weak preferences for public services and low-income households with relatively strong preferences for public services.

5. More recently, Epple, Peress, and Sieg (2010) developed and estimated a semiparametric version of the residential sorting model of Epple and Sieg (1999). Using data from the Pittsburgh metropolitan area, they found significant differences in the sorting patterns of households with and without children. Specifically, their results suggest that households with children are more sensitive to interjurisdictional differences in school quality and crime than households without children and, furthermore, that households with children exhibit more stratification by income than households without children.

that a household will choose to live in a particular community by between 1.7 and 3.1 percent.⁶

Barrow (2002) used a discrete choice model to examine how school quality affected household residential location decisions in Washington, DC. Consistent with the notion that households sort across communities based on their demand for school quality, she found that the probability of choosing a location with higher school quality increased with both household income and educational attainment, particularly among households with children. Her results suggest that higher school quality leads to sorting across neighborhoods, with the highest-income and best-educated households sorting into neighborhoods with the highest school quality.

Bayer, Ferreira, and McMillan (2004, 2007) developed a general equilibrium model of residential sorting in which households have preferences defined over school quality and the sociodemographic characteristics of their neighbors.⁷ Using individual-level census data from the San Francisco Bay Area, they found compelling evidence that households sort across school attendance zone boundaries, with higher-income and more highly educated households sorting into attendance zones with higher school quality. Their results also suggest that households have strong self-segregating preferences, leading to significant sorting on the basis of income, education, and race. The combination of heterogeneous demand for school quality and heterogeneous preferences for neighbors leads to what Bayer, Ferreira, and McMillan (2007) termed the “social multiplier effect” of increased school quality. According to these researchers, an exogenous increase in school quality leads to re-sorting across neighborhoods on the basis of income, race, and educational attainment that reinforces the initial effect that changes in school quality have on housing values and community composition. As a result, initial changes in school quality set in motion a self-reinforcing sorting process that leads to substantial stratification along both racial and socioeconomic dimensions, with white, highly educated, and high-income households sorting into neighborhoods that contain the highest-quality schools.

To gain some insight into how important school quality is in determining the degree of residential segregation across metropolitan areas, Bayer, Ferreira, and McMillan (2004) used the results from their general equilibrium sorting model to simulate what would happen to the degree of segregation if household preferences

6. In a more recent study, Bayoh, Irwin, and Haab (2006) reached a similar conclusion. Using a discrete choice model to examine household residential location choices in the central city and the suburbs, they found that among community characteristics, school quality had the largest impact on community choice: a 1 percent increase in the quality of central city schools increased the probability of choosing a city residence by 3.7 percent.

7. Specifically, Bayer, Ferreira, and McMillan (2004, 2007) developed a random utility model of residential choice based on the framework suggested by Berry, Levinsohn, and Pakes (1995). Their methodology combined structural and instrumental variable methods to identify a household’s willingness to pay for school quality and neighborhood amenities.

for school quality were “turned off.” Their results suggest that if households did not sort on the basis of school quality, income stratification would decline by approximately 25 percent and stratification based on educational attainment would decline by over 30 percent.

RESIDENTIAL LOCATION RESPONSES TO SCHOOL DESEGREGATION AND ASSIGNMENT ZONE CHANGES

In recent years, a growing number of studies have begun to provide quasi-experimental evidence on how changes in school quality and the socioeconomic and racial composition of schools affect residential mobility patterns. These studies, which exploit variation in the timing of court-ordered school desegregation, variation in the historical settlement patterns of immigrants, and quasi-random changes in school assignment zones, provide compelling evidence on how changes in perceived school quality affect residential mobility patterns.

Reber (2005) and Baum-Snow and Lutz (2011) exploited the arguably random timing of court-ordered school desegregation during the 1960s and 1970s to examine how exogenous changes in school quality and the racial composition of schools affected residential mobility patterns. Both studies found that court-ordered desegregation led to an approximately 6–12 percent decline in white student enrollment in central city schools, a decline that was primarily driven by the migration of white households to suburban districts. Furthermore, Reber (2005) found that this white flight was particularly severe in metropolitan areas that contained a larger number of school districts, while Baum-Snow and Lutz (2011) found that white flight was most pronounced among households with school-age children. In addition, Baum-Snow and Lutz documented that while court-ordered desegregation caused white households to migrate to the suburbs, it also led to the in-migration of African American households to central city districts.

Cascio and Lewis (2012) examined how immigration-induced changes between 1970 and 2000 in the share of limited English proficient (LEP) Hispanic children living in California school districts affected the residential mobility patterns of non-Hispanic households with children. To account for the potentially nonrandom nature of immigrant inflows into school districts, Cascio and Lewis instrument for the share of LEP immigrant children in a school district using historical Mexican settlement patterns. In addition, to isolate the causal effect of immigration on the residential location decisions of non-Hispanic households with children, Cascio and Lewis compared changes over time in the residential location patterns of non-Hispanic households with school-age children versus those of non-Hispanic households without school-age children. Their results suggest that increased exposure to LEP Hispanic immigrant children has a substantial effect on the residential location decisions of non-Hispanic households with children. Specifically, they found that “between 1970 and 2000, the average California school district lost more than 14 non-Hispanic households with chil-

dren to other districts in its metropolitan area for every 10 additional households enrolling low-English Hispanics in its public schools” (91).⁸

Weinstein (2012) and Liebowitz and Page (2012) used data from the Charlotte-Mecklenburg public school district to examine the effects of school redistricting on residential sorting patterns. Prior to 2001, in order to comply with court-ordered desegregation, school attendance zones in this district were drawn in a way that would ensure racial balance in the public schools. Following a court order to cease busing for racial integration in the fall of 2001, school attendance boundaries were radically redrawn so that each student was guaranteed admission to a school close to his or her residence.⁹ As a result, in 2002 approximately half of all the families in the district were assigned to new schools.

Weinstein (2012) and Liebowitz and Page (2012) exploited this unique natural policy experiment to estimate the causal effect of these policy changes on residential location decisions. The results of both studies suggest that redistricting had a large effect on the residential location decisions of white households. Specifically, Liebowitz and Page (2012) found that the redrawing of school attendance zones and the move to neighborhood-based schools increased the odds by over 50 percent that a white household with children would relocate to a neighborhood that had a greater percentage of white households than their original neighborhood. Weinstein (2012) reached a similar conclusion. His results suggest that the policy shift led white households to move out of school attendance zones that experienced an increase in the percentage of black residents after the school boundary changes and move into attendance zones that experienced a decline in the percentage of black residents.

RESIDENTIAL LOCATION RESPONSES TO SCHOOL FINANCE REFORM

The Tiebout model assumes a decentralized system of local governments each providing a unique mix of public services and taxes that mobile households can choose from. In many respects, the decentralized system of local school districts that personifies the provision of K–12 education in the United States is a classic example of the Tiebout model. Since the 1970s, however, the constitutionality of that system, or more precisely disparities in the distribution of school funding across districts that typically arise under a decentralized system of school finance,

8. Cascio and Lewis (2012) also found that increased concentrations of LEP Hispanic immigrant children within school districts led to an increase in the private school enrollment rate of non-Hispanic households. Similarly, Brunner, Imazeki, and Ross (2010) found that white households with children were significantly more likely than nonwhite households with children and households without children to vote in favor of a California referendum that would have provided universal vouchers for students to attend private schools if they resided in a school district with higher concentrations of LEP Hispanic students.

9. The year 2002 was also the first year the Charlotte-Mecklenburg school district introduced a districtwide school choice plan that allowed students to attend schools other than their assigned schools. Access to oversubscribed alternative schools was rationed through a lottery.

has been challenged in state supreme courts across the nation. Beginning with the 1971 landmark decision in *Serrano v. Priest*,¹⁰ in which the California Supreme Court ruled that California's system of public school finance was unconstitutional, nearly every state has faced challenges to its system of public school finance. In response to those challenges, many states have significantly reformed their systems of public school finance, typically by equalizing spending per pupil across school districts.

Nechyba (2003b) used a computable general equilibrium model to simulate the effects of moving from a purely decentralized (locally financed) system of school finance to a purely centralized (state-financed) system in which all districts receive the same level of spending per pupil. His simulation results suggest that equalizing spending per pupil across districts has only a modest effect on residential income segregation. Specifically, although moving to a purely centralized system of school finance reduces income disparities across rich and poor school districts, the effects are quite small. As noted by Nechyba (2010), this result may stem from the fact that school spending represents only one of the critical inputs to school quality. To the extent that school quality (or parents' perceptions of school quality) depends on other factors (e.g., peer quality) that are correlated with income, equalizing spending per pupil will not equalize school quality and thus should not be expected to induce large changes in the residential location decisions of households.¹¹

Several scholars have used the natural experiments brought about by school finance reform to empirically examine how the equalization of spending per pupil across school districts affected property values and residential location decisions. Aaronson (1999) explored the effects of school finance reform on within-district income heterogeneity. As he noted, since school finance reform tends to reduce spending disparities across school districts, most commonly by increasing the amount of state aid provided to low-spending districts, households have less incentive to sort across districts after reform. Consequently, school finance reform should lead to a decline in residential income segregation and hence an increase in within-district income heterogeneity.¹² Using data on all school districts in the United States in 1976 and 1990, he found only weak evidence that school finance reform reduced the degree of residential income stratification across districts, a finding consistent with the simulation results of Nechyba (2003b).

10. *Serrano v. Priest*, 5 Cal. 3d 584 (1971).

11. Hanushek and Yilmaz (2013) also used a calibrated general equilibrium model to examine the effects of school finance reform policies and expenditure equalization on residential location choices. Similar to Nechyba (2003b), they found that equalizing school spending does not equalize school quality because of peer effects.

12. Nechyba (2003b) also makes this point, and his simulation results are consistent with that prediction. Specifically, he found that moving from a purely locally financed system to a purely state-financed system increases within-district income heterogeneity, as some higher-income households now find it more attractive to live in previously low-spending districts.

Dee (2000) explored the effect of school finance reform on housing values and residential rents. Using district-level census data from 1970, 1980, and 1990, he first demonstrated that court-ordered school finance reform significantly increased per pupil spending in the poorest school districts, as states responded to court-mandated changes by significantly increasing state aid to those districts. Dee then showed that the increase in state aid brought about by court-ordered reform was capitalized into housing values and residential rents. Specifically, his results suggest that court-ordered school finance reform may increase housing values and residential rents in the poorest districts by approximately 8 percent. Brunner, Murdoch, and Thayer (2002) reached a similar conclusion using residential housing sales data from Los Angeles County for the years 1975, 1980, 1985, and 1990. Specifically, they found that reform-induced changes in spending per pupil were capitalized into housing values: a 1 percent increase in spending per pupil was associated with approximately a 4 percent increase in housing values.

Three more recent studies, Epple and Ferreyra (2008), Ferreyra (2009), and Chakrabarti and Roy (2012), focused specifically on Michigan's experience with school finance reform. In 1994, Michigan radically overhauled its system of public school finance in response to voter discontent over high property tax rates. As noted by Epple and Ferreyra (2008), the 1994 reform had two major objectives: reduce property tax burdens and reduce revenue disparities across school districts. To accomplish those objectives, Michigan effectively transferred the authority for financing K–12 spending from local school districts to the state by lowering school district property tax rates and replacing lost property tax revenue with state sales tax revenue. As a consequence, the share of school funding coming from the state rose from 31.3 percent in 1993 to 77.5 percent in 1997 (Chakrabarti and Roy 2012). To equalize expenditures across districts, the state substantially increased aid to low-wealth districts and constrained the spending of high-wealth districts.

Epple and Ferreyra (2008) and Ferreyra (2009) analyzed the effects of school finance reform in Michigan on housing values and neighborhood demographic composition within the Detroit metropolitan area. Both studies found that while the property tax reductions that accompanied school finance reform were capitalized into housing values, reform had little impact on household location decisions or neighborhood demographic composition. The results of these studies appear to reinforce the conclusion reached by Nechyba (2003b): to the extent that school quality depends heavily on factors other than spending such as peer quality, equalizing financial resources across districts is unlikely to equalize school quality and thus will not substantially affect residential sorting behavior.

One limitation of Epple and Ferreyra (2008) and Ferreyra (2009) is that their analysis focused solely on the Detroit metropolitan area, which experienced much smaller revenue changes as a result of school finance reform than other parts of the state. More recently, Chakrabarti and Roy (2012) examined the effects of school finance reform in Michigan using district-level data for the entire state.

Using a difference-in-differences estimation strategy, they found that school finance reform led to an increase in home values in previously low-spending districts and a reduction in income and educational attainment stratification across districts. Specifically, their results suggest that following reform, within-district income and educational attainment heterogeneity rose in previously low-spending districts, suggesting that reform induced some higher-income and better-educated households to move into these districts. Nevertheless, they found evidence of significant stratification across school districts in terms of income, educational attainment, and housing values after school finance reform. Thus, consistent with the results of Nechyba (2003b), Epple and Ferreyra (2008), and Ferreyra (2009), their results further reinforce the point that equalizing school financial resources is unlikely to equalize school quality and therefore is unlikely to significantly reduce residential segregation patterns.

School Choice and Residential Mobility _____

As noted previously, under a residential-based assignment system, access to high-quality schools is rationed through housing markets. Homes located in high-quality school districts or school attendance zones sell at a premium, making the price of a home the implicit price of access to high-quality public schools. Tiebout sorting then leads to households stratifying across communities according to their willingness to pay for school quality, thus leading to stratification across communities by income and educational attainment, with highly educated and high-income households sorting into the communities that have the highest-quality schools.

The court-ordered and legislatively induced school finance reforms of the 1970s and 1980s were an attempt to equalize school quality by equalizing spending across school districts. While those reforms were generally successful in equalizing financial resources across schools, there are several reasons they were significantly less successful in equalizing school quality. First, it is now widely recognized that equalizing financial resources across schools will not equalize school quality unless the equalization of financial resources also leads to the equalization of other inputs to school quality such as peer and teacher quality (Nechyba 2010). Second, school finance reforms did little to sever the strong link between school and housing markets, primarily because they did not alter the mechanism by which students were assigned to schools, namely via a residential-based assignment system. While households located in states with significant school finance equalization schemes can no longer sort across communities based on variation in spending per pupil, they continue to sort based on other inputs to school quality such as peer and teacher quality. Furthermore, since the quality of these nonfinancial inputs tends to be positively correlated with income, households continue to stratify by income across communities, with the highest-income and most highly educated households sorting into the communities that contain the highest-quality schools.

The school choice movement, which began in the 1960s and gained more widespread acceptance in the 1990s, is in many ways based on the premise that the equalization of school quality across communities can be achieved only by severing the link between residential location and school assignment and thus moving away from a strict residential-based assignment system.¹³ To that end, over the past several decades states have begun adopting policies designed to decouple the link between residential location and schooling options. As an alternative to residentially zoned public schools, parents in many states can now take advantage of charter schools, magnet schools, inter- and intradistrict choice plans, and vouchers to attend private schools.¹⁴ This section provides a brief overview of the school choice options available to households, then surveys the emerging theoretical and empirical literature that examines how school choice policies that decouple the strict link between school quality and residential location affect housing markets and residential mobility.

PUBLIC SCHOOL CHOICE PROGRAMS

According to the National Center for Education Statistics, between 1993 and 2007 the number of students who attended residentially zoned public schools declined from 80 percent to 74 percent (Grady and Bielik 2010). Nearly all of this decline can be attributed to the expansion of public school choice programs. In terms of enrollment, the largest such programs are charter schools, magnet schools, and intra- and interdistrict choice plans. Magnet schools, which were introduced in the 1960s largely in response to court-ordered school desegregation, represent one of the earliest attempts to broaden the public school choice options available to parents. As noted by Miron and Welner (2013), magnet schools are “designed to reduce racial and ethnic segregation in school districts or provide an academic or social focus on a particular theme” (11). Unlike traditional public schools, magnet schools typically do not have attendance zones and thus are open to all students within a district (and in some cases students from other districts) regardless of residential location. As of 2010–2011, approximately 4 percent of all public school students attended a magnet school.

Charter schools represent one of the fastest-growing forms of public school choice. Minnesota established the first two charter schools in 1992; by 2010, the number of charter schools nationwide had risen to 5,274. While traditional public schools are governed by local school boards, charter schools operate as

13. In the commentary to this chapter, Charles Clotfelter points out that equity may not have been the only or even the primary objective of the school choice movement. An alternative interpretation of the movement posits that it was designed not only to promote equity but also to reduce government bureaucracy and the role teachers' unions play in the provision of K–12 education.

14. Homeschooling is also an option available to parents. According to Bielik (2008), the number of parents choosing to homeschool their children rose from approximately 850,000 in 1999 to 1.5 million in 2007.

independent entities and are typically exempt from many of the regulations imposed on traditional public schools. Furthermore, similar to magnet schools, charter schools tend to have much broader attendance zones than traditional public schools, with attendance being open to all students within a district, and in some cases nearby districts, regardless of a student's residential location. As of 2010–2011, approximately 3.7 percent of all public school students attended a charter school. While that represents a relatively small proportion of students, there is quite a bit of variation in charter school attendance rates across states. In 2010–2011, for example, 11.8 percent of public school students in Arizona and 9 percent of public school students in Colorado were enrolled in charter schools. Table 3.1 lists the states that allow charter schools and the years of the authorizing legislation. As of 2013, all but eight states had passed laws authorizing the establishment of charter schools, with the majority of states passing this legislation during the 1990s.

Inter- and intradistrict choice plans have also expanded dramatically since the 1990s. Interdistrict choice plans allow students to cross district boundaries and attend schools in nearby districts. Similarly, intradistrict choice plans, also commonly called open-enrollment plans, typically allow students to attend any school within the boundaries of a school district, regardless of their residential location. Table 3.1 lists the states with voluntary or mandatory intra- or interdistrict choice plans as of 2013 and the years of the authorizing legislation.¹⁵ While no comprehensive data on enrollment in inter- and intradistrict choice plans are available, according to Lavery and Carlson (2012), in 2012 these programs served more students than any other public school choice program, including charter schools, magnet schools, and school vouchers. As with charter schools, enrollment in inter- and intradistrict choice plans varies substantially across states, with participation typically being higher in states with mandatory policies. For example, in Colorado, Minnesota, and Nebraska, three states that adopted mandatory interdistrict choice plans during the early 1990s, interdistrict choice participation rates in 2008 were 7 percent, 18.8 percent, and 5.8 percent, respectively (Joint Committee on Education 2009).

School voucher programs and tuition tax credits have also grown in popularity since the 1990s. Both programs are designed to provide financial assistance to families wishing to send their children to private schools. Vouchers typically cover all or a fixed proportion of the expenses associated with attending private schools; tuition tax credits provide families with a tax deduction for those expenses. To date, voucher and tuition tax credit programs have typically been designed to serve students from low-income families, students with special needs,

15. Inter- and intradistrict choice plans can be either mandatory or voluntary. Mandatory policies require districts to admit incoming transfer students residing in other districts (interdistrict) or in other attendance zones (intradistrict), typically subject to capacity constraints. Voluntary policies allow districts to abstain from admitting nonresident students.

and students attending low-performing public schools. As of 2013, there were 16 voucher programs and 11 tuition tax credit programs in the United States (Glenn and Swindler 2013).¹⁶ While these programs have been growing in popularity, they nevertheless serve a very small proportion of school-age children: in 2012, school voucher and tuition tax credit programs served less than 0.5 percent of school-age children.

LESSONS FROM STRUCTURAL AND COMPUTABLE GENERAL EQUILIBRIUM MODELS

Over the past decade, a number of theoretical papers have begun to explore the effects of school choice programs on housing markets and residential sorting. In an important contribution to the literature, Nechyba (1999, 2000) developed a computable general equilibrium model to examine the effects on housing values and community composition of introducing private school vouchers into a previously residential-based school system. In his structural model, households sort across communities based on their income and their preferences for housing and school quality. Housing quality is assumed to vary exogenously both within and across school districts, while school quality is assumed to depend on both spending per pupil and peer quality, the latter of which is correlated with household income.¹⁷

Nechyba (1999, 2000, 2003a, 2003b) calibrated this theoretical model to data from either New Jersey or New York. For example, in 2000 he calibrated the model to three representative suburban school districts in New York. In the calibrated benchmark equilibrium, which assumes decentralized school finance and a residential-based assignment system, the calibrated levels of spending per pupil, household income, and housing values match relatively closely the observed levels of these variables for the representative districts. Specifically, consistent with Tiebout sorting, the benchmark equilibrium is characterized by income, school quality, and housing price stratification, with household income, housing prices, and spending per pupil all rising monotonically with school quality.

Nechyba (1999, 2000, 2003a, 2003b) used his model to simulate the effects of introducing private school vouchers into a previously residentially zoned school system. His simulation results suggest that voucher programs have the potential to significantly reduce income and housing value disparities across school districts. By decoupling the link between residential location and school quality, vouchers create an incentive for middle- and high-income families to move to less affluent districts in order to take advantage of lower housing values. As a result,

16. In 2012, there were also 11 special needs scholarship programs in the United States (Glenn and Swindler 2013).

17. See Nechyba (2006) for a more detailed overview and description of these models.

Table 3.1
School Choice Programs, 2013

State	Charter Schools	Interdistrict Choice		Intradistrict Choice	
		Year Enacted	Mandatory or Voluntary	Year Enacted	Mandatory or Voluntary
Alabama	—	—	—	—	—
Arizona	1994	1994	M	1994	M
Arkansas	1995	1989	M ^a	—	—
California	1992	1993	V	1993	M
Colorado	1993	1994	M	1990	M
Connecticut	1996	1998	M ^b	1996	V
Delaware	1995	1996	M	1995	M
Florida	1996	2002	V	1997	V ^c
Georgia	1993	2000	V	2009	M
Idaho	1998	1991	V	1993	M
Illinois	1996	—	—	1980	V ^d
Indiana	2001	1976	V	1995	V ^e
Iowa	2002	1989	M	—	—
Kansas	1994	1984	V	—	—
Kentucky	—	—	—	—	—
Louisiana	1995	2001	V	2006	V ^f
Maine	2011	2000	V	2012	V
Maryland	2003	—	—	—	—
Massachusetts	1993	1992	V	N/A ^g	V
Michigan	1993	1996	V	1992	V
Minnesota	1991	1989	M	1988	M
Mississippi	2010	2001	M	—	—
Missouri	1998	1993	V	2003	V
Montana	—	1993	V	—	—
Nebraska	—	1993	M	1976	V ^h
Nevada	1997	1967	V	—	—
New Hampshire	1995	1998	V	1998	V
New Jersey	1996	1999 ⁱ	V	—	—
New Mexico	1993	1978	V	1998	M ⁱ
New York	1998	1993	V	2003	V ^k
North Carolina	1996	—	—	—	—

Table 3.1
(continued)

State	Charter Schools	Interdistrict Choice		Intradistrict Choice	
		Year Enacted	Mandatory or Voluntary	Year Enacted	Mandatory or Voluntary
North Dakota	—	1993	V	—	—
Ohio	1997	1993	V	1993	M
Oklahoma	1999	1990	M	—	—
Oregon	1999	1991	V	2011	M
Pennsylvania	1997	1949	V	—	—
Rhode Island	1995	1956	V	—	—
South Carolina	1996	1976	V	—	—
South Dakota	—	1997	M	1997	M
Tennessee	2002	1992	V	1992	V
Texas	1995	1995	V	1995	V
Utah	1998	1993	M	1993	M
Vermont	—	2000	V ⁱ	—	—
Virginia	1998	1993	V	1993	V
Washington	2012	1993	M	1990	M
West Virginia	—	1985	V	—	V
Wisconsin	1993	1997	M	1975	V
Wyoming	1995	—	V	—	—

Note: Information on charter school policies comes from the National Center for Education Statistics. Information on intra- and interdistrict programs is based on state legislation that describes each state's relevant policies (using LexisNexis and state archives), as well as appendix B from Bierlein, Sloane, and Muhlolland (1993). To resolve cases in which policy details were not obvious, the authors contacted individual state departments of education.

^a Students allowed to apply for admission to a school in any district provided the transfer does not adversely affect the desegregation of either district.

^b In the 1998–1999 school year, the state began phasing in this open-enrollment program to improve academic achievement; reduce racial, ethnic, and economic isolation; and provide a choice of educational programs for students. During the 2001–2002 school year, the program became operational in every priority district in the state.

^c The 1997 state law requires school districts “to develop a controlled open enrollment plan” in order “to make student school assignments using parents’ indicated preferential school choice as a significant factor.”

^d Program is mandatory in Chicago public schools.

^e Program is mandatory in Indianapolis.

^f Policy is mandatory in New Orleans, where an open-enrollment policy was enacted after Hurricane Katrina in 2005.

^g No state policy, but many districts have developed their own policies. Most prominent are intradistrict choice in Boston (enacted in 1989) and intradistrict choice in Cambridge (enacted in 1981).

^h Policy is mandatory in 11 school districts within Douglas and Sarpy Counties, including the city of Omaha.

ⁱ Amended in 2010 to create the permanent Interdistrict Public School Choice Program.

^j If there is room in the school, students must be admitted in state-determined priority. First priority is resident students; second priority is students from low-performing schools.

^k Program is mandatory in Buffalo (enacted in 2004) and New York City high schools (enacted in 2003).

^l Program is mandatory in high schools.

residential income segregation declines, while housing values in low-quality districts rise and housing values in high-quality school districts fall.¹⁸

Ferreya (2007) built on Nechyba (1999, 2000) by developing and estimating a structural general equilibrium model of household sorting in which households have preferences defined over school quality, neighborhood attributes (e.g., quality of housing stock), and religious schooling. Ferreya (2007) used this structural framework to simulate the effect of introducing universal school vouchers into the Chicago metropolitan area. Similar to Nechyba (1999, 2000, 2003a, 2003b), she found that introducing school vouchers into a previously residentially zoned school system will lead to a reduction in income and housing value disparities across districts as “some voucher users migrate toward neighborhoods with relatively low tax inclusive housing prices and send their children to private schools, thus weakening the residential stratification of the current public school system” (Ferreya 2007, 791).

Epple and Romano (2003) developed a computable general equilibrium model to analyze the effects of districtwide open enrollment (intradistrict choice) on housing values and community composition. Similar to Nechyba (1999, 2000) and Ferreya (2007), Epple and Romano (2003) assumed that school quality depends on spending per pupil and the average ability (peer quality) of the students who attend a particular school. Furthermore, they assumed that household income and student ability are positively correlated. However, because their model focuses on a single school district that contains multiple neighborhood schools, spending per pupil is equalized across schools, implying that differences in school quality arise solely from differences in peer quality. With access to schools determined by a strict residential-based assignment system, Tiebout sorting leads to income stratification across neighborhoods, with the highest-income households residing in the neighborhoods that contain the highest-quality schools and the highest housing values.¹⁹

Epple and Romano (2003) then considered what happens to this stratified equilibrium if a school district implements an intradistrict choice policy that allows students to attend any neighborhood school in the district. Two cases are considered. In the first case, choice is assumed to be unconstrained, implying that schools face no capacity constraints and households bear no transportation costs (either because transportation costs are assumed away or because the district

18. More recently, Hanushek and Yilmaz (2013) built on Nechyba (1999, 2000) by developing a structural general equilibrium model that also considers the role of employment access in a household's residential location choice. Similar to Nechyba (1999, 2000, 2003a, 2003b), they found that the introduction of private school vouchers reduces the degree of income and housing value segregation across jurisdictions.

19. Note that similar to Nechyba (2003b), Epple and Ferreya (2008), and Ferreya (2009), Epple and Romano (2003) found that equalization of spending per pupil does not lead to the equalization of school quality, since households continue to sort across communities based on variation in nonfinancial school inputs (e.g., peer quality).

provides free transportation to any school). In the second case, households are assumed to face a transportation cost associated with sending a child to a school in a different neighborhood.

The immediate implication of unconstrained school choice is that, with access to high-quality schools no longer tied to residential location and thus no longer rationed through the housing market, school quality must be equalized across all schools. As a result, the introduction of unconstrained school choice leads to the equalization of housing values and in most cases a reduction in residential income stratification across neighborhoods.²⁰ As might be expected, the introduction of transportation costs reduces the effects school choice has on residential mobility patterns and housing values, as some households now face binding constraints on their choice of school. Nevertheless, Epple and Romano (2003) found that as long as transportation costs are not excessively high, the introduction of intradistrict choice leads to a convergence in housing values and a reduction in income stratification across neighborhoods.

THE IMPACT OF EXPANDED SCHOOL CHOICE ON HOUSING VALUES

The theoretical results of Nechyba (1999, 2000) and Epple and Romano (2003) suggest that by severing the link between school quality and residential location, expanded school choice should lead to a reduction in income and property value disparities across school districts (or school assignment zones). Several studies have attempted to empirically test those predictions using data from a variety of school choice initiatives. In one of the earliest studies in this strand of literature, Walden (1990) examined whether the introduction of magnet schools in Wake County, North Carolina, affected property value disparities across school attendance zones. His identification strategy exploited the fact that while magnet programs were quite prevalent at the elementary school level, they were significantly less prevalent at the middle and high school levels. Consequently, he predicted that if magnet schools successfully break the link between school quality and residential location, there should be less capitalization of school quality into housing values at the elementary school level (where magnet school programs were most extensive) than at the middle and high school levels. Using housing sales transaction data from 1987, he found evidence consistent with that prediction. Specifically, his results suggest that while middle and high school test scores are capitalized into housing values, elementary school test scores have no effect on these values.

20. Because school quality is equalized across neighborhoods, equilibrium is characterized by a random allocation of households to neighborhoods (since households are now indifferent to where they live). Thus, while in most cases unconstrained school choice will lead to a reduction in neighborhood income inequality, it is also possible that all households will choose to remain in their current neighborhoods following the adoption of the choice plan, implying that there would be no change in residential income inequality.

Reback (2005) examined how the adoption of a wide-scale interdistrict choice program in Minnesota affected property values. To identify the effect of interdistrict transfer opportunities on housing values, Reback (2005) related the percentage change in a district's residential property values between 1990 and 1998 to the percentage of students who transferred out of a school district and the percentage of students who transferred into a school district in the initial year of the program. If interdistrict choice programs weaken the link between school quality and residential location, districts with high outgoing transfer flows (an indication of initial low quality) should experience an increase in housing values, while districts with high incoming transfer flows (an indication of initial high quality) should experience a decline in housing values. Consistent with that notion, Reback found that, controlling for preexisting trends in school district property values, a one-standard-deviation increase in initial outgoing transfer flows was associated with more than a 3 percent increase in residential property values, while a one-standard-deviation increase in initial incoming transfer flows was associated with about a 3 percent decrease in residential property values.

Brunner, Sonstelie, and Thayer (2001) provided more indirect evidence on the property value implications of school choice programs based on voter support for universal school vouchers. As they noted, because school vouchers decouple the link between residential location and school quality, the adoption of a universal school voucher should cause property values to decline in previously high-quality school districts and to rise in previously low-quality districts. As a result, voters located in districts with good public schools should face significant capital losses if a school voucher system were implemented, giving those voters a strong incentive to vote against school vouchers. Using precinct-level returns from California's 1993 universal voucher initiative, they found evidence consistent with that prediction: homeowners located in good school districts were significantly less likely to support school vouchers.²¹ Brunner and Sonstelie (2003) reached the same conclusion using individual-level survey data on voter support for California's 2000 voucher initiative.

Two recent studies also provide evidence consistent with the theoretical prediction that expanded school choice should reduce housing value disparities across communities. Fack and Grenet (2010) compared housing price differentials across school attendance zone boundaries in Paris, France. They found that a one-standard-deviation increase in student test scores increased home values by approximately 2 percent. However, this effect was found to be quite heterogeneous. In neighborhoods that contained the fewest private schools (bottom quar-

21. An alternative explanation for these results is that homeowners located in good school districts were already satisfied with the quality of their public schools and thus had little reason to support a voucher program. However, Brunner, Sonstelie, and Thayer (2001) also found that while homeowners located in good school districts opposed the program, renters in the same districts voted in favor of it, a result more consistent with the hypothesis that homeowners would vote against the program to protect their property values.

tile of private school availability), the impact of test scores on housing values was about twice as large as the average effect of 2 percent, and in neighborhoods that contained the most private schools (top quartile of private school availability), test scores had no effect on housing values. Thus, consistent with the predictions of Nechyba (1999, 2000), Fack and Grenet's (2010) results suggest that the capitalization of school quality into housing values declines as the private school options available to parents increase.

Finally, Machin and Salvanes (2010) exploited a natural policy experiment in Oslo County, Norway, to examine the effect of expanded school choice on housing values. Prior to 1997, students in Oslo County were assigned to schools using a residential-based assignment system. In 1997, school authorities altered the school assignment mechanism by allowing students to attend any high school in the county regardless of their residential location. Machin and Salvanes found that prior to the adoption of this intradistrict choice plan, households were willing to pay a significant premium to live within the attendance zone of a high-quality school: a one-standard-deviation increase in student test scores was associated with an approximately 8 percent increase in housing values. Following the introduction of the intradistrict choice plan, the premium associated with living within the attendance zone of a high-quality school declined by approximately 50 percent.

DIRECT EVIDENCE ON SCHOOL CHOICE AND MOBILITY

The results of the capitalization studies previously discussed provide evidence consistent with one of the predictions from the theoretical literature, namely that school choice programs reduce housing value disparities across communities. What has received less attention in the empirical literature are the effects of expanded school choice on residential income segregation and household mobility.

In that regard, Brunner, Cho, and Reback (2012) examined how state adoption of interdistrict choice policies during the 1990s affected household mobility patterns and housing values. Like other forms of school choice, interdistrict choice programs, which allow parents to enroll their children in schools located outside their assigned school districts, decouple the strict link between school quality and residential location. As a result, interdistrict choice programs create an incentive for some middle- and high-income households to move into initially lower-quality districts with desirable nearby transfer opportunities in order to take advantage of lower housing prices. If households respond to these incentives, the adoption of interdistrict choice programs should lead to an increase in income, housing values, and population density in initially low-quality districts.

To examine whether interdistrict choice programs actually induce such changes in household mobility patterns, Brunner, Cho, and Reback (2012) exploited the fact that between 1989 and 1998, 12 states adopted mandatory interdistrict choice programs that required school districts to accept nonresident students. Using data on the approximately 1,700 school districts located in those

12 states, the authors regressed district-level changes in housing values, income, and population density between 1989 and 1999 on the share of students who transferred out of a given district in 1999. The key prediction from their empirical model was that housing values, income, and population density should all be positively related to the share of students who transfer out of a given school district. Specifically, the share of students transferring out of a school district is a direct measure of the interdistrict transfer opportunities available to parents: districts with high outflows of students represent initially low-quality districts providing access to nearby and presumably higher-quality transfer opportunities, while districts with high inflows of students represent initially high-quality districts that attract families taking advantage of interdistrict choice.

Using an instrumental variables approach to account for the possible endogeneity of student transfer rates and controlling for a host of district-level characteristics (including preexisting trends in housing values, income, and population density), Brunner, Cho, and Reback (2012) found that the adoption of interdistrict choice programs reduced housing value disparities and residential income segregation across school districts. Specifically, their results suggest that a 1 percent increase in the number of students transferring out of a district was associated with an approximately \$2,500 increase in average housing values, a \$650 increase in average household income, and a 3 percent increase in the number of households that chose to live in the district.

To put their results in context, Brunner, Cho, and Reback (2012) provided a useful comparison of the magnitude of their results with the magnitude of the simulated general equilibrium effects associated with the adoption of a \$1,000 universal school voucher found by Nechyba (2003a) and Ferreyra (2007). For example, the results of Brunner, Cho, and Reback (2012) suggest that approximately 3.2 percent of households in a metropolitan area would relocate following the adoption of interdistrict public school choice, a response comparable to Ferreyra's (2007) estimate that 4 percent of households would relocate in response to a \$1,000 private school voucher program in Chicago. Similarly, the simulation results of Nechyba (2003a) suggest that a \$1,000 private school voucher introduced into a metropolitan area with three representative school districts would cause housing values to increase by 10.9 percent and mean household income to increase by 7.4 percent in the lowest-quality districts. In comparison, the estimates of Brunner, Cho, and Reback (2012) suggest that the lowest-quality districts in a metropolitan area (i.e., the bottom third of the districts) would experience a 5.2 percent increase in mean housing values and a 3 percent increase in mean household income following the adoption of a mandatory interdistrict choice program.

Conclusions

An extensive and diverse body of literature documents the extent to which households sort across communities based on their demand for school quality. The

results from that literature provide a rich characterization of the many ways in which school quality affects residential location decisions, housing values, and the stratification of households across communities. This chapter has attempted to lay out what that literature has to say about the link between residential location decisions and school quality when access to high-quality schooling options is rationed through a residential-based assignment system and when school choice programs weaken the strict link between school quality and residential location.

A central theme that emerges from the literature is that when access to high-quality public schools is rationed through a residential-based assignment system, Tiebout sorting leads to communities that are stratified along racial and economic lines. For example, Bayer, Ferreira, and McMillan (2004, 2007) suggest that heterogeneous preferences for school quality and neighbors lead to substantial stratification along racial and socioeconomic lines, with white, highly educated, and high-income households sorting into communities that contain the highest-quality schools. Similarly, Eberts and Gronberg (1981), Clotfelter (1999), and Urquiola (2005) suggest that the degree of income, racial, and educational attainment stratification that occurs under a residential-based assignment system tends to be more pronounced in metropolitan areas that contain a larger number of school districts (i.e., greater Tiebout choice).

A second theme that emerges from the literature is that court-ordered and legislatively induced attempts to equalize educational opportunities have been only partially successful in meeting their objectives, in part because they have not addressed the underlying mechanism used to assign students to schools, namely residential location. For example, Reber (2005) and Baum-Snow and Lutz (2011) found that court-ordered desegregation led to an approximately 6–12 percent decline in white student enrollment in central cities, a decline that was driven primarily by white households moving to suburban districts that were not under court-ordered desegregation. Similarly, as Nechyba (2003b), Epple and Ferreyra (2008), and Ferreyra (2009) demonstrated, although school finance reform was successful in equalizing spending per pupil across districts, it was less successful in equalizing school quality, primarily because households continued to sort across communities based on their demands for other inputs to school quality such as peer and teacher quality.

A final theme that emerges from the literature is that by severing the strict link between school quality and residential location, school choice programs have the potential to significantly alter the ways in which households sort across communities. Indeed, the school choice movement is in many ways based on the fundamental notion that equal educational opportunity for all students can be achieved only by severing the strong link between school quality and residential location that arises under a residential-based assignment system. To that end, over the past two decades states have adopted policies designed to decouple the link between school quality and residential location through programs such as charter schools, intra- and interdistrict choice, and school vouchers. The theoretical models developed by Nechyba (2000), Ferreyra (2007), and Epple and

Romano (2003) provide important insights into how these policies are likely to affect housing values and the degree of residential income stratification across communities. In particular, this literature suggests that by breaking the link between school quality and residential location, school choice policies have the potential to significantly reduce income and housing value disparities across communities.

The recent empirical literature that examines the general equilibrium effects of school choice policies has begun to provide evidence that is largely consistent with predictions from the theoretical literature. For example, Reback (2005) and Brunner, Cho, and Reback (2012) found that the introduction of mandatory interdistrict choice programs during the 1990s reduced housing value disparities across school districts. Similarly, Machin and Salvanes (2010) found that the introduction of an intradistrict choice plan in Oslo County, Norway, reduced housing value disparities across school attendance zones by approximately 50 percent. In addition, Brunner, Cho, and Reback (2012) provided some of the first evidence (based on interdistrict choice plans) that expanded school choice may also reduce residential income segregation. Nevertheless, much more work needs to be done before any consensus can be reached on how and to what extent expanded school choice is likely to significantly alter residential sorting patterns or the educational opportunities of students.

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