2009

Who Cares About School Quality?; The Role of School Quality in Household Preference, School District Choice, and Willingness to Pay

Youngme Seo
Cleveland State University

WHO CARES ABOUT SCHOOL QUALITY?

THE ROLE OF SCHOOL QUALITY IN HOUSEHOLD PREFERENCE, SCHOOL DISTRICT CHOICE, AND WILLINGNESS TO PAY

YOUNGME SEO

Bachelor of Arts in French Literature
Korea Open University
February, 1994

Master of Science in Urban Studies
Cleveland State University
August, 2005

Submitted in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY IN URBAN STUDIES AND PUBLIC AFFAIRS

at the

CLEVELAND STATE UNIVERSITY

May, 2009

Approval Page

This dissertation has been approved for the COLLEGE OF URBAN STUDIES and the

College of Graduate Studies by Dissertation Committee

_____

Robert A. Simons, Ph.D.
Urban Studies/ May, 2009

_____

Larry Ledebur, Ph.D.
Urban Studies/ May, 2009

_____

Brian Mikelbank, Ph.D.
Urban Studies/ May, 2009

_____

Aly Karam, Ph.D.
School of Architecture and Planning
University of the Witwatersrand
May, 2009

Acknowledgments

I would like to thank all of those who supported me to complete this dissertation. This dissertation could not be accomplished without their support. I would like to thank my advisor, Dr. Robert A. Simons, for his endless support and advice. He provided me with precious advice and consistent encouragement.

My thanks to my committee: Dr. Larry C. Ledebur, Dr. Brian A. Mikelbank, and Dr. Aly Karam. Their critical suggestions and comments helped me polish this dissertation. I also want to thank Dr. William Bowen and Dr. Mark S. Rosentraub who helped me through different parts of my program. I would like to acknowledge Dr. James Webb who supported and funded my dissertation so that I could complete my dissertation. I appreciate his enormous support and very useful advice.

My friends, Nora Kancelbaum, Wendy Slone, and James Petruzi deserve to receive my recognition. I also thank other faculty members and staff in the Levin College of Urban Affairs, as well as other Korean students.

I deeply thank my husband, Joon Ku Lee, for his infinite support and patience. His understanding allows me to complete my degree. My gratitude is received for my children, Yoon Jae and Jang Bok. I would like to dedicate my dissertation to my family.

WHO CARES ABOUT SCHOOL QUALITY?

THE ROLE OF SCHOOL QUALITY IN HOUSEHOLD PREFERENCE, SCHOOL DISTRICT CHOICE, AND WILLINGNESS TO PAY

YOUNGME SEO

ABSTRACT

School quality is considered a key factor affecting homebuyers' location choices and willingness to pay. Previously, many studies found that school quality plays a critical role in determining housing prices and location choice. School quality is positively capitalized into housing prices. Households are willing to pay for school quality, in particular, school outcomes such as test scores and performance index. However, there is a view that willingness to pay for school quality is different based on household demographics and socioeconomic status (SES).

The purpose of this dissertation is to investigate heterogeneous preference for school quality, school district choice, and willingness to pay for school quality according to a household's demographic background and SES, including the presence of school-age children, marital status, income, education, race/ethnicity, and occupation. This dissertation takes occupational variables into account in the model as a proxy for human capital. This dissertation was also developed to find whether or not a household's preference for school quality leads to their school quality consumption regarding school district choice and willingness to pay.

Two datasets were used: the 2006 homebuyer's survey and the 2006 transacted housing sales in Cuyahoga County, Ohio. With the aggregated dataset, the national model also analyzes household demographics and school quality data aggregated by school district in 2,531 school districts in 14 states. Three models were used to test the groups of hypotheses for preference, school district choice, and willingness to pay: ANOTA, ordered logit, and the hedonic price model.

The findings of this dissertation indicate household heterogeneous preferences for school district choices and willingness to pay for school quality. It also found a gap between preference for school quality and actual consumption of school quality. In particular, larger gaps appear in low-income, low-educated, and single-head households than in other households. These findings help policy makers understand residents' preferences, school district choice, and willingness to pay for specific public goods and services according to their demographics and SES. They also call for policies to reduce the gaps.

TABLE OF CONTENTS

LIST OF TABLES

Chapter 2

Chapter 4

Chapter 5

Chapter 6

LIST OF FIGURES

Chapter 3

Chapter 4

Chapter 5

CHAPTER I

INTRODUCTION

1.1 Introduction

Studies of consumer behavior in the housing market have evolved and diverged in two directions. A sizable literature, on the one hand, has focused on factors affecting housing prices, including attributes of dwellings, public services, and location-specific amenities. Desired attributes have a positive externality on housing prices and vice versa. On the other hand, studies have examined the impact of these attributes on consumers' housing choices and their location choices.

These approaches are closely related to each other because specific attributes of public services and amenities are preferable to consumers, thus leading to their location choice and willingness to pay. A consumer's decision on purchasing a house is made based on not only where to live but also how much to pay for public services. It is important to identify household preference for the attributes of public services in the housing market because their preferences lead to choices and to willingness to pay for public services that are capitalized into housing prices.

The initial study that focused on the impact of household location decisions based on the quality of public services was Tiebout's (1956) work, which demonstrated that consumer-voters reveal their preferences for public services by making location decisions, voting with their feet. His hypothesis has been tested in many studies, which have found empirical evidence that favorable public goods have positive effects and are capitalized into housing prices.

Households' location choices and willingness to pay for public services have considerable influence on housing prices in a region: Differences in housing prices in a region will also reflect the individual attributes of the properties or changes in characteristics, including amenities in the neighborhood in which they are located. Different levels of public service and amenities implicitly reflect a homebuyer's preference, choice, and willingness to pay for favorable amenities, and scale of preference for public goods and services, such as school quality.

It is widely believed that public school quality has long been considered a key factor for homebuyers making location decisions within a region (Haurin & Brasington, 1996). School quality provides the basis for developing human capital, and technological developments that grow as a result of human capital can make the region grow (Wobmann, 2003). Primary and secondary education are known not only as the foundation of future academic achievement and future human capital, but also as a favorable amenity for current human capital (Weiss, 2004).

Currently, there is a view that household preference, school district choice (Barrow, 2002), and willingness to pay (Bayer, Ferreira, & McMillan, 2004) is heterogeneous; household behavior is not deterministic but stochastic (McFadden, 1977). The current findings consistently indicate that household location choices and willingness to pay are different according to household demographics and socio-economic status (SES).

The purpose of this dissertation is to investigate household heterogeneous preferences regarding school quality, school district choices, and willingness to pay for school quality. It also examines whether household preference for school quality can lead to school district choice and willingness to pay for school quality as Tiebout (1956) hypothesized. This pertains to school districts with better school quality as well as those of lesser school quality, and to what extent homebuyers are willing to pay for public school quality through location decision and housing prices.

In particular, this study tests the role of school quality[1] among homebuyers with different demographics and SES, and examines their home-buying and school district choices and willingness to pay. Although homebuyers are well aware of the importance of education (Barrow, 2002), the importance of school quality may have different influences on a homebuyer decision regarding purchasing a house, depending on a household's demographic and SES, including the presence of school-age children, marital status, income, education, and occupation. It is particularly interesting to observe how households without children or those with children but

[1] In this paper, school quality refers to public school quality.

not at school age express their preferences regarding school quality, school district choice, and willingness to pay for school quality since those households do not directly enjoy school quality.

This dissertation utilized a survey in order to assess homebuyer location preference and school district choices based on school quality. The first approach called for the use of a survey instrument to reveal actual preferences of homebuyers and choices for school quality when purchasing a home. A listing of homeowners who purchased homes in Cuyahoga County in 2006 was obtained from the Cuyahoga County Auditor's Office. Participants for the survey were randomly selected from names of homeowners on this list. In order to find household preference and school district choice, the survey results were analyzed by analysis of table (ANOTA) and ordered logit analysis.

The second methodological approach called for the use of a hedonic price model to estimate not only individual and aggregated willingness to pay for school quality but also the amount to which school quality variables capitalized into housing prices. A hedonic price model was applied to the Cuyahoga County model with individual housing sales data for 2006 and to the national model with aggregation by school district in 14 states (Arkansas, California, Colorado, Delaware, Illinois, Indiana, Massachusetts, Michigan, New Jersey, Pennsylvania, Rhode Island, South Carolina, Texas, and Washington).

1.2 Definition of School Quality in the Housing Market

The impact of school quality on the decision of a homebuyer to purchase a house in a particular region potentially can be explained by a series of input and output school quality variables and value added. Input variables such as expenditure per pupil, teacher characteristics, class size, and teacher-to-student ratio have been shown to impact student performance. Conversely, output variables such as student test scores and academic performance measurements determine school quality.

Currently, multiple measurements of student outcome, such as performance index and school district report cards, increasingly are in demand. The variable of value added, which refers to the differences between previous year and current year academic achievement is also considered an important indicator of student performance due to the lack of accountability and the lack of validity of test scores (Meyer, 1997).

1.3 Statement of Research Questions

This study was developed to answer the question of who cares about school quality, what school quality a homebuyer prefers, and to what extent a homebuyer is willing to pay for school quality. Household demographics and SES play a critical role in not only choosing communities with varying school quality but also having varying willingness to pay for school quality.

The research questions being asked in this dissertation include:

(1) Which homebuyers care about school quality when purchasing a house?

(2) Which homebuyers choose school districts with high school quality or low school quality?

(3) How much are homebuyers willing to pay for better school quality? Which variables of school quality are most valued?

(4) Do household preferences regarding school quality influence their school district choices and their willingness to pay?

1.4 Contribution to Literature

A great number of studies have attempted to find the factors that influence housing prices because the importance of school quality is currently well recognized among homebuyers and capitalized into housing prices. In addition, there is controversy as to which school measure is the most capitalized into housing prices. By analyzing school input factors (expenditure per pupil, teacher salary, and teacher experience), and school output factors (test scores, performance index, and value added), this dissertation found that the performance index is the best measure of school quality.

These measures of school quality may have varying influence on housing prices, because homebuyers have different preferences, choices, and willingness to pay for school quality. Although there are studies testing the relationship between school quality and homebuyer marital status, the presence of school-age children, income,

education, and race, none of the studies test for homebuyers who have different occupations. This dissertation includes various occupations as independent characteristics of households. Homebuyers, as human capital, are the driving force of local economic development. Local governments have attempted to attract human capital and to provide public goods and services to meet the demands and desires of the residents.

A survey is the best methodology to learn the demands and desires of the residents. This dissertation surveyed homebuyers to determine their preference for school quality and school district choice. Comparing homebuyer preference and school district choice with one's willingness to pay for school quality in this dissertation allows analysis of the gap between consumers' desires and their behavior.

The methodological approaches of this dissertation will assist future researchers with the impact of school quality on homebuyers' heterogeneous preferences, school district choices, and willingness to pay for school quality, based on household composition (e.g., income, race, education, occupation, and the presence of children in the household). In particular, this dissertation looks at which homebuyers care about school quality, making this study different from other studies related to school quality because occupation variables and homebuyers without children are also examined. The inclusion of the occupation variable also provides useful policy indicators for housing advocates/policymakers by identifying homebuyer preferences,

choices, and willingness to pay for homes in particular locations based on school quality.

1.5 Organization of This Dissertation

The rest of this dissertation is organized as follows. Chapter 2 begins by introducing theoretical backgrounds. The theories applied to this dissertation focus on consumer behavior, such as preference, choice, and utility. Literature review of school quality in the housing market follows. The definition of school quality will be discussed briefly using a study conducted by the National Center for Education Statistics (2000). Although it is difficult to define school quality, the importance of school quality is evident, and is capitalized into housing prices which affects location decisions. Chapter 2 also includes the utility theory that economic man acts rationally. However, bounded rational choice theory asserts that consumers' actions are based on the limited circumstances to which they are exposed.

Chapter 3 presents the conceptual model and states the hypotheses to be tested. The conceptual model provides the overall process of decision-making regarding willingness to pay for school quality and the school district in which one decides to live, as well as preference for school quality. Hypotheses are grouped into three categories: (1) preference for school quality, (2) school district choice, and (3) willingness to pay for school quality.

Chapter 4 describes how the hypotheses were tested and what methodologies were used. The methodological approaches to test hypotheses are descriptive analysis, ANOTA analysis, the ordered logit model, and the spatial hedonic price model. Each model is described showing how it works and how it is applied. How to obtain data and variables is also discussed in this chapter.

Chapter 5 presents the statistical findings and data analysis. The results of the survey data show heterogeneous homebuyers' preferences regarding school quality using ANOTA analysis. The result of the ordered logit model indicates that homebuyers with school-age children are more likely to live in an "excellent school district." The hedonic models are used for both the Cuyahoga County model and the national model; the results are consistent with previous studies which show that households with higher income and educational levels are willing to pay more for school quality.

Finally, Chapter 6 discusses the summary of study regarding methodologies applied to this dissertation, testing of four hypotheses, and findings for households' preferences for school quality, in addition to the probabilities of homebuyers choosing which school district to live in, and to what extent a household is willing to pay for school quality. The limitations of this dissertation, conclusions, and policy implications follow.

CHAPTER II

THEORETICAL BACKGROUND & LITERATURE REVIEW

2.1 Introduction

This chapter begins by discussing the theory that explains consumer behavior based on consumer preferences and choices, which maximize their utility. In economics, economic man acts rationally to maximize his/her utility of consumption. Consumer behaviors are explained by utility maximization.

In the framework of consumer behavior and utility maximization, the role of school quality in the housing market is considered a key factor in determining consumer preference, school district choice, and willingness to pay. According to the theory of bounded rationality, however, consumers will make different choices due to imperfect information and the constraints of complex variables at individual levels of satisfaction. It is important to know the role of school quality in homebuyer location decisions, willingness to pay for better school quality, and school quality choice in the housing market. Homebuyers with different socioeconomic

backgrounds and characteristics may have different levels of satisfaction regarding school quality.

Many studies have attempted to define school quality, but few have received universal acceptance. Test scores have long been considered as a proxy for school quality in the housing research that focuses on the relationship between school quality and housing prices. However, critics note that it is impossible for a simple variable to represent school quality, leading to controversy among researchers as well as inconsistent empirical results. The multiple criteria employed to measure school quality in this study were suggested by research conducted by the National Center for Education Statistics.

The relationships between student achievement and school-related input variables, such as expenditure per pupil (Hanushek, 1986; Hedges, Laine, & Rob, 1996), teacher characteristics (Hanushek, 1971; Hammond, 1999), peer group effect (Winkler, 1978; Rivkin, Hanushek, & Kain, 2001)), class size (Cooper, 1989; Hanushek, 1998), and parental influence, including income and education (Perl, 1973), social status (Chu & Willims, 1996), race and ethnicity (Rosen, 1959), and occupation (Pearlin & Kohn, 1966), have been studied. Of these school quality input variables, parents have tremendous influence on student academic performance. Parents with different levels of income, education, race/ethnicity, and occupation also influence their children's achievements. In the housing market, academic performance, especially output variables such as test scores (Rosen & Fullerton,

1977), are capitalized into housing prices. Input variables, such as class size, teacher characteristics, and expenditure per pupil (Oates, 1969, Hayes & Taylor, 1996; Brasington, 1999) have relatively little impact on housing prices or are not statistically significant.

2.2 Consumer Behavior

This section begins with the related theory that provides the background for introducing preference theory, rational choice theory, and utility theory. The consumer is always in a situation where he or she makes a choice among the given choice sets. Here, the consumer means an individual or a household that can make a decision. The choice set is one of the well-defined preordering preferences or is defined as a set of possible (mutually exclusive) alternatives from which the consumer must choose (Green, 1995).

The consumer acts rationally in consumption behavior. The rational behavior should occur in accordance with the set of preferences (Green, 1971). To the economist, rationality is that the choice to be made from the set of alternatives can be determined (Arrow, 1963). The rationality of the consumer is discussed in detail in the section on consumer preference and choice.

2.2.1 Consumer Preference and Choice

In microeconomics, a consumer is rational if a decision is made according to a preference ordering. There are two types of preference relationships: strict

preference relation (x is preferred to y but y is not preferred to x) and indifference relation (x is as good as y). The assumptions of the preference ordering are completeness, transitivity, and convexity.

The first assumption of completeness is that, if there are x and y, a preference ordering is complete and well defined between two possible alternatives. For example, we have that $x \geq y$ or $y \leq x$ if $x, y \in X$. This assumption enables the consumer to rank all possible combinations of goods and services. The completeness assumption, however, is criticized by Simon's (1955) bounded rationality. This assumption cannot always be true because the world is too complex and there are many goods we know too little about to be able to evaluate them decisively. However, it is a useful simplifying assumption for the analysis of choices among bundles of goods with which consumers are familiar.

The transitivity assumption is that, given three consumption goods, x, y, and z, if one prefers x to y and prefers y to z, then one prefers x to z. That is, for x, y, and $z \in X$, if $x \geq y$ and $y \geq z$, then $x \geq z$. The transitivity assumption is of importance in rationality. The transitivity assumption can be applied to both strict and indifferent preference relations. If x is indifferently preferable to y, and y is as good as z, then x is as equally preferred as y.

A consumer choice theory begins with the consumption choice set. As previously mentioned, the consumption set is a bundle of goods and services available in the market. A consumer's choice is made under the budget constraint;

$$I = Px + Py \qquad (2\text{-}1)$$

where I is the consumer's income, P is the price of goods and services, x is non-housing consumption, and y is housing consumption.

2.2.2 Utility Theory

The utility function is used to measure the consumer's preference by assigning the utility function. Utility is defined as the satisfaction or benefit the consumer receives from the consumption of a bundle of goods and services.

Utility can be measured by assigning a numerical value to each bundle. In the cardinal sense, these numerical values imply differences and meaning so that rational consumers maximize their utility by choosing the highest sum of these numerical values.

At the beginning of the 19th century, scholars, such as Fisher (1892) and Pareto (1896) introduced the ordinal concept. Utility function simply represents the ranking of consumer preferences. In other words, if a consumer prefers an apple to an orange and the numerical values of these goods are three and one, respectively, it does not mean an apple is preferred three times as much as an orange, but that an apple is simply more preferable than an orange.

According to Hicks and Allen (1934), "Utility will be maximized when the marginal unit of expenditure in each direction brings in the same increment of utility." The marginal utility is the ratio of utility gained from consuming a good to utility from the other good, or the difference between opportunity costs of goods.

They explained marginal utility as "the marginal rate of substation between any two goods, The marginal rate of substation of good X for any other good Y is defined as the quantity of Y which would compensate him for the loss of a marginal unit of X. Now the gain in utility got by gaining such an amount of Y equals an amount of Y gained X marginal utility of Y" (p. 55).

Lancaster (1966) emphasized consumer utility derived from the characteristics possessed by goods rather than from goods that do not directly give utility to consumers. Lancaster's view was that consumer's preference was the same for all is criticized by Hendler (1975), who thought that the utility function was subjective.

2.2.3 Location Preference and Land Value

This section builds a bridge between general economic theory and relatively practical household behavior in the housing market by introducing the brief concept of land economic studies. In the previous section, a general economic theory was introduced to explain consumer behavior in the market. This section starts with the households' (consumer in the housing market) behavior with respect to location choice and price. However, land price in residential locations is different from agricultural and industrial land price. That is industrial and agricultural land value (Thünen, 1826) is determined by how much profit is generated by the land. Muth (1969) and Alonso (1964) devised the model for residential land values.

2.2.4 Non-Use Value

The non-use value theory is used to validate the inclusion of households without children in the model. Total value from utility consists of use-value and non-use value. Non-use value is produced when non-market goods, such as public goods and natural resources, are the status of the natural or physical environment. Non-use value is defined as the preference of individuals who may not use a resource but can be affected by change in its status. There are two concepts of non-use values: existence value and bequest value. While existence value is the benefit generated today by knowing that a resource exists even if no on-site use is anticipated, bequest value is the value individuals gain from the preservation of a resource for use by their heirs.

Krutilla (1967) introduced the concept of bequest value as a type of non-use value by saying, "Individuals do not have to be active consumers of a resource. Consumers might hold values unrelated to their current use of a resource. These reasons were related to bequeathing natural resources to one's heirs and preserving options for future use."

However, McConnell (1997) had a different point of view in that resources are valued by their use in most cases. He states that, "Non-use value occurs only insofar as bequest or altruistic notions prevail. We want resources there because they are valued by others of our own generation or by our heirs."

Although homebuyers without children do not directly use school services provided by local governments, school quality might affect their preferences regarding school district choice and their willingness to pay for school quality through housing prices.

2.2.5 Public Finance

Since Tiebout (1956) introduced his model that consumer-voters reveal their preference by voting with their feet, there has been controversy among scholars. Some theorists believe that when consumer-voters shop in local communities, fiscal differentials among communities will be capitalized into housing prices. This capitalization represents a disequilibrium phenomenon and will disappear in the long run as housing suppliers respond to price differentials (Edel & Sclas, 1974; Epple, Zelenitz, & Visscher, 1978). Others argue that preference revealing is dependent not only on location decisions but also voting decisions (Romer & Rosenthal, 1978; Tideman, 1983).

Yinger (1982) states that "the capitalization of local public goods into housing prices is a central feature of the Tiebout model; capitalization under a wide range of circumstance is a characteristic of long-run equilibrium" (p. 918). He also states that "household mobility by itself cannot generate an efficient pattern of local services, but local voting may lead to local services levels that satisfy the standard efficient condition relative to non-taxed composite goods" (p. 918).

2.2.6 Human Capital

The importance of human capital in economic development has been recognized in the recent economy, which is characterized by technology and innovation bringing competitive advantages into the region. Human capital plays a critical role not only in creating high technology and skills required for business, but also in adopting and using new ideas in new products, services, or processes.

Public school quality has not only influenced economic factors such as productivity and wages, but also has had non-market effects that contribute to communities. Many regions have focused on attracting human capital since human capital is shown to promote growth and development through externalities of knowledge stock. Human capital increases the productivity of labor and capital, provides the pool of entrepreneurs who implement and diffuse invention and innovations, promotes agglomeration of mature growth firms and encourages quality.

Owens (2004) note that the return to education may be either direct or indirect, and social. Private non-market effects include personal health, capacity to enjoy leisure, and efficiency in making a variety of personal choices, as well as education ladder. Moreover, the community-level benefit of education includes the production of community wealth, improving social equity, strengthening national cohesiveness, reducing environmental stress through its effects on fertility and population growth, and lowering crime rates.

Measuring school quality on housing price implies not only how school quality as an amenity is attractive to human capital, but also how much parents are willing to invest in housing for better public school quality, which leads to generating future human capital of new children. In this dissertation, occupation variables were used as a proxy for human capital.

2.3 School Quality

The purpose of education is to teach students the values and social skills to become good citizens and to be economically productive (National Center for Education Statistics; NCES, 2000). Defining school quality is of importance in evaluating how schools perform. The NCES introduces three elements of school quality: teachers, schools, and classrooms.

School quality can be defined differently in housing markets. It can be determined by households, based on their willingness to pay for school quality. This dissertation defines school quality as the school quality measure that is the most capitalized into housing prices. The detailed school quality definition and importance are stated in Sections 2.3.1 and 2.3.2.

2.3.1 Definition of School Quality

In 2001, the No Child Left Behind Act (NCLB) was enacted to accomplish the goals of enhancing student achievement, giving information to parents, and expanding opportunities for parental school choice. The major principles of NCLB

focused on (1) accountability, (2) scientific research, (3) expansion of parental options regarding the school they want their children to attend, and (4) expansion of local control and flexibility. According to the NCLB regulations, (1) school districts need to provide more information for parents, (2) states should measure students' progress in reading and math, and (3) states should provide easy-to-read, detailed report cards on schools and districts in their state.

The NCES (2000) also proposed comprehensive school quality measurements that consider all factors related to school quality, such as teacher characteristics, classrooms, and school administration ability. It was suggested that the multiple criteria be used to measure school quality. The performance index is used to convey information about school quality to parents. The performance index uses multiple criteria to provide an overall indication of how well students perform. In Ohio, the performance index is calculated based on the level of performance on the standardized tests and attendance rates. In California, the academic performance index is used to measure the academic performance and growth of schools. The performance indices in these states are similar to one another, but they have different scales.

2.3.2 Importance of School Quality

It is a widely accepted notion that school quality and schooling are positively related to economic growth, at least indirectly through human capital (Hanushek, 1971). Schooling makes people more productive, healthy, successful, and able to

consume goods and services. According to Weiss (2004), "Education is the best investment we can make for the future because human capital is a vital element of any economic growth equation." In the knowledge-based economy, competitive advantages are gained from the technology and innovation associated with knowledge (Romer, 1994). According to Wobmann (2003), acquiring knowledge and skills is an investment in human capital in the sense that people sacrifice current consumption for increased future income and future productivity. In other words, education increases future labor productivity and future income and can thus be seen as an investment in human capital, which is embodied in human beings (Wobmann, 2003).

Barro (2001) stated, "recent researchers have been inspired by the excitement of the new growth model, which focuses on growth using cross-country and cross-regional data." He tested the determinants of economic growth and investment in one hundred countries observed between 1960 and 1995. He found that growth was positively related to average years of school attainment of adult males at the secondary and higher levels; however, growth was insignificantly related to schooling at the primary level. He also discovered that the effect of school quality represented by test scores was important; the quantity of schooling measured by average years of attainment of adult males at secondary and higher levels was still positively related to subsequent growth.

Another aspect of school quality is its role in attracting a quality workforce that can make a region grow (Garmise, 2006). On the other hand, Mathur (1999) stated that the stock of knowledge is not a sufficient condition to generate growth and development. People with knowledge, ideas, and skills provide the pool from which innovators and entrepreneurs emerge. In other words, skilled and educated workers are the source of technological progress and knowledge externalities. The clustering of human capital will tend to attract venture capital and promote venture investment in high-tech growth industries.

Both school quality and quantity of years attained are related to one's future wages and income by encouraging creative and innovative ways of thinking. Innovation also comes from knowledge that is transmitted from one person to another by face-to-face contact. A human capital pool is known as a critical factor in making a region grow (Cortright, 2001). School quality is considered a strong quality of life variable that affects location decisions.

Hanushek and Woessmann (2007) asserted that cognitive skills are a key dimension of schooling outcomes, but it is difficult to obtain data on cognitive skills along with earnings and the other determinants of wages. They also stated that the evidence shows that the values of skills and of school quality have grown in the past and will have an influence on future general improvements in productivity.

On the other hand, school quality not only has an influence on economic factors, such as productivity and wages, but also non-market effects that contribute to

communities. Owens (2004) noted that the return to education may be either direct and private or indirect and social. Private non-market effects include personal health, the capacity to enjoy leisure, and efficiency in making a variety of personal choices, as well as an education ladder. Moreover, the community-level benefits of education include the production of community wealth, improving social equity, strengthening national cohesiveness, reducing environmental stress through its effects on fertility and population growth, and lowering crime rates.

2.4 Literature Review

The literature review in this dissertation is divided into two categories: consumer choices, and capitalization and willingness to pay for school quality. Consumer choice is stochastic rather than deterministic, while prices for public services are deterministic (price taker). The literature about choice is introduced first followed by capitalization of public services, particularly school quality. The literature related to methodology is discussed in detail in each chapter.

2.4.1 Homebuyer's Location Choice

Although the choice model was originally developed and used for transportation choice and brand choice, it is now frequently used in the housing market to determine residential location choices. McFadden (1977) modeled consumer choice and taste using the random utility model and he criticized the hedonic price model that treats heterogeneity of consumer preferences and tastes homogeneously. He

argued that consumers' preferences and tastes for housing vary, and their choices are limited as bounded rationality described (McFadden, 1977).

The literature review of homebuyers' preferences and choices is organized as follows. First, this dissertation introduces the choice models used in the housing market. Second, the rest of the literature focuses on school quality preference and choice studies.

Thereafter, the choice model has been used in various housing market studies, in particular, those related to tenure choice (Li, 1977), housing type choice, housing demand, neighborhood choice, and community or town choice (Nechyba & Strauss, 1997; Rapaport, 1997) in the housing market.

Some studies examined heterogeneous household location choice (Li, 1977; Rapaport, 1997), while others investigated the effect of public goods on location choice (Nechyba & Strauss, 1997). Using a logit model, Li examined heterogeneous homeownership decisions based on income, family size, age of the head of household, and race in Boston and Baltimore, using a logit model. The findings of this study showed that the probability of a location choice for each demographic is heterogeneous. For instance, as income increases, the probability of homeownership goes up. Race and family size are also substantially influential on homeownership. Households with two-parents with an average age of 40 years old, four members, and income of $12,500 have the highest probability of having homeownership—72.6 percent in Boston and 81.4 percent in Baltimore, respectively.

Rapaport (1997) studied housing demand and community choice. By examining 10,484 residents in Tampa, Florida, housing demand and community choice were estimated across household characteristics, such as gender, race, age of the head of household, and the number of children. Households, who are White, have higher educational attainment and higher income, and are a two-parent, demand housing more than those who are non-White, have lower income, less education, and disabled head of household.

Using a logit model, Nechyba and Strauss (1997) focused on the effect of location decisions on public services. With 22,739 residents in New Jersey, they estimated the effect of community characteristics—including local public school spending, distance to a metropolitan area, and degree of commercial activity—holding housing characteristics constant. These community characteristic variables increase the probability of choosing a particular community.

In contrast, by looking at race and immigrant status, Painter, Gabriel, and Myers (2001) investigated different homeownership rates and found that overall homeownership rates increased in Los Angeles County between 1980 and 1990. With the individual dataset PUMS (public use micro-data sample), their results indicated different homeownership rates among race-ethnicity groups when controlling for income, education, age, marital status, and size of household. Asians had high probability of homeownership, and the largest gap between homeownership probabilities was for Whites and Blacks.

Table 2-1 Summary of Choice Model Literature

Author	Year	Title	Method	Dependent variable	Independent variables	Log Likelihood	Findings
Li	1977	A logit model of homeownership	Logit	Dummy (1 own, 0 rent)	Age of head of household, income, family size, race		Heterogeneous probability of homeownership
Nechyba and Strauss	1997	Community choice and local public services: A discrete choice approach	Logit	communities	Public goods, private goods, housing prices, community characteristics		School quality plays significant role in choosing community
Rapaport	1997	Housing demand and community choice: An empirical analysis	Two stage (mixed logit	Community/tenure choice	Log_price, log_income, spouse, male_head, White immigrant, disabled, head_education, spouse_education, age, number of kids		Heterogeneous demand for level of housing
Painter, Gabriel, & Myers	2001	Race, immigrant status, and housing tenure choice	Sample selection model	Tenure choice	Number of people and workers in household, income, immigrant status, race, length of stay, education, age	-81237	Heterogeneous homeownership rate according to race, age, and immigrant status

On the other hand, many studies have examined the role of school quality in residential location choice using the various discrete choice models. One of these studies was done by Barrow (2002) with the multinomial logit model. Household characteristics were categorized into four items—income, education, age, and race. Barrow estimated the probability of location choice using SAT scores as a proxy for school quality. Barrow found that households with children prefer a school district with higher SAT scores, although African American households with children put less weight on school quality than African American households without children. However, African American households with children in higher income, education, and age brackets weight school quality as high as other race/ethnicity households with children.

Bayer, Ferreira, and McMillan (2004) studied residential sorting empirically. They asserted that residential sorting is driven by demand for good school quality. Bayer, Ferreira, and McMillan also said that many studies had failed to capture the indirect effect of school quality generated by heterogeneity in demand for school quality and different preferences for the characteristics of their neighbors. Using census data from 1990 and a random utility model developed by McFadden, they were not only able to observe characteristics of house choice, including housing characteristics, tenure status, and neighborhood characteristics, but also socio-demographic characteristics such as household race, income, education, and working status. Bayer, Ferreira, and McMillan were also able to determine the characteristics

Table 2-2 Summary of School Quality Choice Literature

Author	Year	Title	Method	Dependent Variables	Independent Variables	Log-likelihood	Findings
Barrow	2002	School choice through relocation: evidence from the Washington, D.C. area	Multinomial logit model	Probability of choosing one of 26 school districts	SAT (+), rent (-), distance from D.C in miles (-), per capita county expend net on education (+), crime rate (-), land area (+), median rooms per housing unit (-), proportion owner-occupied housing units (+), proportion of persons in poverty (-), number of D.C. Metro stations (+), education (high school graduate (+), some college (+), college graduate (+)), number of housing units (+)	-8,104	Different probability to choose location between each category; income, race, education, and age
Bayer, Ferreira, & McMillan	2004	Tiebout sorting, social multipliers and the demand for school quality	Conditional logit model	School districts	Monthly house price (-), average test scores (+), own (+), year built (-), elevation (-), population density (+), crime index (-),%black (-), % Hispanic (+.-), % Asian (+), % with college degree or more (+),average block group income (+),working status (+), and distance to work	Not reported	School quality facilitates residential sorting on neighborhood stratification
Bayoh, Irwin, & Haab	2006	Determinants of residential location choice: How important are local public goods in attracting homeowners to central city locations?	Multinomial logit model	School districts	School quality (+), total crime (-), local tax (-), school district tax (-), per capita income (+), % houses built before 1970 (-), per capita business establishments (+), per capita retail establishments (-), commute time (-)	-1,895	Strong evidence of the importance of local public goods—particularly school quality

of a neighborhood's race, educational attainment, and income. They also used housing price and working distance from residence. Ultimately, they found neighborhood stratification and heterogeneous preferences, and a willingness to pay for better school quality.

2.4.2 Capitalization of School Quality in Housing Prices

Many studies have attempted to answer the questions of what is the most appropriate measure of school quality and what attributes are capitalized in housing prices. They also focused on what variables related to school quality are the most attractive factors for which a homebuyer is willing to pay. Although previous studies have confirmed school quality is positively capitalized into housing prices, it is still controversial which school measures are capitalized into the housing market.

The seminal study capitalizing on the influence of school quality relative to housing prices dates back to Oates (1969). Oates used aggregated median house values in New Jersey. The purpose of Oates' study was to provide evidence that the output of public services should have influence in attracting residents and affecting property values. Oates examined the relationship between public expenditures and property values and hypothesized that the benefits resulting from providing public services exceed the cost of tax liability. Consumers who want high levels of public services tend to bid up property values in communities with high-quality public service programs. Using the two-stage-least-square estimation technique, Oates found that while property values have a significant negative relationship with

property taxes, property values are positively correlated with expenditure per pupil in the public schools. He found that the increase in one percent of property tax rate reduced housing prices by approximately $1,500. In contrast, the increase in expenditure per pupil from $350 to $450 made housing prices increase by approximately $1,200. He concluded that public services positively affect property values, and better schools have a significant positive influence on the value of local residential property. However, Oates' work is not free from criticism in terms of oversimplification. Pollakowski (1973) argued with the exception of per pupil expenditure as a proxy for educational services because Oates ignored other general public services proxies, without explicit explanation about the relationship between general public services and per pupil expenditure.

Rosen and Fullerton (1977) also indicated that the variable of expenditure per pupil alone could not explain the influence of school quality clearly, because prices associated with educational factors, educational production function, and the endowments of non-market inputs differed among communities. They also stated that, if information such as output measures is included in the analysis, the statistical results are more consistent with theoretical prediction than when expenditure levels are used. Rosen and Fullerton replicated Oates' study, using achievement test scores as a measure of public benefits. They concluded that expenditures are inappropriate variables to capture the impact of school quality on housing price. Additionally, they

found that the expenditure per pupil variable has a negative sign and is statistically insignificant.

After examining which attributes of local schools individuals consider, Downes and Zabel (2002) also concluded that the most important attribute of school quality is school achievement. Using housing values in Chicago for 1987 and 1991, they found test scores were reflected in housing price and that parents were willing to pay for a house close to a school with higher standardized test scores. Expenditure appeared to be statistically insignificant. Figlio and Lucas (2000) also complemented the Downes and Zabel (2002) study by exploring whether state school report cards influence parental decisions to purchase homes in certain communities correlated to housing prices. They found that the difference between an "A" and a "B" in the school report card reflected an estimated housing price difference of $21, 229.

Using per pupil spending, test scores, and marginal effect of the school on student performance, Hayes and Taylor (1996) tested the relationship between school quality and housing prices in Dallas, Texas. Test scores were divided into both school effect and peer effect. Hayes and Taylor found that parents pay a premium not on per pupil spending or test scores, but on the marginal effect of the school on student performance.

In education and economic research studies, the value-added method has been considered the most theoretically appropriate and has gained popularity. Because other effects such as parental background, neighborhood qualities, and innate

intelligence inherited from their parents might reflect on test scores and outcome, the value-added method measures improvements of academic achievement (Brasington, 1999).

Brasington and Haurin (2006) attempted to test empirically the hypothesis that the value added to student achievement influences housing prices. Using 77,578 house transactions in Ohio, school quality was measured by expenditure per pupil, proficiency tests, and value added. They employed neighborhood control variables such as air quality, racial composition, income levels, tax rates, and crime rates, rather than using county fixed-effect dummy variables. However, their research had multicollinearity problems, which made the data unreliable. Ultimately, their results showed that school expenditures and proficient test scores are more readily capitalized into housing prices than the value added variable of schools.

Seo and Simons[2] (2009) also attempted to find the measure of school quality, which is capitalized into housing prices. With individual transacted housing sales in Cuyahoga County, Ohio, the relationships between various school quality measures—expenditure per pupil, test scores, performance index, and value added—and housing prices were tested. They concluded that the comprehensive school measure, like the performance index introduced by the No Child Left Behind Act (2001), is more capitalized (by $9,667) than other school quality measures. They also found that school district designations—excellent, effective, continuous

[2] Seo and Simons' paper has been accepted and will be published in the *Journal of Real Estate Research* in 2009

improvement, academic watch, and academic emergency— are also capitalized into housing prices in Cuyahoga County, Ohio.

The first attempt to explicitly address the implicit price of school quality was Brasington's (2002) study, which examined demand for public schooling using the price of public schooling and tax. The implicit price of school quality is calculated by multiplying the median house price by the Metropolitan Statistical Area (MSA) public school quality parameter (which is a unit of school quality price) and dividing by the proficiency test score. The reason he calculates the implicit price of school quality is that there is no explicit price of school quality in the market. Using the 43,123 houses in 135 school districts in Ohio, he examined the different demand for school quality associated with various household demographic backgrounds such as high school diploma, income, and marital status using proficiency test scores as the dependent variable using the two-stage-least-square approach. He found that school quality is positively related with housing prices. The public schooling price elasticity of demand is -.11 while the tax price elasticity of demand is -.17. The income elasticity of demand for schooling is .32. Households with a high school diploma demanding school quality is more than those without a high school diploma— the elasticity is -2.62 for no high school diploma and -0.29 for high school graduates, respectively. Households who are currently married demand more school quality than single families or never married households.

Table 2-3a Summary of Capitalization of School Quality Literature

Author	Year	Title	Method	Dependent Variable	Independent Variables	R^2	Findings
Oates	1969	The effect of property taxes and local public spending on property values; an empirical study of tax capitalization and the Tiebout hypothesis	Two stage least square regression	Housing price (median value of owner-occupied dwellings)	Effective percentage tax rate (-), annual current expenditure per pupil (+), distance to Manhattan (-), median number of rooms per owner-occupied house (+), percentage of houses built since 1950 (+), family income (+), percentage if family income of less than $3,000 (+)	93%	Positive relationship between expenditure and housing price
Hayes & Taylor	1996	Neighborhood school characteristics: What signals quality to homebuyers?	Hedonic model	Housing price	Housing size (+), year built (+), pool (-), fireplace (-), distance to the central business district (-), share of apartment in the neighborhood (+), private school (+), neighbors (-)' peer group effect (+), school effect (+)	54%	Homebuyers are not only cognizant of differences in school quality but also reveal their preferences for higher quality schools by paying a premium for their home
Rosen and Fullerton	1977	A note on local tax rates, public benefit levels, and property values	Hedonic model	Median value of owner-occupied housing	Effective tax rate (-), expenditure per pupil (+,-), distance to midtown Manhattan (-), Median number of rooms per home (+), percentage of housing stock built in the last 10 years (+), median income of individuals (+), percentage of the population that has income under $4,000 (+)	91%	School achievement scores are positively related to housing price

Table 2-3b Summary of Capitalization of School Quality Literature (Cont.)

Author	Year	Title	Method	Dependent Variable	Independent Variables	R^2	Findings
Brasington	1999	Which measures of school quality does the housing market value?	Hedonic model	Log house price	Air conditioning (+), fireplace (+), lot size (+), age (-), rooms (+), garage (+), full bathrooms (+), part bathrooms (+), deck (+), pool (+), Q2 (+), Q3 (+), Q4 (+) for sales dummy, tax rate (-), median income (+), distance to MAS' CBD (-), percent minority (-), crime (-), expenditure per pupil (+), teacher master's plus (+), teacher salary (+), student/teacher ratio (+), average teacher experience (+), graduation rate (+), attendance rate (+), value added (+)	75%	Proficiency tests are positively related to housing price
Figlio & Lucas	2000	What's in a grade? School report cards and housing prices	Hedonic model	Housing Price	Student attributes (Third grade and free or reduced price lunch eligible) effect of an A grade versus a B grade (+) effect of an A grade versus a C grade (+) effect of an B grade versus a C grade (+) effect of an A grade versus a B grade (-) effect of an A grade versus a C grade (-) effect of an B grade versus a C grade (-)	Not reported	The positive relationship between school report card and housing price and residential sorting
Downes & Zabel	2002	The impact of school characteristics on house prices: Chicago 1987-1991	Hedonic model	Natural log of house value	Tax (+), proportion of African American Students (+), proportion of Hispanic students (-), proportion of students in limited proficiency (+), students with limited English proficiency (-), expenditure per pupil (+), 8^{th} grade reading (+), distance to CBD (-), median age of individual in the census tract (+), proportion of non-White individual in the census tract (-), proportion of individuals over 25 who have completed high school in the census tract (-)	44%	Current test performances of students are considered when purchasing a home

Table 2-3c Summary of Capitalization of School Quality Literature (Cont.)

Author	Year	Title	Method	Dependent Variable	Independent Variables	R^2	Findings
Black	1999	Do better schools matter? Parental valuation of elementary education	Hedonic model	House price	Bedroom (+), bathroom (+), age of building (-), lot size (+), internal square footage (+), distance to Boston (-), percent Hispanic (-), percent non-Hispanic black (-), percent 0-9 years old (+), percent 65+ years old (+), percent female-headed household with children(-), median household income (+), percent with bachelor's degree (+), percent with graduate degree (+), percent with less than high school (-)	67%	Parents do care about school peers and other unmeasured components of school quality
Bogart & Cromwell	2002	How much is a neighborhood school worth?	Hedonic model	Housing price index	School district change(+), sales in 1987 or later(+), school district change and sale in 1987 or later(-), % nonwhite in school(-), lot size(+), living area(+), construction grade AA or A+(+), construction grade (+), construction grade B or C or D (+), age of house(-), Bad or fair condition(-), excellent condition (+), average room size(+), plumbing fixtures (+), heavy traffic (-), % nonwhite in tract 1980 (+), % nonwhite in tract 1990 (-)	65%	Test score is good proxy for school quality and there is a positive relationship between test score and housing price
Seo & Simons	2007	The effect of school quality on residential sales price	Hedonic model	Housing price	Housing characteristics (single residential (+), summer sale (+), year built (-), good condition (+), basement (+), bedroom (-), bathroom (+), fire place (+) lot size (+)), Neighborhood (White (+) commuting time under 30 minutes (+)), School Quality (teacher salary (+), building expenditures (-), instruction expenditures (+) 4^{th} grade math test scores (+), report card excellent (+))	78%	School district designation has statistically significant positive relationship with housing price.

2.4.3 Heterogeneous Willingness to Pay

The extent of capitalization of school quality can be interpreted as willingness to pay for school quality or the implicit school quality price a household is willing to pay, holding other variables constant. In 1974, Rosen defined the hedonic price as follows:

> The implicit prices of attributes or characteristics are revealed to economic agents utilizing the observed prices of differentiated products and the specific amounts of characteristics associated with them. This constitutes the empirical magnitudes explained by the model. Economically, implicit prices are estimated by the first step regression analysis (product price regressed on characteristics) in the construction of hedonic price index. (p. 34).

In market equilibrium, the hedonic price function specifies how much an attribute contributes to the price of a commodity (Eppel, 1987). In other words, the price of school quality can be estimated by regressing school quality on housing prices. The marginal utility bearing school quality and household willingness to pay in housing prices is the price of school quality. The estimate of school quality in the regression model is called "hedonic price or implicit price (Rosen, 1974). The interpretation of parameters generated from the hedonic price model is transformed into the form of the implicit price of attributes. The magnitude of the effects of each attribute on housing sales price is the marginal utility and marginal willingness to pay.

By applying Rosen's method, Bajari and Kahn (2005) examined the heterogeneous demand for differentiated products using three-step procedures. They

studied three MSAs—Chicago, Atlanta, and Dallas—with microdata from the Census Integrated Public Use Microdata Series (IPUMS). The first step of this study estimated hedonic housing prices using locally weighted kernel regression so as to recover the unobserved preference parameter. The second step estimated the preferences for continuous characteristics by applying the implicit prices, which was estimated from the first equation and the observed choice of housing characteristics. Lastly, the estimated implicit price was a function of residents' demographic characteristics. They found the heterogeneous demand for housing products across race, income, household size, gender, and marital status. For instance, in regard to the demand for the number of rooms, African Americans had less willingness to pay for rooms than other races by approximately $172 while married couples were more willing to pay for rooms by $411 than households with other marital types.

Brasington (2002) examined the elasticity of demand for public schooling using the price of public schooling and tax. The price of public school, the implicit price of school quality, was used as an indicator of market price of public schooling since there was no explicit price of school quality in the market. The implicit price of school quality is calculated by multiplying the median house price by the MSA's public school quality parameter (which is a unit of school quality price) and dividing by the proficiency test score. With the 43,123 houses in 135 school districts in Ohio, he examined the different demand for school quality associated with various households' demographic backgrounds, including high school diploma, income, and

marital status using proficiency test score as the dependent variable using two stage least square. He found that school quality is positively related to housing prices. The public school price elasticity of demand is -.11 while the tax price elasticity of demand is -.17. The income elasticity of demand for schooling is .32. Households with a high school degree demand more for school quality than those without a high school degree—the elasticity is -2.62 for no high school diploma and -0.29 for high school graduation, respectively. Households currently married demand more for school quality than single family or never married households.

Table 2-4 Summary of Variables Used in Previous Literature

Variables	Preference for School Quality	Willingness to Pay	School District Choice
Homebuyer with children	NA	+	+
Homebuyer without children	NA	+/-	+
Income below $40,000	NA	-	-
Income above $40,000	NA	-	-
White	NA	+	+
Black	NA	+/-	+/-
Asian	NA	+	+/-
Hispanic	NA	+/-	+/-
High School Degree	NA	+/-	+/-
Bachelor's Degree	NA	+	+
Graduate Degree	NA	+	+
Blue collar worker	NA	-	-
White collar worker	NA	+	+

To summarize the literature review, school quality causes housing price variations within a region and also causes residential sorting. School quality is a factor in location choice and is capitalized into housing prices by homebuyers with different income, education, and race/ethnicity. The relationship between school

quality, which is capitalized into housing prices and homebuyers with different demographic characteristics are indicated in Table 2-4.

Most of the previous studies did not examine more specific categories of homebuyers' occupations or detailed stratification of income levels as the independent variables. Moreover, none of the studies investigated various aspects of heterogeneous preference, location choice in school districts, and willingness to pay for school quality. The relationships investigated in this dissertation include the dependent variables of preference regarding school quality, willingness to pay for school quality, and location choice in school districts.

This dissertation hypothesizes that different homebuyers' backgrounds and characteristics affect heterogeneous preferences regarding school quality, location choices in school district, and willingness to pay for school quality through housing prices. The next chapter introduces the hypothetical relationships between the independent variables describing homebuyers' backgrounds and characteristics (including income, education, race/ethnicity, occupation, and presence of school-age children in a household) and the dependent variables of preferences, school district choices, and willingness to pay for school quality. The detailed classifications of homebuyers' backgrounds and characteristics and the expected signs for the variables used are hypothesized in the following chapter.

Table 2-5 Homebuyer Backgrounds and Characteristics and Expected Signs

	Variables	Preference for School Quality	Willingness to Pay for School Quality through Housing Price	School District Choice
Presence of school-age children	homebuyer with children	+	+	+
	homebuyer without children	-	+/-	+
Income	Income Less than $10,000	-	-	-
	Income $10,000 to $14,999	-	-	-
	Income $15,000 to $24,999	-	-	-
	Income $25,000 to $34,999	+/-	+/-	+/-
	Income $35,000 to $49,999	+/-	+/-	+/-
	Income $50,000 to $74,999	+	+	+
	Income $75,000 to $99,999	+	+	+
	Income$100,000 to $149,999	+	+	+
	Income $150,000 to $199,999	+	+	+
	Income $200,000 or more	+	+	+
Race	White	+	+	+
	Black	+	+/-	+/-
	Asian	+	+	+/-
	Hispanic	+	+/-	+/-
	Some other race	+	NA	NA
Education	High School Degree	+	+/-	+/-
	College Degree	+/-	+	+
	Bachelor Degree	+	+	+
	Master Degree	+	+	+
	Doctoral Degree	+	+	+
Occupation	Management, professional, and related	+	NA	NA
	Service	+	NA	NA
	Sales and office	+	NA	NA
	Farming, fishing, and forestry	+	NA	NA
	Construction, extraction, maintenance and repair	+	NA	NA
	Transportation and warehousing, and utilities	+	NA	NA
	Production, transportation, and material moving	+	NA	NA

CHAPTER III

CONCEPTUAL MODEL

3.1 Introduction

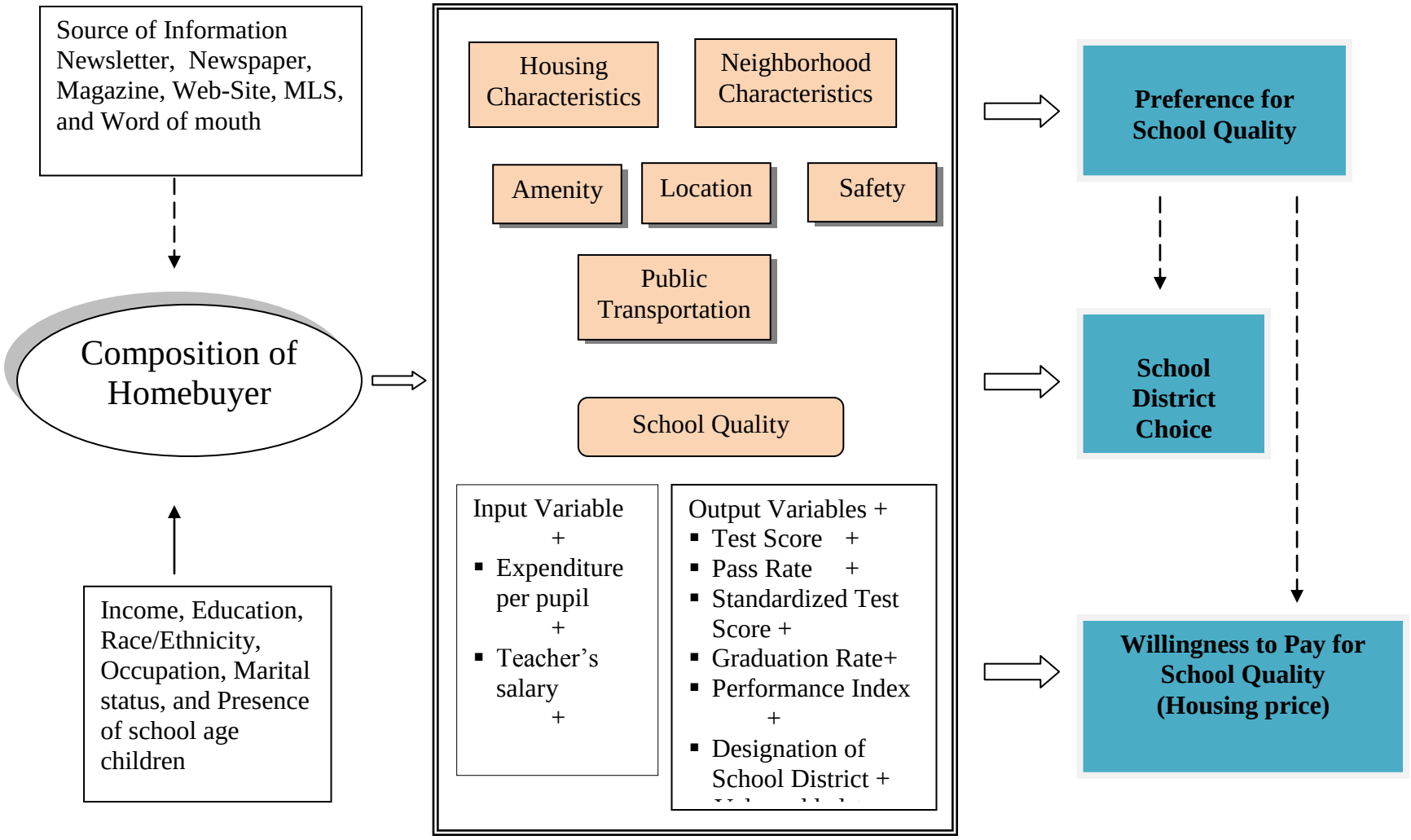
In the previous chapter, the theoretical background provided is that consumers act rationally to maximize their utility, based on their preferences. A consumer makes a decision based on a well-defined preordering choice set. The choice set is constrained by budget, physical limitations, and information. The preference of a consumer can also be changed and affected by advertising, price change, and choices of other consumers (Green, 1971).

This dissertation hypothesizes that utility derived by school quality will be heterogeneous and will vary according to household demographics and socio-economic status (SES). The approach for this dissertation to modeling is to measure heterogeneous preference, school district choice, and willingness to pay for school quality.

When a homebuyer is looking to buy a house, he/she considers various aspects of the house: size, number of rooms, quality of neighborhoods, and other location factors, including school quality. The preferences for school quality would be different among homebuyers with different demographics and SES. For instance, a homebuyer with school-age children would sacrifice the size of the house in order to live in a good school district and vice versa. School district choice and willingness to pay would be different as well.

My conceptual model is devised to test the role of school quality on homebuyers by determining in which school districts they will live and how much they are willing to pay for school quality through their home purchase. This conceptual model describes the individual preference, choice, and willingness to pay. It also illustrates the aggregated willingness to pay for better school quality in 14 states. This dissertation expects similar results, although it will vary by unit of analysis and by state.

Figure3-1 Preference, Location Choices, and Willingness to Pay for School Quality



3.2 Hypotheses to be tested

The hypotheses in this dissertation are divided into four groups: (1) Whether or not homebuyers prefer school quality differently based on their demographics and SES, (2) whether or not school quality affects a homebuyer's school district choice, (3) whether or not homebuyers with different backgrounds and characteristics have different willingness to pay for school quality and how much they are willing to pay for school quality, and (4) whether individual and aggregate models are indifferent. This dissertation defines school quality as a performance index or school district designation. For the national model, the comprehensive measure of school quality is used: reading and math performance (RAMP). The detailed hypotheses are discussed below.

3.2.1 Hypotheses Group I

The first group of hypotheses is to test whether or not homebuyers with different demographics and SES prefer school quality differently. The first group of hypotheses is tested by decomposing homebuyers' demographics and SES.

Since homebuyers with school-age children can directly enjoy school quality by sending their children to public schools, this dissertation made the assumption that homebuyers with school-age children would prefer more school quality than those with children not school age, and those without children.

Hypothesis I-1 Preference for School Quality and Homebuyers with Children.

- H_0 = the probability of the preference for school quality is the same for homebuyers with children, with children but not of school age, and no children.
- H_1 = the probability of school quality preference for homebuyers with school-age children is higher than the average probability of school quality preference for all homebuyers.
- H_2 = the probability of school quality preference for homebuyers with children but not of school age is lower than the average probability of school quality preference for all homebuyers.
- H_3 = the probability of school quality preference for homebuyers with no children is lower than the average probability of school quality preference for all homebuyers.

The second hypothesis tests heterogeneous homebuyers' preferences depending on household marital status. The probability for married homebuyers' preferences for school quality is higher than any other family types: never married, widowed, and divorced.

Hypothesis I-2 Preference for School Quality and Homebuyer's Marital Status.

- H_0 = the probability of the preference for school quality is the same for homebuyers who are married, never married, divorced, and widowed.
- H_1 = the probability of school quality preference for homebuyers who are married is higher than the average probability of school quality preference for all homebuyers.
- H_2 = the probability of school quality preference for homebuyers who are never married is lower than the average probability of school quality preference for all homebuyers.
- H_3 = the probability of school quality preference for homebuyers who are divorced is lower than the average probability of school quality preference for all homebuyers.
- H_4 = the probability of school quality preference for homebuyers who are widowed is lower than the average probability of school quality preference for all homebuyers.

The third hypothesis is whether there is a positive relationship between the probability of preferring school quality and income categories. Homebuyer annual

income categories are grouped as less than $10,000, $10,000 to $14,999, $15,000 to $24,999, $25,000 to $34,999, $35,000 to $49,999, $50,000 to $74,999, $75,000 to $99,999, $100,000 to $149,999, $150,000 to $199,999, and more than $200,000.

Hypothesis I-3 Preference for School Quality and Homebuyer's Income.

- H_0 = the probability of the preference for school quality is the same for homebuyers with different income categories.
- H_1 = the probability of school quality preference for homebuyers with income less than $10,000 is lower than the average probability of school quality preference for all homebuyers.
- H_2 = the probability of school quality preference for homebuyers with income $10,000 to $14,999 is lower than the average probability of school quality preference for all homebuyers.
- H_3 = the probability of school quality preference for homebuyers with income $15,000 to $24,999 is lower than the average probability of school quality preference for all homebuyers.
- H_4 = the probability of school quality preference for homebuyers with income $25,000 to $34,999 is lower than the average probability of school quality preference for all homebuyers.
- H_5 = the probability of school quality preference for homebuyers with income $35,000 to $49,999 is lower than the average probability of school quality preference for all homebuyers.
- H_6 = the probability of school quality preference for homebuyers with income $50,000 to $74,999 is higher than the average probability of school quality preference for all homebuyers.
- H_7 = the probability of school quality preference for homebuyers with income $75,000 to $99,999 is higher than the average probability of school quality preference for all homebuyers.
- H_8 = the probability of school quality preference for homebuyers with income $100,000 to $149,999 is higher than the average probability of school quality preference for all homebuyers.
- H_9 = the probability of school quality preference for homebuyers with income $150,000 to $199,999 is higher than the average probability of school quality preference for all homebuyers.
- H_{10} = the probability of school quality preference for homebuyers with income more than $200,000 is higher than the average probability of school quality preference for all homebuyers.

The fourth hypothesis is based on homebuyers' educational levels. The hypothesis is that homebuyers with high educational attainment prefer more school quality than those with low educational levels. The education levels are divided as some high school, high school graduate, some college, college graduate, and post-graduate.

Hypothesis I-4 Preference for School Quality and Homebuyer Education.

- H_0 = the probability of the preference for school quality is the same for homebuyers with different educational backgrounds.
- H_1 = the probability of school quality preference for homebuyers with some high school is lower than the average probability of school quality preference for all homebuyers.
- H_2 = the probability of school quality preference for homebuyers with high school degrees is lower than the average probability of school quality preference for all homebuyers.
- H_3 = the probability of school quality preference for homebuyers with some college is lower than the average probability of school quality preference for all homebuyers.
- H_4 = the probability of school quality preference for homebuyers with college degrees is higher than the average probability of school quality preference for all homebuyers.
- H_5 = the probability of school quality preference for homebuyers with post-graduate degrees is higher than the average probability of school quality preference for all homebuyers.

Race/ethnicity is one of major factors affecting homebuyers' preferences for school quality. The race variables utilized in this dissertation are White, African American, Asian, Hispanic, and some other race. It is assumed that Whites have higher probability to have a preference for school quality.

Hypothesis I-5 Preference for School Quality and Homebuyer Race/Ethnicity.

- H_0 = the probability of the preference for school quality is the same for homebuyers who are White, African American, Asian, Hispanic and some other race.
- H_1 = the probability of school quality preference for homebuyers who are White is higher than the average probability of school quality preference for all homebuyers.
- H_2 = the probability of school quality preference for homebuyers who are African American is lower than the average probability of school quality preference for all homebuyers.
- H_3 = the probability of school quality preference for homebuyers who are Hispanic is lower than the average probability of school quality preference for all homebuyers.
- H_4 = the probability of school quality preference for homebuyers who are Asian is higher than the average probability of school quality preference for all homebuyers.
- H_5 = the probability of school quality preference for homebuyers who are some other race is lower than the average probability of school quality preference for all homebuyers.

Occupation variables are grouped as management, professional, and related occupations; service occupations; sales and office occupations; construction, extraction, and maintenance occupations; and production, transportation and material moving occupations. Homebuyers with management, professional, and related occupations are assumed to have a higher probability than any other occupational categories (See Appendix 1).

Hypothesis I-6 Preference for School Quality and Homebuyer's Occupations.

- H_0 = the probability of the preference for school quality is the same for homebuyers with different occupations.
- H_1 = the probability of school quality preference for homebuyers who are unemployed is lower than the average probability of school quality preference for all homebuyers.
- H_2 = the probability of school quality preference for homebuyers in management, professional, and related occupations is higher than the average probability of school quality preference for all homebuyers.

- H_3 = the probability of school quality preference for homebuyers in service occupations is lower than the average probability of school quality preference for all homebuyers.
- H_4 = the probability of school quality preference for homebuyers in sales and office occupations is lower than the average probability of school quality preference for all homebuyers.
- H_5 = the probability of school quality preference for homebuyers in construction, extraction, and maintenance occupations is lower than the average probability of school quality preference for all homebuyers.
- H_6 = the probability of school quality preference for homebuyers in production, transportation, and material moving occupations is lower than the average probability of school quality preference for all homebuyers.

3.2.2 Hypotheses Group II

Hypothesis Group II: Location Choice in School District.

In hypotheses group II, this dissertation tests whether homebuyers' school district choice is influenced by the presence of school age children, marital status, educational level, race/ethnicity, and occupation, as well as income. Holding income constant, different preferences for school quality, which stem from a variety of factors, lead to homebuyer school district choice to reside in a community, which provides public goods to maximize both the utilities of individual homebuyers and aggregated homebuyers. The designation of school district will be used as a proxy for school quality.

The first hypothesis is to test whether homebuyers with school-age children are more or less likely to live in an "excellent school district" than any other homebuyers or not. The hypothesis is that homebuyers with school-age children have a higher

probability to live in an excellent school district than homebuyers with children who are not school age, or homebuyers with no children.

Hypothesis II-1 School District Choice and Homebuyers with School Age Children.

- H_0 = the probability of choosing an "excellent school district" is the same for homebuyers with school-age children, with children but not at school age, and with no children.
- H_1 = the probability of choosing an excellent school district for homebuyers with school age children is higher than for homebuyers with children not of school age.
- H_2 = the probability of choosing an excellent school district for homebuyers with school age children is higher than for homebuyers with no children.

Hypothesis II-2 School District Choice and Homebuyer with Marital Status.

- H_0 = the probability of choosing an "excellent school district" is the same for homebuyers who are married, never married, divorced, and widowed.
- H_1 = the probability of choosing an "excellent school district" for homebuyers who never have been married is lower than for homebuyers who are married.
- H_2 = the probability of choosing an "excellent school district" for homebuyers who are divorced is lower than for homebuyers who are married.
- H_3 = the probability of choosing an "excellent school district" for homebuyers who are widowed is lower than for homebuyers who are marrried.

The probabilities for homebuyers who are married, never married, divorced, and widowed are estimated to test whether there is heterogeneous school district choice according to homebuyer marital status.

Hypothesis II-3 School District Choice and Homebuyer Income.

- H_0 = the probability of choosing an "excellent school district" is the same for homebuyers with various income categories.
- H_1 = the probability of choosing an "excellent school district" for homebuyers with income less than $10,000 is lower than for homebuyers with income $50,000 to $74,999.
- H_2 = the probability of choosing an "excellent school district" for homebuyers with income $10,000 to $14,999 is lower than for homebuyers with income $50,000 to $74,999.

- H_3 = the probability of choosing an "excellent school district" for homebuyers with income $15,000 to $24,999 is lower than for homebuyers with income $50,000 to $74,999.
- H_4 = the probability of choosing an "excellent school district" for homebuyers with income $25,000 to $34,999 is lower than for homebuyers with income $50,000 to $74,999.
- H_5 = the probability of choosing an "excellent school district" for homebuyers with income $25,000 to $34,999 is lower than for homebuyers with income $50,000 to $74,999.
- H_6 = the probability of choosing an "excellent school district" for homebuyers with income $35,000 to $49,999 is lower than for homebuyers with income $50,000 to $74,999.
- H_7 = the probability of choosing an "excellent school district" for homebuyers with income $75,000 to $99,999 is higher than for homebuyers with income $50,000 to $74,999.
- H_8 = the probability of choosing an "excellent school district" for homebuyers with income $100,000 to $149,999 is higher than for homebuyers with income $50,000 to $74,999.
- H_9 = the probability of choosing an "excellent school district" for homebuyers with income $150,000 to $199,999 is higher than for homebuyers with income $50,000 to $74,999.
- H_{10} = the probability of choosing an "excellent school district" for homebuyers with income more than $200,000 is higher than for homebuyers with income $50,000 to $74,999.

The relationship between the probability of an excellent school district choice and homebuyers' educational levels is tested. Homebuyers' educational levels are the same as the first group of hypotheses. The hypothesis is that as homebuyers' educational level increases, the probability of their living in an excellent school district increases.

Hypothesis II-4 School District Choice and Homebuyer Educational Level.

- H_0 = the probability of choosing an "excellent school district" is the same for homebuyers with various educational levels.
- H_1 = the probability of choosing an "excellent school district" for homebuyers with some high school is lower than for homebuyers who are college graduates.

- H_2 = the probability of choosing an "excellent school district" for homebuyers with high school diplomas is lower than for homebuyers who are college graduates.
- H_3 = the probability of choosing an "excellent school district" for homebuyers with some college is lower than for homebuyers who are college graduates.
- H_4 = the probability of choosing an "excellent school district" for homebuyers with post-graduate degrees is higher than for homebuyers who are college graduates.

The fourth hypothesis tests the relationship between the probability of living in an excellent school district and homebuyers' race. It is believed that Whites are more likely to live in an excellent school district.

Hypothesis II-5 School District Choice and Homebuyer Race/Ethnicity.

- H_0 = the probability of choosing an "excellent school district" is the same for homebuyers who are White, African American, Asian, Hispanic, and some other race.
- H_1 = the probability of choosing an "excellent school district" for homebuyers who are White is higher than for homebuyers who are African American.
- H_2 = the probability of choosing an "excellent school district" for homebuyers who are White is higher than for homebuyers who are Asian.
- H_3 = the probability of choosing an "excellent school district" for homebuyers who are White is higher than for homebuyers who are Hispanic.
- H_4 = the probability of choosing an "excellent school district" for homebuyers who are White is higher than for homebuyers who are some other race.

As previously stated, it is worthwhile to test homebuyers' occupations and their school district choices, because homebuyers with management, professional, and related occupations are assumed to have higher probability of choosing an excellent school district.

Hypothesis II-6 School District Choice and Homebuyer Occupation.

- H_0 = the probability of choosing an excellent school district is the same for homebuyers in different occupations.
- H_1 = the probability of choosing an "excellent school district" for homebuyers in service occupations is lower than for homebuyers in management, professional, and related occupations.

- H_2 = the probability of choosing an "excellent school district" for homebuyers in sales and office occupations is lower than for homebuyers in management, professional, and related occupations.
- H_3 = the probability of choosing an "excellent school district" for homebuyers in construction, extraction, and maintenance occupations is lower than for homebuyers in management, professional, and related occupations.
- H_4 = the probability of choosing an "excellent school district" for homebuyers in production, transportation, and material moving occupations is lower than for homebuyers in management, professional, and related occupations.

3.2.3 Hypotheses Group III

Hypothesis Group III: Willingness to Pay for School Quality through Housing Price.

In hypotheses group III, the heterogeneous homebuyer's willingness to pay for school quality through housing prices will be tested. As mentioned previously, consumer willingness to pay for school quality may vary by homebuyer demographic and SES.

The first hypothesis is to test the relationship between school quality, performance index, and housing prices. It is expected to be positive.

Hypothesis III-1 Relationship between School Quality and Housing Prices.

- H_0 = there is no positive relationship between school quality and housing prices.
- H_1 = there is a positive relationship between school quality and housing prices.

The second hypothesis is to test a positive relationship between school quality and willingness to pay for school quality by households with school-age children.

Hypothesis III-2 Willingness of Households with School Age Children to Pay for School Quality.

- H_0 = the willingness to pay for school quality is the same for households with school-age children, with children not at school age, and with no children.

- H_1= the willingness of households with school-age children to pay for school quality is higher than the average willingness of all households in Cuyahoga County.
- H_2= the willingness of households with children but not at school age to pay for school quality is lower than the average willingness of all households in Cuyahoga County.
- H_3 = the willingness of households without children to pay for school quality is lower than the average willingness of all households in Cuyahoga County.

Hypothesis III-3 Willingness to Pay for School Quality and Household Marital Status.

- H_0 = the willingness to pay for school quality is the same for homebuyers who are married, and homebuyers who have never been married.
- H_1 = the willingness of married households to pay for school quality is higher than the average willingness of all households in Cuyahoga County.
- H_2 = the willingness of households who have never married to pay for school quality is lower than the average willingness of all households in Cuyahoga County.

Hypothesis III-4 Willingness to Pay for School Quality and Household Income.

- H_0 = the willingness to pay for school quality is the same for households with income from $10,000 to $200,000.
- H_1= the willingness of households with a median income of $122,503 to pay for school quality is higher than the average willingness of all households in Cuyahoga County.
- H_2= the willingness of households with a median income of $43,227 to pay for school quality is lower than the average willingness of all households in Cuyahoga County.
- H_3= the willingness of households with a median income of $70,069 to pay for school quality is higher than the average willingness of all households in Cuyahoga County.

Previous literature consistently found educational levels to be positively related to willingness to pay for school quality. The fifth hypothesis is to test the positive relationship between educational levels and willingness to pay for school quality.

Hypothesis III-5 Willingness to Pay for School Quality and Household Educational Levels.

- H_0 = the willingness to pay for performance index is the same for all educational levels of households.
- H_1 = the willingness of households with a high school diploma to pay for school quality is lower than the average willingness of all households in Cuyahoga County.
- H_2 = the willingness of households with college degrees to pay for school quality is higher than the average willingness of all households in Cuyahoga County.
- H_3 = the willingness of households with post-graduate degrees to pay for school quality is higher than the average willingness of all households in Cuyahoga County.

Hypothesis III-6 Willingness to Pay for School Quality and Household Race/Ethnicity.

- H_0 = the willingness to pay for school quality is the same for households of all races.
- H_1 = the willingness of White households to pay for school quality is higher than the average willingness of all households in Cuyahoga County.
- H_2 = the willingness of African American households to pay for school quality is lower than the average willingness of all households in Cuyahoga County.
- H_3 = the willingness of Asian households to pay for school quality is higher than the average willingness of all households in Cuyahoga County.
- H_4 = the willingness of households of other races to pay for school quality is lower than the average willingness of all households in Cuyahoga County.

Hypothesis III-7 Willingness to Pay for School Quality and Homebuyer Occupation.

- H_0 = the willingness to pay for school quality is the same for households of all occupations.
- H_1 = the willingness of households in management, professional, and related occupations to pay for school quality is higher than the average willingness of all households in Cuyahoga County.
- H_2 = the willingness of households in occupations other than management, professional, and related to pay for school quality is lower than the average willingness of all households in Cuyahoga County.

3.2.4 Hypothesis IV

Hypothesis IV-1 Comparison of Cuyahoga County Hedonic Model and National Model.

- H_0 = there is no difference between the Cuyahoga County hedonic model and the national model in terms of the presence of school-age children, race, income, education, and occupation.
- H_1 = there is a difference between the Cuyahoga County hedonic model and the national model in terms of the presence of school-age children, race, income, education, and occupation.

In summary, Chapter 3 discusses four groups of hypotheses used to estimate heterogeneous household preference for school quality, school district choice, and willingness to pay for school quality, based on household demographics and SES. A variety of methodological approaches are discussed in the following section.

CHAPTER IV

RESEARCH DESIGN & METHODOLOGIES

4.1 Introduction

The objective of this chapter is to discuss the research design and methodologies utilized for this study. Three models were utilized: homebuyer preference for school quality, school district choice in school districts with survey data, and heterogeneous willingness to pay model run with the two different units of analysis. The first model (named Homebuyer Heterogeneous Preference for School Quality and School District Choice) is used to test the first and the second groups of hypotheses, and the second model (Heterogeneous Household Willingness to Pay for School Quality) is used to test the third and the fourth groups of hypotheses.

With ideas that preference and school district choice are stochastic, although willingness to pay for school quality is deterministic, two models were used with three methodologies. Three methodological approaches—(1) the Analysis of Table (ANOTA) Model, (2) the Ordered Logit Model, and (3) the Spatial Hedonic Model— were used to test the hypotheses previously discussed in Chapter 3.

The study employed the use of ANOTA (Analysis of Table) to analyze homebuyer preference for school quality when purchasing a home (the first group of the hypotheses). The ANOTA model allowed the researcher to analyze demographic data in order to determine variation in homebuyer preference for school quality in the selection of a home. The ANOTA model also helps to find out what were the most influential school factors affecting homebuyer decisions.

Conversely, the ordered logit model was used to analyze the hypothesis regarding the school district choice in homebuyer selections of housing based on the quality of the school districts. The ordered logit model provides the researcher the ability to estimate the probability of location choices of homebuyers among school districts in which they decide to reside.

In addition, the spatial hedonic price model was used to estimate household heterogeneous willingness to pay for school quality in Cuyahoga County. The two-step procedure of the national model was used to compare the aggregated willingness to pay with an individual's willingness to pay.

The procedures used for collecting data and the aforementioned methodological approaches for analyzing the data are discussed in this chapter. In section 4.2, with survey data, two models test homebuyer school quality preferences, and whether or not these preferences led to a location decision for the school district in which they live. Section 4.3 focuses willingness to pay for school quality among heterogeneous households in Cuyahoga County and 2,531 school districts in 14 states.

4.2 Preference for School Quality & School District Choice Among Homebuyers

4.2.1 Introduction

This section was designed to explore preferences for school quality among heterogeneous homebuyers. This was also developed to find evidence that school quality differently influence homebuyers' school district choices. First, ANOTA (Analysis of table), which is a useful statistical tool to analyze a categorical relationship between dependent and independent variables, was applied to test groups of hypotheses I: Which location factors affect a homebuyer's decision on purchasing a home. The preferences for location factors were tested utilizing three models: school quality is the most important factor, how much school quality is important, and what school quality variables were considered when homebuyers purchased a house.

Second, the ordered logit model allowed this study to estimate the probability with which homebuyers made a specific school district choice. Because the dependent variable of this model is school district designations, which is ordered, the ordered logit model was appropriate. Six models were utilized for each demographic and SES group: presence of school age children, marital status, race, income, education, and occupation.

The survey data were analyzed using various methodological approaches, which included the use of ANOTA and ordered logit model. The ordered logit model is analogous to the multinomial logit model in terms of algorithm.

4.2.2 Data and Study Areas

To test hypothesis groups I and II, the survey data set was used to analyze homebuyers' heterogeneous preferences and school district choices. The survey sample is homebuyers who purchased a house in Cuyahoga County in 2006.

4.2.2.1 Study Areas and Survey Sample

It may be hard to measure heterogeneous individual preferences for school quality and individual choices with publicly available secondary data. This dissertation utilized a survey methodology to ascertain homebuyers' opinions about school quality. The survey results allow this dissertation to analyze homebuyers' actual preferences for school quality without any constraints, such as income and location of work.

With the survey data, this study measured variances of preference for school quality variables and for school district choices among individual homeowners with different backgrounds and characteristics. Although they were well informed, after the No Child Left Behind Act (2001), homebuyers may be differently aware of the importance of school quality when purchasing a house. The fact that a homeowner lives in a good school district does not mean he/she cares about school quality more than those who live in a poor school district. The survey dataset was obtained from a telephone survey of single-family homeowners, who purchased a house in 2006 and currently live in Cuyahoga County.

The telephone survey is a method whereby interviewers collect data through telephone interviews with respondents. The advantages of the telephone survey include: rapid data collection, cost savings, anonymity, and assurance that instructions are followed; whereas the disadvantages of this method are: less control, less credibility, lack of visual materials, and reduced ability to ask complex questions (Bingham & Felbinger, 1989). The role of interviewers is more pronounced in the telephone survey versus a written survey with regard to the interview process (Rea & Parker, 2005).

Participants of the telephone survey were homebuyers in 2006 randomly selected from various cities located in Cuyahoga County, with the exception of Cleveland, Ohio. A total of 400 surveys out of 11,900 housing sales from the Cuyahoga County Auditor were completed; however, only 397 of the 400 completed surveys contained valid information and were analyzed. The survey sample was divided into several categories: (1) the presence of school age children (homebuyers with school age children, those without children, and those with children who are too old or too young to attend K-12 school), (2) whether homebuyers moved from the same city or different cities, (3) relationship with a child, (4) race, (5) educational background, (6) income, and (7) occupation.

4.2.2.2 Homebuyers' Survey Instrument

The purpose of the survey is to find out homebuyers' preferences regarding school quality variables and school district choices. This survey reveals whether

school quality is the greatest factor when homebuyers purchase a house, what school quality variable is preferred when homebuyers make location decisions, and the amount of variation among different income levels, educational levels, race/ethnicity, and occupation.

The survey instrument was developed to obtain quantitative individual homebuyers' information regarding income, education, race/ethnicity, and occupation, as well as qualitative homebuyers' preferences regarding school quality. The survey instrument consists of four sections that focus on (1) general information, (2) information about school quality, (3) student information about the school he or she attends and the student's academic achievement, and (4) the homebuyer's demographic backgrounds and characteristic information. See the survey instrument in Appendix 3.

Questions 1 to 4 in Section I of the survey instrument try to ascertain information about the city in which respondents live, the price of housing, and from where a homebuyer moved. Section II was designed to look for homebuyers' preferences regarding school quality. Questions 5 to 11 ask about an information source, the school quality variables they considered when purchasing a house, and both the level of preferences for school quality and the most preferred school quality variable. Question 11 asks whether or not a homebuyer has a school age child. If a respondent answers "Yes," the respondent will be asked to answer questions about his/her school age child.

Section III was designed for those who have a school age child. The questions are about what school the homebuyer's child attends, how well his/her child is doing in terms of academic achievement, and what the relationship is between the respondent and the student.

Lastly, Section IV was developed to find demographic information. Questions 17 to 22 are about race/ethnicity, income, education, and occupation. Race/ethnicity includes White, African American, Hispanic, Asian, Native American, and others. Income is broken into ten groups: below $10,000, between $10,001 and $14,999, between $15,000 and $24,999, between $25,000 and $34,999, between $35,000 and $49,999, between $50,000 and $74,999, between $75,000 and $99,999, between $100,000 and $149,999, between $150,000 and $199,999, and over $200,000. Education levels are primary, high school incomplete, high school graduate, college graduate, associate degree, bachelor degree, masters' degree, and doctoral degree. Occupations are broken into categories as follows: management, professional, and related occupations (hereafter MPO), service occupations (SO), sales and office occupations (SOO), construction, extraction, maintenance and repair occupation (CEMO), and utilities production, transportation, and material moving occupations (PTMO).

4.2.2.3 Homebuyers' Survey Administration

The homebuyers' survey was conducted by Field House Marketing Research (FHMR) from February 28 to March 26, 2008. Four hundred surveys were

administered over the telephone to homebuyers out of 11,193 home sales, with the approval of the Institutional Review Board (IRB) in February, 2008.

Sixteen surveys were completed by March 7, and 135 surveys were completed by March 13. After reviewing the survey results, the sampling strategy was revised due to the lack of diversity of races and the lack of low income and low education households represented. The survey focused on the areas where African Americans, Asians, and Hispanics live, and households with low income and low education. On March 26, 2008, 400 surveys were completed out of 11,193.

4.2.3 Methodology

4.2.3.1 Descriptive Analysis

Descriptive analysis is helpful describing characteristics of respondents, and focuses on race, income, education, and occupation. Although the survey data set includes 400 survey respondents, three were removed because two of the respondents live in the city of Cleveland and one respondent did not properly answer the question concerning the number of employees are thier family. It ends up with 397 surveys ready to be analyzed.

The survey results are analyzed by various descriptive statistical techniques such as frequency, chi-square, and median. The scale frequency distribution analysis will be utilized to answer the question of which school quality variables are preferred. Chi-square will be used to justify the differences between the averages of each group, since the school quality variables will use the Likert scale questions. This study will

also use median, considered the proper measure of central tendency, because the measurement scale for the school quality variables is ordinal data (Rea & Parker, 2005).

4.2.3.2 ANOTA Analysis

In this section, ANOTA analysis was used to test the first group of hypotheses that there is no variation in preference for school quality across heterogeneous homebuyers. The preference for school quality refers to three measurements: whether school quality is the most influential factor, how much school quality is important, and what school quality variables homebuyers considered when they bought a house.

ANOTA permits exploring relationships between a bundle of homebuyer characteristics and a set of choices. The coefficients generated by ANOTA can be interpreted as those of a multiple regression since ANOTA is analogous to the regression model. The main difference is whether or not the both dependent and independent are categories. ANOTA measures the effect of the categories of the dependent variables and explore the categorical relationships.

Although ANOTA is not frequently used, it is a useful tool to analyze the relationship between heterogeneous homebuyer demographica and SES, and a bundle of housing attributes. ANOTA was used to examine tenure choices by households with different income and economic categories (Dieleman, Clark, & Deurloo, 1989). By separating the dataset by owner and renter, they compared housing consumption of two groups. Income is the most deterministic factor for

tenure choice. The probability of households with more than $30,000 for owning a house is 68.8percent, whereas, a low income family has a 38.8 percent probability to own a house. Other demographic factors such as size of household and marital status have an effect on choices. Larger and married households have a greater probability of owning a house than low income and smaller size households do.

Murie, Dieleman and Hooimeijer (1991) focused on behavior of elderly homebuyers. Unlike other literature examining younger generations who are more mobile, they observed the importance of elderly households. A large number of elderly households are more likely homeowners, so their consumption behavior has an impact on the housing market. With ANOTA analysis, they decomposed elderly households by employment status, marital status, and income. While couples with high income are able to live in an expensive dwelling (64.7%), singles with low income tend to live in a cheap, rented dwellings (49.4%).

4.2.3.3 ANOTA Model Specification

Three models were used to explore the relationship of homebuyer preferences for location variables, the extent to which school quality is important, and which school qualities are the most preferred with heterogeneous homebuyers' demographics, including race, income, education, occupation, and marital status.

The ANOTA model is specified as below (Bethlehem, 2006);

$$P_k(I) = \beta_{k0} + \sum_{i=1}^{m} \beta_{ki}(I) \qquad (4\text{-}1)$$

where P_k is a matrix of dependent scores, β_{k0} is constant, and $\beta_{ki}(I)$ is an unknown parameter. *k* is a number of dependent variables, and *m* is a number of independent variables. *I* is predict scores of dependent variables.

The independent variables in the first model are location variables: location, public transportation, neighbors, amenity, safety, near friends/relatives, public school quality, housing size, and housing style. The first model of the ANOTA analysis reveals which location variables homebuyers take into account when they buy a house. The dependent variables for the first model are grouped into six categories; race, education, occupation, whether or not homebuyers have school age children, marital status, and income.

The second model examines the relationship between the importance of school quality and the homebuyer's demographics. A group of the dependent variables is importance of school quality (i.e., very important, somewhat important, average importance, not very important, and not at all important).

For the third model, 16 school quality variables are given in the choice set as dependent variables: teacher education, teacher experience, teacher salary, class size, per pupil expenditure, school safety, sports programs, parent-teacher organization (PTO) meetings, percentage of students going to college, graduation rate, SAT scores, standardized math test scores, standardized reading test scores, and school district designation.

4.2.3.4 Ordered Logit Model

In the previous section, ANOTA analysis was applied to examine differences in school quality preference. Although ANOTA allows analysis of the larger dataset, and the parameter is straightforward and easily interpreted, the drawback is that other variables affecting the dependent variable simultaneously cannot be controlled.

Choices made by consumers are not only affected by one factor but also by a variety of attributes in conjunction with different types of homebuyers. McFadden (1977) was skeptical about the hedonic model that treated residents as homogeneous groups. In reality, homebuyers actually have heterogeneous preferences, willingness, and choices. He argued that, "consumers vary substantially in their preferences and tastes for housing, and their choice is limited as bounded rationality described (McFadden)." The basic concept of his model is that all attributes are not observed but unobserved variables will have some probability in the population, conditioned on the value of the observed variables.

The various logit models are designed to analyze the categorical dependent variable. Various types of logit models— ordered, multinomial logit, and conditional logit— have been used to investigate residential satisfaction (Lu, 1999), tenure choice (Goodman, 1988), and community choice (Nechyba & Strauss, 1997).

In case dependent variables are ordinal, the ordinal logit model is recommended (Borooah, 2002). For example, Likert-type responses range from "very important," "somewhat important," "average important," "not very important," to "not at all

important." The ordinary linear regression model is not an appropriate method because it treats ordered-nature variables as continuous variables by calculating the mean. The multinomial logit model fails to account for the ordinal nature of variables (Liao, 1994). In contrast, the ordered logit model is an appropriate approach to deal with polytomous variables. For example, Lu attempted to explain residential satisfaction (which was the ordinal dependent variable) by comparing the ordered logit model and the regression model with various explanatory variables, including individual attributes and housing and location variables. Lu concluded that the ordered logit model is more appropriate.

4.2.3.5 Ordered Logit Model Specification

The hypothesis of this dissertation is that different school quality has different influence on homebuyers' school district choices. As previously mentioned, the school district designations are used as dependent variables indicating school quality in the ordered logit model. The school district designation was introduced by the "No Child Left Behind" Act (2001) to evaluate school performance and inform parents. The school district designations are 'excellent,' 'effective, ' 'continuous improvement,' and 'academic watch.' which are the dependent variable in the model, except academic watch. The model is designed to test the second group of hypotheses, school district choice.

Table 4-1 School District Designations in Cuyahoga County (2006)

School District Designation	Name of school districts	Number of school districts
Excellent	Bay Village, Beachwood, Berea, Brecksville-Broadview Heights, Chagrin Falls, Cuyahoga Heights, Independence, Mayfield, North Olmsted City Schools, North Royalton, Olmsted Falls, Orange City School District, Rocky River, Solon Strongsville, and Westlake.	16
Effective	Brooklyn, Cleveland Heights-University Heights, Fairview Park, Garfield Heights, Parma, Shaker Heights, South Euclid-Lyndhurst, and Richmond Heights.	8
Continuous Improvement	Bedford, Euclid, Lakewood, and Maple Heights	4
Academic Watch	Cleveland Municipal, East Cleveland, and Warrensville Heights.	3
Total		31

Source: Ohio Education Department

There are N observations (i=1,…, N) in the survey sample and K independent variables (k=1,., k). The ordered logit model, which is a form of the extension of the binary-outcome model, was applied.

$$S^{*} = \sum_{k=1}^{k} \beta_k X_{ik} + \varepsilon_i \qquad (4\text{-}2)$$

where S^{*} is a linear function of k factors, which, however, is not observable but is the underlying tendency (or latent variable) of an observed phenomenon (Liao, 1994). β_k is the coefficient for the k^{th} variables and X_{ik} is a matrix of homebuyer' demographics and SES. The role of school quality on a homebuyer's location decision depended on a variety of factors. For instance, housing price, housing size (number of bedrooms and number of bathrooms), and local tax rate might be considered so that different choices

are excised differently. The model above is designed to examine the differences among homebuyers with heterogeneous demographics and SES, holding other things constant. The independent variables related to homebuyers' demographics and SES are presence of children, race, income, education, and occupation.

S is an ordinal variable (school district designation; including excellent, effective, and continuous improvement), which is the unobserved implicit value of S*.

$$\begin{aligned} &S = 1 \quad \text{if } S^* \le \xi_1 \\ &S = 2 \quad \text{if } \xi_1 < S^* \le \xi_2 \\ &S = 3 \quad \text{if } \xi_2 < S^* \end{aligned} \tag{4-3}$$

where ξ are threshold parameters, separating the categories to be estimated along with β_k.

If there are homebuyers who are the same race and have the same-grade children, same income bracket, and same occupation, school district choice may be different.

The probabilities of a homebuyer choosing a school district are estimated below;

$$\begin{aligned} &\text{Prob}(S = 1) = L(\xi_1 - \sum_{k=1}^{k} \beta_k X_k), \\ &\text{Prob}(S = 2) = L(\xi_2 - \sum_{k=1}^{k} \beta_k X_k) - L(\xi_1 - \sum_{k=1}^{k} \beta_k X_k), \\ &\text{Prob}(S = 3) = 1 - L(\xi_2 - \sum_{k=1}^{k} \beta_k X_k). \end{aligned} \tag{4-4}$$

where S = 1 if continuous improvement school district is chosen;
S = 2 if effective school district is chosen;
S = 3 if excellent school district is chosen;
L = Log Likelihood Function;
X = A vector of independent variables;
β = Unknown parameter.

4.3 Heterogeneous Households' Willingness to Pay for School Quality

4.3.1 Introduction

In order to investigate heterogeneous willingness to pay for school quality and to test the group of the third hypotheses, various methodologies are applied. Two approaches are adopted—separating data according to demographics and SES and utilizing a two-stage procedure model applied in this chapter designed to measure heterogeneous willingness to pay for school quality across households with different demographics and SES in Cuyahoga County and 14 states in the United States. It is assumed that different willingness to pay results from the fact that an individual values subjectively the bundle of various attributes of housing in the housing market.

The unit of observation in the Cuyahoga County model is individual housing sales transacted in 2006 in Cuyahoga County. Due to the lack of individual demographic data, the heterogeneous demographics and SES are grouped by relatively homogeneous characteristics of households by conducting cluster analysis. By dividing the dataset into subsets of each demographic characteristic, this dissertation can examine the differences in the willingness of relatively homogeneous households to pay for school quality. The magnitudes of each parameter that represent household willingness to pay for each attribute are directly compared since the estimates generated from the hedonic model indicate the utility maximization derived by consuming school quality.

The national model is used to test heterogeneous willingness to pay for school quality across states. The unit of analysis is a school district; there are 2,531 school districts in the 14 states studied. A two-step procedure is utilized: the first is the hedonic price model that estimates the implicit prices of school quality and the second is heterogeneous willingness to pay model.

4.3.2 Cuyahoga County Hedonic Price Model

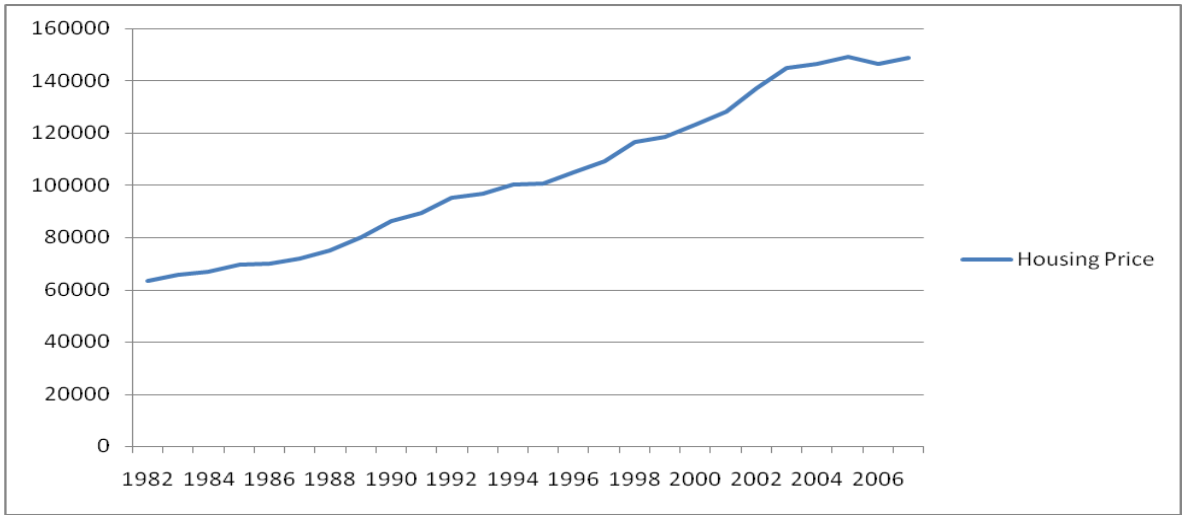
4.3.2.1 Study Area

The study areas of the model include all school districts in Cuyahoga County, except the city of Cleveland. Cuyahoga County is a region where population has dissipated to other places, especially adjacent counties. From 1950 to 1970, according to the U.S. Census, population in Cuyahoga County rose and peaked at 1.72 million, then declined sharply by 1980 (1.39 million in 2000). The age group of 15 to 34 year-old decreased by 12 percent and those under age 18 increased slightly by four percent (Social Indicators 2003-2004, 2004).

As population declined, the growth of owner-occupied housing units grew slowest in adjacent counties. The housing stock in Cuyahoga County has also aged due to lack of new construction. The median age of housing was 46 years in 2000, and half of housing units were built before 1954. Regarding housing price in the study area, the average housing price was $123,150 in 2000. The average housing price of the dataset analyzed is $176,715 in 2006, which is slightly higher than housing prices used for Figure 4.1 as a result of the cleaning process which will be

discussed in Section 4.3. In 2006, housing price in Cuyahoga County, Ohio, dropped by 1.8 percent from the previous year.

Figure 4-1 Housing Price Trends from 1982-2007 in Cuyahoga County



Source: Cuyahoga County Auditor

According to the 2000 U.S. Census, Whites are the dominant race in Cuyahoga County, making up approximately 83.6 percent of the population. Other races are 12.7 percent African American, 1.8 percent Asian, and less than 0.5 percent some other races. The average percentage of now married households is 57.4 percent. Regarding educational attainment, 29.0 percent are high school graduates.

The median household income in 1999 dollars is $55,050. The higher-income households appear to live in suburban areas, whereas low-income households tend to live in downtown and inner-ring areas.

4.3.2.2 Data and Variables

The study area of this model includes 30 school districts in Cuyahoga County, excluding the city of Cleveland. The source of the transacted housing sales data was from the Cuyahoga County Auditor. The County Auditor records housing characteristics and transacted housing prices for tax purposes. The dataset includes information about lot size, number of bedrooms, number of bathrooms, age of house, number of fireplaces, garage size, basement size, and total living area.

Housing prices less than $50,000 and more than $400,000 were deleted because the lower and higher housing prices are not regarded as normal transactions in the market and are also regarded as outliers. Houses with more than five bedrooms, no living area, and unrecorded year built were also deleted. After cleaning this data, there are 11,193 observations to be analyzed out of 11,990.

There are 31 school districts in Cuyahoga County. The Cleveland municipal school district is the largest. Enrollment was 57,698 in the 2005-6 school year. The second largest is the Parma school district (12,453). The smallest school district is Cuyahoga Heights, whose enrollment is 821. The average enrollment among school districts is 5,769. The average teacher salary is $59,393, and the average expenditure per pupil is $11,738. The detailed school districts and their designations are displayed in Table 4-1 in Section 4.2.3.5.

Various school quality variables were used to test heterogeneous willingness of households to pay. School quality variables include input school variables

(expenditure per pupil, teacher salary, and teacher experience), output variables (10^{th} grade math proficiency rate and performance index[3]), and value-added.

Information about school quality used in this dissertation is publicly available and accessible to parents via the website of the Ohio Department of Education, newspapers, realtor databases, general reputation, or word of mouth, except value added. According to Ohio Department of Education (2006), value-added is defined as the point estimates of the mean gains for each grade-subject combination. In this dissertation, the value-added variable is defined as the difference between the previous year and the current year. The performance difference (value-added) was calculated by subtracting the current year (2005-6 school year) performance index by the previous year (2004-5 school year). The performance index variable is a comprehensive measure calculated on how well each student does on all tested subjects in grades 3-8 and the 10^{th} grade graduation test.

In addition to housing characteristics and school quality, demographic information is attached to the data file. The demographic data is obtained from the U.S. Census. The demographic dataset consists of information about races (percentage of White, African American, Asian, Hispanic, and some other race), median income, educational attainment (percentage with high school diploma, associate's degree, bachelor's degree, post-graduate education), occupation

[3] Since the variable of school district designation is calculated based on the performance index for each year, performance index and school district designation are treated interchangeably.

(management, services, sales and office, construction, and production), and marital status (never married, now married, widowed, and divorced).

Regarding occupation variables, this dissertation utilizes the Bureau of Labor Statistics' standard occupation classification. The major occupation category in Cuyahoga County, Ohio, is management, which is a broad category including management, business, and financial operation occupations, and professional and related occupations, such as computer and mathematics, architecture and engineering, legal, education, art, and healthcare. The detailed occupation categories are displayed in Appendix 1.

4.3.2.3 Methodology

4.3.2.3.1 Cluster Analysis

Cluster analysis, in general, involves grouping by breaking a heterogeneous group into relatively homogeneous groups. By measuring distance, the heterogeneous group is categorized by smaller groups. The distance method reflects how close two objects are. The Euclidean distance is utilized to measure the distance as follows:

$$D_{ij} = \left[\sum \left(x_i - x_j \right)^2 \right]^{1/2} \qquad (4\text{-}5)$$

where D_{ij} is the Euclidean distance between object i and j, which measures the closeness (Lattan, Carroll, & Green, 2003)

The purpose of utilizing cluster analysis in this study is to break down the dataset into each category (marital status, proportion of school-aged children, race, income, education, and occupation). Therefore, we can compare the magnitude of school quality for clusters representing relatively homogeneous households' demographics and characteristics by clearly defining each cluster.

4.3.2.3.2 Hedonic Price Model

After grouping heterogeneous demographics and SES into homogeneous groups, the hedonic price model is utilized to estimate the willingness to pay for school quality. The hedonic model is commonly used to evaluate the effect of individual factors on housing sales price, based on actual transactions.

The hedonic model developed by Rosen (1974) allows us to measure the implicit prices of goods by decomposing housing prices into attributes of the physical and neighborhood characteristics, and amenities. The estimate of the regression model indicates the proportion of each independent variable contributed in the model.

Due to the easiness of interpretation and use, the hedonic price model has been conducted in various studies testing positive and negative externalities. There are the positive effects of desired amenities and policies and natural environments; water view (Benson, Hansen, & Schwartz, 2000), water quality (Legget & Bockstael, 2000), open space (Bolitzer & Netusil, 2000), ocean view (Fraser & Geoff, 1998), and desert riparian areas (Colby & Wishart, 2002); and policies on historic designations (Coulson & Leichenko, 2001) and historic preservation (Leichenko,

Coulson, & Listokin, 2001). On the other hand, undesired environments— noise (Frankel, 1991), traffic (Hughes & Sirmans, 1992), and waste sites (Greenburg & Hughes, 1993)—lead to decrease in housing prices.

4.3.3 Model Specification

The hedonic price model is, in general, a linear function of the house's physical and local neighborhood characteristics and school quality:

$$HP = f(S, N, SQ) \qquad (4\text{-}6)$$

where S is the vectors of physical housing characteristics, N represents neighborhood characteristics, and SQ is school quality.

A hedonic model was used to test the hypothesis that school quality is positively related to housing price. With school quality variables or school district dummy variables as independent variables in 2000 and 2005, the model's reduced form is:

$$Ln(HP) = \beta o + \beta_1 S + \beta_2 N + \beta_3 SQ + \varepsilon \qquad (4\text{-}7)$$

Where,

Ln(HP)	=	Log of sales price of the house;
S	=	Vector for structural characteristics of the house;
N	=	Vector that consists of neighborhood characteristics;
SQ	=	School quality vector, including school district dummy variables, input factors (teacher characteristics and expenditure per pupil), output factors (PI (performance index) and 10^{th} grade math proficiency rate), and value added;
β	=	Parameters to be estimated;
ε	=	Error term.

Although the detailed test for unbiased estimates is discussed in the diagnostic section, it is reasonable to believe that there is a spatial autocorrelation problem in the housing market. Basu and Thibodeau (1998) assert that there are two reasons for spatial autocorrelation: similar structure of housing and quality of public service. The residential developments, in general, occurred at the same time so that housing structure, size, and design might not be different. Another reason Basu and Thibodeau introduced the spatial autocorrelation problem is because neighborhood residents enjoy the same location and public amenities.

Therefore, to modify the spatial autocorrelation problem in the model, this dissertation utilizes the spatial models; spatial lag and spatial error based on the Lagrange Multiplier (LM) test. The "Lagrange Multiplier (LM test)[4]" was used to test spatial autocorrelation on this dataset. According to Anselin (1998), Spatial dependence and heterogeneity is structural instability in the form of non-constant error variances or model coefficients. . . Spatial autocorrelation is through the specification of a spatial stochastic process. Spatial stochastic processes are categorized as spatial autoregressive (SAR) processes."

The spatial models are utilized and described as follows:

$$Ln(HP) = \rho WHP + \beta_1 S + \beta_2 N + \beta_3 SQ + \varepsilon \qquad (4\text{-}8)$$

Or

$$Ln(HP) = X\beta + \varepsilon,\ \varepsilon = \lambda Wu + u,\ E(\varepsilon\,\varepsilon') \neq 0 \qquad (4\text{-}9)$$

[4] The LM equation is: $\frac{n-k}{m}\frac{R^2}{1-R^2}$

Model 4-8 is the spatial lag model and model 4-9 is the spatial error model. For the spatial lag model, ρ is the coefficient of autocorrelation that indicates the spatial relation, and W is the weighted matrix.[5] For the spatial error model, λ (Lambda) is a spatial autoregressive error parameter (Anselin, 2003). This dissertation used the spatial error model with the second order spatial matrix as a result of the LM test.

4.3.4 National Model

Unlike the county model discussed in the previous section, the national model is aggregated by school district. The purpose of utilizing the national model is to test whether or not aggregated willingness is consistent with individual decisions. With the 2,531 school district data in 14 states, two approaches were utilized to measure heterogeneous willingness to pay for school quality.

This model is analogous to Bajari and Kahn's (2005) method, which used the three-step procedure to find the total utility from housing characteristics. However, the model used in this dissertation differs from theirs in that the unit of analysis and the dataset is different and the purpose of this dissertation is to find the implicit price of school quality by adopting the marginal utility concept, which is proportional to the price. The national model in this dissertation was used to find the same result as the county model regarding willingness to pay for school quality.

[5] The second order of contiguity matrix was used.

4.3.4.1 Data and Study Areas

The major source of the national model is from the 2000 U.S. Census dataset. The 2000 U.S. Census dataset is full of information not only about demographics but also about housing characteristics. This data set includes 11,039 school districts in 50 states. States that do not have enough information about school quality were deleted, and those that use the county as the school district unit were also eliminated from the dataset. The school districts that have population more than five million and are in major cities were also excluded in this dissertation. The total of 2,531 school districts in 14 states is ready to be analyzed (See Figure 4-2).

Figure 4-2 Study Areas in the National Model

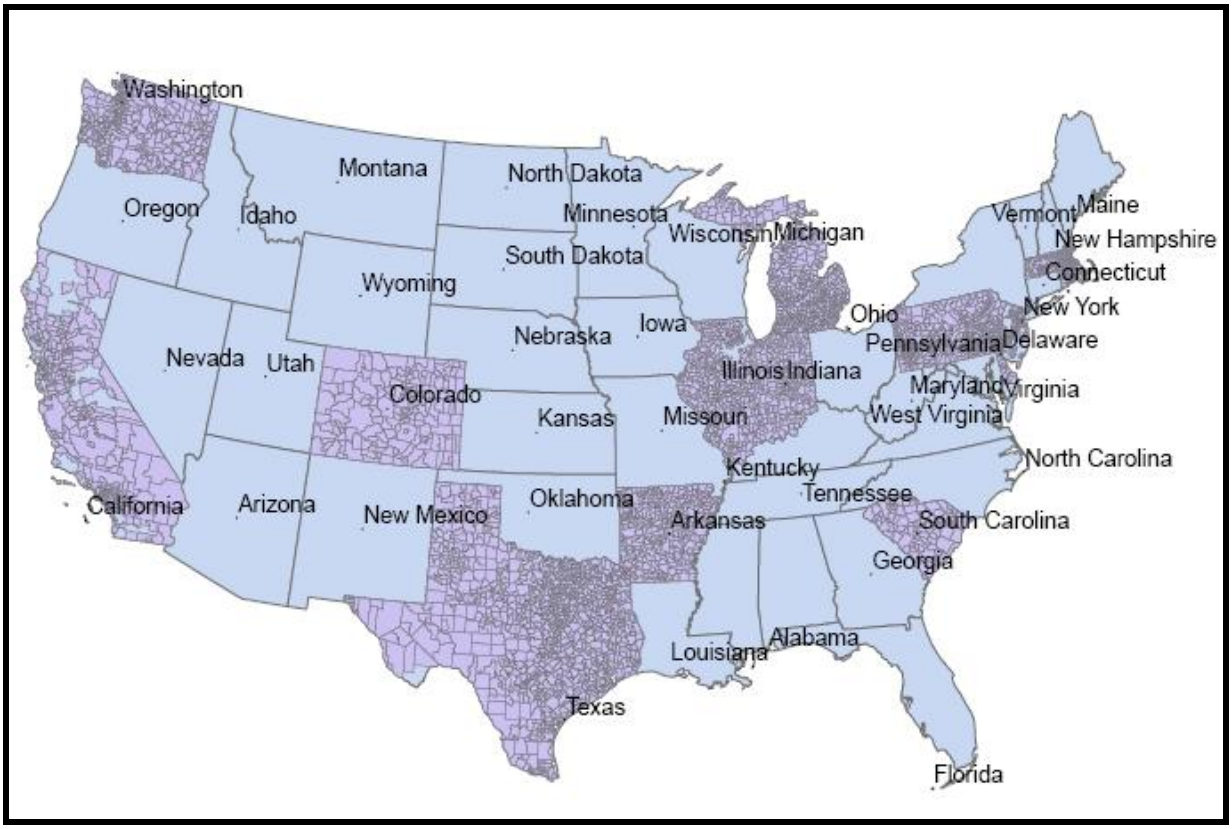


Table 4-2 Housing Prices and School Quality in Study Areas

States	N	AVG HP ($)	LOG HP	RAMP	TEST	Salary ($)	Spending ($)
Arkansas	93	65,040 (19,195)	11.04 (0.28)	41.67 (10.86)	22.74 (10.95)	5,439 (460)	2,677 (187)
California	249	207,965 (140,184)	12.07 (0.57)	43.41 (15.46)	49.08 (16.48)	6,519 (743)	3,147 (353)
Colorado	34	148,400 (61,888)	11.83 (0.41)	80.26 (8.51)	59.21 (13.99)	6,389 (832)	2,994 (357)
Delaware	16	112,913 (26,355)	11.61 (0.22)	66.13 (7.26)	41.94 (10.88)	8,243 (656)	3,888 (396)
Illinois	173	98,079 (49,258)	11.39 (0.44)	66.88 (9.15)	57.26 (10.21)	5,842 (937)	3,056 (483)
Indiana	206	94,604 (25,223)	11.42 (0.26)	70.47 (7.43)	71.17 (9.06)	6,233 (867)	3,052 (383)
Massachusetts	193	205,624 (91,310)	12.16 (0.38)	57.20 (13.43)	57.31 (15.95)	8,059 (1,478)	4,204 (620)
Michigan	316	113,216 (44,036)	11.57 (0.36)	66.36 (11.47)	62.32 (14.52)	7,130 (1,058)	3,192 (403)
New Jersey	198	190,176 (80,081)	12.07 (0.41)	72.23 (14.49)	58.78 (18.95)	10,015 (1,622)	4,918 (678)
Pennsylvania	414	100,083 (40,783)	11.44 (0.38)	60.36 (11.17)	51.71 (13.62)	7,384 (1,189)	3,697 (578)
Rhode Island	24	149,592 (30,204)	11.90 (0.20)	51.38 (11.84)	44.83 (14.06)	8,456 (1,038)	4,624 (505)
South Carolina	65	74,617 (22,574)	11.18 (0.27)	26.69 (9.79)	17.54 (9.29)	6,374 (761)	2,996 (294)
Texas	421	70,373 (34,284)	11.07 (0.40)	79.93 (7.39)	72.46 (12.05)	6,215 (732)	3,306 (331)
Washington	129	147,118 (56,835)	11.85 (0.31)	49.11 (10.32)	37.30 (11.59)	6,294 (395)	3,070 (179)

The source of school quality data is from each state Department of Education. This study uses a comprehensive measure of school quality, called reading and math proficiency (RAMP). Ramp is calculated by the average of the proficiency rates achieved across all reading and math tests, weighted by the number of tests taken,

such that proficiency rates on tests with greater numbers of test takers have more influence than proficiency rates on tests with fewer test takers. [6]

In Table 4-2, the descriptive statistics were summarized. The number of observations in each state, the average housing price; the average RAMP, test scores, teacher salary, and the average spending per pupil was displayed. The average test scores are obtained from each state Department of Education, and spending and salary are available at the National Center for Education Statistics (NCES, 2000).

4.3.4.2 National Model Specification and Variables

In order to test the relationship between willingness to pay for school quality and heterogeneous homebuyers' demographics and SES, a two-step strategy was applied. The first step is analogous to the hedonic price model, which generates the implicit price of school quality. With implicit school quality prices, the second approach is to decompose different willingness to pay for school quality based on heterogeneous households' demographics and SES.

The first step of this study is to estimate the implicit price of school quality by utilizing the hedonic model. The hedonic model consists of physical and neighborhood characteristics, amenities, and error. The equation is as follows;

$$\text{Ln (HP)} = \beta_0 + \beta_1 S + \beta_2 N + \beta_3 SQ + \varepsilon \qquad (4\text{-}10)$$

Where

[6] www.schooldatadirect.org

Ln (HP)	=	Log of housing price in a school district ;
S	=	Vector of structural housing characteristics in a school district in a state;
N	=	Vector of neighborhood characteristics in a school district in a state;
SQ	=	A school quality variable in a school district in a state;
ε	=	Error term.

In the national model, the variables for structural housing characteristics are a bit different from the individual hedonic model. This study utilizes the percentage of owner-occupied housing units, the percentage of detached housing, median year built, and density. The density variable is used to indicate the average size of houses. The density variable is calculated by dividing total housing units in a school district by total area. Regarding neighborhood characteristics, median income, percentage with a high school diploma, and percentage of White households were included in the model.

As mentioned previously, RAMP is used as the school quality variable in this study[7]. The hedonic model was run separately for each state because there are a great deal of variations in housing prices and school quality. For example, the state of California has the highest average housing prices ($207,965) among the study states, but its RAMP scores are the second lowest. The three states with the highest average housing prices are California, Massachusetts, and New Jersey. However, the states with the highest RAMP scores are Colorado, Texas, and New Jersey.

[7] This dissertation utilized other school quality variables such as test scores, teacher salary, and expenditure per pupil. However, the results of these coefficients were not statistically significant; therefore, RAMP was used as the proxy for school quality.

The coefficients estimated from the first step are the average implicit prices of school quality residents are willing to pay. After estimating the implicit prices of school quality for each state, this study recovers the different willingness to pay for school quality by multiplying the school quality estimate by standard deviation which indicates the percentage of willingness to pay for school quality. The equation is as follows;

$$\hat{\gamma}_{ij} = \frac{\partial Ln(HP)}{\partial SchoolQualtiy} * \partial_j \qquad (4\text{-}11)$$

where $\hat{\gamma}_{ij}$ = Implicit price of school quality in a school district in a state;
∂_j = Standard deviation of RAMP;
Ln(HP) = Log of housing price.

In other words, the equation (4-11) measures the proportion of housing prices households are willing to pay for school quality.

The educational preference parameter is a function of demographics. The degree of willingness to pay for school quality is determined by a compilation of household demographic background and SES. The reduced form model is as follows.

$$\hat{\gamma}_{ij} = \delta_0 + \delta D_{ij} + \varepsilon_{ij} \qquad (4\text{-}12)$$

Where, $\hat{\gamma}_{ij}$ = School quality preference and taste estimate in school district;
D_{ij} = Demographic and socio-economic status in school district;
ε_{ij} = Error term.

Demographic backgrounds and SES are broken into five categories: race, educational attainment, marital status, income level, and occupation. The race

variable includes percentage of households that are White, African American, American Indian, Asian, Native Hawaiian and other Pacific islander, and some other race.

Regarding educational attainment levels, the percentage of households with a high school diploma, associate's degree, bachelor's degree, master's degree, and doctoral degree were used as educational background variables. This study also examines whether those who are now married are more willing to pay for school quality than those not married. Income level is broken down into seven intervals: income less than $10,000; income between $10,001 and $24,999; income between $25,000 and 39,999; income between $40,000 and $59,999; income between $60,000 and $99,999; income between $100,000 and $149,999; and more than $150,000.

This study also utilizes occupation variables. The categories of occupation variables include management occupations; service occupations; sales and office occupations; construction, extraction, maintenance, and repair occupations; and production, transportation, and material moving occupations. According to the Standard Occupational Classification (SOC), management occupation includes managers for advertising and marketing, including top executives. However, this study has a broader range of management occupations, including management occupations, as well as business and financial operations occupations, professional occupations (architecture, engineering, computer and mathematical, life, physical, and social science occupations), and business and financial operation occupations.

In summary, this chapter discussed the methodological approaches to test three hypotheses groups: ANOTA, ordered logit, and the hedonic model. Each model was specified, and study areas and data were also stated. In particular, although the Cuyahoga county model and the national model were used to find willingness to pay for school quality, the former model used the individual housing sales data and the latter one used the aggregated average sales by school district. The following chapter discusses the results of those methodologies in detail.

Table 4-3 Summary of Hypotheses and Methodologies

		Survey Data		Secondary Data		Methodology		
		Preference Model	Choice model	County Model	National Model	ANOTA	Ordered Logit	Hedonic
Hypotheses Group I Preference for School Quality								
H I-1	Homebuyer with School-age Children	X				X		
HI-2	Homebuyer's Marital Status	X				X		
H I-3	Homebuyer's Income	X				X		
H I-4	Homebuyer's Education	X				X		
H I-5	Homebuyer's Race/Ethnicity	X				X		
H I-6	Homebuyer's Occupations	X				X		
Hypotheses Group II Location Choice in School Districts								
H II-1	Homebuyer with School-age Children		X				X	
H II-2	Homebuyer's Marital Status		X				X	
H II-3	Homebuyer's Income		X				X	
H II-4	Homebuyer's Education		X				X	
H II-5	Homebuyer's Race/Ethnicity		X				X	
H II-6	Homebuyer's Occupations		X				X	
Hypotheses Group III Willingness to Pay for School Quality								
H III-1	Relationship between School Quality and Housing Price.			X	X			X
H III-2	Homebuyer with School-age Children			X	X			X
H III-3	Homebuyer's Marital Status			X	X			X
H III-4	Homebuyer's Income			X	X			X
H III-5	Homebuyer's Education			X	X			X
H III-6	Homebuyer's Race/Ethnicity			X	X			X
H III-7	Homebuyer's Occupations			X	X			X

CHAPTER V

DATA ANALYSIS & RESULTS

5.1 Introduction

This chapter explains the results of each methodology discussed in the previous chapter (descriptive and ANOTA analysis) to test the first group of hypotheses regarding homebuyers' preference for school quality, ordered logit for the second group of hypotheses regarding school district choice, and regression analysis for the last group of hypotheses regarding willingness to pay for school quality.

First, ANOTA analysis analyzed the categorical variables and tested the relationship between each demographic group and preference for school quality. The result of ANOTA indicates that heterogeneous demographic and SES groups prefer school quality differently. The ordered logit model provides the probability of a particular demographic group choosing to live in a specific school district. Income and tax rate were used as control variables to capture the differences of each school district. Lastly, a regression and spatial analysis was utilized to measure heterogeneous willingness to pay for school quality in Cuyahoga County and 2,531 school districts in 14 states.

5.2 Homebuyers' Preferences for School Quality & School District Choice

To test the groups of hypotheses I and II, the survey sample was analyzed using ANOTA and ordered logit statistical tools. The results of these analyses were introduced in the following sections (Section 5.2.1, 5.2.2, and 5.2.3).

5.2.1 Results of Survey Analysis

Although the survey data set includes 400 survey respondents, three were removed because two respondents live in the city of Cleveland and one respondent did not properly answer the question of how many workers are in the family. A total of 397 surveys were suitable for analysis.

To check the validity of the sample, proportion analysis is a useful tool to justify the accuracy of the sample proportion and the size of the sample. The null hypothesis of proportion analysis is that the proportion is the same as the proportion of population ($H_0: P_p = P_{s1}$). The results of proportion analysis indicate that I failed to reject the null hypotheses, that is, none of the city samples is statistically different from population. In other words, the sample is represented. The sample sizes of each city and 2006 housing sales in Cuyahoga County are summarized in Table 5-1. The survey sample represents 3.3 percent of the population in the study area. The sample is generally quite representative of the population regarding geographical distribution, which is not statistically different at the 95 percent confidence interval.

Table 5-1 Comparison of Survey and Population in Cuyahoga County

School District	Sample		Population		Z-test scores	Statistical significant
	Sample	%	Housing Sales	%		
Bay Village	11	2.77	299	2.67	-0.04	TRUE
Beachwood	6	1.51	106	0.95	-0.11	TRUE
Bedford	5	1.26	342	3.06	0.10	TRUE
Berea	17	4.28	690	6.16	0.27	TRUE
Brecksville-Broadview Heights	24	6.05	228	2.04	-1.07	TRUE
Brooklyn	5	1.26	141	1.26	-0.02	TRUE
Chagrin Falls	4	1.01	72	0.64	-0.06	TRUE
Cleveland Heights- University Heights	31	7.81	877	7.84	0.00	TRUE
Cuyahoga Heights	5	1.26	44	0.39	-0.27	TRUE
East Cleveland	0	0	228	2.04	NA	NA
Euclid	12	3.02	746	6.66	0.47	TRUE
Fairview Park	11	2.77	243	2.17	-0.17	TRUE
Garfield Heights	6	1.51	532	4.75	0.35	TRUE
Independence	4	1.01	77	0.69	-0.06	TRUE
Lakewood	32	8.06	590	5.27	-0.68	TRUE
Maple Heights	6	0.5	500	4.47	0.26	TRUE
Mayfield	10	3.53	372	3.32	-0.03	TRUE
North Olmstead	13	3.27	390	3.48	0.01	TRUE
North Royalton	6	1.51	298	2.66	0.22	TRUE
Olmsted	8	2.02	175	1.56	-0.06	TRUE
Orange village	6	1.51	122	1.09	-0.04	TRUE
Parma	37	9.32	1,630	14.56	0.79	TRUE
Richmond Heights	5	1.26	103	0.92	-0.07	TRUE
Rocky River	15	3.78	250	2.23	-0.40	TRUE
Shaker Heights	24	6.05	313	2.80	-0.78	TRUE
Solon	32	8.06	208	1.86	-1.87	TRUE
South Euclid- Lyndhurst	16	4.03	739	6.60	0.36	TRUE
Strongsville	28	7.05	479	4.28	-0.55	TRUE
Warrensville	0	0	120	1.07	NA	NA
Westlake	18	4.53	279	2.49	-0.46	TRUE
Total	397	100	11,193	100		

Note: If the z-test scores are less that 1.96 at the 95 percent confidence interval, and if "TRUE" appears in the statistical significant column, it means the sample is representative of the population.

Proportion analysis was used to check the validity of the survey sample regarding the presence of school-age children, homebuyers' marital status, income, education, race, and occupation. Table 5-2 shows the representative of the survey sample.

The results of proportion analysis[8] indicate that homebuyers who are married, high income, high education, White, and have school-age children are over represented; whereas homebuyers who are single, in management, sales and office, and have high school diplomas are under represented. The total of Asians in the survey sample is represented, which is not statistically significant.

88 Over or under representation of the survey sample may cause biased results of ANOTA and the ordered logit model.

Table 5-2 Comparison of Households Survey Sample and Population in Study Area

Homebuyers	Sample		Population		Z-test scores	Representative
	Frequency	%	Housing Sales	%		
with school-age children	196	49.37	166,413	17.69	11.61	FALSE
with children but not at school-age	119	29.97	NA	NA	NA	NA
no children	82	20.65	NA	NA	NA	NA
single	29	7.30	201,511	25.86	-2.28	FALSE
married	333	84.40	414,478	55.44	10.63	FALSE
divorced	24	6.30	75,366	10.23	-0.64	TRUE
widowed	7	1.80	65,238	8.47	-0.63	TRUE
median income	$67,974		$59,396			
some high school	7	1.80	59,361	0.09	1.51	TRUE
High school diploma	28	7.10	188,626	28.67	-2.52	FALSE
some college	60	15.10	136,923	21.24	3.30	FALSE
Associate's degree	173	43.60	37,502	5.42	8.15	FALSE
College degree	127	32.00	123,570	19.18	3.67	FALSE
post graduate degree	2	0.50	77,977	13.03	-0.53	TRUE
White	340	85.60	730,550	81.40	1.99	FALSE
African American	32	8.10	136,677	14.20	-0.99	TRUE
Asian	9	2.30	18,865	2.10	0.04	TRUE
Hispanic	2	0.50	11,812	1.50	-0.78	TRUE
other	12	3.00	18,765	24.00	-6.37	FALSE
management, professional, and related occupations	235	59.19	178,915	78.50	-7.20	FALSE
service occupations	26	6.55	55,983	12.08	-0.87	TRUE
sales and office occupations	45	11.34	132162	28.22	-2.52	FALSE
construction, extraction, and maintenance occupations	12	3.02	28155	6.30	-0.47	TRUE
production, transportation and material moving occupations	11	2.77	53347	11.25	-0.89	TRUE
Total	397	100.00	11,971	100.00		

Note: If the z-test scores are less that 1.96 at the 95 confidence interval, and if "TRUE" appears in the statistical significant column, it means the sample is representative of the population.

5.2.2 Results of ANOTA Analysis

There are three models utilized to test homebuyers' preference for school quality: location factors, importance of school quality, and the measure of school quality. These models were applied for the first group of hypotheses regarding the relationship between preference for school quality and homebuyers with heterogeneous demographic backgrounds and SES. This dissertation hypothesized that there is no variation in school quality preference across homebuyers with different demographics and SES.

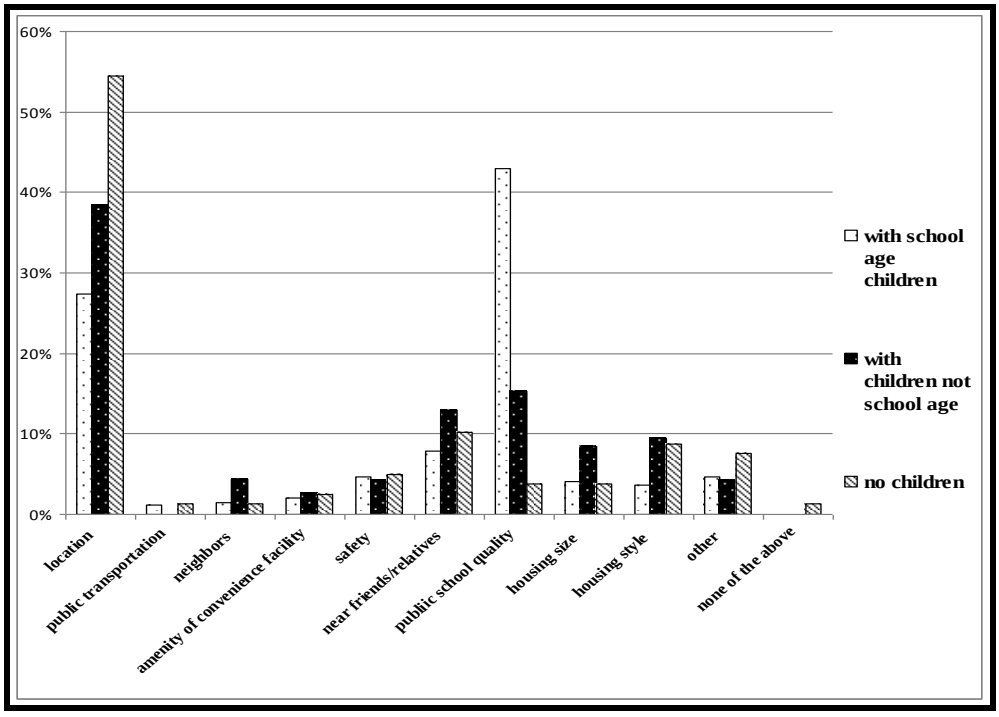
5.2.2.1 Results of the Location Factor Model

The first model of ANOTA analysis is utilized to test the first group hypotheses concerning which homebuyers prefer school quality. The choice set includes location, neighbors, amenity, safety, near friends/relatives, housing size, housing style, and none of the above. The results of ANOTA analysis indicate that the probability of choosing "location" is unexpectedly the highest (36.2%), and the "public school quality" is the second highest (26.7%).

It is of interest to note that the probability of school quality choice for households with school-aged children (Hypotheses I-1) is high—up to 43.0 percent—compared to 15.3 percent for those with children but not at school age, and 3.8 percent for those with no children. The hypothesis that there is no variation in school quality choice among heterogeneous homebuyers can be rejected. This is statistically significant. The detailed probabilities of the presence of school-age children are also summarized

in Table 5-4. Figure 5-1 illustrates a variety of probabilities of homebuyers choosing location factors[9].

Figure 5-1 Presence of Children and Location Factors



Although it is believed that households with higher income and education are positively correlated with school quality preference in the housing market, marital status may be one of the major factors affecting preference for school quality; married households may place more importance on school quality than any other family types, such as single, divorced, and widowed households (Hypotheses I-2).

[9] Location includes all aspects of the other choices, such as reputation, transportation, distance to work, public school quality, living close to family, and other amenities. It can be defined as a comprehensive location factor.

Table 5-3 Probabilities of Households with Marital Status Choosing Location Factor

Location Factor	Marital Status			
	Single	Married	Divorced	Widowed
Location	38%	37%	13%***	71%**
Public Transportation	0%	1%	0%	0%
Neighbors	0%	2%	4%	0%
Amenity Of Convenience Facility	0%	2%	4%	0%
Safety	7%	5%	0%	14%
Near Friends/Relatives	17%	9%***	21%**	0%
Public School Quality	14%	27%	42%**	14%
Housing Size	4%	6%	0%	0%
Housing Style	14%*	6%	8%	0%
Other	7%	5%	8%	0%
None Of The Above	0%	0%	0%	0%

Note: * = $\alpha \leq .10$, ** = $\alpha \leq .05$, *** = $\alpha \leq .01$

The statistical results indicate homebuyers who are single and widowed are more likely to choose location than school quality (38% and 71%, respectively), while married and divorced households consider public school quality, rather than location. Interestingly, divorced households have a higher probability (42%) of choosing school quality than married households (27%). Although divorced households have high priority of public school quality over location, this result is not statistically significant. The null hypothesis that there is no variation in preference for school quality among homebuyers with different marital status cannot be rejected.

As shown in Table 5-3, households with higher income have a higher probability of choosing school quality (Hypothesis I-3). For example, those households with incomes between $100,000 and $149,999, and more than $200,000 prefer public school quality the most, with 35.9 percent and 38.4 percent probabilities, respectively.

Although, the result of those households with income more than $200,000 indicate the highest probability of choosing school quality, it is not statistically significant. On the contrary, the result of households with income between $100,000 and $149,999 is statistically significant.

Table 5-4 Probabilities of Households with Different Income Choosing Location Factor

Location Factor	Income								
	$10K-$24,999	$25K-$39,999	$40K-$54,999	$55K-$69,999	$70K-$84,999	$85K-$99,999	$100K-$149,999	$150K-$199,999	$200K or more
Location	25%	29%	44%	41%	33%	33%	36%	29%	46%
Public Transportation	0%	0%	3%	2%	2%	0%	0%	0%	0%
Neighbors	0%	6%	3%	4%	2%	2%	1%	0%	8%*
Amenity Of Convenience Facility	13%*	12%***	0%	0%	2%	2%	3%	3%	0%
Safety	0%	6%	3%	4%	4%	15%***	3%	3%	0%
Near Friends/ Relatives	25%	6%	13%	14%	13%	7%	6%	8%	4%
Public School Quality	13%	29%	19%	14%***	25%	28%	36%***	29%	38%
Housing Size	13%	0%	6%	6%	7%	4%	3%	11%	0%
Housing Style	0%	6%	3%	4%	4%	6%	8%	16%***	4%
Other	13%	6%	6%	12%***	7%	4%	3%	3%	0%
None Of The Above	0%	0%	0%	0%	2%***	0%	0%	0%	0%

Note: * = $\alpha \leq .10$, ** = $\alpha \leq .05$, *** = $\alpha \leq .01$

The range of the probability of choosing public school quality is from the lowest of 13 percent ($10,000 to $24,999) to the highest of 38 percent ($200,000 or more). The range of probabilities to choose location is from the lowest of the 25 percent ($10,000 to $24,000) to the highest of 46 percent ($200,000 or more). While low-income homebuyers ($10,000 to $39,999) care more about amenities and housing

size, those with incomes from $100,000 to $149,999 and more than $200,000 consider the quality of the neighborhood and housing style (12.5%). The income categories of $40,000 to $54,999, $55,000 to $69,999, $70,000 to $84,999, and $85,000 to $99,999 have the three percent to six percent chances of choosing housing style and near friends (7% to 14%) in addition to location and school quality. The detailed probabilities for each income category are summarized in Table 5-4.

Table 5-5 Summary of Probabilities for Households Educational Level

Location Factor	Education				
	Some High School	High School graduate	Some College	College Graduate	post-Graduate Degree
Location	25%	29%	44%	41%	33%
Public Transportation	0%	0%	3%	2%	2%
Neighbors	0%	6%	3%	4%	2%
Amenity Of Convenience Facility	13%*	12%***	0%	0%	2%
Safety	0%	6%	3%	4%	4%
Near Friends/Relatives	25%	6%	13%	14%	13%
Public School Quality	13%	29%	19%	14%***	25%
Housing Size	13%	0%	6%	6%	7%
Housing Style	0%	6%	3%	4%	4%
Other	13%	6%	6%	12%	7%
None Of The Above	0%	0%	0%	0%	2%

Note: * = $\alpha \leq .10$, ** = $\alpha \leq .05$, ***= $\alpha \leq .01$

The variables of educational attainment also have substantial influence on heterogeneous preference for school quality (Hypothesis I-4). Households run by college graduates have approximately 25 percent chance of choosing public school quality, which is highest among other education categories. The lowest probability is

13 percent for those with no high school diploma and 29 percent for those with some college, although these are not statistically significant. The probabilities for those with some high school to choose location and school quality are 25 percent and 13 percent, respectively.

Table 5-6 Summary of Probabilities for Presence of School-age Children and Race

Location Factor	Presence of school age children			Race			
	With School-Age Children	With Children Not School Age	No Children	African American	White	Asian	Other Races
Location	27%***	38%	54%***	19%**	38%**	11%	42%
Public Transportation	1%	0%**	1%	3%	1%	0%	0%
Neighbors	2%	4%***	1%	3%	2%	0%	0%
Amenity of Convenience facility	2%	3%	3%	3%	2%	0%	8%
Safety	5%	4%	5%	23%***	2%***	11%	17%
Near Friends /relatives	8%	13%**	10%	3%	11%	11%	0%
Public school quality	43%***	15%***	4%***	26%	27%	56%**	17%
Housing size	4%	9%***	4%	10%	5%	0%	8%
Housing style	4%**	9%***	9%	10%	7%	0%	0%
Other	5%	4%	8%	0%	5%	11%	8%
None of the above	0%	0%	1%***	0%	0%	0%	0%

Note: * = $\alpha \leq .10$, ** = $\alpha \leq .05$, *** = $\alpha \leq .01$

Regarding race variables (Hypothesis I-5), Asian respondents predominately cited public school quality as the most influential factor in their location choice (56 %), which is statistically significant. The probability of Whites choosing location is 38 percent and public school quality is 27 percent. Whites were evenly divided

into location and public school quality; Asians focus more on public school quality than any other race. African Americans chose public school quality 26 percent of the time and location 19 percent of the time. African Americans also have a high probability of citing safety (23%) and housing size and style (10 % for each)—a probability higher than for Whites and Asians.

Table 5-7 Probability for Occupational Categories of Choosing Location Factors [10]

Location Factor	Occupations					
	Unemployed	MPRO	SO	SOO	CEMO	PTMO
Location	36%	33%	32%*	33%	55%	44%
Public Transportation	0%	0%	0%*	0%	0%	11%***
Neighbors	0%	4%	5%	8%	0%	11%*
Amenity of Convenience Facility	3%	2%*	0%*	0%	0%	0%
Safety	2%	5%	5%	0%	9%	0%
Near Friends/Relatives	6%	11%	5%	8%	0%	33%
Public School Quality	29%	30%	32%	25%	36%	0%*
Housing Size	9%	5%	11%	8%	0%	0%
Housing Style	5%	6%	5%	8%	0%	0%
Other	11%	3%**	5%	0%*	0%*	0%
None of The Above	0%	0%	0%	8%	0%	0%

Note: Occupation Categories
Unemployment, (**MPRO)** management, professional, and related occupations, (**SO)** service occupations, (**SOO)** sales and office occupations**, (CEMO)** construction, extraction, and maintenance occupations, and (**PTMO)** production, transportation and material moving occupations

* = $\alpha \leq .10$, ** = $\alpha \leq .05$, ***= $\alpha \leq .01$

Households in various occupations (Hypothesis I-6) tend to choose either location or public school quality among a given choice set. The probability of

[10] The occupation categories in this dissertation followed the Standard Occupation Classification of the Bureau of Labor Statistics (BLS)

choosing “location” ranges from 32 percent to 55 percent, and those for “public school quality” are from 25 percent to 36 percent, except for production, transportation, and material moving occupations (0%). The majority of survey respondents were in management, professional, and related occupations (235 out of 397), while there are only nine respondents of production, transportation, and material moving occupations.

5.2.2.2 Results of the Importance of School Quality Model

The second model of importance of school quality examines to what extent homebuyers prefer school quality. The survey results for this question are Likert-scale responses: very important, somewhat important, average importance, not very important, and not at all important. As expected, most respondents answered that school quality is very important (58.9%) or somewhat important (20.7%). The probabilities of answering average importance, not very important, or not at all important are relatively small (6.3%, 5.8%, and 9.0%, respectively).

Moreover, just as in the previous model regarding location factors, homebuyers with school-age children are more likely to answer very important and somewhat important. The probabilities of choosing these two categories are 83.4 percent and 9.4 percent, respectively, both of which are statistically significant. The probabilities of choosing very important for homebuyers with children but not at school age or no children are obviously lower than for those with school-age children: 43.6 percent and 24.1 percent, respectively. Unexpectedly, the probability of choosing not at all

important for all households are 3.1 percent, 12.0 percent, and 14.0 percent, respectively. The detailed probabilities are in Table 5-9.

Similar to the result of the previous model, divorced households have higher probabilities (62.5%) of responding "very important" than married households (61.2%), although the probability of married households is statistically significant, and divorced is not significant. Overall, single and widowed households consider school quality as very important, but there are high probabilities of responding "not at all important," (13.8 % and 28.6 %, respectively).

Table 5-8 Probability of Importance of School Quality for Martial Status

	Marital Status				
	some high	high graduate	some college	college graduate	post-graduate
Very Important	43%	39%**	63%	63%	58%
Somewhat Important	14%	14%	17%	20%	24%
Average Important	29%***	18%***	5%	4%*	6%
Not Very Important	0%	7%	7%	5%	6%
Not At All Important	14%	22%***	9%	8%	5%
Don't Know	0%	0%	0%	0%	1%

Note: * = $\alpha \leq .10$, ** = $\alpha \leq .05$, ***= $\alpha \leq .01$

It is assumed that household income and school quality is positively correlated. In other words, this dissertation expects that higher income homebuyers have a higher probability of saying school quality is important, and vice versa.

Table 5-9 Probability of Importance of School Quality for Income Categories

	$10K-$24,999	$25K-$39,999	$40K-$54,999	$55K-$69,999	$70K-$84,999	$85K-$99,999	$100K-$149,999	$150K-$199,999	$200K or more
Very Important	25%**	53%	63%	47%*	66%	61%	63%	50%	77%
Somewhat Important	13%	18%	19%	24%	16%	24%	21%	26%	15%
Average Importance	38%***	18%**	3%	4%	4%	7%	3%	8%	8%
Not Very Important	0%	6%	6%	16%***	4%	4%	3%	11%	0%
Not At All Important	25%*	6%	9%	10%	11%	4%	9%	5%	0%
Don't Know	0%	0%	0%	0%	0%	0%	0%	0%	0%

Note: * = $\alpha \leq .10$, ** = $\alpha \leq .05$, ***= $\alpha \leq .01$

The probability result, however, indicates that there are no differences among heterogeneous income categories. The sum of the probability of responding very important, somewhat important, and average importance range from 75 percent (income category of $55,000 to $69,000) to 100 percent ($200,000 or more). The probability of responding "not at all important" is evenly distributed regardless of income category. There is a 25 percent probability of homebuyers with income $10,000-$24,999 to answer "not important" or "not at all important," and 9.4 percent ($40,000-$54,999), 9.8 percent ($55,000-$69,999), and 10.9 percent ($70,000-$84,999) probability of middle income homebuyers choosing these categories. See Table 5-9.

Table 5-10 Summary of Probabilities of Importance of School Quality for Education

	Education					
	some high	high graduate	some college	college graduate	post-graduate	refused
Very Important	43%	39%**	63%	63%	58%	83%
Somewhat Important	14%	14%	17%	20%	24%	9%
Average Important	29%***	18%***	5%	4%*	6%	3%
Not Very Important	0%	7%	7%	5%	6%	2%
Not At All Important	14%	22%***	9%	8%	5%	3%
Don't Know	0%	0%	0%	0%	1%	0%

Note: * = $\alpha \leq .10$, ** = $\alpha \leq .05$,***= $\alpha \leq .01$

Homebuyers with some college or a college degree have a higher probability of answering school quality is very important than other educational categories, 63 percent respectively. There are high probabilities for those who did not graduate from high school or with a high school diploma to consider school quality as not at all important (14.3 % and 21.5 %, respectively).

Regarding race, the probability for any race to respond very important is very high: 78 percent (Asian), 71 percent (African Americans), and 58 percent (Whites), but none of them are statistically significant. Unlike other races, the probability of Whites answering not important and not at all important is 6 percent and 9 percent (No African Americans or Asians chose not at all important category). Holding income and education constant, Whites are 11.1 percent less likely to choose very important than African Americans and 20.1 percent less likely than Asians. Similar to the result of location factor model, Asians have a higher probability to respond that school quality is very important (see Table 5-11).

Table 5-11 Summary of Probabilities of Importance of School Quality for Presence of school Age Children and Race

	Presence Of School Age Children			Race			
	With School Age Children	With Children Not School Age	No Children	African American	Whites	Asian	Other Races
Very Important	83%***	44%***	24%***	71%	58%	78%	50%
Somewhat Important	9%***	27%**	37%***	13%	21%	22%	17%
Average Important	3%***	9%*	10%*	10%	6%	0%	17%
Not Very Important	2%***	7%	15%***	6%	6%	0%	0%
Not At All Important	3%***	12%*	14%***	0%*	9%	0%	17%
Don't Know	0%	1%	0%	0%	0%	0%	0%

Note: * = $\alpha \leq .10$, ** = $\alpha \leq .05$,*** = $\alpha \leq .01$

In a similar result to the previous model for occupations, the probability of responding very important is evenly scattered across occupations. The probabilities for choosing very important are from the highest of 64 percent to the lowest of 42 percent. Households in service occupations give high priority to school quality, followed by management, professional, and related occupations. Interestingly, households who are not employed have a high probability of answering very important (60%). Conversely, households in construction, extraction, and maintenance occupations, and production transportation, and material moving occupations care less about school quality than other occupations (See Table 5-12).

Table 5-12 Probability of Importance of School Quality for Occupational Categories

	Unemployed	MPRO	SO	SOO	CEMO	PTMO
Very Important	60%	60%	64%	56%	42%	44%
Somewhat Important	13%	22%	22%	25%	33%	11%
Average Important	7%	5%	4%	9%	17%	11%
Not Very Important	7%	7%	4%	2%	0%	0%
Not At All Important	10%	6%	7%	9%	8%	33%***
Don't Know	2%	0%	0%	0%	0%	0%

Note: 1. Occupation Categories
Unemployment, (**MPRO)** management, professional, and related occupations, (**SO)** service occupations, (**SOO)** sales and office occupations**, (CEMO)** construction, extraction, and maintenance occupations, and (**PTMO)** production, transportation and material moving occupations.

2. * = $\alpha \leq .10$, ** = $\alpha \leq .05$, ***= $\alpha \leq .01$

5.2.2.3 Results of the Measure of School Quality Model

The last model is designed to test what school quality variables were considered when a homebuyer bought a house. Groups of choice sets were given, such as teacher characteristics, after-school programs, academic performance, and miscellaneous. Among school quality variables, the probability of choosing school district designations is highest among school quality measures (27.7%), followed by school safety (16.1%) and class size (10.3%). In contrast to literature that considers test scores as the appropriate proxy to represent school quality in the housing market,

the probabilities of respondents choosing test scores for math and reading are very low, 0.8 percent and 1.5 percent, respectively.

The probability of choosing school district designation is very high, although it varies according to the presence of school-age children. The probability of choosing school district designation is 29 percent for households with school-age children, 26 percent for those with children not at school-age, and 25 percent for those without children, all of which are not statistically significant. See Table 5-15.

Table 5-13 Probability of School Quality Measure Choice and Marital Status

School Quality Measure	Single	Married	Divorced	Widowed
Teacher Education	0%	5%	21%	14%
Teacher Experience	4%	5%	0%	29%
Teacher Salary	0%	1%	0%	0%
Class Size	0%	11%	17%	14%
Expenditure Per Pupil	0%	2%	8%	0%
School Safety	21%	16%	13%	14%
Sports Programs	0%	1%	0%	0%
PTO Meeting	0%	1%	0%	0%
% Of Students Going To College	21%	8%	4%	14%
Graduation Rates	7%	8%	17%	0%
SAT Scores	0%	2%	0%	0%
Standardized Math Test Scores	0%	1%	0%	0%
Standardized Reading Test Scores	0%	2%	0%	0%
School District Designation	31%	29%	13%	0%
None Of The Above	17%	9%	8%	14%

Note: ***** = $\alpha \leq$ **.10, **** = $\alpha \leq$ **.05, ***** = $\alpha \leq$ **.01**

Single and married homebuyers are also more likely to respond that school district designations are important, 31 percent and 29 percent, respectively, although

neither of these are statistically significant. On the contrary, widowed homebuyers take teacher experience into account. Divorced homebuyers consider teacher education (20.8%), graduation rate (16.7%), class size (16.6%), and school safety and school district designation (12.5%), although none of them are statistically significant.

Table 5-14 Probability of School Quality Measure Choice and Education

School Quality Measure	Some Other Race	Some High	High Graduate	Some College	College Graduate	Post Graduate
Teacher Education	8%	0%	22%***	7%	4%	4%
Teacher Experience	17%	14%	4%	2%	6%	5%
Teacher Salary	0%	0%	0%	0%	1%	1%
Class Size	8%	29%	4%	12%	9%	12%
Expenditure Per Pupil	8%	0%	0%	5%	2%	2%
School Safety	0%	29%	32%***	22%	14%	14%
Sports Programs	0%	0%	4%***	0%	1%	0%
PTO Meeting	0%	0%	0%	0%	1%	1%
% Of Students Going To College	25%	0%	4%	3%	8%	13%
Graduation Rates	0%	29%**	11%	10%	7%	7%
SAT Scores	0%	0%	0%	0%	2%	3%
Standardized Math Test Scores	0%	0%	0%	0%	2%	0%
Standardized Reading Test Scores	0%	0%	0%	2%	1%	2%
School District Designation	25%	0%	7%***	22%	32%*	29%
None Of The Above	8%	0%	14%	15%	10%	7%

Note: * = $\alpha \leq .10$, ** = $\alpha \leq .05$, *** = $\alpha \leq .01$

School district designation tends to be chosen by homebuyers with higher education. For instance households with college degrees have 32 percent chance to

choose school district designation. Teacher characteristics and school safety are weighted more heavily by those with lower education, such as households with high school diploma. Interestingly, homebuyers without a high school diploma take into account graduation rates (29%, which is statistically significant). Homebuyers with post-graduate education consider school district designation with a 29 percent probability, which is not statistically significant.

Table 5-15 Probability of School Quality Measure Choice and Presence of School-age Children and Race

School Quality Measure	With School Age Children	With Children Not at School Age	No Children	African American	White	Asian	Some Other Race
Teacher Education	7%	6%	3%	13%*	5%	0%	8%
Teacher Experience	5%	7%	1%*	0%	5%	11%	17%
Teacher Salary	0%	0%	3%***	0%	1%	0%	0%
Class Size	12%	10%	6%	10%	11%	11%	8%
Expenditure Per Pupil	2%	3%	4%	0%	3%	0%	8%
School Safety	16%	16%	19%	19%	17%	11%	0%
Sports Programs	1%	0%	1%	0%	1%	0%	0%
PTO Meeting	0%	2%**	0%	3%**	0%**	0%	0%
% Of Students Going To College	9%	5%	11%	16%	7%	33%**	25%
Graduation Rates	7%	10%	9%	6%	9%	0%	0%
SAT Scores	3%	3%	0%	0%	2%	11%*	0%
Standardized Math Test Scores	1%	1%	0%	7%***	0%***	0%	0%
Standardized Reading Test Scores	3%*	1%	0%	3%	1%**	11%**	0%
School District Designation	29%	26%	25%	19%	28%	11%	25%
None Of The Above	6%***	11%	18%**	3%	11%	0%	8%

Note: * = $\alpha \leq .10$, ** = $\alpha \leq .05$, *** = $\alpha \leq .01$

There is a 28 percent probability of Whites choosing a school district designation and 19 percent for African Americans, although neither of these is statistically significant. It is very interesting to note that Asians are more likely to respond "percentage of students going to college" as their school quality measure choice. There is also a high probability of choosing school safety, 19 percent (African American), 17 percent (White), and 11 percent (Asian), although neither of them are statistically significant.

Table 5-16 Probability of School Quality Measure Choice and Homebuyer Income

School quality measure	10K-24,999	25K-39,999	40K-54,999	55K-69,999	70K-84,999	85K-99,999	100K-149,999	150K-199,999	200K or more
Teacher Education	25%***	24%***	3%	10%	0%**	8%	5%	0%	4%
Teacher Experience	13%	12%	3%	6%	6%	7%	2%	0%	0%
Teacher Salary	0%	0%	0%	0%	2%	0%	1%	0%	0%
Class Size	13%	0%	9%	10%	18%**	9%	7%	5%	12%
Expenditure Per Pupil	0%	0%	3%	4%	4%	4%	0%*	5%	0%
School Safety	25%	18%	19%	16%	18%	13%	20%	21%	8%
Sports Programs	0%	0%	0%	2%	0%	0%	0%	3%*	0%
PTO Meetings	0%	0%	0%	0%	0%	2%	0%	3%*	0%
% Of Students Going To College	13%	6%	9%	4%	6%	11%	10%	8%	15%
Graduation Rates	0%	12%	9%	14%	4%	9%	8%	8%	12%
SAT Scores	0%	0%	0%	0%	0%	4%	2%	0%	15%***
Standardized Math Test Scores	0%	6%***	0%	0%	2%	2%	0%	0%	0%
Standardized Reading Test Scores	0%	0%	3%	2%	0%	4%	2%	0%	0%
School District Designation	0%*	12%	28%	22%	29%	24%	36%**	37%	23%
None Of The Above	13%	12%	13%	12%	13%	4%8	7%	11%	12%

Note: * = $\alpha \leq .10$, ** = $\alpha \leq .05$, *** = $\alpha \leq .01$

Furthermore, respondents with higher income and higher levels of education have a higher probability of taking school district designation into account than homebuyers with lower income and lower levels of education. Homebuyers with incomes more than $70,000 are more likely to choose school district designation with probabilities ranging from 23 percent to 37 percent. Low-income homebuyers (between $10,000 and $24,999 and between $25,000 and $39,999) care about teacher education, while homebuyers with incomes between $100,000 and $199,999 regard school district designations as the measure of school quality. (See the second and third highest income categories).

Table 5-17 Probability of School Quality Measure Choice and Homebuyer Occupation[11]

School quality measure	Unemployed	MPRO	SO	SOO	CEMO	PTMO
Teacher Education	5%	4%	5%**	8%*	9%	0%
Teacher Experience	9%	2%	5%	8%	9%	0%
Teacher Salary	0%	0%	0%	0%	0%	0%
Class Size	12%	10%	26%*	8%	36%	11%
Expenditure Per Pupil	3%	2%	0%	0%*	0%	0%
School Safety	15%	21%	26%	8%	9%	22%
Sports Programs	0%	0%	0%	8%	0%	0%
PTO Meeting	0%	0%	5%	0%	0%	0%
% Of Students Going To College	8%	6%	0%	33%	18%	11%
Graduation Rates	2%**	10%	5%	0%	0%	0%***
SAT Scores	6%***	2%	0%	0%	0%	22%
Standardized Math Test Scores	2%	0%	0%	0%	0%	0%
Standardized Reading Test Scores	3%	1%	0%	0%	9%	0%
School District Designation	21%	29%	21%	17%	9%*	33%*
None Of The Above	15%	12%	5%	8%	0%	0%

Note: Occupation Categories
Unemployment, (**MPRO)** management, professional, and related occupations, (**SO)** service occupations, (**SOO)** sales and office occupations**, (CEMO)** construction, extraction, and maintenance occupations, and (**PTMO)** production, transportation and material moving occupations
* = $\alpha \leq .10$, ** = $\alpha \leq .05$, ***= $\alpha \leq .01$

[11] Refer to the note on Table 5.5 on page 102.

School district designation has a high probability to be chosen. Especially, homebuyers in production, transportation and material moving occupations focus on school district designation, 33 percent probability, which is statistically significant at the 90 percent confidence interval. Homebuyers in management, professional, and related occupations also consider and have a high probability of choosing school district designation (29%), but it is not statistically significant. Overall, school safety and school district designation have higher probabilities to be chosen by homebuyers in service occupation, 26 percent (statistically significant at the 90 percent confidence interval) and 21 percent (not statistically significant), respectively. Homebuyers in construction, extraction, and maintenance occupations consider class size and percentage of students going to college, although neither of them is statistically significant.

In summary, respondents were asked about three choice sets: location factors affecting the decision to purchase a house, the importance of school quality, and school quality variables. Among the first choice set, location and school quality are the most important factors homebuyers considered when they bought a house. Unexpectedly, location is the most important factor for homebuyers overall and school quality is the second most important. Homebuyers with school-age children, however, consider school quality as the most important location factor. Those with no children or no school-age children rated school quality lower than those with school-age children.

Table 5-18a Hypotheses Group I: Preference for School Quality with Survey Data

Hypothesis #	Hypothesis contents	Expected Sign	N	Statistical Results	
				Location Factor	Importance of SQ
H I-1 Preference for school quality and homebuyers with children	With school-age children > average preference	+	196	16.3 (7.41)***	9.5 (5.28)***
	With no school age children < average preference	-	119	- 11.4 (-4.96)***	-5.2 (-1.93)**
	No Children < average preference	-	82	-22.9 (-6.74)***	-15.2 (-4.47)**
H I-2 Preference for School Quality and Homebuyer Marital Status	Married > average preference	+	333	0.6 (0.6)	1.53*(1.88)
	Never Married < average preference	-	29	-12.9 (-1.63)	-3.1 (-0.5)
	Widowed < average preference	-	7	-12.4 (-0.74)	-28 (-2.22)***
	Divorced < average preference	-	24	15.0 (1.41)	-6.7(-0.97)
H I-3 Preference for School Quality and Homebuyer Income	less than 10,000 < average preference	-	1		
	10,000-24,999 < average preference	-	8	-14.2 (-0.92)	-8.1 (-070)
	25,000-39,999 < average preference	-	7	2.7 (0.25)	2.3 (0.28)
	40,000-54,999 < average preference	-	17	-8.0 (-1.07)	-1.0*** (-2.48)
	55,000-69,999 > average preference	+	33	-13.0 (-2.24)	-11.4 (-0.05)
	70,000-84,999 > average preference	+	51	-1.3 (-0.24)	-0.2 (1.14)
	85,000-99,999 > average preference	+	56	1.0 (0.18)	5.0 (0.27)
	100,000-149,999 > average preference	+	89	9.2*** (2.24)	1.7 (0.53)
	150,000-199,999 > average preference	+	39	2.2 (0.32)	-1.3 (-0.25)
	200,000 or more > average preference	+	27	11.7 (1.39)	14.1 (2.17)**
H I-4 Preference for School Quality and Homebuyer Education	some high < average preference	-	7	-12.4 (-0.75)	-0.2 (-0.02)
	high graduate < average preference	-	28	-5.3 (-0.65)	-14.5** (-2.30)
	some college < average preference	-	60	-10.0 (-1.07)	-0.9 (-0.22)
	college graduate > average preference	+	173	5.1** (2.04)	1.4 (0.70)
	Post-graduate > average preference	+	127	-0.7 (-0.22)	1.5 (0.60)

Note: 1. Numbers in parentheses are t-values. The dependent variable is school district designation in Cuyahoga County.

2. * = $\alpha \leq .10$, ** = $\alpha \leq .05$, ***= $\alpha \leq .01$

Table 5-18b Hypotheses Group I: Preference for School Quality with Survey Data (Cont.)

Hypothesis #	Hypothesis contents	Expected Sign	N	Statistical Results	
				Location Factor	Importance of SQ
H I-5 Preference for School Quality and Homebuyer Race/Ethnicity	African American > average preference	-	32	-0.0 (-0.12)	7.6 (1.34)
	White > average preference	+	340	-0.2 (-0.22)	-1.2 (-1.71)
	Asian < average preference	-	9	28.8** (1.97)	14.1 (1.23)
	some other < average preference	-	12	-10.1 (-0.80)	-2.6(-0.26)
H I-6 Preference for School Quality and Homebuyer Occupations	Unemployed < average preference	-	68	2.7 (0.55)	-5.0 (-1.32)
	MPO> average preference	+	235	1.4 (0.78)	0.9 (0.60)
	SO< average preference	-	28	5.4 (0.67)	3.4 (0.54)
	SOO< average preference	-	45	-4.5 (-0.73)	3.0 (0.61)
	CMO< average preference	-	12	-18.4 (-1.46)	5.8 (0.59)
	PMO< average preference	-	9	-26.7 *(-1.83)	-19.2 (-1.67)

Note: Numbers in parentheses are t-values. The dependent variable is school district designation in Cuyahoga County.
* $= \alpha \leq .10$, ** $= \alpha \leq .05$, *** $= \alpha \leq .01$

In light of the findings of the survey analysis, there are heterogeneous preferences evident for school quality across all homebuyers. Homebuyers with school-age children choose school quality as the most important location variable and answer that school quality is very important, both of which are statistically significant. Homebuyers with high income and high education, however, are more likely to care about school quality than those with low income and low education but

these results are not statistically significant. Interestingly, homebuyers with higher income and higher educational attainment have a higher probability of responding that school district designations are the most representative of school quality, although this variable is new.

5.2.3 Results of the Ordered Logit Model

There are a total of six models—the presence of school-age children, marital status, race, income, education, and occupation— run for each demographic characteristic and SES. These models test the second group of hypotheses regarding the school district choice based on homebuyers' demographic and SES. Unlike the previous models of the ANOTA analysis, in which the dependent variables relied upon respondents' answers, this model utilizes the dependent variable as the real location decision in which school district a homebuyer lives. There are three dependent variables categorized by school quality (excellent, effective, and continuous improvement).

Although the Pseudo R^2 is not analogous to the R^2 in the ordinary lease square (OLS) regression that measures the goodness to fit, nor is the Pseudo R^2 as meaningful as it in the OLS, the Pseudo R^2 measures the goodness to fit in the maximum likelihood model. McFadden's R^2 is defined as: $1 - (LLF_{ur}/LLF_r)$ where LLF_{ur} is the unrestricted log likelihood function and LLF_r is the restricted log likelihood function (Gujariti, 2003). According to Gujariti, the Pseudo R^2 is the ratio of the total sum of squares to the residual sum of the squares because LLF_{ur} is

analogous to the residual sum of squares and LLF_r is analogous to the total sum of squares.

Chi-square was used to test how well the models fit and to test that all the slopes of coefficients are equal to zero, analogous to the F test in the OLS regression. The Log Likelihood tests whether all coefficients for independent variables in the model are simultaneously zero.

As shown in Table 5-19, the Pseudo R^2 are from 0.16 to 0.19, chi-squares are from 123.5 to 141.9, and -2 Log likelihoods are from 618.2 to 650.9.

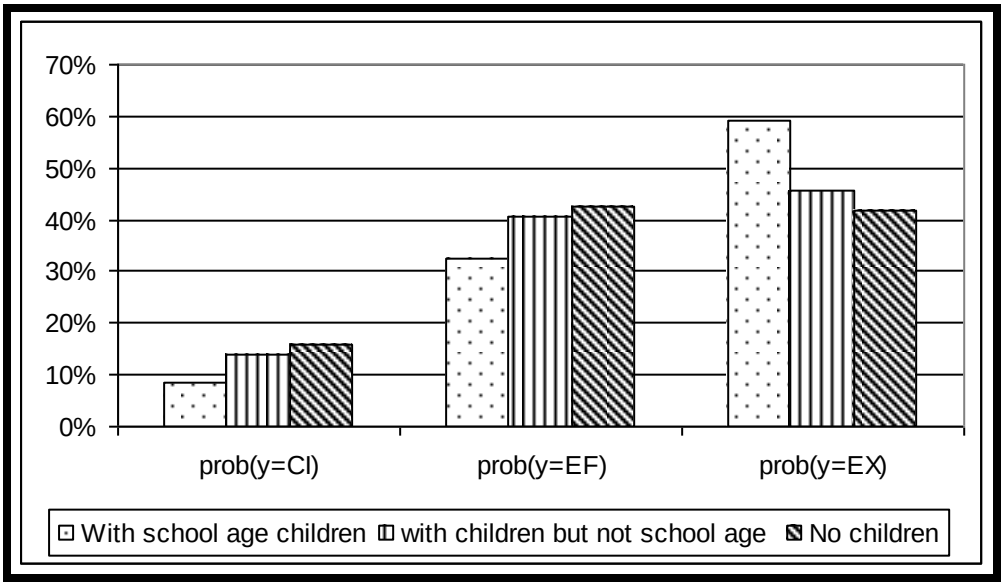
Table 5-19 Summary of Pseudo R^2, Chi-square and Log Likelihood

	Pseudo R^2	Chi-Square	Log Likelihood
The presence of school age children	0.16	123.57	650.78
Marital status	0.16	123.50	650.85
Race	0.18	135.70	638.65
Income	0.19	141.92	618.18
Education	0.17	129.45	630.65
Occupation	0.17	127.81	632.29

Holding the number of bedrooms, bathrooms, housing prices, and tax rates constant, the overall probability of living in an excellent school district is 52 percent across the homebuyers who responded. There are lower probabilities of living in an effective or continuous improvement school district (39% and 8%, respectively). Unlike the ANOTA analysis, which shows relatively homogeneous homebuyers' preference for school quality, the ordered logit results show that there is apparently

heterogeneous school district choice according to homebuyers' demographics and SES.

Figure 5-2 Probability of Homebuyers with School-age children Choosing a School District



Note; CI is Continuous Improvement School District Designation;
EF is Effective; EX is Excellent School District Designation. Y axis indicates the probability of living in each school district designation

To test the hypothesis of hypotheses II-1, three categories of the presence of children—homebuyers with school-age children, with children but not school age, and no children—were utilized as dependent variables in the model. The average of the probabilities of choosing an excellent, effective, or continuous improvement school district are 53 percent, 40 percent, and 8 percent, respectively. The probability, however, of homebuyers with school-age children choosing an excellent school district is 59 percent (48.5% for those with children not school-age and 44.5% for those with no children, which is not significant), while there is only a six percent

probability of choosing continuous improvement for the first group, and 9 percent and 10 percent likelihood for those with no school-age children and no children, respectively.

Interestingly, households who are divorced have the highest probability of living in an excellent school district, followed by those who are married homebuyers, 68 percent and 53 percent, respectively (Hypothesis II-2). Married homebuyers were used as a reference variable. The probabilities for households who are widowed and single are 45 percent and 39 percent, respectively. None of these are statistically significant. The probabilities of living in an effective school district are 48 percent for single homebuyers, 40 percent for married, 28 percent for divorced, and 45 percent for widowed.

Hypothesis II-3 is the probability of households with a variety of income levels choosing an excellent school district. The income category of $55,000 -$69,999, which is the median income group in the sample, was used as a reference variable. The probabilities of homebuyers with various incomes living in a specific school district were estimated. The statistical results indicate that as income increases, the probabilities of living in an excellent school district increase. Homebuyers with income less than $25,000 have a high probability of living in an excellent school district, which may be due to the small number of respondents. Households with higher income than the reference have a higher probability of living in an excellent school district, and this is statistically significant.

Similar to income groups, educational attainment (Hypothesis II-4) shows a similar result. The higher educational background homebuyers have, the higher probability they live in an excellent school district. Homebuyers with less than high school education attainment have a 31 percent probability of choosing an excellent school district and a15 percent probability of choosing a continuous improvement school district, whereas those with post-graduate degrees have a 58 percent and a six percent probability of choosing an excellent or continuous improvement district, respectively.

Testing the third hypothesis regarding the probability of households of different races choosing an excellent school district (Hypothesis II-5), Asians have the highest probability of living in an excellent school district at 80 percent, and only an 18 percent probability of living in an effective school district, both statistically significant. African Americans are more likely to live in an effective school district, 55 percent, and a 22 percent chance to live in an excellent school district, both of which are statistically significant. Whites, which are a reference category, have a 54 percent probability of living in an excellent school district, a 39 percent chance of living in an effective school district, and only a seven percent chance of living in a continuous improvement school district.

Unlike the results of other homebuyers' characteristics, the probabilities of homebuyers with various occupations (Hypothesis II-6) living in an excellent school district do not vary much, ranging from 40 percent to 62 percent. The lowest

probability of choosing an excellent school district is for unemployed households, while the highest probability is for households in construction, extraction, and maintenance occupations. It is interesting to note that households in construction, extraction, and maintenance occupations live in either a continuous improvement district or an excellent school district.

Consumer school district choice is composed of various demographics, and revealed using the ordered logit model. Obviously, the presence of school-age children and race are the most distinct demographic characteristics. Homebuyers with school-age children have the highest probability of living in an excellent school district. This is consistent with the answer of homebuyers with school-age children to the question that school quality is important.

Table 5-20 Results of Hypotheses Group II: School District Choice

Hypothesis #	Hypothesis Contents	Excepted Signs	N	Statistical Results
H II-1 School District Choice and Homebuyer with Children.	With school-age children	NA	196	Reference
	With no school-age children < reference	-	119	-0.41*** (2.86)
	No Children < reference	-	82	-0.58*** (4.25)
H II-2 School District Choice and Homebuyer Marital status	Married		333	Reference
	Never Married < reference	-	29	-0.56* (1.95)
	Widowed < reference	-	7	-0.31 (0.17)
	Divorced < reference	-	24	0.64 *(1.95)
H II-3 School District Choice and Homebuyer Income	less than 10,000 < reference	NA	1	NA
	10,000-24,999 < reference	-	8	1.49*** (3.87)
	25,000-39,999 < reference	-	7	0.04 (0.005)
	40,000-54,999 < reference	-	17	0.45 (1.19)
	55,000-69,999	+	33	Reference
	70,000-84,999 > reference	+	51	0.51** (2.08)
	85,000-99,999 > reference	+	56	0.60 ***(2.87)
	100,000-149,999 > reference	+	89	1.22*** (13.23)
	150,000-199,999 > reference	+	39	1.49*** (9.26)
	200,000 or more > reference	+	27	1.33*** (5.20)
H II-4 School District Choice and Homebuyer Education	some high school < reference	-	7	-1.01* (1.80)
	high school graduate < reference	-	28	-1.54 ***(14.26)
	some college < reference	-	60	-0.31 (0.99)
	college graduate		173	Reference
	Post-graduate > reference	+	127	0.0005 (0.00)
H II-5 School District Choice and Homebuyer Race/Ethnicity	African American < reference	-	32	-1.43*** (14.34)
	White	+	340	Reference
	Asian < reference	-	9	1.20*** (2.96)
	some other < reference	-	12	0.17 (0.08)
H II-6 School District Choice and Homebuyer Occupations	Unemployed < the reference	68	-	0.30 (0.89)
	MPRO >the reference	235	NA	Reference
	SO < the reference	28	-	-0.21 (0.26)
	SOO < the reference	45	-	0.14 (0.18)
	CEMO < the reference	12	-	-0.57 (0.98)
	PTMO< the reference	9	-	-0.40 (0.37)

Note:

1. Numbers in the parentheses are wald values. The dependent variable is school district designation in Cuyahoga County.
2. Occupation Categories

Unemployment, (MPRO) management, professional, and related occupations, (SO) service occupations, (SOO) sales and office occupations, (CEMO) construction, extraction, and maintenance occupations, and (PTMO) production, transportation and material moving occupations.

3. * = $\alpha \leq .10$, ** = $\alpha \leq .05$, ***= $\alpha \leq .01$

In summary, hypotheses group II was used to test different school district choices based on homebuyers' demographics and SES. The signs and magnitudes of the results are as expected. Whether or not a homebuyer has school-age children is an important factor in choosing an excellent school district. A homebuyer with a high income and a high education level is also more likely to choose an excellent school district, although the occupational categories are not as clear as are other demographics and SES.

Another distinctive demographic characteristic is race. In particular, Asians consistently ranked school quality as important and are more likely to live in a high-quality school district. These results may be affected by the fact that Asian respondents were more likely to be older (between 41years old and 50 years old) and have high school age children attending public school. Furthermore, African Americans addressed school quality as very important with a probability of 71 percent; however, they have a chance of only 22 percent of living in an excellent school district.

Table 5-22 displays the summary of the heterogeneous probabilities of school district choice according to homebuyers with different demographics and SES, using the ordered logit model, holding housing characteristics constant.

Table 5-21 Summary of Probability for Households with Different Demographic And Socioeconomic Status To Choose School District

		Probability (CI)	Probability (EF)	Probability (EX)
Presence of Children	With school age children	6%	35%	59%
	With no school age children	9%	43%	48%
	No Children	10%	45%	44%
Marital Status	Single	13%	48%	39%
	Married	8%	40%	53%
	Divorced	4%	28%	68%
	Widowed	10%	45%	45%
Race	African American	23%	55%	22%
	White	7%	39%	54%
	Asian	2%	18%	80%
Income	10K_25K	4%	26%	70%
	25K_40K	14%	51%	36%
	40K_55K	9%	45%	46%
	55K_70K	14%	51%	35%
	70K_85K	9%	44%	47%
	85K_100K	8%	42%	50%
	100K_150K	5%	31%	65%
	150K_200K	3%	25%	72%
	morethan200K	4%	29%	67%
Education	Some High school	16%	51%	33%
	HIGH School Graduate	24%	53%	22%
	Some College	9%	42%	49%
	College graduate	7%	36%	57%
	Post-graduate	6%	36%	58%
Occupation	Unemployed	6%	54%	40%
	MPRO	8%	44%	48%
	SO	10%	38%	53%
	SOO	7%	49%	44%
	CEMO	13%	25%	62%
	PTMO	11%	31%	58%

Note: Occupation Categories

Unemployment, (MPRO) management, professional, and related occupations, (SO) service occupations, (SOO) sales and office occupations, (CEMO) construction, extraction, and maintenance occupations, and (PTMO) production, transportation and material moving occupations.

Taking results from ANOTA and ordered logit analysis into account, this dissertation indicates that consumers' location choice is heterogeneous and is affected by their preferences and interests. There are slightly different probabilities for heterogeneous homebuyers to state that school quality is important, although there are distinctive school district choices among homebuyers. The following section explains to what extent households are willing to pay for school quality by looking at their demographics and SES. Various methods are utilized to measure the differences in willingness to pay for school quality.

5.3 Heterogeneous Households' Willingness to Pay for School Quality

In order to measure heterogeneous willingness to pay for school quality, this dissertation takes two approaches: grouping heterogeneous demographics and SES as relatively homogeneous subgroups and applying a two-step procedure. These two datasets are applied to individual housing sale transactions in Cuyahoga County and to housing sales that are aggregated by school district throughout 14 states.

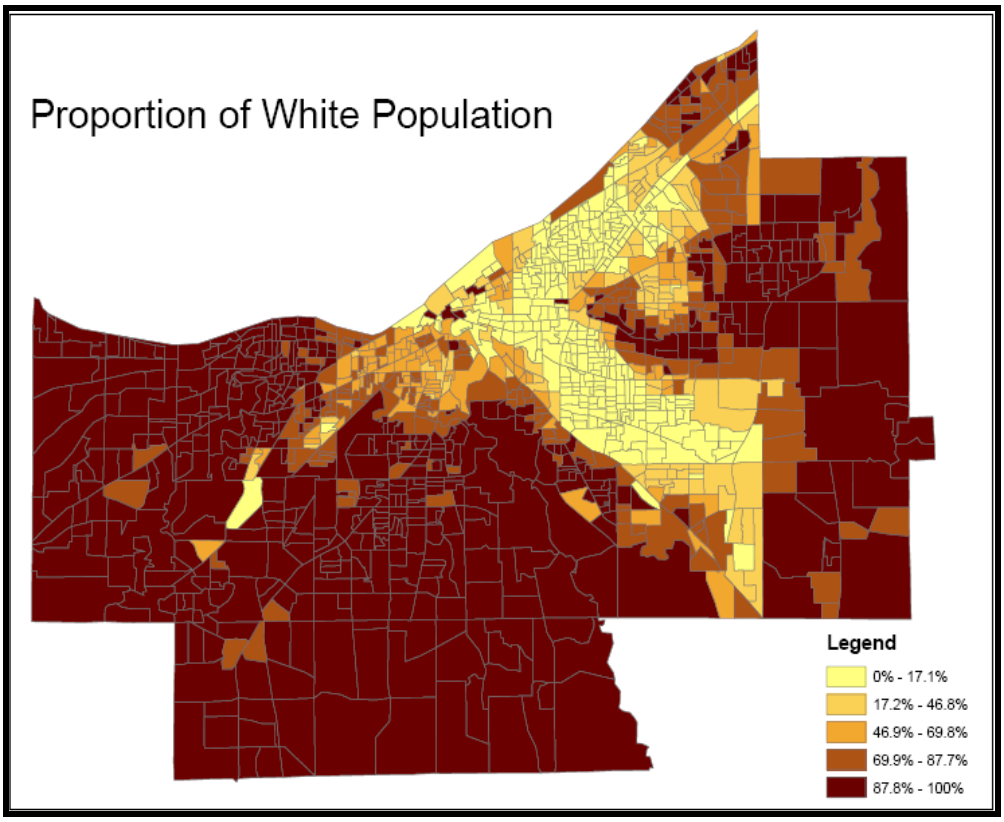
5.3.1 Cuyahoga County Model

5.3.1.1 Result of Cluster Analysis

Cluster analysis was conducted in order to group the heterogeneous data into homogeneous demographic subsets. The purpose of utilizing cluster analysis in this study is to break down the dataset for each category (marital status, proportion with

school-age children, race, income, education, and occupation). Therefore, we can compare the magnitude of school quality for clusters representing relatively homogeneous household demographics and characteristics by clearly defining each cluster.

Figure 5-3 White Population Distribution in Cuyahoga County



With the 11,193 housing sales data for Cuyahoga County, heterogeneous households' willingness to pay for school quality is analyzed. Regarding households' demographics and SES in the study area, the average housing price is $162, 915, and the average proportion of Whites and African Americans is 84 percent and 13

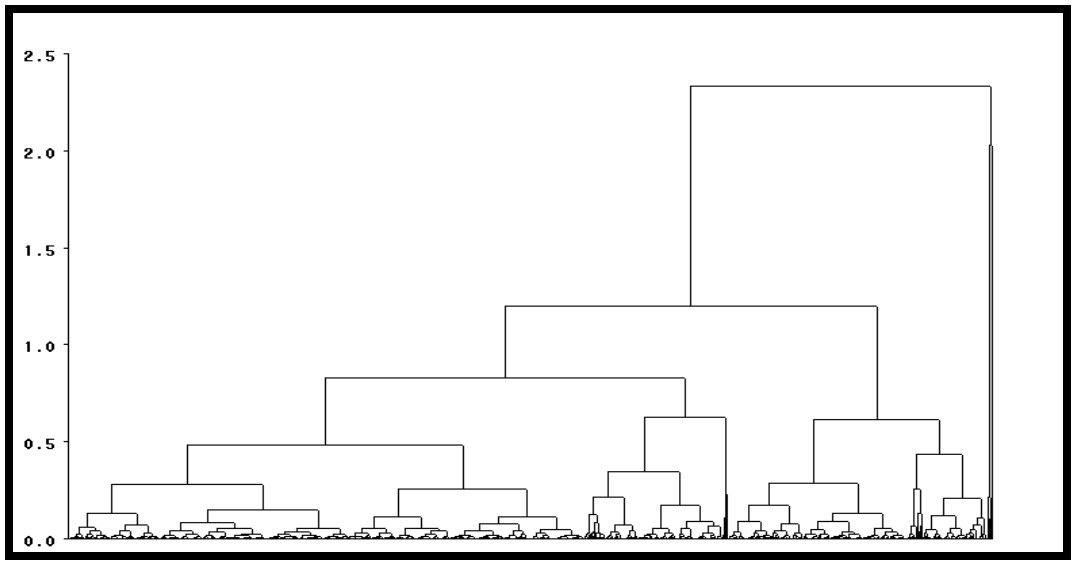
percent, respectively. Asian and some other race account for less than two percent. The geographical pattern of White population distribution, as shown in Figure 5-3, is concentrated on the outskirts of the county. Regarding school quality, the averages for performance index, test scores, and value added are 95.6, 84.4, and 3.2, respectively, in the study area.

This dissertation utilized dendrograms for each demographic and SES category. The dendrograms illustrate the distance between each observation and help researchers make a decision based on the cluster numbers. The decision as to how many clusters should be used in this dissertation was made using the dendrogram displayed in Figure 5-4.

The proportion of school-age children in a census block group may have substantial influence on a household's willingness to pay for school quality. The proportion of school-age children is the ratio of the total population to the number of school-age children. There are three clusters based on the proportion of school-age children in a census block group. The first cluster has 4.08 percent of school-age children; 4,379 observations belong to the first cluster. The second cluster (4,707 observations) has the lowest proportion of school-age children of three clusters, with an average of 6.96 percent. The third cluster has 10.26 percent of school-age children, which is the highest proportion of school-age children. The overall average of the proportion of school-age children is 6.46 percent. See Appendix 32.[12]

[12] Appendix 32 contains all tables supporting the figures in this section (5.3.1.1).

Figure 5-4 Dendrogram Of Proportion Of School Age Children



There are three clusters for four marital status categories: never married, married, widowed, and divorced. The hypothesis is that the married couples have more willingness to pay for school quality than any other household types. In other words, the higher the proportion of married couples, the higher the willingness to pay for school quality. The first cluster of marital status is characterized as married households, and 4,788 observations belong to this first cluster. The average proportion of married households is 66.3 percent. The second cluster has the highest proportions of households who never married among three clusters. The average proportion of never married is 38.9 percent in the second cluster. However, approximately 40 percent married households also belong to the second cluster. The third cluster has mixture of households who never married (26.3), married (53.3), widowed (9.6), and divorced (10.8).

In Cuyahoga County, the dominant races are White and African American, with overall average percentages of 83.6 percent and 12.7 percent, respectively. The average proportions of Asians and some other races are less than two percent—1.8 percent and 0.4 percent, respectively. Two clusters were grouped for race variables. The first cluster is defined as White population (average of 92.1%). There are 9,719 observations belongings to this first cluster. The second cluster is more likely to be African American (average of 68.4 percent). For Asian and some other race, there are 1.9 percent and 0.4 percent for the first cluster, and 1.1 percent and 0.4 percent for the second cluster, respectively.

With the median income in the census block group, income categories were grouped into three clusters. The overall median income of the study area is $53,937. The first cluster for income represents the average income group with the average income of $48,297, and 5,979 observations belong to this cluster. The second cluster is characterized as the high-income group, with an average of $78,916. The third cluster is the low-income group ($33,518).

There are two clusters for education: one for high school graduate and associate's degree and the other for college and post-graduate degrees. For the educational clusters, the first cluster is defined as the high educational group, and the second is low educational group. The first cluster has 17.7 percent high school graduation, 5.4 percent associate's degree, 28.4 percent bachelor's degree, and 21.6 percent post-

graduate degree. The second cluster has 36.2 percent, 6.0 percent, 13.9 percent, and 5.8 percent, respectively.

The prevailing occupation in Cuyahoga County is management and professional (38.7%), followed by sales and office (29.9 %), production and transportation (12.4 %), and service occupations (12.3 %). The smallest occupation is construction (6.7%). Due to the fact that households with various occupations are dispersed across the county, it is very difficult to define the clusters. However, the first cluster has a higher proportion of sales and office occupations (35.6%). The second cluster show a mixed proportion of occupation. The third cluster represents management and professional occupations, with an average of 60.9 percent. The fourth cluster can be defined as construction and production occupations, with averages of 9.2 and 21.6 percent, respectively.

Due to the lack of individual data for households' demographics and SES, cluster analysis was used. There are 18 clusters representing each demographic and SES group. It is hard to say that these clusters behave as individuals, but it is assumed that they have a relatively homogeneous willingness to pay for school quality. The willingness to pay for school quality of households in each cluster is interpreted as a household collective willingness to pay. Detailed housing prices, median income, and school quality are summarized in Table 5-22.

Table 5-22 Summary of Cluster Housing Prices, Average Income, and School Quality

		Housing price ($)	Average Income ($)	10^{th} grade math	Performance Index	Value Added	Expenditure Per pupil ($)	Teacher Salary ($)
Overall		173,275	55,049	84.4	83.1	3.2	11,316	57,575
Proportion of school-age children	Cluster 1	160,562	51,369	94.7	86.0	3.1	11,131	59,212
	Cluster 2	165,488	55,079	96.6	83.4	3.2	11,570	58,868
	Cluster 3	162,059	56,724	95.1	93.3	3.0	11,254	56,572
Marital status	Cluster 1	195,984	66,913	88.9	99.5	2.7	11,360	58,221
	Cluster 2	127,811	37,972	89.7	89.7	4.2	12,061	59,643
	Cluster 3	141,123	46,004	82.7	93.5	3.3	10,997	57,606
Race	Cluster 1	169,437	55,660	86.8	97.2	2.9	11,081	58,163
	Cluster 2	119,912	56,852	68.3	85.1	5.0	12,642	56,852
Income	Cluster 1	310,491	122,503	89.6	102.8	1.7	10,961	56,316
	Cluster 2	135,126	43,227	81.8	93.0	3.4	11,026	56,667
	Cluster 3	208,267	70,069	89.5	100.6	2.8	11,561	60,078
Education	Cluster 1	206,126	68,492	87.4	99.5	2.8	12,328	61,005
	Cluster 2	137,841	45,492	82.6	93.3	3.4	10,682	56,240
Occupation	Cluster 1	133,699	44,441	83.5	93.7	3.1	10,639	56,183
	Cluster 2	176,386	56,992	88.4	98.6	2.9	11,117	59,992
	Cluster 3	230,836	76,784	86.4	99.7	2.7	13,208	62,348
	Cluster 4	117,191	40,662	76.6	89.1	4.2	10,689	54,626

5.3.1.2 Results of Regression of the County Model

With 11,193 individual housing sale transaction data in Cuyahoga County, the spatial hedonic price model was used to estimate household willingness to pay for school quality. The R^2 of the input model is 72.4 percent and those of the outcome models of test and value added are slightly higher than the input model, 72.5 percent for each. The highest R^2 is 72.6 percent for the performance index model. The λ (spatial error variable) is statistically significant.

Table 5- 23a Result of the Spatial Hedonic model in Cuyahoga County[13]

Variables	Input Model	Performance Index	Test	Value-added
CONSTANT	6.48** (38.20)	6.32 ** (37.81)	6.43 ** (38.36)	6.62** (37.25)
LOG_LIVO	0.40 ** (37.89)	0.40** (38.26)	0.40** (38.35)	0.40** (37.99)
LOG_LOT	0.08** (14.57)	0.07** (13.22)	0.07** (13.95)	0.08** (14.06)
AGE	-0.004** (-25.62)	-0.003** (-24.62)	-0.003** (-24.45)	-0.0036** (-24.79)
BASESQFT	0.00007** (13.59)	0.0001** (14.15)	0.00007** (13.95)	0.00007** (13.67)
BEDROOMS	0.01** (2.38)	0.01** (2.41)	0.01** (2.43)	0.01** (2.34)
BATHS	0.06** (10.76)	0.06** (10.89)	0.06** (11.01)	0.06** (10.80)
FIREPL	0.04** (8.52)	0.04** (8.48)	0.04** (8.49)	0.04** (8.59)
GARSIZE	0.00017** (10.02)	0.0002** (9.97)	0.0002** (9.79)	0.0002** (9.86)
P_WHITE	0.002** (15.02)	0.0016** (9.47)	0.0016** (8.13)	0.0023** (13.49)
P_MARR	0.001** (2.67)	0.0011** (2.51)	0.0012** (2.76)	0.0012** (2.65)
P_HIGH	-0.004** (-9.79)	-0.003** (-8.54)	-0.004** (-9.41)	-0.00 4** (-10.03)
TAXRATE	-1.52 (-1.36)	-0.59 (-0.54)	-0.29 (-0.26)	-2.20* (-1.93)
D_CBD	0.0041** (3.35)	0.0032** (2.75)	0.0035** (2.98)	0.0041** (3.41)
SQ_D_CBD	0.0001 (0.75)	-0.0001 (-0.94)	0.00001 (-0.10)	0.0001 (1.10)
P_OWNER_OC	-0.11** (-4.98)	-0.10** (-4.67)	-0.10** (-4.88)	-0.10** (-4.77)
DENSITY	0.15** (3.71)	0.13** (3.11)	0.14** (3.39)	0.15** (3.59)
D_WATER	0.07** (5.03)	0.08** (6.39)	0.08** (5.68)	0.07** (5.36)
LOG_INCOME	0.10** (6.38)	0.09** (5.75)	0.09** (5.76)	0.10** (6.04)
EXPENDITURE	0.000003(1.20)	0.00001**(4.24)	0.000008**(3.32)	0.000004 (1.64)
EXPERIENCE	-0.01** (-4.84)	-0.01** (-5.53)	-0.01** (-4.63)	-0.01** (-5.37)
SALARY	0.00001** (11.46)	0.000007**(5.64)	0.00001** (7.63)	0.00001**(10.65)

[13] The detailed description is displayed in Appendix 6a.

Table 5-23b Result of the Spatial Hedonic model in Cuyahoga County (Cont.)

Variables	Input Model	Performance Index	Test	Value-added
PI56		0.007** (9.51)		
TEST			0.004** (7.71)	
VALUE ADDED				-0.005** (-2.61)
λ	0.41** (19.96)	0.37** (17.70)	0.38** (18.46)	0.40** (19.69)
R^2	72.4 %	72.6%	72.5%	72.5%
Log likelihood	1227.95	1271.03	1256.76	1231.34

Note: Numbers in the parentheses are t-values. The dependent variable is log of housing price in 2006.

* = $\alpha \leq .05$, ** = $\alpha \leq .01$

In the Cuyahoga County model (Hypotheses Group III), the overall willingness of households to pay for school quality is positive (Hypothesis III-1). In particular, households' willingness to pay for the performance index is 5.3 percent of housing prices, which is $8,567 at average housing prices of $162,915. The test model is similar to the performance index model but slightly lower, that is, $6,799. The value-added model indicates negative willingness to pay at -$1,791, all of which are statistically significant at the 99 percent confidence interval.

Table 5-24 Households' Willingness to Pay for School Quality

Mean of housing prices	Median Income	Performance Index		TEST		Value-Added	
		%	$	%	$	%	$
$162,915	$53,937	5.3***	8,567	4.2***	6,799	-1.1***	-1,791

Note : * = $\alpha \geq .10$, ** = $\alpha \geq .05$,*** = $\alpha \geq .01$

As shown in Table 5-23, seventy two models were run separately for each cluster. Overall, the R^2 values for input models are less than the output models. The largest R^2 is 76.4 percent for the first cluster of household martial status, which has 61.3 percent of married households. On the contrary, the smallest R^2 is 39.4 percent for the race cluster 2, which is characterized as African American, 68.4 percent. The detailed R^2 and log likelihood values are displayed in the table.

Table 5-25 Summary of R^2 and Log Likelihood for Four School Quality Model

		Input		Performance Index		TEST		Value-Added	
		R^2	Log likelihood	R^2	Log likelihood	R^2	Log likelihood	R^2	Log likelihood
Overall		72.4	1227.95	72.6	1271.03	72.5	1256.76	72.5	1231.34
Proportion of school age children	C1	69.92	438.65	69.99	445.66	69.95	441.37	69.94	439.99
	C2	75.20	659.10	75.38	684.56	75.34	679.56	75.21	661.12
	C3	72.18	194.39	72.35	203.19	63.93	126.64	72.40	205.00
marital Status	C1	76.3	964.31	76.4	977.50	76.4	969.82	76.3	964.40
	C2	49.5	-45.22	49.6	-45.75	49.6	-45.80	49.6	-45.28
	C3	61.6	483.91	61.6	509.51	61.6	505.99	61.4	486.35
Race	C1	74.3	1537.12	74.4	1581.76	74.4	1563.76	74.3	1541.34
	C2	39.4	-126.09	39.5	-125.91	39.6	-124.67	39.5	-1254.83
Income	C1	60.25	809.52	60.53	836.29	60.47	830.89	60.25	809.85
	C2	67.69	325.59	67.81	337.37	67.72	329.39	67.76	330.89
	C3	52.30	226.04	52.43	229.68	52.47	230.29	52.30	226.07
Education	C1	68.4	80.28	68.6	101.45	68.5	90.91	68.4	80.39
	C2	65.1	1376.17	65.4	1415.03	65.3	1407.22	65.1	1376.61
Occupation	C1	54.9	643.53	55.5	667.69	55.4	665.54	54.9	644.23
	C2	67.7	539.99	67.8	548.96	67.8	545.43	67.7	540.47
	C3	67.3	4.59	67.5	10.27	67.4	6.87	67.3	4.65
	C4	51.0	312.60	51.4	321.28	51.4	320.37	51.1	313.13

Regarding the proportion of school-age children clusters, the R^2 ranges from the lowest of 63.93 percent to the highest of 75.38 percent. The signs and magnitudes of housing characteristics variables—age, basement size, number of bedrooms, fireplaces, and so on—are consistent with other studies and are statistically significant.

The school input variables—expenditure per pupil, teacher experience, and teacher salary—have small effects on housing prices. The signs of expenditure per pupil and teacher salary are positive and statistically significant at the 95 percent confidence interval. Teacher experience is negative and statistically significant, holding others constant.

Regarding the performance index model for the proportion of school-age children, the highest R^2 is 75.38 percent for the second cluster. The signs of performance index are positive and statistically significant as expected. The magnitudes of these coefficients are 0.007, 0.004, and 0.007 for each cluster. These coefficients of the performance index can be interpreted as the collective willingness to pay of households in a block group.

To test Hypothesis III-2, households in the first cluster, which has 4.08 percent of school-aged children in a block group, are willing to pay 5.3 percent of their housing price for school quality, accounting for $8,589 of the average housing price of $160,562. Households in the second cluster, which has an average of 6.96 percent school-age children, has a willingness to pay $4,953, accounting for 3.1 percent of

their housing prices at $165,488 mean housing price for school quality. The result of the third cluster, which has the highest proportion of school-age children in a block group, shows households in this cluster are willing to pay 5.2 percent of their housing prices, accounting for $8,378 at a mean housing price of $162,059.

The results of the test model are similar to the performance index model, although households' willingness to pay for test scores are less than those of the performance index model. Households' willingness to pay for test scores in the first, second, and third clusters are 1.9 percent ($3,033), 5.4 percent ($8,747), and 1.4 percent ($2,229), respectively. The average percentage of school-age children in the base model is 6.46, and willingness to pay for test scores in the base model is $6,798. Interestingly, households with school-age children care about test scores, rather than performance index. The signs of value added are negative in all models, except the first cluster with the average of 4.08 percent school-age children in a block group, holding other factors constant. The willingness to pay for value added, therefore, is negative: 1.0 percent ($1,555), -1.3 percent ($2,164), and -4.8 percent (-$7,652), respectively.

Table 5-26 Results of proportion of School-age Children Cluster Model

	Mean of Proportion of school age children	Mean of housing prices ($)	Performance Index		TEST		Value-Added	
			%	$	%	$	%	$
C1	4.08%	165,562	5.3***	8,589	1.9**	3,033	1.0**	1,555
C2	6.96%	165,488	3.1***	4,953	5.4 ***	8,747	-1.3*	-2,164
C3	10.26%	162,059	5.2***	8,378	1.4	2,229	-4.8	-7,652

Note : * = $\alpha \leq .10$, ** = $\alpha \leq .05$, *** = $\alpha \leq .01$

As mentioned previously and shown in the results of the ANOTA and the ordered logit model, households' marital status affects the preference for school quality and school district choice. Therefore, it is assumed that married households have a greater willingness to pay for school quality than households who never married.

Hypothesis III-3 is that households who are married have higher willingness to pay for school quality than any other types of households including single, divorced, and widowed. The marginal willingness of households in the first cluster (married households) to pay for the performance index is $7,547, for test scores, $4,887, and for value added, $382. The second cluster is characterized as never married (single), and their willingness to pay for school quality is lower than the first cluster that has more married households. The third cluster is mixed and has more widowed households. The results of the third cluster indicate the lowest willingness to pay for school quality: $665 for the performance index, $963 for the test scores, and -$911 for value added. The detailed results are described in Table 5-25 below.

Table 5-27 Results of Marital Status Cluster Model

	Mean of Proportion of married (%)	Mean of Proportion of never married (%)	Mean of housing prices ($)	Performance Index		TEST		Value-Added	
				%	$	%	$	%	$
C1	61.28	22.46	188,040	4.7***	8,621	3.9***	7,088	-0.9	-1,593
C2	35.54	46.28	160,886	2.0	2,685	2.2	2,869	-0.6	-791
C3	43.89	31.87	168,971	0.5***	665	0.7***	963	-0.7**	-911

Note : * = $\alpha \leq .10$, ** = $\alpha \leq .05$, ***= $\alpha \leq .01$

In general, there is a positive correlation between household income and willingness to pay for school quality (Hypothesis III-4). The statistical results of the income models support this statement. The average income in the base model of the county is $53,937, and the average willingness to pay for the performance index is 5.3 percent ($8,567 of their housing prices) and test scores is 4.2 percent ($6,799 of their housing prices).

In comparison, the average income of the first cluster of block groups is $48,297, and their willingness to pay for the performance index is slightly lower at 4.6 percent ($6,657 of their housing prices) and for test score results is 4.1 percent ($5,944 of their housing prices). The second cluster of block groups has an average income of $78,916, their willingness to pay for the performance index is 5.0 percent ($11,233 of their housing prices), and for test score results is 3.0 percent ($6,744 of their housing prices). Households living in the third cluster of block groups have an average income of $33, 518, and their willingness to pay for the performance index is 3.0 percent ($3,597 of their housing prices) and for test score results is 3.4 percent ($4,116 of their housing prices).

Table 5-28 Results of Income Cluster Model

	Mean of income ($)	Mean of housing prices ($)	Performance Index		TEST		Value Added	
			%	$	%	$	%	$
C1	48,297	145,264	4.6***	6,657	4.1***	5,944	0.4	621
C2	78,916	226,379	5.0***	11,233	3.0***	6,744	-2.2***	-4,937
C3	33,518	120,374	3.0***	3,597	3.4***	4,116	-0.3	-306

Note : * = $\alpha \leq .10$, ** = $\alpha \leq .05$, ***= $\alpha \leq .01$

There are two clusters for the education groups: the first cluster characterized as high educated households and the second as low educated. As expected, the higher proportion of highly educated households in a block group, the higher willingness to pay for school quality, except for value added (Hypothesis III-5). The magnitudes of performance index are 0.0099 and 0.0069 for each cluster. They can be interpreted that households in the first cluster have a willingness to pay $13,579 and those in the second cluster, $7,590. The results of the test model are similar, $10,453 and $6,610 for the first and second, respectively. The results of value added indicate household negative willingness to pay as in other models: -0.3% (-$635) and -0.5% (-$623), although the value added is not statistically significant.

Table 5-29 Results of Education Cluster Model

	Mean of proportion of high school degree	Mean of proportion of bachelor and post-graduation	Mean of housing prices ($)	Performance Index		TEST		Value Added	
				%	$	%	$	%	$
C1	17.7%	50.0%	206,126	6.6***	13,579	5.1***	10,453	-0.3	- 635
C2	36.2%	19.7 %	137,841	5.5***	7,590	4.8***	6,610	-0.5	-623

Note : * = $\alpha \leq .10$, ** = $\alpha \leq .05$, ***= $\alpha \leq .01$

Regarding race variables (Hypothesis III-6), there are two clusters: the first cluster (Whites) and the second cluster (African American). The R^2 ranges from the lowest 39.4 percent to the highest 74.4 percent. The signs of teacher experience are negative for both first and second cluster models, while those of teachers' salary and expenditure per pupil are positive and statistically significant, with the exception of

the expenditure per pupil variable for the second cluster. Results show that households' willingness to pay for performance index in the first cluster is $9,151, which is higher than the average, and $1,324 in the second cluster, which is lower than the average. For test scores, households in the first cluster are willing to pay $6,832 and those in the second cluster, $2,558. The value added model, however, indicates negative willingness to pay, -$2,219 and -$2,327, respectively.

Table 5-30 Results of Race Cluster Model

	Mean of Proportion of white (%)	Mean of Proportion of African American	Mean of housing prices ($)	Performance Index		TEST		Value-Added	
				%	$	%	$	%	$
C1	93.1	4.2%	169,437	5.4***	9,150	4.0***	6,832	-1.3***	-2,219
C2	27.9	68.4%	119,911	1.1	1,324	2.1*	2,558	-1.9	-2,327

Note : * = $\alpha \leq .10$, ** = $\alpha \leq .05$, *** = $\alpha \leq .01$

This dissertation includes the occupational variable (Hypothesis III-7) as a proxy for human capital. Four models of occupational clusters were run. Households belonging to the third cluster, the highest proportion of management occupation (60.9%), have the highest willingness to pay for school quality in terms of dollar amount. The result of what percent of housing prices households are willing to pay for school quality indicates that the first-cluster households have a higher willingness to pay for school quality.

Table 5-31 Results of Occupation Cluster Model

	Mean of the proportion of management occupation	Mean of income ($)	Mean of housing prices ($)	Performance Index		TEST		Value Added	
				%	$	%	$	%	$
C1	28.9%	44,441	133,699	5.3***	7,122	5.0***	6,740	-0.9	-1,175
C2	42.9%	56,992	176,386	3.3***	5,741	2.8***	4,872	0.5	967
C3	60.9%	76,784	230,836	4.8***	11,160	3.1**	7,133	-0.3	- 753
C4	24.6%	40,662	117,190	4.2***	4,971	3.8***	4,474	-0.8	-959

Note : * = $\alpha \leq .10$, ** = $\alpha \leq .05$, *** = $\alpha \leq .01$

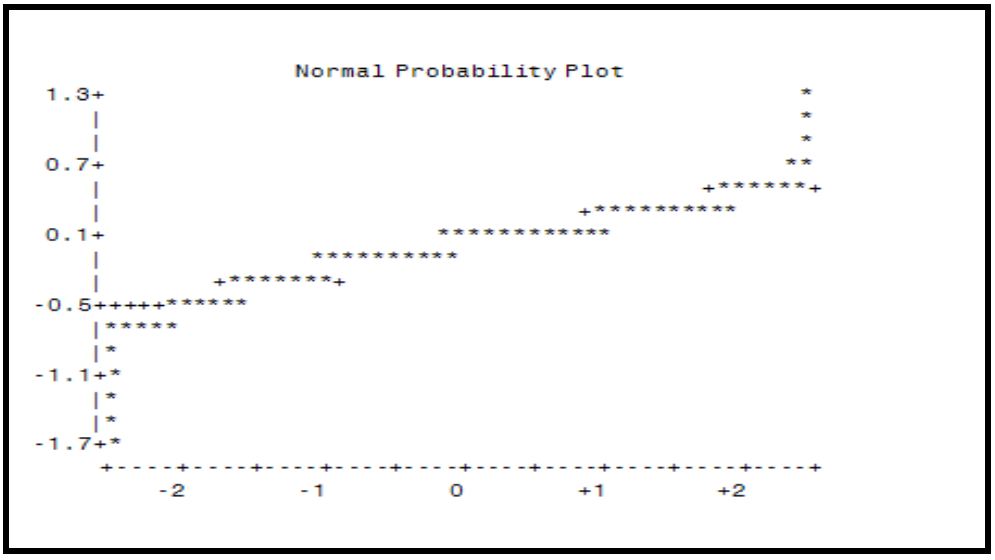
In summary, the average willingness of households to pay for performance index in the base model is 5.3 percent of their housing prices. As expected, households' willingness to pay for school quality is heterogeneous. For instance, households with a high proportion of school-aged children, high income, and high education have a high willingness to pay for performance index. White households are also highly willing to pay for performance index.

Interestingly, although households in the highest income cluster were expected to have the highest willingness to pay for school quality, those in the second highest income cluster ($70,068) have a higher willingness to pay than the highest income cluster. This result may be due to the small number of households in the high income cluster and a small standard deviation of performance index. It is also noteworthy that households in a block group with a mixture of public and private school children have higher willingness to pay for performance index than those in the block group that has many school-age children in public school.

5.3.1.3 Diagnostics

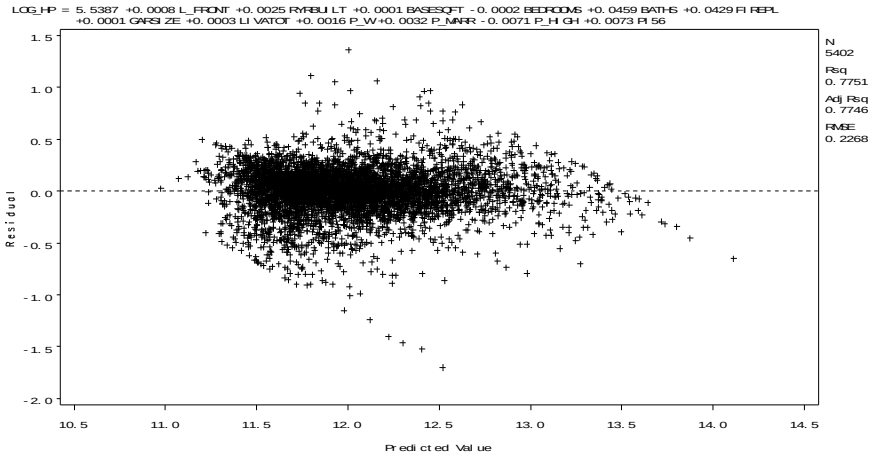
The diagnostic tests applied in this dissertation are the normality test, multicollinearity test, non-linearity test, and heteroscedasticity test. Without various tests, the parameters estimated by the model are not reliable and violate the properties of regression that are a linear function of independent variables in the model and unbiased estimates with least variances. The graphing method is utilized to test normality, mulitcollinearity, non-linearity, and heteroscedasticity. Regarding spatial autocorrelation, Moran's I plot, particularly, is applied along with the value of Moran's I.

Figure 5-5 Result of Normality Test



First, the assumption of the ordinary least squares model, normality of residuals distribution, was tested. The graphical method was utilized as shown in Figure 5-5.

Figure 5-6 Result of Heteroscedasticity Test



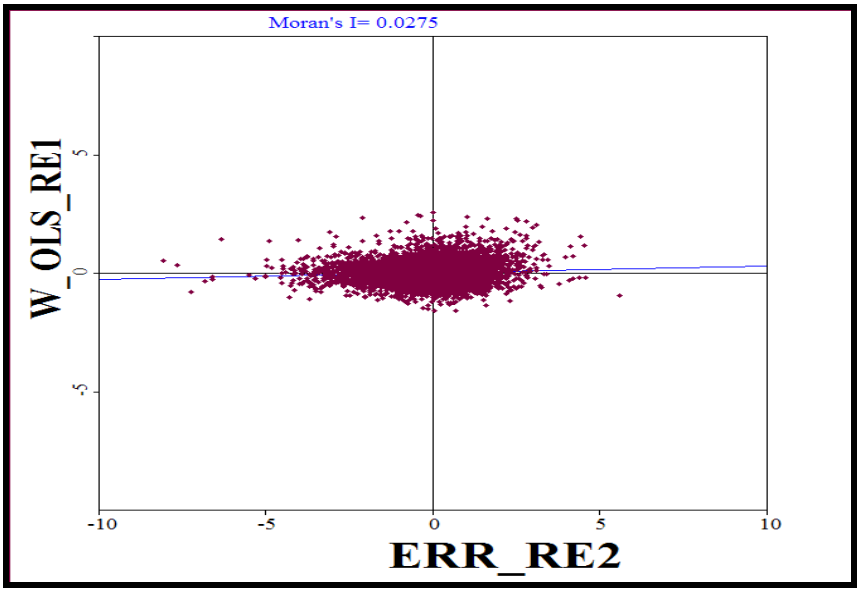
The heteroscedasticity test detects whether the model goes against the assumption of homoscedasticity that is equal variance. The graphical method was utilized to illustrate the pattern of residuals. As shown in Figure 5-6, there is a systematical pattern in residual.

The spatial autocorrelation problem is that there is a systematic residual pattern due to the spatial autocorrelation. The presence of spatial autocorrelation can be detected by Moran's I test, which is based on residuals in the model, that is;

$$I = e'We/e'e$$

where e is a vector of the regression residuals, and W is a spatial weight matrix. Moran's I can be visualized as the slope in the scatter plot with the spatial weighted error versus the unweighted error. The slope of the regression line indicates the Moran's I statistics. See Figure 5-7.

Figure 5-7 Result of Moran's I Test



Another approach to test the spatial autocorrelation problem is the LM test. The LM test is applied to test for two types of misspecification of the model due to either the omission of a spatial autoregressive or the omission of a spatially lagged dependent variable. The LM test statistic for the detection of residual spatial autocorrelation has the following form:

$$\frac{n-k}{m}\frac{R^2}{1-R^2} \qquad (5\text{-}1)$$

Multicollinearity problems arise when there are linear relationships among independent variables. The multicollinearity problem causes biased estimates generated in the model. In order to detect the multicollinearity problem, the variance inflation factor (VIF) is used as an indicator of multicollinearity. If the VIF value of a variable is greater than ten, we can say there is a multicollinearity problem. For

example, although there were initially 18 independent variables used in the model, the variables of age and age squared have high VIF values; therefore. the age variables were removed. The VIF test also shows that other variables have no multicollinearity problems: the VIF ranges from 1.03 to 3.51.

5.3.2 Results of the National Model

The national model was used to estimate collective willingness to pay in a school district in 14 states. The first step (called the hedonic model) is to estimate household marginal willingness to pay for school quality for each state. The amount of household marginal willingness to pay for school quality is estimated by multiplying the marginal willingness to pay by the standard deviation. This was used as the dependent variable in the second step procedure (called the heterogeneous willingness to pay model). The amount of willingness to pay is a function of household demographics and SES (Bajari & Kahn, 2005). The detailed results of each step follow.

5.3.2.1 Result of the Hedonic Price Model

The results of the first step of the hedonic price model indicate the positive relationship between housing prices and school quality variables. The detailed results of the hedonic price model are described in Appendix 35. The R^2 for each state model ranges from 76.8 percent to 92.4 percent, which are highly satisfactory. There are no spatial autocorrelation and multicollinearity problems in the national model.

Unexpectedly, the signs of percentage of homeownership are negative and overall statistically significant (13 out of 14 states). These results reflect the fact that the median housing prices used in this dissertation are not single-family detached housing prices, but are all kinds of housing types, including multi-family housing and attached.

The variable of vacancy rates is not statistically significant, and they are negative overall. The percentage of detached housing has mixed impacts. It is positive in Massachusetts, Pennsylvania, and Washington, which is statistically significant at the 95 percent confidence interval, while it is negative in California and Illinois, all both of which are statistically significant.

It is of interest to note that income[14] has substantial influence on willingness to pay for school quality in the national model as opposed to the results of the Cuyahoga County model. The coefficients of income have a small effect in the models, but those are statistically significant at the 95 percent confidence interval and have very high t-values ranging from 26.48 to 3.10.

The variable of housing age is negative overall and statistically significant. Unlike the county model, tax rate is positively related to housing prices. The variable of density, which is a proxy for lot size, has mixed and is statistically significant overall.

[14] The income variable is standardized as same as the z scores.

Table 5-32 Descriptive Statistics of the National Model

States	# of school districts	Housing prices ($)	RAMP	Std. RAMP	% WTP	Avg. WTP ($)	Rank
Massachusetts	193	205,624	57.2	13.43	10.7*** (4.48)	22,496	1
New Jersey	198	190,176	72.23	14.49	11.6*** (5.55)	22,050	2
Rhode Island	24	149,592	51.38	11.84	13.0** (2.10)	19,485	3
California	249	207,965	43.41	15.46	9.3*** (4.82)	19,327	4
Colorado	34	148,400	80.26	8.51	10.2** (2.29)	15,089	5
Washington	129	147,118	49.11	10.32	9.3*** (5.47)	13,683	6
Delaware	16	112,913	66.13	7.26	8.7*** (2.64)	9,839	7
Michigan	316	113,216	66.36	11.47	5.7*** (5.53)	5,308	8
Texas	421	70,373	79.93	7.39	5.2*** (5.03)	3,631	9
Arkansas	93	65,040	41.67	10.86	5.5*** (2.56)	3,551	10
Pennsylvania	414	100,083	60.36	11.17	3.4*** (4.42)	3,362	11
Indiana	206	94,604	70.47	7.43	2.9*** (3.20)	2,787	12
Illinois	173	98,079	66.88	9.15	2.7*** (1.93)	2,686	13
South Carolina	65	74,617	26.69	9.79	2.0 (0.81)	1,463	14

Note : * = $\alpha \leq .10$, ** = $\alpha \leq .05$, *** = $\alpha \leq .01$

The school quality variables, RAMP, salary, expenditure per pupil, and test scores were used as the measures of school quality. School outcomes, test scores, RAMP are a better measure of school quality in terms of R^2, t-values and the magnitudes of coefficients. The school quality output measure of RAMP is statistically significant in most of the states (11 out of 14), while the input measures are not statistically significant. Table 5-30 shows the number of school districts, the average housing prices, and RAMP, and the average willingness to pay for school quality. The rank is in an order of willingness to pay for school quality in dollars.

By applying the methodology set forth by Black (1999), the implicit prices of RAMP are recovered as shown in Table 5-30. The highest willingness to pay for RAMP in dollars is in Massachusetts, while states with the highest willingness to pay for school quality are Rhode Island (13.0%), New Jersey (11.6%), and Massachusetts (10.7%) in terms of the proportion of housing price. The states with the lowest willingness to pay for school quality are South Carolina (2.0%, $1,463), Illinois (2.7%, $2,686), and Indiana (2.9%, $2,787).

5.3.2.2 Result of Heterogeneous Willingness to Pay Model

The model of the second stage is designed to find the heterogeneous willingness to pay for school quality across school districts with the presence of school-age children, marital status, income, education, race, and occupation. For each model of willingness to pay for school quality, since the price of school quality is standardized, the variance in tax rate and income in each school district were controlled in the model. The national model was used to test Hypothesis IV.

Due to the large differences in the housing market and the implicit prices of school quality in each state, this dissertation also standardized the implicit school quality prices by the same logic of z-value, which is the difference to the mean divided by standard deviation. It is a necessary process for this model when dealing with states that have large variations in housing prices.

Regarding marital status, the R^2 is 74.8 percent, and adjusted R^2 is 74.8 percent. While the tax rate in this model is negative and is not statistically significant, the

variable of income is positive and has a high t-value (67.42). There are four categories: never married, now married, widowed, and divorced. Although the magnitude of never married coefficient is small and is not statistically significant, the signs of those variables are positive. Unexpectedly, other variables are negative and statistically significant at the 95 percent confidence interval.

Since there is a multicollinearity problem, the race model cannot test Whites and African Americans simultaneously, so two models were run separately. The first model tests the White population's willingness to pay for school quality. The positive sign implies that the higher proportion of Whites in a school district, the more they are willing to pay for school quality. Interestingly, a school district with a high proportion of Asians has a greater willingness to pay for school quality than one with Whites. Households living in a school district with some other race and African Americans have less willingness to pay for school quality.

The adjusted R^2 of the education model is 78.2 percent. As expected, education is an important determinant of willingness to pay for school quality. The variables of a high school graduate and associate's degree have negative signs, while the variables of higher education—bachelor's or post-graduate degree—have positive signs, respectively.

Table 5-33 Statistical Results of the National Model

Demographics and SES	Variables	Estimate	t-value	R^2	Adjusted R^2	F
Marital Status	(Constant)	1.766	10.768	74.84%	74.78%	1251.14
	P_Never married	0.000	0.886			
	P_Now married	-0.024	-11.417			
	P_Widowed	-0.012	-2.335			
	P_Divorced	-0.020	-3.995			
	TAX_RATE	0.000	0.187			
	income	0.915	67.418			
Race	(Constant)	-0.106	-1.243	73.30%	73.25%	1386.63
	P_ White	0.002	2.202			
	P_ Asian	0.013	4.783			
	P_ some other	-0.002	-1.486			
	TAX_RATE	0.000	-1.216			
	income	0.839	72.959			
Education	(Constant)			78.29%	78.24%	1516.91
	P_High schools	-0.005	-3.306			
	P_Associate degree	-0.035	-7.044			
	P_Bachelor	0.015	5.016			
	P_postgraduate	0.033	8.685			
	TAX_RATE	-0.002	-5.149			
	Standardized_income	0.691	52.265			
Income	(Constant)	-1.169	-2.646	64.49%	64.39%	654.64
	P_10,000_24,999	-0.029	-3.655			
	P_25,000_39,999	0.020	2.852			
	P_40,000_59,999	0.020	3.311			
	P_60,000_99,999	0.023	3.950			
	P_100,000_149,000	0.008	1.000			
	P_more than 150,000	0.129	21.312			
	TAX_RATE	-0.007	-13.459			
Occupation	(Constant)	0.039	0.138	75.90%	75.82%	992.59
	P_management	0.012	5.940			
	P_education	-0.017	-2.512			
	P_service	0.002	0.450			
	P_sales	-0.011	-2.939			
	P_construction	-0.012	-2.622			
	P_production	-0.003	-0.979			
	TAX_RATE	-0.002	-4.272			
	income	0.739	45.858			

Similar to the result of the education model, income is one of the best measures of willingness to pay in the national model. The R^2 is 64.5 percent and F-value is 654.64. Households in a school district with a median income of $10,000 to $25,999 have less willingness to pay for school quality than households with the higher income. It is also worthwhile to note that the higher the income, the higher the willingness to pay for school quality, holding other variables constant. This result is opposed to the findings of the county model.

Regarding the occupation variables, the results indicate that households who live in a school district in management (statistically significant) and service (statistically not significant) occupations in a school district show positive willingness to pay, while the others show negatively. The detailed results are displayed in Table 5-31.

In summary, the results of the national model are different from those of the individual model. Marital status is not important, while income and education are the most influential variables for willingness to pay for school quality. The different results may result from geographical variances in each state in terms of housing prices and school quality.

CHAPTER VI

CONCLUSIONS AND POLICY IMPLICATIONS

6.1Introduction

This dissertation was motivated by idea that there is a heterogeneous influence of school quality on households of varying demographics and socioeconomic status (SES). Household demographics and SES include the presence of school-age children, marital status, income, race, education, and occupation. This dissertation analyzed the supporting evidence, which includes:

- heterogeneous preference;
- school district choice in an excellent school district; and
- willingness to pay for school quality.

By applying various statistical methodologies, my dissertation was developed to find new approaches to modeling preference for school quality and the role of school quality on homebuyers' school district choices using the discrete choice model, and estimated the heterogeneous willingness to pay for school quality in Cuyahoga County and 14 states in the United States using the hedonic models.

This final chapter starts with the summary of the study, including the purpose of the study and the research question. The summary of research design is discussed in the next section (Section 6.3); followed by four groups of hypotheses regarding household's preference, school district choice, and willingness to pay for school quality. The major findings from the analyses used in this dissertation are addressed and the limitations and the conclusions of this dissertation are also stated, as well as policy implications.

6.2 Summary of Study

The purpose of this dissertation is to examine the role of school quality on homebuyers' preference in location decisions and willingness to pay. When homebuyers make a decision to buy a house, they choose a community with either good school quality or a lesser school quality. They also choose how much they are willing to pay for the quality of the public school education. This study focuses on homebuyers' heterogeneous preferences for school quality, school district choices, and willingness to pay for school quality, based on homebuyers' demographics and SES.

Household preference, school district choice, and willingness to pay are mosaics of the local housing market and affect housing prices among regions. In other words, variances in household preference, school district choice, and willingness to pay lead to housing price differences among regions, as well as regional economic fortunes. Differences in housing prices in a region would reflect heterogeneous households'

willingness to pay for the quality of public services and school quality, holding other variables constant. In addition, differences in household preference, school district choice, and willingness to pay result in heterogeneous demographic backgrounds and SES. This dissertation inquired which types of households care more about school quality.

The study was designed around three research questions: (1) Which homebuyers care about school quality when purchasing a house?, (2) Which homebuyers choose school districts with high school quality or low school quality?, and (3) How much are homebuyers willing to pay for better school quality? Which variables of school quality are most valued?

The research questions designed for this study lead to the development of three groups of hypotheses: the first group of hypotheses tests for homebuyers' preference of school quality. The second group of hypotheses tests homebuyers' school district choice. The third group of hypotheses tests homebuyers' willingness to pay for school quality. The last hypothesis IV is to compare the Cuyahoga County model to the national model.

6.3 Summary of Hypotheses Tests

This study was motivated by an idea that the utility derived from school quality might be different for each household. The lack of individual information led this research to develop survey data and various methodologies. Three methodological

approaches to modeling are to measure heterogeneous preference, school district choice, and willingness to pay.

6.3.1 Hypotheses Group I

I used three approaches to modeling homebuyers' preference for school quality in order to test the Hypothesis Group I. Homebuyer's preference can be defined as their actual preference, and three hypotheses were used to determine their preference. The first approach to examining school quality preference is to test the first hypothesis that "Public School Quality" is the most important factor for homebuyers among a given location choice set. The second approach is to explore to what extent homebuyers consider school quality important. The last approach is to define the measure of school quality homebuyers take into account when purchasing a home.

In previous studies, the relationship between school quality and housing prices is positive. School quality is considered a key factor affecting housing prices in a region. Many studies have quantitatively analyzed not only the positive relationship but also the measures of school quality which are most correlated with housing prices.

Homebuyers were asked whether or not school quality is the most important determinant of housing prices and what measure of school quality was considered when homebuyers purchased a house. To test the hypothesis, this dissertation directly asked homebuyers who purchased a home in Cuyahoga County in 2006.

The detailed results of the first group of hypotheses are as follows. First, the result of the location factors homebuyers think are the most important are stated.

Second, the analysis of the degree of the importance of school quality is addressed. Lastly the measure of school quality homebuyers considered is discussed.

6.3.1.1 Result of Location Factors

When given a reason for buying a house, "location" was the most important factor for homebuyers. The second most important location factor was "public school quality." The probabilities of choosing location were high across almost all homebuyer demographics and SES (income, education, race, marital status, the presence of school-age children, and occupation). The higher the probability of a homebuyer choosing location as the most important factor, the more likely the household is higher income, higher education, and White. Interestingly, the probabilistic results for the presence of school-age children and Asian are distinctive from those of other demographics and SES features. The probability of choosing public school quality for homebuyers with school-age children is 43 percent, while the probability of these households choosing location is 27 percent, both of which are statistically significant at the 95 percent confidence interval. On the contrary, the probability for households without children choosing public school quality is only four percent, while the probability of these households choosing location is 54 percent, both of which are statistically significant at the 95 percent confidence interval. It is worthwhile to note Asians[15] substantially consider school quality. The probability of choosing public school quality for Asian households is 56 percent

[15] The sample size of Asians is only 9 respondents.

(which is statistically significant at the 95 percent confidence interval, while Whites, African Americans, and other races have 27 percent, 26 percent, and eight percent probability, respectively. However, none of them are statistically significant.

6.3.1.2 Result of Importance of School Quality

The second approach to testing the first group of hypotheses is to find out to what extent homebuyers consider school quality is important on the Likert-scale: very important, somewhat important, average importance, not very important, and not at all important. This analysis leads to measuring the heterogeneous willingness to pay for school quality.

As expected, most respondents across all demographics and SES answered that school quality is important. Their summations of probability answering very important, somewhat important, and average importance range from 67 percent to 100 percent. For each demographic and SES category, homebuyers with incomes between $10,000 and $24,999, and $55,000 and $69,999 have the lowest probabilities of rating second quality as important (76 percent and 75 percent, respectively). The probability for households with children is 95 percent, and it is only 71 percent for those with no children. Asians and African Americans have probabilities of 100 percent and 94 percent, respectively. Regarding educational attainment, as educational attainment goes up, the probabilities of stating that school quality is important goes up, with the exception of the some high school category (86

percent). Unexpectedly, the probabilities for occupation variables are not different from one another statistically.

6.3.1.3 Result of School Quality Measure

Inspired by the controversy in the previous literature about which measure of school quality is capitalized into property value, the approach this dissertation made is to ask homebuyers directly. Previous research focused on the relationship between school quality and housing prices confirmed that school outcomes, such as test scores, is a better school measure than input.

The probabilities for each household category are that households with school-age children care about school safety (16%) and school district designation (29%), but neither of these are statistically significant. Interestingly, each race category cares about school measures differently. Asians primarily consider school quality as the percentage of going to college. Whites consider school district designation (28%) and school safety (17%), but neither of these are statistically significant. The preference for school quality measures of African Americans is evenly distributed into school safety (19%), the percentage going to college (16%), and school district designation (19%), but neither of these are statistically significant.

Regarding income categories, low-income households take teacher characteristics and school safety into account, while high-income households think of school district designation. The results of educational attainment indicate the same as the income

results. The higher the educational attainment of the household, the higher probability of choosing school district designation.

Table 6- 1a Hypothesis Group I : Preference for School Quality

Hypothesis #	Hypothesis contents	Expected Sign	Results	Sig.
H I-1 Preference for school quality and homebuyers with children	With school-age children > the average preference	+	+	***
	With no school age children < the average preference	-	-	***
	No Children < average preference	-	-	**
H I-2 Preference for School Quality and Homebuyer' Marital Status	Married > average preference	+	+	
	Never Married < average preference	-	-	
	Widowed < average preference	-	-	
	Divorced < average preference	-	+	
H I-3 Preference for School Quality and Homebuyer's Income	less than 10,000 < average preference	-	NA	
	10,000-24,999 < average preference	-	-	
	25,000-39,999 < average preference	-	+	
	40,000-54,999 < average preference	-	-	
	55,000-69,999 > average preference	+	-	
	70,000-84,999 > average preference	+	-	
	85,000-99,999 > average preference	+	+	
	100,000-149,999 > average preference	+	+	***
	150,000-199,999 > average preference	+	+	
	200,000 or more > average preference	+	+	
H I-4 Preference for School Quality and Homebuyer's Education	some high < average preference	-	-	
	high graduate < average preference	-	-	
	some college < average preference	-	-	
	college graduate > average preference	+	+	**
	Post-graduate > average preference	+	-	
H I-5 Preference for School Quality and Homebuyer's Race/Ethnicity	African American < average preference	-	-	
	White > average preference	+	-	
	Asian < average preference	-	+	**
	some other < average preference	-	-	

Note: * = $\alpha \leq .10$, ** = $\alpha \leq .05$, *** = $\alpha \leq .01$

Table 6- 1b Hypothesis Group I : Preference for School Quality (Cont.)

Hypothesis #	Hypothesis contents	Expected Sign	# of respondents	Sig.
H I-6 Preference for School Quality and Homebuyer's Occupations	Unemployed < average preference	-	+	
	MPRO> average preference	+	+	
	SO< average preference	-	+	
	SOO< average preference	-	-	
	CEMO< average preference	-	-	
	PTMO< average preference	-	-	*

Note: Occupation Categories
Unemployment, (**MPRO)** management, professional, and related occupations, (**SO)** service occupations, (**SOO)** sales and office occupations**, (CEMO)** construction, extraction, and maintenance occupations, and (**PTMO)** production, transportation and material moving occupations

* = $\alpha \leq .10$, ** = $\alpha \leq .05$, ***= $\alpha \leq .01$

6.3.2 Hypotheses Group II

In order to test the second group of the hypotheses of homebuyers' heterogeneous location choice in a school district, six groups of homebuyer demographics and SES were tested. The ordered logit results indicate somewhat different results from those of the ANOTA model.

The probabilities of choosing excellent school districts for households with school-age children, without school-age children, and no children are 59 percent, 46 percent, and 42 percent, respectively. Recalling that the results of the probabilities of choosing public school quality were 43 percent, 15 percent, and four percent,

respectively, the difference in the probabilities of living in an excellent school district does not seem substantial.

Marital status, income, and educational attainment are also important factors affecting school district location choices. The highest probability of living in an excellent school district is 68 percent for a married couple, while a single person has the lowest probability at 39 percent. The higher income and educational attainment households are more likely to make a location choice in an excellent district. These results are consistent with the previous findings.

The probabilities for occupational categories living in excellent school districts range from 44 percent (sales and office occupations) to 62 percent (construction, extraction, and maintenance occupations). Unexpectedly, households in management and professional related and office occupations have less likely to live in excellent school districts and service related occupations. Those in service occupations, and production, transportation, and material moving occupations have higher probability of living in excellent school districts. The detailed probabilities of school districts choices are displayed in Table 5.13 in section 5.2.3 "Results of the ordered logit model."

In summary, the results of location choices in school districts are slightly different from those of the ANOTA model, which explores the preference for school quality. The affordability to live in a good school district plays a critical role in homebuyers' location decision.

Table 6-2 Hypotheses Group II: School District Choice

Hypothesis #	Hypothesis contents	Excepted signs	Results	Sig.
H II-1 School District Choice and Homebuyer with Children.	With school-age children	NA	NA	Reference
	With no school-age children < reference category	-	-	***
	No Children < reference category	-	-	***
H II-2 School District Choice and homebuyers' marital status	Married	NA	NA	Reference
	Never Married < reference category	-	-	*
	Widowed < reference category	-	-	
	Divorced < reference category	-	+	*
H II-3 School District Choice and Homebuyer's Income	less than 10,000 < reference category	NA	NA	NA
	10,000-24,999 < reference category	-	+	***
	25,000-39,999 < reference category	-	+	
	40,000-54,999 < reference category	-	+	
	55,000-69,999	NA	NA	Reference
	70,000-84,999 > reference category	+	+	**
	85,000-99,999 > reference category	+	+	***
	100,000-149,999 > reference category	+	+	***
	150,000-199,999 > reference category	+	+	***
	200,000 or more > reference category	+	+	***
H II-4 School District Choice and Homebuyer's Education	some high school < reference category	-	+	*
	high school graduate < reference category	-	+	***
	some college < reference category	-	+	
	college graduate	NA	NA	Reference
	Post-graduate > reference category	+	+	
H II-5 School District Choice and Homebuyer's Race/Ethnicity	African American < reference category	-	-	***
	White	NA	NA	Reference
	Asian < reference category	-	+	1***
	some other < reference category	-	+	
H II-6 School District Choice and Homebuyer's Occupations	Unemployed < the reference category	-	+	
	MPO > the reference category	+	NA	Reference
	SO < the reference category	-	-	
	SOO < the reference category	-	+	
	CMO < the reference category	-	-	
	PMO< the reference category	-	-	

Note: * = $\alpha \leq .10$, ** = $\alpha \leq .05$, ***= $\alpha \leq .01$

6.3.3 Hypotheses group III

The third group of hypotheses to be tested is how much households are willing to pay for school quality. This dissertation hypothesized that there is heterogeneous willingness to pay for school quality according to households' demographics and SES. It also expected this result would be related to their choices in the sense that households who want to and can pay more for school quality would make a location choice in a good school district.

Two different units of analyses methodological approaches were utilized with individual sales in Cuyahoga County and with aggregated median housing prices in 14 states. The similar results of these models were hypothesized and expected, holding housing and neighborhood characteristics and other school quality constant, in particular differences across states in the national model.

6.3.3.1 Cuyahoga County Model

The methodological approach of this dissertation for the inexistence of individual data is to group heterogeneous households' demographics and SES into relatively homogeneous groups by utilizing cluster analysis. Cluster analysis allows this dissertation to make 18 relatively homogeneous groups for each household demographic and SES in Cuyahoga County based on the proportion of school-age children (four clusters), marital status (three clusters), race (two clusters), income (three clusters), educational attainment (two clusters), and occupation (four clusters).

This dissertation used three school measures: performance index, test scores, and value added, as well as other school inputs. The performance index is a superior school measure over other school measures used in the sense that the performance index is more capitalized than other measures in most of the models.

The overall average willingness to pay for school quality in Cuyahoga County is $8,566 for the performance index, $6,799 for the test scores, and -$1,791 for value added. However, households with school-age children, who are married, White, have higher education, higher income, and are in management and professional occupation, have a higher willingness to pay for school quality than the average willingness for households living in Cuyahoga County.

Comparing the result of the willingness to pay for school quality model with the results of the preference for school quality models, it is true that households with school-age children and married households prefer school quality, live in an excellent school district, and are willing to pay for school quality.

Table 6-3 Hypotheses Group III: Willingness to Pay with Cuyahoga County Sales and Block Group Demographics

Hypothesis		Expected Signs	Results	Sig.
H III-2 Homebuyer with Children	Willingness of households with school-age children to pay for school quality> average willingness to pay for school quality	+	+	**
	Willingness of households with no children to pay for school quality< average willingness to pay for school quality	-	-	**
H III-3 homebuyers' Martial Status	Willingness of households who are married to pay for school quality > average willingness to pay for school quality	+	+	**
	Willingness of households who are never married to pay for school quality < average willingness to pay for school quality	-	-	**
H III-4 Preference for School Quality and Homebuyer's Income	Willingness of households with income $43,227 to pay for school quality < average willingness to pay for school quality	-	-	**
	Willingness of households with $70,069 to pay for school quality > average willingness to pay for school quality	+	+	**
	Willingness of households with $ 122,503 to pay for school quality > average willingness to pay for school quality	+	+	**
H III-5 Preference for School Quality and Homebuyer's Education	Willingness of households with high school graduate or less to pay for school quality < average willingness to pay for school quality	-	-	**
	Willingness of households with college graduate or more to pay for school quality > average willingness to pay for school quality	+	+	**
H III-6 Preference for School Quality and Homebuyer's Race/Ethnicity	Willingness of households who are Whites to pay for school quality > average willingness to pay for school quality	+	+	**
	Willingness of households who are African American to pay for school quality < average willingness to pay for school quality	-	-	**
H III-7 Preference for School Quality and Homebuyer's Occupations	Willingness of households in management and professional occupation to pay for school quality > average willingness to pay for school quality	+	+	**
	Willingness of households in other than management and professional occupation to pay for school quality < average willingness to pay for school quality	-	-	**

Note: The T-test was conducted to test whether or not two groups that is statistically different.

* $= \alpha \leq .10$, ** $= \alpha \leq .05$, *** $= \alpha \leq .01$

6.3.3.2 National Model

The findings of the national model are slightly different from those of the Cuyahoga County model since housing prices used in Cuyahoga County and the national model are different in terms of housing characteristics. While housing prices in the Cuyahoga County model are single housing transaction data, those in the national model are from various housing types. Additionally, the unit of observation in the national model is a school district while that in the county model is individual housing. The results of willingness to pay for school quality for each household demographic and SES are mixed. For instance, although married households were expected to have more willingness to pay for school quality, the result indicates that those who are never married have the highest willingness to pay for school quality. The results of race in both the Cuyahoga County and the national model are consistent. The result of the national model confirms the positive relationship between household income and education and willingness to pay for school quality.

6.3.31 Hypothesis IV

The fourth group of hypotheses compares the results of the Cuyahoga County model to those of the national model. It is hard to compare them to each other since housing prices utilized in the both models are not the same regarding data, study areas, and methodology. The Cuyahoga County model was run with individual housing sales data by separating block groups that have a high proportion of households for each demographics and SES group. The national model has 14 states

with aggregated data by school districts using the two-stage model. It is also worthwhile to note that there are tremendous differences among states in terms of income and housing prices.

Five groups of household demographics and SES were compared: marital status, race, income, education, and occupation. Interestingly, the results of race, income education, and occupation indicate similar patterns. For instance, Whites and Asians are willing to pay more for school quality, and households with higher income, higher education, and management and professional occupations tend to have a higher willingness to pay for school quality.

On the contrary, for households' marital status, the results of both models are not consistent. Married households have the highest willingness to pay for school quality in the Cuyahoga County model, while those who are single seem to have highest willingness to pay for school quality in the national model.

6.4 Conclusions and Policy Implications

School quality has been considered a location-specific amenity that is positively capitalized into housing prices, and it is believed to play a critical role in households' consumption decisions on purchasing a home and location decisions on where to live. The attention is paid to school quality due to the importance of education in the current economy. The importance of school quality in the housing market varies by household in terms of preference, choice, and willingness to pay.

This dissertation explored consumer behavior using a utility function by integrating stochastic (ANOTA and ordered logit) and deterministic (hedonic) approaches. In particular, homebuyers' preferences to purchase homes in a certain school district as indicative of their willingness to pay for school quality based on their demographics and SES. Therefore, this dissertation hypothesized consumer home buying behaviors regarding their different preferences, school district choices, and willingness to pay. The approach to modeling their different behaviors of preference, choice, and willingness to pay is to combine the survey, which is homebuyers' active voices of preference regarding school quality, with the housing sales dataset in Cuyahoga County. The statistical findings of this dissertation conclude that household preferences, choices, and willingness to pay are heterogeneous.

More specifically, this dissertation surveyed homebuyers' preference for school quality in order to listen to their actual voice. The preference in this dissertation is regarded as homebuyers' stated preference which can be defined as preference without any limitation, although household preference has been estimated from their observed behaviors in previous studies. Therefore, the findings on preference for school quality in this dissertation are quite different from those of previous studies, while the results of school district choice and willingness to pay for school quality are consistent with previous studies (Barrow, 2002; Bayer, Ferreira, & McMillan, 2007; Haurin and Brasington, 1996).

It is believed that households with higher income and higher education are willing to purchase homes based on school quality and have the ability to live in a better school districts, while the opposite is true for households with lower income and lower education. However, the statistical findings indicated that elderly households have low priority to school quality, but tend to live in good school districts and have willingness to pay for school quality. Conversely, households who are married with school-age children prefer school quality more, tend to live in better school districts, and have higher willingness to pay for school quality than any other household types that are statistically significant.

Tiebout (1956) asserted that consumer-voters reveal their preference by making location choice in a community that provides the most satisfactory public goods. Previous studies estimate household preference from their observed behavior (Bajari & Kahn, 2005; Bayer, Ferreira, & McMillan, 2007). By estimating households' willingness to pay for a certain characteristic, Bajari and Kahn , and Bayer, Ferreira, and McMillan attempted to recover household preference. Preference recovered in their studies was from observed household behaviors in the housing markets and was regarded as an indicator of willingness to pay for school quality.

However, the statistical results of this dissertation do not support Tiebout's assumption that consumers' reveal their preferences by choosing a community. Some households cannot reveal their preference by making a school district choice because it is assumed that they cannot afford to pay the premium for school quality in a good

school district. For instance, households with school-age children, low income and low education prefer school quality, but they cannot afford in a good school district. African American households rate school quality highly, but the probability of an African American household to live in an excellent school district is only 22 percent. On the other hand, widowed households do care about school quality (only 14 percent probability to choose public school quality), but the probability of living in an excellent school district is 45 percent.

As a result, there is a gap between preference for school quality and actual consumption of school quality by choosing a school district and willingness to pay for school quality. This gap implies disutility or inequity of households who do not reveal their preference. This disutility may cause problems, market failure, and false efficiency. The gap may also result in the issues of affordability of public goods and residential disadvantages.

Any existing economic theory and technique that estimates the unobserved preference from observed consumers' behavior cannot capture households' disutility and explain problems taking place in urban areas because they recover consumers' preference from their observed behaviors. The falsely estimated demand hampers the local government in dealing with those problems of disutility and efficiency. In time, the problems become worse. Failing to estimate demand for school quality does not allow the local governments to allocate resources efficiently.

- There are gaps between households' preference and their behavior.

- These gaps imply disutility and disadvantage of households, which in turn cause problems, market failure, and false efficiency in the housing market.
- The results of this dissertation recommend the efficient allocation of educational resources such as the school voucher program.

The findings of this dissertation provide information to policy makers regarding their residents' heterogeneous preference for a specific public good, school quality, based on residents' demographics and SES. The results of this study also can assist in determining the level of expenditure for education based on the extent residents are willing and able to pay. It also can contribute to educational reform by addressing the efficient allocation of resources to economically disadvantaged residents. The dissertation calls for expanding and facilitating policies providing residents the freedom to choose a school district, particularly in reducing the gap between desire and affordability of residents with school-age children.

6.5 Limitations and Future Research

The limitations of this dissertation come from two issues: the number of the survey sample and multi-type housing prices in the national model. The survey methodological approach was to hear the active voice of homebuyer preference regarding school quality. One of the major limitations of this dissertation is the small number of survey data, making the survey dataset skewed to high income and education. It is hard to find statistical significance due to the small sample for each households' demographic and SES. For instance, there are only two Hispanic

respondents and only one respondent with income less than $10,000. Asian households are represented to some degree, which is statistically significant, however, there are only nine respondents. That causes a threat to validity and reliability, which may affect the accuracy of the measurement.

Additional survey data are needed to find statistical significance in homebuyers' preference for school quality. In future research, more survey samples validate comparisons of actual preference for school quality and consumption behavior for how much a homebuyer is willing to pay for school quality. More survey data for each household's demographic and SES would also give this model more power to explain households' preference for school quality and school district choices. In the ordered logit model, the thresholds are very large and statistically significant, which means a large portion of the model remains unexplained.

In addition to survey data, the housing data used for the national model was not all based on single-family housing but consisted of various housing types (e.g., multi-family, apartment, and condominium), which limited the researcher's ability to compare single-housing sales data collected from Cuyahoga County.

Future research in this subject includes interaction variables of households that have multiple characteristics such as African American and middle income households. For instance, although households with school-age children are assumed to prefer school quality, their behaviors also vary by race, income, and education.

The last recommendation for future studies is that various advanced methodological approaches such as the sample selection model should be developed because households' consumption behaviors in a housing market are complex and complicated.

REFERENCES

Anselin, L. (2003). "Spatial externalities, spatial multipliers, and spatial econometrics." *International Regional Science Review,* Vol. 26 (2), 153-166.

Alonso, W. (1964). *Location and land use; toward a general theory of land rent.* Harvard University: Cambridge, MA.

Arrow, K. (1963). "Social choice and individual values," Cowles Foundation.

Astome, N. M. & McLanahan, S. S. (1991). "Family structure, parental practices and high school completion." *American Sociological Review,* Vol. 56 (3), 309-320.

Bajari, P. & Kahn, M. (2005). "Estimating housing demand with an application to explaining racial segregation in cities." *Journal of Business & Economic Statistics,* Vol. 23(1), 20-33.

Barro, R.J. (2001). "Human capital and growth." The American Economic Review, Vol. 91(2), 12-17.

Barrow, L. (2002). "School choice through relocation: evidence from the Washington, D.C. area." *Journal of Public Economics*, Vol. 86, 155-189.

Basu, S., & Thibodeau, G.T. (1998). "Analysis of Spatial Autocorrelation in House Prices." *The Journal of Real Estate Finance and Economics,* Vol. 17 (1), 61.

Bayer, P., Ferreira, F., & McMillan R. (2007). "A unified framework for measuring preferences for schools and neighborhood." *Journal of Political Economy,* Vol. 115(4), 588.

Bayer, P., Ferreira, F., & McMillan R. (2004). *Tiebout sorting, social multipliers and the demand for school quality.* National Bureau of Economic Research, working paper 10871.

Bayoh, I., Irwin, E.G., & Habb, T. (2006). "Determinants of residential location choice: How important are local public goods in attracting homeowners to central city locations?" *Journal of Regional Science,* Vol. 46(1), 97-120.

Benson, E.D., Hansen, J.L., & Schwartz Jr., A.L. (2000) "Water views and residential property values," *The Appraisal Journal,* Vol. 68 (3), 260-271.

Bethlehem, J. (2006). *ANOTA-Analysis of tables.*

Bingham, R.D., & Felbinger, C.L. (1989). *Evaluation in practice: A methodological approach*, 2nd edition, New York: Longman.

Black, S. (1999). "Do better schools matter? Parental valuation of elementary education." *The Quarterly Journal of Economics*, Vol. 114 (2), 577-599.

Bogart, W. & Brian, C,. (1997). "How much more is a good school district worth?" *National Tax Journal.* Vol. 20 (2).

Bogart, W. & Crowell, B. (1997). "How Much More Is A Good School District Worth?" *National Tax Journal.* Vol. 50(2), 215-232.

Bolitzer, B. & Netusil, N.R (2000). "The impact of open spaces on property values in Portland, Oregon," *Journal of Environmental Management*, Vol. 59, 260-271.

Borooah, V. (2002). *Logit and probit: Ordered and multinomial models*. Thousand Oaks, CA: Sage.

Brasington, D., & Haurin, D. (2006). "Education outcomes and house values: a test of the value added approach." *Journal of Regional Science*, Vol. 46 (2), 245–268.

Brasington, D. (2004). *School quality and the flight to private schools: to what extent are public and private school substitutes?* Department of Economics, Louisiana State University working paper.

Brasington, D. (2002). "The demand for local public goods: The case of public school quality." *Public Finance Review*, Vol. 30 (3), 163-187.

Brasington, D. (1999). 'Which measures of school quality does the housing market value?"*Journal of Real Estate Research*, Vol. 18 (3).

Case, B., & Quigley, M. J. (1991). "The dynamic of real estate price." *The Review of Economics and Statistics*, Vol. 73 (1), 50-58.

Clark, W., & Frans, D. (1996). *Households and housing: Choice and outcomes in the housing market*. Center for Urban Policy Research.

Colby, B.G. & Steve, W. (2002). "Quantifying the influence of desert riparian areas on residential property values," *The Appraisal Journal*, Vol. *70* (3), 304-308.

Coleman, J.S. (1966). *Equality of educational opportunity.* National Center for Educational Statistics.

Cooper, H. M. (1989). "Does reducing student-to-instructor ratios affect achievement?" *Education Psychologist,* Vol. 24 (1), 79-98.

Cortright, J. (2001). "New growth theory, technology and learning." *Review of Economic Development Literature and Practice:* No.4, Impresa, Inc.

Coulson, E.N. & Leichenko, R. M. (2001). "The internal and external impact of historical designation on property values," *Journal Of Real Estate Finance And Economics,* Vol. 23 (1), 113-124.

Darling-Hammond, L. (1999). *Teacher quality and student achievement: A review of state policy evidence.* Center for the Study of Teaching and Policy.

Datcher, Linda. (1982). "Effects of community and family background on achievement." *The Review of Economics and Statistics*, Vol. 64 (1), 32-41.

Desimone, L. (1999). "Linking parent involvement with student achievement: Do race and income matter?" *The Journal of Educational Research*, Vol.93 (1).

Dieleman, F.M., Clark, W., & Deurloo, M. (1989). "A comparative view of housing choices in controlled and uncontrolled housing markets." *Urban Studies*, Vol. 26, 457-468.

Downes, T. & Zabel, J.E. (2002). "The impact of school characteristics on house prices: Chicago 1987-1991." *Journal of Urban Economics,* Vol. 52(1), 1-25.

Ehrenberg, R. G., Crewer, D. J., Gamoran, A., & Willams, J. D. (2001). "Class size and student achievement*." Psychological Science in the Public Interest,* Vol. 2 (1).

Eppel, D. (1987). "Hedonic process and implicit markets: Estimating demand and supply functions for differentiated products." *The Journal of Political Economy*, Vol.95 (1), 59-80.

Epple, D., Zelenitz, A., & Visscher, M. (1978). "A search for testable implications of the Tiebout hypothesis." *The Journal of Political Economy,* Vol. 86(3), 405-425.

Figlio, D. & Lucas, M.E. (2004) "What's in a grade? School report cards and the housing market." *American Economic Review*, Vol. 94(3), 591-604.

Fisher, I. (1892). *Mathematical investigations in the theory of value and prices.* New Haven: Connecticut Academy of Arts and Sciences.

Frank, R. (2000). *Microeconomics and behavior*. New York: McGraw Hill.

Frankel, M. (1991). "Aircraft noise and residential property values: Results of a survey study," *The Appraisal Journal,* Vol. 96 (100).

Fraser, R. & Spencer, G. (1998). "The value of an ocean view: An example of hedonic property amenity valuation," *Australian Geographical Studies,* Vol. *36* (1), 94-98.

Garmise, S. (2006). *People and the competitive advantage of place.* Cleveland: Cleveland State University.

Goodman, A.C. (1988). "An econometric model of housing price, permanent income, tenure choice, and housing demand." *Journal of Urban Economics*, Vol. 23(3), 327.

Green, J. R. (1995). *Microeconomic Theory*. New York: Oxford University Press.

Green, H. (1971). *Consumer Theory*. London: MacMillan.

Greenberg, M. & Hughes, J.(1993). "Impact of hazardous waste sites on property value and land use: Tax assessors' appraisal," *The Appraisal Journal,* Vol. 42-51.

Grether, D., & Plott, C. (1979). "Economic theory of choice and the preference reversal phenomenon." *The American Economic Review,* Vol. 69 (4), 623-638.

Gujarati, D. (2003). *Basic Econometrics*. New York: McGraw-Hill.

Henderson, J. V., & Ioannides, Y.M. (1983). "A model of housing tenure choice." *The American Economic Review,* Vol.73(1), 98-113.

Hanemann, M. W. (1984). "Discrete/Continuous model of consumer demand." *Econometrica,* Vol. 52 (3), 541-561.

Hanushek, E. (1998). *The evidence on class size.* Occasional paper no. 98-1, Wallis Institute of Political Economy, University of Rochester.

Hanushek, E. (1986). "The economics of schooling: production and efficiency in public schools." *Journal of Economic Literature*, Vol. 24 (3), 1141-1177.

Hanushek, E. (1971). "Teacher Characteristics and Gains in Student Achievement: Estimation Using Micro Data." *American Economic Review*, Vol. 61 (2), 280.

Hanushek, E., & Woessmann, L. (2007). *The role of school improvement in economic development.* National Bureau of Economic Research, working paper 12332.

Hastings, J. S., Kane, T. J., & Staiger, D. O. (2005). *Parental preferences and school competition: Evidence from a public school choice program*. National Bureau of Economic Research Working paper, No.11805.

Haurin, D., & Brasington, D. (1996). "School quality and real house prices: inter-and intrametropolitan effects." *Journal of Housing Economics*, Vol.5, 351-368.

Hayes, K., & Taylor, L. (1996). *Neighborhood school characteristics: what signals quality to homebuyers?* Federal Reserve Bank of Dallas Economic review, fourth quarter.

Hedges, L., Laine, R., & Rob, G. (1996). "Does money matter? A Meta-analysis of studies of the effects of differential school input on student outcomes." *Education Research*, Vol. 23 (3), 5-14.

Henderson, V., & Ioannides, Y. (1986). "Tenure choice and the demand for housing." *Econometrica,* Vol.53 (210), pp. 231-246.

Hendler, R. (1975). "Lancaster's new approach to consumer demand and its limitations." *The American Economic Review,* Vol. 65(1), 194-199.

Hicks, J., & Allen, R.G.D. (1934). "A reconsideration of the theory of value." *Economiica,* Vol. 1(1), 52-76.

Ho, E. S, & Willms, J. D. (1996). "Effect of parental involvement on eighth-grade achievement." *Sociology of Education,* Vol. 69 2), 126-141.

Houtenville, A. J., & Conway, K. S. (2005). *Parental effort, school resources and student achievement.* Unpublished manuscript.

Hughes, W.T. & Sirmans, C.F. (1992). "Traffic externalities and single family house prices," *Journal of Regional Science*, Vol. 32 *(4),* 487-500.

Hurd, R. M. (1903). *Principles of city land values.* New York: The Record and Guide.

Hicks, J. R. (1956). "Revision of demand theory." Oxford: Clarendon Press.

Krutilla, J. (1967). "Conservation reconsidered." *The American Economic Review*, Vol. 57 (4), 777-786

Lattan, J., Carroll, J.D., & Green, P.E. (2003). *Analyzing multivariate data.* Toronto: Brooks/Cole, Thomson Learning.

Lancaster, K. J. (1966), "A New Approach to Consumer Theory." *Journal of Political Economy*, 74 (2), 132.

Leggett, C. & Bockstael, N. (2000). "Evidence of the effect of water quality on residential land process," *Journal Of Environmental Economics And Management*, Vol. 39, 121-144.

Leichenko, R.M., Coulson, N. E. & Listokin, D. (2001). "Historical preservation and residential property values: An analysis of Texas cities," *Urban Studies*, Vol. 38 (11), 1973-1987.

Li, M. (1977). "A logit model of homeownership." *Econometrica*, Vol. 45 (5), 1081-1097

Liao, T. F. (1994). "Interpreting probability models logit, probit, and other generalized linear models." London: Sage.

Lu, M. (1999). "Determinants of residential satisfaction: Ordered logit vs. regression models." *Growth and Change*, Vol. 30 (2), 264.

Mathur, V. (1999). "Human capital-based strategy for regional economic development." *Economic Development Quarterly*, Vol. 13 (3), 203-216.

Mayer, D. P., Mullens, J.E., & Moore, M.T. (2000). *Monitoring school quality: An indicators report.* National Center for Education Statistics 2001-030.

McConnell, K. E. (1997). "Does altruism undermine existence value?" *Journal of Environmental Economics and Management*, Vol. 32 (1), 22

McFadden, D. (1977). *Modeling the choice of residential location*. Cowels Foundation discussion paper, No.477, Yale University: New Haven, CT.

Meyer, R. H. (1997). "Value-added indicators of school performance: A primer." *Economics of Education Review*, Vol. 16 (3), 283-301.

Murie, A., Dieleman, F.M., & Hooimeijer, P. (1991). "Housing asset values and the mobility of elderly home owners: housing research and policy issues." *Netherlands Journal of Housing and the Built Environment.* Vol.6 (1), 21-34.

Murnane, R. J., Maynard, R. A., & Ohls, J. C. (1981). "Home resources and children's achievement." *The Review of Economics and Statistics*, Vol. 63 (3), 369-377.

Muth, R.F. (1969). *Cities and housing, the spatial pattern of urban residential land use.* Chicago: The University of Chicago Press.

Nechyba, T., & Strauss, R. (1998). "Community choice and local public services: A discrete choice approach." *Regional Science and Urban Economics*, Vol. 28 (1), 51-74.

Oates, W. (1969). "The effect of property taxes and local public spending on property values; an empirical study of tax capitalization and the Tiebout hypothesis." *The Journal of Political Economy*, Vol. 77 (6), 957-971.

Olson, M. (1965). *The Logic of Collective Action.* Cambridge, MA: Harvard University Press.

O'Sullivan, A. (2003). *Urban Economics.* New York: McGraw Hill.

Owens, J. (2004). *A review of the social and non-market returns to education.* United Kingdom: ELWA.

Painter, G., Gabriel, S., & Myers, D. (2001). "Race, immigrant status, and housing tenure choice." *Journal of Urban Economics*, Vol. 49, 150-167.

Pareto, V. (1896). *Course of political economy.* Lausanne.

Pearlin, L. I., & Kohn, M. L. (1966). "Social class, occupation, and parental values, a cross-national study." *American Sociological Review*, Vol.31 (4), 466-479.

Perl, L. J. (1973). "Family background, secondary school expenditure, and student ability." *The Journal of Human Resources*, Vol. 8 (2).

Pollakowski, H. (1973). "The effects of property taxes and local public spending on property values: a comment and further results." *The Journal of Political Economy*, Vol. 81 (4), 994-1003.

Quigley, J. M. (1984). "Consumer choice of dwelling, neighborhood and public services." *Regional Science and Urban Economics*, Vol.15, 41-63.

Rapaport, C. (1997). "Housing demand and community choice: An empirical analysis." *Journal of Urban Economics,* Vol. 42, 243-260.

Rea, L., & Parker, R. (2005). "*Designing and conducting survey research."* San Francisco: Jossey-Bass.

Ricardo, D. (1817). *Principles of political economy and taxation*. London.

Rivkin, S.G., Hanushek, E.A., & Kain, J.F. (2001) *Teachers, schools, academic achievement.* Working Paper, No. 6691, National Bureau of Economic Research

Romer, P. M. (1994). "The origins of endogenous growth." *The Journal of Economic Perspectives,* Vol. 8 (1), 3-22.

Romer, T. & Rosenthal, H. (1978). *"Political resource allocation, controlled agendas, and the status quo."* Public Choice. Vol. 33, 27-43.

Rosen, B. C. (1959). "Race, ethnicity and the achievement syndrome." *American Sociological Review,* Vol. 24 (1), 47-60.

Rosen, H., & Fullerton, D. (1977). "A note on local tax rates, public benefit levels, and property values." *The Journal of Political Economy*, Vol. 85 (2), 433-440.

Rosen, S. (1974). "Hedonic price and implicit markets: Product differentiation in pure competition." *The Journal of Political Economy*, Vol. 82 (1),34-55.

Samuelson, P. A. (1948). "Consumption theory in terms of revealed preference." *Economica*, Vol.15 (60), 243-253.

Samuelson, P. A. (1938). "A note on the pure theory of consumer behavior." *Economica*, Vol. 5, 67-71.

Sen, Amartya (1973). "Behavior and the concept of preference." *Economica,* Vol.40 (159), 241-259.

Sen, A. (1971). "Choice functions and revealed preference." *The Review of Economic Studies*, Vol. 38 (3), 307-317.

Seo, Y. & Simons, R. A. (2007). *The effect of school quality on residential sales price.* Unpublished manuscript/*.Submitted to the *Journal of Real Estate Research*

Shadish, W., Cook, T., & Campbell, D. (2002). *Experimental and Quasi-experimental Designs*. New York: Houghton Mifflin.

Simon, H. A. (1955). "A behavioral model of rational choice." *The Quarterly Journal of Economics,* Vol. 69 (1), 99-118.

Social Indicators 2003-2004 (2004) *Housing,* The Center for Community Solutions.

Tideman, T.N. (1983). "An experiment in the demand-revealing process." Public Choice, Vol. 41(3), 387-401.

Tiebout, C. M. (1956). "A pure theory of local expenditures." *The Journal of Political Economy*, Vol. 64(5), 416-412.

Thünen, V.J. (1826). *The isolated state.* English edition, London: Pergamon.

Wayne, A. J. & Young, P. (2003). "Teacher characteristics and student achievement gains: A review." *Review of Educational Research*, Vol. 73 (1), 89-122.

Weiss, J. (2004). *Public schools and economic development*. Knowledge Work Foundation working paper.

Winkler, D. R. (1978). "Education achievement and school peer group composition." *Journal of Human Resources*, Vol. 10 (2), 189-204.

Wobmann, L. (2003). "Specifying Human Capital." *Journal of Economic Surveys,* Vol. 17 (3),239-270.

Yinger, J. (1982). "Capitalization and the theory of local public finance." *The Journal of Political Economy,* Vol. 90 (5), 917-943

Yinger, J., Bloom, H., Borsch-Supan, A., & Ladd, H. (1988). *Property taxes and house values; the theory and estimation of intrajurisdictional property tax capitalization*. Academic Press.

APPENDICES

APPENDIX1: Standard Occupational Classification

Male:	Census Code	Equivalents
Management, professional, and related occupations:	001-359	11-0000 through 29-0000
Management, business, and financial operations occupations:	001-099	11-0000 through 13-0000
Management occupations, except farmers and farm managers	001-019, 022-049	11-1000 through 11-3000, 11-9020 through 11-9190
Farmers and farm managers	020, 021	11-9010
Business and financial operations occupations:	050-099	13-0000
Business operations specialists	050-079	13-1000
Financial specialists	080-099	13-2000
Professional and related occupations:	100-359	15-0000 through 29-0000
Computer and mathematical occupations	100-129	15-0000
Architecture and engineering occupations:	130-159	17-0000
Architects, surveyors, cartographers, and engineers	130-153	17-1000 through 17-2000
Drafters, engineering, and mapping technicians	154-159	17-3000
Life, physical, and social science occupations	160-199	19-0000
Community and social services occupations	200-209	21-0000
Legal occupations	210-219	23-0000
Education, training, and library occupations	220-259	25-0000
Arts, design, entertainment, sports, and media occupations	260-299	27-0000
Healthcare practitioners and technical occupations:	300-359	29-0000
Health diagnosing and treating practitioners and technical occupations	300-329, 354-359	29-1000 and 29-9000
Health technologists and technicians	330-353	29-2000
Service occupations:	360-469	31-0000 through 39-0000
Healthcare support occupations	360-369	31-0000
Protective service occupations:	370-399	33-0000
Fire fighting, prevention, and law enforcement workers, including supervisors	370-372, 374-389	33-1010, 33-1020, 33-2000 through 33-3000
Other protective service workers, including supervisors	373, 390-399	33-1090 and 33-9000
Food preparation and serving related occupations	400-419	35-0000
Building and grounds cleaning and maintenance occupations	420-429	37-0000
Personal care and service occupations	430-469	39-0000
Sales and office occupations:	470-599	41-0000 through 43-0000
Sales and related occupations	470-499	41-0000
Office and administrative support occupations	500-599	43-0000
Farming, fishing, and forestry occupations	600-619	45-0000
Construction, extraction, and maintenance occupations:	620-769	47-0000 through 49-0000
Construction and extraction occupations:	620-699	47-0000
Supervisors, construction and extraction workers	620	47-1000
Construction trades workers	621-679	47-2000 through 47-4000
Extraction workers	680-699	47-5000
Installation, maintenance, and repair occupations	700-769	49-0000
Production, transportation, and material moving occupations:	770-979	51-0000 through 53-0000
Production occupations	770-899	51-0000
Transportation and material moving occupations:	900-979	53-0000
Supervisors, transportation and material moving workers	900-902	53-1000
Aircraft and traffic control occupations	903-910	53-2000
Motor vehicle operators	911-919	53-3000
Rail, water and other transportation occupations	920-949	53-4000 through 53-6000
Material moving workers	950-979	53-7000

Source: U.S. Census

APPENDIX 2: IRB Approval of the Survey

Cleveland State University

College of Graduate Studies and Research
Office of Sponsored Programs and Research
Institutional Review Board (IRB)

Memorandum

To: Robert Simons
Urban Studies

From: Barbara Bryant
IRB Recording Secretary

Date: March 3, 2008

Re: Results of IRB Review of your project number: **28166-SIM-HS**
Co-Investigator: Youngme Seo
Entitled: Who cares about school quality? The role of school quality in homebuyers' location decision and housing

The IRB has reviewed and approved your application for the above named project, under the category noted below. Approval for use of human subjects in this research is for one year from today. If your study extends beyond this approval period, you must again contact this office to initiate an annual review of this research.

By accepting this decision, you agree to notify the IRB of: (1) any additions to or changes in procedures for your study that modify the subjects' risk in any way; and (2) any events that affect that safety or well-being of subjects.

Thank you for your efforts to maintain compliance with the federal regulations for the protection of human subjects.

Approval Category: **Date: February 28, 2008**

__X__ Expedited Review: Project approved, Expedited Category **7**

cc: Project file

Mailing Address: 2121 Euclid Avenue, HH 3rd Floor • Cleveland, Ohio 44115-2214
Campus Location: Hannifin Hall, 3rd Floor • 2258 Euclid Avenue • Cleveland, Ohio
(216) 687-3630 • Fax (216) 687-9382

Trans #:

Cleveland State University

Institutional Review Board for Human Subjects in Research
Application for Project Review

I. Title Page

Date (mm/dd/yyyy): 02/07/2008 **Transaction Number (office use only):** 28166-Sim-HS
Project Title: Who cares about school quality? The role of school quality in homebuyers' location decision and housing prices

PRINCIPAL INVESTIGATOR OR ADVISOR
Name: (Last, First): Simons, Robert Title: Professor
Department: URBAN AFFAIRS Campus Address: 1717 Euclid Ave, Cleveland Oh 44115
Electronic Mail Address: robr@urban.csuohio.edu
Office Phone: (216) 687-5258 Home Phone: (216) 401-1700
Has the investigator completed the CITI course in the protection of human subjects? ☒ Yes ☐ No

CO-PRINCIPAL OR STUDENT INVESTIGATOR
Name: (Last, First): Seo, Youngme Title: Student
Department: Urban Affairs
Electronic Mail Address: y.seo@csuohio.edu
Office Phone: ( ) - Home Phone: (440) 554-9089
Has the investigator completed the CITI course in the protection of human subjects? ☐ Yes ☒ No

If this is a student investigator, please indicate status:
☐ Undergraduate ☐ Master level student ☒ Doctoral level student
and level of involvement in the research:
☐ Assisting Faculty Research ☐ Thesis ☒ Dissertation ☐ Classroom project: Class name/number ____

ADDITIONAL INVESTIGATORS? ☐ Yes ☒ No **(If yes, please complete the "Additional CSU Investigators" form.)**

PROPOSED PROJECT DURATION (research may not begin prior to IRB approval):
From (mm/dd/yyyy): 02/01/2008 To (mm/dd/yyyy): 12/31/2008 (date following anticipated approval; maximum one year later)

Please be aware that ***data collected prior to approval or outside of authorized dates may not be used.*** If your study (i.e. collection of data) will extend beyond the one year authorization, ***it is your responsibility to notify the IRB prior to expiration and request an extension.***

***Type of funding or support: Other Sponsor

FOR IRB USE ONLY

Initial Evaluation	Final IRB Action
☐ Approve as is	☐ Exempt Status: Project is exempt under 45 CFR 46.101 ____
☒ Requires Revision before evaluation or final action	☒ Expedited Review: Approval Category 7
☐ Full IRB review required 02/05/08	☐ Regular IRB approval
	☐ Other: ____

Reviewer: [signature] Signature: [signature] Approval Date: 02-8-08

Cleveland State University Office of Sponsored Programs and Research IRB
Form updated 11/30/2007
All other forms are obsolete
dpo

APPENDIX 3: Survey Instrument

Survey of Homebuyers' Preference for School Quality and Location Choice

Hello, my name is _____ from Field Housing Market Research, a research firm based in_____. We are conducting a brief survey for Young Me Seo's dissertation from Cleveland State University that examines the role of public school quality on homebuyer location decisions and housing prices advised by Dr. Simons. The questions of your demographic, status and preference for the school quality will be asked. You have been randomly selected and all responses are confidential. Participation is voluntary and you may withdraw at any time. It will take about ten minutes. Do you have a few moments to participate? Y/N____

SECTION I: GENERAL INFORMATION

1. Are you a homeowner?	Yes	No
2. What year did you purchase the house?		
3. In what city do you live (and indicate your zip code)?	City	Zip Code
4. How many bedrooms do you have? Bathrooms?	Number of bedrooms	Number of bathrooms
5. What was the purchase price of your homes?	$	
6. Where did you live previously?	The same city	
	Different city in the same county	
	A different county	
	Outside of Ohio	

1

SECTION II: SCHOOL QUALITY

7. When searching for your new home, where did you get information about school quality?	Newsletter		Newspaper	
	Magazine		Web-site	
	Word of mouth		Parent/teacher meeting	
	Others (where?)		Multiple listing Service	
8. What were the three most important reasons for your decision to buy the house you did?	Location		Public Transportation	
	Neighbors		Amenity or Convenience Facility (shopping center, etc.)	
	Safety		Near friends/relatives	
	Public School Quality		Other	
	Housing size		Housing style	
9. If public school quality was among your choices for the previous question, how important was school quality when you were deciding to buy your house?	Very Important		Somewhat Important	
	Average importance		Not Very Important	
	Not at all Important		Not sure	

10. Please answer the following factors related to school factors you considered when you bought your house.
(1 =Very Important,
2 = Somewhat Important,
3 = average importance,
4 = Not Very Important,
5 = Not Important at All).

	1	2	3	4	5	Not Sure
a) Teacher's education						
a) Teacher experience						
b) Teacher salary						
c) Class size						
d) Per pupil expenditure						
e) School safety						
f) Amount of homework						
g) Sports programs						
h) Parent Teacher Organization (PTO) meeting						
i) Percent of student going to college						
j) Attendance rates						
k) Graduation rates						
l) SAT scores						
m) Standardized Math Test scores						
n) Standardized Reading Test scores						
o) School District Designations, such as excellent, effective, continuous improvement, and academic watch						

11. What three school (or district) factor(s) listed from a) to o) in question number 10 were most important when you were deciding to buy your house?

(1)
(2)
(3)

12. Do you know the school district designation that the State of Ohio has given to your school district? (yes/no) If yes, what is it?		
13. Which is more important, school district quality or features at your oldest school age child's school?	School District	School your child attending

14. How many children do you have?		
15. Do you have a K-12 school-aged child?	Yes	No

If you answered yes, go to question number 16
If you answered no, go to question number 21

SECTION III: STUDENTS INFORMATION ABOUT SCHOOL & ACHIEVEMENT

Please answer the questions regarding your oldest K-12 school age child information.

16. What grade is your oldest child in K-12?						
17. Please indicate the type of school	Public School		Home Schooling			
	Charter School		Religious Private School			
	Other(types?)		Non-Religious Private School			
18. Is your child in any of the following? If yes please check.	**Math**		**Science**		**Reading**	
	Remedial		Remedial		Remedial	
	Advanced Placement		Advanced Placement		Advanced Placement	
	Honors		Honors		Honors	
19. What is your child's overall grade point average (approximately)?	Less than 2.0					
	2.0 – 2.9					
	3.0 – 3.9					
	4.0 or Higher					
	Not Sure					
20. What is your relationship to the child?	Mother		Aunt/Uncle			
	Father		Foster parent			
	Stepmother or Stepfather		Legal Guardian			
	Grandmother/Grandfather					

SECTION IV: HOMEBUYERS' DEMOGRAPHIC INFORMATION

21. What is your gender?	Male			
	Female			
22. What is your age?	Less then 20		21-30	
	31-40		41-50	
	51-60		61-70	
	71-80		Older than 80	
23. What is your race/ethnicity? (Please check the appropriate box).	African American		White	
	Hispanic		Asian	
	Native American		Other	
24. What is your approximate total household income per year before tax?	Below $10,000		$10,001 -$24,999	
	$25,000 -$39,999		$40,000 -$54,999	
	$55,000 -$69,999		$70,000 -$84,999	
	$85,000 -$99,999		$100,000-$149,999	
	$150,000 -$199,999		Over $200,000	
25. What is the highest education level you completed?	Primary		High School Incomplete	
	High School Graduate		College Graduate	
	Associate Degree		Bachelor Degree	
	Masters Degree		Doctoral (Ph.D.; MD; JD)	
26. If you are employed, is it full time or part-time?	Part-Time			
	Full-Time			
	Not employed			
27. How many people in your family work outside the home?				
28. Please describe your current occupation in 5 words or less?				
29. Marital status	Single			
	Married			
	Divorced			
	Widowed/Widower			

30. Are there any comments regarding school quality that you would like to share?

Thank for your time. If you have any questions about the survey, you can contact to CSU Institutional Review Board telephone number of (216) 687-3630. Ms. Seo's phone number is 440-554-9089 and Dr. Simons is 216-687-3845.

APPENDIX 4: Survey Results

2. What year did you purchase your house?

Value	Frequency	Percent	Cum. %
2006	348	87	87
2007	51	12.75	99.75
2008	1	0.25	100

Mean:	2006.132
Median:	2006
Standard deviation:	0.347
Standard error:	0.017
Value:	2006
Frequency:	348

3B. May I have your zip code?

Value	Frequency	Percent	Cum. %
41107	1	0.25	0.25
44017	9	2.25	2.5
44022	7	1.75	4.25
44070	12	3	7.25
44105	1	0.25	7.5
44106	1	0.25	7.75
44107	31	7.75	15.5
44112	1	0.25	15.75
44116	15	3.75	19.5
44117	1	0.25	19.75
44118	28	7	26.75
44120	7	1.75	28.5
44121	14	3.5	32
44122	21	5.25	37.25
44123	6	1.5	38.75
44124	15	3.75	42.5
44125	7	1.75	44.25
44126	11	2.75	47
44128	1	0.25	47.25
44129	14	3.5	50.75
44130	16	4	54.75
44131	11	2.75	57.5

44132	4	1	58.5
44133	6	1.5	60
44134	10	2.5	62.5
44136	12	3	65.5
44137	2	0.5	66
44138	9	2.25	68.25
44139	32	8	76.25
44140	11	2.75	79
44141	13	3.25	82.25
44142	3	0.75	83
44143	13	3.25	86.25
44144	5	1.25	87.5
44145	18	4.5	92
44146	5	1.25	93.25
44147	11	2.75	96
44149	16	4	100

Mean:	44116.12
Median:	44129
Standard deviation:	153.122
Standard error:	7.656
Value:	44139
Frequency	32

4A. How many bedrooms do you have?

Value	Frequency	Percent	Cum. %
2	16	4	4
3	182	45.5	49.5
4	172	43	92.5
5	24	6	98.5
6	5	1.25	99.75
7	1	0.25	100

Mean:	3.558
Median:	4
Standard deviation:	0.744
Standard error:	0.037
Frequency:	182
Value:	3

4B. How many bathrooms?

Value	Frequency	Percent	Cum. %
1	61	15.25	15.25
2	191	47.75	63
3	104	26	89
4	34	8.5	97.5
5	5	1.25	98.75
6	4	1	99.75
7	1	0.25	100

Mean:	2.368
Median:	2
Standard deviation:	0.977
Standard error:	0.049
Frequency:	191
Value:	2

5. What was the purchase price of your home?

Value	Frequency	Cum. %
Less than $100,000	5	3.25
$100,000-$150,000	117	29.25
$150,001-$200,000	93	53.75
$200,001-$300,000	107	80.5
$300,001-$40,0000	39	90.25
more than $400,000	39	1000

Mean:	243432
Median:	200000
Standard deviation:	168989
Standard error:	8449
Frequency:	25

6. Where did you live previously?

	Frequency	Percent
1 The Same City	99	24.80%
2 Different City In The Same County	171	42.80%
3 A Different County	48	12.00%
4 Outside Ohio	82	20.50%
Total Qualified	400	100.00%

7. When searching for your new home, where did you get information about school quality?

	Frequency	Percent
1 Newsletter	13	3.20%
2 Newspaper	54	13.50%
3 Magazine	51	12.80%
4 Web-Site	137	34.20%
5 Word Of Mouth	227	56.80%
6 Parent/Teacher Meeting	15	3.80%
7 Multiple Listing Service	39	9.80%
8 (Do Not Read) Other (Specify)	72	18.00%
9 (Do Not Read) Did Not Research/Don't Know	39	9.80%
Total Qualified	400	100.00%

8A. What was the most important reason for your decision to buy the house you did?

	Frequency	Percent
1 Location	144	36.00%
2 Public Transportation	3	0.80%
3 Neighbors	9	2.20%
4 Amenity Of Convenience Facility (Shopping Center, Etc.)	9	2.20%
5 Safety	18	4.50%
6 Near Friends/Relatives	42	10.50%
7 Public School Quality	106	26.50%

8 Housing Size	21	5.20%
9 Housing Style	25	6.20%
10 (Do Not Read) Other (Specify)	22	5.50%
11 (Do Not Read) None Of The Above	1	0.20%
Total Qualified	400	100.00%

8B. What was the second most important reason for your decision to buy the house you did?

	Frequency	Percent
1 Location	74	18.50%
2 Public Transportation	5	1.20%
3 Neighbors	29	7.20%
4 Amenity Of Convenience Facility (Shopping Center, Etc.)	31	7.80%
5 Safety	34	8.50%
6 Near Friends/Relatives	45	11.20%
7 Public School Quality	58	14.50%
8 Housing Size	44	11.00%
9 Housing Style	47	11.80%
10 (Do Not Read) Other (Specify)	28	7.00%
11 (Do Not Read) None Of The Above	5	1.20%
Total Qualified	400	100.00%

8c. What was the third most important reason for your decision to buy the house you did?

	Frequency	Percent
1 Location	55	13.80%
2 Public Transportation	4	1.00%
3 Neighbors	31	7.80%
4 Amenity Of Convenience Facility (Shopping Center, Etc.)	66	16.50%
5 Safety	48	12.00%
6 Near Friends/Relatives	33	8.20%

7 Public School Quality	47	11.80%
8 Housing Size	39	9.80%
9 Housing Style	43	10.80%
10 (Do Not Read) Other (Specify)	27	6.80%
11 (Do Not Read) None Of The Above	7	1.80%
Total Qualified	400	100.00%

9. How important was school quality when you were deciding to buy your house?

	Frequency	Percent
1 Very Important	235	58.80%
2 Somewhat Important	83	20.80%
3 Average Importance	25	6.20%
4 Not Very Important	23	5.80%
5 Not At All Important	33	8.20%
6 (DO NOT READ) DON'T KNOW/Refused	1	0.20%
Total Qualified	400	100.00%

11a. Which school factor was most important when you were deciding to buy your house?

	Frequency	Percent
1 A. Teachers' Education	22	5.50%
2 B. Teacher Experience	21	5.20%
3 C. Teacher Salary	2	0.50%
4 D. Class Size	42	10.50%
5 E. Per Pupil Expenditure	11	2.80%
6 F. School Safety	66	16.50%
8 H. Sports Programs	2	0.50%
9 I. Parent Teacher Organization (PTO) Meeting	2	0.50%
10 J. Percent Of Students Going To College	33	8.20%
12 L. Graduation Rates	32	8.00%
13 M. Sat Scores	8	2.00%
14 N. Standardized Math Test Scores	3	0.80%
15 O. Standardized Reading Test Scores	6	1.50%

16 P. School District Designations, such As Excellent, Effective, Etc	110	27.50%
17 (Do Not Read) None Of The Above	40	10.00%
Total Qualified	400	100.00%

12a. Do you know the school district designation that the state of Ohio has given to your school district?

	Frequency	Percent
1 YES	202	50.50%
2 NO	198	49.50%

13. How many children do you have?

Value	Frequency	Percent	Cum. %
0	82	20.5	20.5
1	87	21.75	42.25
2	136	34	76.25
3	70	17.5	93.75
4	15	3.75	97.5
5	8	2	99.5
6	1	0.25	99.75
8	1	0.25	100

Mean:	1.708
Median:	2
Standard deviation:	1.261
Standard error:	0.063
Value:	2
Frequency:	136

14. Do you have a k-12 school-aged child?

	Frequency	Percent
1 YES	198	62.30%
2 NO	120	37.70%
Total Qualified	318	100.00%

15. Which is more important?

	Frequency	Percent
1 school district quality	134	67.70%
2 or, features at your oldest age child's school	58	29.30%
3 (do not read) not sure	6	3.00%
Total qualified	198	100.00%

16. What grade is your oldest child in k-12?

	Frequency	Percent
1 K	11	5.60%
2 1ST	13	6.60%
3 2ND	19	9.60%
4 3RD	16	8.10%
5 4TH	19	9.60%
6 5TH	13	6.60%
7 6TH	19	9.60%
8 7TH	12	6.10%
9 8TH	13	6.60%
10 9TH	17	8.60%
11 10TH	21	10.60%
12 11TH	16	8.10%
13 12TH	9	4.50%
Total Qualified	198	100.00%

17. Please indicate the type of school

	Frequency	Percent
1 Public School	161	81.30%
2 Home Schooling	4	2.00%
3 Charter School	3	1.50%
4 Religious Private School	26	13.10%
5 Non-Religious Private School	4	2.00%

Total Qualified	198	100.00%

18. Is your child in any of the following?

	Frequency	Percent
1 Remedial Math	9	4.50%
2 Advanced Placement Math	34	17.20%
3 Honors Math	25	12.60%
4 Remedial Science	5	2.50%
5 Advanced Placement Science	23	11.60%
6 Honors Science	19	9.60%
7 Remedial Reading	10	5.10%
8 Advanced Placement Reading	21	10.60%
9 Honors Reading	25	12.60%
10 (Do Not Read) Don't Know/None Of The Above	116	58.60%
Total Qualified	198	100.00%

19. What is your child's overall grade point average (approximately)?

	Frequency	Percent
1 Less Than 2.0	2	1.00%
2 2.0-2.9	18	9.10%
3 3.0-3.9	95	48.00%
4 4.0 Or Higher	30	15.20%
5 (Do Not Read) Not Sure	53	26.80%
Total Qualified	198	100.00%

20. What is your relationship to the child?

	Frequency	Percent
1 Mother	126	63.60%
2 Father	60	30.30%
3 Stepmother Or Stepfather	8	4.00%
6 Grandmother Or Grandfather	3	1.50%

7 Legal Guardian	1	0.50%
Total Qualified	198	100.00%

21. What is your (respondent) gender?

	Frequency	Percent
1 MALE	200	50.00%
2 FEMALE	200	50.00%
Total Qualified	400	100.00%

22. WHAT IS your (respondent) AGE?

	Frequency	Percent
2 21-30	78	19.50%
3 31-40	145	36.20%
4 41-50	116	29.00%
5 51-60	46	11.50%
6 61-70	9	2.20%
7 71-80	4	1.00%
8 OLDER THAN 80	1	0.20%
9 (DO NOT READ) REFUSED	1	0.20%
Total Qualified	400	100.00%

23. WHAT IS your (respondent) race?

	Frequency	Percent
1 African American	34	8.50%
2 White	341	85.20%
3 Hispanic	2	0.50%
4 Asian	9	2.20%
6 Other	12	3.00%
7 (Do Not Read) Refused	2	0.50%
Total Qualified	400	100.00%

24. What is your approximate total household income per year before Tax?

	Frequency	Percent
1 LESS THAN $10,000	1	0.20%
2 $10,000-$24,999	8	2.00%
3 $25,000-$39,999	17	4.20%
4 $40,000-$54,999	34	8.50%
5 $55,000-$69,999	53	13.20%
6 $70,000-$84,999	56	14.00%
7 $85,000-$99,999	55	13.80%
8 $100,000-$149,999	89	22.20%
9 $150,000-$199,999	39	9.80%
10 $200,000 OR OVER	27	6.80%
11 (DO NOT READ) REFUSED	21	5.20%
Total Qualified	400	100.00%

25. What is the highest education level your (respondent) completed?

	Frequency	Percent
2 Some High School	8	2.00%
3 High School Graduate	29	7.20%
4 Some College	61	15.20%
5 College Graduate	173	43.20%
6 Post Graduate	127	31.80%
7 (Do Not Read) Refused	2	0.50%
Total Qualified	400	100.00%

26. How many people in your family work outside the home?

Value	Frequency	Percent	Cumm. %
0	14	3.5	3.5
1	141	35.25	38.75
2	229	57.25	96
3	13	3.25	99.25
4	2	0.5	99.75

99	1	0.25	100

Mean:	1.863
Median:	2
Standard deviation:	4.91
Standard error:	0.246
Value:	2
Frequency:	229

27. If you are employed, is it...?

	Frequency	Percent
1 FULL TIME	302	75.50%
2 PART-TIME	37	9.20%
3 (DO NOT READ) NOT EMPLOYED	61	15.20%
Total Qualified	400	100.00%

29. ARE YOU....?

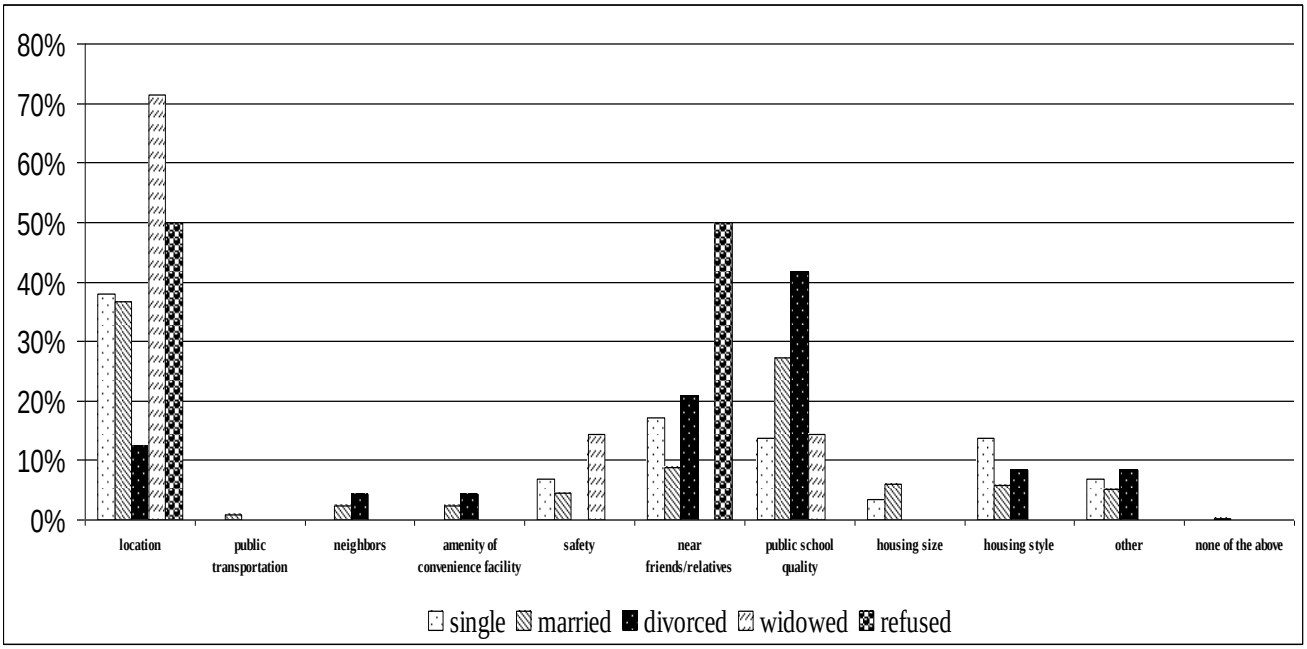
	Frequency	Percent
1 SINGLE	29	7.30%
2 MARRIED	335	84.40%
3 DIVORCED	25	6.30%
4 WIDOWED/WIDOWER	7	1.80%
5 (DO NOT READ) REFUSED	1	0.30%
Total Qualified	397	100.00%

APPENDIX 5: School District Designation in Ohio

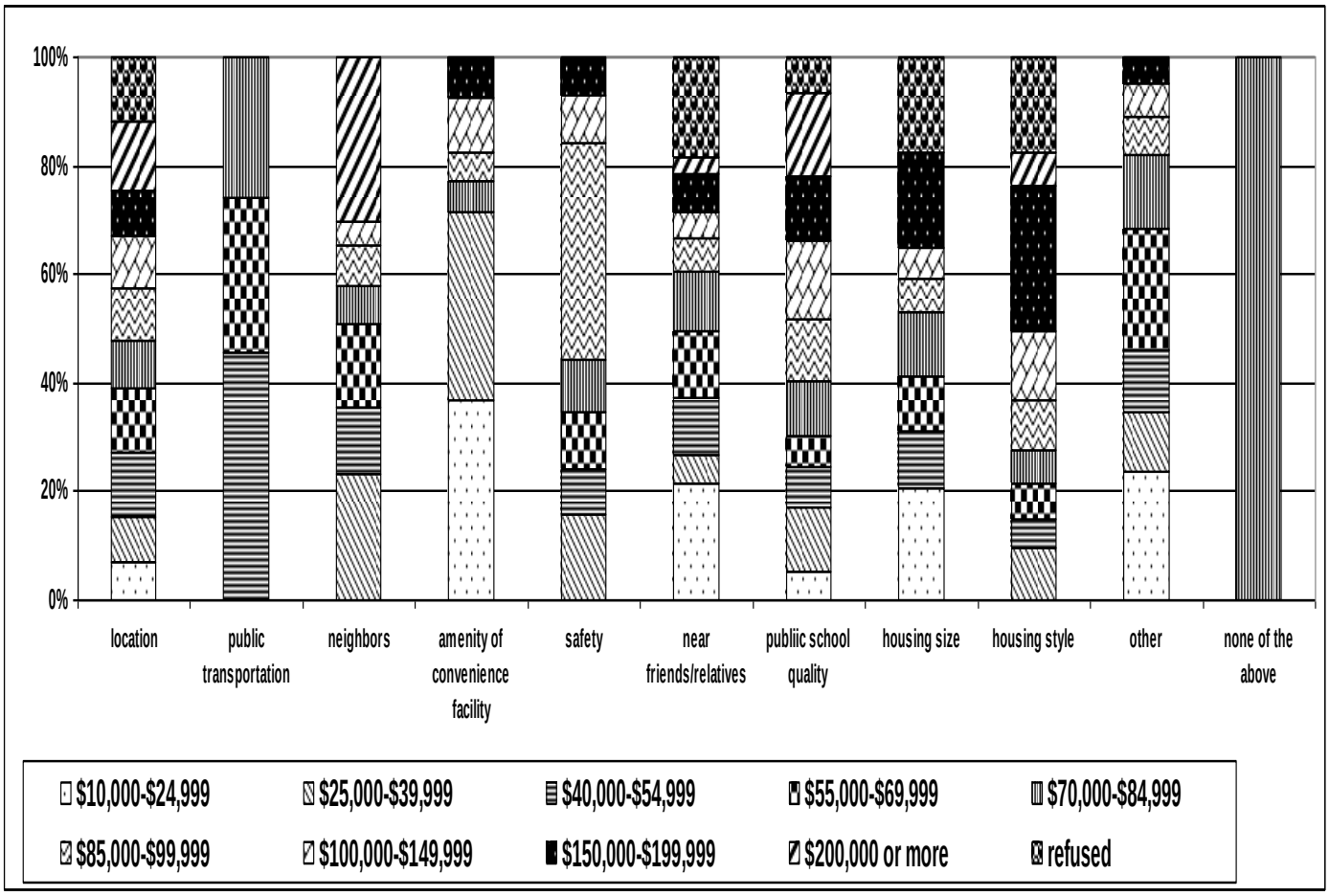
Rating	State Indicators Met		Performance Index Score		AYP Determination	Performance Index Growth Criteria
Excellent	24-25 or 94% - 100 %	*or*	100 to 120	*and*	Met or Missed AYP	Not Eligible
Effective	19-23 or 75% - 93.9%	*or*	90 to 99.9	*and*	Met or Missed AYP	Not Eligible
Continuous Improvement	0-18 or 0% - 74.9%	*and*	0 to 89.9	*and*	Met AYP	
	13-18 or 50% - 74.9%	*or*	80 to 89.9	*and*	Missed AYP	Designated Academic Watch but improved at least 10 points in 2 years with at least 3 points in most recent year.
Academic Watch	9-12 or 31% - 49.9%	*or*	70 to 79.9	*and*	Missed AYP	Designated Academic Emergency but improved at least 10 points in 2 years with at least 3 points in most recent year.
Academic Emergency	0-8 or 0% - 30.9%	*and*	0 to 69.9	*and*	Missed AYP	

Source: Ohio Education Department

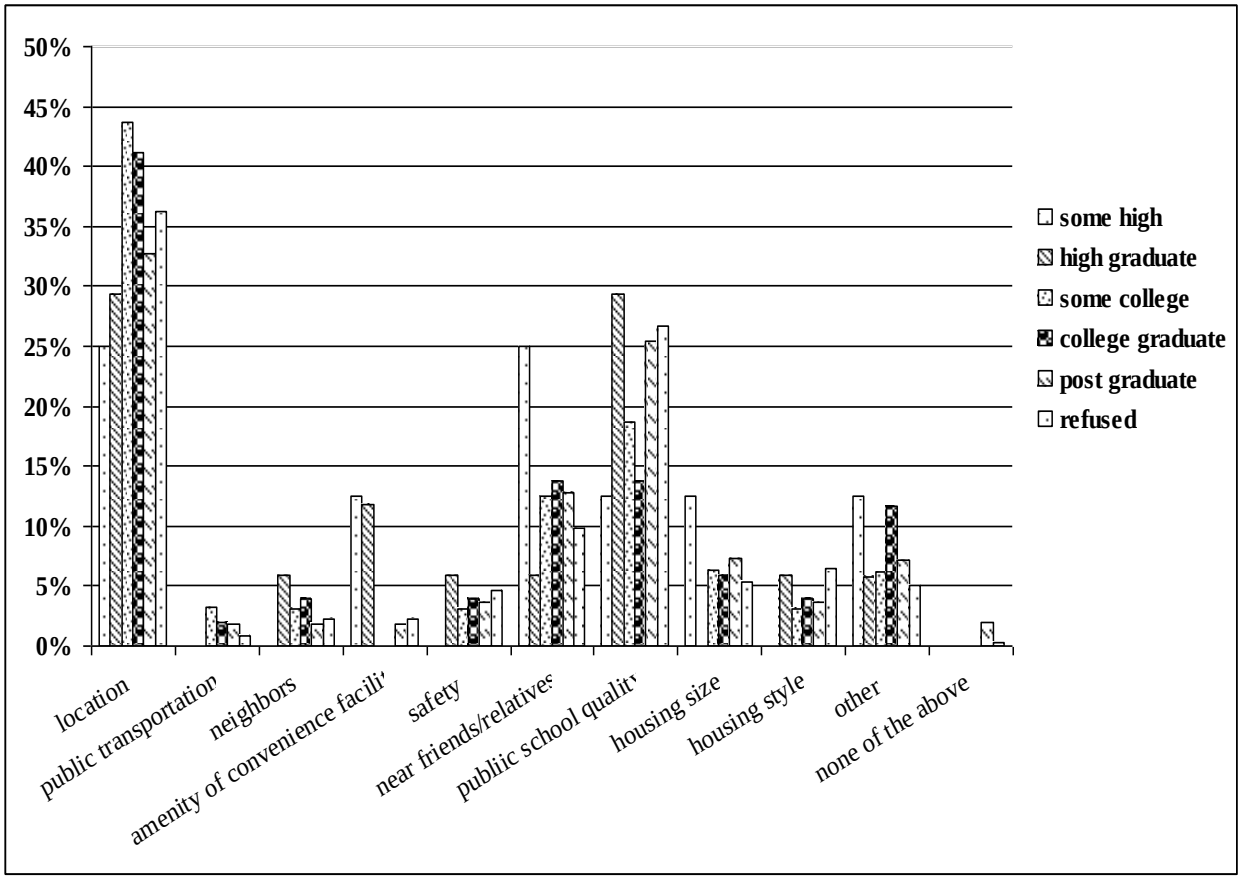
APPENDIX 6: Location Factors and Homebuyers: Marital Status



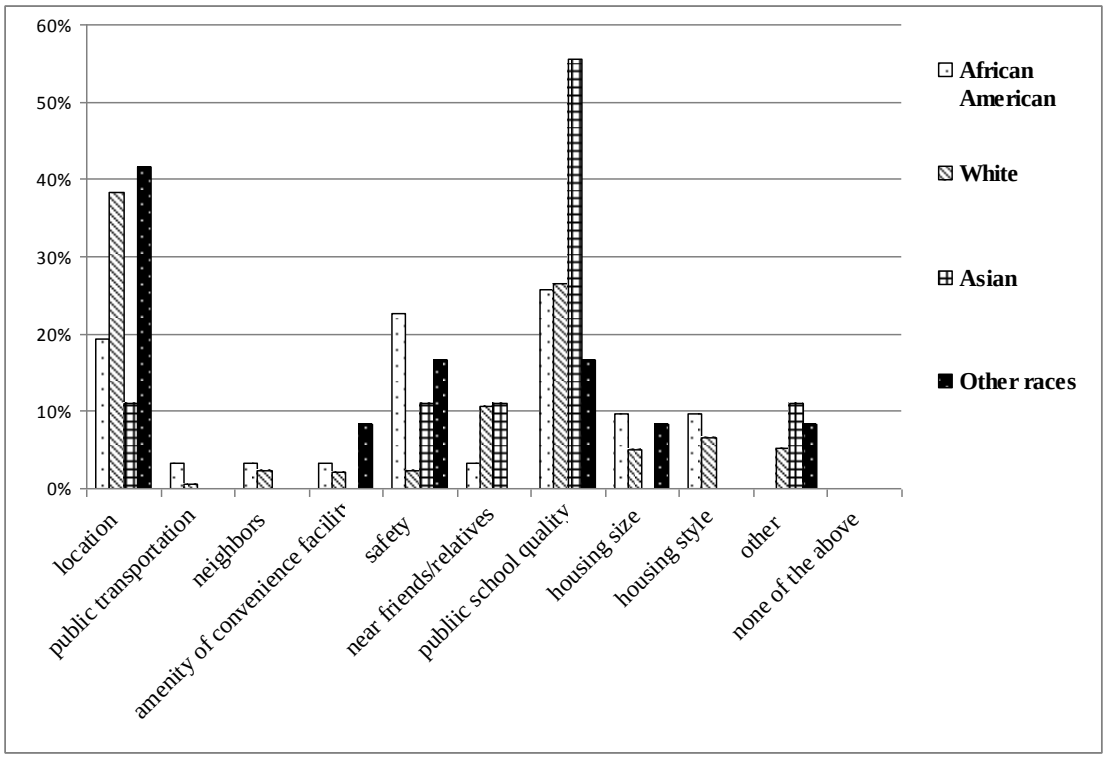
APPENDIX 7: Location Factors and Homebuyers: Income



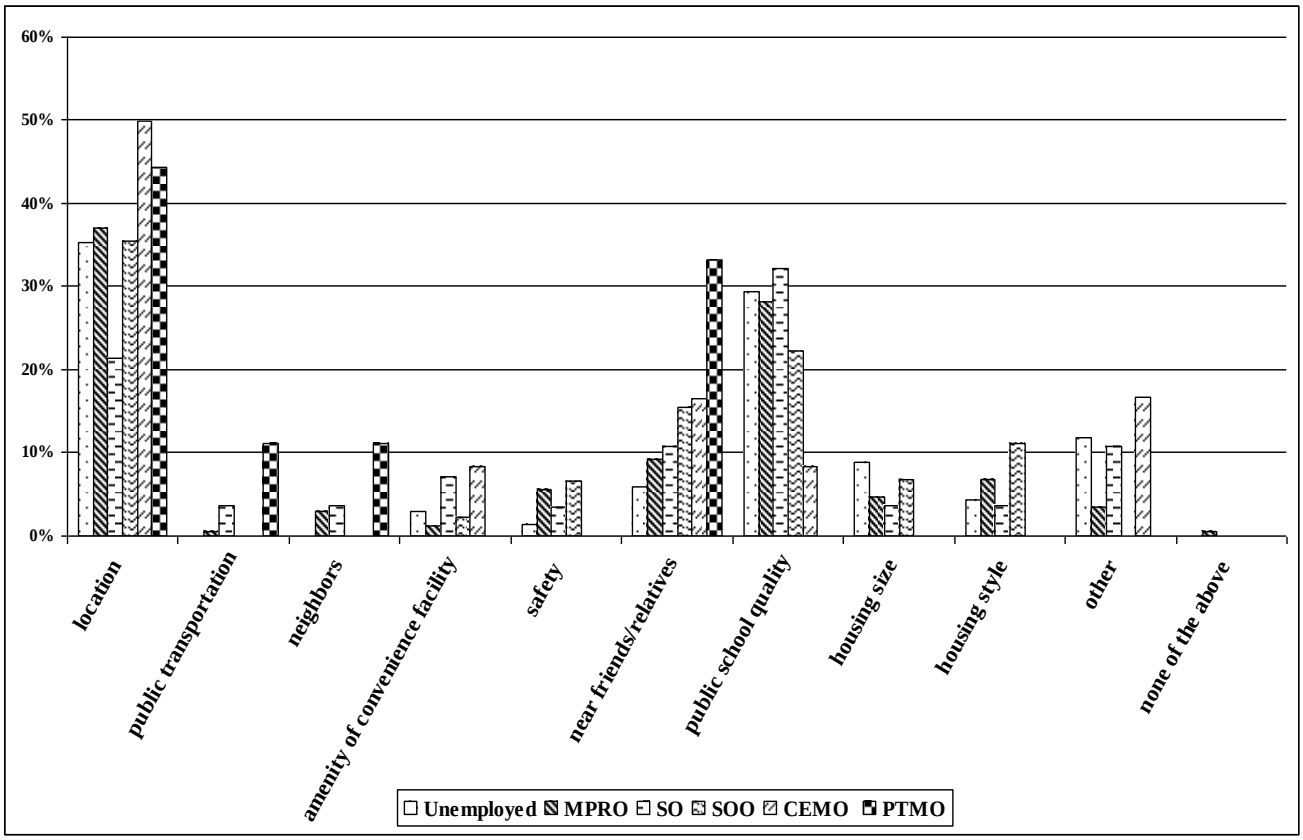
APPENDIX 8: Location Factors and Homebuyers: Education



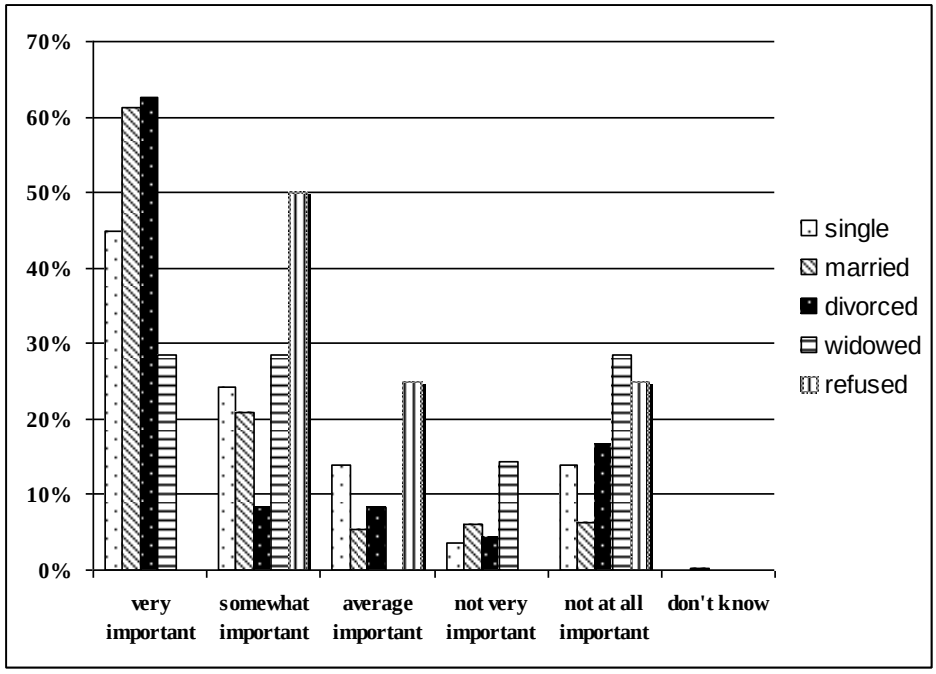
APPENDIX 9: Location Factors and Homebuyers: Race



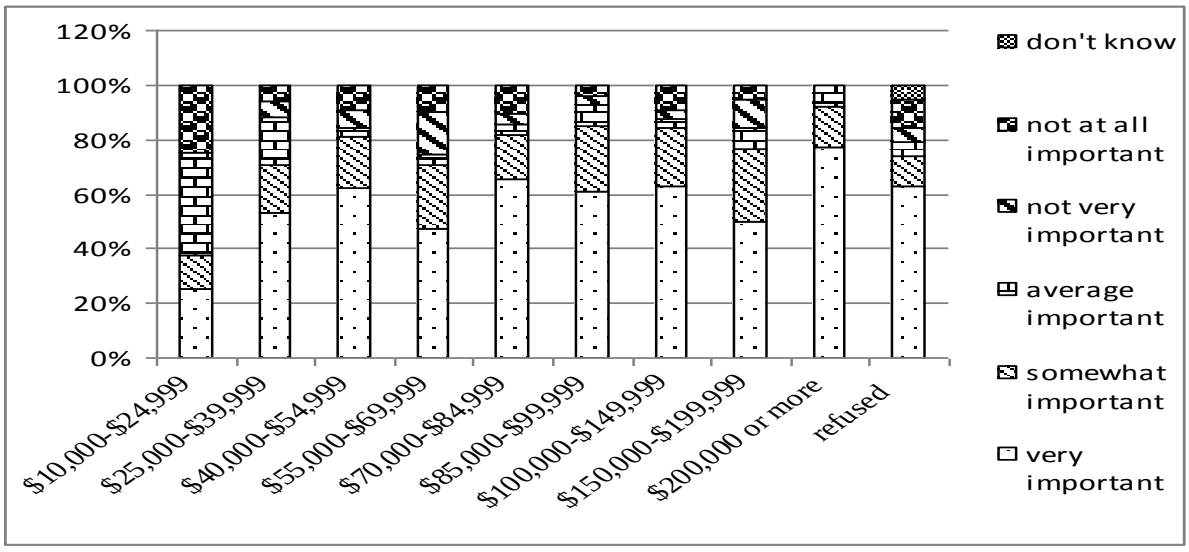
APPENDIX 10: Location Factors and Homebuyers: Occupation



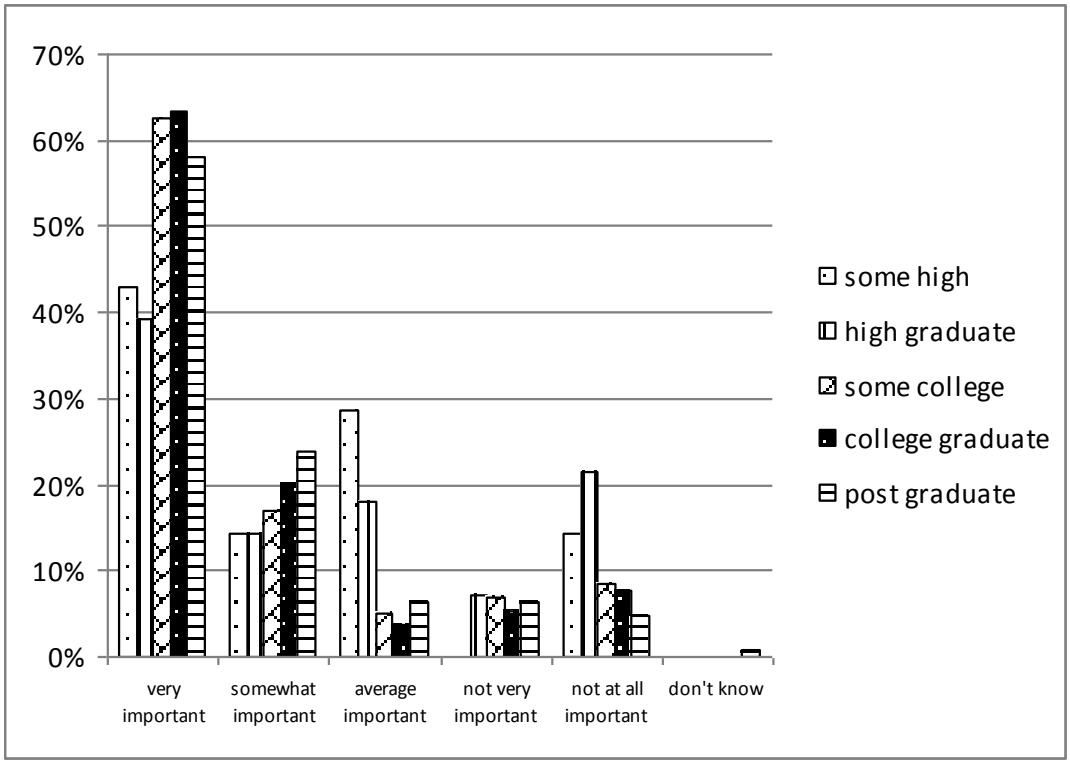
APPENDIX 11: Importance of School Quality: Marital Status



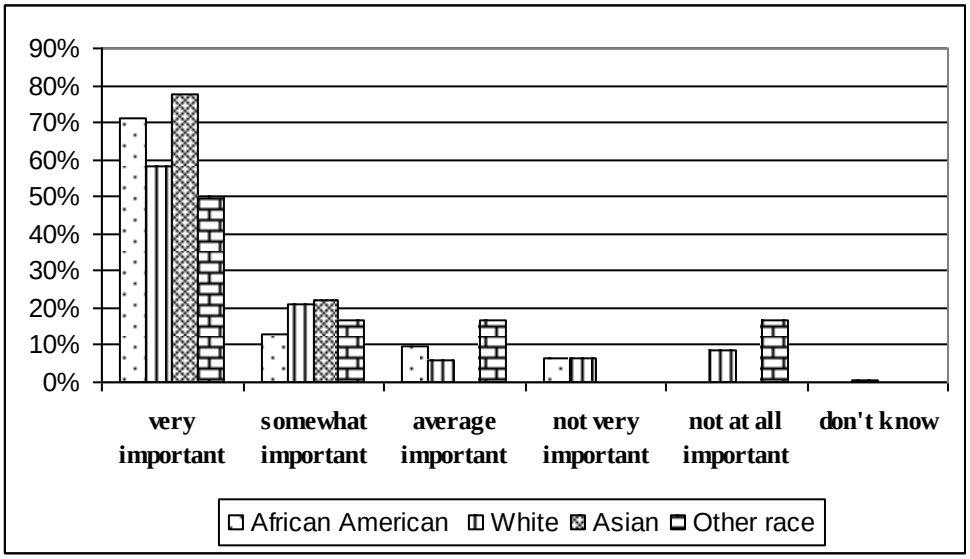
APPENDIX 12: Importance of School Quality: Income



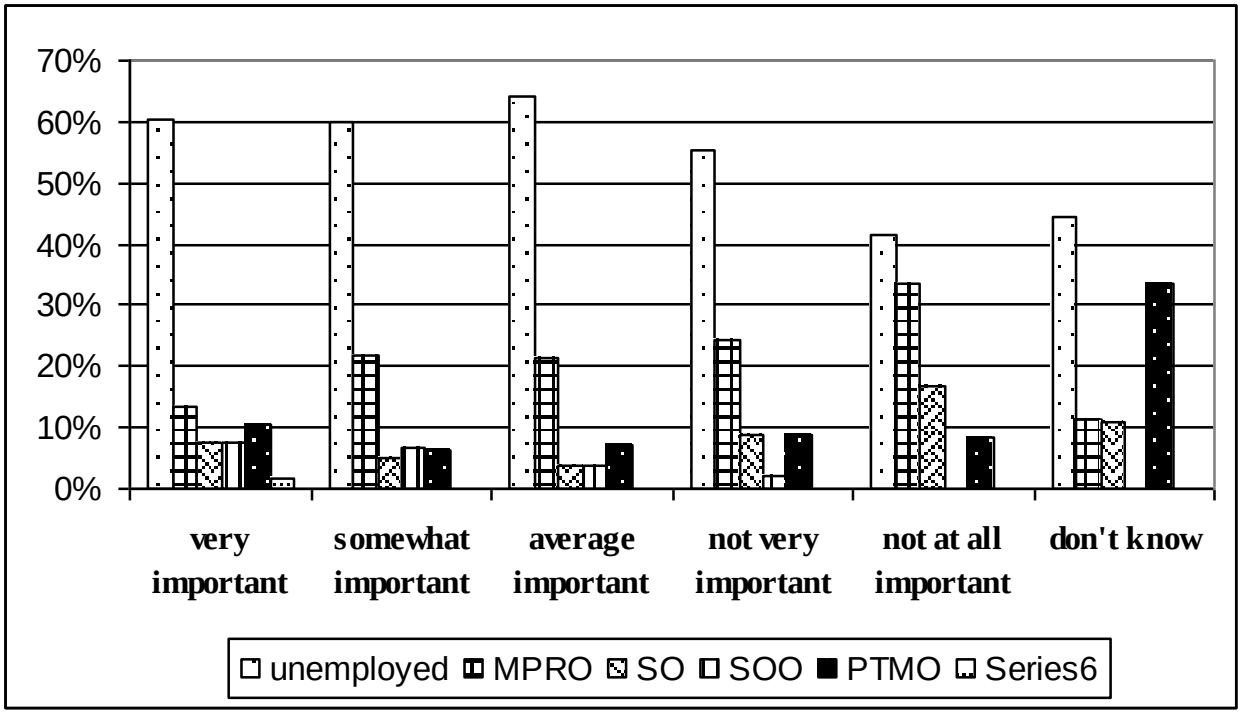
APPENDIX 13: Importance of School Quality: Education



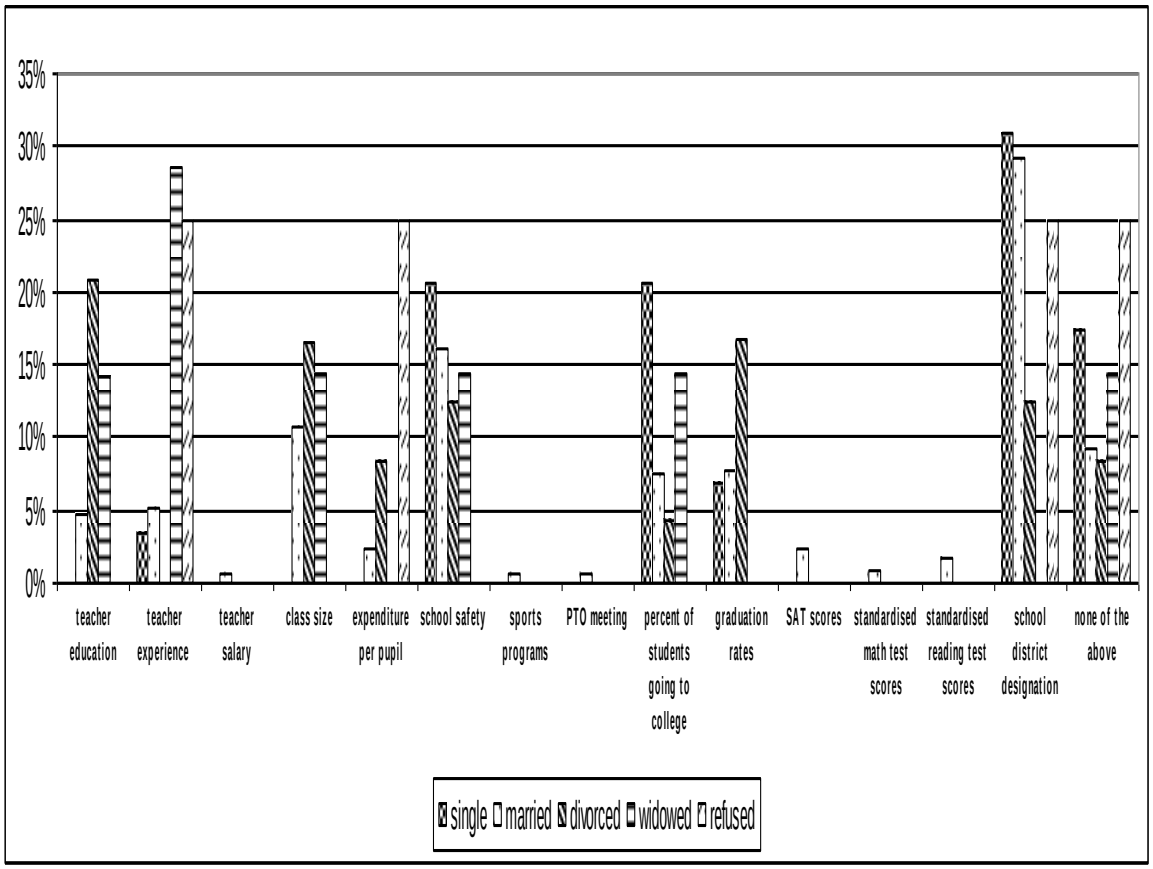
APPENDIX 14: Importance of School Quality: Race



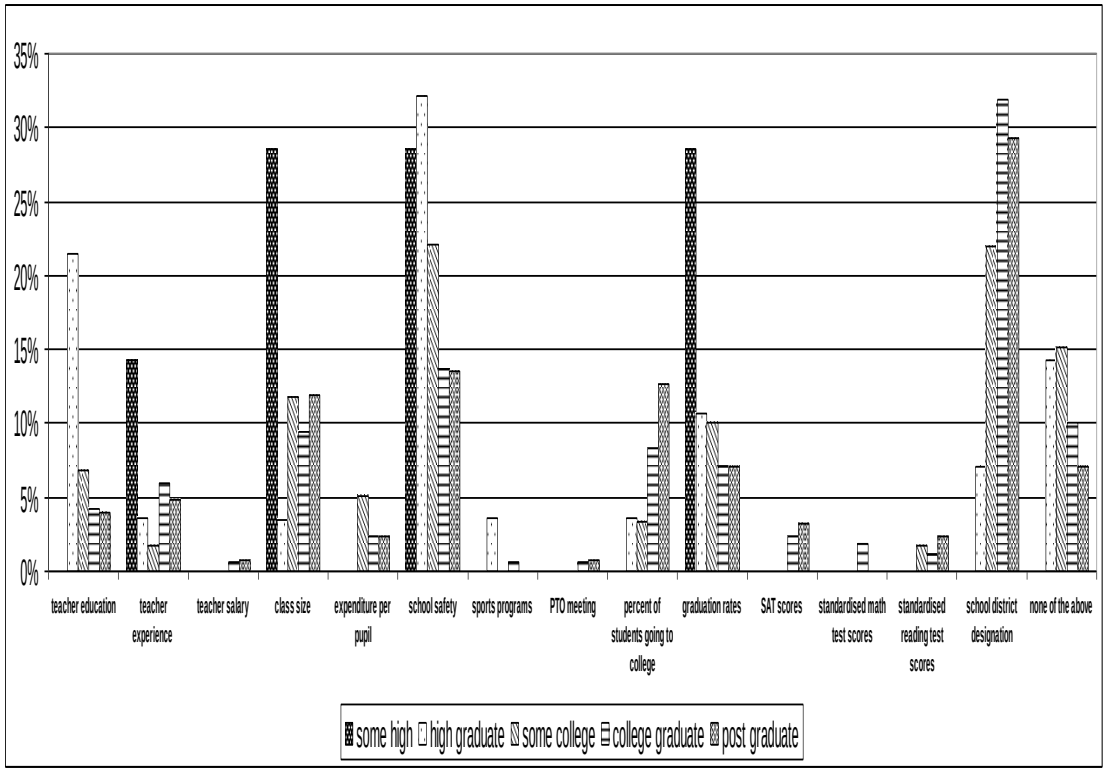
APPENDIX 15: Importance of School Quality: Occupation



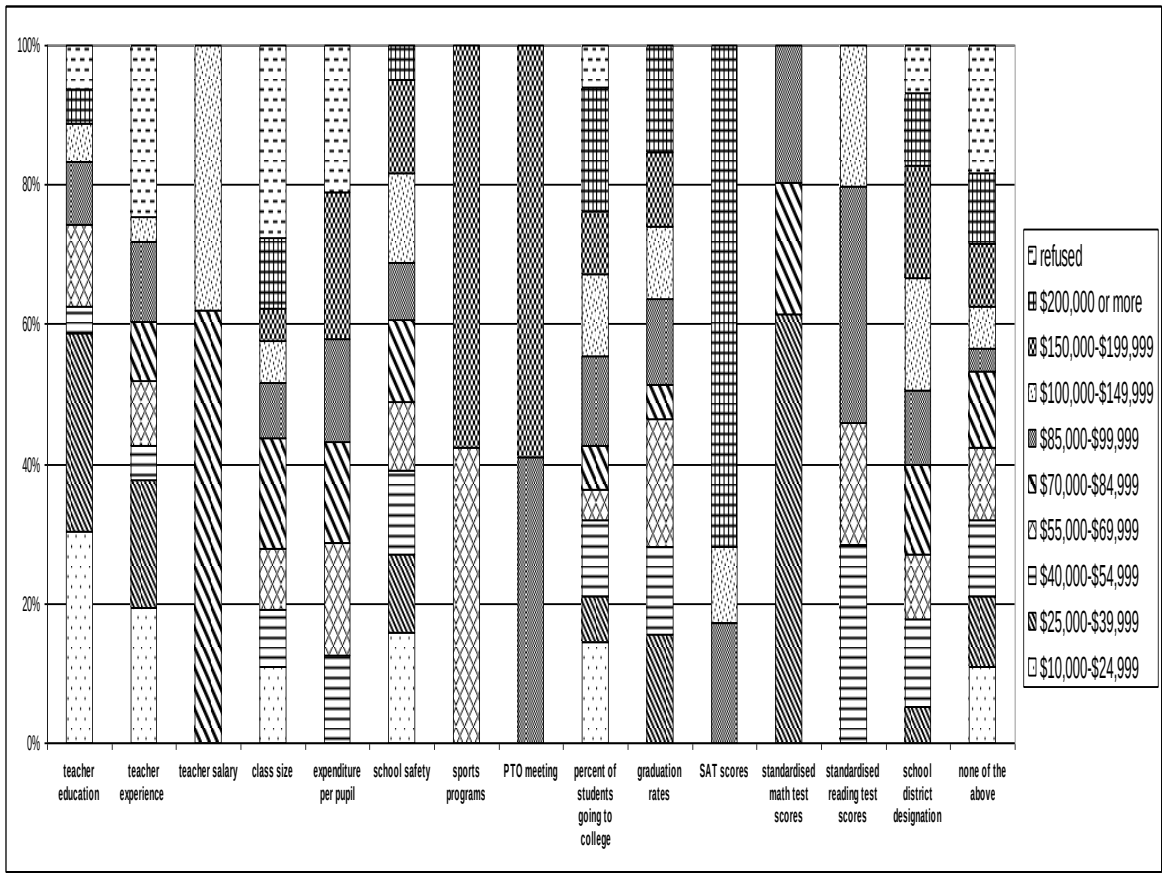
APPENDIX 16: Measure of School Quality: Marital Status



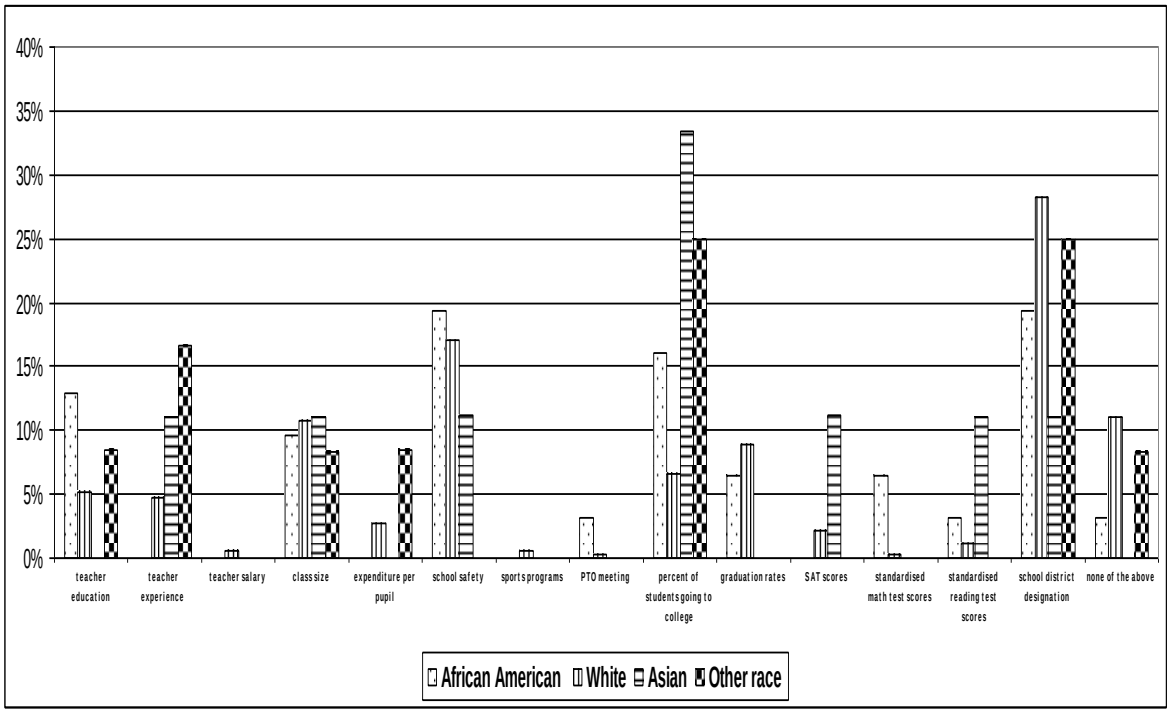
APPENDIX 17: Measure of School Quality: Education



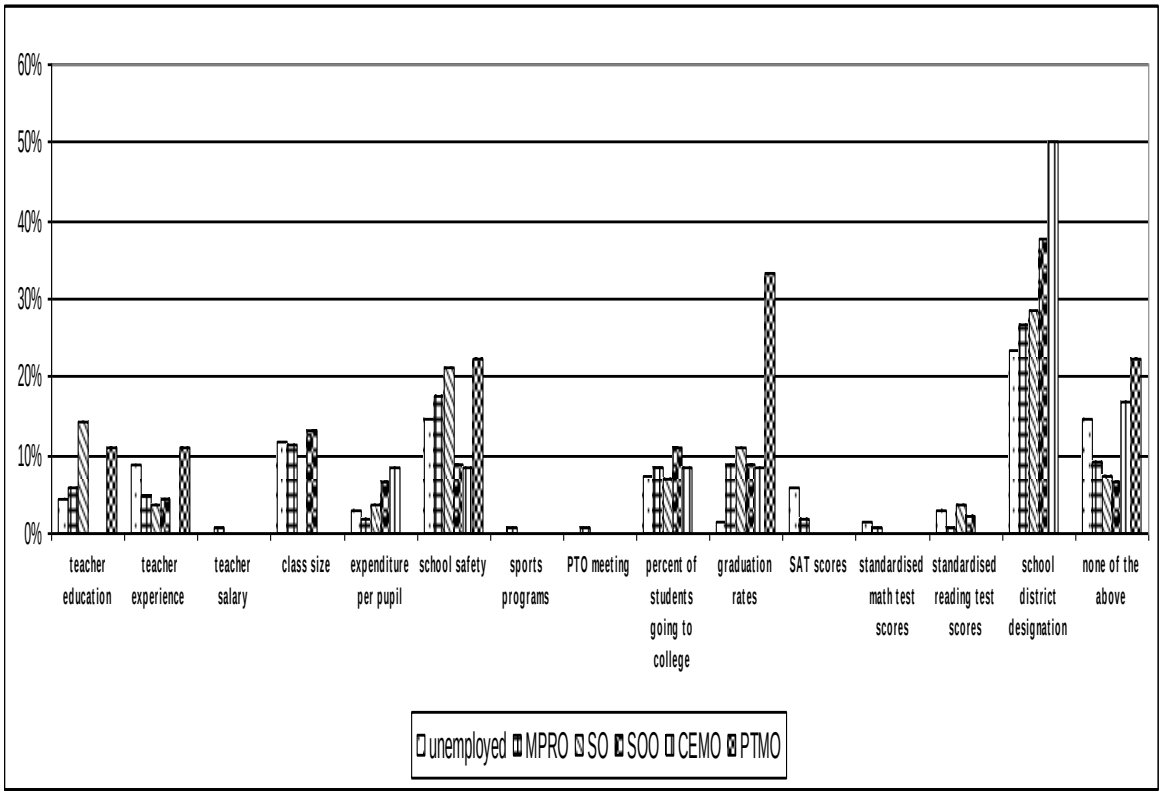
APPENDIX 18: Measure of School Quality: Income



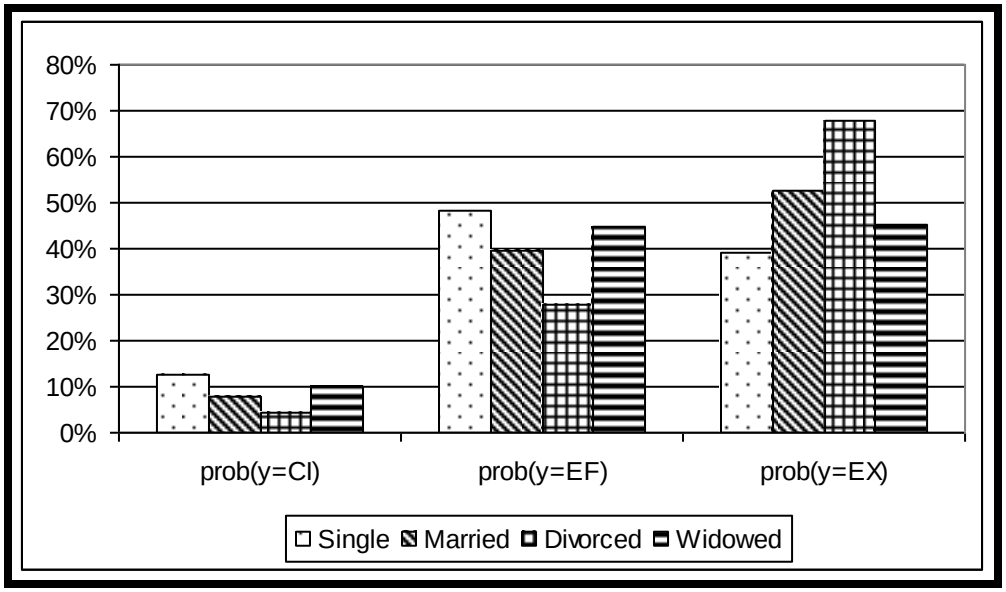
APPENDIX 19: Measure of School Quality: Race



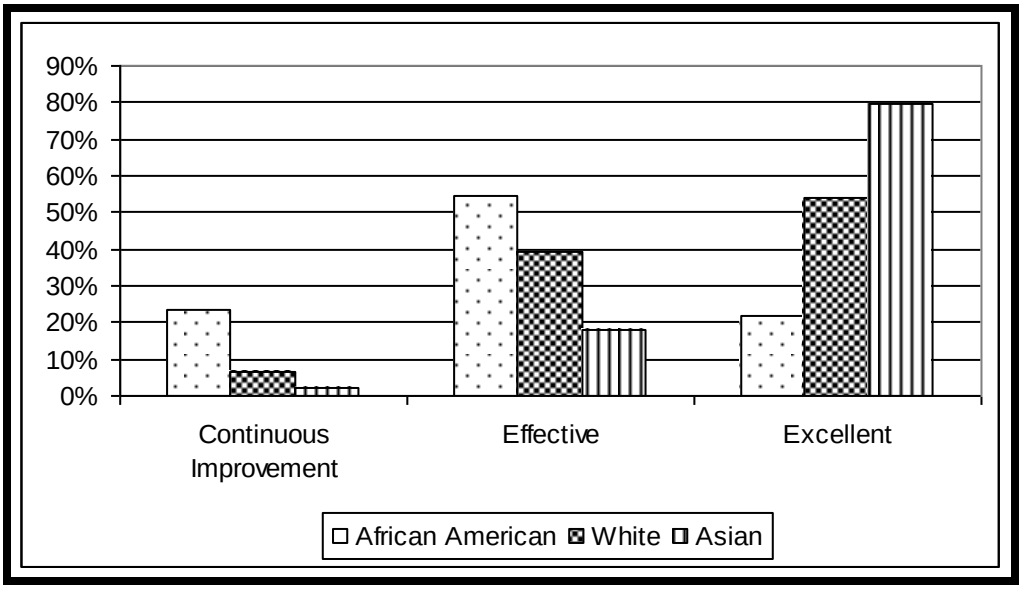
APPENDIX 20: Measure of School Quality: Occupation



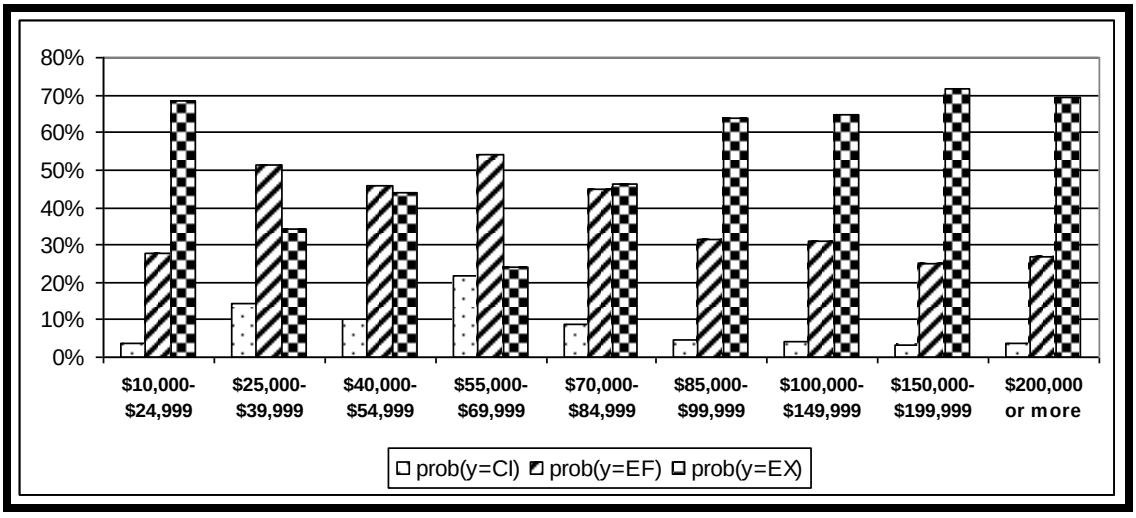
APPENDIX 21: School District Choice: Marital Status



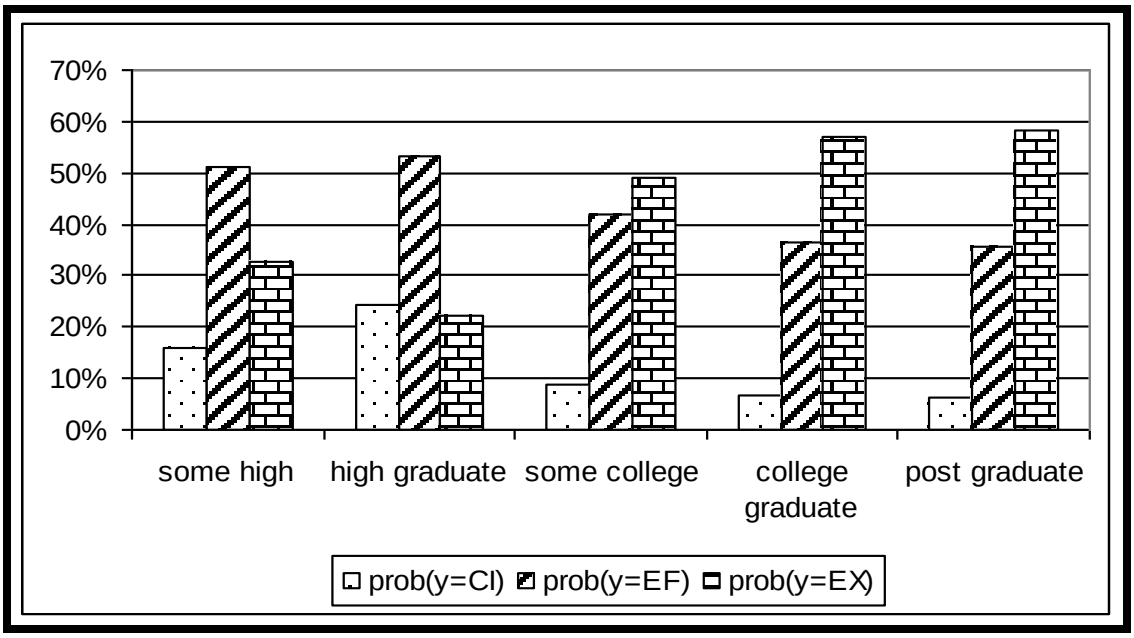
APPENDIX 22: School District Choice: Race



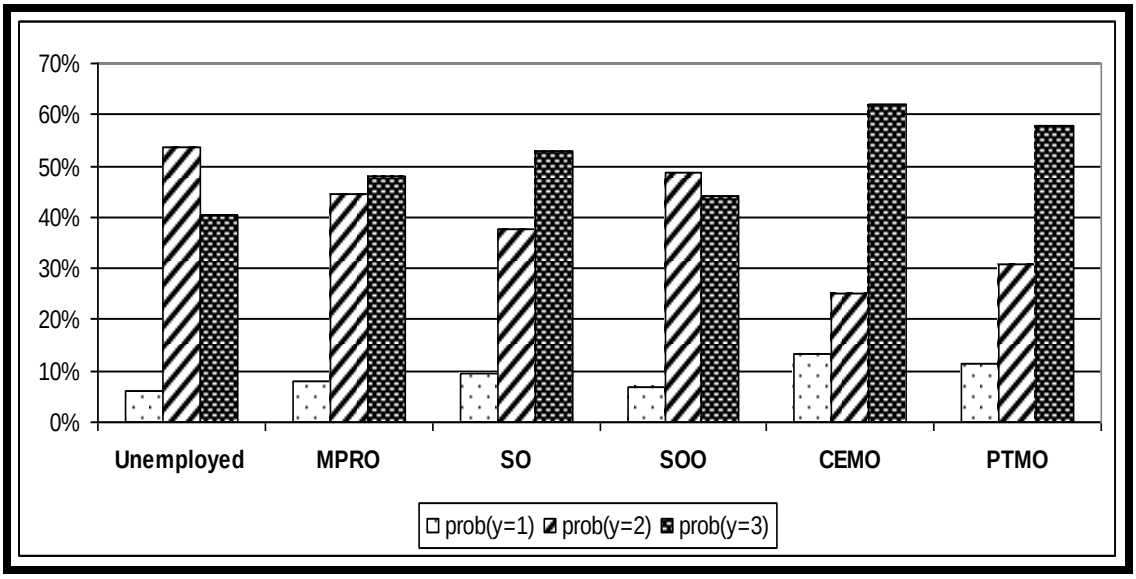
APPENDIX 23: School District Choice: Income



APPENDIX 24: School District Choice: Education



APPENDIX 25 School District Choice: Occupation



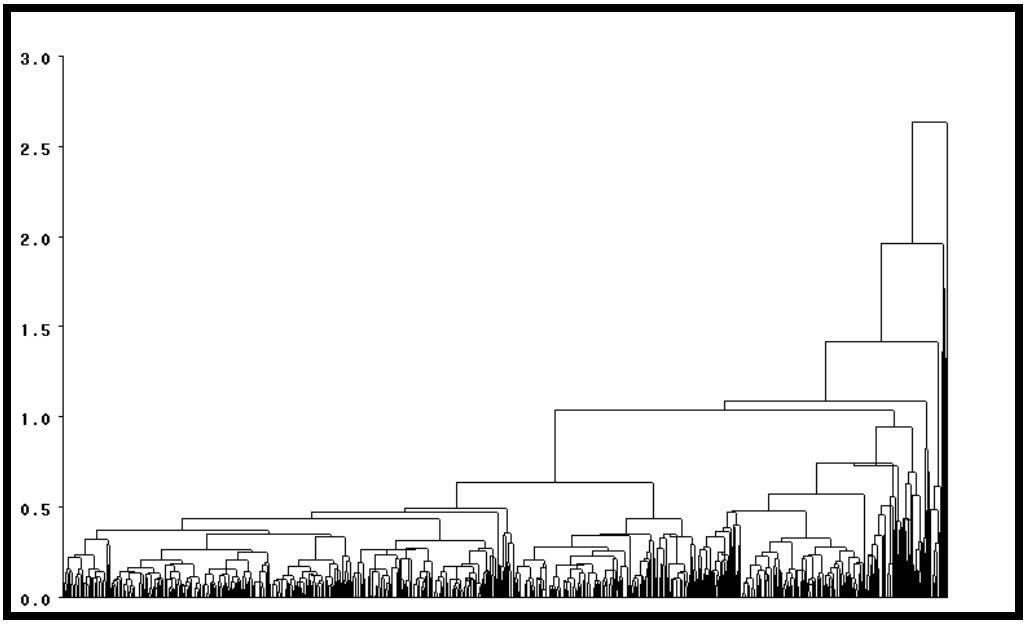
APPENDIX 26a: Descriptive Statistics

Variables	Description	Sources	Signs
	Dependent Variable		
Ln (HP)	Log of Housing Price	Auditor's	
	Independent Variables		
Housing Characteristics			
Log_livo	Log of Total living area (SQFT)	Auditor's	+
Log_lot	Log of lot size	Auditor's	+
age	Year Built	Auditor's	-
basesqft	Basement size	Auditor's	+
bedrooms	Number of bedrooms	Auditor's	+
baths	Number of bathrooms	Auditor's	+
firepl	Fire Place	Auditor's	+
garsize	Garage Size	Auditor's	+
Location characteristics			
Tax rate	Property tax rates		
D_CBD	Distance to central business district		
SQ_D_CBD	Squared distance to central business district		
Density	The ratio of the number of households to area		
D_water	Dummy for close to water front (a quarter mile)		
School Quality			
Expenditure	Expenditure per pupil	Department of Education	+
Test	10th grade math test scores	Department of Education	+
Experience	Teachers' experience (year)	Department of Education	+
Salary	Teachers' salary ($)	Department of Education	+
PI	Performance Index	Department of Education	+

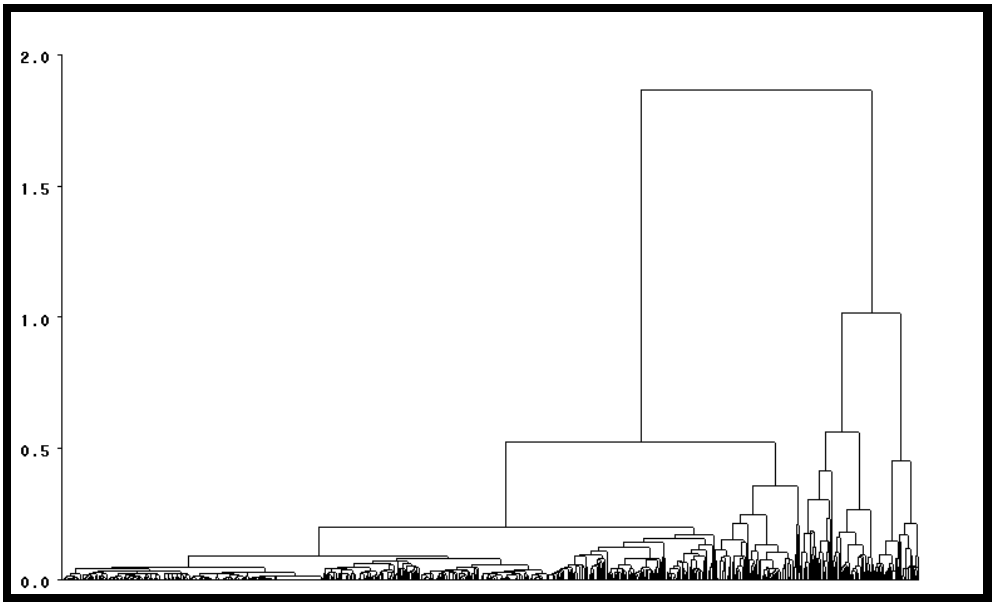
APPENDIX 26b: Descriptive Statistics (Cont.)

Variables	Description	Sources	Signs
DEMOGRAPHICS & SES			
P_White	Percentage of White Population	U.S. census	+
P_AA	Percentage of African American Population	U.S. census	+/-
P_Asian	Percentage of Asian Population	U.S. census	+/-
P_Hispanic	Percentage of Hispanic Population	U.S. census	+/-
Some R	Some Other Races	U.S. census	NA
P_school_a	Percentage of Public Students in block group	U.S. census	+
P_high	Percentage of High school graduation rate	U.S. census	+
P_asso	Percentage of College graduation rate	U.S. census	+
P_post	Percentage of post graduate degree		
P_ba	Percentage of Bachelor Degree	U.S. census	+
Income	Median Income	U.S. census	+
WSC	Households with school age children	U.S. census	+
WOSC	Households with children but of school age	U.S. census	-
WNO	Households with no children	U.S. census	-
Married	Households who are married	U.S. census	+
Never_m	Households who are never married	U.S. census	-
Divorced	Households who are divorced	U.S. census	-
Widowed	Households who are widowed	U.S. census	-
MPRO	Management, professional, and related occupations	U.S. census	NA
SO	Service occupations	U.S. census	NA
SOO	Sales and office occupations	U.S. census	NA
CEMO	Construction, extraction, maintenance and repair occupations	U.S. census	NA
PTMO	Production, Transportation and Material moving occupations	U.S. census	NA
I_U10K	Income Less than $10,000	U.S. census	-
I_10K_15K	Income $10,000 to $14,999	U.S. census	-
I_15K_25K	Income $15,000 to $24,999	U.S. census	-
I_25K_35K	Income $25,000 to $34,999	U.S. census	+/-
I_35K_50K	Income $35,000 to $49,999	U.S. census	+/-
I_50K_75K	Income $50,000 to $74,999	U.S. census	+
I_75K_100K	Income $75,000 to $99,999	U.S. census	+
I_100K_150K	Income$100,000 to $149,999	U.S. census	+
I_150K_200K	Income $150,000 to $199,999	U.S. census	+
I_O200K	Income $200,000 or more	U.S. census	+

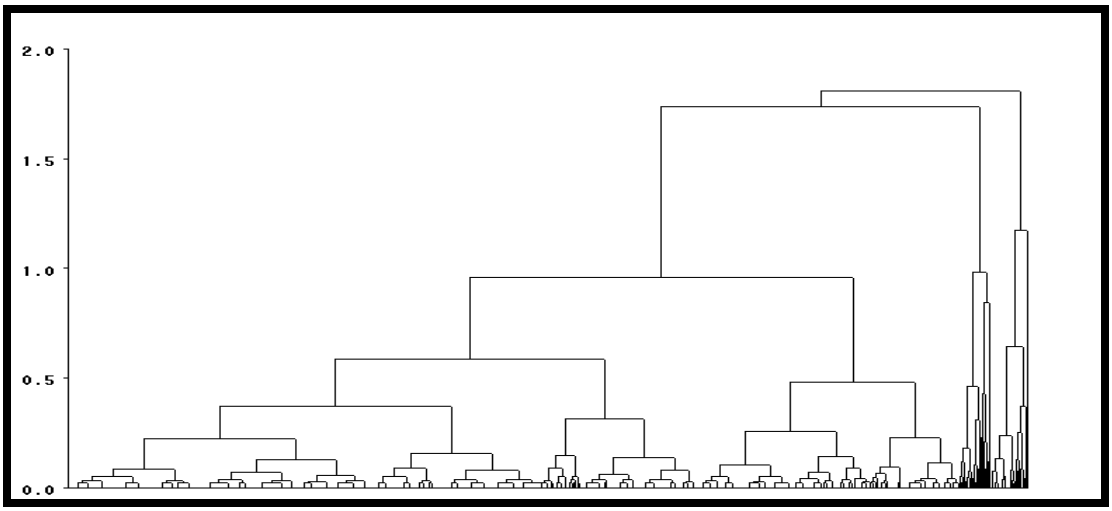
APPENDIX 27: Dendrogram: Marital Status



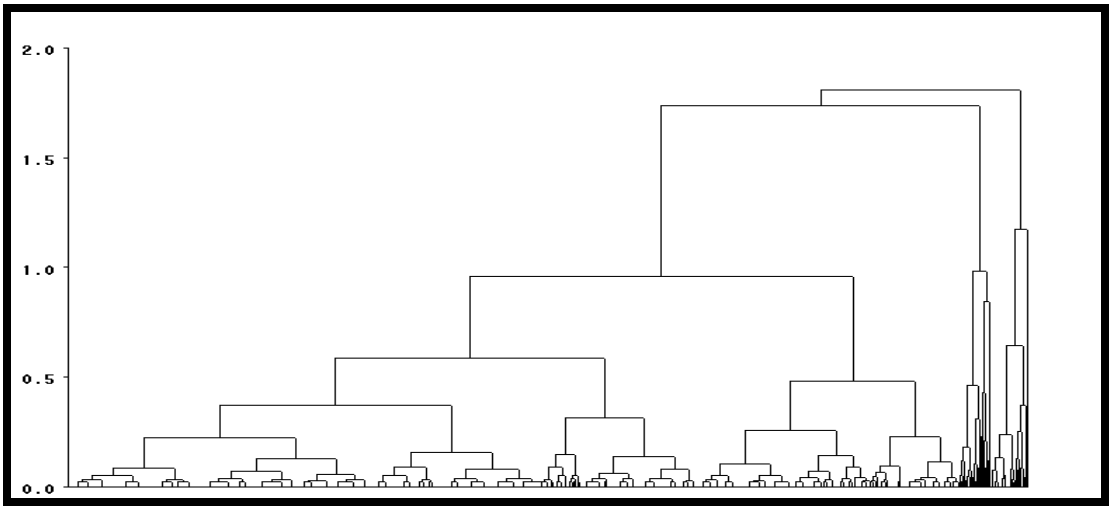
APPENDIX 28: Dendrogram: Race



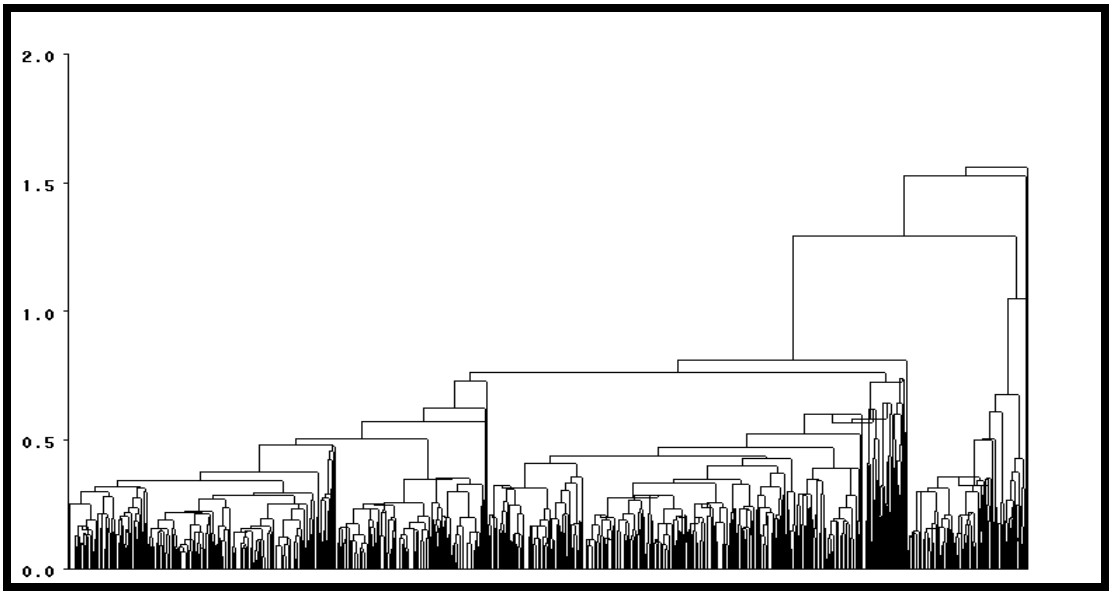
APPENDIX 29: Dendrogram: Income



APPENDIX 30: Dendrogram: Education



APPENDIX 31: Dendrogram: Occupation



APPENDIX 32: Cluster Analysis

Cluster ID	Variable	N	Minimum	Maximum	Mean	Std. Deviation
	p_w	11193	0	100	83.61	23.76
	p_aa	11193	0	100	12.68	23.63
	p_a	11193	0	16	1.75	2.27
	p_so	11193	0	10	0.42	0.96
	p_school_a	11193	0	21.16	29.48	2.50
	p_never_m	11193	4.92	85.31	25.03	7.58
	p_marr	11193	11.69	85.25	57.21	10.27
	p_widowed	11193	0.62	50.82	8.38	4.34
	p_divorced	11193	0.73	24.3	9.38	4.02
	p_high	11193	0	55.7	29.40	11.19
	p_asso	11193	0	16.76	5.79	2.53
	p_ba	11193	0	54.35	19.19	9.21
	p_post_	11193	0	74	11.64	10.28
	p_manage	11193	2.51	85.8	38.68	13.90
	p_service	11193	0	48.04	12.28	5.13
	p_sales_of	11193	7.57	48.46	29.86	6.42
	p_construc	11193	0	29.7	6.70	3.74
	p_producti	11193	0	37.25	12.40	6.70
	Income	11193	$10,879	$200,001	$53,937.11	$20,134.30
Cluster ID	Variable	N	Minimum	Maximum	Mean	Std. Deviation
PROPORTION OF CHILDREN						
cluster 1	P_school_a	4379	0	5.6	4.1	1.1
cluster 2	P_school_a	4707	5.6	8.7	7.0	0.9
cluster 3	P_school_a	2107	8.7	21.2	10.26	1.4
MARITAL STATUS						
cluster 1	p_never_m	4788	4.92	30.66	19.61	3.66
	p_marr	4788	56.49	85.25	66.33	5.02
	p_widowed	4788	0.62	24.39	7.43	3.40
	p_divorced	4788	0.73	13.95	6.62	2.43
cluster 2	p_never_m	1409	20.22	85.31	38.91	7.07
	p_marr	1409	11.69	49.8	39.99	6.81
	p_widowed	1409	0.9	31.46	7.36	4.92
	p_divorced	1409	1.36	24.3	13.74	4.03
cluster 3	p_never_m	4996	7.24	37.36	26.30	4.21
	p_marr	4996	26.15	61.13	53.32	4.51
	p_widowed	4996	1.15	50.82	9.58	4.65
	p_divorced	4996	1.59	20.76	10.80	3.34

RACE						
Cluster 1	p_w	9719	58.69	100	92.05	7.76
	p_b	9719	0	36.93	4.23	6.84
	p_a	9719	0	16	1.85	2.30
	p_so	9719	0	10	0.43	0.96
Cluster 2	p_w	1474	0	57.4	27.91	17.80
	p_b	1474	32.48	100	68.40	18.84
	p_a	1474	0	14	1.06	1.91
	p_so	1474	0	7	0.39	0.91
INCOME						
Cluster 1	Avg. income	5979	39,737	60,664	48,297	5,618
Cluster 2	Avg. income	3088	60,859	200,001	78,916	20,315
Cluster 4	Avg. income	2126	10,879	39,500	33,518	5,786
EDUCATTION						
Cluster 1	p_high	4110	0	31.68	17.71	6.81
	p_asso	4110	0	16.76	5.41	2.66
	p_ba	4110	11.11	54.35	28.37	6.59
	p_post	4110	6	74	21.62	10.45
Cluster 2	p_high	7083	10.64	55.7	36.18	6.76
	p_asso	7083	0	15.19	6.00	2.42
	p_ba	7083	0	28.98	13.87	5.62
	p_post	7083	0	19	5.84	3.51
OCCUPATION						
Cluster 1	p_manage	3307	10.11	36.4	28.94	4.69
	p_service	3307	1.46	33.53	13.34	4.03
	p_sales_of	3307	25.51	48.46	35.64	4.45
	p_construction	3307	0	18.47	8.03	3.33
	p_production	3307	0	26.38	13.95	3.64
Cluster 2	p_manage	3713	33.78	52.12	42.86	4.51
	p_service	3713	3.15	29.73	11.46	3.89
	p_sales_of	3713	8.84	42.31	29.46	4.63
	p_construction	3713	0	15.96	6.19	2.86
	p_production	3713	0	23.53	9.93	4.06
Cluster 3	p_manage	2089	51.68	85.8	60.87	7.63
	p_service	2089	0	18.84	7.71	3.59
	p_sales_of	2089	7.57	35.99	23.32	5.67
	p_construction	2089	0	9.52	2.97	2.11
	p_production	2089	0	15.14	5.10	3.52
Cluster 4	p_manage	606	12	44	22.33	5.64
	p_service	606	0	25	13.66	5.28
	p_sales_of	606	9	38	26.74	4.82
	p_construction	606	3	30	11.19	4.00
	p_production	606	18	37	26.19	4.17

APPENDIX 33: Definition of variables in the National Model

	Descriptive
P_owner	Percentage of homeowner
P_vacant	Percentage of vacant housing units
P_detached	percentage of detached housing units
log_income	log of median income
log_age	log of housing age
tax_rate	Property tax rate
Density	proxy for housing size
Ramp	Standardized comprehensive school quality measure
Salary	Teacher's salary
Spending	Expenditure per pupil
Test	10th grade math test scores

APPENDIX 34: Statistical Results of the National Model

State	Constant	P_OWNER	P_VACANT	P_DETACHED	LOG_INCOME	LOG_AGE	TAX_RATE	DENSITY	RAMP	SALARY	SPENDING	R^2	Adj.R Square
Arkansas	7.5758** (4.1847)	-0.0046 (-1.6077)	-0.0020 (-0.8056)	0.0022 (0.7967)	0.4837** (3.0992)	-0.4272** (-4.5789)	0.0033 (0.9705)	0.0000** (-3.3700)	0.0432* (2.3183)	0.0001* (0.4485)	0.0000** (-0.3328)	79.3%	76.8%
California	-2.4559** (-3.4366)	-0.0039 (-1.8747)	0.0073 (1.7288)	-0.0041** (-2.8071)	1.2533** (18.2156)	0.2617** (5.9422)	0.0024** (2.4929)	0.0000** (-3.6455)	0.1002** (4.3093)	0.0001 (1.8779)	0.0000 (0.4459)	87.2%	86.7%
Colorado	0.5390 (0.2228)	-0.0080 (-1.0837)	0.0019 (0.3209)	-0.0053 (-1.0854)	1.1265** (5.4577)	-0.0243 (-0.1510)	0.0049 (0.9799)	0.0000 (-0.9765)	0.1106** (2.7781)	0.0001 (0.5330)	0.0000 (-0.1406)	87.8%	82.4%
Delaware	1.2598 (0.3608)	0.0137 (1.6360)	-0.0196 (-1.8171)	-0.0051 (-0.8017)	0.8029* (2.5698)	0.0608 (0.5516)	0.0061 (0.8855)	0.0000 (0.7839)	0.0580 (1.6146)	0.0004 (1.6029)	-0.0001 (-0.4990)	94.7%	84.0%
Illinois	-4.7380** (-6.1841)	-0.0089** (-3.7575)	-0.0024 (-1.6779)	-0.0045* (-2.3029)	1.5740** (22.7575)	0.0803 (1.6412)	0.0012* (2.4291)	0.0000 (0.0555)	0.0225 (1.5018)	0.0000 (-0.6147)	0.0000 (1.0076)	92.9%	92.4%
Indiana	1.8960** (2.6282)	-0.0120** (-6.5102)	0.0009 (0.6868)	0.0027 (1.6203)	1.0076** (15.5522)	-0.1438** (-4.0338)	0.0022* (2.3118)	0.0000* (-2.1036)	0.0312** (3.3801)	0.0000 (-0.0605)	0.0000 (-0.3988)	85.9%	85.1%
Massachusetts	0.1132 (0.1331)	-0.0141** (-5.2069)	0.0001 (0.0457)	0.0051** (3.1286)	1.1069** (13.9249)	0.0200 (0.4456)	0.0003 (0.6916)	0.0000* (-2.1682)	0.0799** (4.1933)	0.0000 (-0.3061)	0.0001** (4.5167)	89.1%	88.5%
Michigan	-1.3049* (-2.4420)	-0.0089** (-6.2101)	0.0027* (2.5921)	0.0013 (1.0865)	1.3008** (26.3014)	-0.1218** (-3.5349)	-0.0012* (-2.4442)	0.0000 (-0.7018)	0.0374** (4.6552)	-0.0001* (-2.0816)	0.0000 (1.4853)	90.0%	89.7%
New Jersey	-0.2374 (-0.3053)	-0.0094** (-5.3267)	0.0036 (1.0177)	-0.0014 (-1.1008)	1.1578** (16.7062)	-0.0109 (-0.2110)	0.0006* (2.0766)	0.0000 (-0.2538)	0.0955** (5.2363)	0.0001 (1.4792)	0.0000 (0.2287)	86.7%	86.0%
Pennsylvania	0.2821 (0.5638)	-0.0104** (-9.3425)	-0.0025** (-2.8149)	0.0022** (3.3457)	1.1681** (26.4806)	-0.1720** (-6.1119)	0.0004 (0.7685)	0.0000** (3.0002)	0.0433** (6.0242)	0.0001* (2.5055)	0.0000* (-2.0107)	91.3%	91.1%
Rhode Island	1.8238 (0.8129)	-0.0070 (-1.3392)	-0.0139* (-1.9692)	0.0004 (0.1031)	0.8360** (3.8486)	0.2860* (2.4293)	0.0017 (1.3272)	0.0000 (1.6066)	0.0709* (2.0357)	0.0000 (-0.0948)	0.0001 (1.3324)	92.5%	86.7%
South Carolina	2.8509 (1.6938)	-0.0101** (-3.3610)	0.0001 (0.0247)	0.0032 (1.0281)	0.9400** (6.4228)	-0.3541** (-3.3886)	-0.0026 (-0.5865)	0.0000* (-0.5768)	0.0065 (0.3250)	0.0000 (0.2710)	0.0000 (0.5693)	90.4%	88.6%
Texas	0.5390 (0.2228)	-0.0080 (-1.0837)	0.0019 (0.3209)	-0.0053 (-1.0854)	1.1265** (5.4577)	-0.0243 (-0.1510)	0.0049 (0.9799)	0.0000 (-0.9765)	0.1106** (2.7781)	0.0001 (0.5330)	0.0000 (-0.1406)	87.8%	82.4%
Washington	1.9924 (1.7691)	-0.0135** (-5.5907)	-0.0016 (-0.5481)	0.0064** (2.9722)	1.0102** (11.1127)	-0.1468* (-2.3671)	0.0019* (2.0518)	0.0000 (0.0623)	0.0766** (4.6844)	-0.0001 (-0.4758)	0.0000 (0.5289)	80.9%	79.3%

Note:* = $\alpha \leq$ **.10,** ** = $\alpha \leq$ **.05,** *** = $\alpha \leq$ **.01**