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John M. Clapp

Stephen L. Ross
University of Connecticut

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Recommended Citation
Clapp, John M. and Ross, Stephen L., "Schools and Housing Markets: An Examination of School Segregation and Performance in Connecticut" (2002). *Economics Working Papers*. 200208.
https://opencommons.uconn.edu/econ_wpapers/200208

University of Connecticut

Department of Economics Working Paper Series

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John M. Clapp
University of Connecticut

Stephen L. Ross
University of Connecticut

Working Paper 2002-08

October 2002

341 Mansfield Road, Unit 1063
Storrs, CT 06269–1063
Phone: (860) 486–3022
Fax: (860) 486–4463
http://www.econ.uconn.edu/

Abstract

This paper examines the relationship between house price levels, school performance, and the racial and ethnic composition of Connecticut school districts between 1995 and 2000. A panel of Connecticut school districts over both time and labor market areas is used to estimate a simultaneous equations model describing the determinants of these variables. Specifically, school district changes in price level, school performance, and racial and ethnic compositions depend upon each other, labor market wide changes in these variables, and the deviation of each school district from the overall metropolitan area. The specification is based on the differencing of dependent variables, as opposed to the use of level or fixed effects models and lagging level variables beyond the period over which change is considered; as a result the model is robust to persistence in the sample. Identification of the simultaneous system arises from the presence of multiple labor market areas in the sample, and the assumption that labor market changes in a variable due not directly influence the allocation of households across towns within a labor market area. We find that towns in labor markets that experience an inflow of minority households have greater increases in percent minority if those towns already ahve a substantial minoritypopulation. We find evidence that this sorting proces is reflected in housing price changes in the low priced segment of the housing market, not in the middle and upper segments.

Journal of Economic Literature Classification:D1, D4, I2, R2, R5

Schools and Housing Markets:

An Examination of School Segregation and Performance in Connecticut

The U.S. educational system is characterized by tremendous diversity in terms of both school composition and performance across school districts, but often by substantial homogeneity within districts especially within smaller suburban districts. This homogeneity is the result of a system in which access to education is primarily accomplished by obtaining residential housing. Considerable evidence exists indicating that school quality as captured by test scores or other performance measures is heavily influenced by the socio-economic characteristics of the school (Hanushek, 1986), and has a large influence on property values in each school district (Ross and Yinger, 1999). Moreover, the high price of housing in high quality school districts and the land use decisions in those districts influence the composition of those schools and may create substantial barriers to access for many low income and minority households. In this context, the price of housing and the characteristics of schools are determined simultaneously by a complex process in which households sort over the housing stock and across communities, and communities may intervene in this process by regulating land use. Almost all research in the area has been dedicated to address estimation biases caused by this simultaneity as opposed to direct attempts to study this sorting process.

This paper offers an initial attempt to fill that void by analyzing how the property values, performance, and demographic characteristics of schools evolve over time, and as such offers a potential alternative to traditional single equation studies of these variables. The paper examines a sample of real estate transactions of owner-occupied housing in the State of Connecticut between 1995 and 2000. This sample is merged with the annual school profiles for each school district, as well as annual employment and demographic information for each labor market area in the state. A key feature of the analysis is that the specification models community composition, school performance, and price determination within an individual metropolitan or urban area. Specifically, individual metropolitan or labor market areas are assumed to be independent of each other, and changes in town or school district attributes are modeled based on comparison to other towns within the area.[1]

The paper is organized as follows. The second section presents a broad review of the relevant literature. The third section presents the simultaneous equation model that will be estimated. The fourth and fifth sections describe the data and the empirical results, respectively. The final section summarizes the findings and presents overall conclusions.

Literature Review

An analysis of the complex interaction between the markets for education and housing requires an understanding of a broad set of related literatures. The strong link between residential location and school attendance implies that the large literature on racial and income segregation must form the foundation for any such inquiry. The traditional urban and local public finance models suggest that households sort by income based on the trade-off between commuting costs (Alonso, 1964; Muth, 1967; Mills, 1969) or local public services (Tiebout, 1956) and the price of housing. Wheaton (1977) suggests that the financial trade-off between commuting costs and housing price is independent of income, but Glaeser, Kahn, and Rappaport (2000) find strong evidence income sorting where the poor reside in locations with poor access controlling for transportation mode and are nonetheless concentrated in central cities because they tend to be heavy users of mass-transportation in equilibrium. A huge literature on property tax and local public service capitalization documents that households bid for housing that provide access to desirable communities (Ross and Yinger, 1999), and Epple and Sieg (1999) provide evidence that households sort across communities by income in a manner that is consistent with this bidding process.

The literature also provides compelling evidence that households sort by race and that this sorting is related to human capital accumulation and education. African-American households are much more segregated than predicted by income differences between the races, Denton and Massey (1993), DeRango (1999), Bayer, McMillan and Rueben (2002). Recent work by Cutler and Glaeser (1997) and Borjas (1998) suggest that suggest that households sort over location based racial or ethnic composition due the peer group effects associated with human capital transmission between and within groups. Bayer (2001) finds that black and whites have similar preferences for education and attributes the inferior school quality outcomes of blacks to failures in the housing market. On the other hand, Ross (2002) finds evidence that racial differences in the preference for educational environment can explain a substantial portion of racial segregation. Clotfelter (2001) and Rivkin (1994) provide direct evidence of the role of housing outcomes in general and white household choices in particular in shaping the level of segregation observed in U.S. schools.

The residential sorting process discussed above has a dramatic influence on the educational environment experienced by American children and potentially on their educational performance. The 1966 Coleman Report and the research that followed (Hanushek, 1986) concluded that family background was the most important determinant of educational performance among students and that measurable differences between schools made little differences in student performance. While recent work such as Hanushek, Kain, and Rivkin (1998) and Boozer and Rouse (2001) demonstrate that school inputs matter,[2] they actually accomplish this by techniques that remove or instrument away the effect of student ability on performance measures. Therefore, none of these studies undermine the importance and significance of socio-economic and demographic characteristics for predicting the performance level observed within a given school.

Moreover, the growing literature on peer group effects suggests that the concentration of low performing groups in schools reinforces the other factors leading to poor performance and result in even lower performance for such schools. For example, Hanushek, Kain, Markman, and Rivkin (2001), Ding and Lehrer (2001), Sacerdote (2001), and Hoxby (2000) all provide evidence of peer group effects using research designs that eliminate or mitigate biases caused by student selection into specific schools. Finally, Hanushek, Kain, and Rivkin (2002) and Hoxby (2000) explicitly examine the impact of racial and ethnic composition on performance. Hanushek et. al. find that the segregation by race has a strong adverse effect on high ability blacks while Hoxby finds that Hispanic share positively effects Hispanic performance after controlling for mean student performance.[3]

Finally, the literature on public service capitalization provides strong evidence that households are willing to pay for school quality in the form of higher housing prices. Many studies find a positive relationship between standardized test scores and housing prices using cross-sectional regressions, see for example Weimer and Wolkoff (2001), Haurin and Brasington (1996), and Hayes and Taylor (1996). A few studies provide more compelling evidence by examining differences in housing prices across transactions for units with the same neighborhood attributes.[4] Bogart and Cromwell (2000) examine the effect of a redistricting that changed the school of attendance for many neighborhoods and conclude that these changes have a substantial effect on housing prices. Black (1999) develops a sample of transactions along the boundary of grade school attendance zones. She finds that the effect of test scores on housing prices falls by about 40 percent when a regression including traditional census tract controls for neighborhood is replaced with a comparison of housing transactions along the same boundary. Finally, Briggs, Clapp and Ross (2002) examine a panel of housing transactions. They find that tests scores have no effect on housing price in a model that controls for census tract fixed effects, but that racial, ethnic, and socio-economic composition all influence housing prices.[5]

A separate literature on racial differences in housing prices suggests that the simple regression of housing prices on school racial composition actually represents the results of a complex process. A large literature exists that examines racial differences in housing prices in order to test whether housing market segregation by race is attributable to housing discrimination or to taste based sorting (Cutler, Glaeser, Vigdor, 1999; Kiel and Zabel, 1996; and Chambers, 1992).[6] The literature posits the hypothesis that if blacks are constrained by discrimination to specific neighborhoods and the black population is growing blacks will be forced to pay more for housing. On the other hand, if blacks are excluded from some neighborhoods because whites outbid blacks for access to those neighborhoods, blacks will actually pay less for housing. In this context, the relationship between racial composition and housing price depends on the population growth rate for different socio-economic and demographic groups, as well as the speed and the extent to which the housing market can adjust to the changing metropolitan population and the resulting change in housing demand.

The link between school characteristics and housing price closes the system. The sorting literature explains how individual choices and constraints effect the socio-economic and demographic composition of school. The second literature on performance shows how student ability and family background influences students' performance and creates a strong link between the socio-economic and demographic composition of schools and the level of performance observed at those schools. Finally, the literature on school quality and housing prices capture the effect of performance, as well as composition, on location choice by using prices in order to capture the bidding process for housing in each school district.

Methodology

The paper uses a simultaneous equations system to capture the major factors that determine and describe how the education and housing markets evolve over time within towns of an individual metropolitan area. The first set of equations examines the determinants of changes in the socio-economic or demographic composition of a school district. The second set of equations explains the changes in school district housing prices for various segments of the housing market, and the third set explains the changes in the performance outcomes of students in each school.

The specification and identification of this model results from a series of strategies. First, we use the panel aspect of the data to estimate a model of changes in school district attributes over a two year period rather than levels in order to eliminate the influence of omitted neighborhood variables that may be correlated with observed school district variables (Black, 1999), as well as to control for persistence in the data (Arellano and Honore, 2001). Black (1999) demonstrates that estimations of the relationship between housing prices and school outcomes may suffer from omitted variable bias due a correlation between omitted neighborhood variables, which directly influence housing prices and school outcomes, and such fixed effects are removed from the error terms by examining changes in outcomes rather than levels.[5] Simple fixed effects approaches will be inconsistent, however, when the model includes predetermined rather than exogenous right hand side variables. In such instances, first difference models rather than traditional fixed effects estimation (mean differences) are recommended.[7]

Second, we exploit the variation across metropolitan or urbanized areas by assuming that areas are isolated from each other and that households choose locations within an area ignoring options that might be available outside of that area. This assumption suggests that school district or town changes are driven by overall changes in the area, as well as by how that school district compares to the other districts in the area. The coefficients for the effect of area changes on district changes are identified by the assumptions that area changes are explained by changes in area labor market information and that area labor market changes do not directly affect across-town price differentials or the allocation of households across districts within a given area. The relationship of a given district to other districts in the area is captured by a set of proxies that calculate the difference between the district values and the area averages for demographic composition, price, and school performance. These area comparisons are treated as predetermined level variables rather than exogenous right-hand side variables. Following Arellano and Honore (2001), three-period lags of these level variables are included as control variables in the specifications for changes in district demographic composition and price level.

The school district composition equations (Z_{ijt}) are basically just share equations for school districts (i), different population groups (j) and years (t). The change in population share for a single school district depends upon the change in population share within the metropolitan or urban area, as well as factors that differentiate this school district from the metropolitan area overall, e.g. $\overline{Z}_{lj}$ is share of population group j in the area l.

$$Z_{ijt} - Z_{ijt-2} = \delta_{\overline{Z}j}(\overline{Z}_{lt} - \overline{Z}_{lt-2}) + \delta_{Pj}(P_{it} - P_{it-2}) + \delta_{Oj}(O_{it} - O_{it-2}) + \delta_{Z_d j}(Z_{ijt-3} - \overline{Z}_{ljt-3})$$
$$+ \delta_{P_d j}(P_{it-3} - \overline{P}_{lt-3}) + \delta_{O_d j}(O_{it-3} - \overline{O}_{lt-3}) + \varepsilon_{Zijt} - \varepsilon_{Zijt-3}$$

where P_{it} is price level in the housing market segment and O_{it} is the outcome measure for school performance. The $\delta's$ are estimable parameters, where the secondary subscript l identifies parameters on a town's deviation from the metropolitan average, and ε is a randomly distributed error term.

The price equation follows a form quite similar to the share equations where the bids for housing within a given school district depend upon changes in the metropolitan area and the individual school district, as well as the ways in which that district differ from the overall area.

$$P_{it} - P_{it-2} = \beta_{\overline{P}}(\overline{P}_{lt} - \overline{P}_{lt-2}) + \sum_j \beta_{Zj}(Z_{ijt} - Z_{ijt-2}) + \beta_O(O_{it} - O_{it-2}) + \beta_{P_l}(P_{lt-3} - \overline{P}_{lt-3})$$
$$+ \sum_j \beta_{Z_d j}(Z_{ijt-3} - \overline{Z}_{ijt-3}) + \beta_{O_d}(O_{it-3} - \overline{O}_{it-3}) + \varepsilon_{Pit} - \varepsilon_{Pit-2}$$

where the $\beta's$ are estimable parameters.

The school district outcome equation contains two sets of variables. The first set of variables simply describes the performance based on a simple production function, and as a result these variables should not directly depend upon comparisons to other towns in the area because the students of all districts across all areas in a given state take the same performance exam. Specifically, changes in district performance outcomes are assumed to depend upon changes in district demographic characteristics as well as changes in a vector of non-student related inputs (X_i) such as school expenditures. However, test scores in a school district may also be influenced by the people who move into or out of the district, and the specification controls for the sorting of new migrants by including a set of metropolitan comparison variables that are similar to those used in the price and demographic equations.

$$O_{it} - O_{it-2} = \sum_j \gamma_{Zj}(Z_{ijt} - Z_{ijt-2}) + \gamma_X(X_{it} - X_{it-2}) + \gamma_{\overline{O}}(\overline{O}_{lt} - \overline{O}_{lt-2}) + \gamma_{O_l}(O_{it-3} - \overline{O}_{it-3})$$
$$+ \sum_j \gamma_{Z_l j}(Z_{ijt-3} - \overline{Z}_{ijt-3}) + \gamma_{P_l}(P_{it-3} - \overline{P}_{it-3}) + \varepsilon_{Oit} - \varepsilon_{Oit-2}$$

where the $\gamma's$ are estimable parameters, and again the ε is a randomly distributed error term.

Finally, as discussed earlier, the area changes are endogenous and modeled separately. The area change equations are assumed to depend upon a series of lags for the change in the overall area level of employment ($L_{lt} - L_{lt-2}$), the level of unemployment (U_{lt-3}), and the area mix of employment (M_{lt-3}).

$$\overline{P}_{lt} - \overline{P}_{lt-2} = \sum_{t'} [\alpha_{Lt'}(L_{lt'} - L_{lt'-2}) + \alpha_{Ut'}U_{lt'-2} + \alpha_{Mt'}M_{lt'-2}] + \varepsilon_{\overline{P}lt} - \varepsilon_{\overline{P}lt-2}$$

where t' starts at t and increments backwards to include lags.

Given the assumptions discussed above, identification of the coefficients on changes in price level, demographic composition, and school outcomes arises from fairly natural exclusion restrictions. We assume that changes in the area price level influence changes in the individual district price levels, but does not affect changes in district demographic composition except through the movement of school district housing prices for different market segments. Similarly, we assume that area demographic changes only directly enter the district demographic equations. As a result, variation across metropolitan areas identifies these coefficients in the same way as hedonic demand equations are identified, see Epple (1987).[8] The parameters on changes in school outcomes are identified based on the assumption that public service provision decisions, e.g. education spending, are exogenous to the sorting problem considered in this paper, as well as by the earlier assumption that labor market area changes in tests scores only directly influence the district level test score equation.

Note that the set of demographic equations can be considered reduced form in the sense that we do not consider how contemporaneous changes for one demographic group influences changes for another group. We simply attempt to model the simultaneity between price and demographic sorting. In principle, the coefficients on the influence of contemporaneous demographic changes for one attribute on a second demographic change are identified, but we felt that identifying this simultaneity might be asking too much of the data.

Additional Hypothesis Tests

The specification above is more parsimonious than the specification used in the paper in order to highlight the key exclusion restrictions that identify the simultaneous equations model. A number of additional variables are included in the specification in order to test specific hypotheses. The first additions relate specifically to the across-school district sorting process that lies at the heart of this model. In the demographic share equations, the effect of the metropolitan change on the school district change may vary across towns because new migrants to a metropolitan area from a given racial or ethnic group may be more likely to locate in specific types of towns. For example, an increase in percent Hispanic may have a larger effect on a town's percent Hispanic if the town is already heavily Hispanic as compared to the rest of the metropolitan area. Accordingly, in the Hispanic equation, the metropolitan change in percent Hispanic is interacted with the school district deviation from the metropolitan area on percent Hispanic, price level, and math score. Similarly, the black equation bases the interactions on the metropolitan change in percent black and includes the interaction with the district deviation for percent black and omits the percent Hispanic interaction. The math equation bases the interactions on the metropolitan change in math score and includes the interactions for both percent Hispanic and percent black.

The price equation builds on the logic of the previous equations. The specification includes the interaction between changes in metropolitan area price level and lagged district price level deviation from the metropolitan area in order to test whether relatively high priced markets within an metropolitan area rise more quickly or slower than the rest of the metropolitan area when metropolitan prices are rising overall. Prices may also change because shifting metropolitan area demographics create shortages or surpluses of housing in districts with certain attributes. In order to capture this issue for Hispanics, African-Americans, and households with children who score high on standardized tests, the price specification is expanded to include the interactions of change in metropolitan area percent Hispanic with lagged district deviation on percent Hispanic, change in metropolitan area percent black with lagged district deviation on percent black, and change in metropolitan area math scores with lagged district deviation on math scores. These terms mimic the primary interactions terms included in the percent Hispanic, percent black, and test score equations.

The addition of these interaction terms to the specification raises some issues in terms of identification. These interactions are included in specific equations based on behavioral hypotheses and excluded from the other equations in order to preserve degrees of freedom because the empirical analysis uses a small sample of school districts and a short panel. The exclusion of the interactions from these equations, however, imposes additional exclusion restrictions, and such restrictions are difficult to justify since these interactions include town specific variables. In practice, these exclusions represent an attempt at reasonable compromise between parsimony and completeness, and the robustness of the results to alternative sets of exclusion restrictions will be discussed later in the paper.

Additional variables are added to the specification to enhance our set of control variables and draw from the existing literature. The change in an effective property tax rate, as well as the interaction of this change with the lagged value of the town's property tax deviation from the metropolitan area average, are included in the change in price equation in order to capture the effect of property tax capitalization and the possibility that capitalization of changes depends upon the current level of taxes. Similarly, in the test score equation, the change in education expenditures is interacted with the lagged level of expenditures as well as the lagged level of tests scores. These levels are absolute rather than relative to the metropolitan mean because they relate to the productivity of additional expenditures at various levels of spending and test scores. Finally, district median household income based on the census and distance from the CBD are added to all equations in order to control for district level unobservables that are not eliminated by the differencing process.

House Price Indices

The price level of housing for each school district and housing market segment is represented by a series of estimated house price indices, which are generated based on a locally weighted regression (LRM) of individual housing market transactions over time and space. The LRM starts with a standard cross-sectional hedonic model, except that a flexible function is introduced for the value of housing quality and time. The log of sales price ($lnSP_{ij}$) is regressed on a vector of housing characteristics (X_{ij}) and a two dimensional vector consisting of a housing quality segment and time (Z_{ij}) for a given house, j, in district i, sold at time t:

$$lnSP_{ijt} = X_{ij}\beta_1 + f(Z_{ij}) + \varepsilon_{ijt}$$

where ε_{ijt} is an iid noise term that is assumed to be normally distributed for the purposes of OLS hypothesis testing. The first column of Z classifies the transaction into low (smaller, older houses), middle and upper (larger, newer houses) segments: These segments were based on the 33.33 and 66.66

percentile points for interior square footage and building age. The second column of Z is time, a continuous variable ranging from 1995.00 to 2000.99 based on the year, month and day of the transaction.

Robinson (1988) and Stock (1989) propose a two-step algorithm for estimating a model of the form of equation (1): OLS estimates the parameters on X_{ij} and nonparametric smoothing methods estimate $f(Z_{ij})$. Robinson achieves orthogonality between the parametric and nonparametric parts by using conditional variables.[9] More detail on the LRM method, and particularly on the adaptation of the Robinson-Stock method to housing, is given in Clapp, Gelfand and Kim (2002).

A different equation is estimated for each school district (town) where sufficient data were available. At least 10 transactions were required each year in a district. Precision was increased by adding neighboring districts as an inferior quality category: I.e., neighboring data were used only if the local regression did not contain 25 data points, and neighboring data were down weighted by the local weighting scheme.

The nonparametric estimate of $f(Z_{ij})$ allows construction of three different house price indices for each town and quality segment. This is done by estimating $f(Z_{ij})$ on a two dimensional grid with quality categories on one side and June 30 of each year on the other. The estimating $f(Z_{ij})$ at such target points is standard in the smoothing literature. Once an estimate of $f(Z_{ij})$ is obtained, price indices are contructed by holding constant for town and housing quality segment and for X_{ij} ; time (the second column of Z) is allowed to vary and the predicted value for $f(Z_{ij})$ is estimated by interpolation.

The innovations to the Robinson and Stock models proposed by Clapp, Gelfand and Kim (2002) are:

1. The application to housing data;
2. The introduction of location (here, location in quality space) into Z;
3. The use of local polynomial regression (LPR) instead of the older Nadaraya-Watson method to estimate $f(Z_{ij})$. The LPR has better properties at boundary points.

4. The use of a locally adaptive bandwidths as proposed by Brockmann *et al* (1993). This allows the bandwidth to expand at points with insufficient data, and contract where data are plentiful. Thus, data from neighboring quality or time segments are used only if needed at each point on the quality-time grid.

Accessible treatments of LPR and semiparametric estimation can be found in Fan and Gijbels (1996) and in Wand and Jones (1995).

Data Description

The final data set takes the form of a panel of towns/school districts in the State of Connecticut for the years between 1995 and 2000. In Connecticut, towns and school districts are the same jurisdictions (codeterminous) and so all school district information is simply merged in at the town level.[10] The town level information includes both the property tax mill rate and the effective mill rate controlling for assessment timing from the state of Connecticut's Office of Policy Management database, 1990 and 2000 demographic and housing market characteristics form the Census of Population and Housing, as well as school district racial and ethnic composition, and per student expenditures from the state of Connecticut's Department of Education database.[11]

The housing transaction data contains nearly 100,000 usable housing transactions between 1995 and 2000 from the Banker and Tradesmen database. This database contains the unit address, selling price, the sale date, as well as a detailed list of housing characteristics, which include interior square footage, bedrooms, bathrooms, building age and lot size. Each property is geocoded to the town level and price indices are developed for three quality segments for every year between 1995 and 2000, inclusive, using the LRM method outlined in the previous subsection.[12] The transactions in each town are divided into quality segments by quantiles (thirds) for interior square footage and age. Nine quality segments are constructed as follows: Low quality is the lowest square footage quantile and the highest age quantile; the second segment is the lowest square footage quantile and the middle age quantile; and so forth. To ensure nonoverlapping price indices, the three indices are estimated for the second, fifth and eighth categories. I.e., $f(Z_{ij})$ is estimated for all categories, then the indices for these three are selected for use in this study.

Precise housing price indices cannot be generated for every town in Connecticut and this exercise results in a sample of 54 out of 169 towns that contains housing price information, a total of 324 town-year observations.

Finally, Connecticut Labor Market Areas (LMA's) are used as the definition of metropolitan area in this study. Connecticut LMA's are conceptually quite similar to Standardized Metropolitan statistical Areas (SMSA), but they are constructed by the State of Connecticut and used by the state to collect and report labor market information. These area offer a number of key advantages over SMSA's: 1. the areas are consistent with town boundaries, 2. provide complete coverage of all towns within the state, and 3. defined at a smaller scale and so much more representative of commuting and residential patterns in a small, densely populated state like Connecticut. The Department of Labor in Connecticut provides total employment and unemployment by LMA and year between 1991 and 2000, as well as employment in selected industries. Summing the student totals from the Department of Education school district files creates the LMA average demographic characteristics, and LMA price indices are created by a transactions-weighted average of the town price indices.

All variables are listed in Table One, and the means and standard deviation for changes in these variables and deviation in these variables from the LMA average are shown for all years in Table Two. The first six rows show the means and standard deviations for the change in housing prices, which are effectively percentage changes since they are based on logarithms, and the town deviation from the LMA average. The changes in housing prices are fairly uniform across market segments, but show an increasing rate of price appreciation during the late 1990's. The mean of the town deviation is obviously zero, and the standard error is near one based on the construction of the housing price indices. The noteworthy result here, however, is the extreme uniformity of the town standard error variable over time and across market segments. The within LMA dispersion of town housing price level does not appear to change over time even though the level of housing price is evolving rapidly.

The next six rows show the means and standard errors of town percent Hispanic, percent black, and math scores, as well as of the town deviation from the LMA on each of these variables. The data indicates dramatic increases in percent Hispanic in Connecticut towns especially in later years, and more modest increases in percent black in Connecticut towns. The standard error on changes in percent Hispanic and black are quite high suggesting a sorting of households by race and ethnicity. Nonetheless, the standard errors in town deviation on percent Hispanic and on percent black are relatively constant over time suggesting that the distribution of races within an LMA has not changed much over time. Average test scores exhibit increases over time. The state maintains that test scores are comparable over time during this period, which suggests that student's scores have been improving either due to an improvement in education quality or increased emphasis on testing.

The final variables include the labor market employment information, median family income and distance between the unit and the centroid of the central business district of the major LMA city. Employment and share of employment in finance, insurance, real estate, and service industries are fairly flat during this period, but unemployment fell pretty dramatically during the late 1990's. Median family income and distance to the business district did not change over time, and values are only shown in the average column.

Empirical Results

The parameter estimates of the simultaneous system are presented in Table Three based on the housing price index for the middle segment of the market. The first column presents the parameter estimates for the change in the level of house price, and the next three columns present the estimates for changes in percent Hispanic, percent black, and math score. The rows contain, in order, parameter estimates for the housing price, percent Hispanic, percent black, math score, and additional control variables. The rows are numbered in order to improve the readability of the table.

Naturally, increases in housing price at the LMA level lead to increases in price at the town level (Row 2), but there is little evidence of systematic variation across towns. Towns that currently have high housing prices appreciated at the same rate as lower priced towns regardless of the rate at which LMA prices were appreciating (Rows 3 and 4); in other words, housing price differentials across towns appear stable over time. An increase in percent Hispanic leads to lower prices in the middle price segment (Row

5), perhaps because of middle class flight from the very large increases in Hispanics over this time period. There is no statistically significant relationship between a town's ethnic composition relative to the metropolitan average and price changes (Rows 7 and 8). No evidence exists to suggest that racial composition influences price (Rows 11, 13, and 14). Finally, while changes in town math scores are not directly related to house price changes (Row 17), the level of math scores may play a role. Specifically, if math scores are moving up in an LMA, towns with high math scores relative to other towns in the LMA will have increases in housing prices (Rows 19 and 23). Potentially, an increase in the quality of students increases test scores which then leads to further increases in the demand for housing in these towns. The parameter estimates on effective property tax rates are statistically insignificant (Rows 24 and 25).

The results for the percent Hispanic and percent black equations are quite comparable. In both cases, the LMA changes in ethnicity or race is a strong predictor of town level changes in ethnic or racial composition (Rows 6 and 12). In addition, there is evidence of sorting in residential patterns based on the current demographic composition of the town. Towns that have higher minority concentrations experience a larger than average influx of the minority group when the LMA group population is increasing: I.e., a "beaten path" effect is observed. This effect is highly significant for blacks (Rows 13 and 14). For Hispanics, the individual coefficients are only significant at the 10% level (Rows 7 and 8). Distance from the business district and town median family income also appear to play role in determining ethnic composition. Hispanic composition is less likely to increase in higher income towns (Row 29, 10% significance level only) and far from the central business district (Row 30).

The final column provides the estimates for the change in math score equation. The estimates provide no support for the hypothesis that changes in or the level of demographic composition (Rows 5, 7, 11, and 13) influence a town's test scores. As in the previous equations, an increase in test scores in the LMA overall results in higher math scores in individual towns (Row 18). There is no evidence, however, that these changes lead to systematic shifts in the distribution of student ability across towns (Rows 19, 20, 21, 22, and 23). Additional per pupil expenditures appear to have less effect on test scores in towns that already have high test scores suggesting diminishing returns (Row 29), but other coefficients on expenditures are statistically insignificant, including the direct effect of changes in expenditures (Rows 26 and 27). This result suggests that changes in town education expenditures may not be exogenous, despite the lags in our model.[13]

One concern raised by the empirical results is that the estimated parameters in the price equation are not consistent with the estimated parameters in the other equations. If migrants into an LMA sort into a subset of towns based on the demographic characteristics of those towns, LMA's with large in-migrations should exhibit substantial increases in housing price driven by shortages of housing in the towns that are most desired by the in-migrants. Specifically, the estimated coefficients on the lagged town deviation from the LMA in percent minority and interaction of LMA changes in percent minority with the lagged town deviation should have the same signs in the price and demographic equations. The data do not support this for the middle price segment, but they do support this finding for the low segment: See discussion the next subsection. The findings for the middle price segment suggest that the housing market is fairly fluid and that any localized increases in demand (limited by the low income of many minority migrants) may be accommodated without major increases in prices. Other households in the middle segment may be able to shift their demand for location towards substitute towns that offer a similar level of welfare. The marginally significant (at the 13% level) finding that Hispanic sorting variables affect prices (rows 7 and 8) may be explained by the large influx of Hispanics into Connecticut LMA's, which may have overwhelmed the adjustment capabilities of the local housing markets, even in the middle house price segment; again, see the results in the next section on the high price segment.

Another factor that has not been considered is that these LMA changes may in part be due to internal changes such as differential birth rates or school improvements in test preparation, as opposed to migration into the LMA. While such internal changes may influence housing prices through the mobility decisions of current residents, the changes may also have amenity affects on housing prices. An increase in black school aged children may negatively affect the values in towns with a substantially black population. Similarly, an increase in test scores may lead to higher values in towns with high quality schools. Evidence presented in Table 2 points to a substantial in-migration of Hispanics to Connecticut cities during the 1990's, and the sorting model may have explanatory power for this group. In terms of racial composition and average test scores, the source of change within Connecticut is less clear.

As discussed earlier, the addition of interaction variables such as 9, 10, 15 and 16 to some equations provides additional exclusion restricts. Specifically, our conceptual model suggests that the LMA change in a variable should only enter the town change equation for that variable, but the inclusion of these interactions creates additional exclusion restrictions. In practice, these exclusions represent an attempt at reasonable compromise between strict adherence to our conceptual model and the limited degrees of freedom offered by our sample. The LMA change variables that are associated with the theoretically justified exclusion restrictions are powerful predictors of school district changes, and as a result the estimated equations are well identified without the additional exclusion restrictions. We tested robustness by adding the interaction variables to all equations, thus eliminating the exclusion restrictions (regressions not shown), and the results presented here were robust to such alternative specifications.

Housing Market Segments

Table Four shows the results for the house price equation using the housing price index for different segments of the market. The first column shows the parameter estimates for the low segment, and the next two show the results for the middle and high segments of the market.

The house price equation estimates suggests that demographic variables are especially important for the low market segment. Change in percent Hispanic is no longer related to decreases in housing price (Row 4), but the sorting result that an increase in percent Hispanic in the LMA leads to higher prices in predominantly Hispanic towns remains and is significant at the 10% level (Row 6).[14] The results for the percent black variables are all statistically significant in the low segment equation. Towns that are predominantly black and/or have an above average percent black experience increases in housing prices (Row 7 and 8) unless the LMA is experiencing an increase in the Black population overall in which case housing prices fall (Row 9). This results runs counter to the traditional literature on racial differences in housing prices where the migration of southern blacks to northern cities led to large price premiums in predominantly black neighborhoods. While the results in the Black equation are more difficult to interpret, it seems very reasonable that the influence of demographics is larger in the low segment of the housing market. On the other hand, in the high market segment, the coefficient estimates are insignificant on all demographic variables.

The influence of the math score variables also varies across the submarkets. In the low segment, increases in math scores lead to higher property values in all towns (Row 10), but in the medium and high segments of the market increases in math scores lead to higher property values in towns that have higher test scores (Row 12). Households who purchase housing in the medium and high segments of the market may only be willing to live in towns with the lowest test scores if they do not have children or if they intend to send their children to private school. Under these circumstances, school performance will not affect property values in the medium and high segments in the poorest performing schools, but school performance naturally affects property values in all towns in the low segment because the households in that submarket tend to use the public schools regardless of the school performance in that town.

The effects of changes in property taxes on changes in house price also vary across submarkets. As discussed earlier, changes in property taxes have no influence on house prices in the middle segment of the housing market (Rows 13 and 14). In the low segment, increases in property taxes decrease values in towns that already have high taxes and lead to higher values in towns with low taxes. On the other hand, in the high segment, increases in property taxes have the opposite effect, increasing values in high taxing towns and decreasing values in low taxing towns. Naturally, no one wants higher taxes so these results must in part be driven by what these taxes are buying for residents. The model specification only controls for school test scores and do not consider other services that might be provided by local governments.

Long Run Model

Table Five presents the results for the middle housing segment using changes over a longer period of time. Specifically, the model examines a single year of data in which all changes are calculated between 1996 and 2000 and level variables are lagged one period earlier to 1995. This model has the advantage of smoothing out noise in test score measurement and other variables. The key limitation of this approach is that the sample only contains 6 Labor Market Areas, and sufficient variation does not exist in a cross-section to instrument LMA changes. As a result, LMA changes in this model are assumed exogenous.

Most of the key results from the two year difference model persist in a model with four year differences. In the housing price equation for the middle segment, LMA changes in housing prices matter (Row 2), but there is no systematic variation in housing price effects across towns (Rows 3 and 4). Increases in percent Hispanic leads to lower housing prices (Row 5), and there is no evidence that sorting of Hispanic migrants into predominantly Hispanic towns leads to higher house prices in the middle segment of those towns (Row 8). Property values in high math score towns increase when test scores are rising in the LMA (Rows 19 and 23).

In the percent Hispanic and percent black equations, the standard sorting results persist where increases in LMA group composition leads to increases in town group composition for towns that already contain a substantial percentage of this group relative to the rest of the LMA (Rows 7, 8, 13, and 14). The negative relationship between distance from the central business district and percent Hispanic also persists in this alternative specification (Row 30).

The test score equations does not provide any evidence that improvements in the quality of students in an LMA lead to a sorting of those high quality students into predominantly high test score towns. The previous finding that increases in expenditures have a smaller effect on test scores when the town already has high test scores also persists in this model (Row 28).

A few additional parameters are statistically significant in this model that were not significant in the two year difference model, but the reader should be cautious in interpreting these findings due to the required assumption that LMA changes are exogenous. For example, in the four year difference model, increases in percent black appear to lead to decreases in math scores, and increases in test scores lead to lower percent black in a town intuitively because blacks are outbid by other groups for high quality schools. The effect of percent black on math scores, however, is identified by across LMA variation in changes in percent black, and the effect of math scores on percent black is identified by across LMA variation in changes in math scores. If the LMA changes are endogenous, the estimated parameters on these coefficients cannot be trusted. On the other hand, the estimated parameters on these variables in the two year difference model only requires the assumption that lagged LMA variables describing labor market conditions in the LMA are exogenous.

Summary and Conclusions

This paper examines the determinants of changes in housing price, racial and ethnic composition, and standardized mathematics tests scores for Connecticut Town in the mid to late 1990s. A two-year difference specification is used as opposed to a traditional fixed effects model and all level variables are lagged one year prior to the beginning of the differencing period in order to minimize bias caused by persistence in the data. Identification in the simultaneous equations system arises from the assumption that changes in Connecticut Labor Market Areas on a given variable, such as housing price or percent Hispanic, influence town changes for that variable, but do not directly influence the allocation of households and bidding for housing across towns and therefore has no direct effect on other dependent variables in the system.

The major positive finding is that the sorting of Hispanics and blacks, especially new migrants, are influenced by the racial and ethnic composition of the town. If a Labor Market Area has an influx of new Hispanic or black students into the community, towns that have higher than average percent Hispanic or percent black relative to the LMA will have larger increases in percent Hispanic or percent Black. In fact, when the percent Hispanic or black is not increasing in an LMA, the percent Hispanic or black tends to fall over time for towns that have an above average representation of minorities. These results are quite robust to alternative specifications that consider different segments of the housing market or longer differencing periods.

The above minority sorting process affects housing prices in the low priced housing segment only. In theory, LMA's with a substantial in migration of minorities should experience a shortage of housing in predominantly minority towns leading to an increase in prices in these towns as long as the migration period continues. Our results confirm this in the low priced segment in Connecticut towns during the late 1990s. This finding suggests that minorities, who typically have lower incomes, are competing for housing primarily in the low priced segment. The middle and upper segments of the housing market can adjust fairly quickly, potentially because any competition of new migrants with existing households is limited. To the extent that there is some competition in these segments, current residents may experience only a minor welfare loss from adjusting their community choice, and as a result across town differences in housing prices need to adjust only a little in response to migration.

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Table One: Variable Names and Descriptions	
Variables	Description of Variables
House Price (Low)	Housing sales price index for lower market segment from hedonic regression
House Price (Med)	Housing sales price index for middle market segment from hedonic regression
House Price (High)	Housing sales price index for high market segment from hedonic regression
Percent Hispanic	Percent of students in district who are of Hispanic origin
Percent Black	Percent of students in district who are African-American
Math Score	Eighth grade district mathematics score on Connecticut Mastery Exam
Effective Tax Rate	Property tax rate adjusted for assessment differences across towns
Median Family Income	Median family income from the 1990 Census
School Expenditures	Per pupil education expenditures in 1000's of dollars
Employment	Labor market area employment in 100,000's
Unemployment	Labor market area unemployment rate
Share FIRE and Service	Share of employment in financial, real estate, and service industries

Table Two: Means and Standard Errors for Estimation Variables						
Years	2000	1999	1998	1997	1996	Average
Pct Change in House Price (Low)	0.166 (0.055)	0.121 (0.070)	0.077 (0.074)	0.064 (0.107)		0.107 (0.088)
Town Deviation from LMA on House Price	0.000 (0.010)	0.000 (0.010)	0.000 (0.010)	0.000 (0.010)	0.000 (0.010)	0.000 (0.010)
Pct Change in House Price (Med)	0.188 (0.081)	0.142 (0.068)	0.071 (0.061)	0.025 (0.083)		0.107 (0.097)
Town Deviation from LMA on House Price	0.000 (0.010)	0.000 (0.010)	0.000 (0.010)	0.000 (0.010)	0.000 (0.010)	0.000 (0.010)
Pct Change in House Price (High)	0.154 (0.091)	0.130 (0.091)	0.072 (0.087)	0.033 (0.133)		0.097 (0.112)
Town Deviation from LMA on House Price	0.000 (0.010)	0.000 (0.010)	0.000 (0.010)	0.000 (0.010)	0.000 (0.010)	0.000 (0.010)
Change in Percent Hispanic	0.076 (0.079)	0.101 (0.085)	0.039 (0.062)	0.050 (0.093)		0.067 (0.083)
Town Deviation from LMA on Pct Hispanic	0.000 (0.122)	0.000 (0.121)	0.000 (0.119)	0.000 (0.117)	0.000 (0.117)	0.000 (0.118)
Change in Percent Black	0.042 (0.092)	0.078 (0.097)	0.034 (0.111)	0.043 (0.114)		0.049 (0.105)
Town Deviation from LMA on Pct Black	0.000 (0.163)	0.000 (0.162)	0.000 (0.162)	0.000 (0.161)	0.000 (0.159)	0.000 (0.160)
Change in Math Score	0.357 (0.437)	0.400 (0.389)	0.318 (0.303)	0.146 (0.346)		0.305 (0.382)
Town Deviation from LMA on Math Score	0.000 (0.121)	0.000 (0.120)	0.000 (0.132)	0.000 (0.131)	0.000 (0.134)	0.000 (0.127)
Change in Effective Tax Rate (mills)	0.358 (2.525)	-2.499 (3.786)	-2.596 (4.881)	-2.020 (5.444)		-1.689 (4.442)
Change in School Expenditures (%)	0.078 (0.051)	0.053 (0.041)	0.033 (0.057)	0.031 (0.040)		0.049 (0.051)
Median Family Income, $						51,577 (18,652)
$Ln(Employment)_{t-1}$	12.506 (0.615)	12.505 (0.611)	12.495 (0.615)	12.486 (0.620)	12.484 (0.622)	12.495 (0.612)
$Unemployment (\%)_{t-1}$	3.122 (0.593)	3.237 (0.619)	4.946 (0.983)	5.607 (1.070)	5.448 (1.003)	4.472 (1.388)
FIRE & Svc Emp. $(\%)_{t-1}$	0.511 (0.035)	0.530 (0.039)	0.526 (0.037)	0.525 (0.041)	0.521 (0.044)	0.523 (0.039)
Centroid Distance, CBD						0.782 (0.449)

Notes: Each yearly column is based on 54 observations (school districts). The last column is calculated from 216 (54x4 years) or 270 (54x5 years) observations. Changes are over two year periods. After an additional year lag for some variables, the model was estimated for 1998 – 2000 with 162 town year observations.

Table Three: Parameter Estimates for Simultaneous System (Middle House Price Index)

Variable Names	Change in House Price	Change in Percent Hispanic	Change in Percent Black	Change in Math Score
1. Change in House Price		-0.008 (-0.081)	0.025 (0.204)	
2. Change in LMA House Price	115.252 (9.349)			
3. Lagged Town Deviation from LMA on HP	-1.396 (-1.264)	0.351 (0.141)	-0.492 (-0.281)	
4. Change in LMA HP*Lg Town Dev on HP	924.422 (1.075)			
5. Change in Percent Hispanic	-0.641 (-3.374)			-0.480 (-0.595)
6. Change in LMA Percent Hispanic		11.170 (3.351)		
7. Lagged Town Deviation from LMA on Pct Hsp	-0.404 (-1.501)	-0.667 (-1.657)		2.994 (1.066)
8. Chng in LMA Pct Hsp* Lg Town Dev on Hsp	53.911 (1.522)	95.523 (1.817)		
9. Chng in LMA Pct Hsp* Lg Town Dev on HP		11.983 (0.037)		
10. Chng in LMA Pct Hsp* Lg Town Dev on Math		39.177 (0.832)		
11. Change in Percent Black	0.199 (1.448)			0.262 (0.452)
12. Change in LMA Percent Black			11.214 (5.350)	
13. Lagged Town Deviation from LMA on Pct Blk	0.131 (0.928)		-0.554 (-2.459)	0.124 (0.063)
14. Chng in LMA Pct Blk* Lg Town Dev on Blk	-25.696 (-1.295)		105.503 (3.756)	
15. Chng in LMA Pct Blk* Lg Town Dev on HP			324.532 (1.405)	
16. Chng in LMA Pct Blk* Lg Town Dev on Math			12.677 (0.495)	
17.Change in Math Score	-0.010 (-0.292)	0.007 (0.197)	-0.048 (-1.071)	
18. Change in LMA Math Score				8.583 (2.050)

19. Lg Town Deviation from LMA on Math Score	-0.565 (-2.460)	-.392 (-1.114)	0.008 (0.040)	2.383 (0.842)
20. Chng in LMA Math* Lg Town Dev on Hsp				-89.805 (-1.139)
21. Chng in LMA Math* Lg Town Dev on Blk				-14.219 (-0.248)
22. Chng in LMA Math* Lg Town Dev on Hp				-19.556 (-0.196)
23. Chng in LMA Math* Lg Town Dev on Math	12.725 (2.046)			-82.584 (-1.040)
24. Change in Effective Property Tax Rate	-1.076 (-0.421)			
25. Chg Eff Tax Rate*Lg Town Dev on Eff Tax Rt	-4680.197 (-0.489)			
26. Change in Log School Expenditures				-3.528 (-0.194)
27. Chg School Exp* Lg School Exp				5.272 (0.237)
28. Chg School Exp* Lg Math Score				-7.895 (-2.115)
29. Town Median Family Income 1990	-0.112 (-0.240)	-.820 (-1.832)	.392 (-.706)	-2.490 (-1.093)
30. Centroid Distance from CBD	-0.014 (-0.994)	-0.043 (-3.242)	-0.023 (-1.363)	-0.016 (-0.193)
31. Constant Term	0.037 (0.933)	0.065 (1.630)	0.047 (1.094)	0.167 (0.674)
Equation Chi-Square	189.7	83.0	116.3	29.8

Notes: Changes are over two year periods. After an additional year lag for some variables, the model was estimated for 1998 – 2000 with 162 town year observations. The parentheses contain t-values.

Table Four: Parameter Estimates for House Price Equation for Different Market Segments			
Variable Names	Change in House Price (Low)	Change in House Price (Med)	Change in House Price (High)
1. Change in LMA House Price	98.257 (7.713)	115.252 (9.349)	111.189 (4.668)
2. Lagged Town Deviation from LMA on HP	0.292 (0.226)	-1.396 (-1.264)	4.008 (1.758)
3. Change in LMA HP* Lg Town Deviation on HP	-128.543 (-0.127)	924.422 (1.075)	-2466.549 (-1.275)
4. Change in Percent Hispanic	-0.028 (-0.169)	-0.641 (-3.374)	0.238 (1.019)
5. Lagged Town Deviation from LMA on Pct Hsp	-0.318 (-1.299)	-0.404 (-1.501)	-0.099 (-0.278)
6. Chng in LMA Pct Hsp*Lg Town Deviation on Hsp	56.940 (1.753)	53.911 (1.522)	15.715 (0.338)
7. Change in Percent Black	0.297 (2.261)	0.199 (1.448)	-0.106 (-0.593)
8. Lagged Town Deviation from LMA on Pct Blk	0.304 (2.264)	0.131 (0.928)	0.075 (0.405)
9. Chng in LMA Pct Blk*Lg Town Deviation on Blk	-38.589 (-2.063)	-25.696 (-1.295)	-3.073 (-0.120)
10. Change in Math Score	0.072 (2.176)	-0.010 (-0.292)	-0.034 (-0.668)
11. Lagged Town Deviation from LMA on Math Score	0.019 (0.090)	-0.565 (-2.460)	-0.428 (-1.381)
12. Change in Math*Lg Town Deviation on Math	3.003 (0.519)	12.725 (2.046)	15.909 (1.902)
13. Change in Effective Property Tax Rate	2.221 (1.010)	-1.076 (-0.421)	-5.942 (-1.809)
14. Chg Eff Tax Rate*Lg Town Dev on Eff Tax Rate	-18883.090 (-2.220)	-4680.197 (-0.489)	27217.080 (2.122)
15. Town Median Family Income 1990	0.847 (1.941)	-0.112 (-0.240)	0.185 (0.302)
16. Centroid Distance from CBD	-0.004 (-0.329)	-0.014 (-0.994)	0.005 (0.280)
17. Constant Term	-0.079 (-2.123)	0.037 (0.933)	-0.034 (-0.623)
Equation Chi-square	145.1	189.7	58.1

Notes: Changes are over two year periods. After an additional year lag for some variables, the model was estimated for 1998 – 2000 with 162 town year observations. The parentheses contain t-values.

Table Five: Parameter Estimates for Four Year Lag (Middle House Price Index)

Variable Names	Change in House Price	Change in Percent Hispanic	Change in Percent Black	Change in Math Score
1. Change in House Price		-0.239 (-0.835)	0.092 (0.267)	
2. Change in LMA House Price	101.67 (5.138)			
3. Lagged Town Deviation from LMA on HP	-0.452 (-0.101)	7.676 (0.601)	-1.273 (-0.273)	
4. Change in LMA HP*Lg Town Dev on HP	46.875 (0.024)			
5. Change in Percent Hispanic	-0.436 (-2.762)			-0.729 (-1.098)
6. Change in LMA Percent Hispanic		2.475 (0.458)		
7. Lagged Town Deviation from LMA on Pct Hsp	-0.120 (-0.346)	-2.702 (-2.426)		-2.270 (-0.508)
8. Chng in LMA Pct Hsp* Lg Town Dev on Hsp	7.889 (0.281)	234.810 (2.460)		
9. Chng in LMA Pct Hsp* Lg Town Dev on HP		-551.974 (-0.518)		
10. Chng in LMA Pct Hsp* Lg Town Dev on Math		177.260 (2.162)		
11. Change in Percent Black	0.095 (0.760)			-1.102 (-2.864)
12. Change in LMA Percent Black			8.714 (2.574)	
13. Lagged Town Deviation from LMA on Pct Blk	0.015 (0.090)		-0.818 (-1.498)	0.081 (0.037)
14. Chng in LMA Pct Blk* Lg Town Dev on Blk	-10.070 (-0.654)		82.742 (1.996)	
15. Chng in LMA Pct Blk* Lg Town Dev on HP			392.114 (1.096)	
16. Chng in LMA Pct Blk* Lg Town Dev on Math			7.729 (0.192)	

17.Change in Math Score	-0.021 (-0.605)	-0.260 (-4.570)	-0.260 (-4.570)	
18. Change in LMA Math Score				6.785 (1.625)
19. Lg Town Deviation from LMA on Math Score	-0.900 (-2.053)	-0.235 (-0.472)	-0.235 (-0.472)	-2.476 (-0.605)
20. Chng in LMA Math* Lg Town Dev on Hsp				31.771 (0.499)
21. Chng in LMA Math* Lg Town Dev on Blk				-11.280 (-0.345)
22. Chng in LMA Math* Lg Town Dev on Hp				40.791 (0.476)
23. Chng in LMA Math* Lg Town Dev on Math	10.939 (1.833)			37.106 (0.655)
24. Change in Effective Property Tax Rate	-1.658 (-0.652)			
25. Chg Eff Tax Rate*Lg Town Dev on Eff Tax Rt	-2687.371 (-0.268)			
26. Change in Log School Expenditures				-26.216 (-1.774)
27. Chg School Exp* Lg School Exp				33.301 (1.823)
28. Chg School Exp* Lg Math Score				-8.651 (-2.496)
29. Town Median Family Income 1990	-3.990 (-0.439)	-1.292 (-0.905)	-1.959 (-1.122)	-9.970 (-2.431)
30. Centroid Distance from CBD	-0.042 (-1.793)	-0.102 (-2.993)	-0.053 (-1.160)	-0.089 (-0.641)
31. Constant Term	0.101 (1.196)	0.317 (2.732)	0.303 (2.388)	0.865 (1.662)
Equation Chi-Square	131.7	38.9	71.0	70.8

Notes: Changes are over two year periods. After an additional year lag for some variables, the model was estimated for 1998 – 2000 with 162 town year observations. The parentheses contain t-values.

Annex Table One: First Stage Estimates for LMA Change Variables			
Variables	Change in House Price (Low)	Change in House Price (Med)	Change in House Price (High)
2 Yr Lagged Chng in Employment	0.0120 (9.96)	0.0190 (14.89)	0.0233 (13.78)
3 Yr Lagged Chng in Employ	-0.0080 (-5.05)	0.0051 (3.04)	-0.0105 (-4.73)
2 Yr Lagged Percent Unemployment	-0.0004 (-9.95)	-0.0001 (-3.58)	-0.0002 (-3.91)
3 Yr Lagged Pct Unemployment	0.0002 (4.21)	0.0001 (3.45)	0.0003 (5.47)
2 Yr Lagged Percent FIRE & Service	0.0620 (11.30)	0.0535 (9.25)	0.0662 (8.60)
3 Yr Lagged Percent FIRE & Service	-0.0609 (-11.24)	-0.0543 (-9.49)	-0.0662 (-8.70)
Equation R-Square	0.818	0.858	0.671

Annex Table One: First Stage Estimates for LMA Change Variables (Continued)			
Variables	Change in Percent Hispanic	Change in Percent Black	Change in Math Score
2 Yr Lagged Chng in Employment	0.0418 3.39	-0.0106 (-0.95)	0.5317 (14.54)
3 Yr Lagged Chng in Employ	-0.0340 -2.11	-0.0667 (-4.60)	-0.2738 (-5.73)
2 Yr Lagged Percent Unemployment	-0.0018 -4.40	-0.0024 (-6.69)	-0.0023 (-1.96)
3 Yr Lagged Pct Unemployment	0.0019 4.68	0.0039 (10.69)	0.0098 8.09
2 Yr Lagged Percent FIRE & Service	-0.1683 (-3.00)	-0.2739 (-5.43)	1.0762 (6.48)
3 Yr Lagged Percent FIRE & Service	0.1642 (2.97)	0.3035 (6.09)	-1.1147 (-6.79)
Equation R-Square	0.332	0.678	0.630

Notes: Changes are over two year periods, and lagged variables are available for the four remaining years, 1997 – 2000. The parentheses contain t-values.

Endnotes

[1] The approach in this paper should be distinguished from analyses like Epple and Sieg (1999), who estimate a structural model based on traditional theoretical models of voting and sorting for a single metropolitan area (see Ross and Yinger (1999) for a discussion). Alternatively, this paper estimates a linear model, and identification arises from the presence of multiple, economically independent labor market areas in the sample.

[2] Hanushek (1997) and Greenwald, Hedges, and Laine (1996) perform meta-analyses of the research on school inputs and performance and as a result provide detailed inventories of the previous literature. Greenwald et. al. finds strong evidence that resources influence performance while Hanushek concludes that only a small percentage of studies find systematic evidence that resources matter.

[3] Manski (2000) and Moffit (2001) review the literature on peer group effects and provide detailed discussions concerning the potential biases in estimating peer group effects.

[4] Other papers, like Bogart and Cromwell (2000) and Weimer and Wolkoff (2001), stress the importance of biases due to omitted school district variation in non-education outcomes, such as the town property tax and other local public services.

[5] By including census tract fixed effects, Briggs, Clapp and Ross (2002) are essentially comparing changes in housing price within a tract to the changes in test scores for the district in which that tract is located. Bogart and Cromwell (2000) also find and report a negative relationship between percent black and housing price, but the estimated parameter is statistically insignificant.

[6] Cutler, Glaeser, and Vigdor (1999) and others examine racial differences in housing prices and find evidence that discrimination played a significant role in housing segregation prior to and during the 1970's, but conclude that segregation in 1990's appears to be driven by household preferences. On the other hand, Chambers (1992) and Kiel and Zabel (1996) find evidence on racial differences in housing prices that are consistent with a role for discrimination in some metropolitan areas, but not in others. Using alternative methodologies, Ihlanfeldt and Scafidi (2002) and Ross (2002a) find evidence that racial preferences play a role, but cannot entirely explain the residential patterns observed. See Ross (2002b) for a review of this literature and a comparison to the traditional literature on labor market discrimination.

[7] Specifically, Arellano and Honore (2001) state that this specification does not assume unserially correlated data, but imposes a weaker assumption that errors in first differences exhibit first order autocorrelation and are uncorrelated with all other lags. This weaker assumption seems to us to represent a reasonable compromise given the short panel available for this analysis.

[8] In hedonic demand equations, preferences are assumed to be the same across metropolitan areas while the price vector varies across areas. Similarly, in this model, we assume that the parameters for changes in district attributes are the same across all areas.

[9] A step-by-step exposition of this procedure, showing its relationship to OLS, is given in Hu (1999).

[10] A small number of school districts are consolidated across two or more small towns in order to consolidate both the high school, as well as administrative functions. The characteristics for these consolidated districts are used for both towns. However, most consolidated districts are not part of our sample because of our inability to estimate town level price indices for the small towns in those consolidated districts.

[11] The percentage of students receiving a free lunch and percentage non-English speakers in each school district was also available in this sample. These variables had no substantial affect on estimated results in earlier versions of the model.

[12] The volume of transactions recorded by Banker and Tradesmen during 1994 was too low to support an estimation of town price indices over a wide sample of towns. However, the transaction information from that year is included to increase the precision of the 1995 price index estimates.

[13] In Connecticut, an education cost sharing formula allocates money to towns with the greatest need defined by minority population and other variables.

[14] The coefficient estimates in the town change in percent Hispanic equation on the town deviation from the LMA average on percent Hispanic and on the interaction between the town deviation and the LMA change in percent Hispanic are highly significant in the low price segment model, while they were only weakly significant in the middle price model.