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HOUSING-MARKET COMPARTMENTALIZATION AND HOUSING PRICES

1. INTRODUCTION

A large variation exists across geographic submarkets in the types of housing available, housing prices, and occupant incomes. As has been noted, this variation in housing characteristics and prices by location is a fundamental characteristic of the urban housing market. A description of this compartmentalization in the San Francisco Bay Area housing market is given in section 2. Estimated prices for different housing types across neighborhoods are discussed in sections 3 and 4, and estimates of continuous gradient functions are presented. The geography of the San Francisco Bay Area is not particularly well suited to the traditional assumptions of a circular city. Nevertheless, even those portions of the region in which relatively smooth gradient functions might be expected exhibit highly irregular price and income surfaces. Apparently modest differences in employment, stock characteristics, and other factors influencing the demand and supply sides of the market significantly affect housing prices and neighborhood incomes. Racial discrimination also has distinct effects on the housing market. Section 5 reveals large differences in the housing markets confronting black and white households. The consequences of misspecification in empirical analyses of housing markets arising when data are aggregated across geographic or racial submarket boundaries are discussed in section 6.

2. HOUSING-MARKET COMPARTMENTALIZATION IN SAN FRANCISCO

Two major employment centers—in San Francisco and in Oakland—are the focal points of the housing market in the San Francisco Bay

Area. Households commuting to these centers constitute the largest source of demand for housing. In addition, these two focal points comprise the geographic centers of the oldest and highest-density housing stock in the area.

As with most major United States urban areas, employment growth was initially concentrated in the central cities: first in San Francisco, and then in Oakland in the period from 1900 to 1940. The most rapid suburban employment growth occurred after World War II. Shipbuilding, defense, electronics, and specialized manufacturing products provided much of the impetus. The city of San Francisco is now largely a center of finance, insurance, and real estate and administrative offices, but it does offer some manufacturing employment in the apparel, printing, and shipbuilding trades. Steel and other heavy and light manufacturing are located south of San Francisco in many industrial parks. A long belt of manufacturing exists along the Oakland side of the Bay, with much of the heavy manufacturing centered to the north of Berkeley around Richmond.[1]

The spatial distribution of employment locations is shown in Figure 3.1. The city of San Francisco accounts for 31.3 percent of total employment in the region, and 21.9 percent of the region's population resides there.[2]

The familiar tendency for employment density to decline in more distant suburban areas is present. However, there is also a distinct geographic clustering in employment patterns in the suburbs.

As will be shown in Chapter 4, the location of employment is a major determinant of the spatial variation in the demand for housing, and as a consequence, the geographic patterns of travel can be briefly summarized. For workers employed in the center of San Francisco,[3] four major commuting flows are evident: north across the Golden Gate Bridge to Marin City (10.7 percent), south and west to nearby residential areas within the city of San Francisco (28.7 percent), further south down the peninsula into San Mateo County (22.2 percent), and east across the San Francisco-Oakland Bay Bridge into Oakland and surrounding suburbs (30.9 percent). (The remainder live in more outlying areas [7.5 percent].)

Oakland, as the second major job center, has a somewhat more dispersed employment pattern. Residential choices of Oakland workers

1. Center for Real Estate and Urban Economics, *Jobs, People and Land: Bay Area Simulation Study (BASS)*, Institute of Urban and Regional Development, University of California, Berkeley, 1968, pp. 121–33.
2. Ibid., pp. 355–57
3. San Francisco Census Tracts, K1-K4, A17, A23.

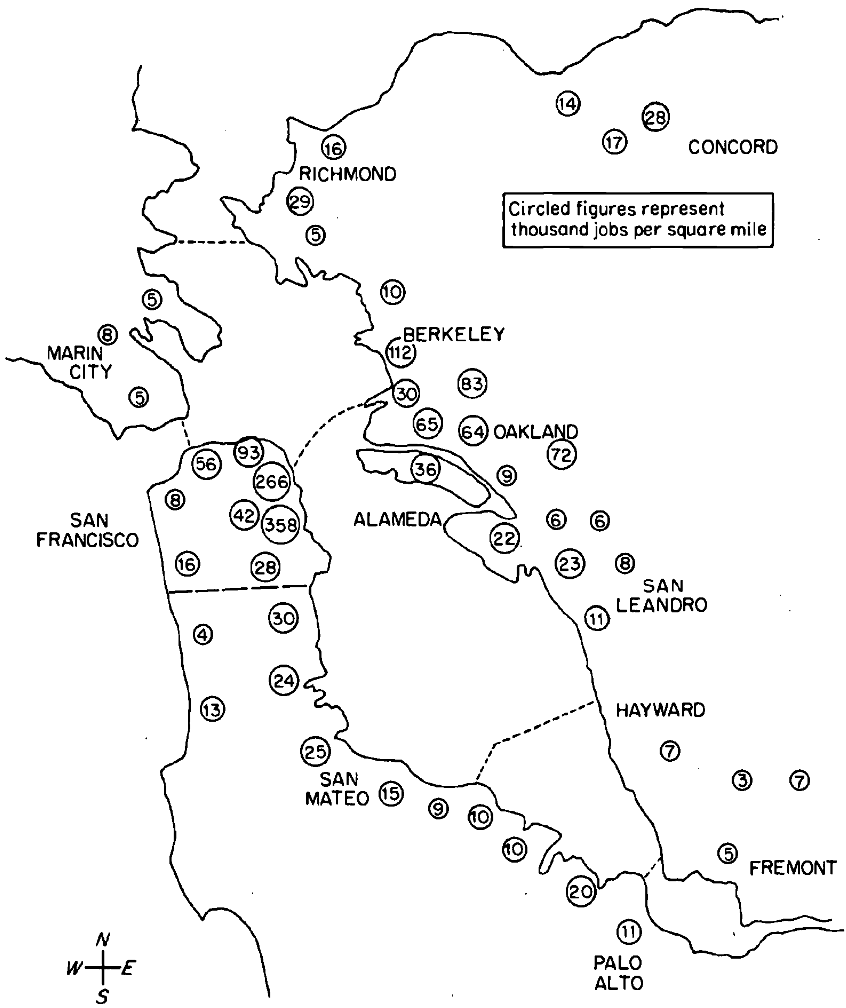

FIGURE 3.1
DENSITY OF EMPLOYMENT
[jobs per square mile]

are widely scattered and are not so easily summarized. Of those workers employed in the center of Oakland,[4] 2.8 percent commute across the Bay Bridge to San Francisco and adjacent counties, 49.0 percent live

4. Approximately ten square miles including the City of Alameda and the immediately neighboring Oakland area to the east, Oakland Tracts OK29-OK38.

in Alameda and Oakland cities, 27.2 percent commute south through and beyond the City of Oakland, and 21.0 percent go to the north into and beyond Berkeley and to new suburbs to the northeast. These flows are shown in Figure 3.2.

Housing-stock characteristics, incomes, and prices across submarkets vary widely and do not lend themselves easily to any brief or simple summary.

The following provides a brief synopsis. First, the spatial pattern of housing-stock characteristics will be considered, then incomes and prices.[5]

Analysis of the spatial variation in the stock is, in essence, a story about the pattern and timing of urban development in the San Francisco area. There is relatively little single-family, owner-occupied housing in downtown San Francisco, whereas in the more distant suburbs the percentage of units which are single family exceeds 75 percent. These supply differences explain why price surfaces for single-family structures are steeper than rent gradients in the rental market. Single-family owner-occupied units in most downtown areas are very old; over 75 percent of all units in most zones in the center of the city of San Francisco were built before 1940, and less than 5 percent were built since 1960. Lot-size differences are also evident. In central areas of San Francisco, over 80 percent of existing housing was built on lots of less than .2 acre and less than 5 percent was built on lots in excess of .3 acre. The spatial variation in land prices in earlier periods was presumably substantial, as reflected by this variation in the density of previous development. In Oakland, single-family housing in the more central portions is not quite as old as in San Francisco. However, while some housing in Oakland has been built after 1940, there is also a large geographic area with virtually no construction since 1960. This includes all of the predominantly black areas.

The principal difference between the supplies of rental (both single and multifamily units) and single-family, owner-occupied units is in the location of new rental housing. Rental housing built prior to 1940 exhibits a concentrated geographic pattern much like single-family, owner-occupied units of the same age. However, rental units built since 1960

5. These summary statistics are based on my analysis of housing statistics reported in the San Francisco Bay Area household interview tape. Much greater detail on population and most housing-stock variables is available from the Census of Population and Housing. However, the Census data provide only one-way classifications (e.g., the frequency distribution of structure age by tract, or median income by tract) but not bivariate or higher-order classifications.

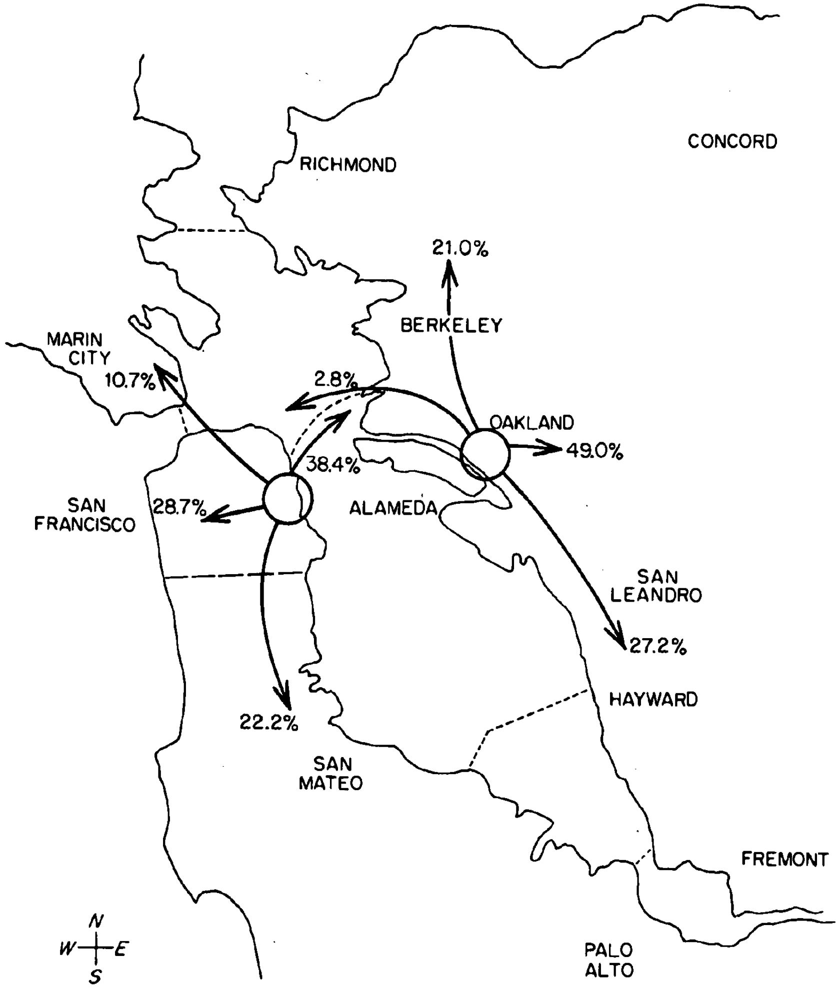

FIGURE 3.2
MAJOR COMMUTING FLOWS, BAY AREA

appear in both suburban and more central locations. In a significant portion of central Oakland, 20 to 30 percent of the rental units have been built since 1960, and in San Francisco the figure is 10 to 20 percent. Virtually no single-family construction has occurred in these central areas since 1950. In contrast, in suburbs to the north and south of the city of San Francisco and to the south of Oakland, differences in the age of the rental and single-family stocks are not nearly so pronounced. Thus, rental housing is newer than single-family units

TABLE 3.1
CORRELATION MATRIX: SELECTED HOUSING CHARACTERISTICS

A. Single-Family, Owner-Occupied Units

		AG	*LT*	*ED*	*EA*	*S34*	*S3*	*SS*	*SL*	*OWN*
Average structure age	*AG*	1.0000								
Average lot size	*LT*	−.3727	1.0000							
Sixth-grade reading scores	*ED*	−.3412	.3139	1.0000						
Travel time to employment location	*EA*	−.4662	.6756	.2494	1.0000					
Percent of units pre-1950	*S34*	.9874	−.3620	−.3406	−.4507	1.0000				
Percent of units pre-1940	*S3*	.9677	−.3563	−.3685	−.4419	.9453	1.0000			
Percent of units lot < .2 acre	*SS*	.6174	−.8413	−.4516	−.6094	.6172	.5885	1.0000		
Percent of units lot > .3 acre	*SL*	−.4228	.8576	.4220	.5831	−.2445	−.4201	−.8552	1.0000	
Percent of single-family units	*OWN*	−.4662	.3512	.3382	.4531	−.6216	−.4014	−.6094	.4291	1.0000

B. Rental Units

		AGR	*EA*	*SR34*	*OWN*
Average structure age	*AGR*	1.0000			
Travel time to employment location	*EA*	−.2816	1.0000		
Percent of units pre-1950	*SR34*	.9838	−.2568	1.0000	
Percent of single-family units	*OWN*	−.6488	.4591	−.6216	1.0000

throughout the Bay Area, but the differences in age are most pronounced in the more central markets. The age difference between rental and single-family, owner-occupied units in the center remains despite the continual process of conversion of the oldest single-family units to multifamily rental use in central-city markets. This conversion process tends to increase the average age of the rental stock.

Careful examination of the geographic variation in housing-stock characteristics suggests that employment location is the best single proxy for the location, type, and density of the single-family housing stock. Table 3.1 presents a correlation matrix for several important measures of housing-stock characteristics. Employment access (a weighted average of travel times to all work sites—see p. 143 below) is relatively highly correlated with average lot size (+.6756), with average age of single-family, owner-occupied housing (−.4662), and with the percent of single-family, owner-occupied housing (+.4531). For rental units, the correlation of employment access and average structure age is considerably lower—only −.2816—reflecting the fact that new rental units have been built both in suburban and more central locations.

That accessibility to employment is a reasonably good proxy for housing-stock characteristics reflects the importance of work-site locations to residential choices in earlier times when much of the more centrally located stock was constructed. Transport systems were less ubiquitous then and work trips were shorter. Moreover, transit systems had significant effects on the particular location of housing, with especially dense development in areas located near transit stations serving central-city job concentrations. As highway systems have improved, the role of work sites in shaping the location of residential development has diminished. While the time of the average commuting trip has not lessened, improvements in urban highway systems have resulted in increases in the average length of such trips. Thus, the improved highway system allows households to choose among a more dispersed set of possible residential locations around any given work site.[6] Nevertheless, given the durability of the capital stock and the relatively slow rate at which employment relocation occurs, employment access remains a good proxy for housing-stock characteristics.

There are, of course, other factors which have influenced the course of metropolitan development in the Bay Area over time. The topography of the region is one factor; only recently has demand pressure in the housing market, together with the existence of major ghettos throughout central Oakland, led to extensive development of the area to the east

6. John Meyer, John Kain, and Martin Wohl, *The Urban Transportation Problem* (Cambridge: Harvard University Press, 1965).

of Oakland on the other side of the mountains. As has been previously noted, local zoning and public finance policies also play a major role.[7]

Examination of the age distribution of the current stock by geographic submarket also reveals the approximate timing of new construction over the last several decades. (Demolition rates are sufficiently low so that the age distribution of the current stock provides a good proxy for the time path of construction, except for the very oldest portions of the central city where the cumulative effects of residential-stock demolition is probably more significant.) For example, there is a high negative correlation between the percent of single-family, owner-occupied units built prior to 1939 and the percent of such units built in the 1960–65 period. This implies that once older zones are developed, the age distribution of the stock is very slow to change. More recent construction has tended to occur where the existing housing stock is young. Over time, this geographic pattern of new construction will tend to increase differences across geographic submarkets in the average age and density of the housing stock.

The next chapter will demonstrate that richer households prefer newer, lower-density housing. This clearly suggests one of the fundamental characteristics of central-city housing markets contributing to central-city declines in income relative to the suburbs: an inability to attract higher-income households because of an old, high-density stock, which, over time, grows older relative to the suburbs inasmuch as little new construction occurs in the core. (Other factors contribute to the exodus of higher-income households as well, for example, the quality of public services and race.)

3. THE SPATIAL VARIATION IN PRICES BY SUBMARKET

The estimates of housing prices and income below are based on a household interview sample of twenty-eight thousand households from the San Francisco Bay Area taken in 1965.[8] Households were asked a series of questions about their family, type of housing, and its current market rent or price. Since the questions were about current circumstances of the household (composition, work experience, income, travel time to work), the problem of errors which occur when a long recall period is involved is minimal. The one variable which is subject to error is the household's estimate of the market value of its home (for those

7. For a more detailed discussion, see Center for Real Estate and Urban Economics, *Jobs, People, and Land.*
8. Bay Area Transportation Study Commission, San Francisco, California, 1965.

households in single-family structures). However, there is some evidence that while such estimates have a high variance, they are not significantly biased, even when the purchase took place many years previously.[9] The large sample available tends to mitigate the effects of this high variance on the estimated coefficients of the price equations.

Eighty-one geographic zones were defined, comprised in such a way as to preserve as much within-zone homogeneity in the racial composition and housing stock as possible (each zone was several census tracts). Racial composition was the first consideration in drawing boundaries. This criterion was adopted to facilitate tests for the effects of race in the models below. Municipal jurisdictional lines were also used to define some boundaries. (In no case did municipal boundaries cut across the geographic boundaries dictated by racial considerations.) In the large central-city municipalities encompassing several geographic zones, housing-stock characteristics served as the criteria for defining boundaries. As a consequence, the zones assumed somewhat irregular shapes and different sizes. However, each one contains approximately the same number of housing units and is spatially compact, i.e., each point in a zone can be reached from any other point without leaving the zone.

Incomes of occupants of particular types of housing in each zone can be directly calculated from the interview results. Prices of housing in each zone were determined by estimating hedonic price indexes for the zone; prices of individual housing units were related to several structure and quality characteristics, including number of rooms and dummy variables for lot size, age of structure, and structure condition. Separate equations were estimated for single-family and rental units, respectively. The dependent variables were:

V = market price of house ($);
R = monthly rent ($);

and the independent variables were as follows:

X_1 = number of rooms;
X_2 = 1 if unit built 1950-60, 0 otherwise;
X_3 = 1 if unit built 1940-50, 0 otherwise;
X_4 = 1 if unit built pre-1940, 0 otherwise;
X_5 = 1 if unit is unsound, 0 otherwise;

9. John Lansing and Leslie Kish, "Response Error in Estimating the Value of Housing," *Journal of the American Statistical Association* (September 1954), pp. 520-38.

X_6 = 1 if unit occupies less than .2 acre, 0 otherwise;
X_7 = 1 if unit occupies .3 to .5 acre, 0 otherwise;
X_8 = 1 if unit occupies more than .5 acre, 0 otherwise.

These equations are essentially descriptive. Observed house prices or rents at any point in time reflect what households pay for housing services in the prevailing housing submarket, the payments mirroring demands, supplies, and the market-clearing process, including market imperfections. There is no compelling logic to perfer a nonlinear form, particularly since virtually all of the included variables are dummy variables. Interaction effects between age, lot size, and quality variables were tested by additional dummy variables: the results were generally insignificant.

TABLE 3.2
THE CLOSENESS OF FIT OF HEDONIC PRICE INDEXES

	Owner Units	Rental Units
Number of residence zones	81	81
Mean sample size	159	114
Mean value of R^2	.67	.64
Mean value of price	$24,591	$123
Mean value standard error of estimate	$5,660	$27
Number of zones with significant independent variables (5% level):		
Rooms	81	81
Structure-age dummies	78	81
Lot-size dummies	78	-
Structure-condition dummies	26	23

A summary indicating the quality of the fit of the estimated regressions appears in Table 3.2. There are significant relationships between prices and structure size, age, and lot size, with R^2 generally in the range of .50 to .80 for zones with one hundred to two hundred observations. Age or lot size dummy variable are almost always statistically significant. In some samples, where there is only limited variation in housing-quality attributes, some of the dummy variables cannot be included. For example, in some of the distant suburban sites no housing is reported on less than .2 acre or built prior to 1940. No single-family construction on larger lots exists in selected downtown zones and, hence, this dummy variable was excluded from the equations pertaining to them. In a few zones in, or immediately adjacent to, the central business districts in downtown San Francisco there is virtually no single-family, owner-occupied housing. The very small sample sizes in these zones precluded any estimation of prices for single-family units.

The estimated prices for different types of housing vary substantially across zones. Figure 3.3 presents the estimated prices for a single-family unit in sound condition, situated on an average-sized lot (.2-.3 acre) and built in 1960 to 1965. Figure 3.4 presents the incremental price savings associated with acquiring the same type unit except that the age is pre-1940; Figure 3.5 presents the incremental savings of acquiring

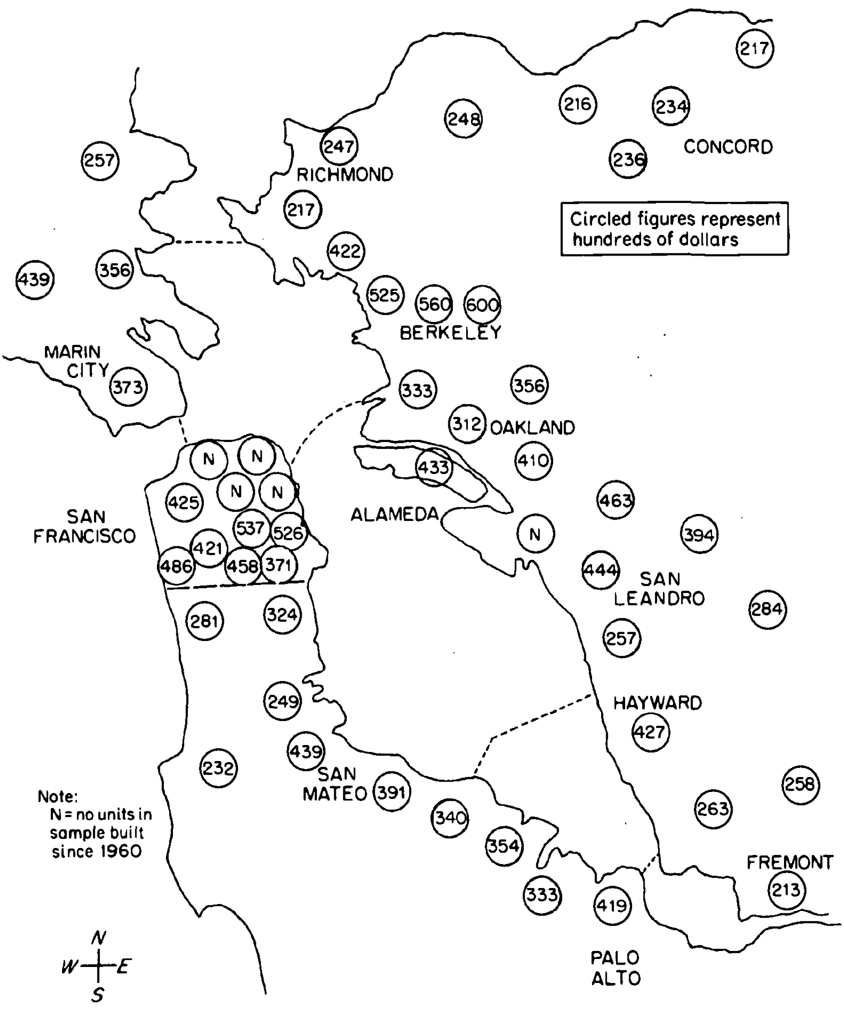

FIGURE 3.3
PRICE OF 5.5-ROOM SINGLE-FAMILY HOUSE, 1960-65, .2-.3 ACRE LOT
[hundreds of dollars]

that same unit except that it is situated on a lot less than .2 acre. Figures 3.6 and 3.7 present the estimated rents for a 4-room apartment in sound condition built in 1960-65 and pre-1940 respectively. These figures provide a good visual summary of the overall spatial variation in housing prices in the Bay Area. A more detailed examination of

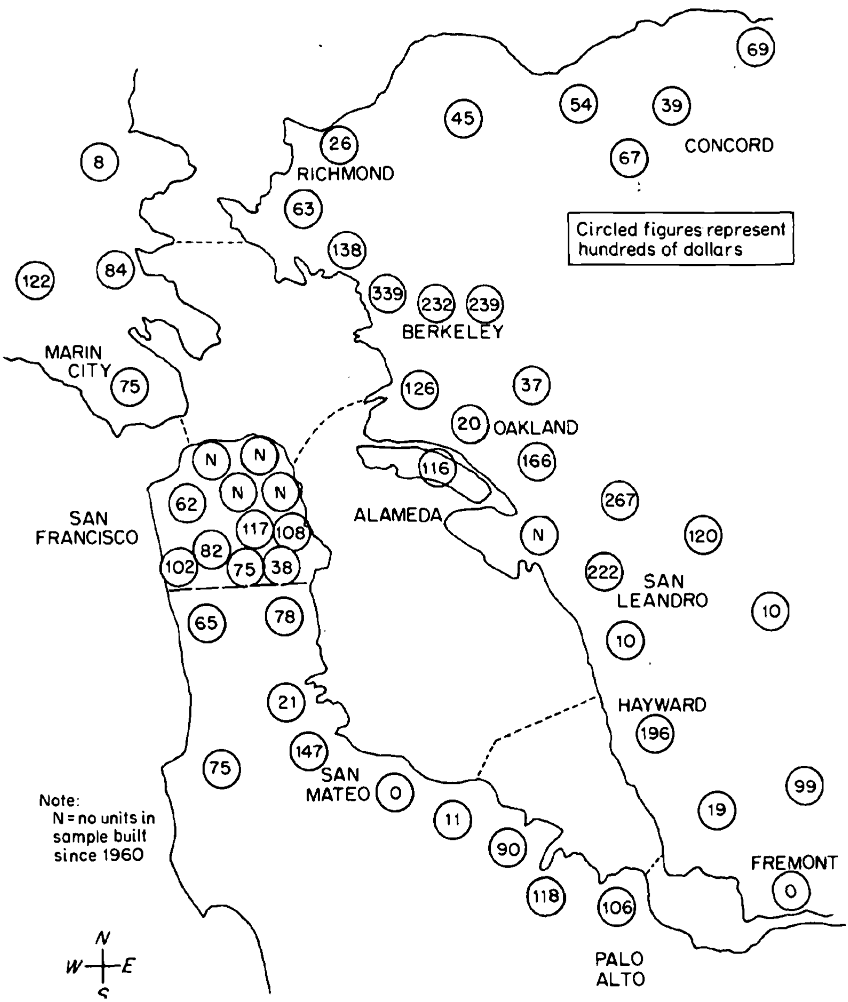

FIGURE 3.4
PRICE DIFFERENCE: SINGLE-FAMILY UNITS BUILT IN 1960-65 VERSUS PRE-1940
[hundreds of dollars]

the characteristics of local housing markets—housing prices by type, income levels of residents of each house type, and the supplies of each type of unit—for several selected housing submarkets is presented in Tables 3.3 and 3.4. These zones were chosen as representative of several distinct types of submarkets, and hence do not reflect the extremes

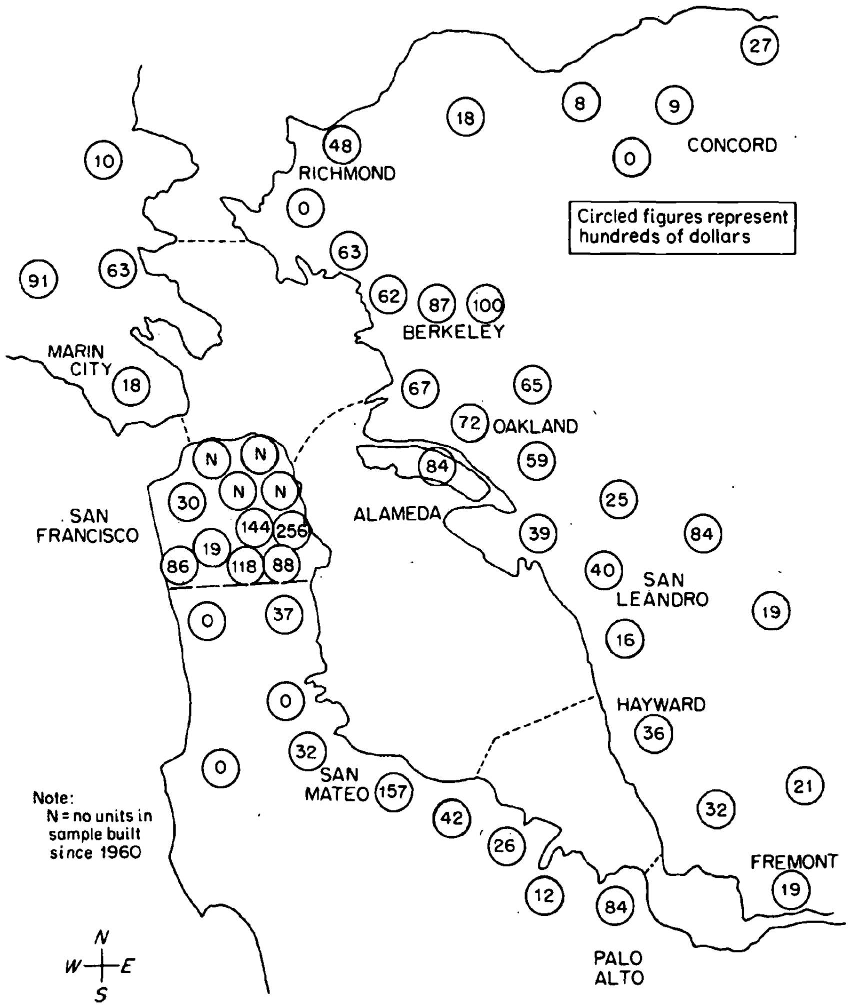

FIGURE 3.5
PRICE DIFFERENCE: SINGLE-FAMILY UNIT BUILT ON .2–.3 ACRE LOT VERSUS LESS THAN .2 ACRE LOT
[hundreds of dollars]

in prices, either high or low, which can be observed in the entire Bay Area.

The comparisons reveal that the estimated prices of housing of a given type vary much more geographically than the average of all housing values. For example, in the several downtown San Francisco zones, the average price of single-family housing is $47,800, versus $18,000

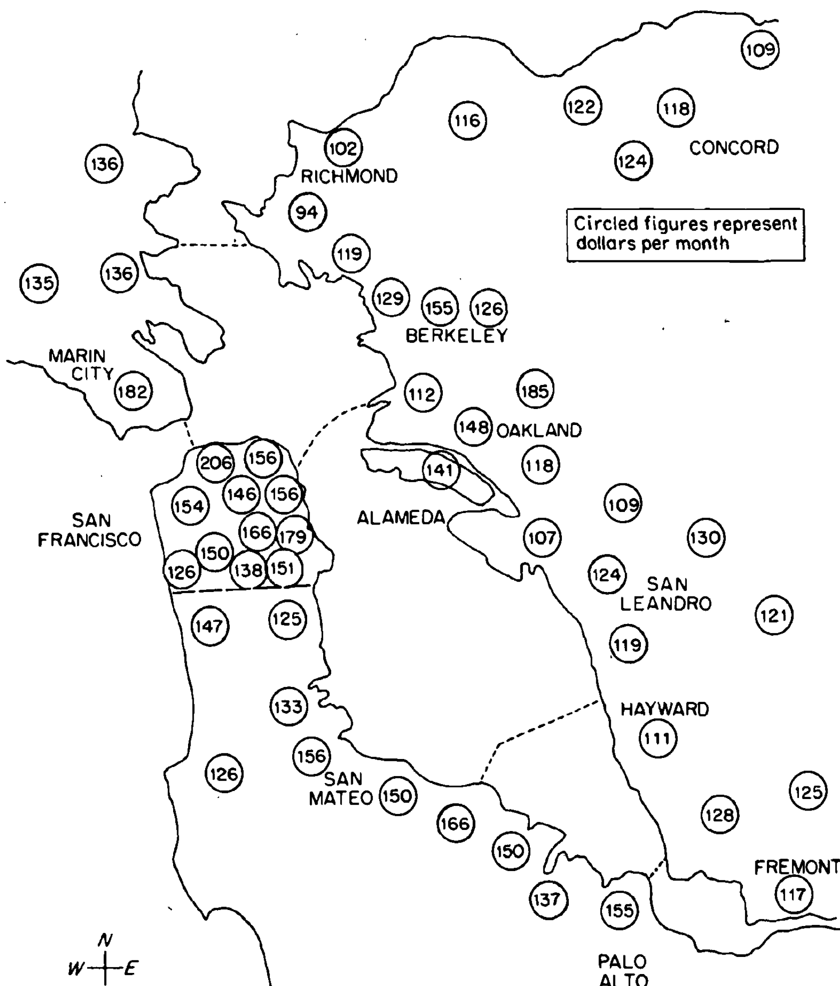

FIGURE 3.6
RENT FOR 4-ROOM APARTMENT BUILT 1960-65
[dollars per month]

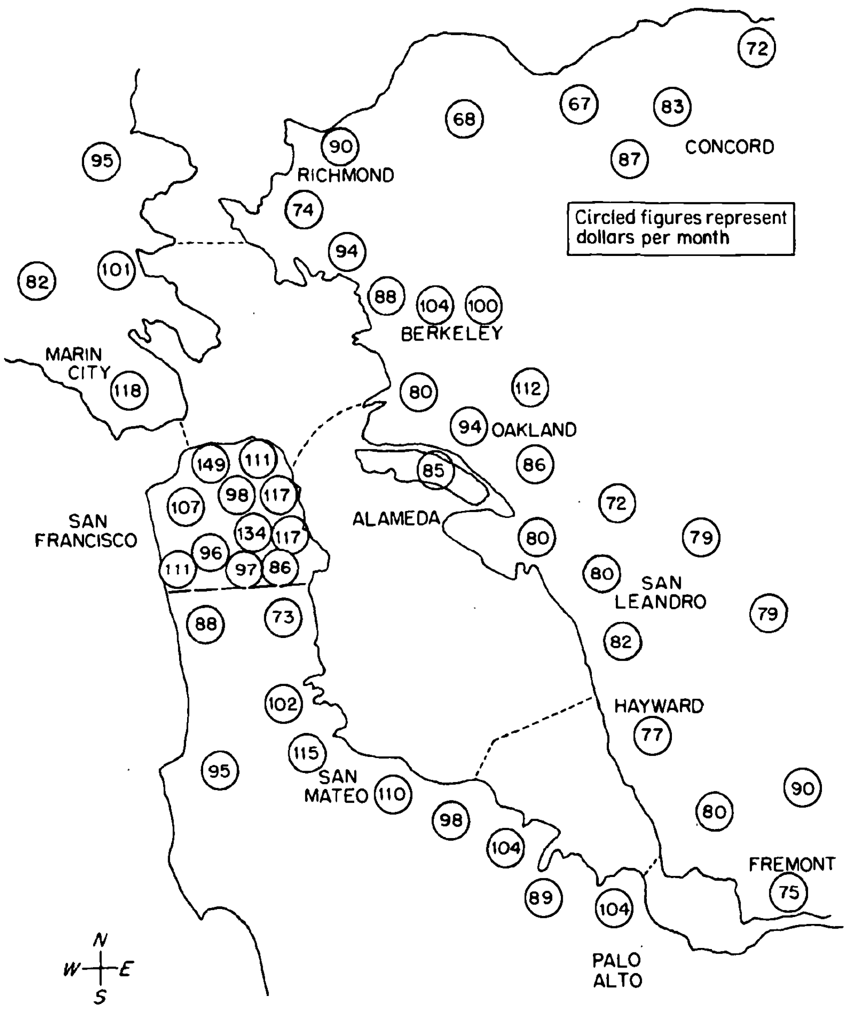

FIGURE 3.7
RENT FOR 4-ROOM APARTMENT BUILT PRE-1939
[dollars per month]

in distant suburbs. Between these zones, the difference in prices of *new* housing or housing on large lots is much greater.

Housing prices for a house standardized for quality (5.5 rooms, built since 1960, and on a lot ranging in size from .2 to .3 acres) are approximately $61,000 in several zones near the center of San Francisco.

In nearby suburbs (within three miles) prices are substantially lower ($42,109) and are as low as $22,000 in distant suburbs (50 minutes of commuting time). Rents for a standardized apartment (a 4-room apartment, built since 1960) vary much less, from $110 in the ring to $185 in the core. The rent gradient is less steep than the single-family-housing price gradient.

Also striking is the large difference in prices of comparable housing between submarkets near to each other. Suburban job concentrations appear to cause a distinct local maximum in rent surfaces. In addition, race appears to have a huge effect. There is a tremendous variation among geographic regions in the Oakland-Berkeley area which are in close proximity. Prices of a standardized unit are very high in Berkeley ($54,260) but are substantially lower in nearby Oakland, particularly in those areas inhabited by blacks.

Third, the price premiums or differences in prices attributable to particular quality attributes are not invariant across submarkets. For example, the premium for houses built since 1960 over those built from 1940 to 1950 may be one-third of the price of a new house in the central city, whereas the premium approximates 15 to 25 percent in suburban areas. In contrast, for rental housing, the comparable premiums on this age difference are on the order of 30 percent and 15 percent respectively. Premiums on units in the central city built in the 1940s over those built prior to 1940 are modest.

Premiums for lot size also vary considerably. In the central portions of San Francisco and Oakland, households can save $13,000 by occupying housing on lots smaller than .2 acre. This is a saving of over 20 percent of the price of a house of average size. Larger than average lots bear very substantial premiums. Lots ranging from .3 to .5 acre bear premiums from $2,000 in the suburbs to $30,000 in downtown San Francisco. For lots in excess of half an acre, the premiums exhibit little systematic geographic pattern. (This may be misspecification; lots in suburban areas classified in excess of half an acre may be very substantially larger than lots so classified in more central locations.)

The intercept term and the dummy variables denoting lot sizes less than .2 acre or .3 to .5 acre in the price equation for any given submarket can be used to estimate the price of residential land in that submarket, holding structure-size and age-of-structure constant. The estimates of the price implied by the intercept and the lot size dummies in the downtown San Francisco area range from as low as $121,000 per acre to $220,000. The dummy variable for the premium of a larger than average lot (.3 to .5 acre) gives the highest estimate of the price of land. This suggests that the price of land may not be invariant to the amount purchased, and that the cost of a site larger than .3 acre is more than proportionately

TABLE 3.3
VARIATION IN INCOMES AND HOUSING CHARACTERISTICS: SELECTED CORE AND SUBURBAN SUBMARKETS

Submarket	Central City, Old Housing, High Density[a]	Established Nearby Suburb, Newer Housing, High Density[b]	New Suburbs: Medium Density[c]	New Suburbs: High Density[d]	New Suburbs: Very Low Density, 85% Owner Occupancy[e]	Suburban Industrial Job Center, Older Stock, 40% Black[f]	Suburban Job Center, Newer Stock, Medium Density[g]
Submarket characteristics:							
EA	6.5	11.5	21.5	16.5	24.5	14.0	12.5
LT (acres)	.09	.09	.20	.12	.60	.10	.19
AG (years)	27.0	24.2	15.0	12.0	12.0	23.3	9.4
OWN (percent)	15.0	60.0	65.0	75.0	85.0	44.0	76.0

Average Income:							
All owners	$13,300	$12,031	$12,227	$10,275	$14,715	$ 9,606	$10,498
Owners:							
Pre-1939	12,953	11,720	11,914	7,113	13,700	6,842	9,803
Pre-1960-65	21,450	12,729	17,916	10,700	16,576	11,749	11,147
Lot <.2 acre	12,775	12,050	12,129	10,363	13,700	7,762	9,970
Lot .3-.5 acre	22,050	24,950	15,575	10,166	15,211	14,115	12,396
Renters:							
pre-1939	10,378	7,475	10,850	7,100	8,227	5,255	7,089
1960-65	13,475	9,153	10,485	10,505	14,345	6,983	7,979

[a] Approximate levels in San Francisco Tracts A-1 to C-1, J-2 to J-20.
[b] Approximate levels in San Francisco Tracts, O-1 to O-9.
[c] Approximate levels in San Mateo County, Tracts 60 to 68.
[d] Approximate levels in San Mateo County, Tracts 16 to 21.
[e] Approximate levels in Contra Costa County, Tracts 38 to 55.
[f] Approximate levels in Contra Costa County, Tracts 76 to 82 (in city of Richmond).
[g] Approximate levels in Contra Costa County, Tracts 27 to 37 (in city of Concord).

TABLE 3.4
PRICES OF HOUSING ATTRIBUTES, SELECTED SUBMARKETS

Submarket	Central City, Old Housing, High Density[a]	Established Nearby Suburb, Newer Housing, High Density[b]	New Suburbs: Medium Density[c]	New Suburbs: High Density[d]	New Suburbs: Very Low Density, 85% Owner Occupancy[e]	Suburban Industrial Job Center, Older Stock, 40% Black[f]	Suburban Job Center, Newer Stock, Medium Density[g]
A. Owners							
Price of standardized unit[h]	$61,051	$42,109	$35,400	$23,240	23,552	$21,660	$23,400
Incremental savings of lower-quality unit over standardized unit:							
Structure age 1950–60	15,151	2,974	1,299	1,701	435	1,215	3,917
Structure age 1940–50	18,209	9,271	5,363	3,151	1,425	4,734	4,423
Structure age pre-1940	21,027	8,255	9,015	7,496	6,671	6,252	2,845
Unsound condition	17,821	8,132	2,033	-	654	2,460	-
Lot size < .2 acre	13,366	1,911	2,602	1,501	0	0	949

Price Premium of higher-quality unit over standardized units:							
Lot Size .3-.5 acre	30,505	19,877	1,033	0	2,203	12,495	0
Lot Size > .5 acre	-	-	9,010	18,321	8,427	-	6,533
B. Renters							
Price of standardized unit[i]	$185.80	$150.40	$150.12	$126.62	$124.33	$94.42	$118.15
Incremental savings of lower-quality unit over standardized unit:							
Structure age 1950-60	38.16	26.71	21.92	6.64	2.24	4.32	9.16
Structure age 1940-50	49.05	23.37	24.12	41.65	19.53	19.31	17.51
Structure age pre-1940	51.01	54.94	46.44	30.67	37.26	20.28	35.01
Unsound condition	28.38	30.34	21.61	-	0	8.99	0

[a] Approximate levels in San Francisco Tracts A-1 to C-1, J-2 to J-20.
[b] Approximate levels in San Francisco Tracts O-1 to O-9.
[c] Approximate levels in San Mateo County, Tracts 60 to 68.
[d] Approximate levels in San Mateo County, Tracts 16 to 21.
[e] Approximate levels in Contra Costa County, Tracts 38 to 55.
[f] Approximate levels in Contra Costa County, Tracts 76 to 82 (in city of Richmond).
[g] Approximate levels in Contra Costa County, Tracts 27 to 37 (in city of Concord).
[h] Standardized owner unit: 5.5 rooms, built 1960-65, on .2-.3 acre lot, in sound condition.
[i] Standardized rental unit: 4 rooms, built 1960-65, in sound condition.

more expensive than smaller-sized parcels. In contrast, in nearby suburban markets the several lot-size dummies all imply about the same price of land (about $70,000 per acre); this suggests that land prices may be invariant to the size of the parcel. In more distant suburbs, the implied price of land is still lower ($25,000 to $35,000 per acre), with the lowest estimate associated with the dummy for the larger lots. This suggests that in the far suburbs, the incremental price of additional land decreases with parcel size.

The price discount associated with an unsound unit appears to be largest in both absolute and percentage terms in the central areas (over 25 percent of the price of a standard unit), and less in suburban markets (as low as 10 to 15 percent). These estimates are probably less accurate than those for other quality attributes. The coefficient for the dummy variable for structure conditions was statistically significant in only about one-half of the submarkets which included unsound housing in the sample. Sound and unsound housing classifications have been notoriously unreliable, with some evidence indicating that the mode of classification is substantially affected by the interviewer who takes the survey. The surrounding neighborhood may also unconsciously affect the judgments of the surveyor; the lower discount for unsound units in the suburbs may reflect the fact that a stricter standard of quality was being applied, giving rise to the possibility that the average quality of units classified as unsound in the older central housing submarkets was lower than that of units so classified in the suburbs.

Finally, the large variation in observed prices and the implied rate of return on residential capital with particular characteristics bears testimony to the validity of the model outlined in Chapter 2, which stressed the time lags in altering the capital stock. The assumption of a fixed stock in the short run, which is not fully adapted to current or anticipated demand, implies that observed prices may bear little relation to the long-run supply price for different types of housing. These estimates reveal substantial differences across submarkets in quasi rents to those supplying the housing stock.

4. ESTIMATES OF PRICE AND INCOME GRADIENTS

Gradient functions relating prices and occupant incomes to distance or commuting time to the center of the city are often used to summarize the spatial dimension of urban housing markets.[10] Owing to the sharp

10. Edwin Mills, "Urban Density Functions," *Urban Studies* (1970), pp. 5-20; Richard Muth, *Cities and Housing*, (Chicago: University of Chicago Press,

discontinuities in travel time from point to point in the Bay Area created by natural barriers, the entire Bay Area can hardly be considered one market. For the present analysis, two separate price gradients were estimated. The first was based on all zones in San Francisco and to the south in San Mateo County, and used travel time to the San Francisco CBD as the criterion. The second included price data for zones in all directions from the center of Oakland but excluding San Francisco and San Mateo County. Travel times between zones *within* each of these two broad regions are distinctly less than travel times between zones which are in the two different broad subsets. These two broad areas are those most likely to be well represented by continuous gradient functions. While some cross-commuting occurs between Oakland and San Francisco, other factors exerting independent and different effects on housing markets in Oakland and San Francisco are such that prices and incomes exhibit different patterns in the two cases.

The results are shown in Table 3.5. The accuracy of the fits for prices and rents is not high, nor is the precise shape of the gradients obvious. A double-log form provides virtually as good a fit as the negative exponential form commonly employed in the literature, though both these nonlinear forms were clearly superior to a linear form.

Income gradients for selected types of housing were also estimated. Average occupant income for particular housing types exhibits a less regular pattern spatially, and a much poorer fit than the price data, with t statistics for the slope coefficients often less than one. Gradients for average occupant incomes of a given housing type exhibit a lower slope coefficient than that for prices.

The risk of errors through aggregation across housing types is also evident. Gradients or spatial patterns for occupant incomes or prices for households aggregated across housing types largely reflect the type and availability of the existing housing stock and neighborhood racial composition. If data are aggregated across all housing types—for example, all owner-occupied housing—the "income gradient" has no significant slope. If owners and renters are pooled, the average income gradient will exhibit a slight positive slope, with higher incomes in the suburbs. Variation in income *across housing types* within a submarket is generally greater than variation across submarkets near to each other.

In the case of rental housing, estimated slopes of income gradients by age of structure are insignificant; large numbers of suburban commu-

1969), Edwin Mills, "The Value of Urban Land," in *The Quality of the Urban Environment*, ed. Harvey Perloff (Baltimore: Johns Hopkins Press, 1969), pp. 231–57.

TABLE 3.5
ESTIMATES OF PRICE AND INCOME GRADIENTS

Dependent Variable (logs)	Negative Exponential			Double Log		
	$\hat{\rho}$	*t* ratio	R^2	$\hat{\beta}$	*t* ratio	R^2
			A. San Franciso			
Owner prices:						
P6	−1.9720	3.64	.4383	−.9539	3.88	.4700
P5	−1.1720	2.75	.3078	−.5761	2.96	.3408
P4	−1.0060	2.38	.2507	−.5168	2.72	.3035
P3	−.9423	1.99	.1897	−.4847	2.25	.2301
PS	−2.1690	2.94	.3375	−1.0600	3.15	.3696
PL	−2.7360	5.15	.6097	−1.2870	5.25	.6186
PT	−.8115	1.63	.1361	−.4307	1.90	.1758
Owner-occupant incomes:						
Y6	−.8737	1.29	.0893	−.4454	1.42	.1065
Y5	−.6961	1.25	.0843	−.3801	1.48	.1153
Y4	−.7428	1.30	.0913	−.4073	1.56	.1259
Y3	−.0186	.02	.0004	−.0970	.30	.0053
YS	−.3159	.83	.0396	−.1824	1.04	.0606
YL	−.9753	1.66	.1399	−.4871	1.79	.1600
YT	−.0749	.15	.0013	−.0954	.41	.0098
			B. Oakland			
Owner prices:						
P6	−1.1850	4.80	.4269	−.4629	4.17	.3601
P5	−.8210	3.56	.2908	−.3301	3.29	.2599
P4	−.5683	2.65	.1852	−.2395	2.62	.1818
P3	−.4713	1.93	.1056	−.1838	1.73	.0887
PS	−.9423	3.67	.3037	−.3529	3.08	.2354
PL	−1.5690	6.41	.5701	−.6469	5.98	.5357
PT	−.2339	1.00	.6316	−.0895	.90	.0256
Owner-occupant incomes:						
Y6	−.3261	.86	.0236	−.0625	.38	.0048
Y5	−.2286	.78	.0194	−.0684	.54	.0096
Y4	−.2981	1.10	.0376	−.1140	.98	.0304
Y3	−.1528	.56	.0103	−.0628	.55	.0096
YS	.0736	.33	.0036	.0368	.39	.0052
YL	−.1654	.53	.0091	−.0468	.35	.0040
YT	.0301	.12	.0005	.0219	.22	.0015

nities contain many high-income renters. If the data are pooled across age classes, a "reverse gradient" is evident—an upward gradient function as distance to the center increases. Of course, pooling owner and rental housing data only compounds the problems of interpretation. Again, a negative income gradient is produced. However, this result reflects various facts: renters tend to be poorer than owner occupants, the tenure mix in suburban areas includes a high percentage of owner units, and the suburban stock is newer and of lower density. All of these circumstances contribute to the higher average income of suburban areas appearing in data aggregated across all housing types.

5. MARKET COMPARTMENTALIZATION BY RACE AND ITS EFFECTS ON HOUSING PRICES

The existence of separate housing markets for blacks and whites in urban areas has been apparent for many years and is a trend which shows little evidence of change over time. The earliest research examining racial patterns in housing was by sociologists who estimated the extent of geographic segregation, or separation, of blacks and whites within urban areas. (*Segregation* is used below as a descriptive term denoting the degree of separation, as opposed to *discrimination,* which is used to refer to a situation in which market opportunities differ for blacks and whites.) Much of the early discussion centered on the choice of an appropriate measure of spatial separation, and involved many of the familiar index-number problems.[11] These segregation indexes provide only a first approximation to the nature of geographic segregation; most of them depend on the size of the zones employed, and none adequately distinguish between alternative geographic patterns of segregation—e.g., whether zones predominantly occupied by blacks are contiguous to each other or spread throughout the city.[12] However, difficulties in interpretation of the absolute values of the indexes do not seriously reduce their usefulness in making comparisons across cities or over time, the principal purposes for which such indexes were devised. Perhaps the most striking result of this research is the fact that black geographic concentration has increased over time, especially in cities with a high percentage of black residents. This tendency toward more concentration is the opposite

11. The first and still the principal contribution is Taeuber's. His index provided a numerical measure of the extent to which actual racial residential patterns differed from one in which blacks were exactly proportionately represented in each zone according to their percentage of the total urban population. Karl E. Taeuber and Alma F. Taeuber, *Negroes in Cities: Residential Segregation and Neighborhood Change* (Chicago: Aldine, 1965).
12. For a discussion of these indexes and the associated index-number problems, see A. A. Pascal, *The Economics of Housing Segregation,* The RAND Corp. (RM-5510-RC), November 1967, pp. 11-37.

of the pattern displayed by all other major ethnic groups, which have tended to disperse.

While this research has not yet been updated using the 1970 Census, summary statistics of black and white residential patterns in metropolitan areas indicate that no significant reduction in the degree of spatial separation by race has occurred. The increase in the population of black people in metropolitan areas in the 1960s occurred largely in the central cities, which accounted for 3.2 million of the 4.0 million total increase in the black metropolitan population in the 1960-70 period. The white population residing in the central cities actually declined during the same period by .6 million. While there has been an increase in the absolute number of blacks residing in the suburbs, the figure for blacks as a percent of the total population living in the suburbs was the same in 1970 as in 1960—5 percent—whereas blacks' share of the central-city population rose from 16 to 21 percent. Only 22.0 percent of blacks living in the metropolitan areas in 1970 lived outside the central city, virtually no improvement over the figure for 1960: 21.9 percent.[13]

It has recently been shown that little of the observed racial segregation can be explained by differences in income between blacks and whites. Calculation of segregation indexes for narrowly defined income groups reveals that black residences are more spatially concentrated than whites.[14] There is increasingly widespread acceptance of an explanation for the observed spatial segregation which stresses the importance of racial discrimination in housing markets. According to this hypothesis, most whites prefer a segregated market and through discriminatory practices, limit entry by blacks to suburban and certain central submarkets.[15]

Theoretical models of the effects of racial discrimination on urban housing prices have been devoted principally to the analysis of price differentials when neighborhood racial composition is stable.[16] The

13. U.S. Department of Commerce, Bureau of the Census, *The Social and Economic Status of Negroes in the United States, 1970*, BLS Report No. 394, pp. 12-16.
14. Raymond Zelder, "Racial Segregation in Urban Housing Markets," *Journal of Regional Science* (April 1970), pp. 93-105. Karl E. Taeuber, "The Effects of Income Redistribution on Racial Residential Segregation," *Urban Affairs Quarterly* (September 1968), pp. 5-14.
15. For a bibliography of this literature, see Chapter 5 below.
16. Gary Becker, *The Economics of Discrimination* (Chicago: University of Chicago Press, 1957), pp. 59-60; Muth, *Cities and Housing;* Thomas King and Peter Mieszkowski, "Racial Discrimination, Segregation, and the Price of Housing," *Journal of Political Economy* (May/June 1973), pp. 590-606.

theory of a discriminatory market assumes that whites will restrict black entry into the white submarket by charging prices to blacks which are above prices at which comparable housing is made available to whites. Other things being equal, prices in the white submarket may also exhibit spatial variation depending on the proximity to black submarkets. It has been hypothesized that prices will be higher in the interior of the white submarket than near the boundary. This may reflect the fact that the disutility to whites of black neighbors declines as distance to the black submarket increases.[17] Higher prices in the interior of the white area than near the boundary may also reflect a difference in whites' subjective estimates of the probability that the neighborhood will "tip" from white to black, which are reflected in the current market price. This subjective estimate of probability is likely to be positively related to proximity to the boundary.

Prices in the black submarket will depend on demand and supply characteristics. A greater black demand, given a fixed supply, can be expected to increase prices. Prices to blacks in the black market may exceed the price at which whites buy and sell comparable housing in the white submarket near the boundary. Neighborhood racial composition will remain stable if prices in the black submarket are below the price in the white submarket plus the premium (or opportunity cost) that whites will give up to avoid selling to blacks. When the price for blacks at the boundary rises above that level, units will change hands from whites to blacks. The dynamics of how black and white households change their expectations regarding future market prices and neighborhood composition are complex.[18] During the process of neighborhood tipping, prices may change dramatically in the short run. As whites' expectations regarding the future racial occupancy of the neighborhood change and whites sell out, prices may fall precipitously. By the time the neighborhood is completely occupied by black households and moving rates return to more normal levels, prices may return to the prior level or may remain lower; the ultimate outcome for housing prices depends on the income levels of the new neighborhood inhabitants, just as in the case of a white neighborhood. Demand conditions in newly tipped black areas will depend on the nature of black demand for housing

17. Martin Bailey, "Effects of Race and Other Demographic Factors on the Values of Single Family Homes," *Land Economics* (May 1966), pp. 215-20.
18. By far the best discussion of the role of expectations and dynamics of neighborhood tipping is Thomas Schelling, "Neighborhood Tipping," Harvard Institute of Economic Research, Discussion Paper No. 100, December 1969.

relative to the newly augmented supply of housing available to blacks.[19]

The role of discrimination in the housing market will be examined in more detail in Chapter 5. This section attempts only to describe the differences between the availability and price of housing in black and white neighborhoods in the Bay Area. Even this seemingly straightforward descriptive task presents difficulties. Black and white submarkets must be defined. In cities where the black population is growing rapidly and/or neighborhoods are changing from white to black occupancy, it may be necessary to specify "transition" or "mixed" neighborhoods as well. Considerable geographic detail seems a necessity in defining black, white, and transition submarkets, and in order to obtain reliable estimates of housing prices, large samples may be required to adjust for geographic and housing-quality differences.

The single cross section available in this study is not well suited for testing the several hypotheses about how housing prices change in the tipping process. This sample does, however, provide a basis for estimating the extent of differences in housing stocks available to whites and blacks, and differences in prices across geographic submarkets at a point in time. These price comparisons do not provide a behavioral or causal explanation of the role of race in determining housing prices, since many factors which affect housing prices remain unspecified. Where housing price data covers a wide geographic area, there are many additional factors which must be taken into consideration before conclusions can be reached about the role of race. Comparison of black submarket prices with prices in adjacent areas may involve comparisons with areas which are nearer the central business district or which are influenced by other factors affecting accessibility. Public services may differ, and the effects of neighborhood income levels must be considered. Thus, the following comparisons are properly regarded as descriptive only; a principal purpose of the model in Chapter 6 is to specify how the many underlying causal factors affect prices, permitting an assessment of the separate effect of race.

There are dramatic differences in the types of housing available to blacks and whites in San Francisco. As in virtually every major city, black residences are concentrated in a small subportion of the

19. Several studies have been made of housing prices before, during and after tipping: David H. Karlen, "Racial Integration and Property Values in Chicago," Urban Economics Report No. 7, University of Chicago, April 1968; Donald Phares, "Racial Change and Housing Values: Transition in an Inner Suburb," *Social Science Quarterly* (December 1971), pp. 560-73, Luigi Laurenti, *Property Values and Race* (Berkeley and Los Angeles: University of California Press, 1960), pp. 47-65.

entire market.[20] Submarket areas were classified as *ghetto* (60 to 100 percent black), *mixed racial* (15 to 60 percent black), *predominantly white* (1 to 15 percent black), and *all white* (less than 1 percent black).

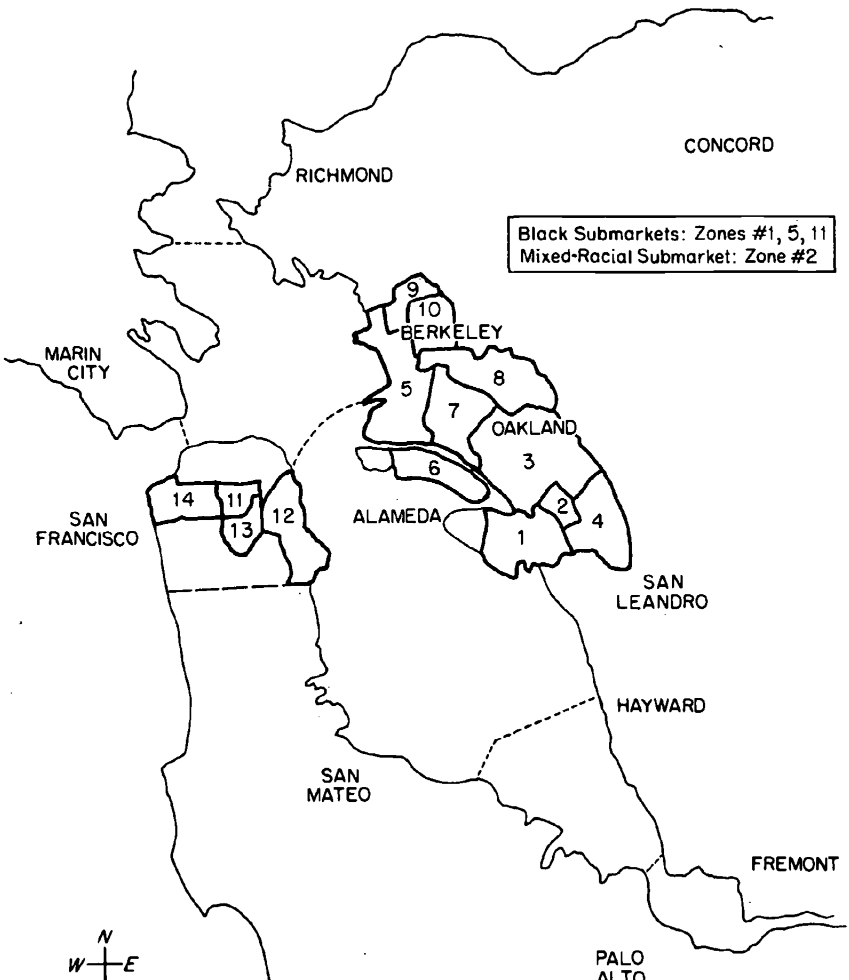

FIGURE 3.8
LOCATION OF BLACK SUBMARKETS AND SELECTED ADJACENT WHITE SUBMARKETS

20. Other studies of segregation patterns across cities have shown that the extent of segregation is less in San Francisco than in most other major cities. Taeuber and Taeuber, *Negroes in Cities*.

There are three principal black submarkets. These are shown in Figure 3.8. The two ghettos located toward the northern and southern edges of the central city of Oakland-Alameda are separated by a virtually all-white residential area about six miles wide. The northern Oakland ghetto extends into the edge of Berkeley and is adjacent to some of the highest-valued housing in the entire Bay Area. The San Francisco ghetto is adjacent to the central business district and includes the oldest, highest-density housing in the Bay Area. A smaller concentration of black households appears in an industrial area north of Oakland, in the city of Richmond. In no other submarket areas of any significant size are more than 15 percent of the residences black-occupied.

As a result of this compartmentalization in the market, the housing stock in areas inhabited by blacks is older, of higher density, and includes more substandard units than the housing stock in the rest of the city. This difference is evident in Table 3.6, which compares mean levels of several housing-quality attributes in ghetto, mixed racial, and white

TABLE 3.6
HOUSING MARKET CHARACTERISTICS, BLACK AND WHITE SUBMARKETS

	Stock Availability		
	Ghetto	Mixed Racial	White
Percentage of owner units	29.6	42.0	64.0
Owner Units:			
Average age (years)	28.9	29.1	16.3
% built 1960-65	0.4	0.8	16.6
% built 1950-60	8.5	8.8	32.0
% built 1940-50	26.9	26.4	16.6
% built pre-1940	64.2	64.0	34.6
Lot size (acres)	.093	.114	.198
% < .2 acre	84.7	79.8	52.1
% .2-.3 acre	13.5	16.8	39.2
% .3-.5 acre	1.8	2.4	6.5
Percent unsound	9.0	8.0	2.9
Rental units:			
Average age (years)	27.9	25.1	15.1
% built 1960-65	1.4	6.5	22.1
% built 1950-60	8.5	23.4	29.4
% built 1940-50	13.6	18.5	24.0
% built pre-1940	76.5	51.6	24.5
Percent unsound	29.0	20.0	3.5

Note: Equality of means for every category can be rejected at .05 level.

submarkets. The biggest differences in the quality of the stock are reflected in the percentage of unsound units. In black submarkets, the figure is significantly higher. The age of housing stock in black submarkets reflects the fact that blacks have generally gained access to the oldest neighborhoods. In addition, the rate of housing construction in all black areas is lower than that in contiguous central white submarkets or suburban submarkets. Different construction rates imply that the average age of housing in black and white submarkets will diverge over time.

A distinct pattern in neighborhood incomes across submarkets classified by racial composition is also evident. Income differences between blacks and whites are least in the ghetto and mixed-racial areas and higher in white submarkets which have permitted some black entry (see Table 3.7). Black owners in the ghetto are 8 percent poorer than whites, while black renters are about 20 percent poorer. Larger differences exist between the income levels of whites and blacks in the suburban submarkets: the incomes of black owners are a third below those of whites, with a differential of 25 percent for renters. (In those suburbs with only token black representation [less than 1 percent] the differentials are not quite so great, the average income of black owners being only about 20 percent below that of their white neighbors.) The fact that income differentials are least in the black submarkets reflects the location choices of both black and white households. The analysis of white households' choice of neighborhood in Chapter 4 reveals that as their income rises, whites are increasingly less likely to reside in a mixed neighborhood. Whites who remain in black submarkets have incomes

TABLE 3.7
INCOMES IN BLACK AND WHITE SUBMARKETS

	Ghetto[a]	Mixed Racial[b]	White[c]	All White[d]
Owner incomes:				
Black	$7,527	$7,941	$ 8,085	$10,855
White	7,807	8,974	11,714	12,251
Ratio of black to white income	.965	.885	.690	.886
Renter incomes:				
Black	$5,723	$5,821	$6,205	$6,448
White	6,140	7,584	8,429	9,251
Ratio of black to white income	.933	.768	.736	.697

[a] More than 60% black.
[b] 15%-60% black.
[c] 1%-15% black.
[d] Less than 1% black.

25 percent below the average of all whites. Income also has a positive effect on the probability that blacks gain access to the white submarket. (See Chapter 5.) The circumstance that income differentials between whites and blacks are least in the black submarkets and greater in suburban white submarkets reflects the fact that many black households with above-average incomes remain in the black submarket.

These differences in the availability of housing between black and white submarkets and in the incomes of occupants can be expected to affect the structure of housing prices. Low ghetto incomes reflect a neighborhood composed primarily of black households and only the poorest white households; because of low incomes, the effective demand for housing will be reduced. Resultant prices will depend on the nature of discrimination barriers and the consequent extent to which black households represent a captive market. Unless there is a severe shortage of units which results in substantial doubling up, ghetto housing prices are likely to be depressed because of the lower level of average household incomes in the ghetto. While overcrowding (the number of households living in units with more than one person per room) is typically higher in central ghetto submarkets than in the rest of the central city, ghetto housing prices in most cities appear to be below prices for comparable structure types in other areas. (Of course, neighborhood conditions are often not comparable.) However, while housing prices in the aggregate will be low in the ghetto, it is possible that prices for the small percentage of higher-quality owner-occupied units available to blacks are bid up sharply. To the extent that black households face discrimination barriers which limit their access to higher-quality housing in suburban markets, newer, lower-density single-family housing in the ghetto may exhibit high premiums over older, lower-quality units located there.

Table 3.8 presents estimates of the hedonic price indexes in the principal black ghettos and selected nearby white submarkets. (Figure 3.3 provides a geographic code.) Racial composition in these areas has not changed dramatically in recent years; thus, observed prices probably reflect the effects of reasonably stable demand and supply influences in the white and black submarkets (rather than any temporary disequilibrium associated with the tipping process). Table 3.9 shows the prices for housing of a particular age and lot size implied by the estimated price indexes. The comparisons are made for a 5.5-room unit in sound condition.

The comparisons reveal that the price of housing averaged across all housing types tends to be lower in black areas than in adjacent white submarkets, but that a different pattern of prices for different quality types exists in black submarkets as against adjacent white ones. Considering first single-family structures, in the black ghetto area to

TABLE 3.8
COEFFICIENTS OF HEDONIC PRICE INDEXES IN SELECTED GHETTO AND CENTRAL-CITY SUBMARKETS

Independent Variable (Zone Number)	Oakland Ghetto: Area A (1)	Mixed-Racial Area Adjacent to Ghetto (2)	Adjacent White Submarkets: Toward Center of Oakland (3)	Adjacent White Submarkets: Away from Center of Oakland (4)
			A. Owners	
Constant[a]	7,865[c]	4,613[c]	5,330[c]	2,405[c]
Rooms	1,446[c]	2,277[c]	2,403[c]	3,025[c]
Dummy variables				
Age 1940–49	724	3,101[c]	3,350[c]	2,872[d]
Age 1950–59	690	12,104[c]	8,961[c]	9,653[c]
Age 1960–65	n.a.	26,717[c]	16,584[c]	11,968[c]
Lot size .2–.3 acre	3,911[c]	2,501	5,888[c]	8,406[c]
Lot size .3–.5 acre	16,895[c]	9,605[c]	192	3,725[d]
Lot size > .5 acre	n.a.	n.a.	3,922[d]	11,970[c]
Unsound condition	−3,378[d]	−3,193[d]	−3,283[d]	−729
			B. Renters	
Constant[b]	64.11[c]	76.67[c]	75.87[c]	81.22[c]
Rooms	7.06[c]	7.89[c]	10.64[c]	9.71[c]
Dummy Variables				
Age pre-1939	−15.38[d]	−31.87[c]	−32.10[c]	−51.56[c]
Age 1940–49	8.55	−21.18[c]	−30.98[c]	−23.13[c]
Age 1950–59	−17.65[d]	−9.89[c]	−14.41[c]	−24.38[c]
Unsound condition	−20.25[c]	−7.19[d]	−21.37[c]	−8.25

TABLE 3.8 Continued

Independent Variable (Zone Number)	Oakland Ghetto: Area B (5)	Adjacent White Suburbs: Alameda (6)	Central Oak-land (7)	Oakland Suburb (8)	Berkeley (9)	Berkeley (10)
			A. Owners			
Constant[a]	14,121[c]	8,120[c]	8,670[c]	5,540[c]	8,320[c]	12,041[c]
Rooms	1,210[c]	2,582[c]	2,401[c]	3,604[c]	2,864[c]	2,570[c]
Dummy variables						
Age 1940–49	1,102	1,553	1,442	399	1,120	−904
Age 1950–59	−9,063	8,723[c]	1,291	9,510[c]	9,136[c]	10,957[d]
Age 1960–65	12,562[c]	11,562[c]	2,025	3,701[d]	23,243[c]	23,888[c]
Lot size .2–.3 acre	6,749[d]	12,150[c]	7,176[c]	6,515[c]	−8,764[c]	10,055[d]
Lot size .3–.5 acre	35,937[c]	14,015[c]	8,275[c]	6,656[c]	4,671[d]	10,552[d]
Lot size > .5 acre	n.a.	20,317[c]	n.a.	22,905[c]	17,004[c]	28,114[c]
Unsound condition	−7,599[c]	−6,639[d]	2,124	−21,228[c]	−13,247[c]	−16,676[d]
			B. Renters			
Constant[b]	62,94[c]	98.19[c]	75.81[c]	80.87[c]	38.13[c]	101.80[c]
Rooms	10.10[c]	10.64[c]	18.29[c]	26.42[c]	21.94[c]	13.35[d]
Dummy variables						
Age pre-1939	−32.85[c]	−57.94[c]	−56.29[c]	−73.48[c]	−26.50[c]	−51.36[c]
Age 1940–49	−21.62[d]	−34.25[c]	−52.17	−104.42[c]	−6.41	−39.92[c]
Age 1950–59	−18.91[d]	−23.43[c]	−2.59[c]	−73.56[c]	−10.75[d]	−16.98[c]
Unsound condition	20.21	−2.26	−6.31	−26.65	−32.23[c]	−7.88[d]

TABLE 3.8 Concluded

Independent Variable (Zone Number)	Central San Francisco Ghetto (11)	Adjacent White Suburbs: Adjacent Suburb to East: Contiguous to CBD (12)	Adjacent Suburb to South: Away from CBD (13)	Adjacent Suburb to West: Away from CBD (14)
		A. Owners		
Constant[a]	26,001[c]	11,101[c]	16,050[c]	17,320[c]
Rooms	1,540[c]	1,805[c]	2,455[c]	2,906[c]
Dummy variables				
Age 1940–49	n.a.	3,061[d]	−705	−3,942
Age 1950–59	n.a.	9,540[c]	−4,980	1,714[d]
Age 1960–65	n.a.	10,790[c]	12,574[c]	6,201[c]
Lot size .2–.3 acre	n.a.	4,615[d]	n.a.	2,960[d]
Lot size .3–.5 acre	n.a.	−5,961	−8,205	44,522[c]
Lot size .5 acre	n.a.	n.a.	n.a.	43,079
Unsound condition	−21,660[c]	−5,399[d]	1,794	−9,484[d]
		B. Renters		
Constant[b]	85.05[c]	70.10[d]	51.00[c]	114.10[c]
Rooms	20.23[c]	24.55[c]	25.15[d]	10.14[c]
Dummy variables				
Age pre-1939	−31.00	−62.44	−12.26	−47.22[c]
Age 1940–49	−25.20	−29.56	−45.24	−33.50[c]
Age 1950–59	−13.06[d]	−30.01[d]	−6.26	−24.51[c]
Unsound condition	−37.19	−46.83[d]	−67.82	−20.45[d]

Note: Zone numbers are as shown in Figure 3.3.

n.a. = No units in sample with these characteristics.

[a]Constant term denotes unit built pre-1939, on less than .2 acre lot when all dummy variables zero.

[b]Constant term denotes rental unit built 1961–65 when all dummy variables zero.

[c]Coefficient significant at .5 level.

[d]*t*-ratio on coefficient greater than one.

TABLE 3.9
PRICE OF SOUND UNITS IN SELECTED GHETTO AND CENTRAL-CITY SUBMARKETS
[dollars]

			Adjacent White Submarkets			Adjacent White Suburbs	
Independent Variable (Zone Number)	Oakland Ghetto: Area A (1)	Mixed-Racial Area Adjacent to Ghetto (2)	Toward Center of Oakland (3)	Away from Center of Oakland (4)	Oakland Ghetto: Area B (5)	Alameda (6)	Central Oakland (7)
A. 5.5-Room Owner Unit							
Pre-1940, <.2 acre lot	17,818	17,136	18,546	19,042	20,776	19,571	21,930
1940–49, <.2 acre lot	(18,542)	20,237	21,896	21,914	21,878	21,124	23,372
1950–59, <.2 acre lot	(17,128)	29,240	27,507	28,695	29,839	28,294	23,221
1960–65, <.2 acre lot	n.a.	43,853	35,130	31,010	33,338	31,133	23,955
Pre-1940, .2–.3 acre	21,729	19,637	24,434	27,448	27,525	31,721	29,106
Pre-1940, .3–.5 acre	34,633	28,741	18,738	22,767	56,713	33,586	30,205
B. 4-Room Rental Unit							
Pre-1940	76.97	76.36	86.33	68.74	70.49	82.19	92.68
1940–49	(100.90)	87.05	77.45	97.17	81.72	106.50	96.80
1950–59	74.70	98.34	104.02	95.92	84.43	117.32	146.38
1960–65	92.35	108.23	118.43	120.30	103.34	140.75	148.97

Independent Variable (Zone Number)	Adjacent White Suburbs: Oakland Suburb (8)	Adjacent White Suburbs: Berkeley (9)	Adjacent White Suburbs: Berkeley (10)	Central San Francisco Ghetto (11)	Adjacent Suburb to East: Contiguous to CBD (12)	Adjacent Suburb to South: Away from CBD (13)	Adjacent Suburb to West: Away from CBD (14)
A. 5.5-Room Owner Unit							
Pre-1940, <.2 acre lot	25,362	24,072	26,176	34,671	21,028	29,552	33,303
1940–49, <.2 acre lot	25,761	25,192	25,272	n.a.	24,089	(28,847)	(29,361)
1950–59, <.2 acre lot	34,872	33,208	37,133	n.a.	30,568	(24,572)	35,017
1960–65, <.2 acre lot	29,063	47,315	50,064	n.a.	31,818	42,126	39,504
Pre-1940, .2–.3 acre	31,877	32,836	36,231	n.a.	25,643	n.a.	36,263
Pre-1940, .3–.5 acre	32,018	28,743	36,738	n.a.	(15,067)	(37,757)	77,825
B. 4-Room Rental Unit							
Pre-1940	113.07	99.29	103.84	(135.97)	(105.86)	(139.34)	107.44
1940–49	82.13	119.38	115.28	(140.77)	(138.74)	(106.36)	122.16
1950–59	112.99	115.04	138.22	152.91	138.29	(146.34)	130.15
1960–65	186.55	125.79	155.20	165.97	168.30	151.60	154.66

Notes: Zone numbers are as shown in Figure 3.3.
n.a. = No units with these characteristics in the sample.
Parentheses around a price denote estimate based on coefficients in hedonic price index with *t*-ratios less than one.

the south of the central business district of Alameda-Oakland, prices of the oldest units on the smallest lots (less than .3 acre) are about 10 to 20 percent below prices of comparable units in the adjacent white submarket. There are no single-family units built since 1960 in the sample. However, among units built before 1960, there are no statistically significant effects of structure age on prices. Most units in this zone were built before 1950. Since the sample includes only three units built in 1950–59, the estimated premium for units built in the 1950s may be unreliable. However, the absence of a premium for units built in the 1940s over older units is surely significant and a striking contrast to adjacent white submarkets where age premiums are evident. These results suggest that all units, regardless of age, command very depressed prices in this ghetto, the poorest zone within the Bay Area (the average owner-occupant income is $7,748, the lowest of any zone of comparable size in the Bay Area sample). A large and statistically significant premium exists for lots of above average size in this area, though again the sample is small. A lot .3–.5 acre bears a premium of $16,815 over a lot less than .2 acre, holding size of the housing, age, and quality constant. (In adjacent white submarkets the figure is $3,725.)

A somewhat different price pattern is evident in the large adjacent racially mixed area. While prices of the oldest single-family units on the smallest lots again exhibit prices below adjacent white submarkets, newer units bear very substantial premiums. In this case, the sample of 179 units includes several units in the newest age class. A 5.5-room single-family unit built since 1960 on a lot less than .2 acre costs $43,853 in this mixed-racial area; in contiguous white submarkets in Alameda and Oakland such a unit is priced between $31,000 and $35,000. Large-lot premiums are also substantial: $9,605 more for a lot .3–.5 acre than for a lot less than .2 acre.

In the other principal ghetto area in Oakland, a price pattern emerges for single-family units much like that in the mixed-racial area. Prices of the oldest units are about 10 percent below prices in surrounding white areas, but much higher premiums exist for newer units and larger lots in the ghetto than in the surrounding white submarkets. The price of a unit built since 1960 is $33,333 in the ghetto, as against a range of $23,000 to $31,000 in surrounding central white submarkets (but it is below the $47,000–$50,000 level prevailing in adjacent Berkeley). Lot-size premiums also appear to be dramatically higher in this ghetto area. The price premium for a .3 to .5 acre lot versus a lot less than .2 acre is estimated to be $35,937, again a statistically significant result but based on only two units in the sample with a large lot.

In the smaller black ghetto near downtown San Francisco, the only single-family units available were built before 1940 on the smallest-size lots; these units have prices roughly comparable with similar units in nearby white submarkets.

Rental prices in these three main black submarkets exhibit a different pattern. Rents tend to be lower in the black submarkets than in adjacent white submarkets across every age class of rental unit, with the biggest differences occurring among newer rental units. The fact that newer rental units do not command as high a percentage premium over older rental units in the ghettoes as that which prevails in the white submarket suggests either that newer rental units are not in scarce supply in the black submarkets or that black households' tastes differ from whites in this regard, with black households willing to pay only a lesser premium for newer rental units.

This discussion of housing prices confronting blacks has focused primarily on prices in black submarkets relative to nearby white submarkets. Much of the previous literature has addressed a different question; namely, the price markup that blacks face when they buy into white submarkets. Several of these studies are described below. As noted there, it is difficult to measure the extent of the price markup which black households pay in suburban white submarkets. An attempt to do so was made by including a race dummy in the price equation estimated for each white submarket. The race variables were generally insignificant in equations for prices in the mixed-racial areas. However, in white submarkets, the race variable was often significant, and generally assumed a negative value, indicating that the price of houses occupied by black households was below that of "comparable" housing for whites. However, it seems unlikely that the race dummy reflects reverse discrimination. It is more likely that the race dummy is correlated to quality effects which are not included in the equation (a plausible conclusion, given that the incomes of black occupants in white submarkets are below the incomes for whites in most such submarkets). The qualitative evidence describing the nature of housing-market discrimination makes a convincing case for the existence of markups, which could be demonstrated if proper standardization for quality could be achieved.

Leaving this measurement problem aside, the main thrust of this research is that the major consequence of discrimination for blacks is the high prices faced by the majority of black households who must compete for the available housing in ghetto submarkets. It is this concentration of black households in a small portion of the entire urban housing market that causes black households to pay high prices for low-quality housing. Any price disadvantage facing black households who have gained access to the white submarket vis-à-vis their white neighbors is probably small. The important differences in prices associated with the existence of racial discrimination therefore arise *across* geographic and racial submarket boundaries. It is necessary to make comparisons across neighborhoods to ascertain the effects of discrimination.

These comparisons of housing prices must be made across neighborhoods in which income, race, and neighborhood quality differ. These differences raise difficult problems in interpretation. The most intractable problem is standardization for neighborhood characteristics. Housing quality must be defined in terms of both dwelling units and neighborhood characteristics. The price comparisons discussed above are based on a standardization for dwelling unit quality but neglect any neighborhood effects. Thus, while the estimated prices for a given quality unit in the ghetto are generally below prices for "comparable" units in white submarkets, it is inappropriate to conclude that blacks face more favorable prices, since the neighborhoods involved are most likely not comparable.

The effects of differences in incomes also must be considered in interpreting price differences by race. Households of different income levels spend different proportions of their income on housing, and households with the same income and tastes may spend different amounts on the same house type situated in different neighborhoods. In comparisons of housing prices by race, black households living in the ghetto are significantly poorer than whites.

One means of standardizing for income is to compare price-income ratios for each dwelling unit type in the black and white submarkets. Price-income ratios might differ by dwelling unit type, income of inhabitants, or neighborhood. Any differences attributable to race are a simple summary of the joint effects of differences in neighborhood quality between the black and white submarkets *and* supply rationing on prices. The latter tends to crowd middle-income black households into low-quality housing.

A comparison of price-income ratios by dwelling unit type reveals that price-income ratios are higher in the black submarket. Price-income ratios by housing type are shown in Table 3.10 for submarkets classified as ghetto, mixed racial, or white. The white submarket classification is, of course, an aggregation of the entire Bay Area market not classified as ghetto or mixed racial. Among single-family structures, newer houses on larger lots exhibit the highest ratios. There are no appreciable differences for rental units in different age structures. This suggests that competition among black households for the highest-quality owner units, which are in scarce supply, drives up prices. (An alternative view of the same effect is that of comparing the quantity of housing consumed by black and white households of equal incomes and tastes. These comparisons, in Chapter 5, reveal that black households consume less housing.)

Based on this standardization for dwelling unit type, prices for housing occupied by blacks in the ghetto must be reduced 10 to 25 percent if prices and incomes inside and outside the ghetto are to bear the same relationship. If ghetto neighborhoods are judged inferior to white submarkets, an additional price reduction would be necessary in order to achieve "equal prices for equal housing and neighborhood services." Of course, the task of public policy is not to achieve equality

TABLE 3.10
PRICE/OCCUPANT-INCOME RATIOS BY RACIAL SUBMARKET CLASSIFICATION

Structure Characteristics	Ghetto	Mixed Racial	White
		A. Owner Units	
5.5-rooms on .2-.3 acre lot			
Built since 1960	3.02	2.94	2.20
Built 1950-59	2.75	2.70	2.21
Built 1940-49	2.65	2.63	2.32
Built pre-1940	2.63	2.62	2.47
5.5-room unit, built pre-1940			
Lot less than .2 acre	2.71	2.65	2.50
Lot .3 to .5 acre	3.05	2.94	2.41
		B. Rental Units	
4-room apartment, in sound condition:			
Built since 1960	.0154	.0149	.0130
Built 1950-60	.0155	.0150	.0132
Built 1940-50	.0148	.0148	.0135
Built pre-1940	.0150	.0144	.0141

Source: Based on hedonic price indexes estimated for each submarket. Prices of individual units were related to structure characteristics for each submarket.

in these price-income ratios between the black and white submarket, since this will probably result in many black households consuming less housing than they would perfer. Rather, the objective should be to provide access by black households to the entire urban housing maket. Open housing would tend to eliminate any racial differences in price-income ratios by permitting many black households to acquire better-quality housing at more favorable prices.

6. SOME REMARKS ON AGGREGATION AND MISSPECIFICATION: A POSTSCRIPT ON PREVIOUS EMPIRICAL STUDIES

The model outlined in this book suggests a different interpretation of the existing empirical literature on urban housing prices. Several empirical studies have related housing prices by location to the type or quality of the housing stock and the socioeconomic characteristics of the neighborhood. Early attention was devoted to the shape of rent surfaces as related to the center of the city; more recently it has been recognized that the nature of the housing stock and the income level of residents are likely to be more important determinants of housing prices or rents.[21]

Several methodological problems must be addressed in interpreting this type of empirical analysis. First, the very considerable variation in the characteristics of the bundle of housing services must be incorporated in the explanation for prices. When the data is available, multivariate regression techniques are well suited to this task. Two studies using individual household interview data stand out in this regard. King and Mieszkowski collected rental data on 220 units in New Haven, Connecticut, along with data on many variables describing the nature of the apartment and structure. Rents were regressed on these quality characteristics, on other variables describing the terms of the lease, and on race. Many of the variables describing the quality characteristics proved significant, as did the racial coefficient. The race coefficient revealed that black household residents pay 11 percent more than comparable whites, and that black households residing in the city for less than two years pay 5.7 percent more than other black families.[22]

21. Ronald Ridker and John Henning, "The Determinants of Residential Property Values with Special Reference to Air Pollution," *Review of Economics and Statistics* (May 1967), pp. 246–57; Paul F. Wendt and William Goldner, "Land Values and the Dynamics of Residential Location," in *Essays in Urban Land Economics* (Berkeley and Los Angeles: University of California, 1966); Edwin S. Mills, "Value of Urban Land," pp. 231-53; Muth, *Cities and Housing*; Eugene F. Brigham, "The Determinants of Residential Land Values," *Land Economics* (November 1965), pp. 325-34. John Kain and John Quigley, "Measuring the Value of Housing Quality," *Journal of the American Statistical Association* (June 1970), pp. 532-48; John Kain and John Quigley, "Evaluating the Quality of the Residential Environment," *Environment and Planning* (January 1970), pp. 23-32.
22. Thomas King and Peter Mieszkowski, "Racial Discrimination, Segregation, and the Price of Housing," *Journal of Political Economy* (May/June 1973), pp. 590-606.

Kain and Quigley have utilized a much larger and richer sample from St. Louis, roughly fifteen hundred observations on individual house rents or value and many detailed characteristics of the type of structure, its condition, and the nature of the surrounding neighborhood. This sample permitted a very detailed specification of quality differences across individual housing observations. Principal components were used to reduce the thirty-nine variables describing structure and neighborhood quality to five orthogonal indexes. Regressions for rent were then estimated, using as independent variables these principal components and a set of other variables describing the size, type, and age of the structure; the terms of the lease; and selected socioeconomic characteristics of the tract, including race. When data were pooled for the entire city, the race coefficient proved to be significant, implying that holding quality constant, a unit would rent for 8 percent more if located in an all-black area than if situated in an all-white one. For owner units, the price differential was estimated at 5 percent.[23] Subsequent regression analysis with these same data, stratifying observations into two submarkets—the ghetto and the rest of the central city—revealed the fits to be different. Using the coefficients to estimate the value of a unit of comparable quality in the ghetto versus the rest of the central city revealed significant price differences, with black households in the ghetto facing higher prices.[24]

While progress has been made in dealing with the problems of standardizing for housing quality, other serious specification problems are to be found throughout the empirical literature. Most of these center around excessive aggregation. Many studies have been based on data in which the dependent variable reflects an average of prices or rents for many types of housing.[25] Census-tract data on median house price or median occupant income for the dependent variable are typical examples. The problems in specification introduced by aggregating micro

23. Kain and Quigley, "Housing Quality"; Kain and Quigley, "Quality of Residential Environment."
24. John F. Kain and John M. Quigley, *Housing Markets and Racial Discrimination: A Microeconomic Analysis* (New York: NBER, 1975), Chap. 8. The principal problem in interpreting these results is in the interpretation of the coefficients for the five quality indexes defined by the principal components. As with all principal components analysis, the interpretation of the numerical values assumed by the principal components must be based on the factor loadings of the original variables. In this case, many of the original measures of dwelling unit or neighborhood quality were ordinal indexes; the definition of the principal components will not be invariant to ordinal transformation of the original data.
25. Ridker and Henning, "Determinants of Residential Property Values."

relationships hardly need elaboration. As noted in section 4, the gradients for average housing prices or occupant incomes are very different from prices for particular types of housing. The estimation described above also suggests that age and lot-size effects are not linear; use of such variables as average age in continuous form in equations to estimate prices is likely to provide only a first—and often crude—approximation.

In some cases, researchers have combined owner and rental units, postulating a common multiplier relating owner-occupied housing prices and monthly rentals.[26] This technique requires very strong assumptions about the underlying structure of rents and prices, which are so unlikely to be met that the procedure must inevitably be viewed with suspicion. The estimates above reveal that there is substantial variation in the ratio of owner-occupied prices to rents across housing types and geographic submarkets. Use of an "average" ratio to pool data across tenure classes introduces a variety of biases into the estimation.

Perhaps the most common error of aggregation arises as a consequence of pooling over many submarkets when the underlying parameters differ by submarket. (Interaction terms between quality and neighborhood characteristics or location have not been included in these studies.) Pooling data over a wide geographic area implies that a single underlying price structure exists; i.e., that the price premium for quality attributes is invariant across locations. As has been noted, the assumptions required in order to justify pooling data across wide geographic submarkets are very strict and are not likely to be satisfied. Where neighborhood or submarket boundaries are distinct and sharply drawn, a huge within-sample variation in prices is not taken into account by such studies. More recent regression studies of housing prices which have been based on individual household data avoid the misspecification which is likely to arise when the dependent variable is an aggregation across housing types, but such studies still make a specification error by aggregating across geographic submarkets. The size of the bias associated with such a procedure will depend on the true underlying structure of prices across markets.[27]

Many of the attempts to estimate the effects of race on housing prices involve only a slight variant of this problem. Typically, a household race dummy is included in a regression equation for prices based on

26. Muth, *Cities and Housing,* Chap. 8.
27. Assuming linear equations which differ across submarkets, the estimated coefficient for any independent variable in an equation which pools data will be a linear sum of the true coefficients in the individual submarkets, with the weights dependent on the sizes of the samples drawn from each submarket and the values of the independent variables in each submarket.

data drawn from a broad geographic area. The basic problem remains; i.e. the quality premiums represented by the other independent variables in the equation for prices may *also* differ for whites and blacks. This is especially likely to occur when the majority of black households are purchasing in a single ghetto submarket whose housing-stock characteristics are not representative of the total area from which the sample is drawn. In the case of San Francisco, the relationship between demand and housing supplies has resulted in a very different structure of prices in the ghetto than in nearby white submarkets.

The several attempts to estimate racial effects on prices have generally pooled data across a wide geographic area and found the race coefficient to be positive. Ridker and Henning related median housing value by tract in St. Louis in 1960 to structure age and location, income and other neighborhood characteristics, and percent nonwhite. They find prices $1,775 higher in a neighborhood of all-black occupancy than in a comparable neighborhood which is all white.[28] Muth analyzed Census-tract data for the South Side of Chicago. He fitted regressions for expenditures per household (the figure being a weighted average of rents and owner-occupant housing values in each tract), using as independent variables housing-stock characteristics, location and access dummies, and race. Muth found average housing expenditure about 30 percent higher in black areas.[29] As noted, King and Mieszkowski's analysis of rents in New Haven, Connecticut, revealed a significant positive effect of race on prices.

However, the positive race coefficient for black households or black submarkets in these studies reflects not only the differences in underlying price structures but also the differences in the types of housing available to blacks and whites and in the submarkets in which each are residing. For example, if rent gradients for housing of a given quality tend to decline, if blacks tend to be concentrated in more central locations and excluded from the suburbs, and if lower-quality housing is concentrated in the core, then a regression explaining prices pooling data across all markets will yield a positive race dummy. This case is depicted in Figure 3.9, in which prices are related to housing quality in three submarkets ("geographic" and "quality" abstractions being used for purposes of illustration). In general, using pooled data and a single race dummy provides little insight into the differences between prices for comparable housing confronting blacks and whites in different markets. It may well be that blacks face prices for low-quality units in the ghettos which are below the prices which whites pay for central-city housing of like

28. Ridker and Henning, "Determinants of Residential Property Values."
29. Muth, *Cities and Housing*, pp. 215-40.

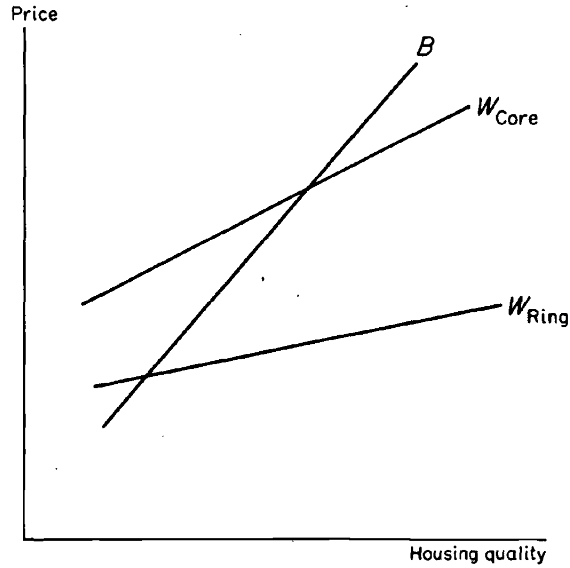

FIGURE 3.9
PRICES IN GHETTO AND WHITE SUBMARKETS AND AGGREGATION BIAS

quality, while the prices for higher-quality ghetto units are substantially above the prices that whites pay for comparable units in suburban markets. This is the nature of the Bay Area market.

More elaborate attempts to incorporate neighborhood or submarket differences in the estimation of housing prices may, by including such variables as crime, school quality, the racial mix, accessibility to employment, or distance to the CBD in the equation, reduce some of the across-submarket variation in prices and hence increase the percentage of the variance in housing prices explained by the regression. However, it is likely that these variables will affect not just the intercept terms but will also affect the coefficients of the several quality indexes describing the individual unit; location rents or other characteristics of prices unique to any given submarket are unlikely to appear only in the intercept term or in the coefficient for such variables as "distance to the CBD." If the true structural coefficients for the several quality indexes vary across submarkets, there is no substitute for stratifying the data before estimation, or otherwise allowing these particular coefficients to vary across submarkets.

By making explicit assumptions about the underlying form of the price equations, the biases associated with several kinds of aggregation problems can be determined. These problems might be better illustrated by showing their empirical magnitude in the case of San Francisco. Data for several broad geographic areas in the Bay Area were pooled and price equations estimated. This provides a means of comparing results after pooling with the results obtained when individual submarkets are properly treated separately. (For reasons noted below, only housing-stock characteristics were included in the equations.) The results are shown in Table 3.11, which compares the results of the fit using the pooled sample to results obtained when each submarket is treated separately. F tests reveal the equations to be separate. (Similar results are obtained for rental units and for suburban submarkets.) Aggregation improves the t-ratios on coefficients, but the coefficients for the aggregated data tell nothing about the spatial variation in the true underlying coefficients.

The final specification error which appears in the existing literature arises from the inclusion of income and other socioeconomic characteristics of the neighborhood in the equation to explain prices. This introduces questions of causation. As has been indicated in Chapter 2, income and prices are jointly determined, and hence the probable existence of a simultaneous equation bias must be faced. The determination of prices involves not only the demand side of the bidding process, higher-income households bidding up the price in certain submarkets, but also the rationing effect of prevailing prices in allocating households to submarkets by household income level. The coefficient of income in an ordinary least squares regression with housing prices as the dependent variable reflects both of these effects.

In Chapter 6, a simple model of housing price determination which treats income and prices as endogenous is presented. Exogenous variables include neighborhood accessibility, housing-stock characteristics and availability, and race. The differences in estimates using this specification rather than simple ordinary least squares estimates are shown in Table 3.12, which compares alternative equations explaining the price of a standardized owner-occupied unit (5.5 rooms, built since 1960, on .2 to .3 acre). Equations 1 through 3 include several measures of housing-stock characteristics and race, but exclude income. A huge negative race coefficient results. Equations 4 and 5 include income, which proves highly significant, and the race coefficients change dramatically. Equation 6 is the specification used in the structural model of Chapter 6, including race, employment access, and housing-supply availability as exogenous, and treating income as endogenous. Equation 6 is estimated by two-stage

TABLE 3.11
COMPARISON OF COEFFICIENTS OF HEDONIC PRICE INDEXES FOR OWNER-OCCUPIED STRUCTURES UNDER ALTERNATIVE LEVELS OF GEOGRAPHIC AGGREGATION
[*t*-ratio in parentheses]

Independent Variable	City of San Francisco			Suburbs to South of San Francisco			Central Oakland, Alameda and Berkeley		
	Entire Central City[a]	Zone A[b]	Zone B[b]	Entire Suburban Area[c]	Zone A[b]	Zone B[b]	Entire Central City[d]	Zone A[b]	Zone B[b]
Constant[e]	21,850	15,140	36,851	11,450	12,790	21,900	21,780	8,919	40,510
	(5.85)	(2.57)	(3.42)	(7.14)	(3.12)	(5.81)	(13.75)	(1.98)	(3.95)
Rooms	3,841	4,906	4,401	4,044	1.934	3,981	3,132	4,025	2,570
	(17.04)	(9.44)	(8.05)	(21.62)	(3.68)	(8.94)	(24.18)	(7.58)	(4.33)
Structure age dummies									
Pre-1940	−8,349	−8,255	−21,027	−2,731	−7,496	−14,669	−11,692	−8,366	−22,014
	(4.28)	(2.74)	(2.33)	(3.29)	(3.68)	(7.78)	(10.03)	(3.51)	(2.72)
1940–49	−9,102	−9,271	−18,209	−3,423	−3,151	−13,818	−8,387	−4,093	−19,306
	(4.45)	(2.88)	(2.05)	(4.37)	(2.37)	(6.17)	(6.57)	(1.74)	(2.14)
1950–59	−4,831	−2,974	−15,151	−2,576	−1,701	−9,649	53	274	−8,520
	(2.19)	(.88)	(2.19)	(3.77)	(1.67)	(5.06)	(.04)	(.11)	(.87)

Lot-size dummies									
Less than .2 acre	−3,751	−1,911	−13,366	−6,142	2,083	−3.163	−6,671	−4,533	−6,381
	(1.29)	(.47)	(2.04)	(7.10)	(1.01)	(1.71)	(7.52)	(2.03)	(1.96)
.3–.5 acre	9,133	9,877	30,505	1,972	1,358	3,063	294	−3,310	4,770
	(1.66)	(2.44)	(1.42)	(1.31)	(.84)	(1.95)	(.19)	(.99)	(1.60)
Greater than .5 acre	1,158	8,104	n.a.	16,280	18,321	10,051	10,263	4,354	18,331
	(.24)	(2.00)		(11.97)	(4.60)	(3.09)	(6.26)	(1.33)	(1.82)
Unsound condition dummy	−6,502	−9,074	17,821	−2,100	−3,826	n.a.	−5,155	−3,814	−7,812
	(4.24)	(3.96)	(1.05)	(.81)	(1.84)		(7.66)	(1.76)	(1.75)
Sample size	897	260	82	1,487	203	201	1,743	112	90
R^2	.3038	.3593	.5422	.5059	.2350	.5774	.4762	.6467	.4204
Standard error of estimate	11,400	11,400	10,480	8,867	5,878	8,756	9,979	6,550	14,170
Test for reduction in sum of squared errors due to geographic stratification		F(99,877) = 24.20			F(54,1417) = 12.05			F(126,1593) = 30.89	

[a] Pooling 12 zones.

[b] Two individual submarkets within the pooled sample area selected to illustrate the extremes of the equations.

[c] Pooling 7 zones.

[d] Pooling 15 zones.

[e] Defines price of house built since 1960, on .2–.3 acre lot, in sound condition, with zero room. Number of rooms enters equation in continuous form.

TABLE 3.12
SIMULTANEOUS-EQUATION BIAS WHEN INCLUDING INCOME IN HEDONIC PRICE EQUATIONS
[*t*-ratio in parentheses]

Method of Estimation	Independent Variables								
	LT	*AG*	*EA*	*OWN*	*S6*	*Y6*	*R1*	*R2*	R^2
A. Omission of income									
(1) OLS		1,546	−186.9				−8,072	−12,100	.5134
		(7.37)	(1.40)				(1.95)	(2.09)	
(2) OLS	−1,435	1,545	−175.4				−12,110	−11,540	.5155
	(.11)	(7.32)	(1.03)				(2.08)	(2.34)	
(3) OLS	−1,630	924	−67.8	−288.4	−70.37		8,474	13,790	.5908
	(.13)	(2.65)	(.41)	(3.66)	(.51)		(2.15)	(2.50)	
B. Income included									
(4) OLS	−4,801	1,028	−103.3			1.006	−1180	−1,929	.6539
	(.43)	(5.01)	(.71)			(5.44)	(.31)	(.36)	
(5) OLS	−4,457	657	−36.0	−210.0	−40.9	.8814	−2,292	−4,472	.6918
	(.41)	(2.12)	(.25)	(2.97)	(.34)	(4.85)	(.62)	(.86)	
C. Structural model with income endogenous									
(6) 2SLS			−10.30	−213.4	−365.8	1.076	−34	−384	.6516
			(.08)	(2.62)	(2.50)	(2.35)	(.81)	(1.05)	

Note: OLS: Ordinary least squares.
2SLS: Two-stage least squares.

least squares in order to obtain a consistent estimate. The estimated income coefficient is significantly larger than in either Equation 4 or Equation 5, reflecting the simultaneous-equation bias.

7. SUMMARY

This chapter reveals that the urban housing market in the San Francisco Bay Area is highly compartmentalized. The processes of metropolitan development typically produce large variations in the supply of housing with particular attributes at different locations. Since supply changes occur more slowly than demand changes, prices vary substantially across geographic submarkets. Because racial discrimination sharply limits access to the suburbs by black households and creates barriers between white and black submarkets, demand and supply conditions are often very different in the two types of submarket. Prices vary substantially across racial submarket boundaries as well. The next two chapters estimate the effects of this spatial variation in housing prices on the consumption of housing by white and black households.