Volume Title: Housing Markets and Racial Discrimination: A Microeconomic Analysis

Volume Author/Editor: John F. Kain and John M. Quigley

Volume Publisher: NBER

Volume ISBN: 0-870-14270-4

Volume URL: http://www.nber.org/books/kain75-1

Publication Date: 1975

Chapter Title: Determinants of Housing Expenditures

Chapter Author: John F. Kain, John M. Quigley

Chapter URL: http://www.nber.org/chapters/c3717

Chapter pages in book: (p. 154 - 189)

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Determinants of Housing Expenditures

INTRODUCTION

Economists have long been interested in explaining the level of housing expenditures by households and have carried out extensive statistical investigations using a variety of data sources. These studies, based on the traditional theory which views housing as a homogeneous good, usually have had the estimation of demand functions for "housing services" as their principal objective. The variables most often used in these studies to explain housing expenditures are income and price, reflecting economists' traditional concern with these economic variables.

There have been a few studies of the determinants of housing expenditures based on time-series data. However, most studies have relied on cross-section data, and because there is little or no observed variation in net housing prices in cross-section samples, few investigators have succeeded in obtaining estimates of price elasticities.[1] As a result, these studies have been concerned almost exclusively with estimating the income elasticity of demand for housing services. These attempts have been the source of no little controversy. The primary disagreement has centered on whether the demand for housing services is income elastic, i.e., whether the elasticity of housing expenditures with respect to income is greater or less than one.

[1]The most prominent time-series studies are: Richard F. Muth, "The Demand for Non-Farm Housing" in *The Demand for Durable Goods*, Arnold C. Harberger, ed. (Chicago: University of Chicago Press, 1960), pp. 29–96; Tong Hun Lee, "The Stock Demand Elasticities of Non-Farm Housing," *Review of Economics and Statistics* 46, no. 1 (Feb. 1964): 82–89; idem, "More on the Stock Demand Elasticities of Non-Farm Housing," *Review of Economics and Statistics* 49, no. 4 (Nov. 1967).

Margaret Reid and Richard Muth, two of the principal protagonists in this debate, have presented evidence that the income elasticity is greater than one, indeed perhaps as large as two.[2] They contend that the lower estimates obtained by other researchers are attributable to an incorrect measurement of income. Housing decisions, the argument goes, are long-term decisions and depend more on permanent than on annual income. Studies relying on annual income will always obtain biased estimates of the income elasticity with respect to permanent income, which is *the correct measure of income* to use in studying the demand for housing services.

Reid and Muth used several samples of aggregate data for metropolitan areas, communities, and census tracts to obtain estimates of the elasticity of housing expenditure with respect to permanent income. Their argument is that the use of aggregate data averages the transitory components of income, thereby providing something approximating permanent income. It seems possible, however, that the aggregation procedures used by Reid and Muth to obtain estimates of permanent income have created other problems of specification and bias.

The analysis of housing expenditures is further complicated by the fact that households may consume housing services either by renting or by purchasing. The former method requires weekly or monthly payments for the services provided by a particular dwelling unit, while the latter requires that the household purchase a dwelling unit, typically with the aid of external financing, and subsequently make regular outlays for expenses such as maintenance, repair, property taxes, utilities, and insurance. In addition to these regular outlays, most households make monthly payments for interest and the retirement of principal.

As we have pointed out in Chapter 6, the decision to own or to rent is related to household investment and savings decisions; moreover, existing tax laws systematically encourage home ownership for a large proportion of households. Because of these important conceptual differences, and because homeowners' expense data are generally not available, few studies of the demand for housing have combined owner and renter households. For that matter, because of the importance of capital gains and losses, a satisfactory measure of housing expense for homeowners is difficult to define and probably still more difficult to estimate.

When possible, researchers usually obtain separate estimates of the demand for housing services by owners and renters. This practice is entirely ad hoc, since there is no persuasive integrated theory of housing

[2]Richard F. Muth, *Cities and Housing* (Chicago: University of Chicago Press, 1969); Margaret Reid, *Housing and Income* (Chicago: University of Chicago Press, 1962).

demand which deals simultaneously with the ownership-rental decision and the demand for housing services by owners and renters. Although we consider both questions in our analysis, we cannot claim to have provided such an integrated view.

In a recent article, Frank de Leeuw attempts to reconcile several authors' estimates of the demand for housing services with each other, and with recent estimates of his own, based on BLS data.[3] From this evidence, he concludes that the overall income elasticity of rental housing in the United States probably lies in the range 0.8 to 1.0, and that the income elasticity for owner-occupied housing is somewhat higher than that for rental housing.

All but one of the studies reviewed by de Leeuw—Tong Hun Lee's—were estimated from aggregate data and considered only a limited number of determinants of the demand for housing services.[4] By contrast, the analyses of the demand for housing services presented in this chapter are based on individual data and consider a far wider set of explanatory variables.

EXPENDITURES BY ST. LOUIS HOUSEHOLDS

In this chapter we present several statistical models of the demand for housing services by St. Louis owner-occupant and renter households. The first of these equations, referred to as the "full model," includes the same eighteen socioeconomic variables used in Chapters 5 and 6 to explain ownership and purchase decisions. Monthly outlays by renters are measured by gross monthly rents, and those by homeowners are estimated at $1/100$ of the market value of their homes. Next we describe "simple models" of housing expenditure, which include only income and race as explanatory variables. These simple models provide estimates of the effect of annual income on housing expenditures and facilitate comparisons of our findings with those of earlier studies.

Both the full and simple models indicate that black households consume considerably less housing than white households of similar characteristics. Therefore, we estimate both the full and simple models of housing expenditures for whites and blacks separately. The final section of this chapter examines models using one of the estimates of permanent income developed in Chapter 6.

[3]Frank de Leeuw, "The Demand for Housing: A Review of Cross Section Evidence," *Review of Economics and Statistics* 53, no. 1 (Feb. 1971):1–11.

[4]Tong Hun Lee, "Demand for Housing: A Cross Section Analysis," *Review of Economics and Statistics* 45, no. 2 (May 1963): 190–96.

THE FULL MODEL

The full model of the determinants of housing expenditure includes the life-cycle variables which may influence household decisions regarding how much of their income to devote to housing. The included variables are identical to those used to explain ownership, moving, and purchase decisions in Chapter 5, and the results provide a generally consistent view of the interrelated decisions of whether to purchase or to rent and how much to spend under each form of tenure.

The full model contains eighteen explanatory variables in the case of owners and twenty-two in the case of renters. The renter equations include more explanatory variables because of the need to correct monthly rents for differing contract terms, i.e., the provision of heat, water, electricity, and furnishings by the landlord or by the tenant. The eighteen socioeconomic variables used in both owner and renter models include race, family income, years of education of the head of household, several variables describing the labor-force attachment of household members, a series of dummy variables to identify the several types of households without children, and several variables describing the characteristics of households with children.

All of the housing expenditure models presented in this chapter are single-equation estimates obtained by ordinary least-squares. Appendix D, however, presents models estimated using generalized least-squares with the sampling proportions as weights. For all models, alternative estimates are presented for linear (additive), semilog (dependent variable expressed as logarithm), and log-log specifications. In addition, the logarithm of family size (number of persons) is used in all equations, rather than the number of family members.

Estimates obtained from the additive, semilog, and log-log specifications of the full model of housing expenditures for owners and renters are presented in Table 7-1. To make comparisons between the coefficients of the linear owner and renter models easier, each coefficient of the owner model is divided by one hundred. This procedure relies on the widely used rule of thumb that monthly housing outlays by owner-occupants average about 1 percent of the market value of their units.

It is not necessary to adjust the coefficients of the semilog and log-log models, since the coefficients of both have convenient interpretations that are independent of the levels of either the dependent or independent variables. The coefficients of the semilog models measure the percentage change in the dependent variable associated with a one-unit change in an explanatory variable. Thus, if income is measured in thousands of dollars in a model explaining monthly rental outlays, a coefficient of .10 means that a one-thousand-dollar increase in income

TABLE 7-1
Alternative Specifications of the Full Model of Housing Expenditures for Renters and Owners

	Linear		Semilog		Log-Log	
Variables	Renters	Owners	Renters	Owners	Renters	Owners
Race	−10.07[1]	−30.12[1]	−.167[1]	−.252[1]	−.192[1]	−.285[1]
Income	2.40[1]	7.97[1]	.034[1]	.030[1]	.076[1]	.127[1]
Education	1.81[1]	4.82[1]	.028[1]	.034[1]	.241[1]	.372[1]
Years on current job	−.05	.56[3]	−.000	.004[2]	−.000	.005[1]
Retired	2.12	25.51[2]	−.001	.133[2]	−.009	.155[2]
None employed	−1.77	48.02[4]	−.064[4]	.163	−.072[4]	.192
More than one employed	4.16[3]	−15.94[2]	.053[4]	−.016	.104[1]	.005
Families						
Age	.16[4]	−.16	.001	−.001	.001	.001
Number of persons	−1.93	4.64	.004	.015	−.002	−.056[4]
Number of children	−.33	.24	−.002	−.000	.001	.023[4]
Female head < 45 years	6.83[3]	22.24	.090[4]	.095	.051	.015
Female head > 45 years	−3.16	53.60[3]	.029	.351[2]	−.018	.445[1]

Household types						
Single female < 45 years	2.18	22.59	.026	.100	−.004	.051
Single female > 45 years	2.09	23.99[3]	.009	.044	−.029	.015
Single male < 45 years	−12.94[2]	15.49	−.130[4]	−.172[4]	−.102	−.170[4]
Single male > 45 years	−9.13[4]	33.81[3]	−.237[2]	.124[4]	−.258[2]	.114[4]
Couple, head < 45 years	−6.91[4]	17.84	−.078	.095	−.080	.078
Couple, head > 45 years	−.58	13.00[4]	−.071	.009	−.076	−.021
Corrections						
No furniture	7.30[3]		.077[4]		.122[3]	
No heat	−11.39[1]		−.240[3]		−.244[1]	
No appliances	−19.97[1]		−.177[3]		−.202[1]	
No water	.30		−.016		−.019	
Constant	53.19[1]	35.51[2]	3.72[1]	8.96[1]	3.20[1]	7.58[1]
R^2	.44	.46	.39	.42	.35	.33
Income elasticity	.20	.42	.18	.26	.08	.13
Number of observations	594	401	594	401	594	401

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.

increases the household's rental expenditures by 10 percent. The coefficients of the log-log model are, of course, constant elasticities and therefore measure the percentage change in the dependent variable associated with a given *percentage* change in an independent variable. Thus, a coefficient for income of .10 in a log-log model on monthly rental outlays would mean that a *1 percent increase* in income would lead to a one-tenth of 1 percent increase in rental outlays.

The income elasticities implied by the estimated coefficients are presented on the next to last line in Table 7-1. For the linear model, the elasticity is computed by multiplying the estimated income coefficient by the mean value of income and dividing by the mean housing expense. Thus, for the linear form, the income elasticities computed from the regression equation are larger for households who currently spend a smaller proportion of their annual incomes on housing. For the semilog model, in which the dependent variable is expressed in logarithms, the mean elasticity corresponds to the estimated income coefficient multiplied by the mean income of the sampled households. This specification, which implies that the income elasticity is larger for households with higher annual incomes, may seem reasonable for a sample composed of many low-income households. For the log-log model, the elasticity, which is simply the estimated income coefficient, implies that the income elasticity is constant across the sampled households.

From Table 7-1, it is apparent that the alternative specifications explain a large proportion of the total variance in rent and housing value and have coefficients with the expected signs and reasonable magnitudes. The linear model explains the largest proportion of sample variance for both owners and renters, 44 percent of the variance in rents and 46 percent of the variance in house values. Similarly, the semilog model explains a higher proportion of total variance than the log-log model for both renter and owner households.

All six equations have large numbers of statistically significant variables. Race, income, and years of schooling of the head are significantly different from zero at the 1 percent level in all of them. In the linear model, the results indicate that renter households spend an additional $2.40 per month ($28.80 per year) for housing for each additional one-thousand dollars of annual income, whereas owners spend more than three times as much out of each additional thousand dollars of annual income ($7.97 per month or $95.64 per year). The accuracy of these estimates of monthly and yearly expenditures by owners depends, of course, on the correctness of the value/rent conversion ratio of 1:100. Evidence presented in Chapter 8 suggests that the appropriate gross rent multiplier for St. Louis may be closer to 1:150. Even so, owner-occupants spend a larger fraction of additional income on housing than

renters at any capitalization ratio less than 1:300. A similar dominance for owner-occupants exists for years of schooling of the head; an additional year of schooling increases the monthly outlay of renter households by $1.81, as contrasted with an increase of $4.82 by owner-occupants.

The relative magnitudes of the income coefficients for owners and renters are reversed in the semilog model, where a one-thousand-dollar increase in income causes renters to increase their monthly outlays by 3.4 percent, whereas a comparable increase in income causes only a 3.0 percent increase in housing expenditures by owner-occupants. Even so, the income elasticities are larger for owners than for renters in all three specifications. For both tenure types, the linear model provides the largest elasticities and the log-log model provides the smallest. Although the range of estimated elasticities is large, varying between .13 and .42 for owners and .08 and .20 for renters, all elasticities are small in comparison to earlier studies.

Interpretation of these results is facilitated by Figures 7-1 and 7-2, which illustrate how monthly expenditures vary as a function of annual income for the linear and semilog specifications, holding the remaining variables constant at their means.

In all six equations, the level of housing expenditure of black households is significantly lower than that of white households after the effects of all other factors included in the equations (family income, the age and education of the head of household, family size and composition, and the labor-force attachment of family members) are accounted for. The linear models indicate that, on the average, black renters spend ten dollars (or about 16 percent) per month less for housing than comparable white renters, and that black owners spend thirty dollars less per month (live in single-family units worth $3,000 less) than comparable white owners. Even larger differences in the housing consumption of white and black households are indicated by the semilog and log-log models. The former model suggests that black renters spend 17 percent less on housing than comparable white renters, and the latter implies that black owners spend 25 percent less than white owners. Still larger percentage impacts are suggested by the log-log model.

These findings, if correct, have great social significance. They also bear on a number of controversial issues concerning the effects of housing-market discrimination on market prices and consumer behavior. Analyses presented in subsequent chapters suggest that ghetto housing is more expensive than housing outside the ghetto, and that black households are limited to the ghetto. This finding is consistent with the results of many, if not most, empirical investigations and is accepted by a broad spectrum of scholars.

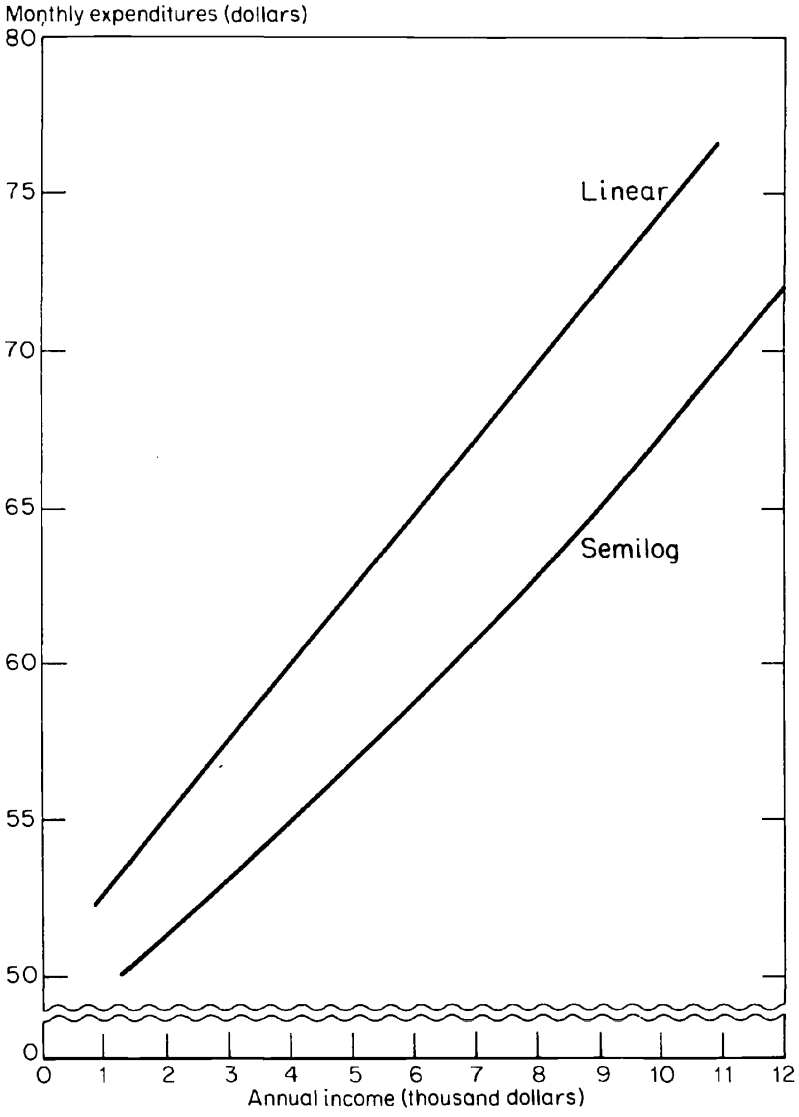

FIGURE 7-1
Estimated Monthly Housing Expenditures for All Renters by Annual Income, Based on Alternative Specifications of the Full Model

However, opinion on the matter is far from unanimous. For example, Richard Muth argues that earlier studies similar to ours were methodologically flawed and, moreover, that the evidence of a ghetto markup is inconsistent with other evidence on market behavior of white and black households. Specifically, he contends that black households

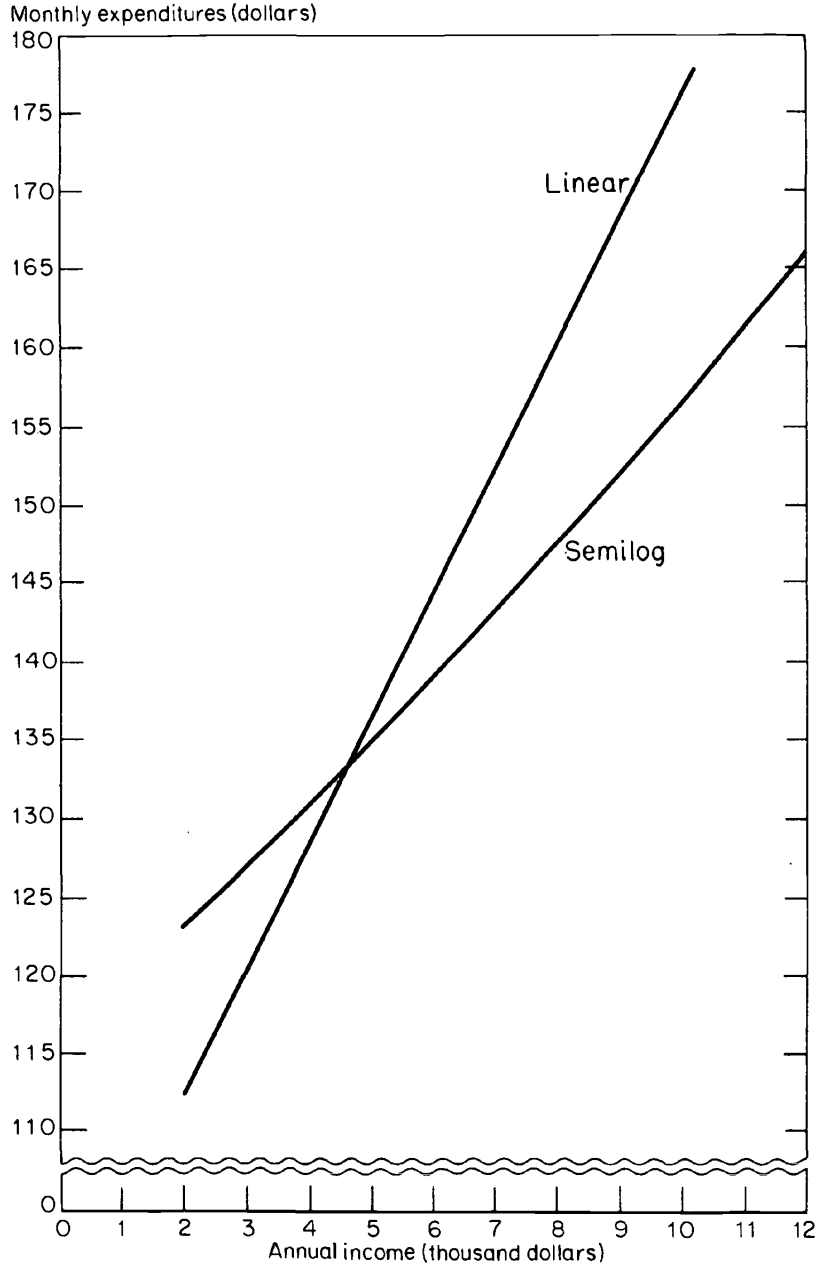

FIGURE 7-2
Estimated Monthly Housing Expenditures for All Owners by Annual Income, Based on Alternative Specifications of the Full Model

spend more on housing at each level of income, and that this behavior is inconsistent with price discrimination.

> Consumer expenditure surveys and census data on average contract rents generally show that Negroes make greater expenditures on housing at any given income level. Such evidence is frequently taken to mean that housing prices are higher to Negroes than to whites, but this evidence is faulty for several reasons . . . if housing prices for Negroes were higher than for whites, Negroes would tend to spend the same or less for housing on this account, not more.[5]

Muth finds further support for his views in his extensive analysis of 1950 and 1960 census-tract data for the South Side of Chicago:

> For both 1950 and 1960 the coefficients of NEGMAJ, the Negro area variable, were statistically significant in the VALHOU (an estimate of the average value of housing consumed in dollars per household per month) and VALAND (a measure of the value of housing produced in dollars per square mile of land per month) regressions, but they were only half as large in the late 1960 as in the corresponding 1950 regressions . . . if Negroes did pay higher prices for comparable housing than whites, one would expect a positive coefficient in the housing expenditure regressions, because it would appear that the price elasticity of housing demand is -1 or even smaller.[6]

He relies heavily on this alleged inconsistency to support his view that the "effects of residential segregation on the price of housing to Negroes is minor."[7]

> In Chapters 9 and 10 several comparisons of land use intensity and housing consumption in Negro areas versus others were made. On the whole, I failed to find the kinds of differences one would expect to exist if Negroes paid greater prices per unit of housing because of limitations on the residential area available to them imposed by their residential segregation. In Chapter 9, per household expenditures for housing were found to be significantly greater in Negro areas both in 1950 and 1960. However, since it would appear that the price elasticity of housing demand is -1 or even larger numerically, higher housing prices would not result in greater expenditures on housing by Negroes.[8]

Our finding that black owners and renters spend substantially less on housing than otherwise comparable households contradicts Muth's findings. If, as Muth suggests, housing demand is highly price elastic,

[5]Muth, *Cities and Housing*, p. 111.
[6]Ibid., p. 239.
[7]Ibid., p. 302.
[8]Ibid., p. 284.

lower housing expenditures by black households are consistent with higher prices for black households. Our finding for St. Louis is consistent with Muth's (and others') findings of price differentials between black and white submarkets and is consistent with our own analysis of the issue in Chapter 8. Specifically, Muth obtains a discrimination markup on the order of 5 percent for tenant-occupied housing, and on the order of 10 to 20 percent for owner-occupied dwellings, based on Chicago census-tract data.[9] However, he disregards these estimates for a variety of reasons.

In the case of the larger markup for owner-occupied units, for example, Muth observes: "Such a difference, of course, if it exists, is a substantial one for those who must pay it . . . but it's of small practical importance since most Negroes are renters."[10] Our finding in Chapter 6 that whereas only 18 percent of Chicago blacks were homeowners in 1960, 47 percent would have owned their homes if their access to housing suitable for home ownership were not impaired is of considerable relevance to Muth's contention.

The lower frequency of home ownership for black households than for white ones and the large differences between the expenditures of black and white owners, and between the expenditures of black and white renters, are consistent with the view that housing-market discrimination limits the locations and types of housing available to black households. Other evidence in support of this interpretation is presented in Chapters 9 and 10.

The estimates summarized in Table 7-1 further indicate that the value of housing services consumed by owner-occupants of single-family units increases slightly as the number of years employed at the current job increases, but that this variable exhibits no statistically significant relationship to the housing expenditures of renters. Indeed, if there is a relationship, it appears to be negative. Renters and homeowners are very different groups in terms of job stability. The sample of owners averaged nearly 12 years of employment at their current jobs, whereas renters averaged only about 5.4 years. It should be recalled, moreover, that years employed at current job is a highly significant determinant of the probability of home ownership. The difference of approximately seven years in the average job tenure of owners and renters is associated with a 6.3 percent increase in the probability of home ownership (Table 5-1). Employment stability also strongly affects housing expenditures by owners; an owner-occupant employed at the same job for an additional twelve years, one standard deviation, will, according to the linear model,

[9]Ibid., pp. 299–300.
[10]Ibid., p. 300.

spend $6.72 more per month for housing than an otherwise identical homeowner who has just accepted a new job. Using the semilog specification of the owner model, a comparable difference in years employed results in expenditures which are 4.8 percent higher.

The retirement dummy has an even larger effect on the expenditures of owner-occupants. The linear model implies that retired owners spend $25.51 more per month on housing than otherwise comparable owners who are still in the labor force. The magnitudes of the semilog and log-log models, expenditures 13 percent and 15 percent higher than comparable households with employed heads, are also large. No statistically significant relationship is obtained between the retirement dummy and rental expenditures; the relationship is negative, if anything. This result suggests that the high expenditures by retired owners are due to a delayed adjustment of their housing consumption, to an understatement of annual income, or to both. Alternatively, these findings may indicate that many retired homeowners are consuming capital previously invested in real property, i.e., they are foregoing maintenance, and their *current* housing outlays are overstated by the market values of their properties.

Most coefficients of the household-type dummy variables have the signs anticipated and are reasonable in magnitude, but only a few are larger than their standard errors. Collectively, these household types account for over 40 percent of owner households and over half of renters, but most of the individual categories are quite small. Only five of the twelve categories (six household types times two tenure types) account for more than 10 percent of their respective tenure groups. The dummy variables for single males living alone most often pass the conventional tests of statistical significance. These households spend considerably less than households with children, single females, or couples (Table 7-1).

Several of the variables which describe families, such as age, number of persons, and number of children, although significantly different from zero in the ownership and purchase models, have only small effects on the level of housing expenditures by renters and owner-occupants. If these household characteristics influence housing expenditures, they do so primarily by affecting tenure decisions. If increases in family size affect housing expenditures within tenure groups, the estimates suggest that they reduce expenditures for renter households and increase them for owner-occupants (Table 7-1).

The dummy variables designating families headed by females over and under forty-five are statistically significant in a number of the models. They indicate that young female-headed families living in rental units spend more than male-headed families living in rental units, but

that older female-headed families living in rental units spend less. By comparison, both young and old female-headed owner-occupant families spend more than otherwise comparable male-headed families; this tendency is most pronounced for older female-headed families. Both types of female owner-occupant households are probably more affluent than their annual incomes indicate. The much higher expenditures of older female owners suggest that many occupy units purchased from insurance policies, obtained in property settlements, or acquired during more prosperous times.

Taken together, the results presented in Table 7-1 provide a highly consistent description of the housing-expenditure patterns of renter and owner-occupant households. The importance of variables stressed in earlier studies—for example, income—is evident in these results. In addition, however, the estimates provide considerable insight into how additional socioeconomic characteristics influence the allocation of income between housing and other goods.

THE SIMPLE MODEL

The full models of housing expenditures presented in Table 7-1 are far more elaborate than those included in most earlier economic studies of the demand for housing. In part, this is because the microdata used to estimate them are not so severely hampered by the multicollinearity and similar statistical problems that plague investigations relying on aggregate data.

The danger of the approach represented by the full model is that its detail and complexity may obscure fundamental underlying relationships. For example, many of the variables included in the sample, such as age and years on current job, are correlated with income. These correlations are lower than those that would exist among the same attributes if aggregate data for census tracts, cities, or metropolitan areas were used, but nonetheless they are present. Including these correlates of income in the model may reduce the magnitude of the estimated income elasticities. Such a reduction is proper if the correlated variables do, in fact, measure different influences. It is possible, however, that all or part of the measured influences of these and other variables can be attributed to their correlations with income; that is, the large education coefficient may merely reflect the higher current and lifetime incomes associated with more education. Where these conditions hold, a model which includes only income may provide a more "correct" estimate of the true influence of income on housing than one which includes both income and education. For this reason, we have estimated a number of

simple expenditure models which include only income, race, and, in the case of the rental models, the contract-rent corrections. This procedure also permits more meaningful comparisons of our results with earlier studies that include only income as an explanatory variable. These simple expenditure models are summarized in Table 7-2.

The simple models explain between two-thirds and eight-tenths as much of the variance in the dependent variables as do the full models. For example, the linear specification of the full owners model, which contains eighteen explanatory variables, explains 46 percent of the variance in the value of owner-occupied dwelling units, while the simple model, which includes only two variables—income and race—explains 40 percent of this variance. To make these comparisons easier, the R^2s from the full models are reproduced toward the bottom of Table 7-2.

The coefficients of the race variable are roughly the same in the simple models as in the full models. The income coefficients, however, exhibit larger and fairly consistent differences. In the simple renter models, the income coefficients are larger than those obtained in the full model for all three specifications. The linear specification of the simple

TABLE 7-2
Alternative Specifications of the Simple Models of Housing Expenditures for Renters and Owners

	Linear		Semilog		Log-Log	
Variables	Renters	Owners	Renters	Owners	Renters	Owners
Race	−9.52[1]	−37.64[1]	−.156[1]	−.270[1]	−.187[1]	−.292[1]
Income	2.85[1]	7.48[1]	.045[1]	.033[1]	.137[1]	.162[1]
Corrections						
No furniture	8.90[2]		.093[4]		.124[3]	
No heat	−12.63[1]		−.260[1]		−.272[1]	
No appliances	−21.51[1]		−.196[1]		−.216[1]	
No water	1.34		.004		.006	
Constant	70.74[1]	107.50[1]	4.15[1]	9.38[1]	3.26[1]	8.24[1]
R^2	.38	.40	.33	.35	.28	.22
R^2(full model)	(.44)	(.46)	(.39)	(.42)	(.35)	(.32)
Income elasticity	.24	.39	.24	.28	.14	.16
Number of observations	594	401	594	401	594	401

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.

model implies that renters increase their housing expenditures by $2.85 per month for each thousand-dollar increase in income, as contrasted with $2.40 per month for the full model. The simple semilog model indicates that rental households increase their monthly outlays by 4.5 percent with each thousand-dollar increase in annual income, whereas the comparable increase for the full model is only 3.4 percent. Finally, for renters, the constant elasticity of income for the log-log model is .14 using the simple formulation and only .08 using the full model.

The effect on the income coefficient of omitting variables is less clear-cut in the case of owner-occupants. In two specifications—the semilog and the log-log—larger income coefficients are obtained for the simple model than for the full model. For the linear specification of the owner model, however, the income coefficient is slightly larger in the full model than in the simple model: $7.97 per thousand versus $7.48 per thousand. The income elasticities of demand implied by the alternative specifications are larger in the simple models than in the full models in five of the six equations. The range of elasticity estimates is somewhat reduced. The largest elasticities are implied by the linear specifications, although all the elasticities are smaller than those reported by investigators making estimates from aggregate data.

Of the studies considered by de Leeuw in his review of the cross-section evidence on income elasticities, only Tong Hun Lee's is based on microdata.[11] Lee obtained cross-section estimates of permanent-income elasticities from the 1960–1961–1962 reinterview Surveys of Consumer Finances. The availability of three years' income permitted him to make rather powerful tests of the permanent-income hypothesis. For both owner-occupants and renters, he estimated both a number of equations similar to our full model, i.e., including several socio-economic variables; and a number of equations, similar to our simple model, including only income. Each alternative model was estimated by ordinary least-squares, by an instrumental-variable technique attributed to Livitan, and by an extension of Livitan's technique. Lee determined that both instrumental-variable techniques provided larger estimates of the income elasticities than ordinary least-squares for both owners and renters, and that the estimates obtained from equations without demographic variables were larger than those obtained from equations including demographic variables. Lee argued that the second instrumental-variable technique provides upper-bound estimates of the permanent-income elasticity.

For owners, Lee's estimates of the income elasticities—using 1961

[11]Tong Hun Lee, "Housing and Permanent Income: Tests Based on a Three Year Reinterview Survey," *Review of Economics and Statistics* 50, no. 4 (Nov. 1968): 480–90.

values as the dependent variables—vary from .371, employing OLS, to .846 for his second instrumental-variable technique. When he adds socioeconomic variables, the corresponding elasticities become .338 and .892. Similarly, the estimated income elasticities for renters vary between .503 with OLS and .663 for the second instrumental-variable technique, when no demographic variables are included. Comparable equations including demographic variables vary between .293, using OLS, and .580, using the instrumental-variable techniques.

Lee's estimates are based on data obtained in a reinterview survey in which no effort was made to follow movers. Since households with a high income elasticity may have a greater probability of moving than households with a low income elasticity, de Leeuw suggests that the omission of frequent movers may have biased the estimated income elasticity. He therefore proposes a correction for this bias that increases the estimated income elasticity for renters from .65 to .85, a value which, de Leeuw reports, is similar to those obtained in other studies. However, he fails to find a plausible justification for increasing the size of Lee's estimate of the income elasticity for owner-occupants, merely remarking that "for owners, Lee's estimate is much lower than the others reviewed."[12]

Because of the different sampling rates employed in collecting our data, the samples used in estimating the elasticities in Table 7-2 are not representative of St. Louis households. Even so, it is useful to compare them with the estimates surveyed by de Leeuw. They are markedly lower than any of Lee's estimates, even his OLS estimates. We cannot fully explain the reasons for the discrepancy; however, the heavy oversampling of central-city and, particularly, low-income populations provides part of the explanation. Evidence on this question is presented in Appendix D, where estimates are shown for the simple expenditure models estimated by generalized least-squares using population weights.

At the same time, our results, with lower income elasticities derived from individual household data, are qualitatively consistent with the lower income elasticities reported by Lee; by Maisel, Burnham, and Austin; by Straszheim; and by Quigley. All of these studies, based upon individual household data, report lower income elasticities than those using grouped data.

Straszheim's results for a sample of white owner-occupants in San Francisco were obtained separately for each of seven life-cycle categories, using individual households as units of observation. Income elasticities ranged from a low of .219 for families headed by a single adult with children to a high of .493 for married couples with two or more

[12]de Leeuw, "Demand for Housing: A Review," p. 6.

children. These estimates, lower than those surveyed by de Leeuw, are larger than our unweighted estimates in Table 7-2 and our weighted estimates in Appendix D.

Maisel, Burnham, and Austin used housing-expense and owner-income data for 2,900 new home purchases, one hundred observations in each of twenty-nine SMSA's, to estimate price and income elasticities. Results are presented for several models, using individual households as units of observation, using SMSA mean values as observations, and using SMSA medians. For the equation containing price, income, and household size, the income elasticity was .45 using individual households, .71 using SMSA means, and .72 using SMSA medians. The corresponding price elasticities were −.89 using individual households, −1.03 using SMSA means, and −.91 using SMSA medians.

It is not obvious why the elasticities computed from individual households as units of observation should be lower than those computed from grouped data; or why our particular results, presented in this chapter (and supplemented by weighted estimates in Appendix D), should be low. There are several possible explanations, but none completely reconciles the differences.

The first, stressed by Reid and others, argues that "errors of measurement" are more pronounced in microeconomic studies, including our own. To the extent that a measurement of income based upon a single household for a single year, or for a few years, contains a significantly larger random error than an estimate based upon grouped data, income-elasticity estimates computed from individual households may be biased downward.

A second explanation emphasizes the "specification error" inherent in estimates derived from grouped data. The process of aggregation in grouping households reduces the information content of the data and generally increases the correlations among important socioeconomic determinants of housing expense—determinants which are then ignored in aggregate estimation.

Closely related to this explanation is the possibility of significant "interaction effects" between income, however measured, and other determinants of housing expenditures. To the extent that these interactions are not adequately represented in the statistical model, the results *may* indicate a stronger downward bias in micro studies than in those using grouped data. However, this hardly seems to be the case, at least when dealing with the simple models presented in this chapter.

The exact nature of the "specification bias" or "interaction bias" depends, of course, upon the correlations between variables omitted and those included in the data. It is definitely *not* clear that aggregation reduces these problems, and we suspect that the collinearity introduced

by averaging individual data makes the problem of omitted variables more volatile in the analysis of grouped data.

A final explanation for the discrepancy between studies based upon aggregate data and those based upon individual households hypothesizes a "peer-group effect" upon housing expenditures. This explanation (suggested by de Leeuw in private correspondence) maintains that the quantity of housing services demanded by a household may depend upon its own income and the income or housing services of its peer group. If this were true, and the peer-group or "relative-income" effect were sufficiently strong (and positive), the income elasticities computed from grouped data would be larger than those computed from individual households.

The analysis of Maisel, Burnham, and Austin, using identical data at different levels of aggregation, stresses loss of efficiency and general "aggregation bias" as primary reasons why disaggregated analysis provides better estimates of income elasticities. Our explanation for relatively low income elasticities in this analysis must also recognize measurement errors in income (as well as in the weighting of observations discussed in Appendix D). We explore this further at the end of the chapter by presenting some results using crude estimates of "permanent income," but we cannot claim that the measurement error in permanent income, as we define it, is negligible.

HOUSING EXPENDITURES BY BLACK AND WHITE HOUSEHOLDS

Both the simple and the full models of housing expenditures indicate that black owners and renters spend considerably less than white households with similar incomes, family structure, and labor-force attachment. The difference is particularly large for owners. However, the models summarized in Tables 7-1 and 7-2 require that each explanatory variable have the same effect on the housing expenditures of white and black households. This unnecessarily restrictive condition may obscure the manner in which market separation operates to modify black housing demand. For example, if racial discrimination operates principally to reduce black access to high-quality housing in high-quality neighborhoods—housing attributes which are presumably more income elastic—a lower income elasticity with respect to total housing expenditures might be expected for black than for white households. Moreover, some of the explanatory variables may have a different interpretation for the two types of household. For example, there is considerable evidence that, on the average, blacks with the same number of years of schooling

as whites receive less education as measured by achievement tests.[13] Precisely how this fact should influence housing expenditure by whites and blacks is uncertain, but it does increase the likelihood that additional years of schooling would have a different effect on the housing expenditures of black and white households.

For the above reasons, we present separate models for white and black households. These models include the same explanatory variables that were used in the full and simple models of housing expenditure obtained for the pooled sample of households. Moreover, each model is estimated for the linear, semilog, and log-log specifications. We shall reverse the order of presentation for these models, first discussing the simple models of housing expenditure and then the full models. The simple models of housing expenditures for white and black renters are presented in Table 7-3 and those for white and black owners are presented in Table 7-4.

From Table 7-3, it is apparent that while there are important differences between the simple black and white renter models, there are also pronounced similarities. For all three functional forms, the constant terms of the white equations are larger than those of the black equations. No consistent pattern exists for the income coefficients, however. The coefficient of income is larger for whites than for blacks in the additive specification, smaller in the semilog specification, and approximately the same in the log-log specification. These differences are somewhat easier to evaluate in Figure 7-3, which illustrates how monthly outlays by black and white renters vary with income for the linear and semilog models presented in Table 7-3. Mean values of the contract-rent corrections for black and white samples are used in Figure 7-3. The income elasticities of demand indicate that the elasticity is substantially larger for whites than for blacks in the linear models. The constant-elasticity model indicates, however, that there is no substantial difference by race for renters.

The coefficients of the contract-rent corrections are quite different between the white and black equations in Table 7-3. Indeed, of the twelve possible sign comparisons (four contract-rent correction variables times three specifications), the signs match in only three cases. In two of the four cases where both coefficients are statistically significant, the signs are the same.

A convenient way of evaluating the differences in the black and white equations is to solve the white equations using mean values of the black sample. If the equations for black households reflect the effects of

[13]James S. Coleman et al., *Equality of Educational Opportunity* (Washington, D.C.: U.S. Office of Education, 1966).

TABLE 7-3
Alternative Specifications of the Simple Models of Housing Expenditures for White and Black Renters

	Linear		Semilog		Log-Log	
Variables	White	Black	White	Black	White	Black
Income	2.97[1]	2.61[1]	.040[1]	.055[1]	.134[1]	.135[1]
Corrections						
No furniture	8.69[4]	−4.04	.126[4]	−.163[4]	.185[3]	−.187[4]
No heat	−6.90[3]	−15.53[1]	−.156[2]	−.304[1]	−.164[1]	−.337[1]
No appliances	−32.80[1]	3.44	−.393[1]	.222[2]	−.410[1]	.213[2]
No water	6.93[4]	−1.73	.101[4]	−.061[4]	.079[4]	−.030
Constant	74.02[1]	55.02[1]	4.21[1]	3.86[1]	3.30[1]	3.05[1]
R^2	.35	.35	.33	.28	.27	.22
Number of observations	328	266	328	266	328	266
Income elasticity	.26	.21	.25	.24	.13	.14

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.

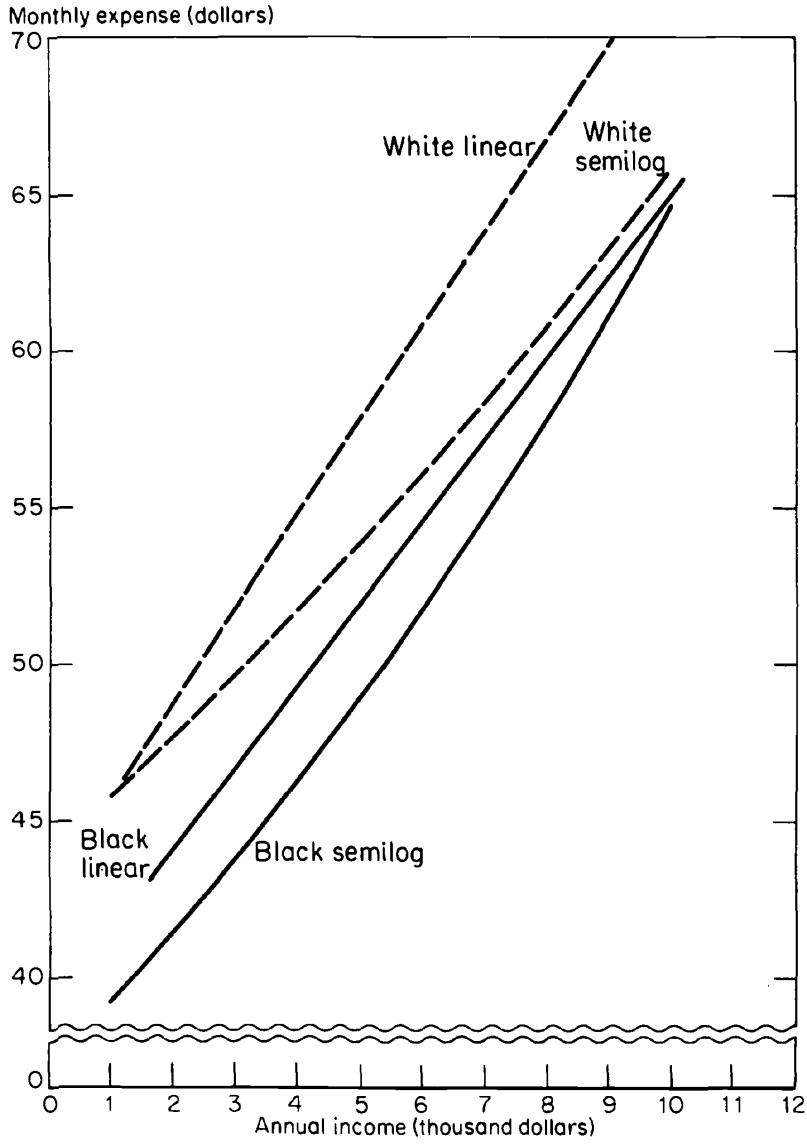

FIGURE 7-3
Estimated Monthly Housing Expense for White and Black Renters by Annual Income, No Utilities Except Water Included in Rent, Based on Alternative Specifications

TABLE 7-4
Alternative Specifications of the Simple Models of Housing Expenditures for White and Black Owners

	Linear		Semilog		Log-Log	
Variables	White	Black	White	Black	White	Black
Income	7.74[1]	3.45[1]	.033[1]	.030[1]	.283[1]	.032
Constant	105.10[1]	95.67[1]	9.38[1]	9.13[1]	7.61[1]	9.06[1]
R^2	.37	.11	.29	.13	.20	.02
Number of observations	329	72	329	72	329	72
Income elasticities	.40	.19	.30	.20	.28	.03

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.

discriminatory limitations on black housing choices, solution of the white equations using mean values for the black rental sample provides estimates of what the housing expenditures of the sample of black households would be if there were no limitations on black housing choices. Mean rental outlay for the sample of black households is $53.66; the values obtained from solving the white rental equation with black means are $62.44 for the simple linear model, $58.01 for the semilog model, and $61.69 for the log-log model.

Richard Muth suggests that the higher rents he obtained in predominantly black census tracts in Chicago can be explained by the more frequent inclusion of utilities and furnishings in the rents paid by black households. Our sample of St. Louis households indicates that the proportion of units that are rented unfurnished and which require the tenants to pay for their own heat is virtually the same for blacks and whites. About 91 percent of both black and white renters choose unfurnished units, and about 73 percent pay for their own heat. There are, however, fairly large differences in the proportions of black and white households who paid their own water bills, or who supplied major appliances such as a stove or refrigerator. However, these differences are opposite to those which Muth anticipated. About 27 percent of black households in this sample paid for their own water, as compared with only 12 percent of white households. Similarly, 89 percent of black renters had to provide their own major appliances, as contrasted with only 77 percent of white renters.

SIMPLE MODELS FOR OWNERS

The housing-expenditure behavior of black and white owners in St. Louis is very different. First, the simple black-owner models explain a far smaller proportion of the variance in the value of owner-occupied single-family units than the comparable models for whites (Table 7-4). (This contrasts with the results for the black and white rental models, which are quite similar in explanatory power.) The difference is particularly large for the log-log model, which explains only 2 percent of the total variance in the monthly expenditures by black owner-occupants of single-family homes. Because the log-log specification of the black-owner model fits the data so poorly, discussion of the white- and black-owner models will be limited to the linear and semilog models.

Both the linear and semilogarithmic models indicate that white owners consume significantly more housing than black owners at every level of annual income. The constant term of the linear model is nearly ten dollars per month (one-thousand dollars in value) larger for white owners than for black owners, and the difference in market value increases as annual income increases.

The income coefficients of the linear models indicate that white owner-occupants spend an additional $7.74 per month ($92.88 per year) for each thousand-dollar increase in annual income, as contrasted with black households who spend only an additional $3.45 per month ($41.40 per year) for each thousand-dollar increase in annual income. Using the linear model, at fifteen-thousand dollars the difference in expected white and black expenditures is $73.77 per month or $7,377 in value.

The relative difference in magnitude of the income coefficients in the black and white equations is somewhat smaller for the semilog models; whites increase their consumption of housing by an estimated 3.3 percent with each thousand-dollar increase in annual income, whereas black owners increase theirs by 3.0 percent with each thousand-dollar increase. The elasticities implied by the three specifications of the model are very different for whites and blacks. For whites, the elasticities are substantially higher for owners than for renters in all three specifications. For blacks, the elasticities are substantially lower for owners than for renters. Moreover, for each specification, the income elasticity is far larger for whites than for blacks. These results are consistent with the observation that moving to a better or larger owner-occupied unit in response to income increases is more difficult for blacks, whose consumption of owner-occupied housing is geographically restricted by discriminatory practices.

The mean value of owner-occupied single detached structures for

our sample of black households is $11,781. If the linear white equation in Table 7-4 is solved using the mean annual income of the sample of black owners, an estimated house value of $15,477 is obtained. The logic behind this is the same as that which applies to the simple rental models; i.e., it provides an estimate of the extent to which housing-market discrimination causes black households to reduce their housing expenditures. Such reductions may be the result of either simple price discrimination or more subtle limitations on the types of housing available to black households. The estimates obtained from solving the semilog equation, $14,675, and the log-log equation, $14,350, are smaller, but they are still larger than the actual expenditure of $11,781 by black homeowners. Figure 7-4, which graphs the expected black and white house values at each level of income for the two specifications, illustrates these differences for black and white households at different income levels.

THE FULL MODELS FOR BLACK AND WHITE RENTERS

Addition of the sixteen demographic variables adds between 9 and 34 percentage points to the explanatory power of the twelve models. For the renter models, the increase in explanatory power is quite uniform, varying from a low of 9 percent to a high of 11 percent for the white and black log-log models (Table 7-5). The range of improvement is much wider for owner models, ranging from a low of 9 percent for the white linear model to a high of 34 percent for the black log-log model (Table 7-6). While the largest improvements are obtained for the three black equations, an improvement of 18 percentage points is obtained for the white log-log equation, whose coefficient of determination is .20 in the simple model and .38 in the full model. The marked improvement in the black-owner models should be assessed against the background of the fairly modest size of the black-owner sample, i.e., only seventy-two observations. The coefficient of determination adjusted for degrees of freedom, 70 in the simple model as contrasted with 54 for the full model, is actually slightly smaller for the full model ($\bar{R}^2 = .12$ for the full model and $\bar{R}^2 = .18$ for the simple model).

The full renter models summarized in Table 7-5 exhibit many of the same regularities evident in the simple rental models. The intercepts of the white equations are larger than those in the black equations in both the linear and semilog models. Moreover, the income coefficients are positive and highly significant statistically in all six equations, and the income coefficient for white renters is larger than that for black renters in

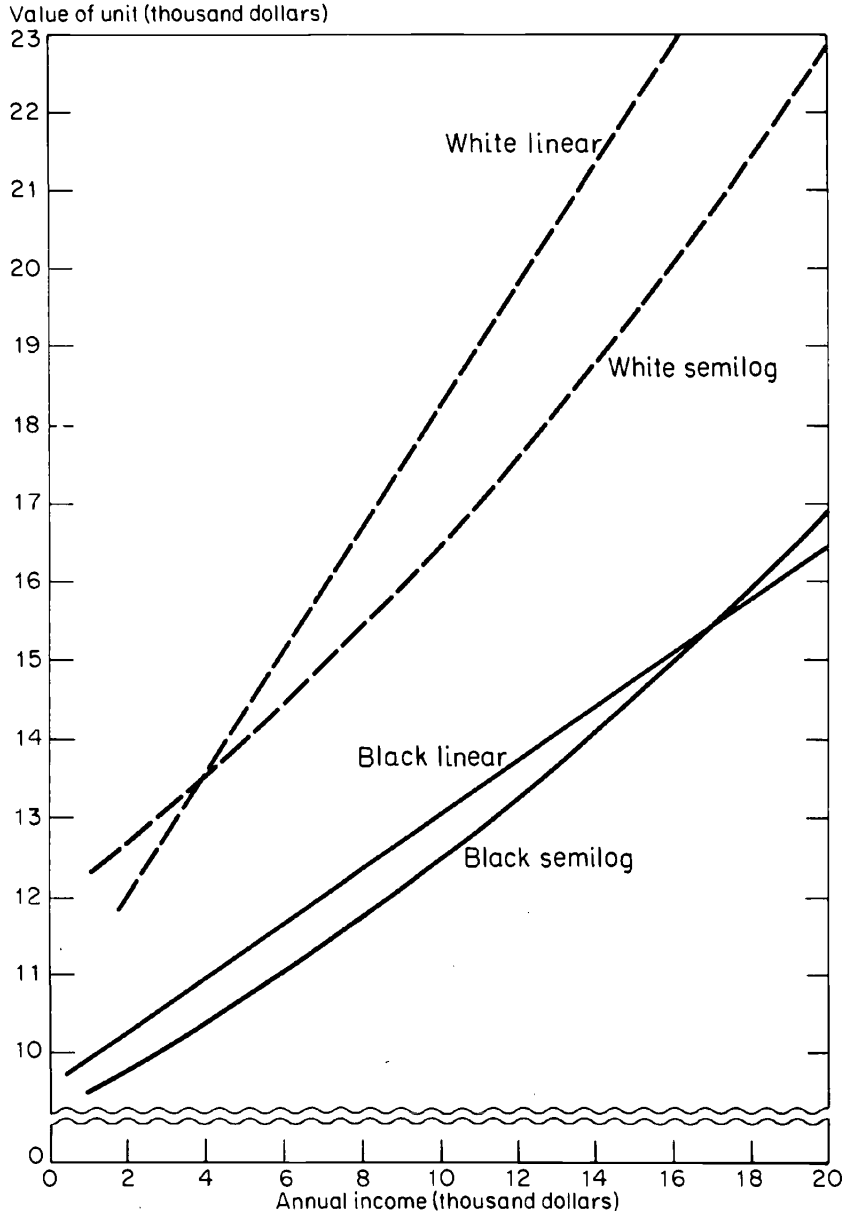

FIGURE 7-4
Estimated Value of Single-Family, Owner-Occupied Units for Black and White Owners by Income, Based on Alternative Specifications

two of the three equations. The sole reversal is obtained in the semilog equation: .036 for whites versus .044 for blacks. The income elasticities are also higher for white than for black households for all six specifications.

The coefficients of the closely related education variable are statistically significant at the .01 level in all three white equations but are significant—and then at the .05 level—in only one of the three black equations. The coefficients of the years-of-education variable are much larger in the white than in the black equations. Many previous studies have reported that blacks earn less than whites from each additional year of schooling, and these black-white differences are also evident in our data, as shown in Figure 7-5. The smaller education coefficients in Table 7-5 may reflect these differences.

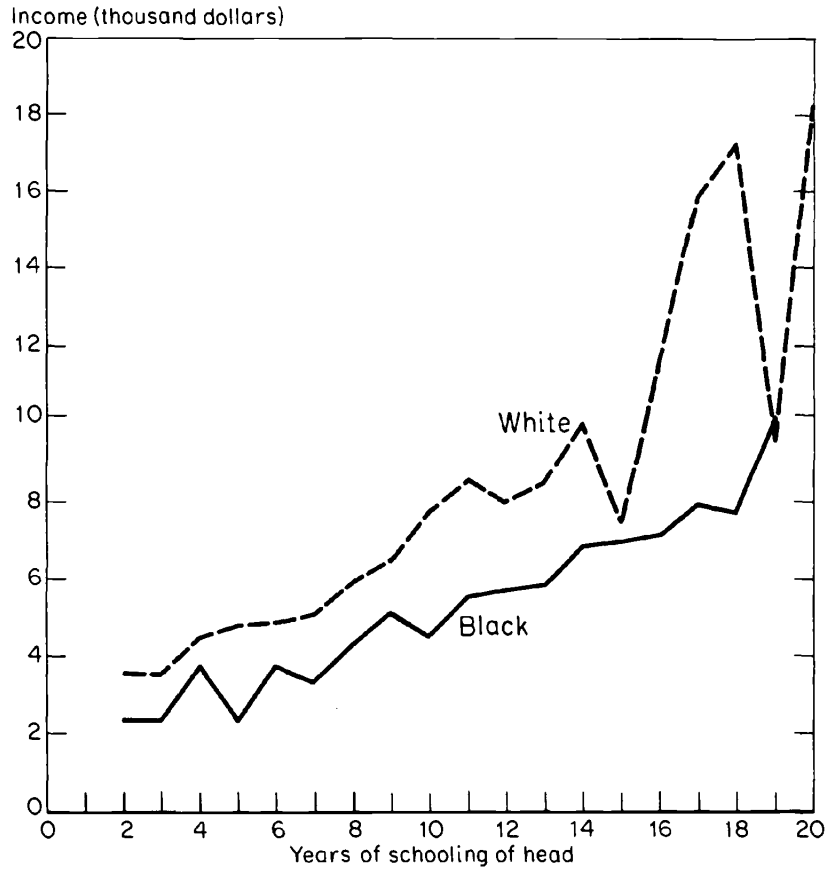

FIGURE 7-5
Mean Family Income by Years of Schooling of Head for White and Black Households

TABLE 7-5
Alternative Specifications of the Full Model of Housing Expenditures for White and Black Renters

	Linear		Semilog		Log-Log	
Variables	White	Black	White	Black	White	Black
Income	2.85[1]	1.93[1]	.036[1]	.044[1]	.090[1]	.069[2]
Education	2.51[1]	.94[2]	.034[1]	.014[4]	.352[1]	.106[4]
Years on current job	−.15	.06	−.002	.001	−.001	.001
Retired	4.52	1.08	.040	−.018	.030	−.037
None employed	−1.50	−3.17	−.078	−.048	−.065	−.094[4]
More than one employed	5.57[3]	2.55[4]	.040	.044	.103[2]	.104[3]
Families						
Age	.19[4]	.12[4]	−.000	.002	−.000	.002
Number of persons	−2.82	.33	−.000	.017	−.004	.023
Number of children	−3.69[2]	1.59[4]	−.051[2]	.034[4]	.040[3]	.024
Female head < 45 years	19.99[1]	−.26	.263[1]	.000	.203[2]	−.025
Female head > 45 years	−6.98	.75	.017	.087	−.001	.004
Household types						
Single female < 45 years	−2.60	7.86[4]	−.092	.183[4]	−.136[4]	.145
Single female > 45 years	−1.77	3.86	−.108[4]	.128[4]	−.135[4]	.068
Single male < 45 years	−18.25[3]	.64	−.221[4]	.085	−.190[4]	.087
Single male > 45 years	−13.84[4]	−9.84[3]	−.298[2]	−.227[4]	−.340[2]	−.265[3]
Couple, head < 45 years	−14.73[2]	4.21	−.215[2]	.105	−.226[2]	.104
Couple, head > 45 years	−4.90	3.50	−.160[3]	.019	−.160[3]	.005
Corrections						
No furniture	6.87[4]	−7.49[4]	.117[4]	−.243[3]	.187[2]	−.243[3]
No heat	−5.50[4]	−15.34[1]	−.138[2]	−.302[1]	−.130[2]	−.320[1]
No appliances	−28.83[1]	5.06[4]	−.046[1]	.258[2]	−.369[1]	.239[2]
No water	4.41[4]	−2.12	.062	−.079[4]	.042	−.057[4]
Constant	49.71[1]	45.85[1]	3.96[1]	3.70[1]	2.90[1]	3.27[1]
R^2	.45	.44	.42	.37	.38	.33
Number of observations	328	266	328	266	328	266
Income elasticity	.25	.15	.23	.19	.09	.07

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.

Also evident are some interesting differences between the rental models for black and white households in the coefficients of the family size and composition variables. The coefficients of the number-of-persons and the number-of-children variables are negative in all three white equations, suggesting that holding the effects of income, education, and

similar variables constant, white renter households tend to reduce their monthly outlays for housing as family size increases. This finding for white renters, which is consistent with results obtained by David in his analysis of the Survey of Consumer Expenditures data,[14] does not hold for blacks. In the three black equations, all family-size variables have positive coefficients, though none are statistically significant. In interpreting these results, one should bear in mind that these variables assume positive values only for families with children.

This difference in the observed behavior of black and white renters is consistent with the hypothesized limitation on the supply of high-quality units available to black households. White households with additional members can substitute quantity (size) for quality expenditures more readily, finding it easier to reduce housing expenditures by economizing on quality. Black households, who are prevented from consuming high-quality housing, are largely unable to make the tradeoff required to shift resources away from housing consumption. Further evidence for this proposition is discussed in Chapters 9 and 10.

This difference in the behavior of white and black renters is related to our finding that racial discrimination in the St. Louis housing market impairs black opportunities for home ownership. The probability-of-ownership models in Chapter 5 indicate that families with children are far more likely to be homeowners than are other household types. Of the six types of households without children, only one—married couples headed by an individual over forty-five—had a higher probability of ownership than male-headed households with children, and this difference was not statistically significant (Table 5-1). Moreover, even old couples had a statistically significant negative probability of purchase (−.16), indicating a lag in their adjustment to changed housing demands. For the remaining groups, the probability of ownership differed from male-headed households with children by the following amounts: single females under forty-five, −.31; single females over forty-five, −.15; single males under forty-five, −.17; single males over forty-five, −.04; and married couples under forty-five, −.31.

The positive relationship between the two family-size variables and rental outlays in the equations for blacks then appears to result primarily from restrictions on black ownership. White families, who desire more space and whose employment and income circumstances permit them to acquire it, tend to become homeowners, and all but the most impoverished or impermanent of white families seem to choose this life-style. From the evidence presented earlier, home ownership is clearly associ-

[14]Martin David, *Family Composition and Consumption* (Amsterdam: North-Holland Publishing Co., 1962).

ated with larger housing expenditures. Thus, the shift from renting to owning accounts for much of the increased expenditures for housing by households with children.

From Table 7-5, it similarly appears that small families with children spend considerably more on housing than households without children of the same income and education levels and labor-force attachment. From the linear model, for example, young couples headed by an individual less than forty-five spend nearly $15 a month less for housing than white male-headed families of three, with one school-age child. The largest expenditures, at given income, education, and labor-force levels, are made by young, white, female-headed households.

THE FULL MODELS FOR BLACK AND WHITE OWNERS

In terms of the coefficients of the family-structure variables, the full white- and black-owner models in Table 7-6 are more similar than are full white and black rental models. For example, the signs of the coefficients of the variables for family characteristics and household types are the same in the black and white equations in twenty-four out of thirty-three possible comparisons. The black and white income and education coefficients, however, are less similar than in the renter models. For example, in the linear model, the coefficient of income is more than four times as large in the white as in the black equation, and the coefficient of years of education nearly six times as large. Similarly, in the semilog model, the coefficient of income is three times as large in the white as in the black model—.03 versus .01—and the coefficient of years of schooling is fully six times as large—.042 versus .007. Moreover, the coefficients of the retirement and the no-member-employed dummy variables are relatively large in magnitude and opposite in sign in the black and white equations.

The income elasticities for whites calculated from the full model are not much different from those presented for the simple model in Table 7-4, but the elasticities calculated for blacks are implausibly low in all three specifications.

MODELS WITH "PERMANENT" INCOME

Much of the controversy surrounding the estimation of models of housing expenditure centers on the proper measurement of income. Specifically, Margaret Reid and Richard Muth have emphasized that the proper measure of income to use in models of the demand for housing is

TABLE 7-6
Alternative Specifications of the Full Model of Housing Expenditures for White and Black Owners

	Linear		Semilog		Log-Log	
Variables	White	Black	White	Black	White	Black
Income	8.20[1]	1.72[4]	.030[1]	.010	.265[1]	−.005
Education	6.20[1]	1.05	.042[1]	.007	.378[1]	.100
Years on current job	.61[4]	.92[4]	.004[2]	.008[3]	.004[2]	.009[2]
Retired	32.42[2]	−8.46	.180[2]	−.061	.274[1]	−.060
None employed	169.30[2]	−29.15	.820[2]	−.239	.715[2]	−.256[4]
More than one employed	−17.10[2]	−2.26	−.025	.010	−.049[4]	.039
Families						
Age	−.24	−.21	−.001	−.001	.000	−.001
Number of persons	5.37	16.47[4]	.005	.145[4]	−.058[4]	.154[4]
Number of children	.10	−2.64	.002	−.025	.025[4]	−.028
Female head < 45 years	22.10	49.05[4]	.074	.368[4]	.042	.345[4]
Female head > 45 years	77.07[4]	39.66[3]	.442[3]	.287[3]	.496[3]	.252[4]
Household types						
Single female < 45 years	21.09	51.13[4]	.004	.412[4]	.026	.400[4]
Single female > 45 years	23.36[4]	25.91[4]	.021	.147	.078	.120
Single male < 45 years	18.84	−12.08	−.185[4]	−.122	−.208[4]	−.136
Single male > 45 years	32.68[4]	.14	.100	−.036	.181[3]	−.028
Couple, head < 45 years	9.08	54.20[4]	.022	.477[4]	.004	.452[4]
Couple, head > 45 years	16.65[4]	20.88[4]	.001	.173[4]	−.004	.163[4]
Constant	17.28	75.51[1]	8.88[1]	8.98[1]	6.35[1]	8.91[1]
R^2	.46	.34	.40	.36	.34	.36
Number of observations	330	72	330	72	330	72
Income elasticity	.42	.09	.28	.07	.26	−.00

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 one that most closely approximates the concept of permanent income.[15]

When microdata are used, as in this analysis, several authors have suggested using the mean income of households with particular characteristics to approximate permanent income, or at least to reduce the transitory component.[16] Two such permanent-income variables were

[15]Reid, *Housing and Income;* Muth, *Cities and Housing.*

[16]R. Ramanathan, "Measuring the Permanent Income of a Household: An Experiment in Methodology," *Journal of Political Economy* 79, no. 1 (Jan. 1971): 177–85.

constructed for use in Chapter 6 to evaluate whether the differences in home ownership between white and black households might be explained by black/white differences in permanent income. The first used the mean annual income of race/education categories as a measure of permanent income. The second used housing expenditures (rent and value divided by one hundred) to proxy permanent income. The former is used in this section to explain the housing expenditures of owner and renter households.

The permanent-income models used to explain the housing expenditures of owner and renter households are identical to the simple housing-expenditure models presented previously, except for the addition of the permanent-income variable. Linear, semilog, and log-log specifications of these permanent-income models are summarized in Table 7-7 for all owners and renters, and for black and white owners and renters. As is evident from the last two columns in Table 7-7, adding a permanent-income variable to the simple expenditure model produces a modest increase in the overall explanatory power, i.e., an increase in R^2. The largest increases, 7 percentage points, are obtained for three of the log-log specifications: the white renters sample, the pooled owner sample, and the sample of white owners. The permanent-income variable is statistically significant at the .01 level in all but five of eighteen equations.

Use of the permanent-income variable in the pooled rental equations substantially reduces the magnitude and statistical significance of the dummy variable for race. These differences are summarized in Table 7-8 for both the renter and owner models. For example, adding permanent income to the simple model of housing expenditures reduces the apparent difference between the level of monthly expenditures by otherwise comparable white and black renters from $9.52 per month to $3.29 per month. Similarly, adding permanent income about halves the coefficient of the pooled semilog rental model, decreasing it in absolute value from $-.156$ to $-.070$.

Addition of the permanent-income variable has a similar, but less pronounced, effect on the race coefficients of the pooled owner equations. For example, the race coefficient in the simple linear owners model is $-$37.64 ($3,764 in value); when permanent income is added, the coefficient declines by about two dollars to $-$35.72 per month ($3,572 in value). Similarly, when permanent income is added to the semilog specification of the pooled owner model, the coefficient of annual income declines from $-.270$ to $-.256$.

From the permanent-income models in Table 7-7, it is apparent that the intercepts of the white equations are consistently larger than those obtained for the black equations, except in the generally less satisfactory log-log equations and in the linear owner equations.

TABLE 7-7
Summary of Models of Housing Expenditures with Permanent Income for Renters and Owners

	Constant	Income	Permanent Income	Race	R^2	R^2 Simple Models
Linear						
All renters[5]	52.75[1]	2.35[1]	2.69[1]	−3.29	.41	.38
White renters	55.28[1]	2.41[1]	2.81[1]		.39	.35
Black renters	47.42[1]	2.34[1]	1.71[2]		.36	.35
All owners	98.02[1]	7.11[1]	1.63[2]	−35.72[1]	.41	.40
White owners	71.09[1]	6.40[1]	5.88[1]		.39	.37
Black owners	94.14[1]	3.38[1]	.33		.12	.11
Semilog						
All renters	3.90[1]	.038[1]	.037[1]	−.070	.35	.33
White renters	3.96[1]	.032[1]	.038		.36	.33
Black renters	3.72[1]	.050[1]	.032		.28	.28
All owners	9.32[1]	.030[1]	.012[1]	−.257[1]	.36	.35
White owners	9.16[1]	.024[1]	.038[1]		.33	.29
Black owners	9.11[1]	.030[1]	.003		.13	.13
Log-log						
All renters	.64[4]	.106[1]	.322[1]	−.056	.31	.28
White renters	−.195	.097[1]	.427[1]		.34	.27
Black renters	1.61[2]	.115[1]	.188[2]		.23	.22
All owners	5.38[1]	.101[1]	.382[1]	−.166[1]	.29	.22
White owners	4.33[1]	.139[1]	.462[1]		.27	.20
Black owners	7.87[1]	.019	.151[3]		.06	.02

NOTE: Table notes *1* through *4* indicate significance of *t* ratios for coefficients (two-tailed test).

[1] > .01.

[2] > .05.

[3] > .10.

[4] *t* ratio greater than 1.0.

[5] All renter models include variables correcting for contract-rent differences which are not presented in this table.

Moreover, the coefficients of the permanent-income variable are larger in the white equations than in the black equations. In Table 7-9, we once again summarize these differences by solving the white equations using means for black households. Including permanent income in the rental equations substantially reduces the discrepancy between actual black expenditures and estimated black expenditures, assuming that the white behavioral equations apply. In fact, the semilog and log-log equations with permanent income for whites yield estimates of black

TABLE 7-8
Effect on the Race Coefficient of Adding Permanent Income to Models of Housing Expenditures for Renters and Owners

	Renters		Owners	
	Coefficient	*t* Ratio	Coefficient	*t* Ratio
Linear				
Without permanent income	−9.52	−4.88	−37.64	−4.40
With permanent income	−3.29	−1.49	−35.72	−4.17
Semilog				
Without permanent income	−.156	−4.69	−.270	−5.99
With permanent income	−.070	−1.85	−.257	−5.70
Log-log				
Without permanent income	−.187	−5.46	−.292	−5.89
With permanent income	−.056	−1.37	−.166	−3.23

TABLE 7-9
"Expected" Black House Values and Rents Obtained by Solving White Equations Using Black Means

	Black Renters		Black Owners	
	Actual	"Expected"	Actual	"Expected"
Linear				
Full model	$53.66	$68.27	$11,781	$14,890
Simple model without permanent income		62.44		15,477
Simple model with permanent income		55.96		14,784
Semilog				
Full model		58.00		14,650
Simple model without permanent income		58.01		14,675
Simple model with permanent income		53.31		14,625
Log-log				
Full model		69.80		15,680
Simple model without permanent income		61.69		14,350
Simple model with permanent income		52.05		14,698

rental outlays which are slightly smaller than the actual ones. In the owner equations, as well, simple models reduce the difference between actual and estimated expenditures. However, in all cases, the estimated value of black owner-occupied units, based on white equations, exceeds the actual value by at least $2,500.

SUMMARY

In this chapter we have presented several analyses of the determinants of housing expenditures. Besides the functional forms employed, the models differ in terms of the set of explanatory variables. The "full models" of housing expenditure include as explanatory variables a complex description of the household's income, family size and composition, and labor-force attachment. The "simple models" include only income and race as explanatory variables. We also present some results based upon crude measures of the permanent income of the sample households.

In general, the results indicate that in addition to income, the education, labor-force attachment, age, and life-cycle characteristics of households are important determinants of their housing expenditures. The estimates of the income elasticity of demand are larger for owner-occupants than for renters for either the full models or the simple models. The computed elasticities are smaller numerically than those obtained by others using aggregate data, but are not much smaller than those obtained in the few analyses based on microdata.

The analyses presented in this chapter clearly indicate that black households in St. Louis devote fewer resources to housing consumption than similar white households. The racial difference in housing consumption constitutes important evidence regarding the effect of discriminatory pricing upon black households. If housing consumption is price elastic, as other researchers have argued, the lower levels of housing consumption by black owners and renters may result from higher housing prices in the ghetto than in the white submarket. When separate analyses are conducted for black and white households, a larger income elasticity of demand is obtained for white owners than for white renters. Among black households, the estimated income elasticity is higher for renters than for owners. Finally, we find that the income elasticities vary more between whites and blacks in the owner-occupied housing market.

These findings reflect limitations on the supply of owner-occupied housing in the ghetto which prevent black households from buying as much housing as their incomes and other household characteristics would dictate, or from trading up in response to increases in income.

Since rental housing is more plentiful in the ghetto, these restrictions are less pronounced in the rental market. However, income elasticities for blacks are generally lower than those for comparable whites, regardless of model, functional form, or tenure.

Crude attempts to extend the analysis by including a proxy for permanent income do not change the substantive conclusions. Holding permanent income constant in the estimated models, black households still devote fewer resources to housing than comparable whites, and the income elasticities are larger for white than for black households.