School Choice Through Relocation: Evidence from the Washington, D.C. Area

By: Lisa Barrow

Working Papers Series
Research Department
WP 99-7

Working Papers Series

School Choice Through Relocation: Evidence from the Washington, D.C. Area

Lisa Barrow
Federal Reserve Bank of Chicago

November 1997
Revised: March 1999

I would like to thank Orley Ashenfelter, Kristin Butcher, David Card, Seth Carpenter, Anne Case, Angus Deaton, Eugena Estes, Henry Farber, Pinelopi Goldberg, Michael Greenstone, Maria Hanratty, Bo Honoré, Alan Krueger, Helen Levy, Cecilia Rouse, Lara Shore-Sheppard, and Douglas Staiger for helpful conversations and advice. I am also grateful to Kimberly Sked for research assistance, Ronald Jantz for assistance with mapping data and software, and Robert Mann of the District of Columbia Public Schools and William Chappell of Prince George's County Public Schools for allowing me access to the school boundary maps for their districts. Seminar and workshop participants at Princeton University have also provided useful comments. Finally, I thank the National Science Foundation Graduate Fellowship Program and the Industrial Relations Section at Princeton University for financial support. The views expressed in this paper are those of the author and are not necessarily those of the Federal Reserve Bank of Chicago or the Federal Reserve System. All errors

are my own.

Abstract

In this paper I show how the monetary value that parents place on school quality may be inferred from their choice of residential location. The method identifies the valuation that parents place on school quality from the differential effect that measures of school quality have on the residential choices of households with and without children. I implement the method with data from the U.S. Census for Washington, D.C. using residential location decisions in 1990. For whites I find that school quality is an important determinant of residential choices and that households with children in the top income quintile are willing to pay $3,300 for schools that generate a 100 SAT point advantage. The evidence does not indicate that the choices of African Americans are influenced by school quality, which suggests that this group may be constrained in their location choices.

Lisa Barrow
Economic Research Department
Federal Reserve Bank of Chicago
230 S. LaSalle St.
Chicago, IL 60604
(312) 322-5073
lbarrow@frbchi.org

I. Introduction

School choice is among the most controversial issues in the United States today. At the center of the debate is the question of whether parents can, or should, be able to choose among alternative publicly-supported schools for their children. In 1996, Presidential candidate Bob Dole found the issue important enough to raise in his nomination acceptance speech, arguing that a wider choice of schools should be available to all families, not just the children of high-income families. In the midst of this debate, a variety of programs aimed at increasing parents' school choices have been adopted across the country. For example, Minnesota enacted an open enrollment policy to allow students to attend public schools outside of their own district; the city of Milwaukee established an experimental education voucher program to enable low-income families to enroll their children in private schools; and, nationwide, so-called charter schools have been set up within many school districts to offer programs that depart from the current offerings of the public school system.[1]

Popular discussions of school choice often seem to overlook the primary mechanism for school choice emphasized by economic models of public-good provision, namely, the choice of residential location. In a seminal 1956 paper, Tiebout argued that competition among local jurisdictions would lead to the efficient provision of a range of public goods including public schooling.[2] In the spirit of Tiebout's

---

[1]See Armor and Peiser (1997) for a general description of the Minnesota plan and charter school programs. I know of no evaluation studies of the Minnesota program. See Wells et al. (1998) for an examination of the politics of charter school reform. Rouse (1998) provides an evaluation of the effects of the Milwaukee program on student achievement, and Witte, Sterr, and Thorn (1995) and Witte et al. (1994) contain more detailed descriptions of the program.

[2]While not many papers have directly looked at households choosing schools through location, Lankford and Wyckoff (1997) examine the effect of racial composition of schools and neighborhoods on white families location decisions. Several other studies implicitly assume that households choose schools through location choice. Hoxby (1994) assumes that households choose location based, at least in part, on school district quality, and thus school districts in metropolitan areas with lower enrollment concentration face more competition. Black (1997) and Bogart and Cromwell (1997) both look at differences in house prices across school boundaries and within the same neighborhood for evidence of how much good schools are worth; thus, they assume that households choose locations within a neighborhood based on school

hypothesis, nearly one-half of parents in the 1993 National Household Education Survey reported that their decision of where to live was influenced by where their child would go to school (McArthur, Colopy, and Schlaline (1995)). The importance of this type of choice is also evident in the real estate market. Real estate agencies routinely provide school information to families with young children. For example, Century 21 South Lakes real estate agency, operating in Northern Virginia, provides average Scholastic Aptitude Test (SAT) scores for school districts in their area on their World Wide Web home page.[3]

In this paper I examine school choice embedded in the choice of residential location. By measuring the sensitivity of residential location choices to school quality, I can assess whether some school choice already exists in some areas of the U.S. A key difficulty that arises in studying the effect of school quality on residential location choice is that unobserved characteristics of different jurisdictions may be correlated with local school quality. To overcome possible biases arising from such unobservable factors, I compare the residential location choices of households with children to households without children. I assume that any unobservable attributes are equally valued by both types of households. Thus, I measure the excess sensitivity of location decisions of households with children to differences in school quality. In the end, I use the results to estimate how much households are willing to pay for quality education, and how increasing the school quality of various location choices would change demands for other communities.

I find that among white households in the District of Columbia, households with income above the bottom quintile seem to exercise school choice through location choice. One implication of these findings is that public schools already face some competition from other public schools in the area. Thus, the promised benefits of competition from moving to complete choice with a full voucher program are diminished. Among African-American households, I do not find evidence that households with children

---

quality.

[3]Century 21 South Lakes' home page: http://www.northernva.com/c21/index.html

locate in areas with higher school quality than households without children. These results give less support to the idea that public schools are competing with one another. More particularly, they suggest that African-American communities may not be competing with each other on the quality of public schools.

The paper is organized as follows. Section II presents the theoretical background and model, Section III discusses the data, and Section IV presents estimation results. In Section V, I interpret the results in terms of changes in location distribution associated with improvements in school quality, and I calculate estimates of the willingness to pay for school quality, as measured by the average SAT score for the area high schools. Section VI concludes.

II. Theoretical Background and Model

In a very influential paper, Tiebout (1956) hypothesized that households choose from alternative locations based on preferences for the local services provided by different communities. Tiebout's analysis arose in response to arguments by Musgrave (1939) and Samuelson (1954 and 1955) that socially optimal levels of public goods cannot be obtained because people do not have the incentive to reveal their true preferences. Tiebout argued, instead, that if people choose locations based on local public service provision, then they reveal their preferences by where they move. This paper builds on Tiebout's theory and attempts to observe differences in preference for school quality, revealed through location choice, arising from differences in household composition.

The conceptual experiment motivating the analysis considers a household living in a certain city and deciding whether to relocate. The household may compare employment opportunities and amenities offered by a set of community choices and choose the location that best matches its ideal. This may mean staying in the current location, moving to a nearby suburb, or relocating to a different labor market entirely. Assuming school quality is more important to households with children than households without children, households with children should be more likely to select residential locations that offer higher school quality. The degree to which they are observed to trade off higher school quality for other amenities (such as lower rent) provides a measure of the relative valuation placed on school quality.

A. Multinomial Logit Model

More formally, I assume households maximize indirect utility of the form:

$$U_{hj}=V_{hj}+\varepsilon_{hj} \ , \qquad \textbf{(1)}$$

where V_{hj} is the component of indirect utility that can be explained by observable household and location characteristics and ε_{hj} is an unobserved component. A household then chooses to locate in the community that maximizes its utility. Assuming that the ε_{hj} are independently and identically extreme value distributed, the probability that household *h* chooses community *j* is:

$$P_{hj}=\frac{e^{V_{hj}}}{\sum_{k=1}^{K} e^{V_{hk}}} \ , \qquad \textbf{(2)}$$

where *K* represents the maximum number of potential communities. As is well known, the multinomial logistic model (2) has a number of advantages over other possible specifications. These include the ease of computation and the fact that choice among a subset of options is governed by a similar logistic model. In addition, estimates from the logistic model easily can be used to simulate the effect of adding another choice option. On the other hand, the extreme value distributional assumption implies that the relative probability of choosing one location over another is unaffected by the characteristics of other choices in the choice set, commonly referred to as independence of irrelevant alternatives. Clearly, this assumption is not innocuous. However, preliminary attempts to relax the extreme value assumption have made little difference in the estimation results.

I further assume that the observed component of indirect utility, V_{hj} , can be approximated by a linear combination of choice specific attributes and interactions of choice specific attributes with household characteristics, *i.e.*

$$V_{hj} = X_j\beta + W_h \cdot Z_j\alpha \tag{3}$$

where X_j are attributes of the community, W_h are household characteristics that do not vary across communities but are interacted with community specific attributes, Z_j. β and α are unknown parameters to be estimated.

B. Identification Strategy

Throughout, I assume that households' preferences for local public goods differ with the composition of the household. Specifically, I hypothesize that households with children will value public education more than households without children because households without children do not directly benefit from higher quality public schools. An identifying assumption I make is that while school quality differentially affects households with and without children, other local amenities affect location probabilities of all households similarly. Thus, consider rewriting equation (3) as follows with school quality as the only observed amenity:

$$V_{hj} = \beta_1 S_j + \alpha_1 S_j \cdot 1(\textit{children under } 18) + \gamma e_j, \tag{4}$$

where S_j is school quality, 1(*children under* 18) is an indicator variable taking on values of one for households with children and zero for households without children, e_j is a local amenity unobserved by the econometrician, and β_1, α_1, and γ are unknown parameters. The value of school quality for households without children is β_1 and the value for households with children is $\beta_1 + \alpha_1$. Therefore, I am interested in estimating β_1 and α_1.

Suppose that the value of the unobservable amenity is linearly related to observable school quality, *i.e.*:

$$e_j = d \cdot S_j \tag{5}$$

Thus, equation (4) can be rewritten as,

$$\begin{aligned} V_{hj} &= \beta_1 S_j + \alpha_1 S_j \cdot 1(\textit{children under } 18) + \gamma(d \cdot S_j) \\ &= [\beta_1 + \gamma \cdot d] S_j + \alpha_1 S_j \cdot 1(\textit{children under } 18), \end{aligned} \tag{6}$$

Thus, the coefficient on school quality alone will be biased by the omitted variable by the amount $\gamma \cdot d$, but the school quality-child interaction coefficient will not. This results from the key assumption that omitted location characteristics have the same effect on households with and without children. Note in particular that if households without children put no value on school quality per se, then the estimated direct effect of school quality depends only on the correlation of school quality with the unobserved amenity, while the estimated interaction of school quality with the presence of children provides an unbiased estimate of the true valuation of school quality by households with children.

More generally, if the unobservable amenity is projected on the observable characteristic with some error, i.e. $e_j = d \cdot S_j + \eta_j$, then equation (1) becomes,

$$\begin{aligned} U_{hj} &= [\beta_1 + \gamma \cdot d] S_j + \alpha_1 S_j \cdot 1(\textit{kids under } 18) + \nu_{hj} \\ &= V_{hj} + \nu_{hj}, \end{aligned} \tag{7}$$

where ν_{hj} equals $\gamma \eta_j$ plus a household and location specific error term. Assuming the combined errors ν_{hj} are independently and identically extreme value distributed, the location probabilities are defined as in equation (2).

C. Empirical Specification

In order to estimate the model, I need a sensible specification for the indirect utility function. I model household indirect utility in each possible location as a function of school quality, other local amenities, household income, and the cost of choosing a particular community. Since local public goods are predominantly financed with a local property tax,[4] the cost of locating in a particular district j can be considered the property tax payment, $t_j p_H H$, where t_j is the local property tax, which varies across counties only, p_H is the unit price of housing, and H is the number of housing units purchased. Additionally, it is possible that zoning regulations put binding constraints on the quantity and quality of housing available for purchase. Because households that buy more and better quality housing pay a larger share of the tax burden, community residents have an incentive to limit the development of lower quality and/or smaller sized housing units. Zoning restrictions of this type may lead to an increase in the size and quality of the median apartment available in the local market. In this way, potential residents may have to buy more housing than they would with no restrictions in order to locate in a particular community. To attempt to capture both the tax cost and differences in the housing stock available in each community, I include median rent as a measure of the tax price of the location combined with some indication of the type of housing available.

Using median rent as a measure of the price of a location raises immediate concerns about the possibility of problems with endogeneity. An analogous issue is commonly discussed in the empirical industrial organization literature in which consumer level data is often unavailable and market shares and prices are simultaneously determined (See Berry (1994)). Relative to a market-level analysis, the use of household level data reduces the simultaneity problem. Nevertheless, if median rents are determined by local market forces and the sample households are representative of net market demand shifts, then the problem still exists. However, there are several reasons to think simultaneity is less of a problem for the

---

[4]See U.S. Bureau of the Census (1993). In the case of the Washington, D.C. area, property taxes are a major source of revenue in all the surrounding communities, e.g., the property tax is 36.5 percent of tax revenue in D.C., 57 percent of local tax revenue in Maryland, and 79 percent of local tax revenue in Virginia.

case at hand. First, the household group of interest—those living in D.C. in 1985 and remaining in the area in 1990—is very small relative to the population of the area. As a result, there are likely other groups of households that are making off-setting location decisions, such as older households relocating for retirement. Furthermore, to the extent that the land in these areas in not fully developed, housing supply may be very elastic, and hence demand shifts would have little if any price effect.[5]

An additional source of endogeneity to consider when using median rent involves the error component related to unobserved location characteristics that are observed by the households. If these unobserved characteristics are valued similarly by all households, then the market rent is expected to reflect these unobserved amenities. As discussed above, this will lead to biased coefficients on variables such as rent but will not affect the coefficient on the school quality-child interaction term.

III. Data

My sample consists only of households that lived in the District of Columbia in 1985. I choose to focus on D.C. for several reasons. First, although D.C. is a majority African-American city, its suburbs include both predominantly white and predominantly African-American communities. In particular, Prince George's County, MD on the eastern border of the District has a majority African-American population, mainly located in communities near the District. Second, there has been a great deal of concern about the quality of the public schools in D.C. The District of Columbia Public School System spends more per pupil (on average) than school districts of similar size and demographic make-up[6] while scoring below

---

[5]In fact, I investigated this problem empirically and found that the proportion of households locating in each area for the sample of interest is negatively correlated with the growth in median rent by area from 1980 to 1990. However, when I use all households in the metropolitan area in 1990 that move between 1985 and 1990, the proportion locating in each area is positively correlated with growth in median rent from 1980 to 1990.

[6]The peer districts as defined by the District of Columbia Financial Responsibility and Management Assistance Authority are: Baltimore, Boston, Charlotte-Mecklenburg, Chicago, Cleveland, Detroit, Memphis, Milwaukee, New Orleans, and Newark.

national and peer averages on the Comprehensive Test of Basic Skills (CTBS) and the SAT (District of Columbia Financial Responsibility and Management Assistance Authority (1997)). Third, and perhaps most importantly, Washington, D.C. is one of the few areas in which this study could be undertaken with Census Public Use Microdata Samples (PUMS) because the school districts in the area are defined at the county and independent city level and thus coincide fairly well with the geographic information on the Census files.[7]

The main source of data for this project is the 1990 Decennial Census Public Use Microdata Sample (PUMS), 5% Sample A files. These data provide detailed information on individuals' households, where they were living in 1985, where they live in 1990, income, age, education, race, and public and private school attendance. From these data, I select households in which the householder reported living in the District of Columbia in 1985 and which were still located in the D.C. Metropolitan Statistical Area (MSA) in 1990 as defined by the 1990 MSA definitions.[8] To these data I have matched information on local characteristics from Census Summary Tape files and other various sources. The 1990 Census PUMS files allow me to identify in which Public Use Microdata Area (PUMA) or sub-PUMA a household is located (See Census of Population (1990b) for more details on PUMAs.). Thus, in the D.C. MSA there are 26 location choices including 5 choices in the District of Columbia proper. A map of the PUMA and sub-PUMA boundaries in the Washington, D.C. MSA is shown in Figure 1.[9]

---

[7]As discussed below, the smallest identifiable area on the Census PUMS files is a Public Use Microdata Area (PUMA) or sub-PUMA of at least 100,000 people. Several counties and independent cities in the D.C. Metropolitan Statistical Area have fewer than 100,000 residents and therefore cannot be identified separately from one or more nearby school districts.

[8]The householder in the Census files, is "the person, or one of the persons, in whose name the house is owned, being bought or rented and who is listed in column 1 of the census questionnaire." Census of Population and Housing (1990b).

[9]Some multi-county PUMAs include counties that are not contained in the Washington, D.C. MSA 1990 definition; however, I include the PUMA in my sample as long as at least one county in the PUMA is in the MSA.

An important component of the data is the school quality measure, specifically average SAT scores by location. I collected high school SAT averages as well as school attendance area maps from the local school districts. For D.C., Montgomery County, and Prince George's County where the location choices are smaller than school districts, I was able to use high school attendance area maps in order to calculate local SAT averages.[10] For all other areas, I use average SAT scores by school district or school district group.

As described above, I focus on the location decisions of households living in the city. Column (1) of Table 1 presents selected mean household characteristics for the 12,805 households in the Census PUMS sample that were living in the District of Columbia in 1985.[11] Compared to the nation as a whole, these households have higher income, are more educated, are less likely to have children under 18, and are more likely to be African-American. By 1990, 1,351 of these households had moved out of the D.C. metropolitan area, 1,568 had moved out of the city to the surrounding suburban communities in Maryland and Virginia, and 9,886 remained in the District of Columbia. In column (2) of Table 1, I summarize characteristics of the households remaining in the D.C. metropolitan area. Again, the households have higher income, more education, are less likely to have children under 18 years of age, and are more likely to be African-American than the average U.S. household.

Sample means by race are presented in the last two columns of Table 1. Means for the white households are presented in column (3), and means for the African-American households are presented in column (4).[12] These calculations reveal striking differences. Most notably, average household income for

---

[10]More details on the data are contained in an appendix available from the author.

[11]This excludes individuals living in group quarters and households whose head reported being on active military duty. Note that this is not the sample I use in estimation.

[12]The sample referred to as white is actually 90.6 percent white; 4.0 percent Asian; 0.6 percent Native American, Eskimo, or Aleut; and 4.8 percent other.

white households is more than double the average for African-American households. The white households are also younger and have an average of three years more education than the African-American households. In addition, whites are nearly half as likely to have children in the household, but conditional on having children, they are more than three times as likely to enroll at least one child in private school.

The D.C. Public School District persistently ranks below average on student outcome measures such as average SAT scores. In fact, the D.C. district-wide SAT average is more than 100 points below any other school district in the D.C. metropolitan area, and only two of the locations within the District have SAT averages above 700 points.[13] Thus, the best way for parents to improve public school quality for their children is to move out of D.C. Of course, private schools may be an option for some households as well. Indeed, households with children are more likely to be living in the suburbs in 1990 than households without children, and this is true for both white and African-American households. Of the households still living in the District of Columbia in 1990, 15 percent of white households and 34 percent of African-American households had at least one child under 18 years of age, while 29 percent of white households and 45 percent of African-American households in the suburbs had children.

The patterns of location, both inside and outside the District of Columbia, vary dramatically by race and reflect the high racial segregation of many of the areas. Eighty-five percent of the households remaining in the D.C. metropolitan area still live in the District in 1990, with the highest percentage located in Anacostia and the lowest in the Northwest part of the city. Breaking this down by race, the majority of white households locate in the Northwest part of D.C. (49.3 percent), and the fewest locate in Anacostia (2.9 percent). For African-American households the reverse is true; the fewest number locate in the Northwest part of D.C. (1.7 percent), and the greatest number locate in Anacostia (37.3 percent). Unfortunately, I cannot identify in which sub-PUMA households were located in 1985 so it is impossible to

[13]SAT scores range from 400 to 1600 points. The national average for 1989, the year used in the estimation, is 903.

say exactly how the distribution of households across locations within the District has changed.

Of the households moving out of the District, over 90 percent move to one of four school districts—two in Maryland and two in Virginia—and 75 percent move to either Montgomery County, MD or Prince George's County, MD.[14] Once again, the location patterns vary by race. For white households, 53.5 percent move to either Montgomery or Prince George's Counties, with 42.3 percent locating in Montgomery. The next most frequent county choice for whites is Arlington, VA with 20.1 percent locating there. For African-American households, over 90 percent move to either Montgomery or Prince George's Counties, with 77.7 percent moving to Prince George's and 13.7 percent moving to Montgomery. No more than 4 percent of African-American households move to any area outside of Prince George's and Montgomery Counties. Clearly, African-American and white households do not choose the same communities. This outcome is consistent with many explanations including differences in income by race, differences in preferences, and housing discrimination.

To measure school quality, I use average SAT scores for each location choice.[15] While average SAT scores are not a perfect measure of school quality, they likely capture information about true school quality as well as information about peer group quality. It is widely acknowledged that average SAT scores vary across schools, school districts, and states due to differences in the participation rate among potential test-takers; however, schools, school districts, and real estate agencies frequently cite SAT

---

[14]Appendix Tables B3a-B3d give means and standard deviations for characteristics of the sample households by location and are included in the appendix available from the author. The most interesting facts to note are that average annual income of sample households by location choice ranges from $26,812 in the Stafford County group to $129,014 in Calvert and St. Mary's Counties, MD and that the households locating in Northwest D.C. are the least likely to have children under 18 years of age.

[15]I have also tried using pupil-teacher ratios to measure school quality. In these estimations, households with children are shown to prefer lower quality schools. However, I do not believe pupil-teacher ratios can be considered a plausible measure of school quality because the District of Columbia Public School System has the lowest pupil-teacher ratios in the area but is not considered to provide the best public education. The low pupil-teacher ratios in D.C. may very well arise due to small special and remedial classes.

averages as evidence of school quality. Thus, it is likely that parents perceive SAT scores as an indicator of school quality. It is also reasonable to think that parents have access to this information since real estate agencies make it available to potential home buyers, and *The Washington Post* publishes many of the local averages every fall. Within the District of Columbia, SAT averages range from 631 in Anacostia to 826 in Northwest D.C. The Anacostia SAT average is the lowest over all of the communities while the Bethesda/ Chevy Chase area (in Montgomery County, MD) has the highest average at 1045. In fact, each of the six locations in Montgomery County has SAT averages at least 100 points higher than the highest SAT average in the District and more than 300 points higher than Anacostia.

IV. Multinomial Logit Estimation Results

As noted above, the Washington, D.C. area is segregated, and household characteristics vary dramatically by race. A likelihood ratio test rejects that the coefficients for white and African-American households from a multinomial logit estimation are equal, $\chi^2(15) = 561.46$, hence I conduct my analysis by race. The results for white and African-American households are presented in subsections A and B, respectively. Subsection C contains results allowing the effect of school quality to vary with income for both races, and subsection D includes estimates allowing some private school choice.

A. Estimates for White Households

Table 3 presents indirect utility coefficient estimates from a multinomial logit model for white households. The specifications model the probability of choosing each of the 26 choices of location in 1990 conditional on living in the District of Columbia in 1985. These 26 choices are public school choices, and hence any household choosing to enroll children in private school is not included in the estimation sample.[16] Note that if independence of irrelevant alternatives holds, excluding the private school choices

[16]Means of household characteristics for all of the estimation samples are presented in Appendix (continued...)

from the model has no effect on the coefficient estimates.

The model in column (1) includes only school quality as measured by average SAT points, median rent as the proxy for the cost of choosing a given location, and the number of housing units to account for differences in the size of the areas. Results from this parsimonious specification suggest that households are more likely to locate in areas with higher median rent and that high SAT scores reduce the probability that a household locates to a given area. It is important to bear in mind that both median rent and SAT scores are likely to be correlated with other location characteristics. As a result, the models in columns (2) and (3) include controls for other location choice characteristics.

Characteristics contained in both the column (2) and column (3) specifications are: the location's distance in miles from central D.C., the crime rate, the number of D.C. Metro stations, total per capita county and state expenditure[17], the population density, the poverty rate, and the proportion of housing that is owner occupied. As households may have strong preferences for living in areas with households of the same race and the same class, in column (3) I additionally include the proportion of whites in a location and indicators for the education level of the householder interacted with the proportion of persons in the community aged 25 and older with the same education level.[18]

Across all specifications the effects of most location amenities do not change and are generally consistent with expectations. The number of D.C. Metro stations in a location has a significant, positive effect on location probabilities. Adding one Metro station increases location probability by as much as 4

---

[16](...continued)
Table B1.

[17]State expenditures are included to make the Maryland and Virginia public expenditures comparable to D.C. which is both the state and local government.

[18]The education levels are education ≤ 12 years of schooling and no high school diploma, high school graduate, some college education, and bachelor's degree or higher.

percent.[19] Per capita state and local expenditure has a positive effect on location probability. To the extent that expenditure reflects provision of other local public goods, households seem to value these public goods. Increasing per capita expenditure for all locations in the District by $500 (from $4,926) would increase the average probability of locating in Northwest D.C. from 0.40 to 0.45.

Population density also has a positive effect on the probability that a household chooses a particular location. This measure was included as a proxy for the presence of open spaces, such as parks, as well as the idea that households might move out of the city for more housing space. While this sample of households does not seem to prefer low population density areas, this is not entirely surprising given that these households exhibit some preference for city dwelling in 1985 and that the majority choose to stay in the city. Finally, as one might expect, the proportion of persons in poverty decreases the probability of location. The poverty coefficient is large in absolute value and implies a 16 percentage point decrease in location probability per 5 percentage point increase in the poverty rate.

The coefficients on the race and class variables in column (3) reflect the observed segregation in the D.C. area. White households are significantly more likely to locate in areas with higher percentages of whites. For all but the most educated, the proportion of people with the same level of education increases the probability of location; however, the negative result for householders with a bachelor's degree or more education is not statistically significant. Only the effects of three variables—distance, crime, and proportion of housing that is owner occupied—are sensitive to including race and class in the specification.

Turning to the variables of interest, both the direct effect of average SAT scores and the interaction effect of SAT scores on households with children rise noticeably when controls for other local amenities are

---

[19]The change in probability of moving to location *j* with a change in X_j is $\beta \cdot P_j \cdot (1-P_j)$ where β is the coefficient on X_j in the indirect utility function and P_j is the probability of moving to location *j*. Thus the maximum change in probability is $0.25 \cdot \beta$ which occurs when $P_j = 0.5$. Since the average predicted probability of locating in Northwest D.C. is 0.41, the change in probability of locating in Northwest D.C. from the change in one of its own characteristics will approximately equal the maximum change.

included. The direct SAT effect becomes positive and significant. The coefficient on average SAT scores implies that a 100 point increase in average SAT scores increases the probability of location choice by a maximum of 13 percentage points for households without children. For households with children, the main effect combined with the interaction term implies that a 100 point increase in average SAT scores increases the probability of location by a maximum of 25 percentage points. Note, however, that I assume the main effect of SAT scores cannot be interpreted directly since I rely on being able to identify the effect of school quality on location choice using the difference in the effect between households with and without children. Thus, if the true valuation of schools by households without children is zero, then only the net 12 percentage point increase in location probability for households with children can be attributed to the change in school quality.

The effect of median rent on location probabilities becomes negative when controlling for the other local amenities, and the negative effect becomes significant when controlling for race and class. The coefficient in column (3) implies that a $100 per month increase in the median rent leads to a maximal 5 percentage point decrease in the probability of location.

In columns (1)-(3) of Table 3, I have allowed preference differences between households with and without children to enter only through the school quality-child interaction. To examine whether the coefficient estimate on the SAT-child interaction term is upwardly biased, I present estimates fully interacting all right-hand-side variables with the indicator for whether a household has children under 18. The coefficient estimates for the direct effects of all variables are listed in column (4) of Table 3, and the coefficient estimates for the interaction effects are listed in column (5). Looking at the SAT coefficient estimates, the estimates tell a remarkably similar story to the estimates in column (3). The SAT-child interaction coefficient estimate in column (5) is 0.424 compared to the coefficient estimate of 0.474 on the SAT-child interaction in column (3). Since I am primarily interested in the school quality variable, I interpret this as evidence that it is not unreasonable to restrict the differences for households with and without children to enter only through the school quality measure.[20] Although I can reject that the child interaction coefficients on all but school quality are jointly zero ($\chi^2(14) = 170$), individually, most are not statistically significant. Thus, I continue to use the simpler specification of column (3) that is easier to interpret and has more precision.

B. Estimates for African-American Households

Table 4 presents the same specifications as above estimated using the African-American household sample. The base SAT coefficient in the simplest specification is again negative, but more importantly, the SAT-child interaction has a negative and statistically significant effect on location probability. Median rent, which is expected to be biased in a positive direction due to omitted amenity variables in this specification, has a negative effect on location probabilities.

The specifications in Columns (2) and (3) of Table 4 include controls for other location amenities that might be correlated with SAT scores and/or median rent. Several amenities have surprising coefficient signs. The crime rate and the proportion of persons in poverty have positive effects on location probabilities, and the number of metro stops has a negative effect on location probabilities. These results may arise because the African-American households largely choose to locate in relatively few places. To the extent that these African-American communities have higher crime and poverty rates and fewer metro stops than the white communities, these results may reflect the differences between the de facto choice set for African-Americans and the full set of choices in the model rather than true preferences. I find some evidence that this may be the case when I restrict the choice set to communities with more than 30 percent

[20]Note, however, that if the SAT-child interaction coefficient estimate is upwardly biased by an unobserved amenity that is highly correlated with the SAT-child interaction but orthogonal to the other amenity-child interaction terms, then this test will not help reveal the upward bias.

African-American populations.[21]

African-American households' location decisions reflect the existing segregation in the area, similar to the estimates for white households. African-Americans are much more likely to move to locations with higher proportions of African-Americans, and all education groups tend to move to communities with more households of their same education level.

Looking at the school quality and cost measures, there is little evidence that SAT scores significantly affect the location probabilities of African-American households. I hypothesized that SAT points would have a positive effect on location probabilities for households with children. The effect of SAT points on the location decisions of households with children is negative for both the column (2) and column (3) specifications; however, the coefficient loses statistical significance with race and class controls. The base effect of SAT scores becomes positive with the inclusion of race and class controls, but again, the result is not statistically significant. The cost measure enters as predicted. Median rent has a significant negative effect on location probabilities, implying up to a 10 percentage point decrease in location probability per $100 increase in median rent per month.

Columns (4) and (5) of Table 4 estimate the column (3) specification allowing the effect of all variables to differ by child status. As with the white households, the results are largely consistent with the estimates of column (3); allowing the difference in preferences by child status to enter only through the school quality measure seems to have little affect on the school quality coefficient estimate.

The findings for African-American households are puzzling. I have explored potential explanations for why these results do not square with economic theory such as income effects, higher costs of relocation, and constrained choice.[22] While I do not present the findings here, they suggest that there is

---

[21]Results and discussion are contained in the appendix.

[22]Specifically, I try reweighting the data for African-American households to reflect the distribution (continued...)

no simple explanation for the persistent negative coefficient on the SAT-child interaction for African-American households. The explanation is likely to require a more complex combination of income and social factors than I can accommodate in the model at this time. However, one set of estimates suggests that a more restricted choice set may be appropriate for African-American households. Restricting the choice set to locations with at least 30 percent of the population being African-American, the coefficient estimates on the base SAT effect, the crime rate, the proportion of persons in poverty, and the number of metro stations all have the predicted sign in this specification while in most other specifications the coefficient signs are counterintuitive.[23] This result could arise if the white communities are effectively not available to the African-American households and the white communities have better than average amenities. If this is the case, it would appear that African-American households have different preferences than expected when, in fact, among the available choices African-American households prefer lower crime, better metro access, etc.

C. Allowing School Quality Effects to Vary with Household Income

The estimations in Tables 3 and 4 assume that indirect utility is linear in household income, and thus income has no effect on the probability of location choice because it does not vary across the choices. However, poorer households are less able to relocate. To the extent that they are located in areas with the lowest quality schools in 1985, I should not observe them exhibiting preference for school quality if they

---

[22](...continued)
of income or income and household structure of the white households. I also try estimating the model using only the wealthiest African-American households, using only households that moved since 1985, or using only the subset of choices with at least 30 percent of the population African-American. See the appendix available from the author for the complete set of results.

[23]Restricting the white sample to the choice set of communities with more than 30 percent of the population white decreases the base SAT effect and increases the SAT-child interaction coefficient. The effect of the proportion of persons in poverty becomes positive and statistically insignificant. All other results remain relatively unchanged.

are unable to trade other consumption, perhaps necessities, for school quality. To explore this possibility, I allow the effect of school quality to vary with income. Table 5 presents estimates including interactions of income quintiles with SAT and with the SAT-child interaction omitting the lowest quintile.[24] Results for white households are presented in column (1), and results for African-American households are presented in column (2).

For both race groups, the results on the amenity, race, and class variables are substantially unchanged from the corresponding estimates in Tables 3 and 4, so I focus on the results for the variables of interest. For whites the base effect of average SAT scores increases monotonically with income quintile, becoming significantly different from zero for the third through fifth quintiles. For the SAT-child interaction, there is no general pattern by income quintile. Although all coefficients are positive, only the coefficient for the third quintile is statistically significant. However, restricting the SAT-child-income interactions to equal zero can be rejected by a likelihood ratio test, $\chi^2(4) = 11.53$. The net effects imply that a 100 point increase in SAT scores maximally increases the probability of location by 14 percentage points for households with children in the lowest income quintile to 30 percentage points for households with children in the third income quintile. For households without children, the maximal increase in location probability associated with a 100 point increase in SAT points ranges from 9 percentage points for the lowest quintile to 16 percentage points for the top quintile.

For African-American households, the base effect of average SAT scores does not vary with income quintile. When interacted with the SAT-child interaction, the coefficients are all positive, and they are statistically significant for households in the second and fourth income quintiles. However, the net effect of SAT scores on location probabilities is only positive for households in the fourth income quintile

[24]The quintiles in $1995 are: household income less than or equal to $14,880; between $14,880 and $29,940; between $29,940 and $46,980; between $46,980 and $77,750; and greater than $77,750. They are constructed from the 1990 Census Summary Tape File 3A using all of the households living in the District of Columbia in 1990.

which implies a maximal 3.3 percentage point increase in location probability for a 100 point increase in SAT points. Compared to households without children, households with children in both the second and fourth income quintiles are more likely to locate in areas with higher SAT scores.

For both white and African-American households, the results suggest that there are some differences in school quality effects by income. Although many coefficients are not individually significant, likelihood ratio tests easily reject that the income-SAT and income-SAT-child interactions are jointly equal to zero. One could conclude from the results that lower income households have less preference for school quality; however, if poor households cannot relocate due to income constraints, one would observe the same outcome. As a whole, these results suggest that wealthier households, particularly wealthier white households, seem to be able to exercise school choice through the choice of residential location.

D. Private School Choice

One omission from the above analysis is that some parents choose to send their children to private school. Forty-five percent of households with children in the Northwest section of D.C. have a child aged 6 to 17 enrolled in private school. Similarly, over 15 percent of households with children living in Damascus/Poolesville or Bethesda/Chevy Chase have at least one child enrolled in private school (See Appendix Tables B3a-B3d). I have considered several ways of incorporating private school choice into the analysis, although none is perfectly satisfactory. One possibility is to add a private school option for households with children for each location choice. This increases the choice set for households with children to 52 choices. However, within location the characteristics for all variables other than school quality and cost, namely private school tuition, are identical. Additionally, any private school could be chosen by the household so it is unclear what quality and cost measures should be assigned to the private school alternative.[25]

In an attempt to assess how private school choices may be affecting the above results, I re-estimate the specification of Table 5 allowing five private school choices—one for each of the locations in the District of Columbia. As a result, any household with children that sends a child to private school and locates in the District is added to the estimation sample. These households account for 86 percent of the white households choosing a private school option and 93 percent of the African-American households choosing a private option. In Figure 2, I present the proportion of households with children locating in D.C. that have at least one child enrolled in private school, by race and by income.[26] For either race, any differences in SAT-child effects that are found are likely to occur in the upper tail of the income distribution where higher proportions of households are sending their children to private school. This is particularly true for white households since the private school enrollment rate increases to 36 percent in the top decile. The private school enrollment rate increases more gradually with income for African-American households in the sample; however, the school quality will be more understated (when not allowing for private choices) to the extent that African-Americans are living in lower quality school districts on average. Of course, any systematic differences in the quality of private schools attended by white and African-American children make this comparison less clear and are not taken into account in the specifications.

Columns (1) and (2) of Table 6 re-estimate columns (1) and (2) of Table 5 including the households that locate in D.C. and choose a private school. In these columns, I have simply treated the households choosing private school as though they chose the public school option. I do this to see more clearly which changes in estimates arise from changes in the estimating sample and which arise from the

---

[25]Another possibility is to control for private school enrollment on the right hand side of the equation. The problem with this option is that the decisions of where to live and whether to send children to private school are likely joint decisions for many households.

[26]The income deciles were created using the full sample of PUMS households living in the District of Columbia in 1990.

change in the choice set. Very little difference results from estimating the model using the larger sample.

Columns (3) and (4) of Table 6 re-estimate columns (1) and (2) expanding the choice set to 31 for households with children. The five "new" choices are each of the location choices in the District with their respective location characteristics but using private school quality and cost measures. Since I do not observe the actual private school a child attends, only that he or she is enrolled in private school, I begin by assigning the quality and tuition cost of the average private school student in the U.S. For private school quality, I assign each of the private school choices an SAT score equal to the average SAT score for all private test-takers (962).[27] Private school cost is median monthly rent plus one-twelfth of the enrollment weighted average tuition for private secondary schools of all types (average annual tuition = $4,708) (National Center for Education Statistics (1995)). Thus, all private school choices have the same SAT score, but cost will vary across choices with differences in median rent. Within a location, the only difference between the public and private choice characteristics are the quality and cost variables. Because private school choices are only included for District of Columbia locations, the school quality of the private choice is always higher than that of the public choice. As a result, for all households choosing private schools in the columns (1) and (2) estimations, the SAT score is understated relative to the private school average.

The estimates in column (3) for white households show a noticeable decrease in the base SAT effect from positive and statistically significant to negative and statistically significant. For African-American households the base SAT coefficient also decreases and becomes negative and statistically significant. The SAT-income quintile interactions change little for either sample; however, both samples show a large increase in the SAT-child-income interaction effect for households in the highest income quintile. This result is consistent with the earlier observation that school quality would be understated for

---

[27]This average is from 1997 for religious and independent school test-takers, converted to the old SAT score scale. (The College Board (1997a, 1997b)).

all households choosing private school and living in the District. For white households with children, all income quintiles show net positive effects of SAT scores on location probability relative to households without children. For African-American households, the same is true for all but the third income quintile; however, any positive effect of SAT for households with children relative to households without children is still quite small.

Looking at a guidebook for private schools in the Washington, D.C. area, the private secondary schools located in the District of Columbia have higher than average tuition (See Coerper and Mersereau (1995)). Assuming higher average tuition reflects higher average quality, columns (5) and (6) simply re-estimate the specification of columns (3) and (4) using a higher quality and higher cost private school option. The hypothetical high quality, high cost option gets an average SAT score of 1100 and tuition of $8,000. The SAT score was chosen to be above the highest quality public school choice in the area, Bethesda/Chevy Chase, and the tuition is approximately equal to the median tuition for private secondary schools in D.C.[28] For both white and African-American households the results show decreased importance of school quality for all but the bottom income quintile for households with children. However, the monthly cost coefficient also declines so I will compare the estimates more directly below using the willingness-to-pay calculations.

V. Interpretation of the Results

These multinomial logit estimates can be used to look at the results in several ways. First, I consider the effect on location choice of improving the quality of public schools in D.C. Northwest D.C. has the highest predicted probability of location for white households with and without children, followed by Central D.C. The next largest probability prediction for whites with children is Bethesda/Chevy Chase. For African-American households, the largest predicted probabilities are for the Anacostia and Northeast

---

[28]Estimated using tuition data and enrollment information from Coerper and Mersereau (1995).

sections of D.C. However, I focus on the effects of improving school quality for whites since the African-American results imply a net negative effect on location probabilities for all but the fourth income quintile.

Consider improving the quality of public schools in Northwest D.C. In 1997 a 100 point increase in SAT score from 50 points below the national mean to 50 points above the mean moves a student from the fortieth to the fifty-ninth percentile (The College Board (1997)). An increase of 100 points in average SAT scores in Northwest D.C. would increase the average predicted probability for white households with children by 13.2 percentage points. For households without children the predicted increase is smaller at 8.8 percentage points.[29] Bethesda/Chevy Chase has the highest location probability outside of the District, and increasing the school quality of Northwest D.C. decreases the probability that households with children locate in Bethesda/Chevy Chase by 1.9 percentage points.[30]

Given the coefficient estimates from the indirect utility functions, one can calculate an estimate of the average willingness to pay for school quality, in this case SAT points.[31] Rewrite the estimated indirect utility function as follows:

$$V_{hj} = f_h(SAT) + g_h(median\ \ rent) + X\beta, \tag{8}$$

where $f_h(SAT_j)$ is the piece of indirect utility that is a function of SAT scores, $g_h(median\ rent_j)$ is the piece

[29]For the District of Columbia, improving the quality of the public schools may have the additional positive effect of helping to increase the tax base of the District. The population of D.C. has decreased over the last several years. Although not all of the decrease may be attributed to poor school quality, these results suggest that improving the quality of the public schools may encourage more households to remain in the District.

[30]The effects on location probabilities for all other choices will be even smaller because the predicted location probabilities are small initially.

[31]This method of calculating willingness-to-pay fails to recognize the possibility that households may change their choices if one location improves its school quality. McFadden (1995) proposes calculating mean willingness-to-pay using equivalent variation and suggests a way for measuring willingness-to-pay by equivalent variation when indirect utility is non-linear in income. At this point, I have not compared my calculations to the McFadden technique.

of indirect utility that is a function of median rent, and $X\beta$ represents everything else. I subscript the functions by h since they will vary with household composition and income. Next, I calculate the willingness to pay for SAT points as $\partial median\ rent/\partial SAT$ using the implicit function theorem. This equals $-f_h'(SAT)/g_h'(median\ rent)$. Using the estimates from column (1) of Table 5,

$$-\frac{f_h'(SAT)}{g_h'(median\ \ rent)} = -\frac{0.369+0.196\cdot 1(child<18)+0.254\cdot Q5+0.328\cdot 1(child<18)\cdot Q5}{-0.191} \qquad \textbf{(9)}$$

for a household with children with income in quintile 5, where $Q5$ is an indicator for a household being in the top income quintile. Since I am interested in the net willingness-to-pay relative to households without children, I subtract off the willingness-to-pay for households without children. The following table summarizes calculations of net willingness-to-pay for households with children for the top and bottom income quintiles using the specifications with and without private school choice. I also include the average estimated willingness-to-pay when school quality effects are not allowed to vary with income. The discussion focuses on the results for white households because African-Americans in the bottom and top income quintiles appear to have negative willingness-to-pay for school quality in the specification without private school choice.[32]

For the estimates by income quintile, the standard errors are quite large and thus I cannot reject that willingness-to-pay for school quality is equal to zero.[33] This reflects the imprecision of the underlying estimates, however, and when willingness-to-pay for school quality is calculated from the estimation without variation by income quintile, the standard error is much smaller.

---

[32]None of the willingness to pay calculations for African-American households are large or statistically significant.

[33]Standard errors were estimated using the delta method.

What Households with Children Are Willing to Pay per Year for 100 SAT Points (Standard Errors)

		White Households
No Private School Choice	Income quintile 1	$1,231 (1359)
	Income quintile 5	$3,298 (4026)
	Average	$2,646 (1108)
Allowing Private School Choice	Income Quintile 1	$163 (5764)
	Income Quintile 5	$3,572 (2148)
	Average	$1,700 (471)

Compared to households in the fifth income quintile without children, households in the fifth income quintile with children would be willing to pay on average $274 more per month for 100 additional SAT points, or $3,292 per year. This same calculation using the estimates from column (3) of Table 3 implies an average willingness-to-pay for SAT points of $2,646 per year per 100 points for households with children in all income quintiles. This amount is net of the average willingness-to-pay for SAT points for households without children. Households with children in the lowest quintile are estimated to be willing to pay $1,231 per year more than households in the same income group without children. When the private school choices within D.C. are included, net willingness-to-pay for school quality is estimated to be only $163 per year for households with children in the bottom quintile and rises to $3,572 for households in the top income quintile.[34] For comparison, the average willingness to pay for school quality is $1,700 per year

[34]For private schools I use the coefficient estimates from column (3) of Table 6 to calculate willingness-to-pay for the first and fifth income quintiles.

per 100 SAT points.[35]

One way to consider the plausibility of these estimates is to look at the tuition costs and SAT averages of private schools in the D.C. area. Private high school tuition is often more than three times this $3,292 estimate and only falls below $4,000 for two high schools inside the District of Columbia. (Coerper and Mersereau (1995)) When I include high schools located outside the District, there are several more schools with tuition under $4,000, but many are still much higher. While I do not have SAT information for these specific schools, nationally the SAT average for private independent schools is 93 points higher than the national public school SAT average, and the SAT average for religious private schools is only 29 points higher (The College Board (1997a, 1997b)). D.C. Public Schools have average SAT scores below the national public average so the gains to sending a child to private school may be closer to 160 points. Given these facts, it is not implausible that parents in the top income quintile are willing to pay nearly $3,300 to gain 100 SAT points.

VI. Conclusion

White households seem to exercise some school choice through location choice. On average, households with children have a greater likelihood of moving to an area with higher SAT scores than households without children. When I allow these effects to vary with income quintile, the coefficients are not individually statistically significant, but I can reject that the income quintile effects for households with children are jointly zero. While it is impossible to say whether the observed amount of choice is the "right" amount of choice, the willingness-to-pay estimates seem plausible given the tuition costs of private schools in the area.

The story for African-American households is much less clear. The counterintuitive results cannot

[35]The estimates allowing for private school choice without variation by income category are not shown in the paper, but they are consistent with the column (3) results of Tables 3 and 4.

be explained by simple income effects and likely result from a complex combination of income and effective choice sets. While on the surface these results may suggest that an education voucher program is useful, several other factors including tuition cost and race need to be taken into consideration.

In the fall of 1997, Congress was considering an education voucher program for D.C. for households earning less than 185 percent of the poverty line (approximately $30,000 for a family of four in 1997[36]). The District of Columbia Student Opportunity Scholarship Act of 1997 would have provided vouchers paying a maximum of $3,200 toward tuition and fees (including transportation) at public, private, or independent schools located in D.C., Montgomery County, Prince George's County, Arlington County, Fairfax County, Alexandria City, or Falls Church City. As noted above, there are only two high schools in the District with tuition below $4,000 and only one has tuition below the $3,200 limit. While there are more high schools in this tuition range outside of the District, transportation costs will not be insignificant. In sum, it would have been difficult for the low income households that qualified for the program to find affordable schools using the tuition voucher. In addition, if the African-American results on race reflect preferences for living in areas with high percentages of African-Americans, these preferences may also carry over to preferences in the racial composition of schools. If this is the case, expanding school choice to more public and private schools in the area may not add many choices that parents really prefer.

[36]Department of Health and Human Services (1997)

References

ADC of Alexandria, Inc. 1996. *A Guide to Montgomery County Public Schools, School Years 1996-1997: Secondary*.

Armor, David J. and Brett M. Peiser. 1997. *Competition in Education: A Case Study of Interdistrict Choice.* Boston: Pioneer Institute for Public Policy Research.

Berry, Steven T. 1994. "Estimating Discrete-Choice Models of Product Differentiation," *RAND Journal of Economics.* 25(2) pp. 242-262.

Black, Sandra. 1997. "Do Better Schools Matter? Parental Valuation of Elementary Education." Federal Reserve Bank of New York Research Paper No. 9729.

Bogart, William T. and Brian A. Cromwell. 1997. "How Much More is a Good School District Worth?" *National Tax Journal.* 50(2) pp. 215-232.

Census of Population and Housing, 1990a: Public Use Microdata Samples U.S. [machine-readable data files] Prepared by the Bureau of the Census. Washington, D.C.: The Bureau, 1992.

Census of Population and Housing, 1990b: Public Use Microdata Sample U.S. Technical Documentation. Prepared by the Bureau of the Census. Washington, D.C.: The Bureau, 1992.

Department of Health and Human Services. 1997. "Update of the HHS Poverty Guidelines," *Federal Register*. 62(46) pp. 10856-10859.

The College Board. 1997a. "High School Information," *Profile of College-Bound Seniors National Report*. http://www.collegeboard.org/index_this/sat/html/cbttyp97.html.

The College Board. 1997b. "SAT I-Composite (V+M) Test Score Distributions and Percentiles for 1997 College-Bound Seniors, Total Test Takers," *Profile of College-Bound Seniors National Report*. http://www.collegeboard.org/index_this/sat/html/totlvm97.html.

Coerper, Lois H. and Shirley W. Mersereau. 1995. *Independent School Guide for Washington, D.C. and Surrounding Area.* Chevy Chase, MD: Independent School Guides.

District of Columbia Financial Responsibility and Management Assistance Authority.1997. Report on D.C. Public Schools Performance. http://www.nubian.com/dcfra/newinfo/edreform3.html

Hausman, Jerry and Daniel McFadden. 1984. "Specification Tests for the Multinomial Logit Model," *Econometrica* 52(5) pp. 1219-1240.

Hoxby, Caroline Minter. 1994. "Does Competition Among Public Schools Benefit Students and Taxpayers?," NBER Working Paper # 4979.

Lankford, Hamilton and James Wyckoff. 1997. "The Effect of School Choice and Residential Location on the Racial Segregation of Elementary Students." Working Paper, State University of New York-

Albany.

Maryland Comptroller of the Treasury, Income Tax Division. 1984. *1984 Summary Report*.

Maryland Department of Fiscal Services. 1989. *Local Government Finances in Maryland, Year Ended June 30, 1989.*

McArthur, Edith, Kelly W. Colopy, and Beth Schlaline. 1995. "Use of School Choice," Education Policy Issues: Statistical Perspectives. National Center for Education Statistics.

McFadden, Daniel. "Modelling the Choice of Residential Location," in *Spatial Interaction Theory and Planning Models.* ed. by A. Karlqvist, L. Lundqvist, F. Snickars, and J. Weibull. New York: North-Holland Publishing, 1978.

McFadden, Daniel. 1981 "Econometric Models of Probabilistic Choice," in *Structural Analysis of Discrete Data*. Ed. By Charles Manski and Daniel McFadden. Cambridge: MIT Press.

McFadden, Daniel 1995. "Computing Willingness-to-Pay in Random Utility Models," Working Paper. Department of Economics, University of California, Berkeley.

Musgrave, Richard A. 1939. "The Voluntary Exchange Theory of Public Economy," *The Quarterly Journal of Economics*. February. 213-237.

National Center for Education Statistics, 1995. *Digest of Education Statistics.* Washington, D.C.: U.S. Department of Education, Office of Educational Research and Improvement.

Office of Criminal Justice Plans and Analysis. 1990. *1990 Crime and Justice Report for the District of Columbia*. Government of the District of Columbia.

Park, Jin Heum. 1994. "Estimation of Sheepskin Effects and Returns to Schooling Using the Old and the New CPS Measures of Educational Attainment" Industrial Relations Section Princeton University Working Paper #338.

Rouse, Cecilia Elena. 1998. "Private School Vouchers and Student Achievement: An Evaluation of the Milwaukee Parental Choice Program" *Quarterly Journal of Economics*. 113(2): 553-602.

Samuelson, Paul A. 1954. "The Pure Theory of Public Expenditure," *The Review of Economics and Statistics.* 36(4) pp.387-389.

Samuelson, Paul A. 1955. "Diagrammatic Exposition of a Theory of Public Expenditure," *The Review of Economics and Statistics.* 67(4) pp. 350-356.

Tiebout, Charles M. 1956. "A Pure Theory of Local Expenditures," *Journal of Political Economy.* 64(5) pp. 416-424.

Wells, Amy Stuart, Cynthia Grutzik, Sibyll Carnochan Catalán, Julie Slayton, and Ash Vasudeva. 1998. "Underlying Policy Assumptions of Charter School Reform: The Multiple Meanings of a

Movement," University of California, Los Angeles, mimeo.

Witte, John F., Cristopher A. Thorn, Kim M. Pritchard, and Michele Clairbourn. 1994. "Fourth-Year Report: Milwaukee Parental choice Program," University of Wisconsin mimeo.

Witte, John F., Troy D. Sterr, and Christopher A. Thorn. 1995. "Fifth-Year Report: Milwaukee Parental Choice Program." University of Wisconsin mimeo.

U.S. Bureau of the Census. 1987. *1987 Census of Governments Compendium of Government Finances.* Vol. 4. No. 5 U.S. Department of Commerce, Bureau of the Census.

U.S. Bureau of the Census. 1993. *Government Finances: 1990-1991,* Series GF/91-5. Washington, D.C.: U.S. Government Printing Office.

Table 1
Selected Household Characteristics

	District of Columbia 1985 (1)	D.C. in 1985 and D.C. MSA in 1990 (2)	D.C. in 1985 and D.C. MSA in 1990: Whites (3)	D.C. in 1985 and D.C. MSA in 1990: African-Americans (4)
Household Income	52,573 [53044]	52,813 [53782]	81,804 [73437]	38,911 [33131]
Householder age	48.3 [17.3]	49.7 [17.2]	49.1 [17.5]	50.1 [17.1]
Householder's education	13.2 [3.5]	13.0 [3.5]	15.1 [3.2]	12.0 [3.2]
% with children under 18	29.4 [45.6]	30.1 [45.9]	18.3 [38.7]	35.8 [47.9]
% with children under 10	22.6 [41.8]	22.9 [42.0]	14.2 [35.0]	27.0 [44.4]
% with children under 6	15.6 [36.3]	15.5 [36.2]	10.5 [30.7]	17.9 [38.4]
% African-American	63.2 [48.2]	67.6 [46.8]	—	—
% White	33.6 [47.2]	29.4 [45.5]	90.6[a] [29.1]	—
% of households with children in private school [b]	10.2 [30.3] (N=3880)	10.6 [30.9] (N=3530)	25.3 [43.5] (N=718)	7.1 [25.6] (N=2812)
N	12,805	11,454	3,865	7,589

Notes: Household income in 1995 dollars. All means are weighted using household weights from the Census. Columns (3) and (4) are not the estimation samples. See Appendix Table B1 for statistics on the samples used for estimation. Standard deviations are in brackets.

[a] The remaining households are: 4.0 percent Asian; 0.6 percent Native American, Eskimo, or Aleut; and 4.8 percent other.

[b] Percentages are conditional on having children under 18 in the household. Number of households with children is given in parentheses.

Table 2
Multinomial Logit Estimation of Location Probabilities for White Households

	Only Interacting SAT with Child Indicator			Interacting Child Indicator with All Right-Hand-Side Variables	
				Direct Effects	Interaction Effects
	(1)	(2)	(3)	(4)	(5)
SAT (100's of points)	-0.794 (0.029)	0.658 (0.139)	0.537 (0.147)	0.525 (0.175)	0.431 (0.317)
SAT x 1(child < 18) (100's of points)	0.299 (0.042)	0.358 (0.045)	0.474 (0.046)	—	—
Median Rent ($100)	0.275 (0.021)	-0.085 (0.087)	-0.215 (0.090)	-0.169 (0.105)	-0.217 (0.211)
Distance from D.C. in miles	—	-0.026 (0.093)	-0.309 (0.098)	-0.121 (0.113)	-0.546 (0.230)
Crime rate (per 1 million people)	—	-0.038 (0.020)	-0.021 (0.020)	-0.054 (0.024)	0.091 (0.045)
Number of D.C. Metro Stations	—	0.183 (0.037)	0.154 (0.038)	0.225 (0.046)	-0.222 (0.082)
Per capita county expend net of education ($1000)	—	1.650 (0.078)	1.498 (0.096)	1.603 (0.112)	-0.554 (0.221)
Population per km^2 (1000's of people)	—	0.264 (0.058)	0.290 (0.059)	0.293 (0.069)	0.068 (0.133)
Proportion of persons in poverty	—	-15.486 (1.700)	-13.136 (1.783)	-16.001 (2.041)	7.911 (4.514)
Proportion owner occupied housing units	—	-2.545 (0.443)	-1.504 (0.464)	-2.580 (0.561)	3.854 (1.017)
Proportion of the population that is white	—	—	1.918 (0.213)	1.424 (0.250)	0.207 (0.477)
1(ed<h.s. graduate) x proportion non-h.s. grads.	—	—	6.564 (0.772)	5.681 (0.871)	0.763 (1.792)
1(ed=h.s. graduate) x proportion h.s. grads.	—	—	5.190 (1.021)	4.361 (1.139)	3.211 (2.704)
1(ed=some college) x proportion some college	—	—	3.050 (1.482)	2.725 (1.710)	5.387 (3.789)
1(ed=college graduate)x proportion college grads.	—	—	-0.227 (0.309)	-0.344 (0.336)	1.771 (0.899)
Number housing units (100,000's of units)	0.364 (0.030)	0.478 (0.045)	0.450 (0.046)	0.455 (0.058)	0.003 (0.094)
Log Likelihood	-11441	-7105	-6971	-6886	

Notes: The dependent variable is an indicator for location choice. There are 26 choices and 3,685 households in each estimation. Estimation results in columns (4) and (5) are from one estimation with all right-hand-side variables interacted with an indicator for the household having children under 18. Standard errors are in parentheses.

Table 3
Multinomial Logit Estimation of Location Probabilities for African-American Households

	Only Interacting SAT with Child Indicator			Interacting Child Indicator with All Right-Hand-Side Variables	
				Direct Effects	Interaction Effects
	(1)	(2)	(3)	(4)	(5)
SAT (100's of points)	-1.178 (0.041)	-0.520 (0.094)	0.027 (0.141)	0.133 (0.185)	-0.009 (0.293)
SAT x 1(child < 18) (100's of points)	-0.071 (0.034)	-0.084 (0.037)	-0.044 (0.037)	—	—
Median Rent ($100's)	-0.379 (0.027)	-0.387 (0.051)	-0.411 (0.055)	-0.504 (0.072)	0.071 (0.123)
Distance from D.C. in miles	—	-0.948 (0.116)	-0.917 (0.122)	-1.203 (0.200)	0.356 (0.260)
Crime rate (per one million people)	—	0.040 (0.017)	0.077 (0.020)	0.100 (0.027)	0.011 (0.043)
Number of D.C. Metro Stations	—	-0.056 (0.032)	-0.094 (0.035)	-0.141 (0.049)	-0.001 (0.073)
Per capita county expend. net of education ($1000)	—	0.229 (0.053)	0.600 (0.093)	0.763 (0.122)	-0.494 (0.192)
Population per km^2 (1,000's of people)	—	-0.014 (0.038)	-0.068 (0.042)	-0.096 (0.058)	-0.062 (0.088)
Proportion of persons in poverty	—	3.593 (1.238)	1.394 (1.269)	0.305 (1.824)	6.844 (2.703)
Proportion owner occupied housing units	—	0.937 (0.438)	0.204 (0.479)	0.268 (0.673)	0.607 (1.003)
Proportion of the pop. African-American.	—	—	0.958 (0.336)	0.563 (0.455)	1.105 (0.683)
1(ed<h.s. graduate) x proportion non-h.s. grads.	—	—	3.667 (0.443)	3.595 (0.561)	0.185 (0.929)
1(ed=h.s. graduate) x proportion h.s. graduates	—	—	4.785 (0.483)	4.433 (0.631)	-0.256 (0.997)
1(ed=some college) x proportion some college	—	—	8.849 (0.909)	9.043 (1.210)	-1.272 (1.863)
1(ed=college graduate) x proportion college grads.	—	—	1.826 (0.255)	1.764 (0.304)	-0.277 (0.603)
Number of housing units (100,000's of units)	0.560 (0.055)	0.338 (0.079)	0.298 (0.079)	0.290 (0.105)	0.043 (0.159)
Log Likelihood	-14214	-13753	-13532	-13412	

Notes: The dependent variable is an indicator for location choice. There are 26 choices and 7,374 households in each estimation. Estimation results in columns (4) and (5) are from one estimation with all right-hand-side variables interacted with an indicator for the household having children under 18. Standard errors are in parentheses.

Table 4
Multinomial Logit Estimation of Location Probabilities Allowing for Differences in School Quality Effect by Household Income Quintile

	White Households (1)	African-American Households (2)
SAT (100's of points)	0.369 (0.162)	-0.017 (0.148)
SAT x 1(child < 18) (100's of points)	0.196 (0.199)	-0.368 (0.100)
SAT x Q2 (100's of points)	0.093 (0.088)	-0.128 (0.068)
SAT x Q3 (100's of points)	0.164 (0.083)	0.074 (0.064)
SAT x Q4 (100's of points)	0.204 (0.080)	0.010 (0.066)
SAT x Q5 (100's of points)	0.254 (0.078)	0.121 (0.074)
SAT x 1(child<18) x Q2 (100's of points)	0.168 (0.245)	0.507 (0.128)
SAT x 1(child<18) x Q3 (100's of points)	0.488 (0.229)	0.201 (0.128)
SAT x 1(child<18) x Q4 (100's of points)	0.050 (0.221)	0.506 (0.123)
SAT x 1(child<18) x Q5 (100's of points)	0.328 (0.209)	0.203 (0.140)
Median Rent ($100's)	-0.191 (0.090)	-0.402 (0.055)
Number of households	3,685	7,374
Log Likelihood	-6953	-13511

Notes: The dependent variable is an indicator for location choice. There are 26 choices for columns (1) and (2). In all cases, SAT scores are measured in hundreds of points. Standard errors are in parentheses. Q2-Q5 are indicators for the second through fifth income quintile. The quintiles are: household income less than or equal to $14,880; between $14,880 and $29,940; between $29,940 and $46,980; between $46,980 and $77,750; and greater than $77,750. The specifications in columns (1) and (2) also include: distance from central D.C., the crime rate, number of D.C. Metro stations, per capita county and state expenditure, population density, the poverty rate, the rate of owner occupancy, number of housing units, and the race and education interactions of Tables 3 and 4.

Table 5
Multinomial Logit Estimates Expanding the Choice Set to Include Some Private School Choice

	Including HHs Choosing Private in DC, Assigning Them the Public Choice		Average Cost and Average Quality Private Option		High Cost and High Quality Option	
	White HHs (3)	African-America n HHs (4)	White HHs (3)	African-America n HHs (4)	White HHs (5)	African-America n HHs (6)
SAT	0.381	-0.032	-0.395	-0.220	-0.366	-0.003
(100's of points)	(0.162)	(0.148)	(0.115)	(0.082)	(0.116)	(0.086)
SAT x 1(child < 18)	0.195	-0.372	0.035	-0.396	0.141	-0.307
(100's of points)	(0.195)	(0.099)	(0.169)	(0.080)	(0.149)	(0.073)
SAT x Q2	0.094	-0.125	0.094	-0.124	0.094	-0.126
(100's of points)	(0.088)	(0.068)	(0.088)	(0.068)	(0.088)	(0.068)
SAT x Q3	0.163	0.077	0.161	0.081	0.161	0.077
(100's of points)	(0.083)	(0.064)	(0.083)	(0.064)	(0.083)	(0.064)
SAT x Q4	0.201	0.012	0.190	0.017	0.190	0.014
(100's of points)	(0.081)	(0.066)	(0.080)	(0.066)	(0.080)	(0.066)
SAT x Q5	0.251	0.124	0.229	0.131	0.230	0.126
(100's of points)	(0.078)	(0.074)	(0.077)	(0.074)	(0.078)	(0.074)
SAT x 1(child<18) x Q2	0.152	0.486	0.145	0.439	0.103	0.370
(100's of points)	(0.238)	(0.127)	(0.210)	(0.102)	(0.181)	(0.092)
SAT x 1(child<18) x Q3	0.435	0.164	0.408	0.227	0.232	0.174
(100's of points)	(0.224)	(0.127)	(0.200)	(0.100)	(0.171)	(0.089)
SAT x 1(child<18) x Q4	0.003	0.473	0.072	0.441	0.029	0.341
(100's of points)	(0.216)	(0.122)	(0.189)	(0.098)	(0.165)	(0.089)
SAT x 1(child<18) x Q5	0.133	0.164	0.504	0.416	0.387	0.327
(100's of points)	(0.203)	(0.136)	(0.178)	(0.106)	(0.155)	(0.096)
Monthly Cost	-0.177	-0.390	-0.258	-0.418	-0.231	-0.352
($100's)	(0.089)	(0.055)	(0.049)	(0.048)	(0.049)	(0.046)
Number of households	3,840	7,573	3,840	7,573	3,840	7,573

Notes: The dependent variable is an indicator for location choice. There are 26 choices in columns (1) and (2), and 31 choices for households with children and 26 choices for households without children for columns (3)-(6). Monthly cost is monthly median rent for columns (1) and (2) and monthly median rent plus monthly tuition payment for (3)-(6). Q2-Q5 are indicators for the second through fifth income quintile. The quintiles are: household income less than or equal to $14,880; between $14,880 and $29,940; between $29,940 and $46,980; between $46,980 and $77,750; and greater than $77,750. Each estimate also includes: distance from central D.C., the crime rate, number of D.C. Metro stations, per capita county and state expenditure, population density, the poverty rate, the rate of owner occupancy, number of housing units, and the race and education interactions of Tables 3 and 4. Standard errors are in parentheses.

Figure 1
Washington, D.C. Area PUMAs

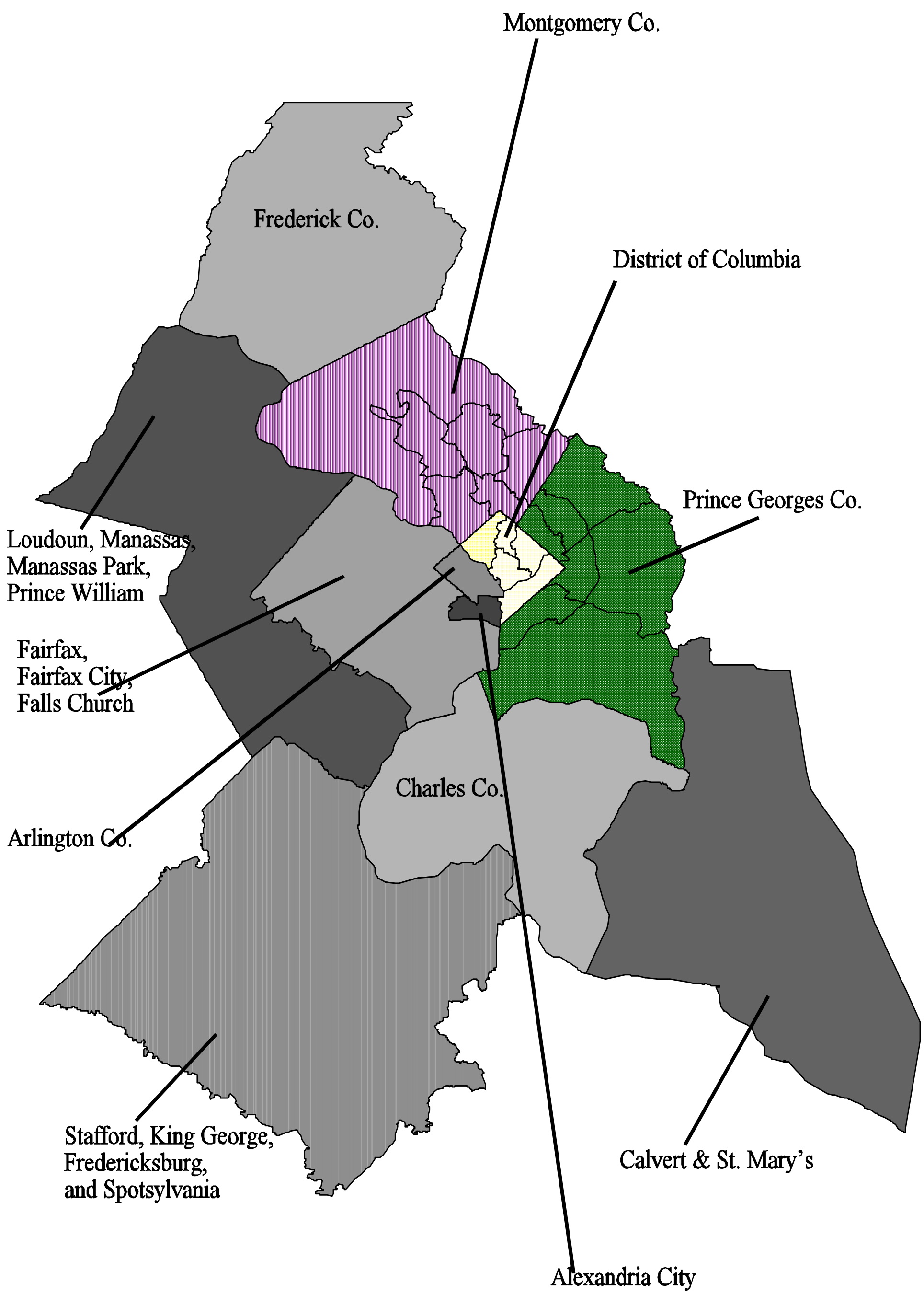
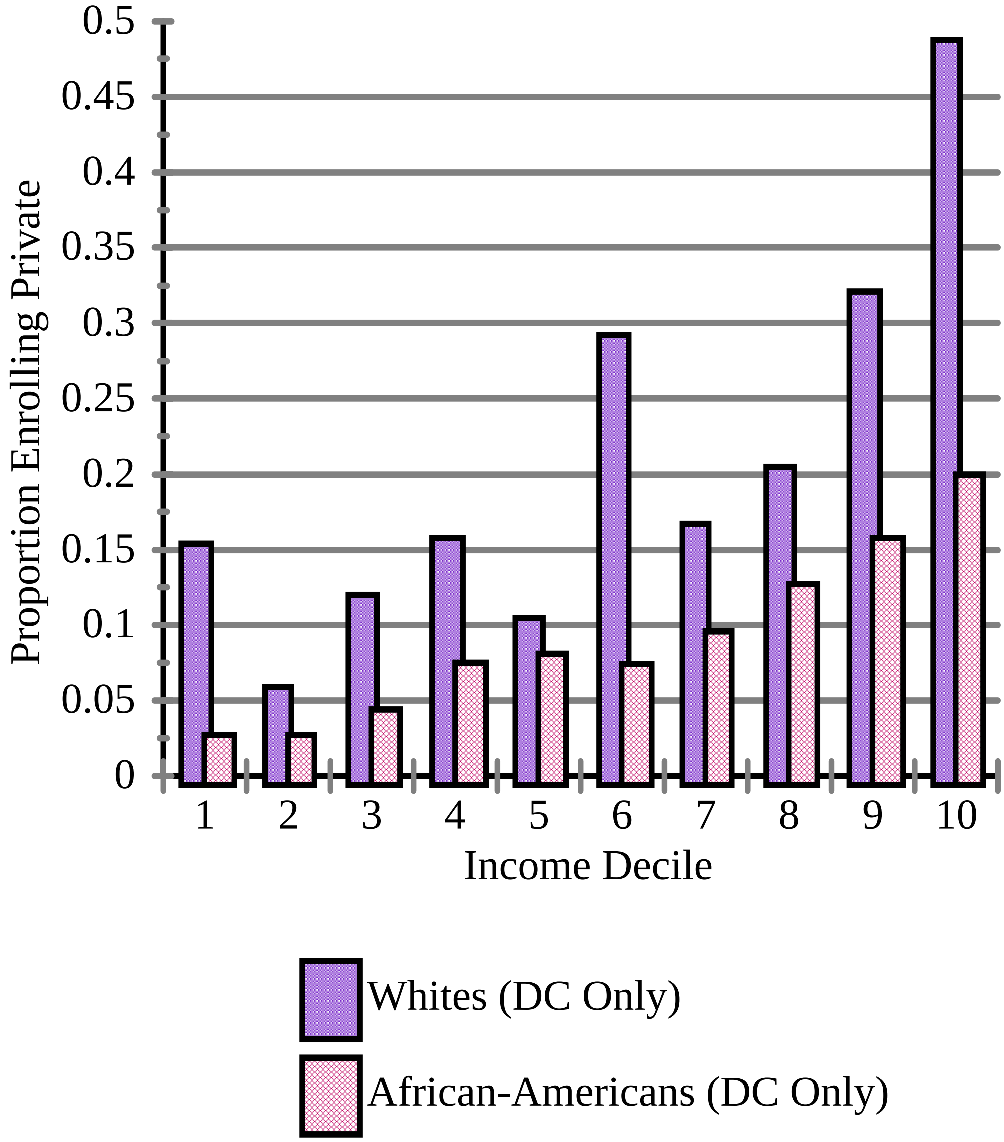


Figure 2
Private School Enrollment Rates for D.C. Households by Race and by Income Decile



Appendix A: Exploring the African-American Results

The findings for African-American households presented in section IV of the paper are quite puzzling. In Table A1, I explore potential explanations for why these results do not square with economic theory. As seen in Table 1 of the paper, the African-Americans have lower household income on average than the whites; thus, the specifications in Table 4 may not fully capture the effect of income on location decisions. Columns (1)-(3) of Table A1 explore the possibility that the results of Table 4 reflect the effects of income. If the effect of SAT scores on location probabilities increases with income for households with children, then the coefficient estimate for white households will be greater than that estimated for African-American households because white households in the sample tend to be in the upper portion of the income distribution. In column (1) of Table A1, the income deciles of the white households have been used to re-weight the African-American households thus giving more weight to high income households. Comparing the results to Column(3) of Table 4, the negative school quality effect only gets stronger and thus cannot be explained by a simple income effect.

The income difference between the white and African-American samples may also reflect differences in household structure. Thirty-six percent of African-American households in the sample are male or female headed family households while only 8 percent of the white households fall in this category.[37] Column (2) of Table A1 combines the income deciles with household type to form weights, again using the distribution of the white sample, to give more weight to married couple, non-family, and wealthier households. Once again, the school quality results are counterintuitive. In column (3) I explore the effects of income in a third way by estimating the specification only for households in the top 60 percent of the D.C. income distribution (53 percent of the African-American sample households). Again, SAT scores as a measure of school quality have no significant effect on location probability.

Columns (4) and (5) explore the African-American results from two additional angles. Relocation may be more costly for African-American households, perhaps because of factors such as housing discrimination or the availability of public housing. Looking only at households that actually relocate, either within or outside the District of Columbia, one might see that school quality affects location probabilities. Column (4) re-estimates the model including only households that are living at a different address than they were in 1985. This sub-sample contains 35 percent of the households in the original estimation sample. Here, the direct effect of SAT becomes positive and statistically significant while the SAT-child interaction becomes more strongly negative and statistically significant. Finally, column (5) simply restricts the choice set to communities with more than 30 percent of the population identified as African-American. This restriction eliminates 16 locations from the choice set but fewer than 5 percent of the households from the original sample.[38] In this estimate, the direct effect of SAT becomes large and statistically significant—a maximal 40 percentage point increase in location probability per 100 SAT points—but the SAT-child interaction remains negative and statistically significant.

---

[37]Married couple households make up 27 percent of the African-American sample and 34 percent of the white sample. The rest are non-family households.

[38]Two location-specific explanatory measures have to be dropped from this estimation because there are only 10 choices in the restricted choice set. In the specification shown, I have dropped population density and proportion of housing that is owner occupied because the coefficient estimates are statistically insignificant in the Table 4, column (3) results. The coefficient estimate on the SAT-child interaction is not sensitive to the choice of excluded variables among those that have statistically insignificant coefficient estimates in Table 4, column (3).

The results in Table A1 suggest that there is no simple explanation for the persistent negative coefficient on the SAT-child interaction for African-American households. The explanation is likely to require a more complex combination of income and social factors than I can accommodate in the model at this time. However, the coefficient estimates on amenities in the column (5) specification suggest that the more restricted choice set may be appropriate for African-American households.[39] The coefficients on the base SAT effect, the crime rate, the proportion of persons in poverty, and the number of metro stations all have the predicted sign in this specification while in most other specifications the coefficient signs are counterintuitive. This result could arise if the white communities are effectively not available to the African-American households and the white communities have better than average amenities. If this is the case, it would appear that African-American households have different preferences than expected when, in fact, among the available choices African-American households prefer lower crime, better metro access, etc.

Finally, I also estimate the Table 5, column (2) specification restricting the choice set to the communities with at least 30 percent of the population African-American. These coefficient estimates are presented in Table A2. The results are similar to the column (2), Table 5 results, but the base effect of SAT becomes strongly positive and statistically significant and the SAT-child coefficient and SAT-child-income quintile interaction coefficients approximately double in magnitude. As a result, all of the SAT-child-income interactions are positive and statistically significant. The second, fourth, and fifth income quintiles for households with children show a small but net positive effect of school quality on location probability relative to households without children. These results suggest that a combination of income and limits on potential choice may explain the counterintuitive results for African-American households with children although the evidence is not very strong.

---

[39]Restricting the white sample to the choice set of communities with more than 30 percent of the population white decreases the base SAT effect and increases the SAT-child interaction coefficient. The effect of the proportion of persons in poverty becomes positive and statistically insignificant. All other results remain relatively unchanged.

Table A1
Multinomial Logit Estimation of Location Probabilities for African-American Households

	Weight by Income (1)	Weight by Income & Type (2)	Household Income Above 40th Percentile (3)	Household Moved Since 1985 (4)	Community Pop. ≥ 30% African-American (5)
SAT	-0.271	-0.051	-0.196	0.314	1.342
(100's of points)	(0.182)	(0.169)	(0.168)	(0.155)	(0.420)
SAT x 1(child < 18)	-0.087	-0.112	-0.022	-0.168	-0.109
(100's of points)	(0.048)	(0.055)	(0.047)	(0.045)	(0.055)
Median Rent	-0.158	-0.289	-0.329	-0.445	-0.770
($100)	(0.072)	(0.072)	(0.068)	(0.082)	(0.269)
Distance from D.C. in	-0.879	-0.992	-1.157	-1.153	-1.023
miles	(0.179)	(0.174)	(0.175)	(0.135)	(0.758)
Crime rate	0.042	0.082	0.069	0.160	-0.068
(per one million people)	(0.026)	(0.024)	(0.024)	(0.026)	(0.065)
Number of D.C. Metro	-0.099	-0.151	-0.127	-0.220	0.044
Stations	(0.046)	(0.045)	(0.042)	(0.040)	(0.033)
Total per capita county	0.757	0.766	0.439	-0.200	1.010
exp. net of education	(0.123)	(0.118)	(0.110)	(0.105)	(0.276)
Population per km^2	-0.010	-0.051	-0.083	-0.193	—
(1000's of people)	(0.057)	(0.055)	(0.052)	(0.049)	
Proportion of persons in	0.342	0.866	2.644	8.489	-6.648
poverty	(1.641)	(1.641)	(1.571)	(1.601)	(2.722)
Proportion owner	0.675	0.647	1.078	0.833	—
occupied housing units	(0.613)	(0.610)	(0.570)	(0.555)	
Proportion of the pop.	0.766	0.524	0.791	1.494	1.393
African-American	(0.450)	(0.443)	(0.392)	(0.345)	(0.406)
1(ed<h.s. graduate) x	3.368	3.110	3.476	4.269	3.067
proportion non-h.s. grads.	(0.657)	(0.698)	(0.658)	(0.628)	(0.547)
1(ed=h.s. graduate) x	4.955	5.335	4.437	3.377	4.929
proportion h.s. graduates	(0.718)	(0.754)	(0.683)	(0.719)	(0.527)
1(ed=some college) x	6.748	6.356	6.291	6.166	10.224
proportion, some college	(1.236)	(1.234)	(1.116)	(1.124)	(0.999)
1(ed=college graduate) x	2.900	2.860	2.584	2.344	0.939
proportion college grads.	(0.303)	(0.291)	(0.316)	(0.411)	(0.326)
Number of housing units	0.505	0.527	0.299	0.255	3.006
	(0.081)	(0.069)	(0.093)	(0.078)	(1.032)
Number of households	7,374	7,374	3,901	2,583	7,034

Notes: The dependent variable is an indicator for location choice. There are 26 choices in each of columns (1)-(4). Column (5) includes only 10 choices. Standard errors are in parentheses.

Table A2
Multinomial Logit Estimation of Location Probabilities Allowing for Differences in School Quality Effect by Household Income Quintile: Restricted Choice Set

	African-American Households, Areas with ≥ 30% African-American
SAT (100's of points)	1.336 (0.424)
SAT x 1(child < 18) (100's of points)	-0.736 (0.138)
SAT x Q2 (100's of points)	-0.168 (0.094)
SAT x Q3 (100's of points)	0.104 (0.093)
SAT x Q4 (100's of points)	-0.024 (0.097)
SAT x Q5 (100's of points)	-0.123 (0.124)
SAT x 1(child<18) x Q2 (100's of points)	0.876 (0.179)
SAT x 1(child<18) x Q3 (100's of points)	0.443 (0.181)
SAT x 1(child<18) x Q4 (100's of points)	0.912 (0.177)
SAT x 1(child<18) x Q5 (100's of points)	0.784 (0.209)
Median Rent ($100's)	-0.772 (0.138)
Number of households	7,034
Log Likelihood	-11465

Notes: The dependent variable is an indicator for location choice. There are 10 choices. SAT scores are measured in hundreds of points. Standard errors are in parentheses. Q2-Q5 are indicators for the second through fifth income quintile. The quintiles are: household income less than or equal to $14,880; between $14,880 and $29,940; between $29,940 and $46,980; between $46,980 and $77,750; and greater than $77,750. The specification also includes: distance from central D.C., the crime rate, number of D.C. Metro stations, per capita county and state expenditure, the poverty rate, number of housing units, and the race and education interactions of Table A1.

Appendix B: Data

Selected mean characteristics for the estimation samples are listed in Table B1. Location characteristics and households characteristics are listed by location choice in appendix tables B2a-B2e and B3a-B3d, respectively. The sources for these data are described below.

<u>1990 Census Public Use Micro Sample</u>

Data on household income, householder education, household type, presence and age of children in the household, public and private school enrollment, and place of birth come from the 1990 Census PUMS 5% Sample files. Household income is in 1995 dollars, and place of birth is an indicator for a choice being located in the householder's state of birth. Householder education in years is converted to a continuous variable using the suggestion by Park (1994).

The 1990 Census PUMS files allow me to identify in which Public Use Microdata Area (PUMA) or sub-PUMA a household is located.[40] Most counties with populations greater than 100,000 can be identified on the PUMS files, and for households living in many large population counties, one can identify residential location by a smaller sub-PUMA area. Households living in counties with fewer than 100,000 residents can only be identified as living in a PUMA that consists of a group of counties and/or independent cities. In the DC area, school districts are defined at the county or independent city level so for large counties I can identify the exact public school district in which a household is living while for smaller counties and cities I can identify a household as living in one of two or more public school districts. Three large district–Washington, DC; Montgomery County, MD; and Prince George's County, MD–can be broken up into between 5 and 7 sub-PUMAs each. Given their large populations, these counties are likely to have a great deal more variation in community type and school quality within the school district; thus, in my model I allow households to choose to locate to one of the several sub-PUMA areas in each of these school districts. The maps in figures B1 and B2 show the boundaries of these areas with the names I have associated with each. Fairfax County, VA is also large in population with approximately 819,000 inhabitants, yet, no sub-PUMA areas are defined, and in fact, the county is grouped with two independent cities, Fairfax and Falls Church.

<u>1990 Census Summary Tape File 1A</u>

Data on percent of housing that is owner occupied, percent of the population that is African-American, and percent of the population that is white were obtained from the 1990 Census Summary Tape File 1A (STF1A) files. For sub-PUMAs, data were aggregated from the census tract level using census tract to PUMA mappings from MABLE/Geocorr.[41] For single- and multi-county PUMAs I use 1990 Census STF1A data at the county level.

<u>1990 Census Summary Tape File 3A</u>

Data on the percent of persons below poverty, median household income, median gross rent, and education category proportions come from Census STF3A files. Again MABLE/ Geocorr census tract to PUMA mappings were utilized in aggregating data to the sub-PUMA level and data for other PUMAs was constructed from county level data. In calculating the various percentiles, I assumed households were

[40]See Census of Population (1990b) for more details on PUMAs.

[41]These mappings were developed by John Blodgett, senior Programmer/Analyst at the University of Missouri, St. Louis, under contract with CIESIN/SEDAC.

uniformly distributed across the income and rent ranges used in the census.

SAT Scores

SAT score averages are for 1989 and come from the school districts themselves as well as annual articles published in *The Washington Post*. For single district PUMA's I use the district SAT average. For location choices containing more than one school district, I use enrollment-weighted averages. In the case of the Loudoun County group, scores were only obtained for the Fredericksburg City and Spotsylvania County districts so the average for the group is based on those two districts alone. Finally, for sub-PUMA areas I gathered information on high school boundary areas and assigned census tracts in whole or in part to a school based on the school boundary definitions and the sub-PUMA area definitions. I assumed population was uniformly distributed across a census tract and that high school students were similarly distributed. Thus, I use the census tract and census tract portion populations to calculate a weighted average of the high schools' average SAT scores by sub-PUMA.

MABLE/Geocorr

Distance from D.C.: All distances are population weighted averages from 38.89° latitude, -77.02° longitude.

Population Density: Land area in square kilometers calculated by MABLE/Geocorr.

Other Data

Crime Rates: FBI Uniform Crime Reports data. For all areas but D.C., crime rates are the average from 1987 to 1990 of serious crimes per 100,000 population. Serious crimes include: murder and non-negligent manslaughter, forcible rape, robbery, aggravated assault, burglary, larceny-theft, and motor vehicle theft. These county-level data came from USA COUNTIES 1996 CD-ROM. For D.C. PUMAs, PUMA-level crime rates were calculated from 1990 census tract level crime index data from Office of Criminal Justice, Plans and Analysis, Government of the District of Columbia, 1990. "1990 Crime and Justice Report for the District of Columbia."

Per capita county plus state expenditures: This is per capita total direct expenditure for individual counties which is equal to aggregate county, municipal, and township expenditures less expenditures on education.

Metro Stations: Counts are based on stations in existence in 1990. Stations that were within, roughly, 0.5 miles of a border were assigned split shares in each bordering PUMA.

Private school tuition: Enrollment weighted, private school tuition was calculated using data from Coerper and Mersereau (1995). The high schools and their enrollment and tuition are listed in appendix Table B4.

Figure B1
Washington, D.C. sub-PUMAs

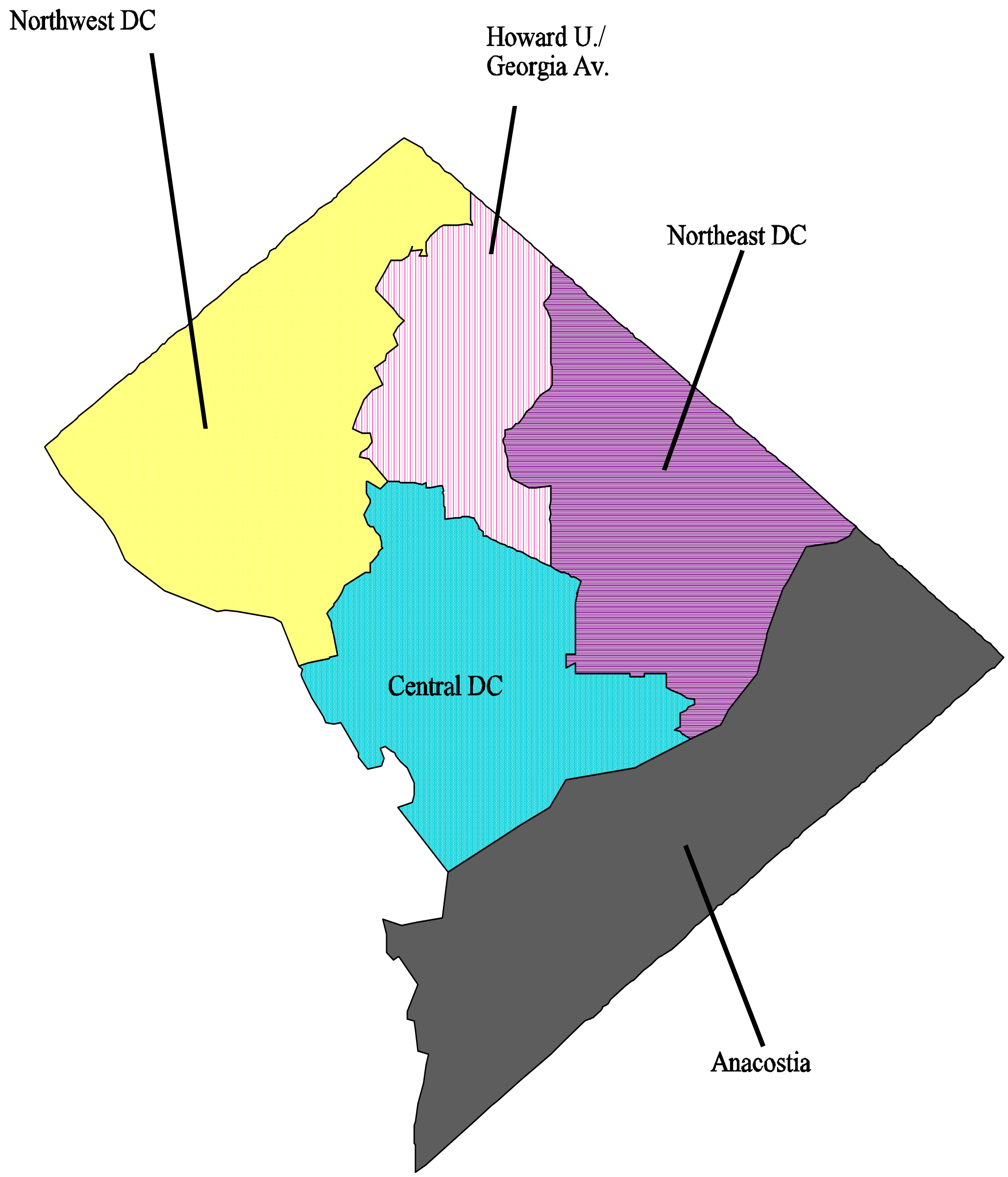


Figure B2
Montgomery Co., Prince George's Co., and Washington, D.C. sub-PUMAs

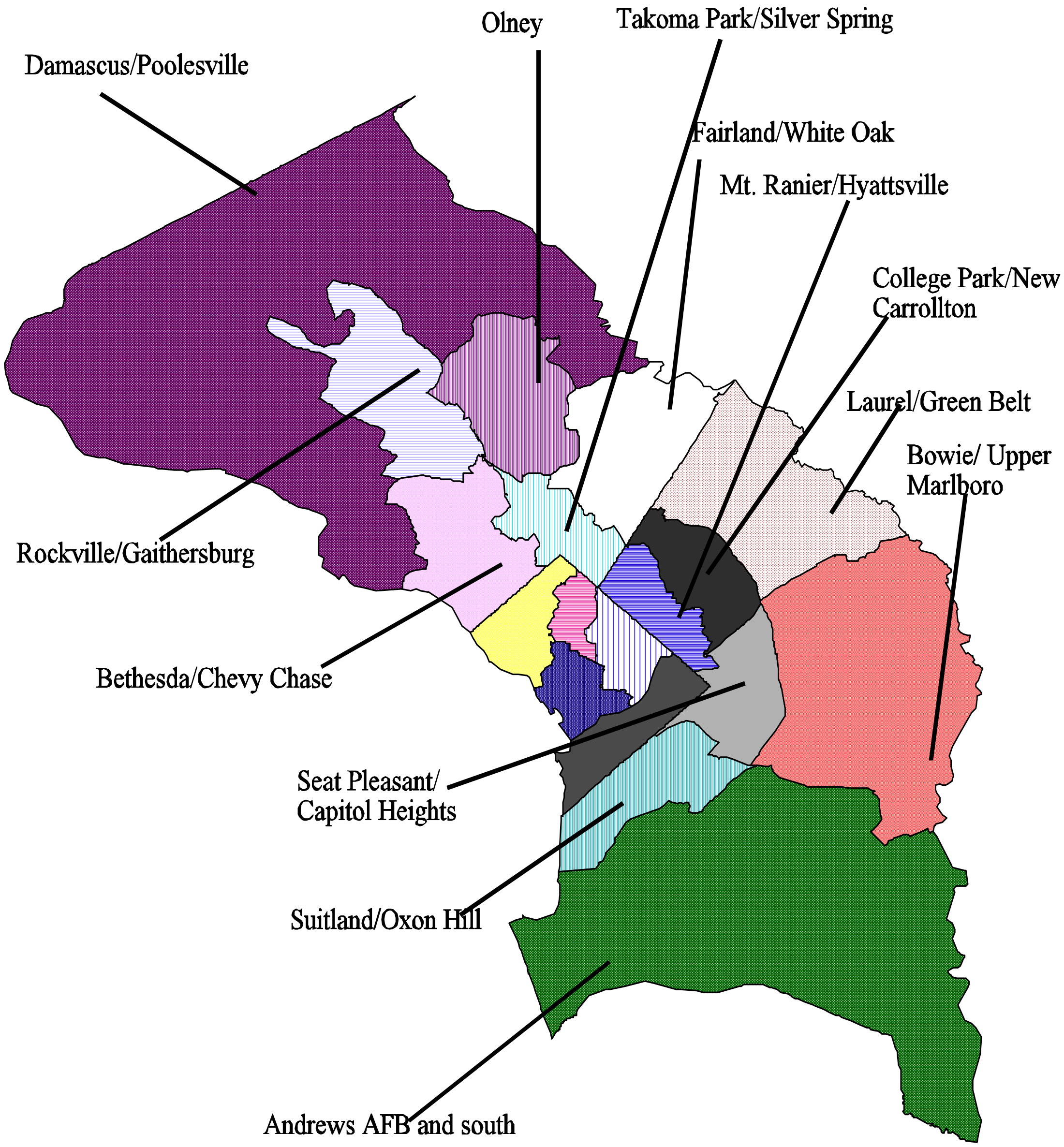


Table B1. Household Characteristics for Estimation Sample.

	White Households		African-American Households	
	Public Only	Public and DC Private	Public Only	Public and DC Private
Household Income	77,842 [68979]	81,341 [72923]	38,284 [32491]	38,852 [33106]
Householder age	49.2 [17.8]	49.1 [17.5]	50.2 [17.2]	50.1 [17.1]
Householder's education	15.1 [3.1]	15.1 [3.1]	11.9 [3.2]	12.0 [3.2]
% Education ≤ 12 years, no diploma	7.4 [26.1]	7.3 [26.0]	29.6 [45.7]	29.3 [45.5]
% High school graduates	11.4 [31.8]	11.0 [31.3]	35.4 [47.8]	35.3 [47.8]
% Some college	16.3 [37.0]	16.0 [36.6]	19.8 [39.8]	19.9 [39.9]
% Bachelor's degree or higher	64.9 [47.7]	65.7 [47.5]	15.2 [35.9]	15.5 [36.2]
% with children under 18	14.4 [35.1]	17.8 [38.3]	34.1 [47.4]	35.6 [47.9]
% with children under 10	12.3 [32.9]	13.9 [34.6]	26.1 [43.9]	26.9 [44.3]
% with children under 6	10.0 [29.9]	10.4 [30.5]	17.8 [38.3]	17.9 [38.3]
% of potential sample[1]	95.3	99.4	97.2	99.8
N	3685	3840	7374	7573

Notes: Standard deviations are in brackets. Public Only includes all households without children and all households with children that have no children enrolled in private school. Public and DC Private includes all of the households in the Public Only sample plus households with children locating in DC that enroll at least one child in private school.

[1]The potential sample is all households (white or African-American) that lived in DC in 1985 and in the DC Metropolitan area in 1990.

Table B2a. Characteristics of Location Choices: Washington, D.C. PUMAs.

	Northwest	Howard U. / Georgia Av.	Northeast	Anacostia	Central DC
SAT	826	670	656	631	741
Median Rent	814	509	508	473	626
Distance	4.28	3.65	2.50	3.30	0.95
Crime rate per 100,000 persons	6,666	7,928	10,019	7,604	22,093
# of DC Metro Stations	4	0.5	4	3.5	11.5
Total per capita county expenditure	4925.61	4925.61	4925.61	4925.61	4925.61
Population Density	2632	5946	3596	3773	4511
% person in poverty	7.0	15.5	14.4	23.6	19.5
% owner occupied housing units	50.7	44.2	47.8	29.1	28.5
% African-American	8.5	80.9	82.8	94.2	46.9
% white	85.8	11.4	15.7	4.8	44.8
% persons w/$\leq$ 12 yrs educ, no diploma.	5.69	34.0	31.8	37.0	22.8
% persons w/ high school diploma.	8.4	22.8	25.2	32.0	15.1
% persons w/ some college.	14.8	21.2	19.7	21.1	15.8
% persons w/ a BA degree or more	71.1	22.0	23.3	9.9	46.3
Median Household Income	63,225	33,793	36,584	29,038	37,260
Tax rate	0.894	0.894	0.894	0.894	0.894
Population	103,662	110,780	115,316	160,407	116,735

Notes: The column headings are intended to give the reader a sense for the location of the PUMAs. They do not reflect any "official" names of areas in the District. See Figure B1 for a map of their locations. Northwest is PUMA 101, Howard U./Georgia Av. is PUMA 102, Northeast is PUMA 103, Anacostia is PUMA 104, and Central DC is PUMA 105. SAT scores are population weighted averages of school averages for 1989. Income and rent figures are in $1995. Tax rates are dollars per $100 valuation. Distance is measured in miles. Population density is in persons per km^2.

Table B2b. Characteristics of Location Choices: Montgomery County, MD.

	Olney	Fairland / White Oak	Gaithersburg / Rockville	Takoma Pk / Silver Spring	Damascus / Poolesville	Bethesda / Chevy Chase
SAT	946	951	958	962	992	1045
Median Rent	892	875	848	768	894	898
Distance	14.97	12.22	19.46	8.66	20.26	9.51
Crime rate per 100,000 persons	4127.5	4127.5	4127.5	4127.5	4127.5	4127.5
# of DC Metro Stations	0.0	0.0	2.0	1.5	0.5	5.0
Total per capita county expenditure	2583.59	2583.59	2583.59	2583.59	2583.59	2583.59
Population Density	986	916	1327	2522	130	1446
% person in poverty	2.7	4.0	5.2	6.5	2.2	3.6
% owner occupied housing units	76.9	66.2	62.6	54.6	88.2	70.1
% African-American	11.5	21.5	11.2	21.5	5.3	3.4
% white	77.7	65.1	76.6	65.4	86.1	88.4
% persons w/≤ 12 yrs educ, no diploma	9.2	8.7	10.4	15.1	7.4	5.1
% persons w/ high school diploma.	20.0	17.5	18.8	19.1	15.6	10.1
% persons w/ some college.	26.3	25.2	27.0	23.5	24.4	17.8
% persons w/ a BA degree or more	44.5	48.6	43.8	42.4	52.6	67.0
Median Income	68,344	67,751	59,880	51,504	86,887	82,833
Tax Rate	0.716	0.716	0.716	0.716	0.716	0.716
Population	102,285	103,695	186,953	127,132	100,984	135,978

Notes: The PUMAs have been named to help give the reader a general sense of location. Refer to the maps in Figure B2 for their location. Olney is PUMA 1201, Fairland/White Oak is PUMA 1202, Gaithersburg/Rockville is PUMA 1203, Takoma Pk/Silver Spring is PUMA 1204, Damascus/Poolesville is PUMA 1205, and Bethesda/Chevy Chase is PUMA 1206. SAT scores are population weighted averages of school averages for 1989. Income and rent figures are in \$1995. Distance is measured in miles. Tax rates are dollars per \$100 valuation. Population density is in persons per km^2.

Table B2c. Characteristics of Location Choices: Prince George's County, MD.

	Mt.Rainier /Hyattsville	CollegePk/ New Carrollton	Seat Pleasant / Capitol Hts	Laurel / Greenbelt	Bowie/ Upper Marlboro	Suitland / Oxon Hill	Andrews AF.B. and south
SAT	782	803	750	851	842	749	781
Median Rent	685	776	708	793	907	745	851
Distance	5.81	8.10	6.88	13.37	13.02	5.84	11.27
Crime rate	5906	5906	5906	5906	5906	5906	5906
# of DC Metro Stations	0.33	1.33	2.83	0.0	0.0	0.0	0.0
Total per capita county exp.	2697.69	2697.69	2697.69	2697.69	2697.69	2697.69	2697.69
Population Density	2446	1759	1689	629	342	1517	181
% person in poverty	8.1	8.6	9.9	4.2	2.0	5.5	2.2
% owner occ. housing units	45.7	49.9	52.0	55.8	84.7	47.9	81.8
% Af.-Amer.	51.0	36.3	89.4	19.5	40.7	73.7	41.6
% white	35.9	55.5	9.3	72.3	55.8	22.0	53.6
%≤ 12 yrs ed., no diploma	24.3	15.8	24.7	12.2	10.2	17.1	13.8
% high school diploma.	28.1	27.8	36.1	23.5	25.5	34.0	30.1
% persons w/ some college.	24.1	26.5	27.2	27.8	30.9	31.1	31.8
% persons w/ a BA or more	23.6	30.0	11.9	36.5	33.4	17.9	24.3
Median Income	42,628	47,851	44,357	56,077	71,335	48,643	65,944
Tax Rate	0.912	0.912	0.912	0.912	0.912	0.912	0.912
Population	101,186	102,598	107,869	104,090	103,361	109,135	101,029

Notes: The PUMAs have been named to help give the reader a general sense of location. Refer to the maps in Figure B2 for more detail. Mt.Rainier/Hyattsville is PUMA 1301, CollegePk/New Carrollton is PUMA 1302, Seat Pleasant /Capitol Hts is PUMA 1303, Laurel/Greenbelt is PUMA 1304, Bowie/Upper Marlboro is PUMA 1305, Suitland/ Oxon Hill is PUMA 1306, and Andrews AF.B. and south is PUMA 1307. SAT scores are population weighted averages of school averages for 1989. Income and rent figures are in \$1995. Distance is measured in miles. Tax rates are dollars per \$100 valuation. Population density is in persons per km^2.

Table B2d. Characteristics of Location Choices: Other Maryland Locations

	Calvert & St. Mary's Co.s	Charles County	Frederick County
SAT	888	872	924
Median Rent	652	805	651
Distance	40.78	22.07	43.37
Crime rate	2831	4299	3079
# of DC Metro Stations	0.0	0.0	0.0
Total per capita county expenditure	1934.95	1971.70	2170.39
Population Density	85	85	87
% person in poverty	6.5	5.0	4.8
% owner occ. housing units	75.8	75.7	70.8
% African-American	14.4	18.2	5.3
% white	84.0	79.3	93.1
%≤ 12 yrs ed., no diploma	22.0	19.0	19.6
% high school diploma.	36.1	36.6	34.0
% persons w/ some college.	24.8	28.2	24.4
% persons w/ a BA or more	17.2	16.2	22.0
Median Income	50,392	57,045	50,859
Tax Rate	0.640	0.837	0.789
Population	127,346	101,154	150,208

Notes: Calvert and St. Mary's Counties, MD are PUMA 400, Charles County is PUMA 700, and Frederick County is PUMA 900. See the map in Figure 1 of the paper for the exact locations. SAT scores are enrollment weighted averages of school district averages for 1989. Income and rent figures are in $1995. Distance is measured in miles. Tax rates are dollars per $100 valuation. Population density is in persons per km^2.

Table B2e. Characteristics of Location Choices: Virginia Locations.

	Arlington Co.	Loudoun Manassas Manassas Park Prince Williams	Alexandria	Fairfax Co. Fairfax City Falls Church City	Stafford King George Fredericksburg Caroline Spotsylvania
SAT	966	909	928	983	903
Median Rent	820	867	818	894	667
Distance	4.54	22.68	6.11	12.65	48.14
Crime rate	6049	3637	6880	3715	3032
# of DC Metro Stations	5.0	0.0	2.5	1.5	0.0
Total per capita county expenditure	2498.89	2056.73	2698.47	2326.07	1730.31
Population Density	2550	149	2811	815	47
% person in poverty	7.1	3.3	7.1	3.6	6.3
% owner occ. housing units	44.6	71.2	40.5	70.5	74.9
% African-Amer.	10.5	10.3	21.9	7.6	14.4
% white	76.6	85.0	69.1	81.5	83.6
%≤ 12 yrs ed., no diploma	12.5	13.1	13.1	8.7	24.6
% high school diploma.	14.8	27.0	15.6	17.0	33.0
% persons w/ some college.	20.5	31.4	22.7	25.4	22.9
% persons w/ a BA or more	52.3	28.5	48.5	48.9	19.5
Median Income	54,814	61,030	50,969	72,458	47,870
Tax Rate	0.690	1.181	0.930	1.012	0.730
Population	170,936	336,506	111,183	847,784	170,410

Notes: Arlington Co. is PUMA 800; Loudoun Co., Manassas City, Manassas Park City, and Prince Williams Co. are PUMA 900; Alexandria City is PUMA 1000; Fairfax Co., Fairfax City, and Falls Church City are PUMA 1100; and Stafford Co., King George Co., Fredericksburg City, Caroline Co., and Spotsylvania Co. are PUMA 2200. See Figure 1 in the paper for the locations. SAT scores are enrollment weighted averages of school district averages for 1989. Income and rent figures are in \$1995. Distance is measured in miles. Tax rates are dollars per \$100 valuation. Population density is in persons per km^2.

Table B3a. Characteristics of the Sample Households: Washington, D.C. PUMAs.

	Northwest	Howard U. / Georgia Av.	Northeast	Anacostia	Central DC
Household income	94,948 [85815]	44,391 [40891]	42,081 [35714]	34,797 [28628]	51,716 [53510]
Householder education	15.51 [2.72]	12.09 [3.61]	11.94 [3.55]	11.69 [2.70]	13.30 [3.92]
%African-American	7.54 [26.42]	86.79 [33.86]	89.38 [30.82]	96.77 [17.69]	50.28 [50.01]
% white	88.64 [31.74]	9.65 [29.54]	9.85 [29.80]	2.52 [15.68]	44.27 [49.68]
Householder age	54.54 [17.52]	54.24 [16.95]	54.79 [16.79]	48.49 [16.19]	49.41 [17.18]
%with children under 18	16.06 [36.73]	29.44 [45.59]	29.34 [44.06]	42.67 [49.47]	18.96 [39.21]
%with children under 10	10.83 [31.08]	22.06 [41.48]	19.99 [40.01]	31.65 [46.52]	14.46 [35.18]
% with children enrolled in private school [a]	45.36 [49.88] (N=275)	12.13 [32.68] (N=540)	9.03 [28.69] (N=577)	5.64 [23.09] (N=1137)	10.06 [30.12] (N=351)
# of households	1758	1796	1931	2530	1871

Notes: The column headings are intended to give the reader a sense for the general area defined by the PUMAs. They do not reflect any "official" names given to areas in the District. Refer to the map in Figure B1 for their locations. Northwest is PUMA 101, Howard U. / Georgia Av. is PUMA 102, Northeast is PUMA 103, Anacostia is PUMA 104, and Central DC is PUMA 105. Standard deviations are in brackets. Means are weighted using the Census household weights. Income is in $1995.

[a] Percentages are conditional on having children under 18 in the household. Number of households with children is given in parentheses.

Table B3b. Characteristics of the Sample Households: Montgomery County, MD PUMAs.

	Olney	Fairland / White Oak	Gaithersburg/ Rockville	Takoma Pk / Silver Spring	Damascus / Poolesville	Bethesda / Chevy Chase
Household Income	55,934	58,907	52,241	62,562	120,489	118,715
	[42843]	[38601]	[34235]	[47196]	[68364]	[87366]
Householder Education	14.14	14.71	14.05	14.68	15.35	16.23
	[2.94]	[2.21]	[2.33]	[3.20]	[2.45]	[1.74]
%African- American	48.19	68.28	20.52	39.51	14.99	3.01
	[50.70]	[47.10]	[40.74]	[49.04]	[36.54]	[17.15]
% White	44.22	27.57	65.06	54.52	71.66	95.62
	[50.39]	[45.23]	[48.10]	[49.95]	[46.12]	[20.53]
Householder age	40.60	33.23	38.92	37.94	39.68	40.27
	[14.73]	[11.35]	[15.70]	[12.26]	[10.63]	[12.53]
%with Child Under 18	46.67	40.51	32.79	37.37	58.55	40.12
	[50.62]	[49.69]	[47.36]	[48.53]	[50.42]	[49.18]
%with Child Under 10	32.79	31.72	29.18	33.81	47.54	29.64
	[47.63]	[47.10]	[45.87]	[47.46]	[51.11]	[45.82]
% with children enrolled in private school [a]	6.25	8.29	0	3.26	17.60	17.92
	[24.91]	[28.38]	[.]	[17.91]	[39.78]	[38.69]
	(N=18)	(N=18)	(N=0)	(N=59)	(N=12)	(N=58)
# of Households	35	42	57	158	22	146

Notes: The PUMAs have been named to help give the reader a general sense of their location. Refer to the maps in Figure B2 for more detail. Olney is PUMA 1201, Fairland/White Oak is PUMA 1202, Gaithersburg/Rockville is PUMA 1203, Takoma Pk/Silver Spring is PUMA 1204, Damascus/Poolesville is PUMA 1205, and Bethesda/Chevy Chase is PUMA 1206. Standard deviations are in brackets. Means are weighted using the Census household weights. Income is in $1995.

[a] Percentages are conditional on having children under 18 in the household. Number of households with children is given in parentheses.

Table B3c. Characteristics of the Sample Households: Prince George's County, MD PUMAs.

	Mt.Rainier /Hyattsville	CollegePk/ New Carrollton	Seat Pleasant / Capitol Hts	Laurel / Greenbelt	Bowie/ Upper Marlboro	Suitland / Oxon Hill	Andrews AF.B. and south
Household Income	43,516	45,829	44,729	51,393	67,819	43,025	65,174
	[21782]	[27548]	[25018]	[32397]	[31123]	[24153]	[24424]
Householder Education	13.52	13.14	12.80	14.42	13.99	12.81	14.37
	[2.70]	[2.35]	[1.92]	[2.21]	[2.56]	[1.85]	[2.27]
%African- American	87.06	83.22	98.75	64.27	82.08	96.72	81.63
	[33.65]	[37.59]	[11.15]	[48.69]	[38.74]	[17.86]	[39.19]
% White	5.89	12.56	0.91	32.01	17.92	2.40	14.18
	[23.61]	[33.33]	[9.55]	[47.40]	[38.74]	[15.36]	[35.31]
Householder Age	36.97	37.16	35.36	34.10	41.60	36.72	42.08
	[11.18]	[13.63]	[9.98]	[8.22]	[14.70]	[12.22]	[13.14]
%w/ Children Under 18	41.63	45.38	57.75	39.21	41.18	42.77	40.06
	[49.43]	[50.09]	[49.54]	[49.60]	[49.71]	[49.63]	[49.60]
%w/ Children Under 10	35.55	41.16	47.57	33.81	31.89	33.70	25.56
	[47.99]	[49.51]	[50.08]	[48.06]	[47.07]	[47.41]	[44.15]
% with children enrolled	5.75	4.71	3.00	0	9.38	4.88	5.90
in private school [a]	[23.43]	[21.47]	[17.14]	[.]	[29.83]	[21.69]	[24.24]
	(N=82)	(N=40)	(N=106)	(N=14)	(N=22)	(N=76)	(N=18)
# Households	187	84	174	32	51	163	42

Notes: The PUMAs have been named to help give the reader a general sense of their location. Refer to the maps in Figure B2 for more detail. Mt.Rainier/Hyattsville is PUMA 1301, CollegePk/New Carrollton is PUMA 1302, Seat Pleasant /Capitol Hts is PUMA 1303, Laurel/Greenbelt is PUMA 1304, Bowie/Upper Marlboro is PUMA 1305, Suitland/ Oxon Hill is PUMA 1306, and Andrews AF.B. and south is PUMA 1307. Standard deviations are in brackets. Means are weighted using the Census household weights. Income is in $1995.

[a] Percentages are conditional on having children under 18 in the household. Number of households with children is given in parentheses.

Table B3d. Characteristics of the Sample Households: Other Maryland PUMAs and Virginia PUMAs.

	Calvert & St. Mary's Co., MD	Charles County	Frederick County	Arlington Co.	Loudoun Manassas Manassas Park Prince Williams	Alexandria	Fairfax Co. Fairfax City Falls Church	Stafford King George Fredericksburg Caroline Spotsylvania
Household Income	76,309	52,715	61,271	68,328	53,902	54,856	84,321	29,169
	[92359]	[36341]	[58333]	[44266]	[30824]	[26340]	[71379]	[15352]
Householder Education	13.11	12.23	14.53	15.52	14.33	15.20	15.06	12.99
	[2.42]	[2.37]	[2.43]	[2.43]	[2.16]	[2.01]	[2.58]	[3.32]
%African-American	36.07	27.56	18.38	9.57	27.33	22.74	26.11	78.05
	[55.45]	[46.25]	[41.84]	[29.53]	[45.57]	[42.27]	[44.10]	[44.71]
% White	63.93	72.44	81.62	81.77	72.67	70.02	64.42	21.95
	[55.45]	[46.25]	[41.84]	[38.76]	[45.57]	[46.20]	[48.07]	[44.71]
Householder Age	48.18	54.39	51.02	37.35	38.43	34.70	40.36	41.15
	[15.70]	[19.19]	[19.03]	[12.23]	[10.22]	[10.91]	[11.98]	[9.04]
%with Children Under 18	0	29.53	10.29	19.51	30.67	10.26	43.26	65.85
		[47.22]	[32.82]	[39.77]	[47.15]	[30.60]	[49.74]	[51.22]
%with Children Under 10	0	29.53	10.29	19.05	26.00	10.26	36.63	51.22
		[47.22]	[32.82]	[39.42]	[44.85]	[30.60]	[48.37]	[53.99]
% with children enrolled in private school [a]	0	0	0	6.07	0	0	8.52	0
		[.]	[.]	[24.33]	[.]	[.]	[28.17]	[.]
		(N=5)	(N=1)	(N=28)	(N=7)	(N=7)	(N=54)	(N=5)
# Households	4	15	7	134	23	60	125	7

Notes: Maryland Counties: Calvert and St. Mary's are PUMA 400, Charles is PUMA 700, and Frederick is PUMA 900. Virginia Counties: Arlington is PUMA 800; Loudoun, Manassas City, Manassas Park City, and Prince Williams are PUMA 900; Alexandria City is PUMA 1000; Fairfax County, Fairfax City, and Falls Church City are PUMA 1100; and Stafford, King George, Fredericksburg City, Caroline, and Spotsylvania are PUMA 2200. See the map in Figure 1 of the paper for the PUMA locations. Standard deviations are in brackets. Means are weighted using the Census household weights. Income is in $1995.

[a] Percentages are conditional on having children under 18 in the household. Number of households with children is given in parentheses.

Table B4. Private Secondary Schools in Washington, D.C.

School Name	Annual Tuition	Grade Range	Total Enrollment
Archbishop Carroll H.S.	$4,000	9-12	700
Edmund Burke School	$11,200	6-12	245
Emerson Preparatory School	$8,000	9-PG	150
Field School	$11,500	7-12	180
Georgetown Day School	$12,925	9-12	1000
Georgetown Visitation Prep.	$8,400	9-12	403
Gonzaga College H.S.	$7,350	9-12	750
Lab School of Washington [a]	$16,565	K-12	250
Maret School	$12,820	K-12	500
National Cathedral School	$13,500	4-12	550
Nationhouse Watoto School	$2,750	N-12	85
Oakcrest School	$6,200	7-12	130
Parkmont School	$10,950	6-12	65
Sidwell Friends School	$13,020	5-12	1053
St. Albans School	$12,499	4-12	550
St. Anselm's Abbey School	$9,100	6-12	198
St. John's College H.S.	$6,290	7-12	510
Washington Academy	$6,800	9-PG	30
Washington Ethical H.S.	$9,700	9-12	40
Washington International School	$11,650	N-12	655

Notes: All data in this table come from Coerper and Mersereau (1995). Where multiple tuition levels are given in Coerper and Mersereau (1995), the highest tuition is listed above. Generally, tuition is higher for secondary school students and higher for non-Catholic students at Catholic schools. MacArthur School is also located in D.C., but it is not listed since it primarily serves students boarding at the Psychiatric Institute of Washington.

[a] Lab School of Washington specializes in education for above average, learning disabled students, and tuition may be funded through D.C. or Maryland if approved by the public school system. (Coerper and Mersereau (1995)).