**Buying In: Positional Competition, Schools, Income Inequality, and Housing Consumption**

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Abstract

Social scientists have suggested that a key socio-behavioral consequence of rising inequality is to intensify market competition for advantageous positions in the opportunity structure, such as residences that afford access to high quality public schools. This article assesses the empirical implications of inequality-fueled positional competition theories (PCT) by analyzing the relationships between metropolitan income inequality, households' efforts to secure residential positions in desirable school districts, and their housing consumption behavior. We assemble a unique dataset, which contains longitudinal information on household finances, residences, and geographic locations from the PSID; information on the quality of the school attendance areas in which these households reside; and information about the local real estate market. We find that greater inequality is associated with steeper housing price premia for residences in desirable districts, more pronounced social class sorting on school quality when relocating, and greater salience of schools relative to other housing amenities in families' housing expenditure functions. Families in high-inequality regions exhibit modestly greater willingness to pay more (relative to their own incomes) for a given improvement in school desirability. The analysis brings important empirical nuance to oft-invoked but untested theories about positional competition as a mechanism by which inequality affects behaviors, consumption, and markets.

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## Introduction

Growing distributional inequality over the past four decades represents a signal transformation in American society, one which carries far-reaching implications for social behavior (Payne et al 2017). Despite extensive research and debate, the effects of widening inequality have proven rather elusive, in part because the underlying mechanisms are often left underspecified or untested (Neckerman and Torche 2007; Moss et al 2013).

One oft-theorized mechanism through which inequality is thought to shape behavior is by intensifying competition for positional assets (Frank 2007). The typically cited case is public schools, which are accessed through the housing market and whose quality is a function of residential location. The fact that school attendance is coupled with neighborhood makes residential choices a linchpin in parents' efforts to reproduce or advance the social class positions of their children (Lareau and Goyette, 2014).

The positional competition thesis (hereafter PCT) suggests that as those at the top have captured a greater share of income, they have bid up the prices for the most advantageous positions, particularly residences in desirable neighborhoods with the best schools (Frank 2007). This has set off a cascading "arms race" whereby widening economic inequality leads to greater disparities between schools at the same time that it heightens the perceived necessity (and cost) of securing access to the best schools. The result is that parents feel compelled to increase their housing expenditures and mortgage debts to provide their children with the educational resources to compete in a society which they perceive to be increasingly winner-take-all. By this account, the socio-behavioral fallout of high inequality is manifested through increasingly costly competition for opportunity in the housing market. The fact that one must pay an ever-greater price to access a constant relative level of school quality is what gives inequality its "teeth" (Grusky and MacLean 2015: 44).

Variants of this argument have been articulated in several places (Frank, 2007; Frank et al., 2014; Bertrand and Morse, 2013; Charles and Lundy, 2013; Grusky and MacLean, 2015; Fligstein, Hastings, and Goldstein 2017; Schneider, Hastings, and LaBriola 2018). However, there is surprisingly little research on the relationship between inequality and positional competition, and even less which focuses on school attendance areas. Positional competition for schools is typically invoked as a mechanism rather than directly observed.

Our study assesses the empirical implications of inequality-fueled positional competition theories (Frank 2007) by analyzing the relationships between commuting zone (hereafter CZ) income inequality, households' efforts to secure residential positions in desirable school districts, and their housing consumption behavior. We focus specifically on school attendance areas because we suspect they function as key structures linking inequality and housing market behavior. The U.S. public education system is marked by a high degree of inequality in resources and outcomes across schools, both between- and within-districts (Corcoran and Evans 2008; Logan, Minca, and Adar 2010). Despite the growth of various school choice programs, attendance during the 2000s remained highly coupled to residential location (Lareau 2014). In 2007 82% of public school students attended assigned neighborhood catchment schools, a decline of only 2% from 1996 (U.S. Dept. of Education, 2010).

We ask to what extent variations in income inequality across CZs drive intensified positional competition for schools within those regions, as manifested in housing price premia across school attendance areas, in family's residential mobility behavior across school attendance areas, and in their willingness to stretch themselves financially in order to upgrade school attendance areas. We then in turn ask whether this positional competition for schools can help account for increasing housing expenditures among parents during recent decades.

If inequality intensifies competition for relative positions in the school distribution, we would expect that CZs with higher inequality would exhibit steeper housing cost premia and more rapid growth of premia between zip codes located in more or less desirable primary school attendance zones. At the household level, we would expect that parents in higher inequality regions would 1) exhibit a greater behavioral propensity to upgrade schools when moving. They will also 2) exhibit greater revealed willingness to stretch financially in order to gain or maintain a certain relative level of school quality, and 3) will weight school quality more heavily than non-positional amenities such as house size in determining housing expenditure.

We empirically test these ideas by assembling a unique dataset, which brings together longitudinal information on household finances, expenditures, and residential location (PSID); indicators of the quality of the assigned primary schools in the census tracts where these households reside (SABINS); and zip-code level information about local housing prices (Zillow Inc.). Our analysis spans 1999-2011, a period that saw substantial growth in housing expenditure burdens for families.

Our analysis has three parts. We first assess the structural premises of the positional competition argument by examining the relationship between CZ-level inequality and school premia, which we define as the differential housing costs associated with a given rank increase in various school "quality" measures. We consider how these premia evolve over time across zip codes within CZs. We then use household-level panel data to track residential moves within CZs characterized by varying levels of inequality. Here we examine which households were most likely to engage in positional competition by moving to areas with more desirable schools, and whether inequality heightens the relative weighting of school quality in households' residential choices. Finally we examine the financial consequences of positional competition by assessing whether inequality heightens parents' willingness to stretch financially in order the degree to which parents' efforts to secure access to higher quality schools propelled growth in housing expenditures and mortgage debt-to-income among families with school age children. We further exploit variation between parents and non-parents, and variation between areas with varying levels of public school choice and/or private school alternatives in order to assess whether school quality was an operative mechanism.

In addressing these questions, our project contributes to several social science literatures. Recent sociological research suggests that growing disparities between school districts have heightened the salience of perceived school quality in residential decision-making (Goyette et al., 2014; Lareau and Goyette, 2014; Weininger 2014; Owens, 2016; Rivera and Lamont, 2012). We build on this line of research by modeling residential moves across school attendance areas, linking the schools-residence nexus to wider patterns of economic inequality, and considering the consequences of competition for schools on families' housing expenditure burdens.

Second, there is a sizable economic literature on the capitalization of school quality in housing prices (Black and Machin, 2010), but this work has not examined how school price premia are related to variations in inequality across time and place. Nor has it considered how behavioral responses to growing school premia might vary across the social class spectrum.

Third, we contribute to a burgeoning literature on the relationship between inequality and consumption (Bertrand and Morse, 2013; Charles and Lundy, 2013; Schneider, Hastings, and LaBriola 2018). Using cross-sectional data, prior work finds that higher levels of local inequality are associated with higher median consumption levels for a variety of goods, including housing and investments in children. By observing families' residential transitions across school attendance areas, we are able to gain greater empirical traction on a likely underlying mechanism.

Fourth, by documenting how behavioral responses to inequality heighten socio-economic sorting on school quality, our analysis identifies a plausible mechanism linking metropolitan income inequality and reduced economic mobility (Chetty et al. 2014). We return to these themes in the discussion.

## Schools, Income Inequality, and Housing Prices

Income inequality has been rising within the United States since at least the early 1980s (Saez and Chetty, 2003). A number of scholars have suggested that this heightens "the stakes" (and anxieties) for parents who hope to provide their children with opportunities to succeed in a competitive, high-risk society (e.g. Nelson 2010). Parents may parent differently as a result, increasing how much time they spend with their children (Altintas 2016), increasing how much money they spend on their children (Kornrich and Furstenberg 2013; Kornich 2016), and shifting how they allocate that money by increasing expenditures on educational "investments" such as lessons, tutoring, and extracurricular activities that may provide advantages in the future (Schneider, Hastings, and LaBriola 2018).

Some parents may seek to advantage their kids by enrolling them in private school (which is costly) or homeschool (which is time intensive). But, the vast majority of American parents utilize public schools (Murnane and Reardon 2018). Further, in most regions school attendance remains closely linked to residential location (Owens 2016). As noted above, during our study period over four fifths of public school students attended assigned catchment schools. (U.S. Dept. of Education, 2010). Meanwhile, steadily declining private school enrollment has diminished its significance as an alternative for middle-income households (Murnane and Reardon 2018), thereby tightening the link between residential location and school.

Given the coupling of residential location and school attendance – along with marked disparities between schools – it is not surprising that educational considerations loom large in families' residential decision-making (Lareau and Goyette 2014). Parents often choose to move to a locale specifically (or at least in part) to reside within the attendance areas of a desirable school (Holme 2002; Kimelberg 2014; Lareau and Goyette 2014). Twenty-four percent of parents with school age children report moving to their current neighborhood specifically for the schools (U.S. Dept. of Ed 2010, Table C-1).

The specific evaluative criteria and heuristics with which actors assess school quality are nuanced and variable across groups and contexts (e.g. Johnson and Shapiro 2003; Dougherty et al. 2009). Some research suggests that but they tend to rely on evaluative shortcuts, such as reputational status, information from alters, or the economic and racial composition of students, rather than in-depth research on variations in school programs or outcomes (Holme 2002; Goyette, Farrie, and Freely 2012; Billingham and Hunt 2016; Rich 2017). However, others suggest that the recent incorporation of test-score ratings into real estate search engines such as Zillow could tighten the link between test scores and housing choices (Weininger 2014).

Notwithstanding variation in *how* parents construct perceptions of "good schools", these perceptions matter insofar as they play a consequential roll in residential outcomes at both the micro- and macro-levels (Holme 2002; Kimelberg 2014; Goyette and Weininger 2014; Lareau 2014). For instance, Owens (2016) points out that increases in residential income segregation since 1990 are driven solely by families with children, a fact which she suggests is attributable to increasing competition for desirable schools (but see Logan et al. 2018).[1]

The connection between schools and housing is also evident in prices. Housing economists have long studied demand for desirable schools by examining the relationship between various "quality" metrics and housing prices (e.g., Black, 1999; Clapp et. al., 2008). Hedonic price models treat schools as a residential amenity. Parents' willingness to pay for better schools is reflected, or capitalized, in higher house prices. Because economic studies tend to be interested in the marginal causal effect of schools on prices, they typically focus on individual cities and use spatial discontinuity designs. Most studies estimate the school premium to be somewhere on the order of 2-10% for a one standard deviation increase in a given school quality metric (Black and Machin 2010).

Although economists have devoted significant attention to quantifying the effect of school quality on house prices, very little research has considered how these premia vary across cities or over time amid widening inequality. This gap is important because the argument that positional competition for schools drove growing expenditures presumes that the relative premium for moving up the school rank distribution grew larger over time, thereby forcing families to take on ever-more expenditure burden in order to attain a given school quality.

Meanwhile, studies of inequality and housing expenditures have shown that greater metropolitan inequality tends to be associated with greater *median* spending on housing within those MSAs (Bertrand and Morse 2013; Charles and Lundy 2013). Although researchers have speculated that this association is driven partly by competition for schools, lack of micro-geographic data has prevented studies from linking expenditure burdens explicitly to the intra-metropolitan geography of educational resources.

[1] Logan and colleagues (2018) correct for sampling bias in the ACS, and find that there has *not* been any substantial growth in average residential income segregation nationally since the 1980s.

**Hypotheses**

The basic claim of PCT is that greater inequality heightens the stakes of positional location, thereby increasing the salience of perceived school quality in residential decision-making and intensifying competition for the best positions in the school distribution. For example, greater inequality may prompt more parents to seek access to the very best schools by triggering anxiety about class reproduction in an increasingly winner-take-all society (Nelson 2010; Schneider et al. 2018; Frank 2007). Furthermore, it might also encourage social comparison processes (Charles and Lundy 2013), or make more visible the costs of failing to attain a relatively desirable position. Hence, even as inequality increases the cost of upgrading, it also heightens the impetus to do so.

These arguments carry implications which we should to be able to observe at both the area and household levels. Below we elaborate eight hypotheses across three sets of outcomes.

At the aggregate level, we expect that greater inequality would be associated with larger housing price premia for top schools, both because inequality heightens overall demand for advantageous positions in the opportunity structure (Grusky and Maclean 2015), and because a more unequal distribution of resources means that wealthier families have more capacity to "bid up" the housing prices in the best areas (Frank 2007; Charles and Lundy 2013). It follows that regions with higher inequality should exhibit steeper gradients of housing cost premia between zip codes located in more or less desirable school attendance zones, as well as more rapid growth of these premia over time.

> Hypothesis 1: The housing price premia for desirable school attendance areas was greater in higher inequality areas.
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> Hypothesis 2: Housing price premia for desirable school attendance areas grew relatively larger between 1999 and 2011 in higher inequality areas.

At the household level, we can ask to what extent parents were actively participating in the positional competition by relocating into better school attendance areas. If contextual inequality increases the salience of perceived school quality in residential decision-making, then ceteris paribus, efforts to upgrade school quality will tend to play a greater role in structuring patterns of residential relocation among families in high inequality areas compared to lower inequality areas. Despite the greater cost, parents will work to ensure that moves maintain or improve school quality, whereas movements of otherwise similar families in lower inequality areas will be less structured by relative differences in school rank because those differences do not carry the same stakes.

> Hypothesis 3: When moving, families are more like to upgrade or avoid downgrading in the desirability of their school attendance zones in more unequal areas relative to less unequal areas.

Of course neither the relative weighting of schools in locational decisions nor the ability to afford upgrades will be evenly distributed across social groups and contexts. As suggested by

Frank (2007), upper-middle income households will engage most directly in positional competition, because they are most directly subject to social comparison pressures to keep up with those at the top, and also because they have the financial resources to compete. Compared to lower income families, they are also more likely to be homeowners, which means they can move purposively rather than reactively in response to rent pressures. Lower income movers often cannot afford to let schools dictate location (Rhodes and DeLuca 2014).

We would expect social class differentials in school mobility to be particularly pronounced in high inequality areas due to affordability constraints. Given a non-monotonic school premium gradient in higher-inequality areas, lower-SES households will be less able to afford any meaningful upgrades in high-inequality areas. Only families in upper and upper-middle SES positions will have both the wherewithal and resources to even play the school maximization game. In other words, inequality heightens the degree to which we will observe social sorting on the basis of school quality. This implies a positive interaction effect between contextual inequality and family SES on upward mobility into more desirable school attendance areas.

> Hypothesis 4: When moving, higher SES parents are more likely to upgrade (or avoid downgrading) the desirability of their school attendance zones, particularly in higher inequality CZs.

Because areas with higher-performing schools are probably desirable places in other respects as well (e.g., lower crime, more retail amenities), school performance will be confounded with other attributes (Bruch and Mare, 2011, p. 11). To the extent that positional competition for school quality is an operative mechanism driving observed premia and housing expenditures, the effects should be weaker in areas with more public school choice due to looser coupling between residential location and available school options. We expect that the association between assigned school desirability and both school price premia and housing expenditures should be weaker in districts where a greater proportion of students attend non-neighborhood charter/magnet schools.

> Hypothesis 5: Greater school choice diminishes the likelihood that families will upgrade when moving.

Next, we can consider the household financial consequences of the positional competition for schools. Above, we hypothesized that as competition for housing in better school attendance areas increases, the housing price premia would increase as well. For families to compete, it may then become necessary to stretch further financially.

Parents will not only feel compelled to live near a better school, but will also take on ever-greater expenditure burdens in order to make the move possible. In the aggregate, our period of study saw substantial growth in housing expenditure burdens among families with children. Real housing expenditures grew between 21% and 31% across all five household income quintiles (author's calculation from Consumer Expenditures Survey). By 2006, 47% of renters and 36% of mortgaged homeowners had monthly housing costs that exceeded the conventional 30% of income affordability cutoff (Schwartz and Wilson, 2008). Despite flattening after the housing bubble burst in 2007, housing expenditure levels remained elevated after the 2008-2009 recession. The inequality-fueled PCT implies that intensifying efforts to attain desirable schools contributed to this expenditure growth.

> Hypothesis 6: Inequality heightens the willingness of families to increase their housing expenditures when upgrading in school attendance areas.

However, as noted above, desirable schools are closely correlated with a number of desirable characteristics of areas. To see if schools are really a key part of the mechanism driving increasing housing expenditures, we can compare parents and non-parents. If parents are expending and leveraging more than non-parents to access a given school quality, then we can be more confident about the mechanism.

> Hypothesis 7: Parents increase their housing expenditures more than non-parents for the same amount of change in school area desirability.

Finally, to test whether greater inequality makes school ranking more salient, we can compare the relative weighting of schools in households' latent demand function. If parents are stretching themselves financially *specifically* in order to maximize school quality as inequality grows, then we would expect them to be economizing on other housing attributes such as absolute size. We can use a parametrically weighted regression model (Yamaguchi 2002; Buis 2012) to test whether the relative weighting of schools vs. non-positional amenities such as house size varies across levels of CZ inequality.

> Hypothesis 8: As inequality increases, the interaction between inequality and schools grows proportionately greater than the interaction between inequality and housing unit size.

Before turning to a discussion of methods, it is worth clarifying that the hypotheses above represent separate empirical implications the PCT theory (Lieberson 2011), none of which are logically dependent upon the others. For instance, an alternative hypothesis suggests that the school price premium did grow, but this growth did not propel a corresponding rise in housing expenditure burdens because the highest-income households were sorting into the places with the best schools. We know that residential income segregation has grown across cities and across school districts since the 1980s (Reardon and Bischoff 2011; Owens et al 2014). A countervailing effect of income sorting may have mitigated any effects of positional competition for schools on housing consumption if those who were seeking top schools could afford to buy into such areas without taking on disproportionate amounts of leverage or expenditure burden.[2] Similarly, another weak form of PCT suggests that school premia did not grow over time, even in high inequality areas. Instead, housing prices grew proportionately across the school distribution for exogenous reasons. But because parents of a given socio-economic class position expect a certain level of schooling for their children, they are willing to take on greater expenditures in order to upgrade or maintain

[2] Consistent with this view, the *median* share of household expenditure on housing was remarkably constant across time and across MSAs during the two decades *preceding* the housing boom (1980-2000) (Davis and Ortalo-Magne 2011). This stability was achieved despite rising income inequality and inter-city price dispersion by a countervailing trend toward more pronounced sorting by income across cities (Gyourko et al 2013).

a constant position. In short, we test all of the hypotheses above, but it is plausible that some will be supported but others not. All hypotheses are summarized at the end of the Results in Table 4.

## Data and Methods

To test these hypotheses, we assemble a unique dataset that brings together longitudinal information on household finances, expenditures, and residential location (the Panel Study of Income Dynamics, or PSID); indicators of the quality of the assigned elementary schools in the census tracts where these households reside (the School Attendance Boundary Information System, or SABINS); and zip-code level information about local housing prices (data from Zillow Inc.). Whereas most prior research on school-housing linkages utilizes granular parcel data from a single city, we are interested in how competition for schools varies *across* metropolitan regions with differing levels of inequality. This involves overlaying multiple types of geographic data, some of which are based on non-nested geographies, and/or reported at differing levels of granularity across administrative agencies. Our approach thus involves some degree of tradeoff between comprehensiveness and spatial measurement precision.

We begin by obtaining two measures of school desirability: Our main measure is a school-level percentile rank measure based on standardized test scores. The ranking is based on the percentage of 3rd-5th graders proficient in mathematics, which is normalized within each state to account for different testing regimes. For robustness, we also consider the school-level proportion of students not eligible for reduced price lunch. Use of multiple measures makes the study less indicator-dependent, and it accords with the mixed findings on parents' evaluation of potential schools. The test score data represent a salient output, one which could shape reputations and is incorporated into various school rankings. The reduced-price-lunch measure partially captures the portion of poor students within the school (although see Domina et al. 2018), something that parents may consider in determining their school preference. School data come from the Department of Education's Common Core Data, and the National Longitudinal School-Level State Assessment Score Database (NLSLSASD).

We then linked the measures of school desirability to each census tract using a geographic crosswalk (based on 2008 school areas linked to 2010 census tracts from SABINS) between school attendance zones and census tracts. School attendance areas are not neatly nested within tracts. In cases where tracts contain multiple primary school attendance areas, we took a block-weighted mean of the school desirability measures. For tracts where school-level attendance area locators were unavailable, we linked to district-level attendance areas and calculated district-level measures. This approach does induce some measurement error insofar as attendance areas might have changed in some areas between 1999 and 2008. Because comparable test score data was not consistently available in most states before 2008, we treat this measure as a time-constant feature within tracts.

Finally, in ancillary analyses we gauged variations in the strength of coupling between residential location and school attendance using a district-level measure of public school choice. We measure choice using the proportion of students enrolled in non-neighborhood charter or magnet schools. We caution that this measure is an imperfect proxy because it fails to capture several forms of intra- and inter-district open enrollment policies, which allow students to attend schools outside of their assigned catchment zone. Unfortunately there is no available systematic data on such programs.

To examine school premia (i.e., the relationship between school desirability and housing prices), we merge data on the annual median zip-code price for 1999-2011 (provided by Zillow, Inc.) with the school desirability data. Then, to examine how income inequality moderates this relationship, we use the Gini index of income inequality at the commuting-zone level.

Commuting zones are aggregations of counties designed to capture local labor markets (Autor and Dorn, 2013; Tolbert and Sizer, 1996). These data are based on the non-top-coded IRS tax returns from 1996-2000 of families with children (Chetty et al., 2014). We avoid simultaneity bias by using a measure of income inequality that pre-dates our outcome measures. CZs are ideal for our analysis because they are specifically constructed to encompass areas where people work. In other words, one could conceivable live anywhere within a commuting zone and maintain the same job, but where they live within the CZ would have important implications for where their children attended school.

Building from the housing price analysis, we then examine families' moves across school attendance zones, and the financial consequences of those moves. We do this by using household level data from the 1999-2011 Panel Study of Income Dynamics (PSID), which provides biennial observations on residential transitions, housing expenditures, and mortgage debt for approximately 8,500 families. We use the restricted-use version of the PSID data, which contains geographic locators at the census-tract level. This allows us to track household moves across school attendance areas. School-level attendance zone data was available for about 60% of the PSID sample, and for the remaining 40% we link tracts to district-level boundaries and calculate school quality measures as the weighted average of primary schools within the district. To maintain comparability between households with and without children, we limit this analysis to households for whom the head of household is under age 65. To gauge the socio-economic status of households we construct a summary SES index from a principle components analysis of total family income and highest educational attainment of either the head or spouse.

For our models of mobility across school attendance areas, we use the move as the unit of analysis and specify a first difference model (also known as a conditional change score model). The model estimates the conditional expected change in the quality of the assigned school between the old and new residence among movers with children under 18, controlling for quality of the assigned school at the old residence. Because the likelihood of moving in the first place is not independent of our covariates of interest, we implemented a two-stage Heckman sample correction (1976), using the inverse Mills ratio. Standard errors are clustered at the family level because some families move multiple times. We confine the sample to local moves within CZs in order to distinguish contextual effects of inequality from the effects of moving to a different context (Sampson 1999). We observed 4,617 intra-CZ moves among families with children.

In the third stage of the analysis we turn to families' willingness to increase their housing expenditure burdens in order to attain better schools. We operationalized housing expenditures, which include mortgage and loan payments, rent, property tax, insurance, and utilities, as (1) the ratio of housing expenditures to total family income, (2) logged housing expenditures (when using this measure we control for income). Because expenditures can change without moving residences, we use the household-year as the unit of analysis and estimate fixed-effects models. As in the move-level analysis discussed above, for the reported models we restrict the analytical sample to households who remain within a single CZ during the study period. This allows us to estimate the contextual effect of inequality on willingness to pay for upgrades when moving across school attendance areas within a CZ. We first examine parents only and then consider how the results differ for parents and non-parents. All of these models include a large number of household level controls (listed in the respective footnotes of Tables 1-3).

Before turning to the results, it is useful to discuss some potential pitfalls of our geographic linkage, and the implications for our analysis. First, limited geographic coverage in the SABINS means that school-level geographic linkages are only available for a subset (~60%) of the PSID analytical sample observations. For the other 40% we use district-level average desirability measures. Thus school desirability is captured with varying degrees of measurement error. To ensure that differences between these groups do not bias the results, we replicated the analyses using only the sub-sample for whom school-level locators were available. We found very a similar pattern of results (see appendix).[3]

Second, where SABINS linkages are available, multiple elementary school attendance areas can span a given census tract. Our inability to distinguish PSID respondents' assigned school within multi-school census tracts will produce only modest measurement error, for the simple reason that schools which span a common census tract tend to be highly correlated in terms of desirability measures. We conducted a variance decomposition using block-level data and found that across all 2,871,485 census blocks with SABINS school-attendance linkages, 87% of the total variance in math test-score proficiency is between tracts, and 95% of the variance in the proportion of reduced-lunch eligible students is between tracts. Among those tracts with multiple SABs, the average within-tract standard deviation in proficiency scores across blocks is 3.8 percentage points (out of 100).

Within-unit heterogeneity is more pronounced in our analysis of the relationship between school desirability and zip code median housing prices: 74% of the total variance in assigned school test scores at the census block level is between zip codes, and 84% of the variance in reduced lunch eligibility is between zip codes. This aggregation is unavoidable given that there is no reliable housing price data with national coverage at sub-zip level.

Finally, one might be concerned that the amount of unmeasured within-area heterogeneity is correlated with our key contextual covariate, metropolitan inequality. This could lead to biased estimates in both the housing price and household analyses. Such bias is plausible insofar as one might expect that regions with greater inequality will tend to be characterized by more fractured and variable socio-spatial geography. We checked this and found that, in fact, CZ inequality

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[3] Aggregation bias is mitigated by the fact that reliance on district-level measures is disproportionately confined to smaller districts, whereas larger, more heterogeneous districts are more likely to report school-level SAB linkages (including 19 of the 20 largest school districts). The median size (in terms of census tracts) of districts for which we lack SAB-linkage data is 10 census tracts, whereas the median size of districts for which we have school-level SAB-linkages is 59 tracts.

(gini) is almost entirely *uncorrelated* with the mean number of SABs which overlap a given tract (r=-.12) and with intra-tract variation in block-level assigned school test scores (r=-.01).

**Results**

*Schools, Inequality, and Housing Prices*

Our first analyses concern the relationships between neighborhood housing price differentials, local school desirability, and CZ-level income inequality. Figure 1 shows patterns of real housing prices at the zip-code level using the school test score metric. The estimates in Figure 1 are derived from simple OLS models in which each zip-code year observation is centered within commuting zones. The differences between school proficiency deciles can be interpreted as the average price differential relative to other zip codes in the same commuting zone. Each model includes a quadratic term for school decile, and the effects of inequality are allowed to vary across time and school-decile levels. Predicted prices are then calculated from the estimates and presented in Figure 1.

[Figure 1 here]

Panel A Figure 1 shows that, consistent with Hypothesis 1, the gradient of the school premium tends to be steeper in CZs with higher inequality (pooled over the study period). However, contrary to Hypothesis 2, the average school premium evidences little growth over time, as seen in the Panel B.

Panel C of Figure 1 shows estimates with three-way interactions between year dummies, school deciles, and CZ income inequality. The relative invariance in school premia over time holds across varying levels of CZ-level inequality. Even in high-inequality areas, the school premium did not grow wider because prices in neighborhoods with lower-performing schools also changed at a rapid rate in high-inequality CZs. For instance, at the 95$^{th}$ percentile of CZ inequality, zip codes with schools at the 4$^{th}$ decile of school performance saw real housing prices grow by 86% from 1999 to the market peak in 2006, while those at the top decile of the school quality distribution saw median prices increase by 64% over the same period.

We obtain very similar results when we use the proportion eligible for school lunch as an alternative measure of school desirability (not shown). We also obtain similar results if we calculate the simple cell means rather than regression estimates of the within-CZ premia.

Taken together, patterns of housing price growth across school attendance areas reveal a nuanced story, which is only partly consistent with the positional competition argument. Higher-inequality CZs do exhibit higher median housing prices on average, more rapid over-time change in median housing prices, and steeper school premium gradients on average. Practically, this means that the relative premium families must pay to access zip codes with top schools is greater in higher inequality CZs, and the absolute cost to access higher-ranked schools does increase to a significantly greater extent for those who reside in higher-inequality areas compared to those who reside in lower-inequality areas. However, it is important to emphasize that we find little evidence of *widening* school premia within CZs over time, even in the highest inequality CZs. In other words, greater income inequality circa 1999 is not associated with increasing *relative* cost to access the top schools over the following 12 years (because housing costs in zip codes with lower ranked schools also change at a comparable rate). The fact that we do not observe a widening premium for top schools in high inequality areas casts some doubt on the theory that inequality-fueled positional competition for schools played a direct role in causing the rapid growth of housing prices in high-inequality CZs.

*Residential Moves Across School Attendance Areas*

Which families experience upward school mobility when moving across census tracts, and how is this shaped by variations in CZ income inequality?

Table 1 shows the results of the first-difference models of change in school desirability, using the school test score percentile rank as a measure of desirability. Here the unit of analysis is the move, and the outcome is measured as the within-family change in assigned school desirability, conditional on moving within a CZ. Because the likelihood of moving in the first place is not independent of our covariates of interest, we estimated a two-stage selection model (Heckman 1976). Identical specifications using the free/reduced-price lunch eligibility measure are shown in the appendix.

[Table 1 here]

Hypothesis 3 predicted that, among families, moves in higher inequality areas will be more consistently structured so as to upgrade school quality. As seen in models 1-3, we find no evidence of any overall effect of contextual inequality on parents' likelihood of improving schools when they move.

We do find that mobility across school attendance zones during this period was highly graded by socio-economic status. When they move within CZs, higher SES families tended to upgrade assigned schools by a full decile relative to their previous school location, whereas families in middle and lower SES quintiles tended to move laterally. This differential response is not entirely surprising given that lower- and middle-SES families are more likely to be moving under conditions of financial duress, eviction, or other unplanned circumstances, all of which make upgrading difficult. However, as seen in model 3, the conditional difference persists even when controlling for the reported reason *why* the household moved. This class-stratified pattern of upgrading versus downgrading school attendance areas is consistent with the idea that competition for schools positively affects residential income segregation among families with children during this period (Owens 2016; but see Logan et al. 2018).

Models 4 and 5 add the interaction term between inequality and SES. Consistent with Hypothesis 4, greater inequality does appear to heighten the salience of school desirability in locational changes, but only among upper-SES families. Figure 2 illustrates this by plotting estimates from model 5 at the $25^{th}$ and $75^{th}$ percentiles of CZ inequality. Top SES quintile families who move within higher inequality CZs tend to upgrade assigned schools (relative to their previous zip code) by a factor twice as great as high-SES movers in lower inequality CZs, or lower SES households in high-inequality CZs. In other words, greater inequality heightens the impetus for higher SES families to move up, thereby amplifying social class sorting on school desirability among families when moving.

[Figure 2 here]

We find very similar results when using the alternative measure of school desirability (% of students not eligible for reduced lunch), which is reported in the appendix. The same basic pattern also attains if we expand the sample to include between-CZ moves, though in this case the interpretation of the inequality effect is less clear. Finally, the above models use a measure of school quality that is normalized within states. The lower mobility in low inequality CZs could simply reflect the more limited distribution of school ranks in those areas, and hence a more limited range of opportunities to move up or down. To ensure that such variations aren't driving the results, we reran the models using CZ-centered versions of the school test score rank. This approach yielded substantively similar results.

To further assess whether schools *per se* are driving residential mobility across school attendance areas, we next turn to Hypothesis 5 by re-examining mobility patterns across CZs with varying levels of school choice. Column 6 of Table 1 shows the specification in which we add an interaction between SES and school choice, controlling for inequality. The bottom panel of Figure 2 plots predictions from this model. Where greater choice loosens the coupling between schools and residential location, families are less prone to move to zip codes with better assigned schools, compared to families who are moving in CZs with less choice. This result is consistent with hypothesis 5, and it lends credibility to the idea that competition for schools (rather than other unobserved neighborhood characteristics) is a key mechanism in driving mobility across more or less desirable school attendance areas.

However, as seen in figure 2, this association between heightened choice and diminished upgrading is confined to families in the bottom 40% and in the top 20% of the parental SES distribution. These families tend to upgrade by four to seven *fewer* percentile ranks when they are moving within CZs with high levels ($90^{th}$ percentile) of school choice availability, compared to movers in CZs with zero non-neighborhood schools. In contrast, for families in the $40^{th}$-$80^{th}$ SES percentiles, greater availability of non-neighborhood charter/magnet schools has little apparent impact on locational decisions when moving. This might reflect the particular appeal of charters and magnets for high- and low-SES families living in urban cores where these types of schools are most prevalent.

Substantively, the results in figure 2 imply that greater choice does modestly diminish the intensity of positional competition in the housing market, but in a subtle, class-differentiated manner. Prior work has found that higher SES families are able to take advantage of school choice programs to a greater degree than lower SES families because they face fewer constraints on moving their children to different schools (Rich and Jennings 2015). The results in figure 2 offer some suggestive evidence that the availability of magnet schools can also disproportionately benefit top quintile families by allowing them to arbitrage looser school-neighborhood coupling in their residential decision-making (Weininger 2014).

In sum, regardless of the primary stated reason why they moved, top quintile SES families tended to move up to better schools, while lower-SES families tended to move laterally. This sorting was particularly marked in higher inequality CZs, where top quintile families were especially likely to upgrade schools despite the high absolute cost, and it was somewhat mitigated in regions with greater availability of non-neighborhood schools. Taken together, these results are consistent with the expectation that higher SES families will engage most directly in positional competition for desirable school districts, and that greater local inequality will heighten the degree to which school desirability structures their residential movements. Middle- and lower quintile families are largely priced out of the competition for schools (Fligstein et al 2017).

*Household-Level Financial Consequences of Positional Competition*

For the third set of analyses we move the school quality measures to the right side of the equation. Here we consider first whether families' efforts to position themselves in more desirable school attendance areas contribute to the growth of housing expenditures, as predicted by Frank (2007) and others. We then ask whether inequality heightens their willingness to stretch financially in order to access better schools.

Table 2 presents the fixed effects models for each expenditure outcome and for each measure of school desirability. Models 1 and 3 use only the sample of families with children. In each of these models, the coefficient of school desirability is positive and statistically significant, meaning that, all else being equal, families took on greater housing expenditures when moving to better schools. For example, Model 3 suggests that a one-decile increase in the math score rank of a school is associated with about a 1.2% increase in housing expenditures. A 0.1 increase in the proportion of students not eligible for a reduced price lunch is associated with about a 3.2% increase in housing expenditures. These patterns are consistent with Hypothesis 6, though we note that the magnitudes are rather small.

In additional specifications, we relaxed the assumption of equal expenditure elasticities across the social class spectrum by adding the interactions between SES and school desirability. There is no consistent pattern of social class differences across any of the various measures of housing expenditure. Although higher SES households are more likely to upgrade than lower-SES families, the financial "effect" of a given one decile increase on housing expenditure to income ratio is no greater or lesser. We interpret this to mean that higher SES families are *no* more willing to stretch themselves financially in order to attain a residence in better school attendance area.

[Table 2 about here]

Models 2 and 4 include households both with and without children, but they exclude respondents who changed parenting status during the analysis period. (Households can change parenting status by having a first child, having their youngest child turn 19, or having a child move in (e.g., a step-child). In each case, these households are probably quite different from households who remain consistently with children or without children.) We include an interaction between non-parent household and school desirability. In these models, the coefficient of school desirability represents the predicted effect for households *with* children, while the interaction term shows the difference in the effect for households *without* children. Again, we find that the effect for households with children remains positive, but the interaction effect is negative (and it is at least marginally significant in seven of the eight models). Consistent with Hypothesis 7, this means that, all else being equal, parents expend more than non-parents for the same improvement in school desirability. This suggests parents are more prone than non-parents to stretch themselves financially in order to realize a given improvement in school attendance areas.

We illustrate this difference in Figure 3, which shows the predicted level for each family, based on coefficients from the full model. Because it is a fixed effects model, the lines are constrained to intersect at zero when the x-axis is zero, but the widening gap between the lines can be interpreted as the amount of increase in the parent/non-parent gap for different levels of school desirability. We return to the magnitudes in the discussion below.

In additional analyses, we also specified models with interactions between school desirability and school choice in order to assess whether moves in areas with a greater extent of public school choice might attenuate the relationship between school desirability and housing expenditure. These analyses were inconclusive (not shown).

[Figure 3 about here]

Having found above that parents take on greater financial burdens than non-parents to attain a given school quality, the models in table 3 below test whether, among parents, the relationship between school mobility and expenditures is amplified in higher-inequality areas. This could occur either because the relative price premium of accessing better schools is greater in higher-inequality CZs (which we observed in Part 1 above) and/or if the willingness of families to expend more on schools is greater in higher-inequality CZs.

Figure 4 shows the focal interaction estimates of inequality and school desirability from models 1-4 of Table 3. The mostly positive coefficient estimates for the two-way interaction between inequality and school quality suggest that moves to more desirable school attendance areas result in greater increases in housing expenditures in high inequality CZs. We interpret this to mean that inequality heightens families' willingness to stretch themselves financially in order to gain access to better schools. However, these results were sensitive to different school quality and outcome measures; the association is statistically significant in only three of the four models.

Moreover, like the main effects of school upgrades reported above, the magnitude of the interaction is substantively small. At the $25^{th}$ percentile of CZ inequality, a one decile upgrade in the test ranking is associated with only a 0.5% increase in housing expenditures, whereas at the $75^{th}$ percentile a comparable upgrade is associated with a 1.5% increase in housing expenditure. This means that even in a relatively high inequality CZ, parents who moved from a $50^{th}$ to $80^{th}$ percentile school attendance area have a conditional expected housing expenditure increase of less than 5%. Given that real mean housing expenditures among parents increased by over 27% from 1999-2011 (and only some families are upgrading) intra-city moves by parents to access better schools can directly account for only a small portion of the overall growth in housing expenditures among families with children.

In additional analyses we expanded the sample for the fixed effects models to also include families who moved between CZs. Interestingly, these specifications yielded substantively very similar estimates for the main effect of school desirability. However, the interaction between CZ-level inequality and school desirability does not attain when moving across CZs. We interpret this to mean that families will heighten expenditures to improve relative school rank when moving between regions. but no more so when moving from a low inequality region to a high inequality region.

[Figure 4 about here]

[Table 3 about here]

As a final test, we considered whether greater inequality increases the weighting of schools relative to non-positional amenities (namely house size) in families' housing expenditure functions. Hypotheses 8 proposed that at higher levels of inequality, willingness to pay for improvements in schools would increase at a comparatively greater rate than willingness to pay for more space. To test this we added an additional two-way interaction between number of rooms and inequality to the fixed effect models above. These specifications are shown on the right hand side of table 4. To test the difference between the respective interactions we compared each of these models against a null model in which the effects of schools and house size are constrained to change proportionately across levels of CZ inequality (Buis 2012). Likelihood ratio tests of the proportionality constraints are shown below the unconstrained models in table 4.

These tests yielded mixed evidence depending on the outcome metric: Models 5-6 suggest that where inequality is greater, competition for schools becomes more determinative of changes in log housing expenditures relative to the weight placed on gaining additional rooms (though in one case the test statistic is only marginally significant). In contrast, models 7 and 8 provide no evidence that inequality heightens the relative weighting of schools over rooms in the housing expenditure to income ratio. Tests of the difference in the interactions indicate that in only one of the four models can we clearly reject the null hypothesis that the contributions of house size and schools increase proportionately across the gini distribution. We interpret this as only weak evidence in support of the idea that inequality leads actors to prioritize positional considerations over other types of housing amenities.

Table 4 summarizes the hypotheses and results.

[Table 4 here]

**Discussion**

In a recent volume entitled *Living in a High Inequality Regime*, Grusky and Maclean (2016) argue that the social fallout of high inequality is felt primarily through the interaction between inequality and the *de facto* commodification of quasi-public goods, such as neighborhood schools. The fact that one must pay an ever-greater price for a constant relative position is what gives inequality its "teeth" (p. 44). Although these arguments are frequently invoked, they have not been subjected to careful empirical scrutiny.

Our study has sought to test core empirical implications of inequality-fueled positional competition theories at multiple levels of analysis (Frank 2007). We focused on the schools-housing nexus, the canonical site of positional competition. Our findings lend support to some elements of the theory, but also highlight several significant qualifications:

At the zip-code level we found only partial support for the theory's expectations regarding housing prices: School price premia do tend to be steeper in higher inequality CZs, and overall housing prices grew faster in higher inequality CZs during the study period. However, within-CZ school price premia did not grow over time. Nor did relative premia grow more rapidly in areas with greater inequality at the beginning of the period.

Prior work has suggested that observed cross-sectional associations between inequality and median housing prices and/or housing expenditures could be driven by more intensive competition for schools (Frank 2007; Charles and Lundy 2013). Having decomposed patterns of housing price growth across attendance areas within CZ housing markets, we find little evidence of growing school price premia from 1999-2011. Although housing price growth was significantly more pronounced in high inequality CZs during this period, the relative stability of the school premium in these areas implies that other exogenous factors were operative.

We found more consistent support at the household-level, though the magnitudes of association were often modest. Greater CZ inequality is associated with heightened tendency for higher SES households to prioritize upgrading schools when moving. Families with children increased their housing expenditures to a greater degree than non-families in order to attain more desirable school attendance areas, and the costs of upgrading were especially high in less equal CZs. Families in high-inequality regions exhibit modestly greater willingness to pay more (relative to their own incomes) for a given improvement in school desirability.

Taken together, these results imply that inequality-fueled positional competition is occurring insofar as greater local inequality does appear to induce the types of behavioral responses identified by the theory. This is especially true for families in the top quintile of the SES distribution. However, the aggregate consequences of these behaviors appear more modest than strong formulations of the PCT theory would imply: Positional competition for schools within CZs provides relatively little explanatory leverage on the over-time patterns of housing price growth across neighborhoods or housing expenditure growth among families.

The small size of the school effect on expenditures in the fixed effect model casts doubt on the extent to which competition for schools is driving aggregate growth in households' housing cost burdens. A simple counterfactual exercise, in which we imagine that those families who did upgrade school attendance areas had stayed put, implies that the direct effects of heightened positional competition for schools can account for only a minute share of the overall growth in housing expenditures among families during this period. Of course one important caveat is that our estimates were based only on intra-CZ moves. This limits our ability to make population level extrapolations.

Competition for schools does appear to have contributed to residential income sorting among families with children during this period (Owens 2016). Within high inequality CZs, relocating families in the top quintile of the SES distribution tended to upgrade by a full decile in the school test rank distribution, over twice as much as high SES households in low inequality areas, and three times as much as families in the bottom two SES quintiles. Heightened income segregation across school attendance areas might help explain the surprisingly modest effects of competition for schools on conditional housing expenditures: the high SES households who are upgrading also tend to have upward income trajectories, which allow them to afford upgrades without excessive increases in their housing expenditure ratios. The effects of positional competition for schools appear to be manifested primarily in increased class sorting (Owens 2016) rather than in expenditure stretching (Frank 2007).

Of course our failure to detect more pronounced effects could reflect any number of features of our study design. Income inequality in the United States has been growing for nearly four decades, but we examine only a twelve-year period from 1999-2011. We also rely on cross-sectional measures of inequality. It is possible that over-time trajectories were more responsive to changes in local inequality than they were to starting (1999) levels, although we doubt this to be the case given the minimal change in within-CZ inequality during the 2000s. It is also possible that our results merely capture the steady-state aftermath of transformations that are perceptible only over a longer span of time. Finally, it is worth reiterating that our estimates could be attenuated by the limited spatial granularity of the data, which effectively obscures variation within census tracts and zip codes. Findings from spatial discontinuity studies suggest that families might be pursuing highly localized strategies which our data cannot capture.

Furthermore, some of our (null) findings could be driven by particularities of the historical period. We focused on the 2000s for a mixture of methodological and substantive reasons. Namely: a) the significant growth in housing expenditures; b) the availability of rich and data on schools and households; c) the still limited penetration of school choice programs which decouple school attendance from residential location. However, the fact that our study coincides with an unprecedented housing market bubble suggests that the gyrations of the housing boom could swamp (and thereby obscure) the underlying processes of interest. Whereas our analysis seeks to detect how inequality and competition for residential resources interact to shape financial outcomes, a housing market bubble implies that prices and investment behavior had become detached from such "fundamentals." On the other hand, the loose credit conditions and widening credit access which prevailed during the first two thirds of our study period gave households ready access to the resources with which to compete for residential positions. Hence we might expect that this period would represent a "most-likely" context for positional competition.

Beyond this, it is important to note several other limitations of analysis. First, commuting zone income inequality – our key contextual variable – may be correlated with a number of factors that affect with housing desirability, such as income segregation; racial segregation; and the amount of geographic spread in the locations of jobs, parks, public transit, and schools themselves. Each of these factors may also heighten competition for the most desirable neighborhoods within a CZ.

Second, relatedly, we focus in this analysis on the best available objective measure of school quality: student test scores. While this data is available to all and increasingly accessible due to online real estate search engines like Zillow, we do not know the extent to which parents use this information in deciding which schools the wish for their children to attend. We noted in our discussion of the existing literature that specific evaluative criteria and heuristics with which actors assess school quality are nuanced and variable across groups and contexts (Holme 2002, Johnson and Shapiro 2003; Dougherty et al. 2009). Race, in particular, seems to be a factor. Studies have found that white parents perceived a school of lower quality and less desirable where the representation of blacks was greater (Goyette, Farrie, and Freely 2012; Billingham and Hunt 2016) and, most relevant to this analysis, that white parents are especially likely to sort into school districts and neighborhoods with mostly-white student populations (Rich 2017). While beyond the scope of this paper, comparing the various factors that contribute to competition for neighborhoods and that guide parents' perceptions about the "best" schools for their children is an important for future research.

Third, our analysis can only examine movers. While examining moves is ideal in that it captures the actual behavior of families, it is limited in that it reveals nothing about the preferences of families who do not move. Some families may, for example, wish to move but be unable to do for financial or other reasons. While also beyond this paper's scope, future work may also seek to integrate the behavior of "not moving" into analyses of the effects of income inequality, school quality, and housing consumption.

Notwithstanding these limitations, our findings bring important empirical nuance to oft-invoked but untested theories about positional competition for schools as a mechanism by which inequality affects behaviors, consumption, and markets.

More broadly, our findings highlight how the behavioral consequences of positional competition play out differentially across the social class structure. PCT is driven most directly by the upper-middle class parents who have the ability to participate in this competition. However, the longer-term consequences also extend to the children of those who cannot compete. Because school quality plays a significant role in status attainment (e.g. Duncan and Murnane 2011), our findings highlight a specific link between inequality and reduced future social mobility (Chetty et al 2014; Grusky and Maclean 2015). Thus, these results have troubling implications for social mobility. Existing research has shown how middle- and upper-class families are making ever larger financial investments in their kids as inequality increases (Schneider et al, 2018). Our work empirically shows yet an additional pathway whereby rising inequality appears to feed itself forward by prompting affluent families can spend in way to advantage their children. They can compete – sometimes at great financial cost – with other households for the homes that come with access to better schools.

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Table 1: Estimates from Two-stage First-Difference Models of Change in Families' Assigned School Percentile Rank

| | (delta) School Rank Percentile | | | | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Previous school rank | -0.301*** | -0.312*** | -0.316*** | -0.302*** | -0.313*** | -0.335*** |
| | (0.0162) | (0.0163) | (0.0165) | (0.0163) | (0.0163) | (0.0127) |
| CZ inequality (gini) | 0.489 | 6.099 | 5.571 | -10.07 | -5.782 | -3.724 |
| | (5.005) | (4.929) | (5.071) | (9.086) | (8.888) | (6.304) |
| 2nd SES Quintile | 0.951 | 0.123 | 0.302 | 0.0641 | -1.294 | 1.279 |
| | (1.009) | (1.009) | (1.030) | (6.382) | (6.358) | (4.684) |
| 3rd SES Quintile | 2.406* | 1.074 | 1.012 | -3.970 | -4.988 | -2.831 |
| | (1.140) | (1.157) | (1.189) | (6.285) | (6.138) | (4.693) |
| 4th SES Quintile | 4.968*** | 3.254* | 3.448* | -3.677 | -7.627 | -4.582 |
| | (1.334) | (1.309) | (1.348) | (7.198) | (7.042) | (5.973) |
| Top SES Quintile | 8.948*** | 6.637*** | 6.853*** | -6.944 | -10.87 | -6.034 |
| | (1.481) | (1.479) | (1.531) | (7.560) | (7.641) | (6.251) |
| Own-to-own Move | | 6.910*** | 7.517*** | | 6.999*** | 6.616*** |
| | | (1.595) | (1.643) | | (1.595) | (1.161) |
| Rent-to-own Move | | 1.864 | 2.548 | | 1.714 | 2.964* |
| | | (1.538) | (1.689) | | (1.540) | (1.174) |
| Own-to-rent Move | | 1.488 | 1.084 | | 1.492 | 2.389 |
| | | (1.607) | (1.654) | | (1.598) | (1.227) |
| 2nd SES x Inequality | | | | 1.658 | 2.809 | -2.846 |
| | | | | (13.82) | (13.79) | (9.832) |
| 3rd SES x Inequality | | | | 13.67 | 12.96 | 7.505 |
| | | | | (13.65) | (13.26) | (9.795) |
| 4th SES x Inequality | | | | 18.45 | 23.19 | 15.52 |
| | | | | (15.59) | (15.04) | (12.43) |
| Top SES x Inequality | | | | 32.98* | 36.24* | 29.56* |
| | | | | (15.85) | (15.88) | (12.86) |
| % School Choice | | | | | | -22.01*** |
| | | | | | | (5.348) |
| 2nd SES x School Choice | | | | | | 0.101 |
| | | | | | | (8.364) |
| 3rd SES x School Choice | | | | | | 17.60 |
| | | | | | | (9.680) |
| 4th SES x School Choice | | | | | | 21.51 |
| | | | | | | (11.55) |
| Top SES x School Choice | | | | | | -13.01 |
| | | | | | | (16.46) |
| Constant | 8.941*** | 11.53*** | -47.49*** | 13.86** | 17.08*** | 17.90*** |
| | (2.581) | (2.601) | (3.035) | (4.270) | (4.231) | (3.187) |
| *Additional Controls* | No | Yes | Yes | No | Yes | Yes |
| *Reported Reason for Moving* | No | No | Yes | No | No | No |
| Observations | 15480 | 15480 | 15316 | 15480 | 15480 | 15480 |

Note: First stage selection equation estimates not shown

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
Notes: Model estimated on within-CZ moves among families with children from 1999-2011. All models employ survey weights. Additional demographic control variables include marital status, household size, and age of youngest child.

Table 2: Estimates from Fixed Effects Models of PSID Respondents' Housing Expenditures

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | housing expenditure-to-income | | log(housing expenditure) | |
| math score rank | 0.00274 | 0.00260 | 0.0123$^{**}$ | 0.00978 |
| | (0.00157) | (0.00214) | (0.00412) | (0.00536) |
| non-parent X math score rank | | -0.00645$^{*}$ | | -0.00994 |
| | | (0.00300) | | (0.00802) |
| | 0.00274 | 0.00260 | 0.0123$^{**}$ | 0.00978 |
| *Additional controls (omitted for space)* | Yes | Yes | Yes | Yes |
| Number of Household-years | 12763 | 14680 | 12763 | 14680 |

Standard errors in parentheses
$^{*}$ $p < .05$, $^{**}$ $p < .01$, $^{***}$ $p < .001$

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | housing expenditure-to-income | | log(housing expenditure) | |
| % no reduced-price lunch | 0.000649$^{**}$ | 0.000781$^{*}$ | 0.00319$^{***}$ | 0.00299$^{***}$ |
| | (0.000239) | (0.000312) | (0.000671) | (0.000840) |
| non-parent X % no reduced-price lunch | | -0.00122$^{*}$ | | -0.00283$^{*}$ |
| | | (0.000479) | | (0.00132) |
| | 0.000649$^{**}$ | 0.000781$^{*}$ | 0.00319$^{***}$ | 0.00299$^{***}$ |
| *Additional controls (omitted for space)* | Yes | Yes | Yes | Yes |
| Number of Household-years | 12470 | 14215 | 12470 | 14215 |

Standard errors in parentheses
$^{*}$ $p < .05$, $^{**}$ $p < .01$, $^{***}$ $p < .001$

Notes: Results from fixed effects models based on PSID respondents from 1999-2011. Models 1 & 3 include families with children. Models 2 & 4 include all families, but exclude respondents who changed parenting status during the analysis period. All models employ survey weights and control for age in years, age squared, years of education, race, marital status, family size, number of rooms in home, and year indicators. Models 3&4 also include a linear and quadratic control for income (logged).

Table 3: Estimates from Fixed Effects Models of Housing Expenditures Among Parents with School-Age Children

| | (1) (ln)HE | (2) (ln)HE | (3) HE-Income | (4) HE-Income | (5) (ln)HE | (6) (ln)HE | (7) HE-Income | (8) HE-Income |
|---|---|---|---|---|---|---|---|---|
| School rank | -0.00332 | | -0.000444 | | -0.00335 | | -0.000259 | |
| | (0.00216) | | (0.000925) | | (0.00217) | | (0.000929) | |
| Gini x rank | 0.00923* | | 0.00134 | | 0.00929* | | 0.000957 | |
| | (0.00438) | | (0.00188) | | (0.00440) | | (0.00189) | |
| School pay lunch | | -0.00877** | | -0.00275* | | -0.00887** | | -0.00247 |
| | | (0.00321) | | (0.00137) | | (0.00323) | | (0.00137) |
| Gini x pay lunch | | 0.0217*** | | 0.00682* | | 0.0220*** | | 0.00624* |
| | | (0.00648) | | (0.00276) | | (0.00652) | | (0.00278) |
| N rooms in house | 0.0699*** | 0.0711*** | 0.0129*** | 0.0133*** | 0.0726*** | 0.0772*** | -0.00551 | -0.00341 |
| | (0.00315) | (0.00319) | (0.00135) | (0.00136) | (0.0196) | (0.0204) | (0.00832) | (0.00863) |
| Gini x rooms | | | | | -0.00578 | -0.0128 | 0.0388* | 0.0352 |
| | | | | | (0.0406) | (0.0424) | (0.0173) | (0.0180) |
| Not home-owner | -0.222*** | -0.220*** | -0.0263*** | -0.0236*** | -0.222*** | -0.220*** | -0.0262*** | -0.0235*** |
| | (0.0147) | (0.0150) | (0.00631) | (0.00640) | (0.0147) | (0.0150) | (0.00631) | (0.00640) |
| Constant | 6.215*** | 6.220*** | 0.150 | 0.167 | 6.216*** | 6.222*** | 0.144 | 0.160 |
| | (0.458) | (0.465) | (0.195) | (0.198) | (0.458) | (0.465) | (0.195) | (0.198) |
| Additional Controls | yes | yes | yes | yes | yes | yes | yes | yes |
| Year dummies | yes | yes | yes | yes | yes | yes | yes | yes |
| Observations | 17832 | 17425 | 17897 | 17489 | 17832 | 17425 | 17897 | 17489 |
| Test of Proportionality Constraint | | | | | f=3.53 (p=.06) | f=7.87 (p=.005) | f=0.19 (p=.66) | f=0.06 (p=.81) |

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Notes: Model estimated on families with children who remain within the same CZ during observation period. Additional demographic control variables include marital status, household size, age, education, income, and race.

Table 4: Summary Of Hypotheses and Results

| | Hypothesis | Outcome | Result |
|---|---|---|---|
| | *Inequality associated with greater housing price premia for schools* | | |
| 1 | Housing price premium for desirable school attendance areas is greater in higher inequality CZs | Zip-code Price | Yes |
| 2 | Housing price premia for desirable school attendance areas grows larger over time in higher inequality CZs | Zip-code Price | Null |
| | *Positional Competition in Moves Across School Attendance Areas* | | |
| 3 | Families more likely to upgrade school attendance areas when moving in unequal CZs | Δ School Desirability | No, only for high SES |
| 4 | High SES families more likely to upgrade when moving in unequal CZs | Δ School Desirability | Yes |
| 5 | Greater school choice diminishes impetus for high-SES families to upgrade when moving | Δ School Desirability | Yes, but only marginally |
| | *Household-Level Financial Consequences of Positional Competition* | | |
| 6 | Families' willingness to pay more for given school upgrade is greater in higher inequality CZs | Housing Expenditures | Yes, but only marginally |
| | | | |
| 7 | Parents willing to pay more than non-parents for desirable schools | Housing Expenditures | Yes |
| | | | |
| 8 | Inequality heightens relative weighting of schools in latent expenditure function | Housing Expenditures | Mixed |

# Figure 1: Real Median Housing Prices in Zip Codes

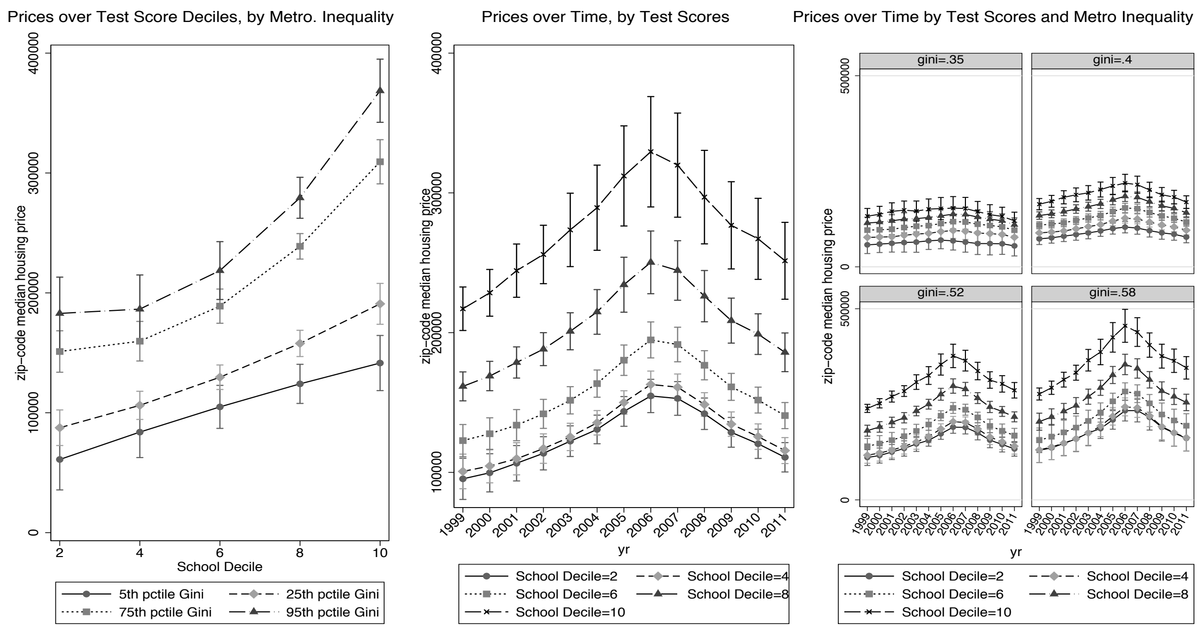
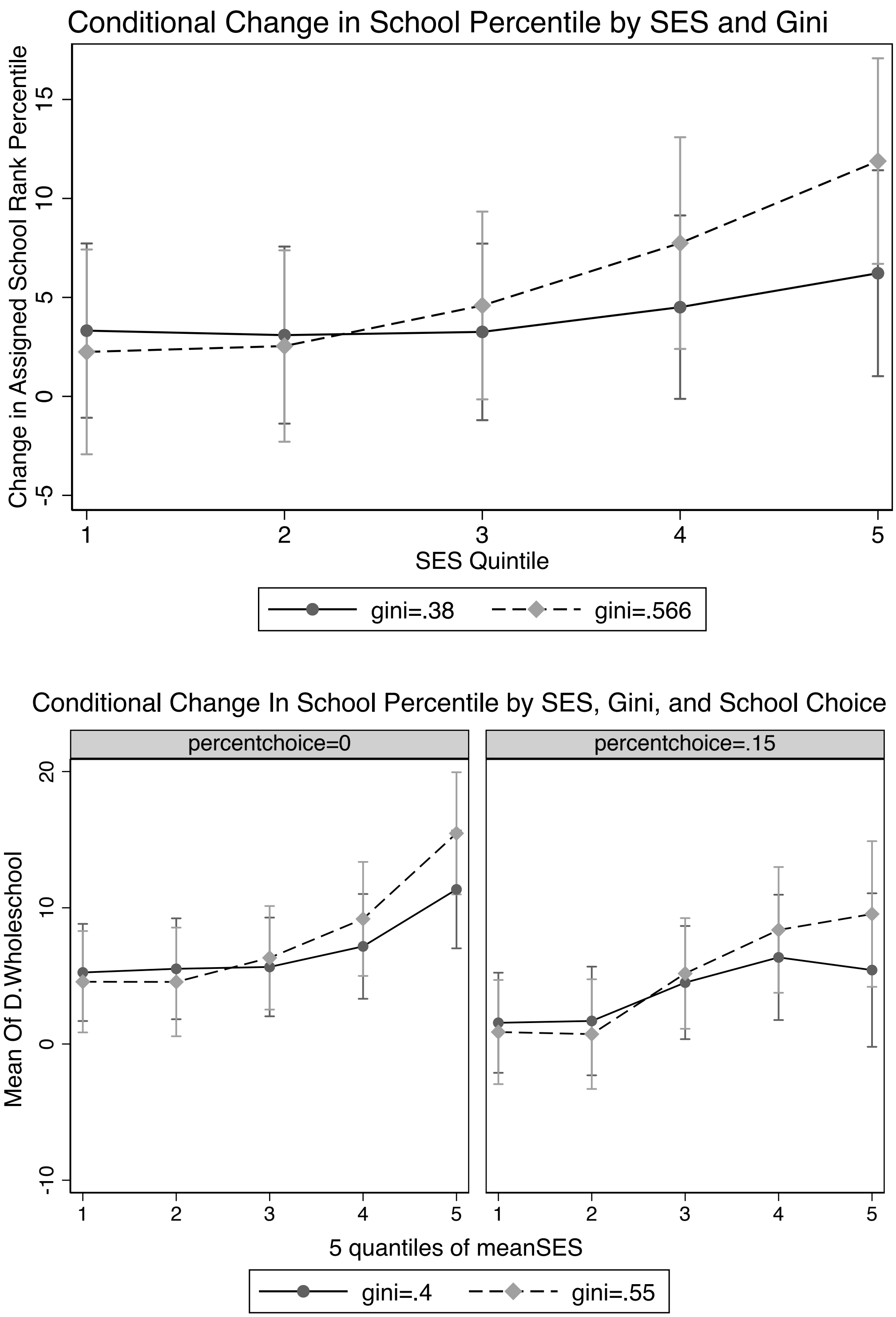


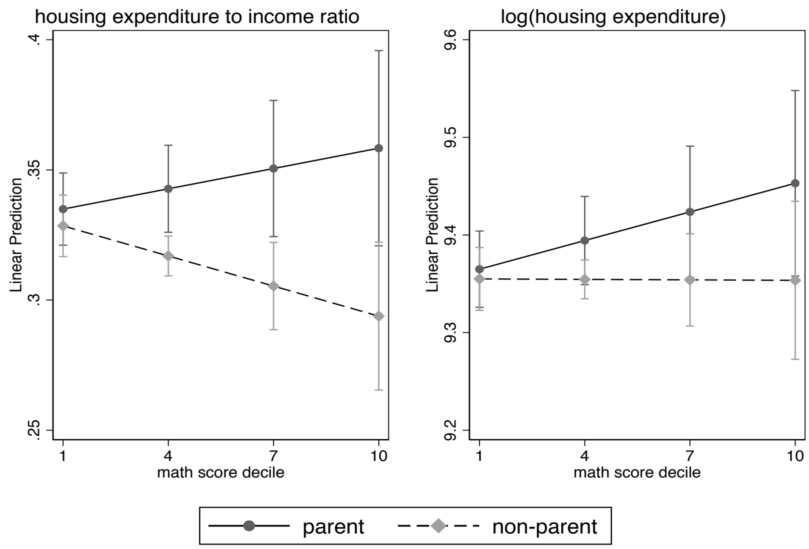
**Figure 2: Average Change in School Percentile Rank, Within-CZ Moves Among Families With Children**



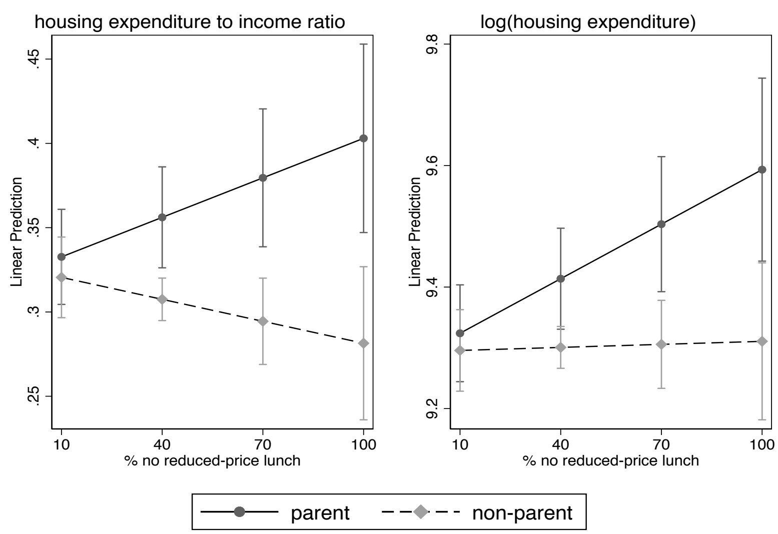

Note: The top panel of Figure 2 shows model predictions of assigned school test score rank mobility among families who move within commuting zones at the 10th and 90th percentiles of income inequality, with all control variables held at their means. The bottom panel plots predictions from model ___ in table 1, with all control variables held at means.

**Figure 3: Financial Consequences of Changing School Attendance Boundaries for Parents and Nonparents**

A: Models with school level math score decile rank




B: Models with school level % no reduced price lunch



## Figure 4: Effects on Housing Expenditures of Upgrading Schools, Across Varying Levels of CZ Inequality

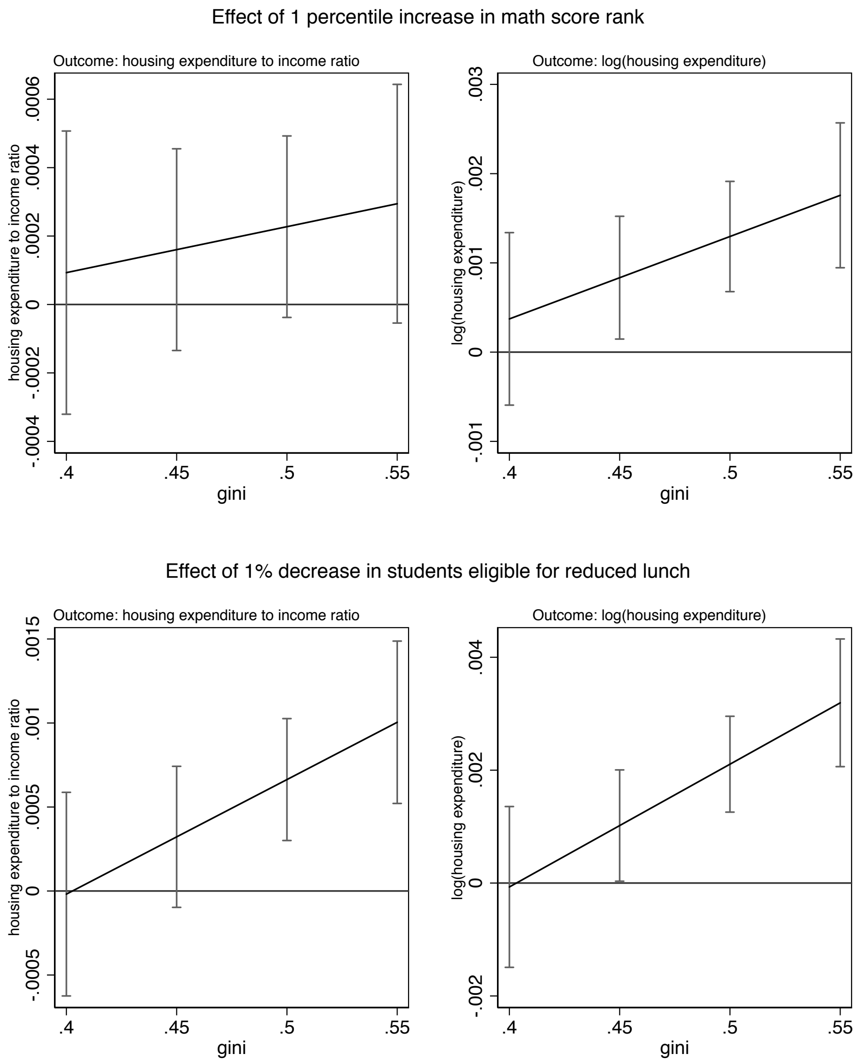


Table A1: Estimates from Two-stage First-Difference Models of Change in Families' Assigned School Percentile Rank

| | (delta) % Not Eligible for Reduced School Lunch | | | | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Previous school rank | -0.179*** | -0.146*** | -0.164*** | -0.289*** | -0.260** | -0.387*** |
| | (0.0429) | (0.0416) | (0.0433) | (0.0843) | (0.0822) | (0.0570) |
| CZ inequality (gini) | -0.00281*** | -0.00292*** | -0.00296*** | -0.00284*** | -0.00295*** | -0.00343*** |
| | (0.000169) | (0.000173) | (0.000177) | (0.000172) | (0.000176) | (0.000149) |
| 2nd SES Quintile | 0.0191* | 0.0141 | 0.0156 | -0.00519 | -0.0134 | 0.00797 |
| | (0.00789) | (0.00777) | (0.00808) | (0.0508) | (0.0499) | (0.0380) |
| 3rd SES Quintile | 0.0265** | 0.0182* | 0.0179* | -0.0290 | -0.0303 | -0.00680 |
| | (0.00884) | (0.00871) | (0.00905) | (0.0503) | (0.0495) | (0.0394) |
| 4th SES Quintile | 0.0513*** | 0.0412*** | 0.0430*** | -0.0426 | -0.0642 | -0.0560 |
| | (0.0103) | (0.00992) | (0.0103) | (0.0552) | (0.0535) | (0.0459) |
| Top SES Quintile | 0.0826*** | 0.0688*** | 0.0730*** | -0.0716 | -0.0941 | -0.139* |
| | (0.0122) | (0.0119) | (0.0124) | (0.0645) | (0.0652) | (0.0543) |
| Own-to-own Move | | 0.0460*** | 0.0466*** | | 0.0466*** | 0.0466*** |
| | | (0.0122) | (0.0132) | | (0.0121) | (0.00928) |
| Rent-to-own Move | | 0.0106 | 0.00560 | | 0.00996 | 0.0192* |
| | | (0.0121) | (0.0136) | | (0.0120) | (0.00930) |
| Own-to-rent Move | | 0.0105 | 0.0114 | | 0.0110 | 0.0209* |
| | | (0.0113) | (0.0118) | | (0.0114) | (0.00920) |
| 2nd SES x Inequality | | | | 0.0504 | 0.0574 | 0.0206 |
| | | | | (0.112) | (0.110) | (0.0814) |
| 3rd SES x Inequality | | | | 0.119 | 0.104 | 0.0567 |
| | | | | (0.111) | (0.109) | (0.0843) |
| 4th SES x Inequality | | | | 0.202 | 0.226 | 0.222* |
| | | | | (0.121) | (0.117) | (0.0996) |
| Top SES x Inequality | | | | 0.324* | 0.341* | 0.495*** |
| | | | | (0.140) | (0.141) | (0.118) |
| % School Choice | | | | | | -0.139** |
| | | | | | | (0.0431) |
| 2nd SES x School Choice | | | | | | 0.00461 |
| | | | | | | (0.0711) |
| 3rd SES x School Choice | | | | | | 0.0452 |
| | | | | | | (0.0764) |
| 4th SES x School Choice | | | | | | 0.0936 |
| | | | | | | (0.0995) |
| Top SES x School Choice | | | | | | -0.160 |
| | | | | | | (0.131) |
| Constant | 0.207*** | 0.229*** | -0.0160 | 0.260*** | 0.284*** | 0.368*** |
| | (0.0248) | (0.0249) | (0.0256) | (0.0418) | (0.0414) | (0.0313) |
| *Additional Controls* | No | Yes | Yes | No | Yes | Yes |
| *Reported Reason for Moving* | No | No | Yes | No | No | No |
| Observations | 15365 | 15365 | 15204 | 15365 | 15365 | 15371 |
| Note: First stage selection equation estimates not shown | | | | | | |

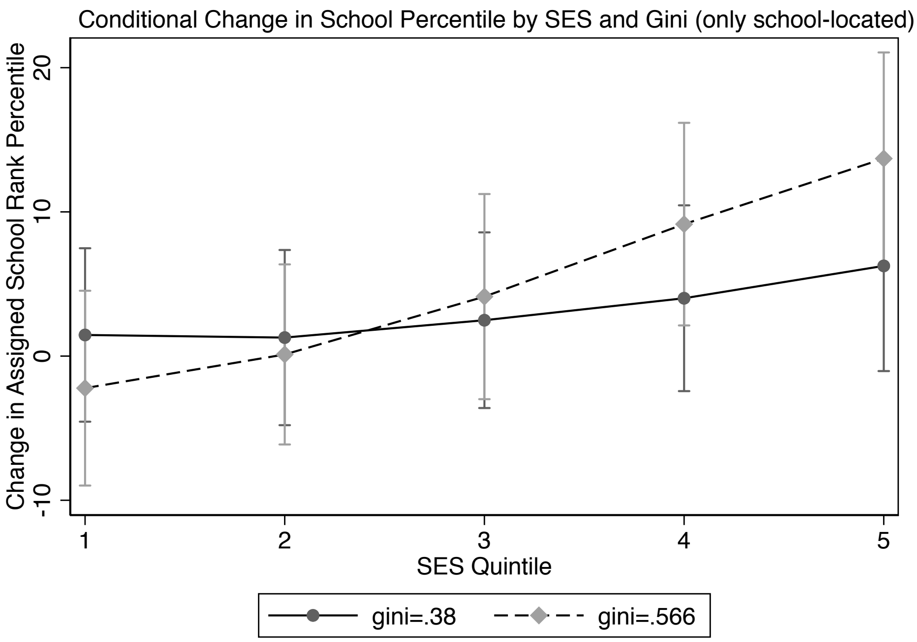
Standard errors in parentheses

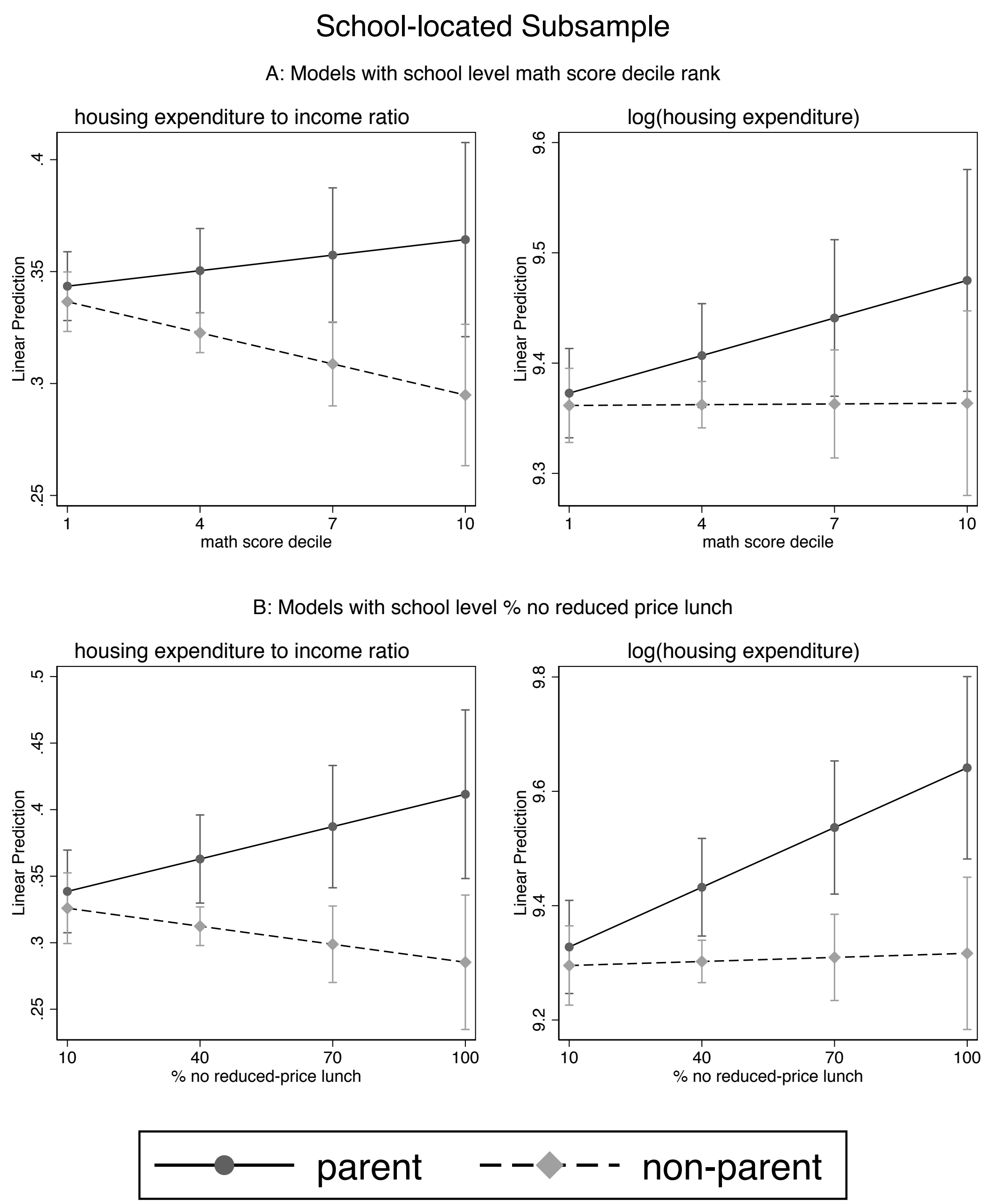
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

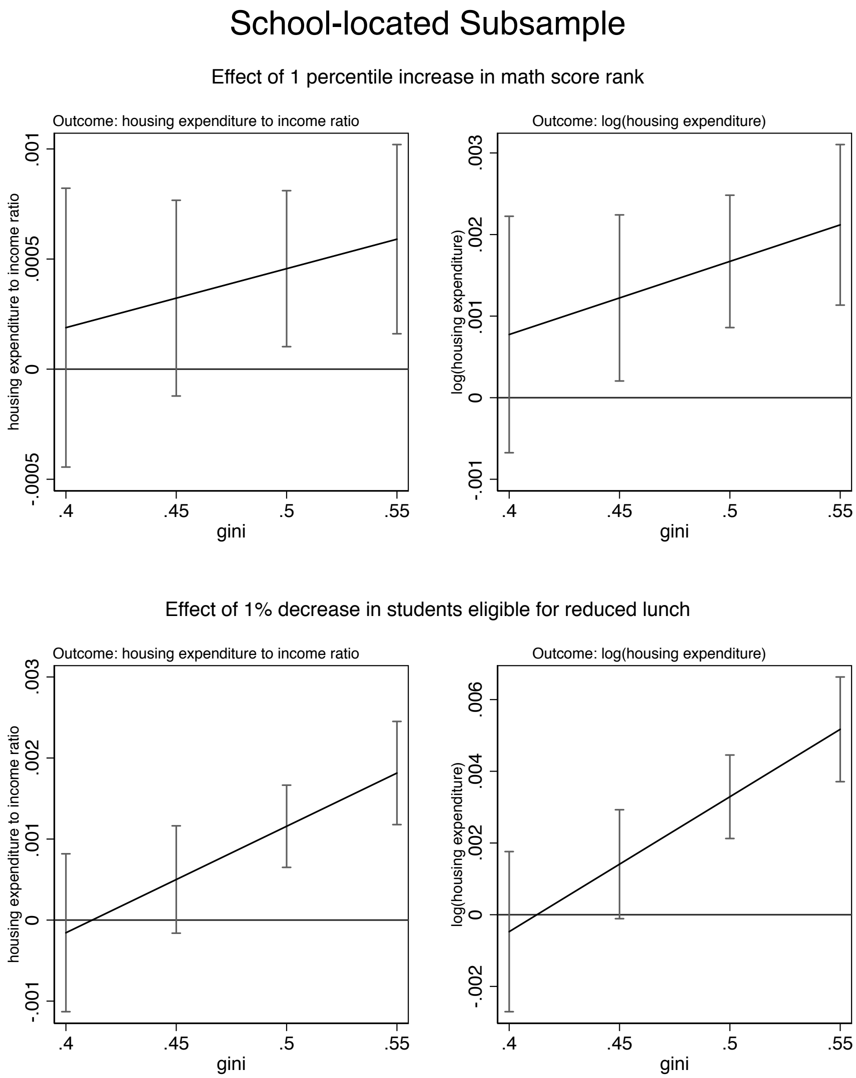
Notes: Model estimated on within-CZ moves among families with children from 1999-2011. All models employ survey weights. Additional demographic control variables include marital status, household size, and age of youngest child.

## Appendix Figures

These figures replicate the model estimation results reported in the main text, but here the analytical sample is confined to cases with school-level (rather than district-level) geographic locators. These correspond to figures 2-4 in the main text.




School-located Subsample
A: Models with school level math score decile rank
housing expenditure to income ratio
log(housing expenditure)
Linear Prediction
.25
.3
.35
.4
9.3
9.4
9.5
9.6
1
4
7
10
math score decile
B: Models with school level % no reduced price lunch
.5
.45
9.2
9.8
10
40
70
100
% no reduced-price lunch
parent
non-parent


School-located Subsample
Effect of 1 percentile increase in math score rank
Outcome: housing expenditure to income ratio
housing expenditure to income ratio
-.0005
0
.0005
.001
.4
.45
.5
.55
gini
Outcome: log(housing expenditure)
log(housing expenditure)
-.001
0
.001
.002
.003
.4
.45
.5
.55
gini
Effect of 1% decrease in students eligible for reduced lunch
Outcome: housing expenditure to income ratio
housing expenditure to income ratio
-.001
0
.001
.002
.003
.4
.45
.5
.55
gini
Outcome: log(housing expenditure)
log(housing expenditure)
-.002
0
.002
.004
.006
.4
.45
.5
.55
gini