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The Value of Housing Attributes

A fundamental proposition of the analyses which we have presented in this work is that the long-run equilibrium model employed implicitly or explicitly in nearly all economic studies of urban housing markets depicts housing outputs, housing production relationships, and the nature of consumer demand in an analytically incorrect and misleading way. As we have discussed in Chapter 2, the traditional model assumes that households demand a homogeneous good which is produced competitively in a market characterized by long-run equilibrium. The influence of this traditional model of the housing market is not confined to the economics discipline. Many policymakers, often unknowingly, accept the assumptions, conclusions, or policy prescriptions of such a model.

An essential element of the revised theory that underlies our empirical analyses is that housing consumers demand not a homogeneous good "housing," but rather bundles of specific housing attributes. In this chapter, we use statistical methods to estimate the market value of individual housing attributes. These imputations, made by regression analysis, are analytically equivalent to the market comparisons made by individual demanders. The principal difference is that prospective buyers will generally confine their detailed comparisons to a fairly limited portion of the market, whereas we seek to describe the structure of attribute prices for the entire housing market. Several earlier studies have attempted to make similar statistical estimates of the contribution of these specific attributes to the total price (rent or market value) of residential services. For example, Ridker and Henning use census-tract data for St. Louis to estimate the effect of variables such as air pollution, accessibility to the downtown area, school quality, and substandard conditions on the average value of single-family homes.[1] Similar analy-

[1]G. Ridker and J. A. Henning, "The Determinants of Residential Property Values with Special Reference to Air Pollution," *Review of Economics and Statistics* 44, no. 2 (May 1967).

ses, incorporating other variables, have been done by Muth, Oates and Pendleton, and others.[2]

Most previous attempts to estimate the market value of specific attributes of the bundle of residential services are deficient because they fail to represent adequately the complexity of bundles of residential services, because they lack adequate measures of residential quality, or because they rely exclusively on aggregate data. In this chapter, we seek to correct these deficiencies by using information for individual dwelling units, by describing the bundles of residential services more completely and, in particular, by making a serious attempt to measure physical and environmental quality.

Quantitative estimates of the value of individual attributes of the bundle of residential services are obtained by regressing market price (value for owner-occupied dwellings and monthly rent for renter-occupied dwellings) on several housing attributes. The coefficients for individual variables then measure the market value of additional quantities of each attribute. If the housing market could be assumed to be in long-run equilibrium, this would be a fairly unambiguous measure, since it would also be equal to the supply price of adding an increment of that attribute to the bundles. However, because stocks are so important in the housing market, we expect to find substantial departures from long-run equilibrium for at least some attributes. For reasons outlined in Chapter 2 and discussed further in this chapter, imputing values to individual housing attributes is somewhat artificial. Each bundle earns a composite quasi rent; it is these quasi rents that are imputed to specific attributes.

[2]Richard F. Muth, *Cities and Housing* (Chicago: University of Chicago Press, 1969); M. Stengel, "Racial Price Discrimination in the Urban Rental Housing Market" (Ph.D. diss., Harvard University, 1970); R. N. S. Harris, G. S. Tolley, and C. Harrell, "The Residence Site Choice," *Review of Economics and Statistics* 50, no. 2 (May 1968): 325–34; W. C. Pendleton, "The Value of Highway Accessibility" (Ph.D. diss., University of Chicago, 1962); Benton F. Massell and Janice M. Stewart, "The Determinants of Residential Property Values" (Institute for Public Policy Analysis, Stanford University, Discussion Paper No. 6, Oct. 1971); Thomas King and Peter Mieszkowski, "Racial Discrimination, Segregation, and the Price of Housing," *Journal of Political Economy* 81 (May/June 1973): 590–606. John C. Musgrave, "The Measurement of Price Canges in Construction," *Journal of the American Statistical Association* 64 (1969): 771–86; Wallace E. Oates, "The Effects of Property Taxes and Property Values: An Empirical Study of Tax Capitalization and the Tiebout Hypothesis," *Journal of Political Economy* 70, no. 6 (Nov./Dec. 1969): 957–71; John F. Kain and John M. Quigley, "Measuring the Value of Housing Quality," *Journal of the American Statistical Association* 70, no. 330 (June 1970): 532–48; Mahlon R. Straszheim, *An Econometric Analysis of the Urban Housing Market* (New York: National Bureau of Economic Research, 1975).

Even so, the imputed market value of specific housing attributes is of considerable theoretical interest and is valuable for many kinds of public and private decisions. For example, estimates of the market value of residential quality obtained from earlier regressions for St. Louis were used to obtain lower-bound estimates of the benefits of urban renewal programs.[3] Similarly, models of this kind would be extremely useful to appraisers in estimating the market value of real estate for tax and comparative purposes.

The coefficients may also be thought of as weights in a hedonic price index.[4] In the September 1969 issue of the *Journal of the American Statistical Association,* John C. Musgrave describes Census Bureau research aimed at the development of such an index for new single-family homes.[5] If measures of quality, such as those which we develop for St. Louis dwelling units, could be obtained for other cities and reproduced over time, it would be possible to develop similar indexes for the housing stock.

Throughout this analysis we allow for possible distortions in the housing market caused by racial discrimination and the existence of the central-city ghetto. Indeed, one of the major objectives of the analysis is to assess the distortions in housing prices and valuations attributable to housing-market discrimination. As we shall discuss subsequently, there is reason to suspect that racial discrimination distorts the housing prices faced by black households, thus influencing consumption of residential services by blacks. Accordingly, separate statistical models are estimated for ghetto and nonghetto properties.

The representativeness of the underlying data is also affected by the fact that the sample of dwelling units includes relatively few observations on suburban housing alternatives. Moreover, some information is completely unavailable for the suburban observations in the sample. As a result, separate estimates of the parameters of the models are made for the city sample and for an expanded sample including suburban observations. Finally, because the price data for renter and owner-occupied dwelling units are not comparable, separate estimates are obtained for

[3]John F. Kain and John M. Quigley, "Evaluating the Quality of the Residential Environment," *Environment and Planning* 2 (Jan. 1970): 23–32.

[4]Musgrave, "The Measurement of Price Changes"; Martin J. Bailey, Richard F. Muth, and Hugh O. Nourse, "A Regression Method for Real Estate Price Index Construction," *Journal of the American Statistical Association* 58 (1963): 933–42; Zvi Griliches, "Hedonic Price Indexes Revisited: Some Notes on the State of the Art," *American Statistical Association, Proceedings of the Business Economics and Statistics Section,* 1967.

[5]Musgrave, "The Measurement of Price Changes."

renter and owner submarkets. These stratifications by owner/renter, ghetto/nonghetto, central city/metropolitan area are chosen to increase the homogeneity of the samples employed. In this as in any other econometric study, the accuracy of individual parameters depends both upon the representativeness of the underlying data and upon the correct specification of the statistical models.

With regard to the second issue, specification, the availability of detailed information about the characteristics of dwelling units reduces the likelihood of bias resulting from the omission of important explanatory variables. The use of individual dwelling-unit data should reduce the problems of collinearity so often encountered in econometric investigation of urban housing markets and permit better estimates of individual parameters. Nevertheless, such problems remain, because fully independent variation in the underlying attributes of housing consumption is not observed.

The specification of the appropriate functional form remains difficult. In particular, the joint purchase of housing attributes, the anticipated departures from long-run equilibrium, and the nonmarket production of many housing attributes virtually insure a jointness in the determination of attribute prices. Theoretical and empirical guidance on what functional form to use for the value and rent equations is sparse. We have dealt with this uncertainty by providing alternative estimates of the rent and value equations for three common and easily interpreted functions, linear (additive), semilog, and multiplicative (logarithmic).

This approach, though widely used in econometric research, is far from satisfactory, since there are no clear-cut criteria for deciding which of the various estimates is "best." Moreover, we have serious reservations about all of the functional forms used in the analysis. This dilemma is not unprecedented in econometric research.

Previous researchers have used a variety of criteria to choose among competing functional forms. The first, and most reputable, is to derive the appropriate functional form from an underlying theoretical model. For example, the semilog form may be chosen to insure diminishing returns in the pricing of housing attributes. Unfortunately, the theoretical model we have outlined, particularly as regards its dynamics, remains too incomplete to provide any but the most general guidance. A second commonly used method is to choose that functional form which fits the data best. In some cases, researchers will have precedent on their side as well, i.e., the fact that a particular functional form worked best in one or more earlier studies. This method, though widely employed, has serious conceptual and statistical weaknesses. We are saved from the temptation of using the "goodness of fit" criterion, because in this, as in many other econometric studies using large numbers of explanatory variables, none of the three specifications employed clearly dominates by this standard.

Some functional forms may be preferred for statistical reasons. In particular, several earlier rent and value studies have used the semilog form of the model because of fears about heteroscedasticity if the untransformed dependent variables were employed. Heteroscedasticity, increasing variance of the dependent variable along some dimension, typically size, may be a minor problem in our samples, but we do not find it a compelling basis for preferring one equation form over another. A particular functional form may be chosen simply because it is easy to interpret. The popularity of additive, semilogarithmic, and logarithmic models is due in no small part to the convenient interpretation of individual coefficients.

All three of these specifications are employed for the rent and value equations presented in this chapter. Finally, to permit a fuller interaction between dwelling-unit size and the remaining attributes of the housing bundles in the determination of prices, we stratify the nonghetto renter and owner properties by number of rooms and estimate separate regressions for each size unit.

All coefficients of the additive value equations are divided by one hundred so that they may function as rental equivalents. This is, of course, analogous to the convention used in Chapter 7. As before, the correctness of this procedure depends on the appropriateness of the gross rent multiplier used. In fact, the rent and value equations obtained in this chapter can be used to estimate some rent/value equivalents. This is accomplished by solving the additive renter equation using mean values of the explanatory variables for owners and by solving the owner equation using means for renters. When mean attributes of owner-occupied units are used in the additive renter equation, a multiplier of 132 is obtained; solving the owner equation with renter means yields a multiplier of 185. In spite of this finding, we continue to use a multiplier of 100 to enable the reader to convert the coefficients to value terms more easily.

No adjustments are needed for the semilog and log-log models, since the coefficients of both have convenient interpretations that do not depend upon the level of the explanatory variables. As noted in Chapter 7, coefficients of the semilogarithmic equations show the *percentage change* in the dependent variable that would result from a *one-unit change* in one of the explanatory variables; the coefficients of the log-log models, which are constant elasticities, show the *percentage change* in the dependent variable resulting from a *1 percent change* in an explanatory variable.

THE MEASURES OF HOUSING ATTRIBUTES

Table 8-1 presents a summary of the information on housing attributes, market prices, and tenancy terms used in the housing-valuation models. The means and standard deviations of the variables are shown separately for the complete sample, which includes 26 rental units and 136 owner-occupied units in the suburbs (Table 9-1).

The explanatory variables used in the attribute-price models are grouped into five categories of conceptually similar attributes. The first category, dwelling-unit quality, comprises five variables that measure various aspects of quality and amenity of the sample dwelling unit and structure.[6] Interior quality, the first of the five, is the mean of seven individual measures of dwelling-unit condition and quality—the condition of floors, windows, walls, levels of housekeeping, and the like—obtained in the Home Interview Survey (see Appendix A, second page). Exterior quality, the second index, is a measure of the condition of the exterior of the structure in which the sample dwelling unit is located. For single detached units, a fairly close correspondence might be expected between these measures of exterior and interior quality. The correspondence would be less for multifamily units, even though there is a tendency for better-quality apartments to be located in better-quality structures. The index of exterior quality that we employ is constructed from several individual measures of structure quality and condition in a manner analogous to the construction of the index of interior quality. The underlying variables used to construct the exterior quality index were collected by building inspectors as part of the Physical Blight Parcel Survey, whereas the variables used in constructing interior quality were obtained in the Home Interview Survey. Thus, exterior quality not only measures a different dimension of quality, but it provides an independent opinion about the quality of the dwelling unit. Since both measures must depend on interviewer judgments, we hope that these independent measurements of closely related attributes have served to reduce enumeration error. On the average, sample owner-occupied units are higher in both interior and exterior quality, have hot water and central heating more often, and are newer than rental units (Table 8-1).

Unit size is measured by four variables: the logarithm of the number of rooms, the number of baths, first-floor area, and parcel area. First-

[6]In Appendix F we present alternative models using somewhat different measures of the quality of dwelling units, structures, parcels and neighborhoods. The derived measures in the appendix rely upon aggregation of some 39 independent measures of the quality of aspects of the housing bundle by the method of principal components (factor analysis).

TABLE 8-1
Means and Standard Deviations of Housing Attributes for Renter and Single-Family Owner-Occupied Units in the City

Variables	Renters Mean	Renters Standard Deviation	Owners Mean	Owners Standard Deviation
Dwelling quality				
Interior	3.80	.68	4.15	.54
Exterior	2.42	.64	2.85	.43
Hot water	.90	–	.97	–
Central heating	.67	–	.93	–
Age	59.80	21.12	50.78	20.55
Size				
Rooms (logarithm)	1.28	.33	1.68	.34
Baths	1.01	.26	1.20	.68
First-floor area (00's sq. ft.)	–	–	9.47	2.72
Parcel area (000's sq. ft.)	1.94	1.56	4.72	3.58
Neighborhood characteristics				
Adjacent units	2.81	.80	3.32	.66
Block face	2.87	.85	3.39	.75
Median schooling	8.93	.88	9.26	.82
Proportion white	.53	.46	.71	.43
Miles from CBD	3.18	1.51	4.56	1.44
School quality	7.88	.56	8.19	.62
Crime	1.15	.84	.63	.65
Structure type				
Single detached	.10	–		
Duplex	.03	–		
Row house	.08	–		
Apartment	.27	–		
Flat	.43	–		
Rooming house	.02	–		
Tenancy terms				
No heat	.73	–		
No water	.18	–		
No furniture	.91	–		
No major appliances	.83	–		
Owner in building	.19	–	–	–
Years of occupancy	5.74	10.29	15.49	12.90
Race of occupant	.47	–	.26	–
Rent (value)	$61.34	$25.41	$14,596	$6,722

NOTE: A flat is a rental unit located in one of the old, small multifamily structures common in St. Louis, as distinct from an apartment, which is a rental unit located in a large apartment structure.

floor area,[7] a surrogate for total area, is not a meaningful measure of unit size for multifamily structures. Inasmuch as single-family units do not have a uniform number of floors, some measurement error exists even for these units.

From Table 8-1, it is evident that owner-occupied single detached units are not only of better quality than renter units but are also larger. Owner-occupied units have an average of about 5.4 rooms, as contrasted with 3.6 rooms for rental units; they have an average of 1.2 baths as compared to an average of 1 bath for rental units; and their parcel areas (lot size in square feet divided by number of dwelling units) average nearly five-thousand square feet, as contrasted with about two-thousand square feet for rental units.

The category "neighborhood characteristics" includes a diverse collection of variables which describe the condition of adjacent and nearby properties, socioeconomic characteristics of the neighborhood, quality of some critical public services, and accessibility to the CBD. The first two neighborhood characteristics, quality of adjacent units and quality of the block face, were obtained from the Physical Blight Parcel and Environmental Block Face surveys. In the Physical Blight Parcel Survey, teams of building inspectors provided detailed evaluation of the condition of properties on each side of the sample property, as well as of the exterior—structure and parcel—of the sample property. The quality-of-adjacent-structures variable is the simple average of the overall evaluations of the condition of the properties on each side of the sample unit (items 32 and 27 of the Physical Blight Parcel Survey). In the Environmental Block Face Survey, the second member of the two-man building inspector teams made detailed observations about the characteristics and condition of the block face for sampled units and provided an overall or combined block-face rating. This overall rating of the block face has a minimum value of 1 ("Bad—major degree of structural deficiencies in maintenance, landscaping, accumulation of trash or adverse influences") and a maximum value of 5 ("Excellent—no deficiencies—evidence of considerable spending"). Data describing adjacent units and the block face were collected to measure the effect of neighboring dwelling units on the value of sample units.

The median-schooling and the proportion-white variables measure the racial and socioeconomic composition of the neighborhood. The neighborhood, in both cases, is defined as the census tract in which the unit is located. Median schooling is the median number of years of formal schooling completed by adult residents of the census tract in 1960. The proportion white is also defined for census tracts, but it is the

[7]This measure was obtained from assessors' records for the structure.

estimated proportion white in 1967. Preliminary analyses employed the census-tract proportion white in 1960 from the Census of Population to measure the racial composition of the neighborhood.[8] Subsequent analyses suggested that the rapid expansion of the ghetto between 1960 and 1967 produced major changes in boundaries of the ghetto between 1960 and the time of the survey. Therefore, we determined to use the sample of St. Louis households to estimate the 1967 proportion white by census tract.

Miles from the CBD, shown in Table 8-1, was but one of several accessibility measures evaluated in the analysis. Several other accessibility indexes were obtained from the East-West Gateway Coordinating Council; and one of them, the accessibility of each dwelling unit to employment, was used in rent and value equations similar to those shown in Table 8-2. These were computed from origin and destination data obtained in the 1967 St. Louis travel survey. All of these accessibility indexes are highly correlated with one another and with distance from the CBD. Rent and value equations were estimated using employment accessibility and distance from the CBD with essentially similar results. Because it is so much easier to interpret, distance from the CBD rather than the accessibility indexes is reported in these analyses.

The last two neighborhood characteristics, school quality and crime, are intended as measures of the quality of neighborhood services. These and other local public goods are featured prominently in public goods–residential location models.[9] Moreover, opinion surveys and public commentary have evidenced widespread concern regarding neighborhood schools and safe streets among urban residents.

The public-goods dimensions of the bundle of residential services present special problems for the analyst. There are few neighborhood measures of these services and little theoretical or empirical guidance about how such measures should be constructed. An important conceptual issue, for example, is whether to measure public service inputs or outputs, presuming that the latter can be defined. Wherever possible, we collected and evaluated both input and output data. However, output measures—achievement scores for neighborhood public elementary schools and the number of major crimes reported per Pauly block—are used in the rent and value equations. As has been discussed in Chapter

[8] Kain and Quigley, "Value of Housing Quality."

[9] Charles M. Tiebout, "A Pure Theory of Local Expenditures," *Journal of Political Economy* 64, no. 3 (Oct. 1956): 416–24; Bryan Ellickson, "Jurisdictional Fragmentation and Residential Choice," *The American Economic Review* 61, no. 2 (May 1971): 334–39; Oates, "The Effects of Property Taxes"; Jerome Rothenberg, "Strategic Interaction and Resource Allocation in Metropolitan Intergovernmental Relations," *American Economic Review* 59, no. 2 (May 1969): 494–503.

4, we assume that in choosing a residential bundle, households are more concerned with public-goods outputs (number of serious crimes in the vicinity, school test scores their children may receive) than with their production process or their inputs (number of policemen or teachers). Of course, as taxpayers, they may be concerned about the cost (taxes) of living in each community.[10]

Output and input measures were obtained for both private and parochial elementary schools within the city, and these measures were coded to the dwelling units served by each school in the city. Output was measured by three achievement-test scores for eighth-grade pupils—reading, literary-writing, and math. All three scores are highly correlated; the eighth-grade math achievement score is used to measure school quality in these analyses. The input measures obtained were student-teacher ratios, student-classroom ratios, the percentage of students and teachers that were nonwhite, the age of the school, and a measure of the condition of the physical plant. Similar data were obtained for both public and parochial schools. However, public and private school achievement scores were highly correlated, and preliminary analyses led us to omit the measures of parochial school quality from the rent and value equations.

It was not possible to obtain at reasonable cost input measures of police protection for each neighborhood. Thus, only output measures—the number of major crimes and the number of minor crimes per Pauly block—were used in the analysis. These were coded to each sample dwelling unit.

Unfortunately, comparable neighborhood-services data are not available for units located outside the city. Many explanations of central-city decline and of the movement of middle- and upper-income families to the suburbs have emphasized the role of the better schools and the lower level of criminal activity to be found there. Obviously, we would have liked to be able to evaluate the importance of these considerations.

[10]Oates makes an attempt to measure these countervailing influences on the desirability of specific locations by regressing property values on expenditures per pupil (an input measure of school quality), effective tax rates, and several other determinants of property value, using census data for fifty-three municipalities in New Jersey. His results indicate that local property values bear a significant negative relationship to the effective tax rate and a significant positive correlation with expenditure per pupil in the public schools. He concludes that "the size of the coefficients suggests that for an increase in property taxes unaccompanied by an increase in the output of local public services the bulk of the rise in taxes will be capitalized in the form of reduced property values. On the other hand, if a community increases its tax rates and employs the receipts to improve its school system, the coefficients indicate that the increased benefits from the expenditure side of the budget will roughly offset (or perhaps even more than offset) the depressive effect of the higher tax rates on local property values" (Oates, "Effects of Property Taxes," p. 968).

TABLE 8-2
Alternative Specifications of Rent and Value Models for the City

Variables	Linear		Semilog		Log-Log	
	Renter	Owner	Renter	Owner	Renter	Owner
Unit quality						
Interior	1.31[4]	8.18[3]	.019[4]	.062[2]	.041	.212[3]
Exterior	4.77[1]	−4.63	.039[4]	−.013	−.015	−.040
Hot water	3.09[4]	–	.248[1]	–	.262[1]	–
Central heating	4.44[1]	–	.129[1]	–	.138[1]	–
Age	−.29[1]	−1.00[1]	−.004[1]	−.008[1]	−.172[1]	−.218[1]
Size						
Rooms	22.63[1]	14.53[3]	.374[1]	.262[1]	.367[1]	.195[1]
Baths	9.07[1]	7.69[3]	.123[1]	.009	.129[1]	.045[3]
Floor area	–	6.34[1]	–	.033[1]	–	.417[1]
Parcel area	.71[3]	6.48[1]	−.002	.011[2]	−.012	.064[2]
Neighborhood						
Adjacent units	1.86[4]	7.77[4]	.042[2]	.065[2]	.108[2]	.175[3]
Block face	3.71[1]	4.19	.054[1]	.023	.131[1]	.174[2]
Median schooling	2.95[1]	14.91[1]	.023[4]	.078[1]	.433[1]	.953[1]
Proportion white	−3.74[3]	−1.47	−.038[4]	−.038	−.001[3]	−.000
Miles from CBD	−.30	−3.54[3]	.009	−.000[4]	−.000	−.044
School quality	2.76[3]	4.90[4]	.038[4]	.048[1]	.312[3]	.285[4]
Crime	−.17	3.39	.013	−.013	−.014	−.015

Structure type						
Single detached	7.68[2]		.143[1]		.144[1]	
Duplex	12.33[1]		.227[1]		.216[1]	
Row house	5.09[4]		.120[2]		.114[2]	
Apartment	5.75[2]		.145[1]		.125[1]	
Flat	6.28[2]		.149[1]		.146[1]	
Rooming house	6.20[4]		.164[2]		.148[3]	
Tenancy terms						
No heat	−9.18[1]		−.157[1]		−.180[1]	
No water	−2.04[4]		−.017		−.006	
No furniture	−5.94[2]		−.076[3]		−.082[3]	
No appliances	−12.00[1]		−.134[1]		−.086[2]	
Owner in building	−4.37[1]		−.071[1]		−.064[1]	
Years of occupancy	−.25[1]		−.004[1]		−.004[1]	
Constant	−25.36[4]	−152.31[2]	2.58[1]	7.56[1]	2.226[1]	3.632[1]
R^2	.714	.772	.745	.724	.757	.721

NOTE: Table notes indicate significance of t ratios for coefficients (two-tailed test).
[1] > .01.
[2] > .05.
[3] > .10.
[4] t ratio greater than 1.0.

The desirability of extending the analyses of the metropolitan housing market to this broader and more critical set of questions cannot be overemphasized.

Structure type constitutes the fourth category. The owner-occupant sample includes only single-family units. Single detached units comprise only 10 percent of the city renter sample (Table 8-1). Flats and apartments are the most common type of rental units occupied by sample households; 43 and 27 percent, respectively, of all city renters reside in these types of structures. A flat is a rental unit located in one of the old, small multifamily structures common in St. Louis, as distinct from an apartment, which is a rental unit located in a large apartment structure.

The housing attributes included in the final category pertain only to renters and describe aspects of the contractual agreement between the landlord and the tenant. The first four attributes indicate whether the rental contract includes the provision of various utilities and furnishings by the landlord. For example, 73 percent of tenants had to pay their own heating bills, 18 percent had to pay their own water bills, 91 percent of the units were unfurnished, and 83 percent did not include major appliances (refrigerator and/or stove).

CITY EQUATIONS

The variables included in price-determination equations for city owners and renters shown in Table 8-2 are generally similar, but they are not identical. For both owners and renters, the models include seven neighborhood characteristics, the number of rooms, the number of baths, parcel area, and three of the five unit-quality variables. In addition, the renter equation includes dummy variables for hot water and central heating, which are excluded from the owner equation, since practically all owner-occupied units include these amenities. Similarly, the owner equation includes first-floor area, which is omitted from the renter equation because it refers to the structure rather than to the dwelling unit.

Finally, the renter equation includes six dummy variables for structure type and six measures of tenancy terms. A seventh structure type is incorporated in the intercept. The first four tenancy-term variables correct the dependent variable, contract rent, for the utilities provided by different landlords. The "owner in building" dummy variable is designed to test the hypothesis that resident landlords accept lower rents to exercise greater control over tenant selection.

Duration of occupancy, though shown for owners in Table 8-1, is not included in the value equations. In the rent equation it provides an estimate of the discounts given to long-term tenants. Landlords are sensitive to turnover because both vacancies and redecorating are expensive. Therefore, it is rational for landlords to share some of the savings from lower expenses with long-term tenants in the form of discounts. The years-of-occupancy variable, which assumes that discounts are proportional to duration of tenure, is, of course, only one of several ways in which this hypothesis might be represented.

Race of occupant is shown in Table 8-1 but is not included in either the renter or owner equations. We hypothesize that housing-market discrimination operates by limiting black housing search and residence to certain well-prescribed neighborhoods. For reasons discussed in Chapter 2, prices in these neighborhoods may differ from those prevailing outside the ghetto. However, we hypothesize that whites and blacks pay the same prices within these neighborhoods.[11]

Table 8-2 shows the estimated coefficients for the 567 rental units and the 267 owner-occupied single-family homes in the city for the linear, semilog, and log-log specifications. In the semilog models, the dependent variable, rent or market value, is expressed in logarithmic form. In the log-log models, the following variables are also expressed as logarithms: interior and exterior quality, age, parcel area, first-floor area, quality of adjacent units and block face, median schooling, miles from the CBD, school quality and crimes. There is very little difference among the six equations in terms of overall goodness of fit; all six explain a very large proportion of the variation in the dependent variables. If the number of statistically significant coefficients (*t* ratios significant at the .05 level) is used as the criterion, there is, again, little basis for preferring one equation over another, although, by this standard, the semilog equation for owners and the semilog and log-log equations for renters are slightly better. Since neither the semilog nor the log-log specification shows a clear superiority, our discussion of the results emphasizes the linear form because of its simpler interpretation.

Despite some important differences, the parameter estimates obtained for the five unit-quality variables are generally consistent among equations, generally conforming to a priori expectations. The least consistent results are obtained for the exterior-quality variable, which has a negative sign in all three owner equations. Its coefficient is,

[11]Because of the intense segregation in U.S. cities, the practical difference may be small. For a study that uses race of the occupant rather than a neighborhood variable, i.e., ghetto, see King and Mieszkowski, "Estimate of Racial Discrimination," and our discussion in Chapter 3.

however, smaller than its standard error in every case. The negative sign may be due to multicollinearity; for single detached units, interior and exterior quality may simply be too highly correlated.

Except for the unanticipated negative sign obtained for exterior quality in the owner equations, the coefficients in Table 8-2 indicate that households pay substantially more for higher-quality units. For example, the linear equation for renters indicates that they will pay about $1.31 per month for an additional unit of interior quality, $4.77 per month for an additional unit of exterior quality, $3.09 per month for hot water, $4.44 per month for central heating, and $.29 per month for an additional year of newness.

The semilog and log-log models suggest even higher valuations of hot water and central heating. Coefficients of the semilog model suggest that units with hot water and central heating rent for 25 percent and 13 percent more, respectively, than otherwise comparable units. It is likely that these variables act as more general measures of dwelling-unit quality, and that the estimates reflect this.

Central heating and hot water are not included in the owner models, and as noted previously, the coefficient of exterior quality is smaller than its standard error. However, the coefficient of interior quality, which is significant at the .10 level, indicates that owners will pay $8.18 per month ($818 in value) for an additional unit of interior quality. Newness is even more valuable in the owner than in the renter submarket; owners will pay $1.00 ($100 in value) for a year of newness as compared with an outlay of only $.29 by renters. The average owner-occupied structure in the city sample is fifty years old; thus, the results in Table 8-2 indicate that a new unit would sell for $5,000 more than an otherwise comparable unit of average age.

The size variables are generally highly significant and have the correct sign. The coefficient of number of rooms, expressed in logarithms in all six equations, indicates in the additive equation for renters that a prospective renter would have to pay about $9.18 more per month for a three-room unit than for a comparable two-room unit, but only an additional $11.56 to obtain a five-room unit rather than one consisting of three rooms. A similar progression exists for owner-occupied units; a six-room unit costs about $1,007 more than a comparable three-room unit, but an eight-room unit costs only $418 more than one consisting of six rooms. In comparing the rooms coefficients of the renter and owner equations, it is essential to remember that the owner equation includes first-floor area, particularly since it is hard to imagine adding a room without increasing the floor area. If an added room measured only ten feet by ten feet, it would add $634 to the value of the unit through the floor-area coefficient. The semilog models indicate that rents increase by

37 percent with each additional room, while the value of single-family houses increases by 26 percent with each additional room, floor-area being held constant.

Neighborhood characteristics include several measures of residential quality that are external to the sampled property. All share the distinctive feature that the owners of individual properties cannot by themselves change their level. Instead, such changes require the aggregation of individual location and investment decisions, government action, or both. Yet these external factors strongly influence the location decisions of individual households and the market valuation of individual properties. Most previous studies of urban housing markets have been based on aggregate data such as census-tract statistics, or on national probability samples, which lack information on neighborhood characteristics. As a consequence, few of these studies have considered the influence of the quality of nearby properties on property values, on housing consumption, and on the quality of an individual property. The estimates in Table 8-2 provide some indication of the relative importance of these aspects of residential quality.

It is apparent from Table 8-2 that the condition of adjacent and nearby properties has a substantial effect on the market value of sample properties. Variables which describe the physical condition of adjacent and nearby properties appear to have nearly as large an influence on the value of sample properties as the interior- and exterior-condition variables. For example, in the renter additive equation, the sum of the coefficients of adjacent and block-face variables is $5.57 per month, whereas the sum of the coefficients of the interior- and exterior-quality variables is $6.08. The condition of adjacent properties and the block face appears to have an even larger effect on the value of owner-occupied single detached properties. The sum of the coefficients of the adjacent and block-face variables in the additive equation is $11.96, as compared with only $3.55 for the interior- and exterior-quality variables. Because of the serious collinearity between the interior- and exterior-quality indexes for single detached units, this comparison may be somewhat misleading. When exterior quality is omitted from the additive value equation for the entire sample, the coefficient of interior quality increases to $12.41, while the coefficients of block and adjacent quality become $6.05 and $4.70, respectively.

In addition to these measures of the condition of nearby dwelling units, the surrogate for neighborhood prestige (median schooling of residents of the census tract) is positive and larger than its standard error in all six equations, differing from zero at the 1 percent level in all but one. The additive models indicate that a rental unit located in a census tract where the median adult has only completed the eighth grade will rent for $5.90 less per month than an otherwise identical rental unit located in a census tract where the median adult has completed the tenth grade. If the unit in question is owner-occupied, it will have a market value $2,982 less than a comparable unit in a tract with a median educational level two years greater. The largest neighborhood-prestige effects are obtained for the multiplicative model; a 1 percent change in median schooling produced a change in house values of about 1 percent and a change in rents of almost 1/2 percent.

The results obtained for the school-quality and crime variables are only suggestive of the importance of these public services. The coefficient of the neighborhood crime index is smaller than its standard error in all of the equations and has the wrong sign in two of the six. The results for the coefficient of school quality are somewhat better. These have the correct signs and are larger than their standard errors in all six equations. Taken at face value, the results of the additive model indicate that renters are willing to pay $2.76 more per month for units served by neighborhood schools where students average one year better in achievement. The semilog and log-log specifications suggest somewhat larger effects. From the frequent references to school quality and crime in discussions of how households make residential choices and of how the urban housing market operates, stronger school and crime effects might have been anticipated.[12]

For a number of reasons, however, part of the influence of better schools on value may be represented by dwelling-unit and neighborhood-quality variables. There is reason to believe that there is considerable error in the school-quality measurement. As a result, since mean school achievement is highly correlated with the indexes of residential quality, the residential variables may be proxying the effects of school quality.[13] Moreover, if better schools attract households with higher incomes, which spend more on housing maintenance, part of these measured effects of dwelling-unit and neighborhood quality are logically indistinguishable from school quality.

Even more acute problems are encountered in attempting to measure neighborhood public safety. Inclusion of a neighborhood crime index in the model is more a statement of good intentions than a serious effort to confront the conceptual and measurement problems of quantifying the perceived safety of a neighborhood. The index of neighborhood

[12]Oates, "Effects of Property Taxes."

[13]For a discussion of this problem see Eric A. Hanushek and John F. Kain, "On the Value of Educational Opportunity as a Guide to Public Policy" in *On Equality of Educational Opportunity,* Frederick Mosteller and Daniel P. Moynihan, eds. (New York: Random House, 1972).

crime used in the analysis is also highly correlated with the indexes of residential quality.

A final reason for anticipating weak school and crime effects is the absence of suburban properties. The largest variation in school quality and level of criminal activity is found not within the city of St. Louis but rather between the city and its suburbs.

Theories of urban spatial structure place considerable emphasis on accessibility to the center as a determinant of housing value. The results in Table 8-2 provide very weak evidence of an accessibility gradient. In only two of the six equations in Table 8-2 does the coefficient of distance from the CBD exceed its standard error, and it is negative in all but one equation. There are several, not necessarily inconsistent explanations for the relatively poor performance of the accessibility variable. The most reasonable is that the relationship between accessibility and rent and value is more complex than can be embodied in any of the simple functional forms included in Table 8-2. In particular, as we have indicated in Chapter 2, the location rent surfaces for various attributes, or bundles of attributes, probably vary. Moreover, the estimates in Table 8-2 are heavily influenced by ghetto properties, and we made the point in Chapter 3 that accessibility considerations play only a minor role in determining the market value of such properties. Subsequent analyses will provide support for both of these contentions.

Of the variables specific to the renter model, all but two of the structure-type dummies and all but one of the tenancy-terms variables are significant at the .05 level in the additive model. All structure-type dummies in the semilog equations, and all but the rooming-house dummy in the log-log equations, are significant at the .05 level. Of the tenancy-terms variables, only the "no water" and "no furniture" variables fail to pass this test. The regression coefficients for the duration-of-occupancy variable are small—a monthly rent discount of only $.25 for each year of occupancy in the additive model and .4 percent per year discount in the semilog and log-log models—but they are highly significant. These small differences presumably capture a lagged adjustment of monthly rent. Landlords are less likely to raise rents when their properties are occupied by stable tenants than when there is a change in occupancy.

A different landlord-tenant interaction may be responsible for the relatively large coefficient of the owner-in-building variable. The additive model suggests that this discount amounts to $4.37 per month, while in the semilog model it amounts to about 7 percent of monthly rent and in the log-log model to about 6 percent. The lower rents for units with resident landlords may result from less sophistication and professionalism on the part of these smaller operators, or they may reflect different tenant-selection policies. When the owner lives on the property, he may select tenants more carefully to achieve lower vacancy rates and lower maintenance and repair costs. The critical impact of these factors on the profitability of rental properties has been emphasized in other studies.[14]

The findings also suggest that standardized dwelling units located inside the ghetto are somewhat more expensive than those outside, a conclusion which is consistent with Ridker and Henning's study of St. Louis and with other investigations of housing-market discrimination.[15] The coefficient of proportion white is negative in all six equations. However, its level of significance is exceedingly low in the regression for owner-occupied housing. For renters, in the additive equation, $t = 1.743$; in the semilog, $t = 1.127$; and in the log-log, $t = 1.649$. Taken at face value, the coefficients in the linear model indicate that a comparable renter unit costs 6.3 percent more in an "all-black" area than in an "all-white" area. The estimated differences from the semilog and log-log models are 3.8 percent and 5.7 percent respectively. For owner-occupied units, the three models imply that comparable units cost 1.0 percent (from the linear form), 3.8 percent (from the semilog form) or 4.2 percent (from the log-log form) more in an "all-black" than in an "all-white" area of the central city.

Although the negative signs for the proportion-white variables in Table 8-2 are consistent with the findings of discrimination markups in most earlier studies of housing-market discrimination, serious questions may be raised about the specifications used for both the owner and rental models.[16] If housing-market discrimination exists, it is doubtful that its effects can be represented by a uniform percentage markup on all types of housing. The phenomenon is undoubtedly far more complex—with the effects of discrimination more or less strongly evident in various submarkets defined by quality and structure type. It should also be remembered that the equations in Table 8-2 are estimated for city dwelling units only. Yet, it is clear that for most households—particularly, white households—the relevant housing market is the entire metropolitan area. In the following section, the small suburban sample is added, and the effect of racial discrimination on housing prices is considered more fully.

[14]Muth, *Cities and Housing;* George Sternlieb, *The Tenement Landlord* (New Brunswick, N.J.: The Urban Studies Center, Rutgers, 1966).

[15]Muth, *Cities and Housing;* King and Mieszkowski, "An Estimate of Racial Discrimination"; Stengel, "Price Discrimination"; Chester Rapkin, "Price Discrimination Against Negroes in Rental Housing Market" in *Essays in Urban Land Economics* (Los Angeles and Berkeley: University of California Press, 1966); David H. Karlen, "Racial Integration and Property Values in Chicago" (Urban Economics Report No. 7, University of Chicago, April 1968); Ridker and Henning, "Determinants of Residential Property Values."

[16]See citations in note 15.

THE VALUE OF HOUSING ATTRIBUTES INSIDE AND OUTSIDE THE GHETTO

In Chapter 3 we asserted that the most useful analytical way of representing the effects of racial discrimination in urban housing markets is to postulate the existence of two relatively independent submarkets: the ghetto and the remainder of the metropolitan area. These two markets are interrelated in a variety of ways, but there are significant barriers between them. The ghetto and nonghetto housing markets are organized by different institutions and have different information networks. Housing prices in the two markets must bear a relation to each other, but this relationship need not be uniform for different types of housing. The two submarkets differ in terms of the composition of their housing stocks, the sources of the supply, and the extent and composition of demand.

Blacks limit their search for housing—or are restricted by discriminatory practices and lack of information—to a few geographically contiguous neighborhoods that are designated by custom and practice for black occupancy. Whites are free to live anywhere in the metropolitan area, but for a variety of reasons (i.e., prejudice, an unwillingness to be the only whites in the neighborhood, or the existence of better or cheaper housing outside the ghetto) they generally reside beyond the confines of the ghetto.

The rent and value equations presented in Table 8-2 tend to corroborate earlier studies that have suggested the presence of a discrimination markup. Our estimates and those obtained in earlier studies assume that the structure of relative prices for the various housing attributes is the same for properties located inside and outside the ghetto, i.e., that the samples of ghetto and nonghetto properties are homogeneous. This assumption of homogeneity is, however, inconsistent with the position that the ghetto and nonghetto housing markets are separate. Although substantial differences in the prices of comparable ghetto and nonghetto properties at the boundaries of the ghetto are unlikely to persist for long periods of time, prices in the interior of the ghetto may differ substantially from prices in the interior of the white housing market. Unfortunately, our sample is not extensive enough to test all hypotheses about the structure of housing-attribute prices inside and outside the ghetto. Nonetheless, some crude tests of sample homogeneity between ghetto and nonghetto properties are possible.

Shown in Table 8-3 are three separate regression estimates of the market value of housing attributes for owner- and renter-occupied properties, depending on whether they are located inside or outside the ghetto. The estimates in Table 8-3 all employ an additive specification; comparable estimates for a semilog specification are presented in Table

TABLE 8-3
Linear Specifications of Rent and Value Equations for Ghetto and Nonghetto Units

	Renters			Owners		
		Nonghetto			Nonghetto	
Variables	Ghetto	City	All	Ghetto	City	All
Dwelling quality						
Interior	−.48	6.73[1]	6.99[1]	10.69[4]	10.03[2]	14.83[1]
Exterior	2.68[4]	6.75[1]	5.39[2]	−17.68[4]	2.78	−1.84
Hot water	4.23[2]	6.95[4]	5.08			
Central heating	7.76[1]	1.41	.06			
Age	−.17	−.39[1]	−.37[1]	−.66[1]	−1.16[1]	−.85[1]
Size						
Rooms	20.24[1]	26.50[1]	30.08[1]	−15.44	30.83[1]	49.08[1]
Baths	7.38[1]	13.36[1]	13.72[1]	7.25[4]	11.52[2]	16.26[1]
Floor area				5.16[1]	5.94[1]	10.60[1]
Parcel area	−.26	1.29[4]	.84[4]	.74[1]	.39[1]	.01[4]
Neighborhood						
Adjacent units	1.68[4]	1.26	1.22	9.08	6.96[4]	2.31
Block face	5.24[1]	1.90	2.92[4]	8.50	.61	6.96[4]
Median schooling	3.61[1]	4.17[1]	2.68[1]	26.83[1]	10.02[1]	.21
Miles from CBD	−1.78[1]	−.99	1.89[1]	−6.08	−1.76	−3.68[1]
School quality	.32	3.35[4]		−2.96	9.47[2]	
Crime	−.00	−.03[4]		.01	.10	

Structure type						
Single detached	4.37[4]	8.13[4]	−.60[2]			
Duplex	1.14	16.18[1]	18.24[1]			
Row house	2.87	5.27	6.54[4]			
Apartment	7.65[1]	−1.19	2.33			
Flat	5.05[3]	4.25	7.36[4]			
Rooming house	7.61	−33.15[2]	−28.70[3]			
Tenancy terms						
No heat	−8.19[1]	−9.25[1]	−7.54[1]			
No water	−.97	−3.13[4]	−2.77[4]			
No furniture	−7.34[2]	−7.64[2]	−9.94[1]			
No appliances	−6.97[1]	−16.56[1]	−16.17[1]			
Owner in building	−1.79	−7.20[1]	6.55[1]			
Years of occupancy	−.16[2]	−.24[1]	−.23[1]			
Constant	−11.87	−18.28	7.32	−102.00	−120.00[2]	3.74
R^2	.7243	.749	.781	.859	.683	.715
Number of observations	314	253	279	88	178	313

NOTE: Table notes indicate significance of *t* ratios for coefficients (two-tailed test).

[1]> .01.

[2]> .05.

[3]> .10.

[4]*t* ratio greater than 1.0.

8-4. The first and fourth equations in both tables present estimates of the market value of individual housing attributes for properties located in the ghetto. For these analyses, the ghetto is defined as consisting of all census tracts that were at least 85 percent black in 1967. The second and fifth equations in Tables 8-3 and 8-4 provide estimates of the market value of housing attributes for central-city renter- and owner-occupied properties located outside the ghetto, i.e., for central-city properties located in census tracts more than 85 percent white in 1967. The third and sixth equations provide estimates for all nonghetto properties, including an additional 26 renter-occupied and 136 owner-occupied properties in St. Louis County. Addition of these suburban properties significantly increases the sample size, particularly for owner-occupied single detached units. More important, it makes the nonghetto sample much more representative of the nonghetto housing market in the St. Louis metropolitan area. High-value properties and the best neighborhoods are still underrepresented in the sample, but the effects of adding these suburban units to the sample are large. With 136 additional suburban properties, the mean value of single-family detached units increases by over $2,000, from $15,309 for the city nonghetto sample to $17,456 for the entire nonghetto sample.

Except for the omission of the school and crime variables from the entire nonghetto sample, the equations estimated for the two nonghetto samples are identical. It is evident from Tables 8-3 and 8-4 that the estimated attribute prices for ghetto and nonghetto properties are very different. For example, the linear equation suggests that city nonghetto renters pay an estimated $6.73 per month for an increment of interior condition; when suburban renter properties are added, an even higher estimate—$6.99 per month—is obtained. For rental properties in the ghetto, the coefficient of interior condition is negative—−$.48 per month—although smaller than its standard error. Similarly, an additional unit of exterior condition has an estimated value of only $2.68 in the ghetto as compared with an estimated value of $6.75 for central-city nonghetto properties, and $5.39 for the combined nonghetto sample. The premium paid for central heating in the ghetto is, however, quite large: $7.76 for the ghetto compared with $1.41 for the city nonghetto sample, and $.06 for the entire nonghetto sample.

In contrast, most types of neighborhood quality appear to be more expensive inside the ghetto than outside. The sum of the adjacent-unit and block-face condition variables is $6.92 per month for ghetto rental units, as compared with only $3.16 for central-city nonghetto rental units, and $4.14 for all nonghetto rental units. The coefficient of median schooling is $3.61 for the ghetto, $4.17 for the city nonghetto, and $2.68 for the entire nonghetto. The coefficient of school quality is ten times as

TABLE 8-4
Semilog Specifications of Rent and Value Equations for Ghetto and Nonghetto Units

	Renters			Owners		
		Nonghetto			Nonghetto	
Variables	Ghetto	City	All	Ghetto	City	All
Dwelling quality						
Interior	−.003	.072[2]	.063[1]	.080[4]	.052[4]	.106[1]
Exterior	.022	.059[4]	.045[4]	.084	.021	.028
Hot water	.213[1]	.491[1]	.482[1]			
Central heating	.153[1]	.088[1]	.093[1]			
Age	−.002[1]	−.005[1]	−.005[1]	−.007[1]	−.008[1]	−.006[1]
Size						
Rooms	.357[1]	.410[1]	.421[1]	.157[3]	.277[1]	.399[1]
Baths	.105[1]	.141[3]	.135[2]	.020	.059[1]	.036[3]
Floor area				.029[1]	.038[1]	.034[1]
Parcel area	−.009[4]	.002	.002	.009[4]	.019[1]	.000
Neighborhood						
Adjacent units	.046[3]	.037[4]	.036[4]	.086[4]	.038[4]	.040[3]
Block face	.079[1]	.013	.024	.021	.020	.041[2]
Median schooling		.0289[4]	.023[4]	.126[1]	.063[1]	.006
Miles from CBD	−.002	−.006	.020[1]	.011	−.019[4]	−.022[1]
School quality	.006	.055[2]		.022	.048[4]	
Crime	.000	−.000		−.000	−.000	
Structure type						
Single detached	.117[2]	.097[4]	.116[3]			
Duplex	.068	.255[1]	.262[1]			
Row house	.091[4]	.041	.056			
Apartment	.154[1]	.038	.058			
Flat	.129[1]	.086[4]	.116[4]			
Rooming house	.196[1]	−.540[1]	−.500[1]			
Tenancy terms						
No heat	−.137[1]	−.161[1]	−.142[1]			
No water	−.011	−.033	−.017			
No furniture	−.085[4]	−.112[3]	−.133[1]			
No appliances	−.100[2]	−.167[1]	−.164[1]			
Owner in building	−.047[4]	−.105[1]	−.091[1]			
Years of occupancy	−.004[1]	−.005[1]	−.004[1]			
Constant	2.671[1]	2.675[1]	3.032[1]	7.915[1]	7.890[1]	8.67[1]
R^2	.741	.771	.795	.690	.744	.748

NOTE: Table notes indicate significance of *t* ratios for coefficients (two-tailed test).
[1]> .01.
[2]> .05.
[3]> .10.
[4]*t* ratio greater than 1.0.

large for the city nonghetto as for the ghetto. For rental properties, additional rooms, larger parcels, and additional baths all appear more expensive in the ghetto than outside.

Similar results are obtained for the owner models. The combined interior- and exterior-condition coefficients are larger for nonghetto than for ghetto properties. When exterior quality is omitted from the entire nonghetto value equation, the monthly cost of interior quality becomes $11.58 as compared with $10.99 for each unit of block quality and $3.52 for each unit of adjacent-unit quality. By comparison, although few of the neighborhood quality variables are statistically significant, their coefficients are uniformly larger for ghetto than for nonghetto properties. The sole exception is school quality, which has a negative coefficient in the ghetto equation. In the city nonghetto model, the coefficient of school quality, which is significant at the .10 level, indicates that St. Louis homeowners are willing to pay nearly a thousand dollars more for a dwelling located in a neighborhood served by public schools that average one grade better on standardized achievement tests.

The results obtained for the size variables in the ghetto regressions are bizarre. The coefficient of the logarithm of the number of rooms in the additive model is actually negative, although smaller than its standard error. In the semilog model, it is positive with a *t* ratio of 1.4 and a value of .16. This coefficient is only about half as large as that obtained in the city nonghetto equation, .28. Similarly, the other principal size measure, first-floor area, has a value of .04 in the nonghetto equation, as contrasted with a value of .03 in the ghetto semilog equation.

We believe that the inconsistent results for the ghetto rent and value models result from the limited range of some housing attributes available there. For example, since ghetto schools are almost uniformly bad, it is not surprising that the coefficient of school quality is small, often incorrect in sign, and always smaller than its standard error in the ghetto value and rent equations. We suspect many of the differences in attribute prices for ghetto and nonghetto properties are explained by supply limitations of this kind.

Analyses in subsequent chapters will indicate that some combination of price discrimination, the unavailability of certain types of housing in the ghetto, and real or imagined limitations on the ability of black households to locate outside the ghetto distort black housing patterns. Even so, it is instructive to ask what the average black household would have to pay in order to obtain its current housing bundle outside the ghetto. Rent would be $49.37 versus $55.90, and the average owner-occupied unit could be purchased for $835 less ($12,319 versus $13,154).

In general, omitting ghetto properties from the sample seems to improve the parameter estimates obtained in the value and rent equations, bringing them into closer correspondence with our a priori expectations about the structure of housing prices. One exception is provided by the distance-from-the-CBD variable. For the additive owner equations, the coefficient of distance from the CBD is smaller than its standard error but negative for all three samples. In the additive renter models, however, the coefficient of distance from the CBD is negative and significant at the 5 percent level for the ghetto. It is negative but smaller than its standard error for city nonghetto properties, while being positive and significant at the 1 percent level in the full nonghetto sample. This reversal with the addition of the relatively few suburban observations may reflect unmeasured higher quality in much suburban rental housing or an actual inversion of the location-rent gradient for rental units. Such an inversion of the usual rent gradient could reflect an equilibrium excess supply of some types of rental units at central locations or a temporary excess demand for certain types of rental units at some suburban locations. The same reversal is evident in the semilog equations; for all nonghetto properties the price of rental housing increases as distance from the CBD increases. Neither the owner nor renter semilog equations provide evidence that the price of ghetto properties declines with distance from the CBD.

This question is only slightly different from that addressed in the analysis of Table 8-2, where it was estimated that the average rental property in the sample costs 4 to 6 percent more in an "all-black" than in an "all-white" area. However, we now acknowledge possible differences in the structure of relative prices in the ghetto and in the nonghetto housing markets.

Estimates of the cost of purchasing the average ghetto owner and renter properties outside the ghetto are obtained by solving the nonghetto rent and value equations using the average characteristics of ghetto properties. Conversely, estimates of the costs of purchasing the average nonghetto property inside the ghetto are obtained by solving the ghetto equations using the average characteristics of nonghetto properties.

Table 8-5 summarizes these calculations, in terms of percentage differences, for the stratified models for both owner and renter properties. For example, the average monthly rent of ghetto units in the sample is $55.90. Using the linear equation for nonghetto properties in the city (Table 8-3, column 2), the monthly rent of a dwelling unit with these same characteristics is estimated to be $50.09; thus the estimated markup on ghetto properties is 11.6 percent. For the same comparison, the coefficients of the semilog model (Table 8-4, column 2) provide an estimated markup of 17.8 percent for a property with the average characteristics of ghetto rental units, i.e., this property is 17.8 percent

TABLE 8-5
Estimated Ghetto Markups for Housing Bundles from Stratified Models (percent)

	Linear	Semilog	Log-Log
Rental bundles:			
Average ghetto housing bundle			
In city nonghetto	11.6	17.8	19.1
In entire sample nonghetto	13.7	9.2	10.0
Average city nonghetto housing bundle			
In city ghetto	12.5	1.3	2.1
Average nonghetto housing bundle (entire sample)			
In city ghetto	6.9	2.5	1.6
Owner bundles:			
Average ghetto housing bundle			
In city nonghetto	5.2	5.1	6.1
In entire sample nonghetto	0.8	0.8	3.2
Average city nonghetto bundle			
In city ghetto	1.7	3.3	8.2
Average nonghetto sample (entire sample)			
In city ghetto	19.2	30.2	51.4

more expensive in the ghetto than in the rest of the central city. Using a log-log specification (not shown in Tables 8-3 and 8-4), the percentage difference is estimated to be 19.1 percent.

When the estimates are computed using the coefficients from the entire nonghetto sample, we are, of course, unable to include the value of schools and crimes in the comparisons. Using the entire nonghetto sample, the estimates of ghetto markups are slightly lower, in the range of 9 to 14 percent.

The monthly rent of the average city nonghetto property is $68.09. Using the coefficients of the linear equation for ghetto properties (Table 8-3, column 1), the estimated rent in the ghetto for a dwelling unit with these characteristics is $76.63; thus the estimated markup is 12.5 percent. The estimated markups using the coefficients of the semilog and log-log models are much smaller.

The fourth line of Table 8-5 presents the estimated markups based on the characteristics of the average nonghetto rental property in the entire sample. Again, because information on the incidence of crime and the quality of schools is unavailable outside of the central city, we are unable to include these important attributes in the comparisons.

The latter part of the table presents the estimated ghetto markups for owner-occupied properties.

For several reasons, we have more confidence in the estimates of ghetto markups presented in lines 1 and 5 of Table 8-5. These calculations are based on the regressions estimated for the city nonghetto properties; thus, they include differences in the value of the schools and the neighborhood crimes associated with each unit. The regression results estimated for nonghetto properties also appear to have fewer problems with collinearity, since there is substantially more variation in the independent variables.

This analysis suggests that the ghetto markup for rental properties may be on the order of 12 percent, and for owner-occupied properties it may be on the order of 5 percent.

The table, however, provides estimates for rental properties ranging between 1 and 19 percent; for owner-occupied properties, the estimates range between 1 and 51 percent. It is worth noting that in none of these comparisons is a comparable property estimated to be cheaper in the ghetto housing market than in the nonghetto market.

STRATIFICATION BY DWELLING-UNIT SIZE

As we mentioned at the beginning of this chapter, we are not fully satisfied with the functional forms used in the regression estimates. We doubt that any of them adequately represents the kinds of jointness and interdependence in attribute prices that characterize urban housing markets. In many respects, additive specification is the least satisfactory. It assumes that the price of each attribute is independent, and that the value of the complete bundle is the simple sum of the prices of the individual attributes, weighted by the quantities of each. This implies that households pay a certain amount for each room regardless of its condition or quality, a certain amount for dwelling-unit quality regardless of the dwelling-unit size, and a fixed dollar amount for quantities of each neighborhood characteristic.

These strong additivity assumptions might be tenable if there were no jointness in the production of the various attributes, if all housing markets were in long-run equilibrium, and if all attributes were produced in competitive markets. Unfortunately, in practice, none of these conditions is satisfied. Many attributes have a clear jointness in production, many others are not provided by competitive firms, and we anticipate rather large departures from long-run equilibrium. As a result of these factors, there may be large spatial quasi rents on individual attributes or on particular bundles of attributes. The independence assumption is particularly offensive in the case of variables measuring dwelling-unit size and quality, since there are technological reasons for expecting the cost of producing dwelling-unit quality to depend on the size of the dwelling unit.

The semilogarithmic and logarithmic specifications are more plausible than the additive model in this respect, since, in both, the payment for a particular attribute depends on the levels of the remaining attributes. For example, in the semilogarithmic model, the payment for a unit of a particular attribute is assumed to be proportional to the level of the remaining attributes. Thus, in the example cited previously, the market value of dwelling-unit quality depends on the size of the dwelling unit; in fact, it is proportional to the base cost. An increase in dwelling-unit quality by one unit increases the cost of the dwelling unit by X percent. If housing bundles included only dwelling-unit size and quality variables, the semilog form of the equation might be a reasonably satisfactory representation. However, there is little justification for requiring that payments for neighborhood quality be proportional to payments for dwelling-unit size and quality, and even less justification for requiring the payment for dwelling-unit quality to be dependent on the level of neighborhood quality. The logarithmic form of the model embodies a similar, but even stronger, interaction among the payments for individual attributes.

The semilog and log-log forms have the desirable property of allowing some interactions among the payments for individual attributes. But the permitted interactions are of a highly specific nature; and in one way or another, each fails to correspond to our prior expectations about the structure of attribute prices. For this reason, we now present an alternative specification of the rent and value models that allows a fuller interaction between dwelling-unit size and the several measures of quality. To estimate these alternative models, we stratify the renter and owner samples by the number of rooms and obtain separate additive equations for each size of dwelling unit. This procedure allows the payment for each of the remaining attributes to vary with dwelling-unit size. However, unlike the semilog and multiplicative forms of the pooled equations, these payments need not vary uniformly with changes in size.

The advantages obtained from stratifying the equations by number of rooms should not obscure the fact that there are also disadvantages to this procedure. The most obvious is the substantial reduction in sample size. The largest sample, five-room owner-occupied units, includes only 125 observations and several samples have less than 50 observations.

Still another serious consequence of stratification is a reduction in the variance of both the dependent and explanatory variables. These reductions in sample variance create a number of statistical difficulties. Due to collinearity among variables and reduced variance in many variables in the stratified samples, it is not possible to obtain meaningful coefficient estimates for many of the variables that were statistically significant in the pooled model. To obtain estimates for the subsamples based on the number of rooms, it was necessary to prune the value and rent equations substantially by omitting obviously nonsignificant variables and those too highly correlated with other included ones.

The reduction in sample variance is exacerbated by yet another problem. As the data in Tables 8-6 and 8-7 illustrate, virtually all of the remaining housing attributes are systematically related to the number of rooms in the dwelling-unit. Moreover, for each size category, units in the ghetto are systematically inferior in both dwelling-unit and neighborhood quality to units located outside the ghetto. The positive relationship between size and quality is quite regular for three-, four-, and five-room rental units, and for four-, five-, six-, and seven-room owner units. The largest and smallest rental units, however, conform less well to this pattern, possibly because the sample sizes are quite small. An important consequence of the association between dwelling-unit size and other housing attributes is that part of the effects on price of both omitted and included housing attributes may be reflected in the intercepts of the stratified equations.

As we have previously noted, the more serious problems of multicollinearity and smaller sample sizes of the stratified regressions made it necessary to omit a number of explanatory variables from these equations. This was accomplished by excluding explanatory variables with small standard deviations and those with very low t ratios in trial regressions. However, three variables of particular theoretical interest—miles from the CBD, neighborhood prestige, and percent white—were retained until the last iteration. This procedure produced the similar, but still nonuniform equations, shown in Table 8-8. Although equations were obtained for the entire sample, for the ghetto sample, and for the nonghetto, only the equations for nonghetto properties for the owner categories and for three out of five of the renter categories are shown in Table 8-8.

Owing to the lack of uniformity among the equations in Table 8-8, it is hard to generalize about them. Still, some interesting patterns are evident. Because of the strong interest that has centered on accessibility in analyses of the housing market, all of the equations in Table 8-8 include distance from the central business district. The results obtained

TABLE 8-6
Means of Housing Attributes by Number of Rooms for Renters of Ghetto and All Nonghetto Properties

	Ghetto (Rooms)					Nonghetto (Rooms)				
Variables	1–2	3	4	5	6–8	1–2	3	4	5	6–8
Unit quality and size										
Interior	3.52	3.56	3.66	3.64	3.53	3.95	4.02	4.11	4.25	3.83
Exterior	2.29	2.08	2.24	2.26	2.10	2.83	2.63	2.77	2.83	2.62
Hot water	.82	.74	.91	.93	.94	.89	.96	.99	.98	.94
Central heating	.65	.44	.70	.80	.71	.67	.59	.88	.85	.94
Age	61.41	65.98	61.61	64.89	71.71	44.78	55.99	47.29	45.90	54.41
Baths	.95	.95	.99	1.02	1.32	.83	.98	1.01	1.06	1.06
Parcel area	15.60	18.87	17.95	23.40	28.54	7.89	15.60	20.22	30.9	35.64
Neighborhood										
Adjacent units	2.57	2.36	2.58	2.68	2.37	3.50	3.09	3.36	3.43	3.32
Block face	2.53	2.37	2.54	2.59	2.48	3.33	3.31	3.47	3.54	3.35
Median schooling	8.69	8.67	8.88	9.13	8.88	9.22	8.88	9.50	9.6	9.44
Proportion white	17.76	18.58	13.42	13.18	11.10	99.71	99.94	99.72	99.51	99.01
Miles from CBD	2.46	2.58	3.13	3.36	3.16	5.04	3.43	4.35	5.06	4.25
Rent	47.56	47.54	60.44	68.24	64.64	61.44	59.27	76.41	87.92	90.00
Number of observations	34	119	82	46	31		108	96	48	17

TABLE 8-7
Means of Housing Attributes by Number of Rooms for Owners of Ghetto and All Nonghetto Properties

	Ghetto (Rooms)					Nonghetto (Rooms)				
Variables	4	5	6	7	8–12	4	5	6	7	8–12
Unit quality and size										
Interior	3.79	3.99	4.04	4.32	3.95	4.25	4.52	4.62	4.63	4.64
Exterior	2.46	2.58	2.50	2.79	2.50	2.91	3.07	3.08	3.15	3.11
Hot water	.89	.95	.94	1.00	1.00	.93	1.00	1.00	1.00	1.00
Central heating	.74	.85	.88	.91	1.00	.91	1.00	.97	1.00	1.00
Age	64.21	62.35	64.06	63.46	64.18	43.32	29.55	31.19	31.71	33.93
Baths	.95	1.00	1.18	1.00	1.88	.98	1.05	1.31	1.53	1.93
Floor area	8.82	8.44	9.06	10.74	10.15	8.74	10.46	10.80	13.27	15.53
Parcel area	29.34	35.79	38.42	43.06	52.44	46.52	90.79	73.18	111.16	227.50
Neighborhood										
Adjacent units	2.68	2.62	2.88	3.00	2.85	3.45	3.70	3.82	4.01	3.85
Block face	2.63	2.75	2.82	3.09	2.88	3.28	3.78	3.94	4.13	4.13
Median schooling	8.77	8.96	8.94	9.16	9.56	9.76	10.09	10.52	10.60	10.21
Proportion white	18.67	6.14	14.56	15.98	5.62	99.68	99.49	99.31	99.25	99.31
Miles from CBD	3.20	3.40	3.39	3.69	4.34	6.00	7.40	8.14	8.60	7.88
Value (dollars)	10,292	10,805	11,695	14,733	14,905	12,416	16,176	17,044	21,170	28,113
Number of observations	19	20	17		17	56	125	62	38	30

TABLE 8-8
Rent and Value Equations by Number of Rooms for All Nonghetto Properties

	Renters (Rooms)			Owners (Rooms)				
Variables	3	4	5	4	5	6	7	8–12
Unit quality and size								
Interior	5.36^{2}			22.59^{2}	11.24^{3}	16.85^{4}	7.64	75.08^{2}
Exterior	4.65^{2}	10.77^{1}						
Hot water	14.81^{1}		11.33					
Central heating	9.18^{1}	−3.73						
Age	$-.32^{1}$	$-.53^{1}$	$-.29^{2}$	$-.98^{1}$	-1.13^{1}	$-.95^{1}$	-1.21^{3}	-1.07^{4}
Rooms				11.86				
Baths			14.50^{3}				9.25	
Floor area				7.91^{1}	4.61^{1}	4.75^{1}	8.66^{1}	19.30^{1}
Parcel area		$.10^{4}$		12.12	-1.18^{4}	−2.89	.26	
Structure type								
Single detached		5.84						
Apartment	-6.16^{2}	4.87	-11.16^{2}					
Flat		4.90^{4}						

Neighborhood								
Adjacent units			11.22[1]	7.78	10.86[3]	12.24[4]	−.62	14.90
Block face			12.17[1]					
Median schooling		−2.22	4.70[1]	3.99	.48	−.97	7.04[4]	−18.78[4]
Miles from CBD	−.24	4.13[1]	.65	−5.86[3]	−3.01[1]	−3.67[3]	−5.32[3]	−6.44[4]
Tenancy terms								
No heat	−16.28[1]	−12.91[1]	−10.49[2]					
No water	−3.72[4]							
No furniture	−10.48[2]	−17.39[1]						
No appliances	−16.24[1]	−13.77[1]	−13.72[2]					
Owner in building	−2.54[4]		−17.09[1]					
Years of occupancy	−.12[3]	−.10						
Constant	63.09[1]	108.9[1]	−14.67	−4,349	7,430	6,609	6,875	−14,550
R^2	.864	.808	.884	.621	.541	.539	.759	.842
Degrees of freedom	94	82	36	47	117	54	29	23
Number of observations	108	96	48	56	125	62	38	30

NOTE: Table notes indicate significance of *t* ratios for coefficients (two-tailed test).

[1]> .01.

[2]> .05.

[3]> .10.

[4]*t* ratio greater than 1.0.

for the three rental equations in Table 8-8 are inconsistent with the price relationships predicted by monocentric theories of urban spatial structure but generally confirm the results obtained for the nonghetto rental equations in Tables 8-3 and 8-4. For the stratified nonghetto rental equations, two of the three distance coefficients are positive, but only one, that for four-room apartments, is greater than its standard error. This coefficient is quite large, however, and is significant at the .01 level. The average four-room nonghetto unit in the sample is located 4.4 miles from the CBD, and the sample standard deviation is 2.7 miles. Thus, a unit one standard deviation closer to the center (1.7 miles from the CBD) would rent for $22.30 less than an otherwise comparable four-room unit one standard deviation toward the periphery (7.1 miles from the CBD).

In contrast to the results for rental units, the coefficients of the variable of distance from the central business district in the owner equations provide rather consistent evidence of declining location rents with distance from the CBD. The coefficient of miles from the CBD is negative for all room size categories and varies in magnitude from a low of $3.01 per mile per month to $6.44 per mile per month ($301 and $644 per mile in value). The pooled owner equation for all nonghetto properties also has a negative coefficient, but it is smaller than its standard error and is only about one-fifth as large as the smallest estimate of a gradient obtained for individual room equations. This suggests that there are different value gradients for the different size structures, a result that is consistent with Straszheim's findings for San Francisco.[17] As a result, pooling these units of different size produces a misspecification that obscures the presence of any gradient. The gradients for five- and six-room units are quite similar. Interestingly enough, it is evident from Table 8-7 that the average five-room unit has as much floor area as the average six-room unit. Both, however, have more square footage than four-room units and are smaller than either seven-room units or eight- to twelve-room units.

The other interesting result shown in Table 8-9 is the very different pattern of significant coefficients for the neighborhood and dwelling-unit quality variables in the renter equations. None of the neighborhood quality variables consistently affects the rent of four- and five-room units. However, both interior and exterior dwelling quality have large and statistically significant coefficients in the three-room equation, and the coefficient of exterior quality is large and statistically significant in the four-room equation. By contrast, nearly opposite results are obtained for five-room units. Of the five measures of dwelling-unit quality, only structure age is larger than its standard error in the five-room equation, but all the coefficients of adjacent quality, block quality,

[17] Straszheim, *Econometric Analysis*.

TABLE 8-9
Additive Rent and Value Equations by Number of Rooms for All Nonghetto Properties

	Renters (Rooms)					Owners (Rooms)				
Variables	1–2	3	4	5	6–8	4	5	6	7	8–12
Unit quality and size										
Interior						18.22^{2}	12.56^{2}	16.65^{4}	13.68	68.68^{2}
Exterior	−11.83	4.761^{3}	10.91^{2}	6.53	8.73					
Age	−.89	$-.44^{1}$	$-.82^{1}$	$-.53^{1}$	-1.03^{2}	-1.14^{1}	-1.10^{1}	$-.93^{1}$	-1.05^{2}	−7.49
Floor area						8.85^{1}	4.64^{1}	4.67^{1}	9.54^{1}	18.37^{1}
Neighborhood										
Adjacent units						8.77	10.76^{3}	12.12^{4}	−1.77	6.59
Block face	5.87	2.19^{4}	−.54	15.68^{2}	−.20					
Miles from CBD						-3.88^{3}	-3.00^{1}	-3.88^{2}	-4.00^{4}	−5.35
Tenancy terms										
No heat	4.53	-16.01^{1}	-11.76^{1}	-8.08^{4}	−4.23					
No furniture	−43.18	-13.36^{2}	-13.21^{2}	1.73	120.97^{2}					
No appliances	−6.64	-15.12^{2}	-14.56^{1}	-11.22^{4}	-125.77^{1}					
Constant	153.3^{4}	100.7^{1}	120.0^{1}	52.05^{3}	124.0^{3}	11.67	71.34^{3}	57.13	96.47	-280.90^{4}
R^2	.842	.785	.740	.752	.764	.602	.534	.538	.749	.826
Degrees of freedom	2	101	89	41	10	50	119	56	32	24
Number of observations	9	108	96	48	17	56	125	62	38	30

NOTE: Table notes indicate significance of t ratios for coefficients (two-tailed test).
[1] > .01.
[2] > .05.
[3] > .10.
[4] t ratio greater than 1.0.

and median schooling are significant at the 1 percent level and quite large. These results suggest further that the markets for small and large multifamily units are quite distinct; a different configuration of attributes command market prices for larger multifamily units than for smaller multifamily units.

In spite of this and other evidence of heterogeneity in the structure of prices for rental and owner units of different sizes, equations including an identical set of explanatory variables for unit-size categories are shown in Table 8-9.

The rental equations include two dwelling-unit quality variables, exterior quality and age; one measure of neighborhood quality, block quality; and three contract-rent corrections. The owner equations include two measures of dwelling-unit quality, interior quality and structure age; first-floor area; the quality of adjacent units; and distance from the CBD. Although equations for the largest and smallest rental units are included in Table 8-9, not much confidence can be placed in them because of the small sample sizes (only nine properties for one- and two-room rental units and seventeen properties for six- to eight-room units).

The identical form of the equation reported in Table 8-9 facilitates comparisons among the equations for different room size classes. Nearly all of the coefficients in the stratified equations have the anticipated signs, though many of the coefficients are not statistically significant. The few sign reversals that do occur are for very small samples, the largest and smallest rental units; and, therefore, do not represent important exceptions. Age of structure appears in both the rental and owner equations and is highly significant statistically in nearly all equations. In the rental sample, the age coefficient varies from forty-four cents per month for each year of age for three-room units to over a dollar per month for six- to eight-room units. There is no clear progression by unit size, suggesting important deviations from long-run equilibrium. In the owner equation, the age coefficient varies from a low of \$.93 per month for each year of age for six-room units to a high of \$7.49 per month for each year for the largest owner-occupied units. The latter figure cannot be considered very reliable since it is based on only thirty observations and is smaller than its standard error. Except for this estimate for the largest units, all of the newness premiums for age vary within a narrow range. If it can be assumed that age measures a uniform dimension of quality for the various size units, this result is somewhat inconsistent with the view that the St. Louis housing market is in long-run equilibrium. Except for the eight- to twelve-room equation, the age coefficients for the stratified owner equations are of approximately the same magnitude as are obtained for the comparable pooled equation in Table 8-3; the premiums for newness for the stratified rental equations in Table 8-9, however, are generally larger than those obtained in the comparable pooled equations in Table 8-3.

The coefficients of both exterior quality and block quality in the stratified renter equations vary substantially in terms of both statistical significance and magnitude, and no simple pattern is evident by room size. However, the tendency observed in Table 8-8 for dwelling quality to be a more important determinant of value for smaller units and for neighborhood quality to be a more important determinant of value for five-room units is supported by the estimates in Table 8-9.

Except for the largest owner units, the coefficients of interior quality vary within a fairly narrow range. Again, as with structure age, there is no noticeable tendency for the premium for dwelling-unit quality to increase with room size. This may result from errors of measurement of the dwelling-unit quality variable, from misspecification, or from differences in the structure of house values for units of different size. Resolution of this important question must await further research with improved measurements and larger, more representative, samples. Similarly, the premium for adjacent-unit quality is quite different among units of different size and fails to exhibit an obvious regularity by size.

The stratification by room size is designed to standardize the sample properties by dwelling-unit size; however, it is evident that the properties included in each of the room size classifications are not actually homogeneous in terms of size. The inclusion of first-floor area in the owner equations then provides a measure of this variation in dwelling-unit size within room size categories. The significant variation in first-floor area for units of the same room size is clearly evident from the relatively large standard deviations of first-floor area within room size categories. The standard deviation of first-floor area which, not surprisingly, increases with the number of rooms, is 226 square feet for the smallest units and 642 square feet for the largest, with a marked increase between six and seven rooms. Evidently, then, there is considerable overlap in dwelling-unit size as measured by floor area among the room size categories. For example, the average first-floor area of five- and six-room units is nearly the same—1,047 square feet and 1,080 square feet, respectively. Since the standard deviations of first-floor area for five- and six-room units are 231 square feet and 354 square feet, it is obvious that many five-room units are larger than many six-room units when measured by first-floor area.

The coefficients of the floor-area variable in the owner equations are all statistically significant at the 1 percent level and vary widely from one room size to another. The most similar estimates are obtained for five- and six-room units, which may be quite close substitutes. Both smaller units—four-room—and larger ones—seven-room and from eight- to twelve-room—are considerably more expensive per square foot of additional floor area. These differences in unit cost per square foot may either be evidence of different quasi rents on units of uniform quality within a room size class, or may reflect some of the previously mentioned differences in dwelling unit and neighborhood quality among the room size classes. Further research is needed to obtain more definitive answers to these questions.

The explanatory power of the individual equations in Table 8-8 is less in many cases than that of the comparable pooled equation in Table 8-3. However, the more interactive specification of the rent and value equations shown in Table 8-9 provides a marginally better explanation of the variation in rents and values than the single equation in Table 8-3. When the variance due to the stratification by room size is added to the variance explained by the independent variables included in each equation in Table 8-9, the overall explained variance is .798 for renters and .795 for owners.

SUMMARY

Housing choices, both as to type and location, reflect decisions by urban households to purchase a wide variety of heterogeneous attributes, including both quantitative and qualitative aspects of dwelling units, structures, neighborhoods, and public services. This chapter has provided a detailed analysis of the market prices of these housing attributes.

Based upon detailed information gathered for each dwelling unit, we have analyzed the market prices of bundles of housing services defined to include both quantitative attributes of the units themselves and qualitative features of the structure, the parcel, and the immediate neighborhood. The results suggest that, for both owner-occupied and rental units, variations in the level of these attributes are systematically related to market prices. Besides attributes that measure dwelling-unit size (number of rooms, baths, parcel area, first-floor area), the quality of dwelling units, of parcels, and of the block face, and neighborhood prestige are all reflected in housing prices. It is worth emphasizing that many of the attributes of a heterogeneous housing stock, for example structure type and lot size in built-up areas, are extremely durable and are expensive to modify. Other attributes, for example, neighborhood characteristics, are not supplied by firms at all.

The analysis of attribute prices also considers, in a limited way, the influence of good schools and safe neighborhoods upon housing values and rents. The results indicate that even within the central city, dwelling units served by better schools command higher prices.

The results of our analyses for both renter and owner-occupied properties indicate that structures of attribute prices differ between properties located in the ghetto and those located outside of it. In part, these differences reflect the limited choice of housing attributes available in the ghetto housing market. For example, the premium for better quality neighborhood schools is estimated to be about $4.85 (per month for an additional year of achievement on standardized tests) outside the ghetto. This premium is not observed for ghetto properties, largely because the schools servicing these properties are uniformly bad.

When the sample of nonghetto properties is expanded to include the important suburban alternatives facing white households, the rent and value equations explain more of the variation in housing prices. The analysis of the combined city-suburban sample is limited, however, by the absence of any information regarding suburban public services.

For the pooled sample of ghetto and nonghetto properties, the results suggest that similar units cost 4 to 6 percent more in an all-black than in an all-white neighborhood. For the comparisons between submarkets, the results suggest that a rental unit with the characteristics of the average ghetto unit would rent for 12 to 19 percent more in the ghetto than in the nonghetto portion of the housing market; for owner-occupied units, the discrimination markup is estimated to be 5 to 6 percent. For example, from the linear model, a representative rental unit in the ghetto costs about $70 a year ($5.80 a month) more than in the unrestricted (nonghetto) portion of the city housing stock. A representative owner-occupied unit in the ghetto would cost $651 less outside.

The analysis concludes by estimating value and rent relationships for nonghetto properties separately for units of varying size (as measured by numbers of rooms). Despite the reduction in the variation of housing attributes when the sample is stratified, the results indicate that there are important interaction effects between payments for size and other housing attributes. For example, the premium for newness appears to vary with dwelling-unit size, though the relationship is a complex one.

In addition, the employment-accessibility variable used in the analysis (miles from CBD) is more often significantly different from zero in the stratified models for owners than in the pooled models. One implication is that simple monocentric analyses, which ignore the existence of residential capital, fail to take into account some important tradeoffs which are considered by households in choosing a residential location, and which are reflected in market prices. Moreover, employment accessibility is systematically related to other important housing attributes, which themselves vary spatially. More detailed analyses of the accessibility measures, using both miles from CBD and more generalized gravity-model measures of accessibility to employment or retail activity, indicate that the interaction of accessibility and the spatial distribution of existing housing attributes deserves more attention in analyses of urban spatial structure.