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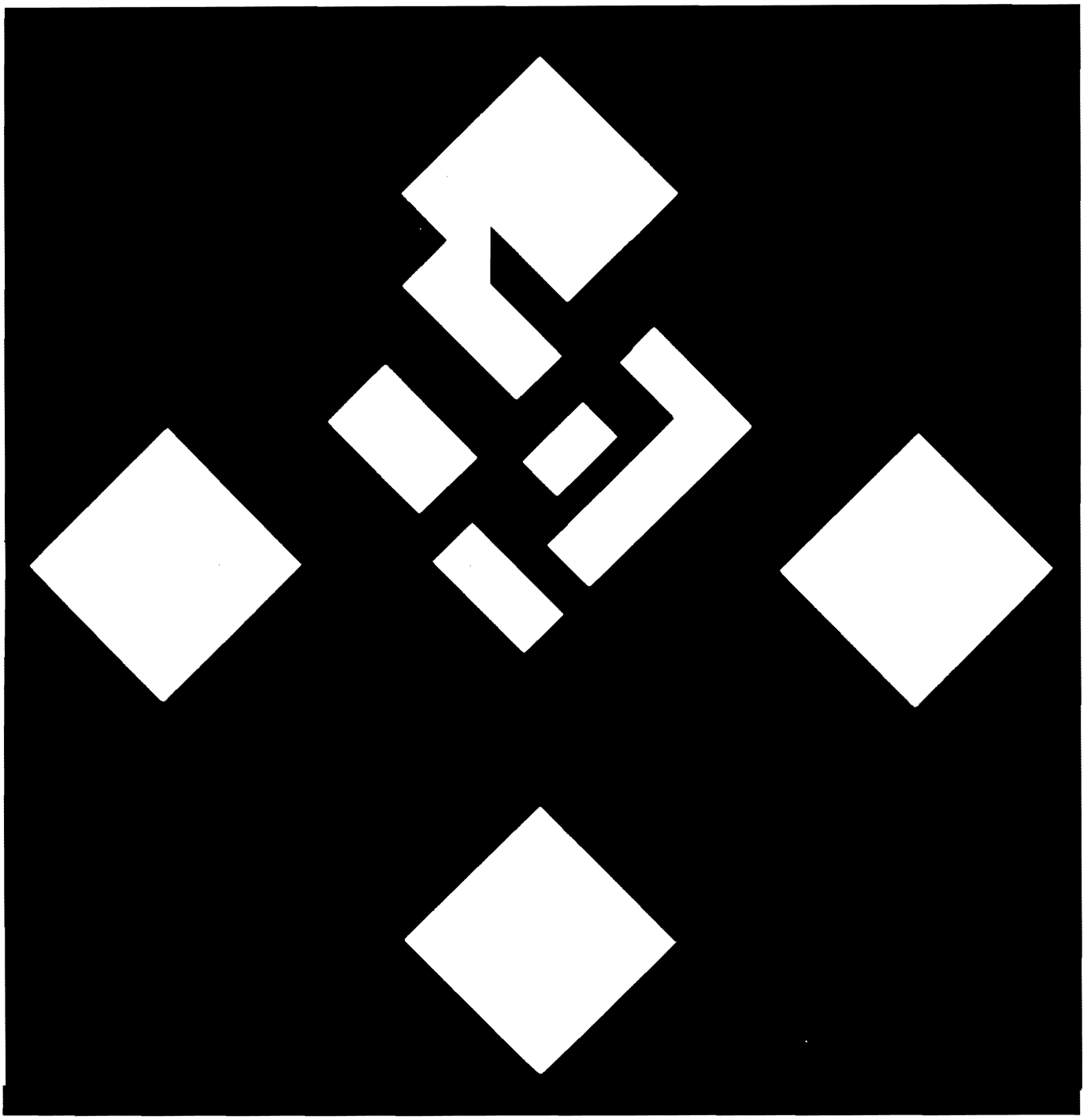

NATIONAL HOUSING NEEDS AND QUALITY CHANGES DURING THE 1980s

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Data from the Annual Housing Surveys are available in joint HUD-Census publications, the Current Housing Reports series. The national data are published in Series H-150, comprising six reports, and the metropolitan data are published in Series H-170, with a separate report for each metropolitan area. Series H-171 is a supplementary summary report on the metropolitan areas surveyed each year. The published reports may be obtained from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. These reports are also available in microfiche form from the Library, Bureau of the Census, Washington, D.C. 20233.

Micro data containing the responses of individual households are available on public use computer tapes from the Center for Social Sciences, Columbia University, 420 W. 118th Street, New York, N.Y. 10027.

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PREFACE

This paper, the tenth in our series of Annual Housing Survey (AHS) studies, demonstrates how AHS data on a variety of metropolitan areas can be useful not only for monitoring and interpreting current developments in housing, neighborhood, and household characteristics, but also for helping to forecast future housing needs.

The Department of Housing and Urban Development has funded a national housing survey, performed by the Bureau of the Census, since 1973, with separate surveys for 60 metropolitan areas included since 1974. The survey provides current information on the size and composition of the housing inventory, characteristics of its occupants, changes in the inventory resulting from new construction and from losses, indicators of housing and neighborhood quality, and characteristics and dynamics of urban housing markets for the Nation and four census regions. Every third or fourth year, these data are also gathered for most of the largest metropolitan areas and for some smaller, fast-growing metropolitan areas.

The Annual Housing Survey is designed to help planners, policymakers and scholars understand and analyze changes in the housing inventory and its costs and changes in housing needs and demand. Longitudinal linkage of the annual national file provides unparalleled opportunities to study market processes and household mobility. The metropolitan surveys provide greater detail on the housing and population characteristics of suburbs and cities in 60 metropolitan areas, with longitudinal linkages now also available.

Such data on past change are essential for understanding possible future trends. In seeking to ensure the availability of decent and affordable housing for all persons, for example, there is continuing need for current and comprehensive projections of future housing consumption, by size, structure type, and tenure. Although exact forecasts of housing consumption are impossible, HUD's responsibilities for monitoring housing needs and inventory and evaluating policy responses require information on the future implications of current trends, should they continue, as well as on the effects of possible changes.

This report, by John Weicher, Lorene Yap and Mary Jones of the Urban Institute, attempts to forecast the major components of the national "need" for new construction during the 1980s by analytically relating past changes in the housing inventory to housing market factors such as income and demographic changes. Based on these analytic relationships, they forecast the national demand for new construction over the decade to meet expected growth in the number of households and to replace units that will be lost from the housing inventory. The forecast is disaggregated by regions and by areas within and outside of metropolitan areas, and includes an assessment of probable trends in tenure and structure type in metropolitan areas.

ACKNOWLEDGEMENTS

This research project has benefited from the participation of an Advisory Panel of specialists in housing. The members of the panel have individually provided valuable suggestions about the design and implementation of the research. They have not, however, had the opportunity to read this final report before submission to HUD, though they have read earlier versions, and should not be held responsible for any of its findings or interpretations.

The members of the Advisory Panel are: Martin Levine, Congressional Budget Office; John Quigley, Yale University; Henry Schechter, AFL-CIO; Morton Schussheim, Congressional Research Service; and Craig Swan, University of Minnesota.

The Government Technical Monitor for this project is Duane McGough, Director of the Division of Housing and Demographic Analysis in the Office of Economic Affairs at HUD. He has also provided helpful suggestions in the development of the project, but is not responsible for the findings or interpretations. The authors of this paper are members of The Urban Institute Housing and Communities Division. They have received helpful comments from Morton L. Isler, Director of the Division, and John L. Goodman, Jr. In addition, Mr. Isler helped to formulate the research design.

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SUMMARY

This report presents forecasts of the national "need" for new housing construction during the 1980s. Following previous studies, we divide "needs" into two components, which are analyzed and forecast separately:

- We forecast the national demand for new construction over the decade to meet expected growth in the number of households and to replace units that will be lost from the housing inventory. The forecast is disaggregated by regions and by areas within and outside of metropolitan areas, and includes an assessment of probable trends in tenure and structure type in metropolitan areas.

- We project the extent of substandard housing in 1990, based on housing market conditions that we anticipate will exist in the 1980s, and on government policies and programs to subsidize housing production for low-income families.

Since the work of the Kaiser Commission in 1967, most studies of "need" have included both of these categories, but the "needs" which they satisfy are in fact rather different. The first category corresponds fairly closely to the economic notion of "demand." These units are desired by households which have the economic ability to pay for them, generally speaking. But the "need" to eliminate substandard housing exists precisely because the households are unable to occupy better housing. Policy-makers have commonly regarded the construction of new housing for additional households as the province of the private sector, and the replacement of substandard units as the responsibility of the government, and have formulated policies to meet each need separately. However, there are interrelationships between the two which imply that neither need can be fulfilled without affecting the other. Subsidized housing may well substitute for unsubsidized, by competing for the same productive resources; and unsubsidized housing may increase the total stock of housing, and generate a "filtering" process which gradually brings higher quality units within the economic reach of lower income households. Our analysis sheds some light on the second of these interrelationships, but not the first.

Because of the interrelationships, we do not believe that it is appropriate to add the two categories together to arrive at a single national total "need." Instead, we analyze each separately, and offer separate forecasts, though we are able to use our forecast of private housing demand in the estimate of substandard housing.

In projecting the demand for new construction to meet household formation and replace lost units, we use two different forecasting methods.

The "traditional" approach estimates the components of additional demand on the assumption that past experience will be repeated in the future. This has been the basic procedure of previous studies of need. The "analytical" method attempts to forecast the components by relating past experience to housing market factors, such as income and demographic changes, then projecting the market factors to 1990, and finally calculating the expected amount of each component from the projection. It assumes that past housing market relationships will prevail over the future.

The difference between the two methods may be illustrated by an example. The annual loss rate from the existing housing inventory for metropolitan areas was 0.89 percent during the early 1970s, and 1.04 percent during the 1960s. A traditional forecast might use either number. Our analytical method begins with a statistical study of rates across metropolitan areas during the early 1970s, using multiple regression analysis. This study shows that the loss rate varied with income, the growth in the number of households, the growth of minority households, and the rate of private housing construction. In making our forecast, we assume that the loss rate in the 1980s will continue to depend on these factors, in the same way as in the early 1970s, but that income, overall growth, and minority growth change in what appear to be reasonable ways. Based on these assumptions, we project a loss rate of 0.72 to 0.88 percent annually.

Using the traditional method, we forecast a demand for additional housing of from 2.24 to 2.89 million units annually. This range is derived from alternative Census projections of household formations during the 1980s. The most plausible projection on present information results in a forecast of 2.67 million units per year. This is based on the Census Bureau's "Series B" household formation projections, which assume that recent trends in formations for different age cohorts of the population will continue into the future. In particular, Series B implies that married couples will continue to decline as a share of total households in each age group. (Table 2 in Chapter II presents the full range of traditional forecasts.)

Compared to the distribution of households now, the demand for new units will be concentrated in the South and West, and will occur in places which are now outside the boundaries of Standard Metropolitan Statistical Areas, although we expect that much will be in counties and other places contiguous to the present boundaries of SMSAs.

The forecasts are particularly sensitive to the assumptions about loss rates, and conversions and mergers. The national forecast changes by 150,000 units annually, depending on whether the loss rate from the 1970s or 1960s is used, and by an additional 300,000 annually depending

on the rate of conversions, mergers, and housing units added to the inventory from non-housing sources. The forecasts are lower if the 1970s' experience is used, rather than the 1960s'.

The sensitivity of these forecasts demonstrates the value of more precise methods of projecting losses and conversions in particular. This is the goal of our analytical method. It appears to be reasonably successful in analyzing and forecasting loss rates; the factors which affect losses are ones which knowledge of the housing market suggests would be important, and the forecasts of the future yield plausible numbers. The major results of this analysis have previously been described. We use these results, in combination with projections of demographic changes and income growth during the 1980s, to forecast loss rates for the next decade. We must forecast new construction and losses simultaneously, because each depends on the other; not only are losses higher in areas with high rates of new private housing construction, as shown in our statistical analysis, but the replacement of units lost from the inventory is an important component of the demand for new construction.

The analytical method proves to be much less useful with respect to the category combining conversions, mergers, and units from other sources. We believe that this occurs because of problems with the data for this small category of housing inventory change. We use the results of both the analytical and traditional methodologies to forecast mergers, but because of the data problems we prefer the traditional approach.

The other major components of inventory change--the demand from new household formation, and changes in vacancies--are also taken from our traditional forecasts. The former is by far the more important, but forecasting household formations is a complicated task by itself, and would require far more time and resources than we have been able to devote to this project. We use Census Bureau household formations in our analysis, as do most other forecasts of need and demand.

Our analytical methodology results in a wide range of demand forecasts, primarily because the Census Bureau household projections cover a similarly broad spectrum. For any given household projection, however, our analytical forecasts are slightly lower than the traditional ones. Table A compares the traditional and analytical forecasts for metropolitan areas only. The traditional forecast of 1.64 million units per year for the Series B Census projections is the metropolitan component of the 2.67 million units mentioned previously as the most plausible national forecast. The corresponding analytical forecasts range from 20,000 to 250,000 fewer units per year. (These are our preferred analytical forecasts; Table 15 in Chapter VI reports several others which seem less likely.) The forecasts vary with the assumptions about conversion rates and about economic trends over the decade. Metropolitan housing conversion rates were much lower in the 1960s than in either the 1950s or 1970s, which implies that less of the demand for additional housing was met from conversions and units created from non-residential buildings, and

TABLE A

FORECASTS OF NEW METROPOLITAN HOUSING DEMAND
(annual rates in millions of units)

Forecast	Demographic Projections		
	Series A	Series B	Series D
Traditional	1.78	1.64	1.38
Analytical:			
Optimistic Scenario, 1960s Conversions	1.66	1.52	1.25
Pessimistic Scenario, 1960s Conversions	1.76	1.62	1.35
Optimistic Scenario, 1970s Conversions	1.54	1.39	1.23
Pessimistic Scenario, 1970s Conversions	1.64	1.50	1.23

more from new construction. The actual rates were .06 percent of the stock annually during the 1960s, compared to between .20 and .24 percent in the other periods. The 1960s conversion rate implies about 120,000 more new units will be needed annually in the 1980s.

The economic scenarios are derived from different underlying assumptions about the rate of inflation. The "optimistic" scenario projects a 6 percent annual inflation rate, and about 1.5 percent growth in real income; the "pessimistic" scenario is based on a 10 percent inflation rate, with no income growth. At the time this project began, the optimistic scenario appeared more likely to occur during the 1980s, but the rapid increase in inflation late in 1979 and early in 1980 now makes the inflation rate in the pessimistic scenario appear more likely, though perhaps not the change in real income. Our analytical forecast is particularly sensitive to the assumptions about income growth, because of the important relationship between loss rates and income which occurs in our statistical work. This relationship is one of the findings of the analytical approach which could not be inferred using the traditional methodology, though it might be guessed at by a knowledgeable observer of housing markets.

In order to construct a national forecast from our analytical approach, it is necessary to make some assumption about demand in non-metropolitan areas. We have utilized two different assumptions. One is simply to use the results of the traditional forecast; when we do so, then the overall national forecast is of course below the traditional forecast by the same 20,000 to 250,000 units per year. The range of demand estimates is from 2.42 to 2.64 million units annually. The second assumption is that the analytical non-metropolitan loss rates

bear the same relationship to the traditional non-metropolitan ones, as the analytical metropolitan ones do to the traditional ones for metropolitan areas. Under this assumption, the projected national new construction demand is from about 30,000 to 400,000 units less annually than in the traditional forecast. (These results are shown in Panels C and D of Table 16 in Chapter VI.) Actual demand ranges from about 2.26 to 2.64 million units per year.

Neither of these assumptions is necessarily better than the other, nor better than other possible assumptions. We use them simply because there is not at present enough data available to construct a statistical analysis of factors affecting demand outside of metropolitan areas.

From these calculations, it appears that the traditional forecast is at about the upper bound of the most reasonable range of forecasts derived from our analytical methodology.

Some of the other findings of our study of losses are of particular interest in themselves, as well as having implications about the forecast of housing demand. For instance, we find that the large-scale subsidized housing programs created in 1968 (Sections 235 and 236) did not generate higher loss rates during the early 1970s, contrary to much popular discussion. Losses since 1970 have been virtually unrelated to subsidized housing construction over the same period.

Our study of probable trends in tenure and structure type indicates that a large share of the increased demand will be for owner-occupied units, and for single-family homes. (These are frequently the same thing, of course, but we do not analyze the demand for tenure and structure type jointly in this study.) Both are strongly influenced by income and by demographic changes. Not unexpectedly, higher incomes are associated with increased owner-occupancy and increase demand for homes rather than apartments. Growth in elderly households also increases both demands, while growth in minority and non-husband/wife households tends to reduce both. The net effect of these and other factors is combined with Census projections of demographic changes and our range of economic assumptions to develop our projections. We estimate that from 65 to 73 percent of the new units in metropolitan areas will be owner-occupied during the 1980s, compared to less than 62 percent of all units today, and that from 60 to 83 percent will be houses, compared to about 62 percent today. The range on the structure type is so large because of the important effect of income; the difference between our two economic scenarios is enough to generate quite large differences in demands for structure type.

We also analyze the extent of substandard housing in the mid-1970s and forecast it as of 1990. Substandardness is strongly related to private housing production, income levels, and demographic factors. It is only weakly related to the production of subsidized housing for low-income families. This may be surprising, but it is consistent with our findings about the relationship between subsidized production and losses.

We forecast only a very slight improvement in housing quality, primarily because the Census demographic projections forecast increases in the importance of household types which disproportionately live in substandard housing at present. Their growth is almost enough to offset the effects of income increases. However, we do not think the forecast should be taken literally; to some extent, at least, the various household types may tend to live in substandard housing because their ability to afford decent housing is less than their current incomes would suggest. This is particularly likely to be true of minorities, and perhaps also of non-husband/wife households. Their expectations about their income in the near future--their "permanent" income--may be low compared to their current income.

None of the findings of our analytical method are particularly startling, but taken together they give a slightly different picture about the future than the consensus views of other housing market analysts. We project a slightly lower demand for new housing, relative to household formation, than has occurred in the recent past; more of that demand will be for homes and for owner-occupancy. We have not been able to pinpoint the reasons for these differences, much as we would like to; the various studies are too complicated to enable us to identify any one or two simple explanations. We also find that economic and demographic factors have important effects on the components of the housing inventory, and that the components themselves are interrelated.

Finally, it should be pointed out that there are unavoidable errors at every step of the procedure. The data contain errors, both sampling and nonsampling; our statistical work estimates the relationships between housing market behavior and other factors, subject to error; and our forecasts of future trends in income and demographic factors--like everyone else's--will turn out to be wrong to some degree. Only the errors from the statistical work can be calculated with much precision; it appears that they are not large enough to invalidate our results. The sampling errors in our primary data source (the Annual Housing Survey) are also reasonably small, with the possible exception of the data on mergers, conversions, and units added from other sources. We think that our forecasts are useful, despite the errors, but the reader should not assign to them a greater precision than the authors intend.

I. INTRODUCTION

The Urban Institute has attempted to forecast the national "need" for new housing construction to the year 1990, in order to enable HUD to forecast long-range production targets. This report summarizes the results of the study.

The study consists of:

(1) a forecast of housing demand over the decade of the 1980s, both nationally, by regions, and by areas within and outside of metropolitan areas (SMSAs) including an assessment of probable trends in tenure and structure type in metropolitan areas;

(2) a projection of the extent of substandard housing in 1990, based on both expected changes in housing market factors, and the extent of government programs to subsidize housing production.

Since at least the work of the Kaiser Commission in 1968,[1] nearly every attempt to forecast national housing "need" has included both categories. The first may be thought of as a forecast of the extent of private construction that will be required to meet expected growth in the number of households and to replace units that will be lost from the housing inventory. Most analysts have anticipated that this private construction will be provided in the absence of government subsidized production programs, through normal market processes. The second is a social problem, which is expected to remain despite the private production of new housing. The federal government has historically sought to eliminate this substandard housing by subsidizing either the production

of new housing for low-income families, the rehabilitation of existing housing, or the maintenance of currently adequate units already available in the private market, through programs providing assistance for families to live in existing housing.

The Forecast of Housing Demand

We have forecast the private demand for new housing in two different ways, which may be loosely characterized as the "traditional" and "analytical" approaches. In both, we begin with Census Bureau projections of net new household formations which have served as the base for virtually all projections in the past.

However, we use quite different techniques to project the other components of new housing demand. These components are: additional vacant units; replacement of losses from the existing stock; units created by conversion of one large unit into two or more smaller ones; units lost by merger of two or more small units into one large one; and units added from nonresidential uses. The last three are combined into one category in our analysis, because the data since 1970 are only available in that form.

In the aggregate, these components account for much less than half of expected housing demand, in our forecast or in any other over the past decade. But they are far more important than their share implies, because forecasters disagree much more sharply about them than about household formation. A recent HUD review of past forecasts, listing some 20 studies, found a wide range of predictions about vacancies and losses in particular. Annual loss projections, for example, ranged from

less than 300,000 to more than 1,000,000 units, and accounted for most of the variability in the total forecasts.[2] Thus it is particularly important to analyze vacancies, losses, and the other components carefully.

The "traditional" method estimates these components of demand on the assumption that the experience of the recent past will continue in the future: the vacancy rate of the 1980s will be the same as the average during the 1970s, for example.

The "analytical" method attempts to forecast these components by first relating past experience to housing market factors such as income and demographic changes, then projecting these market factors to 1990, and finally calculating the expected levels of the components from the projections of market factors and the past relationship between the factors and the components. For example, the annual rate of inventory loss has been related to income, the rate of increase in the number of households, and the rate of growth of minority households. Our projections of changes in these factors yield a forecast loss rate for the 1980s.

We use the Annual Housing Survey, particularly the Selected Metropolitan Area data, for this analysis.

The forecasts of changes in the demand for housing of particular structure types and tenures are developed on the same principles as the "analytical" forecast of overall housing demand.

The "analytical" method brings into focus certain interactions between private construction and the components of demand which have often been overlooked in past work employing the "traditional" method.

New construction is commonly treated as the response to exogenous changes in the number of households and the loss of existing housing units, but it seems likely that the causal relationships run in both directions.

If a unit is lost from the inventory, for instance, it must be replaced, assuming that the total number of households is unchanged. Hence replacement of lost units is a component of the need for new construction. But it is equally true that if a new unit is built and occupied, some existing unit must drop out of the inventory. It therefore follows that new construction affects the replacement rate. (In both cases, we ignore vacancies, which is reasonable given the stability of vacancy rates during at least the past decade.) There is a circularity which can affect the forecast of demand for additional housing: a high loss rate requires a high rate of new construction, and a high rate of new construction in turn generates a high loss rate. In past studies, the loss rate has been determined first by assumption, and the rate of new construction calculated as a response, with the wide variation in results mentioned previously.

A related but probably less serious problem exists for new construction and household formation. In the United States, the number of households and occupied housing units is identical: a household is what lives in a housing unit. Households cannot form unless housing is available. If there is a low rate of new construction over an extended period, there will therefore necessarily be a low rate of household formation. This identity creates difficulties in forecasting housing demand. The typical procedure has been to project the rate of household formation that is

expected to occur, based on past trends, which implicitly assumes that the response of the housing market will be the same in the future as it has been in the past. If the actual rate of household formation departs from the projection, we cannot be sure without further evidence whether the divergence results from changes in the intentions of individuals to form households, or changes in the housing market.

Our "analytical" work attempts to take the first of these interactions into account, but not the second. We model the loss rate in relation to the rate of housing production, and also relate the rate of housing production to the loss rate. We are not able, in the time available for this study, to analyze the interactions between household formation and housing construction. This is a very complicated problem. We believe, however, that it is the less serious of the two for our purpose of projecting the demand for new construction, because alternative household formation projections, embodying different assumptions about future trends, are available from a variety of sources.

The forecasts of changes in the demand for housing of particular structure types and tenures are developed on the same principles as the "analytical" forecast of overall housing demand.

The Concept of "Need"

The term "need" has come to have a special meaning in forecasts of housing market behavior. Additional housing is considered to be "needed" either in order to accommodate the growth in the number of households that is expected in the future (including an allowance for vacant units, to facilitate the normal workings of the housing market), to replace

units which will be lost from the inventory for any of several reasons, or to eliminate substandard units. The "needs" which the additional units satisfy, however, are rather different.

The "need" arising from household growth or replacement of lost units corresponds fairly closely to the economic notion of "demand." These units are desired by households which have the economic ability to pay for them, in the aggregate. The "need" to eliminate substandard housing, on the other hand, occurs precisely because the households are unable, either for economic or other reasons, to occupy better housing.

This consideration has led some respected housing analysts to conclude that the usual concept of "need" is not meaningful, and to discard calculations of needs as a guide to policy-making.[3] We are more optimistic about the usefulness of the calculations. While we recognize the problems inherent in the concept, we nonetheless believe that the calculations can provide at least a rough indication of what is likely to occur in the housing market over the next few years. However, we also believe that the incommensurability between the two categories comprising the concept is great enough so that it is probably not very useful to add them up and call their sum "the need for new housing." Indeed, the sum may be misleading, for several reasons.

Typically, policy-makers have regarded the construction of new housing for additional households as the province of the private sector, and the replacement of substandard units as the responsibility of the government. Thus, the Kaiser Commission's conclusions that some 20 million new units would be required to meet additional demand from 1968 to 1978, and that 6 million substandard units would probably remain in 1978,

were translated into private and public production targets, respectively, which could be separately pursued by different types of policies. This approach overlooks at least two interrelationships between subsidized and unsubsidized housing production, which complicate the achievement of both targets simultaneously. First is the substitution between subsidized and unsubsidized housing construction. Both compete for the same productive resources, and the use of the resources for building one sort of housing precludes their use for the other. Unfortunately, relatively little is known about the extent of substitution. The most widely known independent study of the subject concluded that a very high proportion of new subsidized units merely replaced unsubsidized units that would otherwise have been built, rather than adding to the overall stock of housing.[4] If this conclusion is valid, it means that we cannot add up two types of housing "needs" and treat the sum as a target: achieving the desired level of new subsidized housing will make it harder to achieve the desired level of private units.

There are also interactions in the opposite direction. Private housing production increases the overall stock of housing, and by doing so may lower housing costs to all households, through a "filtering" process which gradually brings higher quality units within the economic reach of successively lower income households.[5] To the extent that this process occurs, a high rate of production is likely to eliminate a share of the substandard housing, as the poorest households are able to afford something better. Thus the level of unsubsidized production may affect the need for subsidized units to eliminate substandard housing.

It is possible to incorporate these interactions in the forecast of the components of need, but relatively little is known about them, and most past forecasts of needs have either ignored them or made rough adjustments to account for them. The Kaiser Commission, for example, did not take account of the substitution between subsidized and unsubsidized production, but did estimate that about one quarter of the units that were substandard in 1968 (or expected to become substandard during the ensuing decade) would drop out of the stock by 1978. It did not provide any basis for the latter calculation.

This study attempts to analyze these interactions systematically, although as previously mentioned it does not use the results to generate a single total estimate of need.

II. THE DEMAND FOR NEW HOUSING CONSTRUCTION: "TRADITIONAL" METHOD FORECAST

We forecast a demand for additional housing for the nation of from 2.24 to 2.89 million units annually during the 1980s. Table 1 shows our forecast, by component. Over 65 percent of the additional units are required for new households, less than 7 percent to maintain current vacancy rates, and about 27 percent to replace losses from the inventory. Three sets of projections are reported; they are based on different Census Bureau projections of household growth, with Series A representing the highest estimate, and Series D the lowest.

The national forecasts have been built up from estimates for the SMSA and non-SMSA areas within each of the four Census regions. Table 2 presents the forecasts by regions, and by location within and outside SMSAs within each region. We estimate that the demand for additional housing will occur disproportionately in the South and West. About 40 percent of the increase, for each projection, will occur in the South, and 23 percent in the West. The North Central region will receive about 20 percent, and the Northeast about 15. By contrast, at present the South includes only about 33 percent of all housing, and the West slightly less than 20, while the North Central has just over 26 percent and the Northeast slightly less. The reasons for the concentration of new units in the South and West are that both regions are expected to grow more rapidly and have higher net loss rates than the other two regions. The actual rates are reported below.

TABLE 1

NATIONAL FORECAST OF HOUSING DEMAND, 1980-1990: "TRADITIONAL" METHOD

	Series A			Series B			Series D		
	Total	SMSAs*	Non-SMSAs	Total	SMSAs*	Non-SMSAs	Total	SMSAs*	Non-SMSAs
Total new housing units (in thousands)	28,936	17,848	11,088	26,660	16,378	10,282	22,445	13,703	8,742
Net household additions	19,080	11,576	7,504	17,026	10,221	6,805	13,248	7,726	5,522
Vacancy adjustments	1,958	859	1,099	1,759	761	998	1,374	615	759
Replacement demand	7,898	5,413	2,485	7,875	5,396	2,479	7,823	5,362	2,461
Inventory losses	(9,139)	(5,752)	(3,387)	(9,110)	(5,734)	(3,376)	(9,050)	(5,697)	(3,353)
Additions from other sources	(-1,241)	(-339)	(-902)	(-1,235)	(-338)	(-897)	(-1,227)	(-335)	(-892)
Annual average (millions per year)	2.89	1.78	1.11	2.67	1.64	1.03	2.24	1.37	0.87

*1970 SMSA boundaries

TABLE 2

REGIONAL FORECASTS OF HOUSING DEMAND, 1980-1990
BY LOCATION WITHIN AND OUTSIDE SMSAS:
TRADITIONAL METHOD

	Series A	Series B	Series D
U.S.	28,936	26,660	22,445
SMSA*	17,848	16,378	13,703
non-SMSA	11,088	10,282	8,742
Northeast	4,529	4,060	3,197
SMSA*	2,847	2,509	1,888
non-SMSA	1,682	1,551	1,309
North Central	6,045	5,482	4,481
SMSA*	3,562	3,214	2,610
non-SMSA	2,483	2,268	1,871
South	11,635	10,846	9,392
SMSA*	6,905	6,432	5,602
non-SMSA	4,730	4,414	3,789
West	6,727	6,272	5,375
SMSA*	4,559	4,223	3,602
non-SMSA	2,168	2,049	1,773

*1970 SMSA boundaries

The forecasts of the demand for new construction result in a projected housing stock ranging between 102.3 and 109.6 million units in 1990. Table 3 reports the total housing stock between 1976 and 1990. Because of the large amount of new housing expected to be built in the South and West, by 1990 these two regions will have a slightly larger share of the nation's housing than they did in 1976, at the expense of the Northeast and North Central regions.

We also project that slightly more than 60 percent of the growth will occur in SMSAs. We have used the 1970 SMSA boundaries for this projection. In fact, of course, SMSA boundaries change continually, as outlying counties become part of existing SMSAs and new ones are created. We have not attempted to forecast these boundary changes, but past experience suggests that the share of housing and population located outside SMSAs is steadily declining as a result of boundary changes. Our forecast shows about 41 percent of the new housing in the South and North Central regions being built outside the current SMSA boundaries, compared to 38 percent in the Northeast and 33 percent in the West (where counties are much larger geographically). We interpret these results to mean that much private construction, particularly in the South and North Central regions, will occur in areas that now lie just outside the present SMSA boundaries. In other words, growth patterns in the 1980s will be much like the 1970s and the entire postwar period.

These forecasts are based on extrapolating past trends to 1990. The assumptions made about the rate of net household formation, the vacancy rate, and the rate of inventory losses are discussed below.

TABLE 3

TOTAL HOUSING STOCK, 1976-1990, U.S. AND REGIONS
(in thousands)

		Series A		Series B		Series D	
	1976	1980	1990	1980	1990	1980	1990
U.S.	80,881	88,571	109,609	88,278	107,065	87,703	102,349
SMSA*	53,934	58,424	70,859	58,230	69,214	57,855	66,166
non-SMSA	26,947	30,147	38,750	30,048	37,851	29,848	36,183
Northeast	18,283	19,455	22,869	19,391	22,339	19,264	21,355
SMSA*	13,972	14,604	16,505	14,556	16,122	14,462	15,412
non-SMSA	4,311	4,851	6,364	4,835	6,217	4,802	5,943
North Central	21,381	22,946	27,168	22,870	26,536	22,721	25,368
SMSA*	13,673	14,465	16,753	14,417	16,363	14,324	15,643
non-SMSA	7,708	8,481	10,415	8,453	10,173	8,397	9,725
South	26,115	29,240	37,742	29,143	36,866	28,953	35,242
SMSA*	14,553	16,465	21,445	16,410	20,948	16,304	20,025
non-SMSA	11,562	12,775	16,297	12,733	15,918	12,649	15,217
West	15,102	16,930	21,830	16,874	21,324	16,765	20,384
SMSA*	11,736	12,890	16,156	12,847	15,781	12,765	15,086
non-SMSA	3,366	4,040	5,674	4,027	5,543	4,000	5,298

*1970 SMSA boundaries

Household Growth

The national household projections are Census projections, from "Projections of the Number of Households and Families: 1979 to 1995," Current Population Reports, Series P-25, no. 805, May 1979. There are four such projections, Series A, B, C, and D. All are based on extrapolations of changes in marital and household status as observed over the 1964 to 1978 period and the most recent Census population projections, by age and sex.

The household projections are based on Series II population projection (Current Population Report, P-25, no. 704) which assumes no general war or other catastrophe will occur during the projected period, and that the level of Armed Forces abroad and in U.S. military barracks will remain at the 1977 level of 1.3 million. Cohort fertility is assumed to be 2.1, the replacement rate. Average life expectancy at birth is assumed to increase from 69.1 to 71.8 years for males and from 77.0 to 81.0 years for females by 2050. Net immigration is assumed to remain at 400,000 per year; this does not allow for any level of illegal immigration, or any change in present immigration policies. Illegal immigration will of course raise the overall population, and therefore the number of households and housing units as well. We are unable to take this phenomenon into account in our forecasts, which are therefore biased downward as a result.

Only one set of population projections is needed, because all of the new households to be formed between now and 1990 will come from persons who have already been born.

In projecting the number of households, the Armed Forces population living abroad and in U.S. military barracks was excluded: the inmate population of institutions is included.

Series B is derived by extrapolating the 1964-1978 trend in marital and household status and continuing this trend forward. Series A and Series D are weighted averages of the 1964-78 extrapolated trend and the 1978 observed proportions of marital and household status. The weights used to obtain Series A were 4/3 Series B proportions and -1/3 of the 1978 proportions, while the Series D weights are 1/3 and 2/3, respectively. Series A results in the highest rate of household formation.

The Series C household projections were obtained in separate stages. The 1980 value was based on the 1974-78 extrapolated trend in marital and household status. The projections beyond 1980 were based on the 1966-80 extrapolated trend. Series C differs only slightly from Series B, and we have excluded it from the calculations in this report.

Series B would appear to be the most plausible on present information, although the Census Bureau in the past has generally underestimated the increase in the rate of household formation. If that pattern continues, then Series A will probably prove to be the best forecast. Series D seems likely to be a substantial underestimate, given recent trends. We include it in our projections only to give a lower bound.

The projected household growth rates for the nation are reported in Table 4. Each series implies a decline in the annual rate of increase of households over the decade. The decline can be attributed to the aging of the adult population; in particular, those born during the post World-War II baby boom will gradually move into middle age.

TABLE 4

ANNUAL AVERAGE GROWTH RATE OF HOUSEHOLDS, NATIONAL ESTIMATES

	1970-76 Actual[1]	1976-80 Projected[2]	1980-90 Projected[2]
Household Growth			
Census Series A	2.40%	2.26%	2.14%
Census Series B	2.40%	2.18%	1.93%
Census Series D	2.40%	2.01%	1.54%

DATA SOURCES:

1. 1976 Annual Housing Survey, General Housing Characteristics, Part A.

2. U.S. Bureau of the Census, "Projections of the Number of Households and Families: 1978-1995," Current Population Reports, P-25, no. 805, May 1979.

TABLE 5

ANNUAL HOUSEHOLD GROWTH RATES USED IN 1980 PROJECTIONS, BY REGION AND SMSA LOCATION

	Series A	Series B	Series D
U.S.	2.14%	1.93%	1.54%
SMSA*	1.94	1.72	1.34
non-SMSA	2.54	2.33	1.94
Northeast	1.59	1.38	0.99
SMSA*	1.23	1.03	0.64
non-SMSA	2.75	2.55	2.15
North Central	1.69	1.49	1.10
SMSA*	1.48	1.27	0.88
non-SMSA	2.08	1.87	1.48
South	2.59	2.38	1.99
SMSA*	2.68	2.47	2.08
non-SMSA	2.46	2.26	1.87
West	2.56	2.35	1.96
SMSA*	2.28	2.08	1.68
non-SMSA	3.45	3.25	2.85

*1970 SMSA boundaries

The national household projections are allocated first by region and then by SMSA/non-SMSA location within each region. The growth rates are reported in Table 5. The regional allocation follows the Census projected distribution of population by region ("Illustrative Projections of State Populations: 1975 to 2000 [Advance Report]," Current Population Reports, Series P-25, no. 735, October 1978). In these projections, the Census has assumed a continuation of the 1970-75 interstate migration patterns through the year 2000. The regional population distribution seems to be an accurate estimate of the regional household distribution, for the household and population distributions were virtually identical during the years 1970-76.

Households are then distributed within and outside SMSAs for each region, using extrapolations of the 1970-76 regional trend in the proportion of households within SMSAs. Using 1970 SMSA boundaries for this projection, the overall percentage of the nation's households who are residing in SMSAs falls slightly from 68 percent in 1976 to 66 percent in 1990, as non-metropolitan growth exceeds metropolitan household growth in each region except the South.

Vacancy Rate Adjustment

New units will also be needed to provide enough vacancies to allow for the matching of households to dwellings. The projected vacancy rates by region and by SMSA and non-SMSA location are reported in Table 6. The projected rates are held constant in our forecast at the 1973-76 average rate. Although the national vacancy rate has fallen somewhat since 1975 we feel the 1970-75 rates are representative of the long-run "normal"

TABLE 6

ANNUAL VACANCY RATES USED IN 1980-90 PROJECTIONS, BY REGION AND SMSA LOCATION

U.S.	8.6%
SMSA*	6.6
non-SMSA	12.6
Northeast	9.2
SMSA*	5.8
non-SMSA	19.3
North Central	7.9
SMSA*	5.3
non-SMSA	12.3
South	9.2
SMSA*	8.2
non-SMSA	10.4
West	8.1
SMSA*	6.7
non-SMSA	12.5

*1970 SMSA boundaries

vacancy rate. During that period, the rate exhibited only slight fluctuations in the course of an extremely pronounced housing production cycle.

	1970	1971	1972	1973	1974	1975	1976	1977	1978
National Vacancy Rate	8.8%	8.7%	8.7%	8.7%	8.9%	8.7%	8.4%	8.4%	8.3%

SOURCE: U.S. Bureau of the Census, "Vacancy Rates and characteristics of Housing in the United States, 1978," Current Housing Reports, Series H-111-78-5, April 1979.

Replacement of Inventory Losses

The net loss rate is composed of several elements: (1) units lost in various ways: through demolition, disaster (fire, flood, etc.) or through becoming vacant and unfit for habitation, or vacant with notice to be demolished or rehabilitated, or through being changed to

non-residential use; and (2) units added from conversions, built on one site and moved to another, or changed to residential use, less those lost through mergers. The loss projections are based on the assumption that the loss rate of the 1960s will apply through 1990. As Table 7 shows, the national rate is somewhat higher than the 1970-76 rate reported in the Annual Housing Survey. We chose the 1960s' rate because it is the latest available complete decade, and because there are data problems with the AHS's estimated loss rate. Unlike the 1960-70 estimate from the Census of Housing's Components of Inventory Change (CINCH), the AHS estimate is thought to overstate losses over the decade for units which have moved out and back into the inventory during the decade. However, the data for the 1960s is not without problems. The rate is substantially higher than for either earlier or later periods. A possible explanation for the difference is that certain federal programs which result in housing demolition were more important in the 1960s. Urban renewal, for example, was responsible for the razing of over 275,000 housing units in the 1960s, compared to less than 125,000 in the 1950s.[1] We do not know how many were located within SMSAs, but if only half of them were, the difference in demolition from urban renewal alone would be enough to account for the difference in metropolitan area loss rates between the two decades. Since urban renewal was suspended in 1973, renewal-generated losses in the 1970s are unlikely to be as high.

Our results are somewhat sensitive to these assumptions. If the lower AHS estimated gross loss rate of the 1970s is used (0.89%), both demand forecasts would be reduced by about 156,000 units annually. If

TABLE 7

ANNUAL AVERAGE LOSSES TO THE INVENTORY
NATIONAL ESTIMATES

	1950-60 Annual Average as Percent of 1950 Inventory[1]	1960-70 Annual Average as Percent of 1960 Inventory[2]	1970-76 Annual Average as Percent of 1970 Inventory[3]
Units Lost through Demolition, Other Means	0.81%	1.04%	0.89%
Units Added from Conversions, Other Sources, Less Mergers	0.22%	0.13%	0.47%
Net Losses	0.59%	0.91%	0.42%

SOURCES:
1. 1960 Census of Housing, Components of Inventory Change.
2. 1970 Census of Housing, Components of Inventory Change.
3. 1976 Annual Housing Survey, General Housing Characteristics.

the AHS estimated rate for additions is also used, the demand forecasts are reduced by about 457,000 units annually.

The loss rates for each sub-national area are reported in Table 8. Losses from demolition, natural disasters, and other means are appreciably higher in the South and West, resulting in higher net loss rates than in the other two regions and contributing to the share of new construction demand accounted for by both the South and West. This higher loss rate may be associated with the reduction in substandard units occurring in non-metropolitan areas, particularly in the South, or to the demolition and drop-out of older units due to rapidly rising incomes.

TABLE 8

ANNUAL NET LOSS RATE USED IN THE 1980-90 PROJECTIONS
BY REGION AND SMSA LOCATION

	Annual Losses as Percent of 1980 Inventory		
	Losses from Demolition, Other Means (Col. 1)	Conversions and Other Additions Less Mergers (Col. 2)	Net Losses (Col. 1 - 2)
U.S.	1.08%	0.14%	0.94%
SMSA*	1.03%	0.06%	0.97%
non-SMSA	1.18%	0.30%	0.88%
Northeast	0.68%	0.09%	0.59%
SMSA*	0.70%	0.03%	0.67%
non-SMSA	0.64%	0.27%	0.37%
North Central	0.95%	0.12%	0.83%
SMSA*	0.95%	0.03%	0.92%
non-SMSA	0.95%	0.26%	0.69%
South	1.34%	0.19%	1.15%
SMSA*	1.32%	0.09%	1.23%
non-SMSA	1.36%	0.31%	1.05%
West	1.29%	0.14%	1.15%
SMSA*	1.14%	0.08%	1.06%
non-SMSA	1.82%	0.35%	1.47%

*1970 SMSA boundaries

III. AN ANALYTICAL MODEL OF THE HOUSING MARKET

We have developed a simple analytical framework which permits us both to forecast several components of housing demand and to study the incidence of substandard housing. This section describes the analytical framework in general terms, and indicates briefly how it is modified in specific instances. Later sections contain the results of the analyses of individual components.

Description of the Model

Our basic framework divides the housing stock in a metropolitan area into two submarkets: housing that is substandard or inadequate or at the bottom of the stock; and housing that is of at least minimum standard quality. For the purposes of this analysis, the actual gradations of quality within both categories--particularly the standard quality group--can be ignored.

Within each submarket, we postulate a supply and a demand function for the number of housing units. This four-equation model with two submarkets effectively collapses into a two-equation model, when the housing units in each submarket are expressed as a percentage of the total housing stock. Because the percent substandard is the complement of the percent standard, any factor which affects the supply of substandard housing, as a percent of the total stock, must necessarily simultaneously affect the supply of standard quality housing, as a percentage of the stock; and similarly on the demand side of each market.

The model can be expressed in terms of either submarket; we have chosen to use the substandard housing market, since that is our primary interest.

Our demand and supply functions are fairly straightforward. Most of the variables in the functions have been employed in other studies of housing, albeit not in the framework which we employ. The major difference is that we express both demand and supply for substandard housing as a function of the relative prices of substandard and standard quality housing. The two qualities are treated as substitutes for each other. Thus we expect the demand for substandard housing to be a negative function of its price, and the supply to be a positive function. We expect the opposite effects for the price of standard housing. If the price of standard quality housing falls, households will demand more of it, and less substandard housing; thus the relationship between the price of standard housing and the quantity of substandard housing demanded will be positive. A rise in the price of standard housing will also cause suppliers to shift from the substandard to the standard market; thus the relationship here will be negative. This latter possibility has generally been ignored in recent academic analyses of housing markets, which have hypothesized that units cannot be improved in quality, once they have been allowed to deteriorate, but can at best be maintained at the same quality level.[1] We believe that this assumption, while convenient for some analytical purposes, is at variance with the facts, which show a substantial volume of rehabilitation and repair of existing homes, and a noticeable number of units moving from substandard to standard in the course of each recent decade.

Other factors affecting demand are income and household characteristics. We expect the demand for substandard housing to be negatively related to income. For a given level of current income, we also expect more substandard housing to be demanded, the more rapid the rate of increase of income. The measurement of income in housing market analysis is difficult. Many past studies have shown that the appropriate measure is the permanent or long-term expected income of the household, since housing consumption decisions are generally long-term commitments which cannot easily or costlessly be modified when circumstances change. Our data do not differentiate the permanent income of households from their current income. However, we believe that a measure of central tendency for the entire metropolitan area should be a reasonably good proxy for the permanent income of the typical household in that area. In order to take account of possible differences, we also use the recent rate of growth of income in our model. We anticipate that the demand for substandard housing will be greater, the more rapid the recent growth of income (holding current income constant), because permanent income is probably lower when the growth rate has been more rapid, and because of the time and effort required for adjustment from one equilibrium position to another.

In addition to the income level, we include measures of the income distribution, in particular the incidence of poverty households, since these are most likely to occupy substandard housing.

Two demographic variables are hypothesized to affect demand: the age distribution of the population, and the household composition. The former is measured as the incidence of households headed by an elderly

person, the latter as the incidence of households which do not consist of married couples. These demographic characteristics reflect both tastes and differences between current and permanent income. We expect substandard housing to be less frequent among the elderly, for example, for given current income levels, because they have had a longer period to accumulate assets, including housing.

These groups generally have lower incomes than other types of households, and are therefore likely to be disproportionately represented among the poverty population. Inclusion of the distributional variable should, however, minimize the extent to which the demographic variables merely measure current low income.

The final variable in the demand function is the rate of growth of households. In rapidly growing metropolitan areas, the housing stock is under pressure for intensive utilization, until the amount that is produced can be increased. In these circumstances, we expect that substandard housing will be utilized to meet part of the growth in demand, rather than being vacant or dropping out of the housing stock. Thus we expect the rate of household growth to have a positive effect on demand for substandard housing.

The supply of substandard housing depends not only on the relative prices of substandard and standard quality housing, but also on these prices relative to the costs of providing units of that quality. In particular, it depends on the price of standard housing relative to both the costs of constructing it and of upgrading substandard housing. Unfortunately, data on both types of costs are difficult to come by, particularly on a cross-sectional basis.

The cost of constructing new units has three major components: building costs, land value, and interest. The most well-known and widely used measure of building costs is the Boeckh Index, which has been compiled since 1915 and is currently available for all metropolitan areas and many smaller cities.[2] Its limitations have been recognized in the professional literature.[3] It is a fixed-weight factor price index, which does not make adjustments for technological progress in building; probably as a result, it has increased much more rapidly in the postwar period on a national basis than any other measure of housing prices or costs. Other indices provide much less geographic detail.

There is virtually no general cross-sectional data on land prices. The Federal Housing Administration does estimate the land value of the homes on which it insures mortgages, including new homes, but this represents a small share of the home market. The sample of homes in any particular metropolitan area is usually quite small, and the reported land values sometimes vary substantially from year to year in the same area.[4] A possible crude proxy for the value of land in a metropolitan area is the population of the area, in the belief that land values are higher in large areas, as indicated by the greater intensity of land use.

Interest rates probably do not vary greatly across metropolitan areas at any given time, and thus present less of a problem in the analysis. However, there is some evidence that rates do vary systematically across regions; mortgage rates have historically been slightly higher in California and the West generally than in other regions. Unfortunately, available data for individual metropolitan areas are inadequate for our analysis.

One way to circumvent these data problems is to include the actual volume of new construction in the supply equation, rather than the cost components or their proxies. The volume of new construction is itself determined by other factors as well as construction costs and new home prices; it depends on the demand for new homes as well as the supply. Demand is probably a function of household growth, incomes, and mortgage interest rates, in particular. If we include new construction rather than the cost components, our model becomes recursive; a more elaborate model would explain the volume of new construction and then use the results of that analysis in explaining the level of substandard housing, or might explain new construction and substandard housing simultaneously.

There are advantages to the procedure, in addition to the obvious one of data availability. The volume of new housing production is a possible policy target variable for the federal government, and there is substantial policy interest in the relationship between substandard housing and the rate of new construction. Moreover, the model incorporating new construction, instead of its component costs, is recursive rather than simultaneous, insofar as the market for substandard housing is concerned; the results of the empirical work therefore should not be biased.

We include separately as a supply factor the rate of government production of subsidized housing. These units may represent at least a partial increase in the supply of standard housing. The extent to which subsidized production substitutes for unsubsidized units that would otherwise have been built has been a much-discussed question, though there is relatively little serious empirical work. Our model

permits us to investigate the possibility empirically, without prejudging the issue.

Racial or ethnic discrimination in housing markets may also affect the supply of substandard housing. When discrimination exists, less standard quality housing will be provided to minority households at a given price, and therefore more substandard housing will be provided. We thus expect the supply function of substandard housing to be positively related to the share of households that are black or Hispanic in the metropolitan area.

Solving the Model

The model described above can be written in linear form in two equations:

$$(1) \quad H_{bd} = a + b_1 P_b/P_t + b_2 Y + b_3 Y_g + b_4 E + b_5 M + b_6 HH$$

$$(2) \quad H_{bs} = c + d_1 P_b/P_t + d_2 R + d_3 NC + d_4 S + d_5 B + d_6 D$$

where the variables are defined as follows:

H_{bd} = quantity of substandard (bottom) housing demanded, as a fraction of the total stock

H_{bs} = quantity of substandard housing supplied, as a fraction of the total stock

P_b = price of substandard housing, per unit of housing services

P_t = price of standard (top) housing, per unit of housing services

Y = median household income

Y_g = rate of growth of median household income

E = percent of households with head over 65 years of age

M = percent of non-husband/wife households

HH = rate of growth of households

R = percent of minority households

NC = rate of private new housing construction

S = rate of subsidized housing production

B = cost of building new housing (measured by the Boeckh Index)

D = ratio of new construction to net household formation during the 1960s

The expected signs of the coefficients are: in the demand equation, b_5 and b_6 positive, and the rest negative; in the supply equation, d_1, d_2, and d_5 positive, and the rest negative. The constant terms are indeterminate.

This model cannot be estimated as a simultaneous system since we lack reliable information on P_b and P_t.[5] However, we can still calculate the net effect of each variable on substandard housing, by rewriting either equation in terms of P_b/P_t, substituting the expression into the other equation, and solving that equation for H_b.

By this procedure, equation (2) can be rewritten:

$$(3) \quad P_b/P_t = \frac{H_{bs}}{d_1} - \frac{c}{d_1} - \frac{d_2R}{d_1} - \frac{d_4NC}{d_1} - \frac{d_5S}{d_1} - \frac{d_5B}{d_1}$$

Substituting equation (3) into equation (1) yields:

$$(4) \quad H_{bd} = a + b_1\left[\frac{H_bS}{d_1} - \frac{c}{d_1} - \frac{d_2R}{d_1} - \frac{d_3NC}{d_1} - \frac{d_4S}{d_1} - \frac{d_5B}{d_1}\right] + b_2Y +$$

$$b_3Y_g + b_4A + b_5M + b_6HH$$

Since in equilibrium $H_{bs} = H_{bd}$,

$$(5)\quad H_b\left[\frac{d_1-b_1}{d_1}\right] = \frac{ad_1-cb_1}{d_1} - \frac{b_1d_2R}{d_1} - \frac{b_1d_3NC}{d_1} - \frac{b_1d_4S}{d_1} - \frac{b_1d_5B}{d_1} + \frac{b_2d_1Y}{d_1} + \frac{b_3d_1Y_g}{d_1} + \frac{b_4d_1E}{d_1} + \frac{b_5d_1M}{d_1} + \frac{b_6d_1HH}{d_1}$$

Therefore,

$$(6)\quad H_b = \frac{ad_1-cb_1}{d_1-b_1} - \frac{b_1d_2R}{d_1-b_1} - \frac{b_1d_3NC}{d_1-b_1} - \frac{b_1d_4S}{d_1-b_1} - \frac{b_1d_5B}{d_1-b_1} + \frac{b_2d_1Y}{d_1-b_1} + \frac{b_3d_1Y_g}{d_1-b_1} + \frac{b_4d_1E}{d_1-b_1} + \frac{b_5d_1M}{d_1-b_1} + \frac{b_6d_1HH}{d_1-b_1}$$

The denominator of each term is positive, since $d_1 > 0$ and $b_1 < 0$. The numerator of each coefficient except the constant term has the same sign as the coefficient of the variable in the structural equation for demand, and the opposite sign of the coefficient in the structural equation for supply. The constant term may have either sign.

Modeling the Components of Inventory Change

The foregoing model can be applied directly to the analysis of substandard housing. We believe that, with minor modifications, it can also be applied to the study of loss rates, although losses occur for other reasons besides those which are incorporated in the model.

Losses from the inventory occur for essentially three reasons: acts of God, acts of government, and responses to market conditions. The first of these categories includes natural disasters, such as floods and hurricanes; the second, public policies such as urban renewal and

highway construction, in the course of which it is sometimes necessary to remove housing units. Apart from these situations, however, most housing losses occur at the bottom of the housing stock, as units are no longer deemed worth inhabiting. We believe that losses of this type occur in response to the same factors which affect the incidence of substandard housing. An increase in income, for example, will result in a greater demand for high-quality housing, and a smaller demand for substandard units; part of the decline will be met by upgrading, and part by substandard units dropping out of the stock. Similarly, we expect a larger loss rate when there is a high volume of new construction, and a smaller one when there is rapid household growth.

Our analysis of loss rates focuses on these losses of low-quality units. We have not attempted to explain losses from natural disasters or government programs, other than housing programs. We lack any sources of data which we could use in the time available for this project. For acts of God, at least, we do not think this is a particularly serious problem. We believe that losses from natural disasters are distributed rather randomly across metropolitan areas, at least over a period of several years. If this is true, then the mean impact of disasters will be captured in the constant term of our regressions, while the variability between areas will add to the variance of the error term, reducing the explanatory power of the model but not otherwise affecting the results. We do not think disasters are likely to be correlated with other factors affecting either the demand or supply of substandard housing, or with losses from the stock of substandard housing.

Acts of government pose a more difficult problem. By including the extent of subsidized housing production in the analysis, we directly estimate the impact of one very important government program on the loss rate. We have no data, however, on units demolished in the course of other programs, such as urban renewal or highway construction. We are forced to ignore these programs, in the hope that their effects are not correlated with losses from other sources or with factors which affect the loss rate directly.

Our model of the loss rate is thus quite similar to the model of substandard housing, though with opposite signs. Thus the "demand" for losses is essentially the negative of the demand for substandard units, and similarly for the "supply." Again we cannot estimate these equations directly, lacking data on the price of substandard and standard housing, but can estimate a reduced form, with the arguments in both the demand and supply functions included. We add one variable to the supply function, which is the ratio of new construction to net household formation during the 1960s. This is an attempt to measure the extent to which the market was in disequilibrium at the beginning of the period for which we have data on loss rates. We expect that loss rates during the 1970s will be greater, the higher the ratio of construction to household formation during the 1960s.

The analysis of conversions, mergers, and additions from other sources is a more complicated problem. The first two are opposite phenomena, and thus can be analyzed in the same framework, but the last is rather different. Data limitations require us to lump all three together, along with statistical and other errors in the data; they are not reported separately.

Conversions occur when one larger unit is divided into two or more smaller ones; mergers are the reverse of this process. We expect that conversions will result from rapid growth in households, or a low rate of new housing construction. Both of these put pressure on the existing stock, creating a demand for additional units. We also expect conversions to occur when there is a decline in household size; the larger units become less desirable for the smaller households. Mergers will occur when the opposite situations exist: a slow growth in households, or an increase in household size will be particularly important. They may also occur when incomes increase, as the demand for housing space increases.

Units are likely to be added from non-housing sources when the housing market is tight, for the same reasons as conversions will occur. However, these additions are not especially likely to occur when household size is declining. They would appear to be a relatively unlikely response to increased housing market pressure when incomes are rising, since more households would be interested in purchasing new units.

The equilibrating mechanism in the market for conversions and mergers is the relative price of housing units of different sizes, and the cost of converting from one size to another. The higher the price of larger units relative to the price of smaller units plus the cost of merging, the more large units will be created by merger; and the higher the price of larger units relative to smaller ones, the fewer large units will be demanded. A different set of prices and conversion costs operate in the market for additional units from non-housing sources: the price of housing relative to the price of commercial or other use of the

property, and the cost of converting from non-housing to housing. Again, supply is a positive function of the price of housing and a negative function of the price of the other use and the cost of converting, while demand is a negative function of the price of housing, but is probably unrelated to the price of the property in its non-housing use. As with losses and substandard units, the absence of price data requires the estimation of a reduced form.

When we attempt to identify the net effect of all three housing stock changes, it would appear that there will be more housing added on balance from these sources when household growth is rapid, housing production (private or subsidized) is low, household size is decreasing, incomes are not growing rapidly, and costs of new construction are increasing. Not all of these factors will affect each component of the change, but none of them appear to have offsetting effects on two different components. These housing market, economic, and demographic factors are among those which we have previously identified as affecting the incidence of substandard housing and the loss rate. We expect them, however, to have the opposite impact on losses as they do on the sum of mergers, conversions, and units from other sources. A rise in income, for example, raises the loss rate, as people tend to buy new, better housing; it also reduces their interest in small units, whether created by conversion or otherwise, and in units added from other sources (such as townhouses serving as small commercial establishments), and may increase their demand for larger units created by merger.

Data Sources

Empirical investigation of substandard housing and the components of inventory change consists of statistical analysis, using multiple regression techniques, in which the dependent variable (the aspect of the housing market) is related to the independent variables (economic, demographic, and other housing market conditions). In each case, we use the "Selected Metropolitan Areas" from the Annual Housing Survey for our empirical work. This source provides information in usable form on 59 metropolitan areas, 18 for the year 1974, 21 for 1975, and 20 for 1976. Most of the information is taken from the published reports of the AHS, but in some cases, including the counts of substandard housing and the rates of private and subsidized construction, we have had to use the data tapes in order to construct the needed variables for the SMSA from the individual housing unit observations. In addition, some data are taken from other sources, such as HUD reports on subsidized production of owner-occupied homes under Section 235.

The empirical work treats each metropolitan area as a single observation, and investigates the conditions in the housing markets on a cross-sectional basis.

IV. "ANALYTICAL" FORECASTING PROCEDURE AND ASSUMPTIONS

The forecasting procedure combines the results of the empirical analyses, using the model and procedures described in the previous chapter, with a set of assumptions about the changes in economic and demographic conditions between the present and 1990.

In making the forecast, the coefficient for each variable in the particular regression is multiplied by an assumption about the change in that variable during the 1980s, or its level in 1990. These products are then summed. The number resulting from these calculations is either the predicted annual loss or conversion rate during the decade of the 1980s, or the predicted incidence of substandard housing in 1990. The loss and conversion rates are then multiplied by the estimated average number of housing units during the 1980s, which is based on the Census Bureau's projections of household formations and our assumption of a constant vacancy rate in the future, in order to produce estimates of the number of units that must be constructed each year to compensate for the losses and conversions (if the latter is negative). It may be worth repeating that we do not attempt to estimate household formations in any way; rather, we accept the Census Bureau's projections as the base for our work.

A similar procedure is employed in Chapters VII and VIII, in which we analyze the rate of homeownership and the share of the housing stock consisting of single-family homes, and then forecast the changes over the 1980s.

This procedure assumes that the relationships estimated for the first half of the 1970s, or for the middle of the decade in the case of substandard housing, will continue to hold in the future. It also assumes that the results of the cross-sectional analysis can be applied over time. There is a large economic and econometric literature on the relationship between cross-section and time-series analysis. One line of argument holds that cross-sectional relationships are likely to be more indicative of long-run conditions than are time-series.[1] There are several reasons for this view. Relative price differences between areas are often persistent, in which case observations across cities are likely to incorporate demand adjustments to the differentials; the long-run effects of a permanent change in price can thus be estimated, since we can observe the adjustments made to higher prices in specific locations. In the specific case of housing, the importance of permanent income also suggests that cross-sectional analysis is preferable for estimating long-run relationships. Income differences between areas, as discussed in the previous chapter, are likely to represent long-term differences, and the consumption patterns of households will reflect their long-term expectations about income. A change in income over time, however, may be either permanent or transitory, and the household's response may therefore reflect either short-run or long-run adjustments, or combine elements of both.[2]

Since our concern is with long-run behavioral patterns, the use of cross-sectional analysis seems appropriate. It should be noted, however, that there is a conflicting school of thought, which argues that cross-sectional relationships may in certain circumstances represent short-term adjustments, and time-series variations will represent long-run changes.[3]

Demographic Assumptions

Our metropolitan area demographic assumptions are taken from the Census Bureau's national household formation projections. The projections for total households and the regional and SMSA breakdowns have already been used in the "traditional" method of forecasting demand. In the "analytical" method, we use additional information from the Census projections concerning several particular types of households, because we believe that these household types exhibit somewhat different housing market behavior from the rest of the population. Three household types are especially relevant: minorities, the elderly, and non-husband/wife households (single persons, divorced, widowed or separated parents, two related or unrelated adults living together, etc.).

Table 9 shows the SMSA projections for those household types which are used in the forecasts. In every case, the growth rate is projected to be greater than that for all households. Thus all three types of households will account for a larger share of the SMSA population in 1990 than they do today. Among these types, the growth rates will be largest for minorities, and smallest for the elderly.

The bottom panel in Table 9 reports the annual percentage change in the incidence of households of each type. This formulation of the demographic changes is used in the analysis of changes in homeownership. For statistical reasons it is convenient to express the change as the annual percentage change in the incidence, using the initial year 1970 as the base. Thus an increase in five years from 60 to 65 percent in homeownership is expressed as a change of 1.667 percent per year; the average annual percentage point change is one, which is divided by the

TABLE 9

SMSA PROJECTIONS
1990 INCIDENCE AND 1980-1990 GROWTH RATES
FOR SELECTED HOUSEHOLD TYPES

	Series A	Series B	Series D
1990 Incidence			
Minority	22.545%	22.041%	21.103%
Elderly	18.826	19.021	19.334
Non-husband/wife	48.763	46.707	42.434
1980-1990 Annual Growth Rate			
All households	1.941%	1.736%	1.345%
Minority	3.882	3.471	2.690
Elderly	2.075	1.964	1.716
Non-husband/wife	3.473	2.897	1.687
1980-1990 Annual Percentage Change in Incidence			
Minority	1.903%	1.706%	1.292%
Elderly	0.131	0.224	0.366
Non-husband/wife	1.502	1.141	0.338

60 percent of the initial year. We use this form of the change because we expect the rate of change to depend on the initial level; an increase from 60 to 65 percent is more difficult to achieve than an increase from 40 to 45 percent.

Economic Assumptions

The key economic variables affecting housing market behavior are income, housing cost, and inflation. Opinions differ widely as to how these may change in the future. In estimating economic change for the 1980s, we have developed two alternative scenarios. The projected changes in each economic variable are shown in Table 10, under the two

TABLE 10

SMSA PROJECTIONS
1980-1990 ANNUAL RATES OF CHANGE FOR SELECTED ECONOMIC VARIABLES

	Optimistic Scenario	Pessimistic Scenario
Inflation	6.0%	10.0%
Nominal household income	7.5	10.0
Real household income	1.41	0
Nominal cost of homeownership	7.5	13.0
Real cost of homeownership	1.41	2.73
Nominal rents	5.0	9.0
Real rents	-.094	-0.91
Nominal cost of construction	8.0	13.0
Real cost of construction	1.887	2.727

alternatives. The more optimistic assumes that income increases at 7-1/2 percent per year, inflation at 6 percent, the cost of homeownership at 7-1/2 percent, and rents at 5 percent. These are not far from the average experience of the 1970s, although the projected inflation rate is somewhat lower. The assumptions imply annual increases of 1.41 percent in both real income and the relative cost of homeownership (compared to all prices).

In the more pessimistic scenario, nominal income and inflation both increase at 10 percent per year, so there is no increase in real

income, while the cost of homeownership grows at 13 percent and rents at 9 percent, leading to an increase of 2.73 percent in the relative cost of owning. This is slightly better than current experience.

The driving force in these economic scenarios is the rate of inflation. The optimistic scenario implies that inflation is brought down markedly from its current rate, which in turn brings down the increase in housing costs, while income grows more rapidly, in real terms, than it appears to be doing currently. The pessimistic scenario is based on the experience of the first half of 1979, which at that time seemed to represent the highest rate of inflation likely to occur over any extended period. The lower rate of real income growth in the pessimistic scenario reflects the pattern of recent years, in which real income growth has declined when inflation increased. The higher real rate of increase in the cost of homeownership is also consistent with recent experience.

It would be possible to construct other scenarios, which might be equally likely. Over the full year 1979 the country experienced inflation at about a 13 percent annual rate, for example, and the rate was higher in early 1980. However, in most of the empirical work, the only significant economic variable turns out to be real income. Real income has not dropped in the course of the current inflation, apart from the 1974-75 recession, so that a lower bound of zero seems reasonable for a long-term trend. At the other end, we have experienced more rapid increases than 1.41 percent, but not in recent years.

Data problems have forced us to omit one variable which we should especially like to include in several statistical analyses: the rate of inflation. There is increasing awareness that inflation has had

dramatic effects on the housing market, driving up the prices of homes in particular, and simultaneously increasing the demand for homeownership. Unfortunately, there is no available data on cross-sectional differences in inflation, other than differences in the change in housing costs themselves, which combines inflation with changes in the relative price of housing. In this area, our cross-sectional approach fails to capture one important aspect of housing market behavior.

V. ANALYSIS OF COMPONENTS OF INVENTORY CHANGE

This chapter reports the empirical results of our studies of loss rates, conversions and mergers, and the rate of private new construction. In the next chapter, we use these results to forecast the components of inventory change for the decade of the 1980s.

Losses

Table 11 presents the statistical analysis of loss rates. The first two regressions contain all variables that were included in the model described in Chapter III; they differ in the treatment of government housing construction programs. The third regression omits variables with coefficients smaller than their standard errors, except for the rate of change of real income, which is included despite its insignificance in order to adjust for the difference between current and permanent income. (The same format for reporting empirical results will generally be followed in subsequent tables: one or more regressions reporting all variables from the model, followed by a regression omitting those with coefficients smaller than their standard errors, except for the rate of change of income.)

In all three regressions, three variables are significant at the conventional two-tail, 5 percent level, with the expected signs: the rate of private new construction, the rate of household growth, and the increase in minority households. The loss rate is higher in areas with a large volume of new construction, lower in areas with a high overall

TABLE 11

RATE OF LOSSES TO HOUSING STOCK (RLOSS):
59 SMSAS FOR 1970-1974 ('75,'76)

Variable	RL1	RL2	RL3
Intercept	0.984 (2.074)	0.937 (1.967)	0.957 (3.071)
Y_g	0.001 (0.049)	0.004 (0.186)	0.003 (0.013)
Y	-0.028 (-1.438)	-0.030 (-1.505)	-0.031 (-1.606)
HH	-0.133 (-2.365)	-0.138 (-2.392)	-0.114 (-2.259)
M	-0.025 (-0.720)	-0.150 (-0.414)	--
E	0.025 (1.220)	0.018 (0.874)	--
R	-0.043 (-3.528)	-0.044 (-3.597)	-0.047 (-4.159)
B	-0.007 (-0.184)	0.003 (0.081)	--
NC	0.173 (3.501)	0.181 (3.582)	0.173 (3.578)
D	0.141 (1.943)	0.121 (1.628)	0.121 (1.700)
S_{70}	0.103 (0.878)	0.092 (0.773)	0.068 (0.605)
S_{65}	--	-0.513 (-0.870)	-0.534 (-0.926)
S_{60}	--	0.726 (1.444)	0.830 (1.764)
	$R^2 = 0.6043$	$R^2 = 0.6215$	$R^2 = 0.6140$

TABLE 11 - VARIABLE DEFINITIONS

RLOSS = rate of losses to the housing stock, as a percentage of the average housing stock

Y_g = rate of growth of real median household income

Y = median household income

HH = rate of growth of households

M = difference between rate of growth in non-husband/wife households and rate of growth of households

E = rate of growth in households with head 65 years or older

R = rate of growth in minority households

B = rate of change in cost of building new housing (measured by Boechk Index)

NC = rate of private new housing construction

D = ratio of new housing construction to net household formation during the 1960s

S_{70} = rate of subsidized housing construction, since 1970

S_{65} = rate of subsidized housing construction, 1965-1970

S_{60} = rate of subsidized housing construction, 1960-1965

NOTE: All rates of growth are annual, from 1970 to the survey year. Housing production rates are annual, relative to the average housing stock between 1970 and the survey year.

growth rate, and lower in areas in which minority households have been increasing rapidly.

In addition, the ratio of new construction to net new household formation in the 1960s is consistently significant at the 10 percent level, with the expected positive sign, and the income level is significant at the 15 percent level. Aside from these variables, only the growth in elderly households has a coefficient larger than its standard error in any regression. It is not significant at the 20 percent level in regression RL1, and drops by almost one-third when additional measures of government construction are included in regression RL2.

The coefficient of private new construction is generally about .17, which implies that 17 units are removed from the inventory for each 100 private new units. This seems remarkably low. However, the coefficient of the "disequilibrium" variable indicates that all of the losses do not occur in the same period of time as the new construction. Losses in the early 1970s were occurring in response to high rates of new construction during the 1960s. The long-run loss rate in response to construction during the 1970s is therefore undoubtedly larger than .17.

The negative coefficient of income should be considered in the context of other variables included in the regression. Our model implies that an increase in income should lead to a higher loss rate. However, this effect will occur partly through an increase in new construction, as richer households seek better housing. The units removed from the inventory in response to this behavior are measured by the coefficient of the rate of new construction. The other way through which an income increase affects losses is by increasing the demand for

larger units, which results in an increase in mergers (as well as new construction). Some at least of the units which are merged would probably otherwise have dropped out of the stock. Thus we would expect income to have a negative effect on losses, and on conversions, when the rate of private new construction is included in the regressions.

Government housing construction deserves special attention. Its coefficient is positive but smaller than its standard error in regression RL1; the coefficient implies that each 100 new subsidized units result in 10 units, all presumably private, dropping out of the stock. But the standard error is so large that a 95 percent confidence interval ranges from +30 to -10; little confidence can therefore be attached to the results. The coefficient also is quite low, slightly more than half that for private new construction.

Regressions RL2 and RL3 analyze this relationship further. They include the past levels of subsidized production, a procedure suggested by the effect of the disequilibrium variable. The coefficient for subsidized production during the period 1960-64--roughly ten years prior--is positive and significant at the 15 percent level. It indicates that units drop out of the stock with a long lag after the subsidized production occurs, but that nearly three units drop out for every four built.

This result should not be overemphasized. The standard error is large, so that the 95 percent confidence interval goes from +173 to -28. Moreover, the coefficient for units built in the later 1960s is implausibly negative and rather large, albeit smaller than its standard error. We are inclined to conclude therefore that subsidized production probably

does increase the loss rate, but that the effects do not occur immediately; however, we would like to have more significant results before giving too much credence to the conclusion.

Despite the limitations of the results, they do shed some light on the old controversy over Section 235 and 236. When those programs were suspended in 1973, one frequent criticism was that they had contributed to the problem of housing abandonment, which was just being recognized as serious in many cities.[1] This argument was based on the assumption that the units built represented a significant increase in the housing stock relative to the number of households, creating a market imbalance which was ultimately corrected by the removal of other housing units from the existing inventory. This argument, while plausible, has never to our knowledge been systematically investigated empirically. Our results indicate that it is at most only partly correct. If true, it would require a rather rapid market adjustment, since the programs began in 1968 and the criticism was being leveled by 1973, or earlier. Regression RL1 indicates that there may possibly have been some effect on the housing market within that short a period of time, but that it was so small that contemporary observers of local housing markets would probably not have noticed it. However, regressions RL2 and RL3 indicate that the programs may indeed lead to the removal of other units from the housing stock on a large scale, though only after a long lag. If this regression is a reasonable representative of the market, then we should see a marked increase in the loss rate during the early 1980s, unless other factors change in an offsetting way.

As a further investigation of this argument, we sought to disaggregate the subsidized production during the 1970s by program type, but the results were inconclusive.

Conversions

The results of the statistical analysis of conversions, mergers, and units added from non-housing sources are shown in Table 12. As in the case of losses, the first regression contains all the variables from the model. Insignificant variables are omitted in the second. (The third will be discussed later.) The insignificant variables include the rate of increase of elderly households, the change in construction costs, and the measure of disequilibrium, and government production.

The results are not very satisfactory. Only two variables are statistically significant in both regressions, one with the wrong sign. This is the rate of growth in non-husband/wife households. The negative coefficient implies that there are fewer conversions and more mergers when there is a high growth rate for these households, holding constant the overall growth rate. This seems implausible, since such households typically have fewer members than the households of married couples, and hence are more likely to desire smaller units. We are unable to rationalize this result.

The other significant variable is unique to the study of conversions, and demonstrates the difficulty with the available data. The AHS reports a positive net addition to the housing stock from conversions, mergers, and non-housing sources for all SMSAs surveyed in 1974 and 1976,

TABLE 12

RATE OF NET ADDITIONS TO THE HOUSING STOCK (RCONV):
59 SMSAS FOR 1970-1974 ('75,'76)

Variable	RC1	RC2	RC3
Intercept	1.340 (2.116)	0.995 (3.232)	0.876 (2.523)
Y_g	0.001 (0.026)	-0.005 (-0.185)	-0.010 (-0.332)
Y	-0.039 (-1.483)	-0.028 (-1.222)	-0.044 (-1.782)
HH	0.116 (1.373)	0.129 (1.683)	0.179 (2.460)
M	-0.188 (-3.992)	-0.179 (-4.121)	--
E	0.010 (0.358)	--	--
R	0.019 (1.079)	0.018 (1.138)	--
B	-0.011 (-0.216)	--	--
NC	-0.061 (-0.808)	-0.069 (-0.967)	-0.140 (-1.892)
D	-0.053 (-0.548)	--	--
DUM75	-0.254 (-3.269)	-0.248 (-3.403)	-0.211 (-2.801)
S_{70}	-0.082 (-0.512)	--	--
	$R^2 = 0.5233$	$R^2 = 0.5134$	$R^2 = 0.3508$

TABLE 12 - VARIABLE DEFINITIONS

RCONV	=	rate of net additions to the housing stock, as a percentage of the average housing stock
Y_g	=	rate of growth of median household income
Y	=	median household income
HH	=	rate of growth of households
M	=	difference between rate of growth of non-husband/wife households and rate of growth of households
E	=	rate of growth of households with head 65 years or older
R	=	rate of growth of minority households
B	=	rate of change in cost of building new housing (measured by the Boeckh Index)
NC	=	rate of private new housing construction
D	=	ratio of new housing construction to net household formation during the 1960s
DUM75	=	dummy variable for SMSAs surveyed in 1975
S_{70}	=	rate of subsidized housing construction, 1970-1976

and a negative one for all those surveyed in 1975. We find this pattern suspect, and are unwilling to take it at face value, the more so since this category also includes statistical discrepancies and other unspecified errors.[2] We conjecture instead that some systematic difference in treatment by the Census Bureau in 1975 is the major factor explaining the average difference between that year and all others. The dummy variable, taking the value 1 if the SMSA was surveyed in 1975 and zero otherwise, is an attempt to adjust the data for this pattern. It is admittedly crude, but it does appear to "work," in the sense that when it is included, the coefficient of determination rises substantially and several other variables have coefficients that are larger than their standard errors, with the signs predicted by our model.

Both income and the rate of growth are significant at about the 15 percent level, with the expected signs. There are fewer conversions, or more mergers, in high-income areas, and more conversions in rapidly growing ones. The coefficient of the growth in minority households also has the expected positive sign, but is barely larger than its standard error.

Both private and government construction have negative coefficients, but neither is larger than its standard error. Disaggregations of government construction by program type, and inclusion of construction during the 1960s, did not change these results.

Because the sign of the coefficient of the increase in non-husband-wife households is so inherently implausible, we re-estimated regression RC2 without it. The results are more reasonable: the rate of growth is nearly significant, and both the rate of private construction and the

level of income are significant at the 10 percent level. All of these variables have the expected signs. Except for the low coefficient of determination, we would find this a "good" regression, if we did not already know that the results are not robust when the rate of growth in non-husband/wife households is included. As it is, the whole analysis of conversions is demonstrating data problems, rather than illuminating housing market phenomena, to an undesirably large extent.

The Rate of Private New Construction

Our basic analytical procedure is to estimate losses and conversions separately and then combine them with the Census Bureau's household formation rates to derive a projection for the rate of housing construction. However, we also attempted to analyze the rate of private new construction directly, as a function of economic and demographic variables. For reasons which will become clear, we are less satisfied with this approach than with either the traditional or analytical method, but the results nonetheless provide insight into the differences between housing market behavior over a five-year period, and over a decade, which have implications for the forecasts which we derive in the next chapter.

Many of the variables included in the analysis are similar to those used in the study of losses and conversions. Most importantly, the rate of new construction depends on the rate of household formation. Indeed, it is likely that they are simultaneously determined, since households cannot form unless housing units are somehow made available, and housing units will not be provided unless there is a reasonable expectation that households will want to live in them. We attempted to construct and

test such a simultaneous model, but the results proved unsatisfactory and are not reported.

In addition, the rate of private new construction should be related to the rate of public new construction. The relationship is probably negative, for reasons of both demand and supply. Households which live in publicly provided units will not be available to live in private ones, so that fewer private units will be built (or, alternatively, vacancy rates and loss rates will be higher). On the supply side of the market, the public units will compete for resources with private builders, putting pressure on the available supply of labor, raw materials, land, and financing. These effects may vary by program, particularly the financial relationships, since private housing is financed through different institutional relationships than public housing, but in a manner similar to privately owned but publicly subsidized rental housing (such as Section 236 or Section 221).

We include the same demand factors as in the loss and conversion models. We expect new construction to be a positive function of income. For given income levels and rates of household formation, we expect new construction to be positively related to the increase in elderly households, and negatively to the increases in minority and non-husband/wife households. The elderly are likely to have greater purchasing power than their current incomes suggest, and the other groups less.

Table 13 first reports the results of a regression including only the significant variables; the demographic factors proved insignificant and are omitted. This regression is sufficient to illustrate the limitations of the analysis. It shows a very strong relationship between

TABLE 13

RATE OF PRIVATE NEW CONSTRUCTION (NC):
59 SMSAS FOR 1970-1974 ('75,'76)

Variable	RP1	RP2
Intercept	0.889 (7.342)	0.914 (8.034)
Y_g	0.140 (2.536)	--
HH	0.900 (20.685)	0.970 (25.989)
S_{70}	0.453 (1.574)	--
	$R^2 = 0.9333$	$R^2 = 0.9222$

VARIABLE DEFINITIONS:

NC = rate of private new housing construction

Y_g = rate of growth of median household income

HH = rate of growth of households

S_{70} = rate of subsidized housing construction, 1970-1976

household formation and housing construction. The coefficient is highly significant statistically, in the sense that it is clearly different from zero; however, a more appropriate test in this instance would be the difference from unity, and by this test the coefficient is significantly negative. The rate of growth of real income has the expected positive coefficient, but the public construction variable does also, which seems implausible.

These results indicate that the regression is probably not measuring long-run relationships. The coefficient of the household growth rate indicates that the private construction of housing amounts to about 96 units for every 100 new households. This is obtained by multiplying the coefficient by 1/1-v, where v is the normal metropolitan vacancy rate during the 1970s (6.6 percent). Over an extended period of time, such a construction rate is impossibly low. It implies that some part of the increase in households must be housed by a reduction in vacancies, conversions, or units created from non-residential structures, and that these sources must also provide replacements for units lost from the inventory.

When income growth and subsidized production are omitted, in regression RP2, the coefficient of household formation rises by enough so that the results imply some production in excess of household formation--104 new units for every 100 households. While technically possible, this rate of production is still extraordinarily low. Historically, the ratio of new construction to new households has been around 1.35 to 1.40 during each decade of the postwar period.[3]

Also, it is hard to believe that private and subsidized housing can be complementary in the long run, for the reasons previously discussed. At most, they would be unrelated.

It seems most likely that these results represent a short-run response to growth, a disequilibrium situation in which the full private response has not yet occurred, and that both public and private building have been concentrated in growth areas, but have not been enough to meet the demand.

The implication of these results for our forecasts will be discussed in detail in the next chapter.

VI. THE DEMAND FOR NEW HOUSING CONSTRUCTION: "ANALYTICAL" METHOD FORECAST

We turn now to the process of forecasting the components of inventory change during the 1980s. As described in Chapter IV, our procedure begins by multiplying the coefficients of each variable in the loss and conversion regressions by the assumed change in the variable over the decade of the 1980s. The assumptions used are stated at the end of that chapter. The products are summed for both the loss and conversion regressions, and the summations in turn added to the rate of new household formation, taken from the Census Bureau's projections and adjusted for vacancies. The result of this procedure is the forecast rate of new construction for metropolitan areas over the decade. We also estimate loss and conversion rates.

In order to derive a national rate of new construction, we assume that construction in non-metropolitan areas will occur proportionately with that in metropolitan areas, given the differences in projected new household formation.

The Simultaneity of Construction, Losses and Conversions

At first sight, this procedure runs immediately into an obvious difficulty. We are trying to forecast new construction, but two of the four components of new construction--losses and conversions--have been shown in the empirical work to be determined in part by the rate of new construction, as well as helping to determine it. The rate of new

construction is especially important in the loss rate. Stated technically, new construction, losses, and conversions are all simultaneously determined, and must be forecast simultaneously.

Fortunately, this problem is more apparent than real. There is no algebraic difficulty in making a simultaneous forecast of all three, and the relationship among them is very straightforward.

The rate of new construction can be written as the sum of the four components listed in Table 1:

(1) $NC = HH + V + L - C$

where

NC = new construction

HH = net household formation

V = additional vacancies to accommodate the new households

L = replacement for units lost from the inventory

C = units added through conversions, less mergers, plus units added from non-housing sources.

In the regressions, new construction, losses, and conversions are all expressed as annual rates of the average housing stock during the period; we therefore state all variables in equation (1) in similar units. Since the vacancy rate is assumed constant as a fraction of the stock, it is possible to rewrite HH + V as HH/1 - v, where v is the vacancy rate.

The next step is to segregate the effect of private new construction on the loss and conversion rates from the effects of the other independent variables:

$$(2)\quad L = \sum_{i=1}^{n-1} b_i l_i + b_n NC$$

$$C = \sum_{j=1}^{m-1} b_j c_j + b_m NC$$

The subscripts i and j refer to the variables in the loss and conversion regressions, respectively.

Substituting these expressions in (1) and collecting the terms in NC on the left-hand side of the equation, we get

$$(3)\quad NC\,(1 - b_n + b_m) = \frac{HH}{1-v} + \sum_{i=1}^{n-1} b_i l_i - \sum_{j=1}^{m-1} b_j c_j$$

This equation is then divided by $(1 - b_n + b_m)$ to determine the value of NC:

$$(4)\quad NC = \frac{HH}{(1-v)(1-b_n+b_m)} + \frac{\sum_{i=1}^{n-1} b_i l_i}{(1-b_n+b_m)} - \frac{\sum_{j=1}^{m-1} b_j c_j}{(1-b_n+b_m)}$$

Our projections are based on the assumption that the usual vacancy rate of the 1970s will remain the norm during the 1980s. We attempted to analyze the vacancy rate in a manner analogous to that used for losses and conversions, but the results were unsatisfactory. We were able to identify short-term factors affecting vacancies, notably the rate of new construction itself, but not long-term or structural reasons for differences between metropolitan areas.

Forecasting: Rates of Construction, Loss and Conversion

It should be clear from the foregoing that the precise forecasts of construction, loss, and conversion, will all depend on which regressions are used for the purpose. What may be less obvious is that the use of a different regression for either losses or conversions will affect the forecast rates of both, and the forecast rate of new construction as well.

Table 14 illustrates this interrelationship, as well as indicating the range of forecasts which result from our statistical work. Each panel of the table presents the results for a different pair of loss and conversion regressions. Six different forecasts are provided for each pair; each forecast is based on a different combination of economic and demographic assumptions. For purposes of comparison, the table also includes the metropolitan area rates from our traditional forecast, calculated from data in Tables 1, 3, and 8. Only the demographic assumptions are varied in the traditional approach, so only three forecasts are generated.

Panel A reports the calculated rates from regressions RL3 and RC2, which are limited to the more significant variables. All of the forecasts vary quite dramatically from the traditional ones. The analytical forecasts of construction rates are much lower, by one-quarter to one-third. The forecast loss rates are also low, by similar percentages. By contrast, the conversion rates are far higher--from 9 to 14 times the traditional rates. The forecast implies that an extraordinarily large share of the desired new housing units will be met by conversions or other sources, and an unusually large share will come from a lower

TABLE 14

FORECAST METROPOLITAN CONSTRUCTION, LOSS, AND CONVERSION RATES FOR THE 1980S

	Optimistic Scenario			Pessimistic Scenario			Traditional Forecast		
	A	B	D	A	B	D	A	B	D
Panel A--regressions RL3 and RC2									
Construction rate	2.11	1.86	1.35	2.16	1.91	1.41	2.76	2.57	2.21
Loss rate	.63	.63	.62	.77	.77	.77	.89	.90	.92
Converstion rate	(.44)	(.49)	(.61)	(.53)	(.58)	(.69)	(.06)	(.06)	(.06)
Panel B--regressions RL3 and RC3									
Construction rate	2.48	2.30	1.96	2.45	2.27	1.93	2.76	2.57	2.21
Loss rate	.70	.71	.73	.82	.84	.86	.89	.90	.92
Conversion rate	(.14)	(.13)	(.10)	(.29)	(.28)	(.26)	(.06)	(.06)	(.06)
Panel C--regression RL3 (RC = .06)									
Construction rate	2.57	2.38	2.01	2.73	2.54	2.17	2.76	2.57	2.21
Loss rate	.71	.72	.74	.87	.88	.90	.89	.90	.92
Conversion rate	(.06)	(.06)	(.06)	(.06)	(.06)	(.06)	(.06)	(.06)	(.06)
Panel D--regression RL3 (RC = .22)									
Construction rate	2.38	2.18	1.82	2.54	2.35	1.98	2.76	2.57	2.21
Loss rate	.68	.69	.70	.84	.85	.87	.89	.90	.92
Conversion rate	(.22)	(.22)	(.22)	(.22)	(.22)	(.22)	(.06)	(.06)	(.06)
Panel E--regressions RL3 and RC2, adjusted for "back forecast" error									
Construction rate	2.72	2.52	2.18	2.89	2.64	2.30	2.76	2.57	2.21
Loss rate	.88	.90	.97	1.08	1.04	1.11	.89	.90	.92
Conversion rate	(.09)	(.10)	(.12)	(.10)	(.12)	(.14)	(.06)	(.06)	(.06)

NOTE: Rates are expressed as annual percentages of the average stock during the decade.

loss rate. The same calculations for regressions RL2 and RC1, with all variables from the model, yield similar results, with slightly lower construction rates and slightly higher conversions.

It is worth reiterating that all of these results depend on the choice of both loss and conversion regressions. From the empirical work, the conversion regressions seem much the less reliable. We therefore derived forecasts for our preferred loss regression, RL3, with other conversion regressions. Panel B shows the forecasts when regression RC3 is used. This regression omits the rate of growth of non-husband/wife households, which consistently had the "wrong" sign. The forecasts in panel B are quite different. The rates of new construction are much higher, though still below the traditional forecast rates, and the rates of conversions are less than half as high. The loss rates are also somewhat higher. These results seem more reasonable, based on past experience, but are based on a set of relationships which do not persist when the rate of non-husband/wife households is included in the regression, and are therefore not firmly based in our empirical work.

Since the conversion regressions are suspect, while the loss analysis seems reasonable, a better approach than either of these might be to ignore the conversion regression entirely, simply assuming a conversion rate based on historical experience and then estimating new construction and losses simultaneously. Panels C and D show these results, for the assumption that conversions add .06 and .22 percent to the stock annually, respectively. The former is the rate used in the traditional forecast; it is also the rate experienced during the 1960s. The latter is approximately the actual metropolitan rate in both the 1950s and 1970s (through

1977). In Panel C, both the rate of new construction and the loss rate are now very slightly below the traditional forecasts for the pessimistic scenario, but they are rather close to the forecasts in Panel B for the optimistic one. For Panel D, both scenarios yield results similar to those in Panel B. Clearly the choice of assumptions about conversion rates makes some difference in the forecasts.

For all forecasts except Panel B, the optimistic scenarios generate lower rates of new construction, losses, and conversions, where the last category is forecast rather than assumed. In Panel B, the pattern is reversed for new construction, but holds for the other rates. The loss and conversion rates are consistently lower because income has a negative effect on both rates. The effect on new construction depends on the relative impact of income on losses and conversions, since they have opposite effects on the housing stock.

These forecasts are of course subject to statistical error. They are point estimates of the rates of new construction, loss, and conversion, derived from regressions which relate these phenomena to economic and demographic factors. Since there is a standard error of estimate for each regression, we have a corresponding standard error applicable to each forecast. Indeed, there is more than one standard error associated with each regression, since the error also depends on the set of assumptions used in the forecast. The error is greater, the farther outside past experience are the forecast assumptions.

The standard errors on the loss rate forecasts are not large. For the optimistic scenarios in regression RL3, they are all about .02, compared to an estimated mean loss rate of .62 to .77; for the pessimistic,

they are about .025, compared to an estimated mean of .77 to .90. The 95 percent confidence interval is thus about .04 to .05 on each side of the point estimate of the loss rate.

For conversions, the errors are larger, about .035 to .04 for the optimistic scenarios of regression RC2, and .028 to .035 under the pessimistic. The confidence interval is thus from .055 to .08 on either side of the point estimates, which range from .44 to .69.

Neither of these ranges seems too large to invalidate our methodological approach. We generate estimates which may be in error by as much as five or six percent for the loss rate, and 12 percent for conversions. We conjecture that our forecasts are more likely to be proved wrong because our assumptions about the future are not borne out, than because of the statistical errors in our regression results.

The numbers in Table 14 are expressed as annual rates of construction, loss or conversion, as a fraction of the average stock over the decade. Table 15 translates these rates into levels of new construction during the 1980s. This facilitates comparison with the levels forecast by the traditional method. The three panels correspond to the first three panels in Table 14.

In Panel A, the optimistic scenarios imply a volume of new construction that is from 4.0 to 4.5 million units lower than the traditional forecast, while the pessimistic scenarios differ by 3.7 to 4.2 million. Losses are 1.5 to 1.7 million units lower under the optimistic scenarios, and 800,000 to 1.0 million under the pessimistic, while conversions are forecast to be higher by from 2.5 to 4.0 million units.

TABLE 15

FORECAST METROPOLITAN NEW HOUSING CONSTRUCTION, LOSSES, AND CONVERSIONS DURING THE 1980S
(in thousands of units)

	Optimistic Scenario			Pessimistic Scenario			Traditional Forecast		
	A	B	D	A	B	D	A	B	D
Panel A--regressions RL3 and RC2									
New units	13,639	11,852	8,371	13,963	12,171	8,743	17,848	16,378	13,763
Losses	4,072	4,014	3,845	4,977	4,907	4,775	5,752	5,734	5,697
Conversions	(2,844)	(3,233)	(3,783)	(3,426)	(3,696)	(4,279)	(339)	(338)	(335)
Panel B--regressions RL3 and RC3									
New units	16,031	14,656	12,154	15,837	14,465	11,968	17,848	16,378	13,763
Losses	4,525	4,524	4,527	5,225	5,353	5,460	5,752	5,734	5,697
Conversions	(905)	(828)	(620)	(1,875)	(1,784)	(1,612)	(339)	(338)	(335)
Panel C--regression RL3 (RC = .06)									
New units	16,613	15,166	12,464	17,647	16,185	13,456	17,848	16,378	13,763
Losses	4,590	4,588	4,589	5,624	5,608	5,581	5,752	5,734	5,697
Conversions	(339)	(338)	(335)	(339)	(338)	(335)	(339)	(338)	(335)
Panel D--regression RL3 (RC = .22)									
New units	15,385	13,891	11,286	16,419	14,975	12,278	17,848	16,378	13,763
Losses	4,396	4,397	4,341	5,430	5,416	5,395	5,752	5,734	5,697
Conversions	(1,422)	(1,402)	(1,364)	(1,422)	(1,402)	(1,364)	(339)	(338)	(335)

In Panel B, the analytical forecast rates of new construction are all less than 2 million units below the traditional forecast rates. Losses are from 1.1 to 1.2 million lower in the optimistic scenarios, and 200,000 to 500,000 lower in the pessimistic ones. Conversions are 300,000 to 600,000 higher in the optimistic scenarios, and 1.3 to 1.5 million higher in the pessimistic. These results are all much closer to the traditional forecast.

In Panel C, new construction and losses are closer still. The optimistic scenarios generate new construction of about 1.2 million fewer units, the pessimistic, only 200,000 to 300,000 fewer. Losses under the optimistic scenarios are close to those in Panel B, while under the pessimistic ones they are all about 125,000 lower than the traditional forecast. Panel D results are fairly close to Panel B.

"Forecasting" the Past

Since our forecast rates of losses and conversions are quite different from those which have prevailed in the past, we have constructed a check on the validity of the empirical work by using the results shown in Tables 11 and 12 to make a "back forecast" of losses and conversions for the decade of the 1960s. The procedure is the same as that used in the forecasts for the future: the coefficients of the variables are multiplied by the actual values of the independent variables that were observed during the decade. Since we deal with the past rather than the future, there is no need for any alternative sets of assumptions.

For regressions RL3 and RC2, the pair used in Panel A, the predicted loss rate is .85 percent, well below the actual rate of 1.03 percent. For conversions, the predicted rate is .35, very far above the historical

rate. It thus appears that our model probably underestimates losses and overestimates conversions. The latter is not surprising, given the data problems, but the former is more disturbing. However, the back forecast is not quite comparable to actual experience. Our variable for minority households during the 1970s includes both black and Hispanic households. The 1960 Census, however, did not publish information on Hispanic households for all metropolitan areas, so that we cannot construct a rate of change for the 1960s, using our definition of minority households.

In an attempt to overcome this difficulty, we re-estimated regression RL3 from Table 11, including the increase in black households only, instead of the increase in black and Hispanic households combined, and then used the results to predict the loss rate during the 1960s. The forecast rate was .92 percent, markedly closer to the actual rate but still below it.

The back forecast can be used to adjust the regression results and generate alternative forecasts for the 1980s. One procedure for doing this is to multiply all the coefficients in the loss and conversion regressions by the ratio of the actual 1960s' rates to the back forecast (1.30 and .22, respectively). Panel E of Table 14 reports the forecasts generated when these adjustments are made to regressions RL3 and RC2, the regressions used in Panel A. The forecast construction rates now bracket the traditional forecast, with the optimistic scenario generating slightly lower forecasts and the pessimistic, slightly higher. The loss rate projections for the optimistic scenario and the Series A and B demographic assumptions are virtually identical to the 1960s' rate, while the others are slightly higher. The forecast conversion rates are

two to three times higher than experienced in the 1960s, but far closer to that experience than any other forecast.

By these comparisons to the traditional forecast rates, we do not intend to convey the notion that the traditional forecast is the "right" one. If it were, we would have no need to conduct the kind of analysis that has comprised the last four chapters. The purpose is to demonstrate that our analytical approach yields results which are not outlandish, but which are to some extent at variance with historical patterns. We think the main reason for the extreme difference in the conversion forecasts is the limitations of the conversion data, which in turn affect both the new construction and loss rate forecasts as well, because of the interrelated nature of all three. Even our highest conversion rates, for that matter, are fairly close to the experience of the 1970s, as reported in the AHS.

An alternative explanation for the differences between our results and past experience is the different time periods of the analysis and the forecast. We analyze changes over five years, on average, and predict over ten. Given the long-lived nature of the housing stock and the gradual process of adjustment in the housing market to exogenous changes, it may be that the forecast period is too long. Support for this view comes from the analysis of private new construction, reported in Table 13 in the preceding chapter. That pattern cannot possibly continue over a long time period, yet it appears to represent the early 1970s quite well.

The obvious method of investigating this hypothesis is to wait for the 1980 Census of Housing, and investigate changes over the full decade.

This of course cannot be done for several years, but it is a fruitful avenue for further work.

Forecasting the National Demand for New Construction

It should be stressed that our results are directly applicable only to metropolitan areas. The data used in the statistical analysis of loss and conversion rates are for 59 metropolitan areas only. We believe it is reasonable to make inferences about all metropolitan areas from our analysis, but it is far less appropriate to extend them to nonmetropolitan areas.

For policy purposes, however, the metropolitan forecasts standing alone are of limited value. Virtually all past forecasts have presented estimates for the nation as a whole rather than for geographic units within it. Thus it is not possible to compare our results with most other work in the field. To provide some basis for comparison, we have therefore developed rough overall national estimates, by extending our results for metropolitan areas to the rest of the country.

One rule of thumb for generating national figures is to assume that the forecast rates from our analytical approach would bear the same relationship to the traditional forecast rates for both metropolitan and nonmetropolitan areas. All the nonmetropolitan rates are in fact higher. For Series B, for example, our traditional forecast in nonmetropolitan areas is that the rate of new construction will be 3.03 percent of the housing stock annually, compared to 2.57 percent in metropolitan areas. We therefore multiply our metropolitan Series B forecast rates by 1.18 (3.03/2.57) to obtain the nonmetropolitan rates. Similarly, we assume

that the nonmetropolitan loss rate bears the same ratio to the metropolitan rate as it did in the 1960s (1.15). The nonmetropolitan conversion rate was five times the metropolitan rate.

Table 16 shows the results of this admittedly crude procedure for the first three metropolitan projections in Table 14. The top panel of Table 16, like Panel A of Table 14, uses regressions RL3 and RC2. As is to be expected, the level of new production is well below the traditional forecast, by from 6.5 to 8.7 million units over the decade. The difference is due primarily to the extraordinarily high volume of units added from conversions and other sources, amounting to between 10 and 15 million units, or 8 to 12 times the traditional forecast. This level almost certainly cannot be sustained over a long period of time. The most unlikely of these results are the forecasts for the Series D demographic assumptions, both of which predict a higher volume of units added from conversions and other sources than through new construction.

More reasonable numbers appear in Panel B. The forecast volume of new construction ranges from 19.6 to 25.6 million units, about 2.5 to 3.3 million units lower than the traditional forecast. The forecast level of conversions is also much lower, particularly under the optimistic scenarios, but still is from two to six times as great as in the traditional forecast.

In Panel C, the optimistic forecasts are about two million units below the traditional ones, and the pessimistic forecasts within about 300,000 to 400,000 units. The Panel D optimistic forecasts are about four million units below the traditional, and the pessimistic forecasts about 2.3 million.

TABLE 16

ANALYTICAL FORECAST OF THE NATIONAL VOLUME OF NEW CONSTRUCTION, LOSSES, AND CONVERSIONS DURING THE 1980S
(in thousands of units)

	Optimistic Scenario			Pessimistic Scenario			Traditional Forecast		
	A	B	D	A	B	D	A	B	D
Panel A--regressions RL3 and RC2									
New units	22,071	19,303	13,710	22,596	19,823	14,309	28,936	26,660	22,445
Losses	6,568	4,474	6,203	8,027	7,913	7,703	9,139	9,110	9,050
Conversions	(10,423)	(11,429)	(13,868)	(12,555)	(13,531)	(15,437)	(1,241)	(1,235)	(1,227)
Panel B--regressions RL3 and RC3									
New units	25,941	23,870	19,905	25,627	23,559	19,600	28,936	26,660	22,445
Losses	7,298	7,296	7,303	8,473	8,553	8,750	9,139	9,110	9,050
Conversions	(3,316)	(3,035)	(2,273)	(6,870)	(6,537)	(5,911)	(1,241)	(1,235)	(1,227)
Panel C--regression RL3 (RC = .06)									
New units	26,883	24,700	20,413	28,556	26,360	22,038	28,936	26,660	22,445
Losses	7,403	7,399	7,403	9,071	9,044	9,003	9,139	9,110	9,050
Conversions	(1,241)	(1,235)	(1,227)	(1,241)	(1,235)	(1,227)	(1,241)	(1,235)	(1,227)
Panel D--regression RL3 (RC = .22)									
New units	24,896	22,624	18,497	26,559	24,389	20,122	28,936	26,660	22,445
Losses	7,080	7,081	6,989	8,785	8,722	8,686	9,139	9,110	9,050
Conversions	(2,249)	(2,236)	(2,156)	(2,249)	(2,236)	(2,156)	(1,241)	(1,235)	(1,227)

The forecasts in Panels A and B are so high because of the assumption that the nonmetropolitan conversion rate is five times the forecast analytical metropolitan rate. Since our metropolitan forecasts of conversion rates are large by historical standards, and nonmetropolitan rates have historically been higher than those in SMSAs, the rule-of-thumb procedure generates ludicrous results. Another way of developing the national forecast is to combine the results of the analytical method for metropolitan areas with the traditional one for nonmetropolitan areas. This forecast is shown in Table 17. The forecast rate of new construction is still about 4 to 5 million units below the traditional forecast in Panel A, and the conversion rate is still three to four times as high, but the results are much more plausible. The other panels are similarly much closer to the traditional rate.

Given the problems with the conversion regressions, we believe that our best forecasts are probably the Panel C or D figures in Table 17. These are based on our analysis of loss rates in metropolitan areas, which implies a corresponding set of new construction rates. The range of forecasts is quite wide--from 21 to 29 million units, or 2.10 to 2.87 million per year. This occurs because of the range of demographic projections developed by the Census Bureau. If we exclude the Series D forecasts, on the grounds that they are based on an improbably low rate of household formation, the forecast is for 24 to 29 million, or 2.42 to 2.87 million per year.

These forecasts use the traditional methodology in nonmetropolitan areas. Our analytical adjustment procedure, shown in Table 16, results in slightly lower numbers for Panel D, around 1 to 1.5 million units over the decade, but no appreciable change for Panel C.

TABLE 17

FORECAST OF THE NATIONAL VOLUME OF NEW CONSTRUCTION, LOSSES, AND CONVERSIONS DURING THE 1980S: "ANALYTICAL" METROPOLITAN AND "TRADITIONAL" NONMETROPOLITAN RESULTS COMBINED
(in thousands of units)

	Optimistic Scenario			Pessimistic Scenario			Traditional Forecast		
	A	B	D	A	B	D	A	B	D
Panel A--regressions RL3 and RC2									
New units	24,727	22,134	17,113	25,051	22,453	17,485	28,936	26,660	22,445
Losses	7,459	7,390	7,198	8,364	8,283	8,128	9,139	9,110	9,050
Conversions	(3,746)	(4,019)	(4,675)	(4,328)	(4,593)	(5,038)	(1,241)	(1,235)	(1,227)
Panel B--regressions RL3 and RC3									
New units	27,119	25,938	20,896	26,925	24,747	20,710	28,936	26,660	22,445
Losses	7,912	7,900	7,880	8,612	8,729	8,833	9,139	9,110	9,050
Conversions	(1,807)	(1,725)	(1,512)	(2,777)	(2,681)	(2,504)	(1,241)	(1,235)	(1,227)
Panel C--regression RL3 (RC = .06)									
New units	27,701	25,448	21,236	28,735	26,447	22,198	28,936	26,660	22,445
Losses	7,977	7,964	7,942	9,011	8,984	8,934	9,139	9,110	9,050
Conversions	(1,241)	(1,235)	(1,227)	(1,241)	(1,235)	1,227)	(1,241)	(1,235)	(1,227)
Panel D--regression RL3 (RC = .22)									
New units	26,473	24,173	20,028	27,507	25,257	21,020	28,936	26,660	22,445
Losses	7,783	7,773	7,694	8,688	8,666	8,624	9,139	9,110	9,050
Conversions	(2,324)	(2,188)	(2,256)	(2,906)	(2,762)	(2,619)	(1,241)	(1,235)	(1,227)

VII. CHANGES IN HOMEOWNERSHIP

Our analysis of change in tenure choice follows the same procedure as the work on the components of inventory change and substandard housing. We first develop a model of the tenure choice decision, using the same basic analytical framework as in the earlier work, and many of the same variables. We again combine the results of our analysis with various assumptions about economic and demographic changes during the 1980s to make our forecasts of ownership rates in 1990.

The Model

A substantial body of literature exists on the subject of tenure choice. This research generally focuses on economic and demographic aspects of households as determinants of tenure choice, and ignores relative prices, construction costs, and government programs.[1] In economic terms, it analyzes the demand side of the market for ownership or renting, and omits or scants the supply side. Our model attempts to remedy this deficiency, at least in part. We analyze the tenure choice decision as a function of factors affecting both the demand for a particular form of tenure--in our case, ownership--and the supply.

As in the case of the components of inventory change, we analyze the changes in tenure during the early 1970s, since our purpose is to forecast changes during the 1980s. We also are concerned that an analysis of the incidence of particular tenure forms may miss changes in the behavior of various groups in the population.

Our demand variables are conventional ones. Following many previous studies, we hypothesize that the incidence of homeownership rises with income, other things being equal. We attempt to account for the effects of permanent and transitory income in the same manner as in the basic model.

We employ several demographic variables, again following previous work. These include a measure of the age distribution of the population --the proportion of households headed by an elderly person; a measure of household composition--the proportion of non-husband/wife households; and a measure of race--the proportion of minority households (defined as black or Hispanic). We expect ownership to be higher among elderly households, because they are likely to have greater assets for a given income level than younger households. For the same reason, we expect ownership to be lower among non-husband/wife households and minority households. Ownership may also be lower among non-husband/wife households because of smaller demands for space associated with their smaller household size.

Two variables attempt to measure the degree of tightness of the housing market. These are the rate of household growth during the 1970s, and the ratio of new construction to net household formation during the 1960s. We hypothesize that the former will be negatively related to the change in ownership, if it has any effect, because the new households are likely to first occupy rental units, particularly if they are migrants from other areas.[2] The latter is expected to measure whether, and by how much, the housing market is in disequilibrium at the beginning of the period. The higher this ratio, the more likely it is that households were able to

satisfy their housing preferences during the 1960s, and therefore the less pent-up demand for homeownership there will be.

Our empirical work relates changes in tenure over the early 1970s to changes in the various economic, demographic, and other variables. We expect, however, that the increase in homeownership will be smaller for a given change in any economic or demographic phenomenon, if the incidence of ownership is high initially. We therefore include the 1970 incidence in our statistical work.

The final variable in the demand function is the relative price of owning versus renting. As in any other demand function, we expect the demand for homeownership to be a negative function of its price, and a positive function of the price of renting; since the relevant price is the ratio of the two, we expect demand to be a negative function of that ratio.

We have been forced to omit one factor which we consider potentially very important during the 1970s: the increasing recognition of the advantages of homeownership as a hedge against inflation, which we believe has been a major factor contributing to the rapid increase during the period.[3] Unfortunately, as noted in Chapter IV, we do not have data on the differences in inflation rates across SMSAs. The Bureau of Labor Statistics has priced out a typical market basket of commodities for many large metropolitan areas, for several dates during the past decade, but the difference in the cost between areas is almost entirely the difference in the cost of housing.[4] Thus the relative changes in this market basket between cities over time are simply the relative changes in the cost of housing. Instead of measuring inflation by these changes, we are merely

measuring the effect of the increase (or decrease) in the price of housing relative to other goods and services. The relative price of housing is very important in explaining the changes in the overall market for housing, but is not particularly likely to have any effect on tenure choice.

In addition to the conceptual limitations of the BLS market basket, its usefulness for this project is limited by the fact that it is compiled for only 27 metropolitan areas in our sample. Despite these problems, we included it in preliminary regressions, substituting the nearest similar SMSA for those for which the market basket data are not collected, but it proved consistently insignificant.

The supply function includes the relative price of owning, with the effect of price being the opposite of the demand function. It includes another variables that is in the demand function as well; the change in minority households, to test for the presence of discrimination, particularly in mortgage markets.

The supply function also contains the relative cost of producing owned versus rental housing. This is measured by the change in the Boeckh Index of construction costs of single-family houses, relative to the change for apartment buildings. We lack cross-section measures of change in other components of cost.

Finally, we include the subsidized housing production by the federal government. We are able to differentiate the housing units by program, and to separate the homeownership program (Section 235) from the various rental and public housing programs. We expect Section 235 to increase the extent of homeownership, if it is effective, while the rental programs may indirectly lower the incidence by competing for the same

resources that are used to build homes. However, if these resources are available at constant cost, the subsidized rental programs will probably have no effect on the incidence of homeownership.

Mathematical Formulation of the Model

The model described in the previous section can be written algebraically in two equations:

$$(1)\quad O_d = a + b_1 P_o/P_r + B_2 Y_g + b_3 Y + b_4 E + b_5 M + b_6 R + b_7 HH + b_8 O_{70}$$

$$(2)\quad O_s = c + d_1 P_o/P_r + d_2 B_o/B_r + d_3 R + d_4 S_o + d_5 S_r + d_6 D$$

where the variables are defined as follows:

O_d = change in the demand for homeownership since 1970

O_s = change in the supply of owner-occupied units since 1970

P_o/P_r = change since 1970 in the price of owning relative to renting

Y_g = change in real income since 1970

Y = median household income in 1975 (adjusted from 1974 and 1976 where necessary)

E = change in the incidence of elderly households since 1970

R = change in the incidence of minority households since 1970

HH = rate of growth of the metropolitan area since 1970

O_{70} = incidence of homeownership in 1970

B_o/B_r = change in the Boeckh Index for single-family homes relative to the change for apartment buildings, since 1970

S_o = share of the housing stock that consists of subsidized owner-occupied homes (Section 235)

S_r = share of the housing stock that consists of subsidized rental units produced since 1970

D = ratio of new construction to net new household formation, 1960-1970.

The expected signs of the coefficients are: positive for b_2, b_4, and b_8, and negative for the others in the demand equation; positive for d_1 and d_4, and negative for the others in the supply equation. The constant terms are indeterminate.

This model can be estimated either as a simultaneous system, or in a reduced form for the change in homeownership. We have chosen the latter approach because we feel that the available data on the relative prices of owning and renting are inadequate for our purposes. The only cross-section data are the Consumer Price Index homeownership and rent components, which are not available for all of the SMSAs in our sample. We attempted to substitute the indices for nearby similar metropolitan areas for those not included in the CPI sample, but the results were unsatisfactory. Restricting the analysis to the 23 areas included in both the CPI and AHS yields too small a sample.

The reduced form approach has the merit of providing direct estimates of the impact of individual variables on the incidence of homeownership, which is the focus of our interest. Thus even without data problems, we would find it desirable to estimate the reduced form, for forecasting purposes.

The reduced form can be derived in the same manner as in the model of substandard housing and losses, by solving equations (1) and (2) for P_o/P_r, and substituting the resulting expression back into either

equation. When this is done, the reduced form is as follows:

$$(3)\quad O = \frac{a^{d_1}-c^{b_1}}{d_1-b_1} + \frac{d_1 b_2}{d_1-b_1} Y_g + \frac{d_1 b_3}{d_1-b_1} Y + \frac{d_1 b_4}{d_1-b_1} E + \frac{d_1 b_5}{d_1-b_1} M +$$

$$\left(\frac{d_1 b_6 - b_1 d_3}{d_1-b_1}\right) R + \frac{d_1 b_7}{d_1-b_1} HH - \frac{b_1 d_6}{d_1-b_1} D + \frac{d_1 b_8}{d_1-b_1} O_{70} -$$

$$\frac{b_1 d_2}{d_1-b_1} B_o/B_r - \frac{b_1 d_4}{d_1-b_1} S_o - \frac{b_1 d_5}{d_1-b_1} S_r$$

Since d_1 is positive and b_1 is negative, the denominator of each coefficient is positive. The coefficients therefore have the same sign in the reduced form as in the demand equation, and the opposite sign as in the supply equation. The coefficient of R, the change in racial minority households, which appears in both equations, is negative. The constant term is again indeterminate.

Statistical Results

Our dependent variable is the annual percentage change in the fraction of households which are homeowners; it is thus the change in the incidence from 1970 to 1974, 1975, or 1976, divided by the percentage in 1970. This formulation of the variable proved most efficacious in the statistical work. The demographic variables representing rates of change are therefore expressed in the same manner, for consistency.

Table 18 reports the results of the statistical analysis. The first regression is the reduced form, equation (3), including insignificant variables. The second deletes three variables with coefficients smaller

TABLE 18

CHANGE IN HOMEOWNERSHIP (RPOWN):
59 SMSAS FOR 1970-1974 ('75,'76)

Variable	RP01	RP02	RP03
Intercept	7.630 (2.040)	7.265 (2.065)	7.307 (1.961)
Y_g	-0.036 (-0.659)	-0.041 (-0.786)	-0.046 (-0.846)
Y	0.048 (0.987)	0.049 (1.147)	0.077 (1.430)
HH	0.059 (1.338)	0.071 (1.918)	0.072 (1.608)
M	-0.274 (-3.194)	-0.267 (-3.216)	-0.311 (-3.448)
R	-0.042 (-1.311)	-0.038 (-1.254)	-0.035 (-1.083)
E	0.092 (1.763)	0.084 (1.707)	0.078 (1.462)
O_{70}	-0.041 (-4.736)	-0.041 (-5.074)	-0.039 (-4.599)
D	-0.092 (-0.510)	--	-0.075 (-0.417)
S_r	0.341 (0.608)	--	0.226 (0.400)
S_o	0.048 (0.122)	--	0.107 (0.270)
B_1/B_r	-4.506 (-1.395)	-4.259 (-1.368)	-4.740 (-1.474)
P_o/P_r	--	--	0.099 (1.258)
	$R^2 = 0.5240$	$R^2 = 0.5181$	$R^2 = 0.5399$

TABLE 18 - VARIABLE DEFINITIONS

RPOWN	=	rate of change in homeownership rate
Y_g	=	rate of growth of median household income
Y	=	median household income
HH	=	rate of growth of households
M	=	rate of growth of percent non-husband/wife households
R	=	rate of growth of percent minority households
E	=	rate of growth of percent households with heads 65 or older
O_{70}	=	percent of housing units owner-occupied
D	=	ratio of new housing construction to net household formation
S_r	=	percent of housing stock in subsidized rent programs
S_o	=	percent of housing stock in HUD 235 program
B_o/B_r	=	ratio of cost of construction of single-unit housing to cost of construction of multi-unit housing as measured by the Boeckh Index
P_o/P_r	=	ratio of change of housing expenditures of owners to change of housing expenditures of renters

than their standard errors. These omitted variables are the disequilibrium variables and the two measures of government subsidy programs.

In both regressions, two variables are statistically significant: the incidence of homeownership in 1970, and the rate of increase of non-husband/wife households. Both have negative signs, as expected. The other demographic variables also have the expected signs. The rate of increase of homeownership is positively related to the growth in elderly households (at the 10 percent level in regression RP02), and negatively to the growth in minority households (at almost the 20 percent level). However, the change in homeownership is positively related to the overall growth rate, at almost the 5 percent level, rather than negatively, as originally expected. Apparently in-migrant households are able to become homeowners very quickly.

Economic variables are less important in explaining the change in homeownership. The cost of constructing homes, relative to apartments, has the expected negative sign, but is significant only at about the 20 percent level, while the level of income has a coefficient smaller than its standard error in regression RP01, and barely larger in RP02.

The model as a whole explains about half of the observed changes in the incidence of homeownership during the early 1970s for these 59 SMSAs.

Since virtually the only significant independent variables in the regressions are demand factors, it is arguable whether we have in fact estimated a reduced form of our model, or merely a demand function. If the latter is true, then the function is misspecified, since homeownership also depends on the omitted relative price variable. To investigate

this possibility, regression RP03 contains the same variables as 01, with the price variable included. The sign of the price variable is positive, which is incorrect for a demand function; households do not increasingly desire to become homeowners in response to a rising cost of doing so.[5] The coefficient also is insignificant by customary standards. None of the coefficients for the other variables differ much in the two regressions, with the possible exception of income. From this we conclude that our regressions probably do represent the reduced form of the model, even though we would like stronger results for supply variables.

Forecasting Tenure Choice

In our forecasting procedure, we first use the results of the statistical analysis, in combination with our economic and demographic assumptions, to forecast the incidence of homeownership in metropolitan areas in 1980 and 1990. From these forecasts, we then calculate the net change in ownership during the decade, relative to the net increase in the housing stock. Finally, we combine the net change with estimated losses by tenure, based on the loss rate forecasts reported in Table 14, to arrive at a rough measure of the gross change in homeownership as a fraction of the total volume of new construction.

There are several reasons for separately forecasting the 1980 and 1990 incidence of ownership. First, our basic purpose is to forecast housing market behavior for the 1980s, not the end of the 1970s. We "forecast" the current period only because we lack data for it. Moreover, we make different assumptions about the changes in the demographic variables for the 1970s and the 1980s, in line with Census Bureau

projections. The variable measuring ownership at the beginning of the decade also requires different treatment in the later period. After we forecast the rate of homeownership in 1980, we substitute its value in our calculations of the change in tenure choice during the following decade. Finally, and most importantly, there are different assumptions about inflation, housing costs, and real income growth for the period after 1978 (the latest available data), which we combine with the actual experience since 1975.

Table 19 presents the results of these calculations for the second regression in Table 18. Calculations for the first are quite similar. Again there are six separate sets of assumptions about the future for each regression: the optimistic and pessimistic inflation scenarios, each applied in turn to the Series A, B, and D demographic forecasts. The table reports the estimated incidence of homeownership in both 1980 and 1990 for all metropolitan areas, under each set of assumptions.

All of the sets of assumptions imply an increase in ownership from the 1976 rate of 61.2 percent. The optimistic scenario consistently produces higher rates by 1990. Among the demographic forecasts, Series A results in the lowest rates of ownership, and Series D the highest. The difference between the economic scenarios arises because of the importance of income in the regressions, while the differences between the demographic projections result from the fact that Series D contains much the lowest rate of increase for non-husband/wife households, and the highest for the elderly, while Series A has the reverse pattern. Since our regressions indicate a negative effect for non-husband/wife households, and a positive one for the elderly, the projected growth

TABLE 19

FORECAST METROPOLITAN HOMEOWNERSHIP CHANGES DURING THE 1980S

	Optimistic Scenario			Pessimistic Scenario		
	A	B	D	A	B	D
1980 ownership incidence	61.84%	61.98%	62.29%	61.84%	61.98%	62.29%
1990 ownership incidence	65.78	66.53	68.25	65.18	65.92	67.58
Change in ownership/net change in households	84.29	90.63	109.34	80.87	86.79	104.41
Incidence of ownership among new units	69.84	72.98	81.36	65.25	67.83	80.60

rates of both household types imply a greater degree of ownership for the Series D projections.

We do not think that the differences between the demographic assumptions should be given too much weight. Casual evidence suggests a strong recent demand for ownership among non-husband/wife households, in particular, which may be in large part a response to inflation. The behavior patterns of the early 1970s for these households may not prevail during the 1980s. If they do not, then our forecast will prove too low.

Our results suggest no major change in the rate of increase of homeownership from that observed in the early 1970s. Extrapolation of the 1970-1975 trend results in a projected ownership rate of 66.6 percent in 1990, about the same as Series B. Further, the differences between our Series A and D forecasts and the crude extrapolation are not very large.

We have repeated our attempt to validate our results by making a back forecast of the change in tenure during the 1960s. The forecast incidence in 1970 is 62.9 percent, much higher than the actual 59.5 percent. The discrepancy is even greater in terms of the change over the decade, since the 1960 level was 58.9 percent. But this difference, while large, is not surprising. We believe that the demand for homeownership has changed very dramatically since the 1960s, primarily because of the greatly increased inflation the nation has experienced since the late 1960s. Thus we would expect a much greater increase in ownership during the early 1970s than previous experience in relatively non-inflationary periods would suggest. Since we expect the 1980s to

be much like the 1970s in terms of inflation, we think that our analysis based on the early 1970s is generally appropriate for forecasting the 1980s. Indeed, given the accelerating inflation since 1977, our forecast may prove too low.

As with the loss and conversion rates, we have calculated the standard error of estimate for our forecasts. The errors are consistently small; they range from .1 to .5 percent for the 1990 ownership incidence. Errors of this magnitude do not affect our forecasts in any meaningful way.

The 1990 ownership incidence forecasts may look very similar for all sets of assumptions, in the range of 65 to 69 percent. However, they imply markedly different changes in ownership during the decade of the 1980s. Table 19 translates the estimates for the beginning and end of the decade into a measure of the change that will occur during it. The third row reports the projected change in homeownership as a fraction of the net increase in housing units during the decade for each set of assumptions. This is <u>not</u> a forecast of the distribution of all new housing units, because it ignores replacement of units that drop out of the stock, and combines new construction with units from other sources. Perhaps more importantly, it ignores the possibility that units existing in 1980 will change tenure during the decade. Thus, it is quite possible for actual construction during the decade to be concentrated in single-family homes which are owner-occupied, while rental rates among the existing stock increase so that there is no net change in the incidence of owner-occupancy.

For regression RP02, the optimistic scenarios imply that the increase in ownership will amount to between 80 and 110 percent of the net increase in housing units. The numbers are about four or five percentage points lower for the pessimistic scenarios. (Calculations for regression RP01 are generally about three percentage points lower than those for RP02.) These numbers undoubtedly look extremely high, but they are possible. Even the Series D results could occur, if there is an increase in ownership among the existing stock. Some housing analysts have in fact conjectured that nearly all the net increase in housing units will be owner-occupied, because of demographic changes alone.[6] (The standard errors on these forecasts range from one-half to four percent, again not enough to affect our forecasts seriously.)

However, a much smaller share of new construction will be owner-occupied, because the losses from the existing inventory are likely to be disproportionately rental units. The last row of the table presents our estimates of the ownership rate among new metropolitan units. To obtain these estimates, we calculate the projected losses by tenure during the decade, based on our forecast of loss rates, and add the losses (which must be replaced by units of the same tenure) to the forecast distribution by tenure of the net increase in the housing stock. We assume that the loss rates by tenure in the 1980s will be the same as during the first part of the 1970s; during that period, 30.7 percent of the units lost were owner-occupied.

The results of these calculations are shown for regressions RP02 and RL3, our preferred regressions. We assume that the rate of conversions is the same as during the 1960s; the estimate of the number of units lost is therefore taken from Panel C of Table 14.

The range of new construction is from about 65 to 82 percent, or a much narrower 65 to 73 percent if Series D is omitted.

There have been few other recent forecasts of tenure during the 1980s, and none to our knowledge which make projections specifically for metropolitan areas. The recent study by Pitkin and Masnick of the Joint Center for Urban Studies does forecast tenure patterns for the nation as a whole at five-year intervals to the year 2000.[7] Their 1990 tenure split shows from 65.7 to 68.0 percent owners, depending on the fertility rate. This is about the same as our forecast levels for metropolitan areas only. Since metropolitan areas generally show much lower rates of owner-occupancy than nonmetropolitan areas, it seems clear that our results imply a substantially higher rate of homeownership in 1990.

VIII. CHANGES IN STRUCTURE TYPE

The study of changes in structure type is very much like that of tenure choice. There are three structure types which can be analyzed: single-family homes, multifamily apartments, and mobile homes. However, the last of these is a minor component of the housing stock in large metropolitan areas. We attempted to analyze each type separately, but the mobile home analysis proved inadequate because of the small number of them. This leaves two structure types which are mutually exclusive and very nearly exhaustive. We therefore consider only one of them, the incidence of conventional single-family homes as a share of the total housing stock.

The Model

Categorization of the housing stock by structure type is very close to categorization by tenure. Over 84 percent of the increase in metropolitan ownership between 1970 and 1976 consisted of single-family homes. Since there was an absolute decline in the number of rented homes, more than 100 percent of the increase in rental units is accounted for by multifamily structures. For our set of 59 metropolitan areas, the simple correlation between the increase in ownership and the increase in single-family homes, as a fraction of the total increase, is +.42, which is significant at the 1 percent level. Thus there is a high, although certainly not perfect, correlation.

Our model of changes in structure type therefore includes essentially the same variables, with the same expected signs, as the model of tenure choice. The dependent variable and the demographic changes are also expressed in the same terms, as the annual percentage increase in the incidence. The only differences are that we replace the 1970 incidence of owner-occupancy with the incidence of single-family homes, for the same reason, and we change the price variable in the demand and supply equations to be the price of homes relative to apartment units. Again we estimate a reduced form of the equation, omitting the price variable, partly because of data limitations and partly because we are primarily interested in the change in the quantity variable, the incidence of single-family homes, rather than the price variable.

Empirical Results

The results, shown in Table 20, are very close to those for tenure choice. (As usual, the first regression includes all variables from the model, while the second omits those which are insignificant.) In general, the same variables, with the same signs, are significant at the 20 percent level or better. The main difference is that the rate of household formation is negative, rather than positive as in the tenure regression. It also is highly significant. The other variables show only minor differences in significance. The increase in the incidence of elderly households is now significant at the 5 percent level, rather than the 10 percent level, while the rate of increase in non-husband/wife households is less significant in the type regression (the 20 percent versus the 5 percent level). Also the 1970 incidence of ownership is significant

TABLE 20

CHANGE IN STRUCTURE TYPE (RTHSE):
59 SMSAS FOR 1970-1974 ('75,'76)

Variable	RPH1	RPH2
Intercept	3.122 (0.447)	0.158 (0.103)
Y_g	0.019 (0.183)	0.045 (0.460)
Y	0.173 (1.772)	0.165 (1.791)
HH	-0.286 (-3.314)	-0.317 (-4.029)
M	-0.210 (-1.240)	-0.275 (-1.748)
E	0.213 (2.087)	0.208 (2.160)
R	-0.058 (-0.903)	--
D	0.230 (0.655)	--
H_{70}	-0.022 (-1.630)	-0.019 (-1.564)
S_o	1.425 (1.872)	1.645 (2.300)
S_r	0.475 (0.439)	--
B_h/B_a	-3.215 (-0.518)	--
	R^2 = 0.5474	R^2 = 0.5283

TABLE 20 - VARIABLE DEFINITIONS

RTHSE	=	rate of growth in single-unit housing structures
Y_g	=	rate of growth of median household income
Y	=	median household income
HH	=	rate of growth of households
M	=	rate of growth in percent of non-husband/wife households
E	=	rate of growth in percent of households with head 65 or older
R	=	rate of growth in percent of minority households
D	=	ratio of new housing construction to net household formation during the 1960s
H_{70}	=	percent of housing stock in single-unit structures, 1970
S_o	=	percent of housing stock in HUD 235 program
S_r	=	percent of housing stock in subsidized rent programs
B_h/B_a	=	ratio of cost of construction of single-unit housing to cost of construction of multi-unit housing, as measured by the Boechk Index

at the 5 percent level, but the corresponding 1970 incidence of single-family homes is significant at about the 10 percent level, or slightly better.

For forecasting purposes, the most important of these differences is that the income coefficient is much larger in the structure type regressions. It is also more significant, falling just short of the 5 percent level.

There is one quite noticeable difference, which has interesting implications for policy. This is the significant impact of the Section 235 program on the increase in single-family homes, as shown in regression RPH2. The coefficient is quite large; in the average metropolitan area, the program raised the incidence of single-family homes by a full percentage point in five years. Public housing and the other rental subsidy programs have no significant effect.

In the ownership regressions, however, Section 235 proves to be insignificant and the coefficient is extremely small. These results mean that Section 235 apparently affected structure type but not tenure; the program "built homes," but did not increase homeownership.

Forecasting Structure Type

The forecast of the incidence of single-family homes in 1980 and 1990 is shown in Table 21, for regression RPH2. As with ownership, all of the assumptions imply an increase in homes from the 1976 rate of 61.5 percent. The differences between the optimistic and pessimistic scenarios, however, are much larger, because of the greater importance of income. Series A generates the lowest level of homes, and Series D the

TABLE 21

FORECAST METROPOLITAN CHANGES IN STRUCTURE TYPE DURING THE 1980S

	Optimistic Scenario			Pessimistic Scenario		
	A	B	D	A	B	D
1980 incidence of homes	62.11%	62.33%	62.77%	61.54%	61.76%	62.19%
1990 incidence of homes	66.75	68.19	71.20	62.54	63.89	66.72
Change in homes/net change in housing stock	88.55	99.73	129,88	67.24	75.17	98.25
New homes/new construction	76.55	82.99	98.31	59.91	64.92	76.46

highest, for the same reasons as in the case of tenure choice: the demand for homes is positively related to the percentage change in the incidence of the elderly, which is highest in Series D, and negatively related to the overall growth rate and the percentage change in the incidence of non-husband/wife households, which are lowest in Series D.

Our back forecast is again an overestimate of the change in the incidence of homes during the decade of the 1960s. Our model predicts that homes would have increased from 66.6 percent of the metropolitan stock to 68.3 percent; actually, they declined to 63.0 percent. We believe that the discrepancy is largely related to the growing problem of inflation, and that this back forecast does not invalidate our analytical approach, or our forecast for the 1980s.

The standard errors on our forecast are large, compared to the tenure choice forecasts. For the optimistic scenario, the standard errors range from about one percentage point for Series A to 2 percentage points for Series D; for the pessimistic scenario, the range is from about .4 to 1.0 percentage point.

When the forecast levels of homes in 1980 and 1990 are translated into changes in the incidence of homes during the decade, the forecasts generate quite diverse results. The optimistic scenarios imply that virtually all or more than all of the net increase in the housing stock will be single-family homes; the negative scenarios generate numbers that are about 20 to 30 percentage points lower. The difference occurs because of the great importance of income in the regressions. The standard errors range from 6 to 15 percentage points for the optimistic scenarios, and 2 to 8 for the pessimistic. This range is large, but in

each case the largest number is for Series D, which is the least likely. The Series B errors are about 8 and 4 percentage points. We do not think these errors are large enough to affect our basic conclusion, which is that single-family homes will constitute a large share of the demand for new housing by historical standards.

Adding in the replacement of units lost from the inventory, as projected from the study of losses and the assumption that the loss of homes will constitute 43.4 percent of losses during the 1980s (this rate prevailed during the first half of the current decade), we estimate that homes will account for between about 60 and 83 percent of new metropolitan construction during the decade. The higher numbers occur under the optimistic scenario. The Series D forecasts are much higher, of course, but the underlying demographic assumptions are generally thought to be unlikely, as discussed previously.

Comparison to Other Studies

Our forecast of the incidence of homes is probably at the high end of the range of recent structure type projections, though direct comparisons are not possible since other studies do not estimate structure type changes in metropolitan areas. Any comparisons are therefore necessarily risky, involving assumptions about the behavior of the market in nonmetropolitan areas that can only be based on analogy, rather than analysis. With that caveat, we offer the following very crude procedure.

The assumption underlying our comparison is that single-family homes accounted for over 63 percent of the increased housing outside metropolitan areas from 1970 to 1975, compared to only 57 percent in metropolitan

areas. For the nation overall, homes represented just over 59 percent. If the same differential were to hold for the late 1970s and the 1980s, then our results suggest that the national share of homes would be close to 90 percent under the optimistic scenario and about 65 percent in the pessimistic case. Again, we do not offer these figures as serious forecasts, but instead merely to indicate in a rough manner how our forecasts compare to others.

In general, our forecast appears to be at the high end of the range of recent projections of structure type. The Pitkin-Masnick forecast, for example, concludes that only about 50 percent of all new units will be homes. This is much the lowest of all recent forecasts.

Professors Jaffee and Rosen of Princeton University have forecast construction from 1978 to 1987 for the National Association of Homebuilders. They estimate that about 70 percent of the new units will be homes. This is in between our optimistic and pessimistic scenarios.

The highest recent forecast is by Thomas Marcin of the U.S. Forest Service, who projects that homes will account for 70 to 80 percent of all new housing from 1978 to 1990. This again lies between our optimistic and pessimistic projections.

IX. SUBSTANDARD HOUSING

Our analysis of substandard housing, like that of the components of inventory change, is derived from empirical econometric estimation of our basic model of the housing market, in order to determine what factors affect the extent of substandard housing. We then forecast the 1990 pattern by combining the results of the statistical analysis with our economic and demographic assumptions.

Definition of Substandard Housing

The basic definition of substandard housing in this analysis is the definition used in the series of reports "How Well Are We Housed?" published by HUD in the past year.[1] According to this criterion, a unit is substandard if it fails to meet quality criteria in at least one of eight categories. The complete definition is shown as Table 22.

We have also utilized other measures of substandard or inadequate housing that have been developed by analysts at HUD, the Office of Management and Budget, and the Congressional Budget Office, as a test of the sensitivity of our findings to changes in the definition of housing quality. The definitions differ in a variety of ways, but nonetheless are basically similar in that they work with most or all of the characteristics of housing quality that are measured in the Annual Housing Survey, grouping them into categories, and defining a unit as substandard on the basis of whether it is deficient in any of these categories.[2]

TABLE 22

HUD DEFINITION OF HOUSING INADEQUACY

A housing unit is inadequate if one or more of the following conditions holds:

Plumbing--unit lacks or shares complete plumbing (hot and cold water, flush toilet, and bathtub or shower inside the structure).

Kitchen--unit lacks or shares a complete kitchen (installed sink with piped water, a range or cookstove, and mechanical refrigerator - not an icebox).

Sewage--absence of a public sewer, septic tank, cesspool, or chemical toilet.

*Heating--there are no means of heating; or unit is heated by unvented room heaters burning gas, oil, kerosene; or unit is heated by fireplace, stove, or portable room heater.

Maintenance--it suffers from any two of the following defects: leaking roof; open cracks or holes in interior walls or ceiling; holes in the interior floor; broken plaster or peeling paint (over 1 sq. ft.) on interior walls or ceilings.

Public Hall--it suffers from any two of the following defects: public halls lack light fixtures; loose, broken, or missing steps on common stairways; stair railings loose or missing.

Toilet Access--access to sole flush toilet is through one of two or more bedrooms used for sleeping (applies only to households with children under 18).

Electrical--unit has exposed wiring and fuses blew or circuit breakers tripped 3 or more times in last 90 days and unit lacks working wall outlet in 1 or more rooms.

* Does not apply in the South Census Region.

Methodological Problems Created by the Definition

All these definitions are derived from the Annual Housing Survey, and include aspects of housing that have never before been investigated by the Census Bureau or any other data-gathering organization. This means that our analysis is forced to relate the current level of substandard housing (as of 1974, 1975, or 1976) to current levels of economic, demographic, and other variables, and to recent changes in these variables, where available. This methodology has inherent limitations. Since housing is a long-lived durable good, and since there are substantial expenses in time and money associated with any major adjustment by a household in its housing quality (or other aspects of its housing), we cannot be sure that the current incidence of substandard housing at any point in time represents a full adjustment to the current levels of the economic and other variables which affect it. The problem of measuring income, described in a previous chapter, is one example of this. It is still more acute with respect to housing production over the recent past, whether private or subsidized.

We would prefer to relate recent changes in substandard housing to recent changes in the economic and demographic factors, and to housing production data over the same time period. However, we lack data on the extent of substandard housing before the first Annual Housing Survey was conducted in 1973, and we lack data for any metropolitan area before 1974. Nor can we use the common earlier definitions, such as the criterion of "dilapidated or lacking complete plumbing" employed by the Kaiser Commission in 1967 and by most previous studies, because the Census Bureau discontinued counting the number of dilapidated units after 1970.

Regression Results

Table 23 contains the results of our empirical estimation of the model developed in Chapter III.

The results are entirely consistent with the model. In regression S1, three variables are statistically significant in the usual sense, three more are significant at the 10 percent level, and two others have coefficients larger than their standard errors. The only variable not in any of these categories is the rate of increase of real income, which is included in order to adjust for the difference between current and permanent income. All of the variables have the expected signs. A negative coefficient means that the incidence of substandard housing decreases--i.e., housing gets better--and the value of the variable increases. Thus regression S1 shows that the incidence of substandard housing is lower in high-income metropolitan areas, and higher in areas which have particular concentrations of minorities, the elderly, or non-husband/wife households. We attribute the results for non-husband/wife households and for minorities to the lower level of assets which such households are likely to have, for given levels of incomes. The result for minorities may also reflect lingering racial discrimination in housing markets.

Housing quality is also affected by both the rate of household formation, and the rate of private housing construction. The coefficients have opposite signs, and are nearly equal in magnitude. Together they imply that a high rate of new construction, relative to household formations, leads to an improvement in housing. The same effect holds for a

TABLE 23

SUBSTANDARD HOUSING (H_{BS}): 59 SMSAS FOR 1970-1974 ('75,'76)

Variable	S1	S2	S3	S4
Intercept	5.829 (1.294)	4.446 (0.919)	6.698 (1.544)	3.057 (0.699)
Y_g	0.105 (0.651)	0.106 (0.613)	0.138 (0.882)	0.118 (0.724)
Y	-0.318 (-1.785)	-0.275 (-1.441)	-0.375 (-2.183)	-0.194 (-1.170)
HH	0.738 (2.033)	0.807 (2.181)	0.742 (2.054)	0.750 (2.038)
M	0.104 (1.905)	0.127 (2.157)	0.092 (1.753)	0.113 (2.058)
E	0.134 (1.721)	0.142 (1.802)	0.146 (1.937)	0.177 (2.261)
R	0.063 (3.041)	0.063 (2.935)	0.067 (3.352)	0.065 (3.108)
NC	-0.876 (-2.324)	-0.961 (-2.488)	-0.871 (-2.360)	-0.967 (-2.543)
D	-0.535 (-1.016)	-0.525 (-0.947)	-0.745 (-1.445)	-0.765 (-1.429)
S_{70}	-1.122 (-1.263)	--	-1.409 (-1.637)	--
S_p	--	-3.340 (-1.348)	--	--
S_r	--	-1.485 (-0.322)	--	--
S_o	--	-0.013 (-0.010)	--	--
S_{65}	--	--	-0.677 (-0.159)	--
S_{60}	--	--	6.962 (2.012)	--
S	--	--	--	0.389 (0.793)
	R^2 = 0.5159	R^2 = 0.5299	R^2 = 0.5754	R^2 = 0.5065

TABLE 23 - VARIABLE DEFINITIONS

H_{bs} = quantity of substandard (bottom) housing supplied, as a fraction of the total stock

Y_g = rate of growth of median household income

Y = median household income

HH = rate of growth of households

M = percent of non-husband/wife households

E = percent of households with head 65 years or older

R = percent of minority households

NC = rate of private new housing construction

D = ratio of new construction to net household formation during the 1960s

S_{70} = rate of subsidized housing construction, 1970-1976

S_p = percent of public housing built 1970-1976

S_r = percent of rent subsidy housing built 1970-1976

S_o = percent of housing stock in HUD 235 program

S_{65} = rate of subsidized new construction, 1965-1970

S_{60} = rate of subsidized new construction, 1960-1965

S = incidence of subsidized housing production, as of 1974, 1975, or 1976, among the total housing stock

high rate of construction in the immediate past, as shown by the disequilibrium variable, but the significance level is much lower.

The value of the coefficient of private new construction implies that for every 100 new units built annually over a five-year period (or for every 500 built during the period) there will be about 95 fewer substandard units at the end of the time, ceteris paribus. This number differs slightly from the coefficient, because the rate of private new construction is expressed in terms of the average number of units in the stock over the period, while the incidence of substandard housing is calculated for the stock at the end. Since the latter is larger, the coefficient understates the fractional improvement per unit built per year.

The coefficient of the disequilibrium variable suggests that part of the improvement from new construction will occur more than five years later, but the standard error is too large for us to be very positive about this effect.

The final variable in regression S1 is the rate of government new production. This coefficient is negative, as expected, and larger in absolute value than that of private new construction; it implies that for every 100 subsidized units built annually during the five years, there will be 123 fewer substandard units at the end. On a unit-for-unit basis, there will be one fewer substandard unit at the end of the period for every four built during it.

But while this effect is larger than that of private new construction, it is much less certain. The coefficient is significant only at

about the 20 percent level. Thus there is a good deal of uncertainty over the magnitude, and even the direction, of the effect.

In regression S2, subsidized production since 1970 is disaggregated by program type. It appears that the impact of total construction in regression S1 is due entirely to public housing; the rent subsidy programs and Section 235 have no statistically significant effect, and the coefficient of Section 235 is extraordinarily close to zero. The coefficients of other variables are not changed much, although that of the disequilibrium variable falls below its standard error.

Neither the general validity nor the policy implications of these results should be overstressed. There is a basic incongruity in our data on substandard housing and new construction which may be affecting our estimates. The extent of substandard housing is a stock concept, while the new construction rates are flows. Our regressions may be estimating a relatively short-run effect of recent new construction (on the average, perhaps two to three years ago) on the stock of substandard housing today, rather than a long-term relationship which can be expected to persist. We have attempted to deal with this problem in part through inclusion of the disequilibrium variable, which indicates that past high rates of new construction (on average, ten years ago) are contributing to the quality of the housing stock today, but the significance level of this coefficient is too low to be fully satisfactory.

The other regressions in Table 23 represent an attempt to adjust for this stock-flow problem. Regression S3 includes subsidized production during the 1960s, divided into two five-year periods. Every variable except the incidence of elderly households is more significant when

these variables are added. In particular, the coefficient of recent government production is significant at about the 10 percent level, and the impact is about 25 percent greater than in regression S1. But the coefficients of subsidized production in the earlier periods imply a rather peculiar longer term pattern. That for the late 1960s is larger in absolute value than for the most recent period, but less significant, while that for the early 1960s is positive, significant, and very large. It implies that for each 100 subsidized units built annually during the early 1960s, there were 150 more substandard units in the stock as of 1975. We do not think this result is believable. We would expect that, at worst, the coefficient would be small and insignificant, if government production were ultimately ineffective as a way of improving housing quality for the poor, in the long run.

It is worth noting that this pattern persists when we use program data from HUD, rather than the AHS. The available HUD data reports location of subsidized units by program type, but not by year built, with the single exception of public housing. For the rental subsidy programs, we can only obtain the total number of subsidized units. Some programs, such as Section 236, were concentrated within a few years, but others, such as Section 221 BMIR, were not. Despite these problems, we re-estimated our model using the HUD data, disaggregated by program and, for public housing, by year built. The public housing results correspond very closely to those for all subsidized housing in regression (2-3), although the t-ratio for units built in the early 1960s is about 1.75, significant at the 10 percent level rather than the 5 percent. None of the other subsidized programs have any impact. (These results are omitted

because they are so similar to those in Table 23. The similarity extends to the economic and demographic variables.)

A possible explanation of this peculiar result is that, since we have already included the overall rate of new construction during the 1960s in our disequilibrium variable, the subsidized production rates may be measuring the differential impact of public versus private housing. The latter is probably of higher quality; thus, the more important public housing has been, as a share of total production, the lower the housing quality is likely to be today. Public housing is rarely substandard by the newer HUD definition, which includes leaky roofs, broken plaster, and similar phenomena. These problems are less serious, and they may be more common in subsidized housing at any point in time because of lags in maintenance and repair activity.

This explanation seems reasonable, but the magnitude of the coefficient is so large that we doubt if it can account for the results by itself, and it is conjectural; we do not have the resources to investigate it further. It could be investigated directly by comparing the incidence of substandardness among private, subsidized, and public housing for units built during the early 1960s. This, unfortunately, would require a complete computer search through the entire set of data tapes for the 59 SMSAs to identify these units and determine whether they are substandard according to the rather complex HUD definition.

The final regression relates the stock of substandard housing to the stock of subsidized units, without reference to when they were built. Since the earliest federal housing programs date from 1937, this measure includes some very old units, but they do not comprise a large share of

the subsidized stock on average, and probably not in any particular metropolitan areas. This version shows the least impact of subsidized housing production; the coefficient is smaller than its standard error. It is also positive, like that for the early 1960s in regression S3. This regression should not be interpreted as "the" long-run relationship; since the subsidized housing was built at various times in the past, we have a mixture of short- and long-term effects here.

Analysis of Alternative Concepts of Housing Inadequacy

Our definition of substandard housing is based entirely on the physical condition of the unit. At HUD's request, we have also extended the definition to include units which are physically adequate but crowded (having more than one person per room), and also those which are physically adequate and uncrowded, but in which the family pays more than one-quarter of its income for rent. These definitions are less valid as measures of housing deficiency. Crowded units represent not so much a problem with the housing unit itself as a mismatch between the unit and its occupants. However, crowded units may be harder to keep in good condition than uncrowded ones, and thus may be more likely to become physically deficient. Housing units with a high rent/income ratio represent still less of a housing problem. If anything, they are indicative of poverty, rather than housing deficiency; a high rent/income ratio can more easily be lowered by increasing the income of the occupants than by increasing the supply of standard quality housing in some way. Moreover, a high rent/income ratio may be indicative of nothing more than a strong preference by the household for spending its money on housing rather than

other goods. Households with such preferences cannot usefully be described as having housing problems, and it clearly seems inappropriate to consider them as living in inadequate housing.

Table 24 reports the empirical results from our model for these alternative definitions. In regression I1, the measure of inadequacy includes all units which are either physically substandard or crowded; those which are both are counted only once. The number of inadequate units by this definition is about 50 percent more than the number of physically deficient alone. In regression I2, the measure of inadequacy also includes rental units in which the tenants pay more than 25 percent of their income for rent; again, those which are inadequate on two or all three criteria are counted only once. The absence of expenditure data for owners in the 1974 AHS forces us to restrict the measure of excessive cost to tenants. Even so, the incidence of inadequacy doubles.

Our model is somewhat less useful in explaining the incidence of these measures of inadequacy. Two variables are significant in the usual sense in regression I1, and two others at the 10 percent level. All have the expected signs: inadequacy is lower in high-income areas and in those with high rates of new construction, and higher in rapidly growing areas and those with a high incidence of minorities.

These results are similar to the findings with respect to substandard housing in Table 23. But there also are differences, of which the most interesting for housing policy is the insignificance of subsidized production for the broader definition including crowded units.

In regression I2, including a high rent burden as inadequacy, two demographic variables are significant in the usual sense--the incidence

TABLE 24

ALTERNATIVE MEASURES OF INADEQUATE HOUSING:
59 SMSAS FOR 1970-1974 ('75,'76)

Variable	I1 SC	I2 SCE
Intercept	16.767 (2.475)	5.205 (0.470)
Y_g	0.010 (0.423)	-0.527 (-1.332)
Y	-0.464 (-1.732)	-0.021 (-0.047)
HH	0.996 (1.823)	1.195 (1.337)
M	-0.047 (-0.572)	0.507 (3.780)
E	0.079 (0.670)	-0.047 (-0.246)
R	0.135 (4.288)	0.120 (2.329)
NC	-1.215 (-2.144)	-1.020 (-1.100)
D	-0.136 (-0.711)	-0.115 (-0.089)
S_{70}	-0.453 (-0.339)	-0.834 (-0.382)
	$R^2 = 0.4250$	$R^2 = 0.4394$

TABLE 24 - VARIABLE DEFINITIONS

SC	=	percent of housing stock physically inadequate and overcrowded
SCE	=	percent of housing stock physically inadequate, overcrowded, and excessive rent-to-income burden
Y_g	=	rate of growth of median household income
Y	=	median household income
HH	=	rate of growth of households
M	=	percent of non-husband/wife households
E	=	percent of households with head 65 years or older
R	=	percent of minority households
NC	=	rate of private new housing construction
D	=	ratio of new construction to net household formation during the 1960s
S_{70}	=	rate of subsidized housing production, 1970-1976

of minorities and non-husband/wife households. Two others are significant at the 20 percent level, including the rate of growth, while the rate of new construction has a coefficient larger (in absolute value) than its standard error, but is not even significant at the 25 percent level. Again the coefficient of subsidized production is smaller than its standard error.

These results do not change greatly when subsidized production during the 1960s is added, although private construction becomes significant at the 10 percent level in the regression including rent burden. It may be worth noting that subsidized production during the early 1960s again has a significant positive effect on both measures of inadequacy, as with the physically substandard definition used in Table 23.

When subsidized production is disaggregated by program type, public housing has a negative effect on crowding, at the 20 percent level, but no program has any effect on the rent burden measure.

These results indicate that housing production, whether private or public, has little effect on the expenditure patterns of individual households. The rent/income ratio apparently depends on demographic factors, rather than housing supply conditions; subsidized, or unsubsidized, production has no effect on it.

As expected, our model does a better job of explaining the physical condition of the housing stock. Attempts to refine a model to predict these hybrid measures are unlikely to be fruitful.

Forecasting Substandard Housing

The forecasting procedure again combines the results for a regression with a set of demographic and economic assumptions. Table 25 presents the forecasts for regressions S1 and S3 in Table 23. The numbers in the body of the table are the estimated incidence of substandard housing in 1990 for all metropolitan areas, under each set of assumptions.

TABLE 25

FORECAST OF SUBSTANDARD HOUSING IN METROPOLITAN AREAS, 1990

	Optimistic Scenario			Pessimistic Scenario		
	A	B	D	A	B	D
Regression S1	8.17%	7.95%	7.49%	8.74%	8.57%	8.10%
Regression S3	8.61%	8.42%	8.01%	9.97%	9.83%	9.41%

The range of forecasts is not large, and all except the pessimistic scenarios for regression R3 imply a very modest improvement in quality by historical standards from the 1975 rate of about 9 percent substandard. The difference in economic scenarios results in about a 1/2 percent difference in the incidence of substandard housing for regression S1, and about 1-1/2 percent for regression S3, because of the greater coefficient for income in the latter. There are more substandard units under the Series A demographic projections than under Series B, and more under B than D. This occurs because substandard housing is positively related to the incidence of all three household types, which are most important under Series A.

The demographic variables have substantial weight in the forecasts; they are the main factors causing the forecast to be so close to the current level. We are inclined to think that the forecasts probably overstate the incidence of substandard housing in 1990 for this reason. The factors which contribute to such households' occupying worse housing than their incomes would suggest--lower levels of assets and racial discrimination--are likely to be decreasingly important during the 1980s. Since our empirical work relates the overall incidence of substandard housing to the incidence of these household types, it does not shed light on the plausibility of this conjecture, but it seems likely. If it is correct, the incidence of substandardness should be lower, perhaps substantially, in 1990.

The standard errors on these forecasts are rather large. This occurs because the projected levels of the demographic variables in particular are substantially larger than they were during the period covered by the regression analysis, so that we are extrapolating from our empirical results to a much greater degree than in the analyses of losses, changes in tenure, and changes in structure type. The standard errors range from about 0.2 to 1.0 percent for regression S1, and 0.5 to 1.0 percent for S3. In each case, the lowest forecasts are for Series D, and the highest for Series A. For both Series A forecasts based on regression S1, and the optimistic Series A and B forecasts based on regression S3, the forecast level of substandard housing lies within one standard error of the current level, so that we cannot be very sure even of the direction of change. While this is less precise than we would

like, it does not alter our belief that the forecast levels of substandardness are too high. The demographic variables are the prime contributor both to the high level of substandard housing forecast for 1990, and the magnitude of the standard errors, and we do not think that the various household types will occupy substandard housing to the same extent in 1990 that they did in 1975, for the reasons discussed in the preceding paragraph.

Analysis of Substandard Housing During the 1960s

We cannot perform the same kind of validation of our model for the analysis of substandard housing as we used for the components of inventory change, because there is no data for the 1960s, or any other time period, on the attributes of housing that comprise the HUD definition of substandard. The decision by the Census Bureau to discontinue the measurement of overall housing condition has created an unbridgeable gap in the data on housing quality between 1970 and earlier years on the one hand, and 1973 and later years on the other.

However, there is an alternative procedure open to us, which provides a somewhat different kind of test for our model. Data is available on the extent of substandard housing for both 1960 and 1970, according to the traditional definition of substandard (lacking complete plumbing or dilapidated). We can therefore use our model to investigate the change in substandard housing, by this definition, over the decade. To the extent that the model can explain the change, with the same variables being significant as in our analysis of the mid-1970s, we would regard the model as being validated. We do not expect identical results, of course.

This procedure has a particular advantage in that it enables us to test the model over a period of time, which is our preferred methodology. We are able to relate changes in substandard housing to changes in economic and demographic variables, rather than relating levels to levels. Also, we can employ the rates of new housing production as independent variables without confronting the stock-flow problem which complicates the analysis and interpretation of the mid-decade data from the Annual Housing Survey.

Table 26 reports the empirical results for the reduced form of the model, omitting insignificant variables. There are several changes in the formulation of the independent variables, occasioned by the high degree of multicollinearity among the rate of private new construction and the various rates of household growth. In particular, the rate of increase in the number of households is extremely highly correlated with the rate of private new construction ($r = .98$). In order to avoid statistical difficulties, therefore, we used the ratio of household growth to new private construction. This is the reciprocal of the disequilibrium variable. It measures the net pressure on the housing stock from household formation and housing production combined, and is expected to be positively related to the change in substandard housing. Where it is high, household growth has outstripped new construction, and substandard housing is likely to be in greater demand; where it is low, a high volume of new construction is likely to facilitate the elimination of substandard housing.

We also minimized the multicollinearity among the growth rates for different types of households by expressing all of them in terms of the

TABLE 26

CHANGE IN SUBSTANDARD HOUSING (SUBSTD):
43 LARGE SMSAS, 1960-1970

Variable	S1
Intercept	-0.0417 (-1.629)
HH/NC	0.133 (3.800)
S	-1.783 (-1.608)
Y_g	-0.0420 (-1.185)
R	0.0214 (2.460)
M	-0.0642 (-0.0394)
R^2	0.5280

Variable Definitions

SUBSTD = change in the incidence of housing units substandard, 1960-1970, defined as units either lacking complete plumbing or in dilapidated physical condition, as a percentage of the 1960 housing stock

HH/NC = ratio of net increase in households within the SMSA to new housing units constructed, 1960-1970

S = ratio of subsidized housing units built, 1960-1970, to 1960 housing stock

Y_g = rate of increase in median family income, 1960-1970

R = percentage change in number of black households in the SMSA, minus the percentage change in total households, 1960-1970

M = percentage change in households consisting of married couples in the SMSA, minus the percentage change in total households, 1960-1970

difference between the growth rate for the particular type and the overall growth rate of the SMSA. This procedure does not affect the expected signs of the demographic variables. We also have to restrict our minority household variable to blacks, as discussed earlier.

The empirical results are generally quite consistent with those for the mid-1970s. Two variables are statistically significant in the conventional sense: the ratio of household formation to new private housing, and the rate of increase in black households. These are the same concepts that were significant in Table 23. The other two demographic variables are less significant; in particular, the rate of increase of the elderly has a coefficient smaller than its standard error. The coefficient for non-husband/wife households is only significant at the 10 percent level, compared to almost 5 percent for the mid-1970s' regressions, and the coefficient of the income variable is significant at only the 25 percent level, rather than 10 percent. The lesser importance of two of the demographic variables is consistent with our conjecture that the mid-1970s incidence regressions may be generating an overestimate of the extent of substandard housing in 1990; the change in substandard housing is affected less by changes in demographic variables than is the stock of substandard units affected by the incidence of these household types.

Finally, the coefficient of subsidized housing production is substantially more significant in the 1960s' regression than in the mid-1970s'. Its estimated impact, however, is smaller. The coefficient implies that for every 100 subsidized units built annually during the decade, there will be 178 fewer substandard units at the end. In regression S1 of Table 23, the coefficient of subsidized production implied

that for every 100 subsidized units built annually during a five-year period, there were 123 fewer substandard units at the end. This suggests that the impact of subsidized production is larger in the short-run than in the long, but the difference may be due to any of the differences between the regressions, so it should not be taken too seriously. The fact that both coefficients have the same sign, and are larger than their standard errors, on the other hand, does buttress the contention that there is some effect, since the probability that both coefficients would be as significant as they are, by chance, is about .025.

An Alternative Approach: Simulating the Effect of Subsidized Production

In addition to the econometric modeling we have just reported, we also sought to analyze the incidence of substandard housing in 1990 by simulating the changes in metropolitan housing markets, using The Urban Institute Housing Market Model. This model is especially well suited for studying the effect of subsidized housing production, which has been the least satisfactory component of our econometric analysis.

A detailed description of the model and the results is contained in the appendix. Here, it is merely worth noting that the model simulates the changes in metropolitan housing markets over decade-long intervals, precisely the period of time which we were asked to study. However, we can only analyze the decade of the 1970s, not the 1980s. The model can be used to study either actual cities or prototypes which represent a large number of metropolitan areas. In this analysis, we have simulated two prototypes: areas with high minority populations and a high growth rate of lower-income households; and areas with high minority populations and a low growth rate.

We first analyzed the changes in the extent of substandard housing that could be expected in the absence of subsidized housing production. We start with the assumption that 15 percent of the stock was substandard in 1970, which appears to be roughly consistent with the 1975 AHS data showing 10 percent substandard at that time. Based on projected changes in income and minority population (but not non-husband/wife households), we expect that about 6.5 percent of the units in the high-growth metropolitan area would be substandard in 1980, and about 4.2 percent in the low-growth area. This is much lower than the forecast derived from our econometric work. Part of the difference undoubtedly results from the difference in disaggregation by household type.

We then simulated two different types of subsidized production programs, corresponding to public housing and Section 236, at four different levels of activity. We find substantial differences between program and activity level. In general, public housing has a greater effect in eliminating substandard housing, in both types of metropolitan areas. Our simulations indicate that public housing reduces substandardness on a unit-for-unit basis for small levels of program activity, similar to the actual levels of the past which are included in the econometric analysis. As the scope of the program expands, however, the reduction in substandardness is smaller; increasing it from 6 to 9 percent of the stock ultimately has no effect. This appears to be consistent with Census data, which report what seems to be an irreducible minimum of substandard housing, at least under the traditional definition of "dilapidated or lacking complete plumbing," in the neighborhood of 1 percent of the stock.

For Section 236, the pattern differs somewhat. In the high-growth area, a small program results in unit-for-unit elmination of substandard housing; larger programs have almost no effect. In the low-growth area, by contrast, a small program leads to an increase in substandard housing; only a very large program is successful in reducing substandardness. We are not sure of the reasons for this anomaly.

The simulations are more nearly comparable to the analysis of changes in substandardness during the 1960s, than to the study of the incidence as of the mid-1970s. However, the simulations use a definition of substandard that is more like the HUD definition than the earlier traditional one. Precisely similar results to any of the empirical work are therefore not to be expected. Nonetheless, there are some similarities. Our disaggregation of subsidized production by program (regression S2 in Table 23), like the simulations, shows that public housing has a stronger effect on substandardness than Section 236, for example. And the incidence of minority households is consistently important. The basic difference is that the simulations show a much greater responsiveness to the government production than does the empirical work. There is no single number, or narrow range, that emerges as "the" effect of subsidized production on substandard housing. The three analyses all do show the same direction of the impact, and thus reinforce each other. That is probably as much as can reasonably be expected from this first step in the analysis of the relationship.

FOOTNOTES

CHAPTER I

1. U.S. President's Committee on Urban Housing, A Decent Home (Washington, D.C.: U.S. Government Printing Office, 1969).

2. Duane McGough, "Housing Needs and Housing Supply: The Effectiveness of Estimates and Responses: A Preliminary Exploration," 1978, Division of Housing and Demographic Analysis, Office of Economic Affairs, U.S. Department of Housing and Urban Development, Washington, D.C. (mimeographed).

3. U.S. Congress, Senate, Committee on Banking, Housing and Urban Affairs, Estimates of Housing Needs: 1975-1980, testimony by Donald Kaplan of Federal Home Loan Bank Board, Office of Economic Research (Washington, D.C.: U.S. Government Printing Office, 1975), pp. 41-57.

5. The possibility of filtering is much debated in the literature. For opposite viewpoints, see Edgar Olsen, "A Competitive Theory of the Housing Market," American Economic Review (1969): 612-621, and James L. Sweeney, "A Commodity Hierarchy Model of the Rental Housing Market," Journal of Urban Economics 1 (January 1974): 288-323.

CHAPTER II

1. The demolitions through 1970 are taken from John C. Weicher, Urban Renewal: National Program for Local Problems (Washington, D.C.: American Enterprise Institute for Public Policy Research, 1972), p. 6. Demolitions through March 31, 1961, were published in Martin Anderson, The Federal Bulldozer (Cambridge, Mass.: M.I.T. Press, 1964), p. 65.

CHAPTER III

1. See, for example, Richard F. Muth, "Moving Costs and Housing Expenditures," Journal of Urban Economics 1 (January 1974): 108-125; or Richard F. Muth, "A Vintage Model of the Housing Stock," papers of the Regional Science Association; and Sweeney, op. cit.

2. American Appraisal Associates, Inc., Building Cost Modifiers (Milwaukee, Wisconsin: Boeckh Publications, May 1971 and January 1974).

3. Margaret G. Reid, Housing and Income (Chicago: University of Chicago Press, 1962).

4. This is a contention based on the authors' comparison of year-to-year changes in land values as reported in U.S. Department of Housing and Urban Development, HUD Statistical Yearbooks, 1970-1976 (Washington, D.C.: U.S. Government Printing Office).

5. Work on relative prices for housing of different qualities is presently underway at The Urban Institute. Results for the first two waves of the AHS are reported in James R. Follain, Larry Ozanne, and Verna M. Alburger, Place-to-Place Indexes of the Price of Housing: Some New Estimates and a Comparative Analysis (Washington, D.C.: The Urban Institute, November 1979).

CHAPTER IV

1. See, for example, Frank de Leeuw and Nkanta F. Ekanem, "The Supply of Rental Housing," American Economic Review (December 1971): 806-817; or Raymond J. Struyk, assisted by Sue Marshall, The Determinants of Household Home Ownership (Washington, D.C.: Urban Institute Reprint, May 1975).

2. For comparisons of permanent and current income, see Richard F. Muth, "The Demand for Non-Farm Housing," The Demand for Durable Goods, ed. Arnold C. Harberger (Chicago: University of Chicago Press, 1960), pp. 29-96; and Margaret G. Reid, Housing and Income, op. cit.

3. See, for example, Harvey S. Rosen and Kenneth T. Rosen, "Federal Taxes and Homeownership: Evidence from Time Series," (Princeton University, January 1978). Mimeographed.

CHAPTER V

1. See, for example, U.S. Department of Housing and Urban Development, National Housing Policy Review, Housing in the Seventies (Washington, D.C.: U.S. Government Printing Office, 1974); or Anthony Downs, Federal Housing Subsidies: How Are They Working? (Lexington, Mass.: Lexington Books, 1973).

2. Net additions are defined in the Annual Housing Survey as unspecified units not specifically measured by the survey as new construction or lost due to demolition, disaster, or other means. These "net additions" include conversions, changes from nonresidential use or group quarters, housing units moved to a site, and units returned to the inventory in the survey year which were defined as lost in 1973. This last category includes units condemned for occupancy because of violations of local ordinances or housing codes, or mobile homes which were vacant in 1973 but occupied during the survey, and vacant units damaged by fire, flood, or vandalism to the extent that the interiors were exposed to the elements, but were rehabilitated by the time of the survey. This "net additions" category also includes sampling and nonsampling errors in the estimation

of conventional new construction, new mobile homes, and losses. U.S. Bureau of the Census, Annual Housing Survey (Washington, D.C.: U.S. Government Printing Office, 1974-1976).

3. Craig Swan, "Housing Subsidies and Housing Starts," American Real Estate and Urban Economics Association Journal 1 (Fall 1973): 119-140.

CHAPTER VII

1. Mahlon R. Straszheim, An Econometric Analysis of the Urban Housing Market (New York: Columbia University Press, for National Bureau of Economic Research, 1975); and Raymond J. Struyk, Urban Homeownership (Lexington, Mass.: Lexington Books, 1976).

2. Data from Panel Study of Income Dynamics indicates that intra-state movers are more likely to be owner-occupants than inter-state movers.

3. John C. Weicher, "New Home Affordability, Equity, and Housing Market Behavior," American Real Estate and Urban Economics Association Journal 4 (Winter 1978): 395-416.

4. U.S. Department of Labor, "Urban Family Budgets and Comparative Indexes for Selected Urban Areas," Bureau of Labor Statistics (Washington, D.C.: Bureau of Labor Statistics, Autumn 1970-1976).

5. The statement in the text does not apply if households expect prices to continue to rise in the future; in that case, they may well respond to a price rise by buying now, rather than confronting a still higher price later. The inflation of the 1970s has of course generated almost continuous price increases in housing as in other goods, and the relative price of housing has risen as well. However, it is unlikely that the results in regression RP03 can be explained by inflation, since the regression uses cross-sectional data for the same time period, during which the differences in inflation across SMSAs were probably not large. This is an area where further research might prove fruitful, but it is not likely to reverse the conclusion in the text.

6. George Sternlieb and Robert W. Burchell, "Multifamily Housing Demand: 1980-2000," American Real Estate and Urban Economics Association Journal 1 (Spring 1979): 1-38.

7. John Pitkin and George Masnick, Analysis and Projections of Housing Consumption by Birth Cohorts: 1960-2000 (Joint Center for Urban Studies of the Massachusetts Institute of Technology and Harvard University, August 1979).

CHAPTER IX

1. U.S. Department of Housing and Urban Development, "How Well Are We Housed?" Office of Policy Development and Research (Washington, D.C.: Government Printing Office, 1978).

2. Kenneth Wieand and Richard Clemmer, "The Annual Housing Survey and Models of Housing Services Output" (mimeographed); U.S. Office of Management and Budget, "An Assessment of the Magnitude of the Nation's Housing Stock Problem and An Examination of Factors Affecting Housing Quality," Study by Economic and Government Special Studies Division (October 1978); U.S. Congress, Federal Housing Policy: Current Programs and Recurring Issues (Washington, D.C.: Congressional Budget Office, June 1978).

APPENDIX

FORECASTING SUBSTANDARD HOUSING WITH THE URBAN INSTITUTE HOUSING MARKET MODEL

INTRODUCTION

One of the components of the need for new construction is an estimate of the influence of federally subsidized new construction. In particular, we would like to explore the effect subsidized housing has on substandard housing, and which households and locations in metropolitan areas would be most affected. To this purpose, we have used The Urban Institute Housing Market Model. This model allows us to examine both the direct and indirect effects of building any number of subsidized units in various locations in metropolitan areas, and selecting households of different income and race to reside there. The study simulates four levels of subsidized housing construction over the 1970-1980 period. Both low-income public housing and Section 236 housing programs are analyzed. The model is simulated on prototypical cities, constructed to be representative of broad types of U.S. metropolitan areas.

The next section of the paper briefly reviews the theory underlying The Urban Institute Housing Market Model. It describes the prototypical cities used in the model simulations, and lays out the assumptions necessary to incorporate subsidized housing construction in the model. The final section presents 1970-1980 simulation results. First the base case results for two prototypical cities are presented and compared to currently available data to check the validity of the model. Then policy simulations are presented for the two subsidized housing programs mentioned above.

THE HOUSING MARKET MODEL

This section presents the theory underlying the Urban Institute (U.I.) housing market model in a summary form. Then the prototypical cities used for the model simulations are presented. Finally, subsidized housing programs are incorporated into the model.

Theory of the Model

The U.I. housing market model is a market simulation model which examines decade-long changes in the price, quantity and location of housing in a metropolitan area. The area is divided into a small number of zones, representing central city and suburban locations of varying housing quality. The population of the metropolitan area is represented by a number of "model" households, whose income, race, and family type are derived from Census data and projections of the characteristics of all households in U.S. metropolitan areas. The existing housing stock is represented by "model" dwellings, again based on Census data for the housing stock in all metropolitan areas. The quality of a dwelling is measured in units of housing services; the higher the quality of a model dwelling, the greater the units of housing services it possesses. In addition to existing dwellings, new dwellings can be constructed in a new suburban zone. These new dwellings can be of any quality, subject only to a government building code minimum. The price per unit of new housing services is fixed outside the model.

Each model household has a demand for housing services, based on its long-run income at the end of the decade, other socio-economic characteristics, and the price per unit of housing services for each model

dwelling it considers. Likewise, each existing dwelling can supply housing services, based on its quality at the beginning of the decade, the price elasticity of supply, and the price each model household offers. Thus, the housing market can be analyzed in terms of the demand and supply for new and existing housing. Figure 1 shows a few typical household demand curves and existing dwelling supply curves, as well as the supply curve for new housing which is horizontal at the given price at new construction.

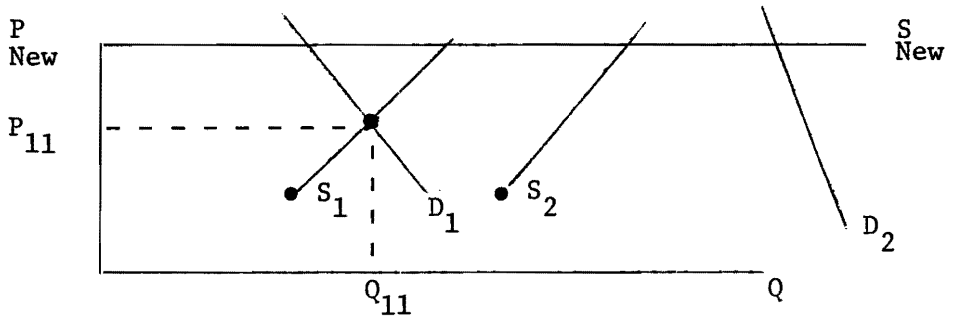

Figure 1

Equilibrium in the housing market is found in several steps. Each household examines the existing dwellings in the central city and suburban zones, as well as a new dwelling, and offers a price, found through the undersection of their demand curve and the supply curve of each dwelling (in figure 1, P_{11} and Q_{11} is one such point of intersection). Each household then ranks the dwellings according to their preference. This ranking takes into account the commuting cost, and the expected racial make-up and relative wealth of the zone in which each dwelling is located, as well as the price and quantity of housing services forthcoming from the dwelling. Based on this ranking, each household attempts

to obtain the dwelling it ranks highest. However, if another household is willing to offer a higher price for that dwelling, the first household is outbid, and must try to obtain its next preferred dwelling. The process continues until no household has a motivation to move; that is, no household prefers to be in a dwelling whose equilibrium price is lower than the household is willing to pay. The final step compares the actual racial composition and relative wealth in each zone to that which the households expected when they ranked their preferences. If they are the same, the solution has been found. If they differ, households rank the dwellings based on the new expected zonal characteristics and the process is repeated until expected and actual zonal characteristics are equal.

The Prototypical Cities

In previous work with the model, four prototypical cities were created for analyzing various housing policies. These cities were created to be representative of all U.S. metropolitan areas in 1970. They differ in two respects: minority population and the growth rate of low to moderate income households. For this analysis, only two of the prototypes are used. These are, the high-minority/high-growth city (HH) and the high-minority/low-growth city (HL). The basic characteristics of these two areas are given in Table 1.

Each of the prototypes is divided into six zones. Two are central city zones representing low-quality housing and high-quality housing. Three are existing suburban zones, two representing low- and moderate-quality housing, and one for all dwellings built between 1960 and 1970.

TABLE 1

1970-1980 CHARACTERISTICS OF PROTOTYPICAL CITIES

	Prototypical City	
	HH	HL
Number of households	92	72
Percent black households	24%	25%
Growth rate for all households	+15%	+7%
Growth rate for low-moderate income households	-2%	-10%
Growth rate for high-income households	+106%	+93%

The last zone is the new construction zone, where all dwellings constructed between 1970 and 1980 are located.

Three additional assumptions are required to complete the basic model. Two are concerned with the supply behavior of the existing housing stock: the rate at which dwellings physically depreciate and the price elasticity of supply of housing services. Depreciation is assumed to occur at an annual rate of 3.5 percent per annum. Supply is assumed to be inelastic, with a value of 0.55 for existing dwellings. The third assumption needed is the price per unit of housing services for a new dwelling. It has been calculated to be $2.30 in 1980, an 85 percent increase from the 1970 figure. By comparison, the Census Bureau price index for new single-family homes (which holds housing quality constant, as we do) has risen approximately 81 percent over the same period.

Modeling Subsidized Housing

All discussion about the supply of housing at this point has focused on the supply of private housing. This section incorporates housing constructed under the auspices of the federal government into the U.I. model. Only newly constructed subsidized housing and not renovated existing housing is considered here. In particular, policies representing alternate levels of construction of Section 236 housing and low-income public housing are analyzed. Several assumptions are required to incorporate subsidized housing into the model. These assumptions are:

(1) The government pays the market price for new construction. Although there is some evidence that the government pays a premium in the construction of subsidized units, for simplicity no such premium is assumed.

(2) The households to occupy the subsidized dwellings are selected outside the model. These households consider no other dwellings in the ranking process described above. Thus participation in the program is not modeled. It would be possible to model participation, but resource constraints precluded this effort.

(3) The income and racial characteristics of the households are selected to approximate households presently participating in subsidized housing programs.

(4) The households occupying subsidized dwellings pay a fixed percentage (25 percent) of their income for housing. This is representative of both public housing and Section 236 housing.

(5) The quality and location of subsidized housing is determined outside the model. Quality, measured in terms of housing services, is

the same for all subsidized units built. Location, on the other hand, is dependent on which program is to be considered, and is based on the location of subsidized housing built to date under each program. Both central city and suburban locations are analyzed.

With these assumptions, the model solution proceeds as before. By inputting additional housing units at a fixed quality and designating model households to occupy these units, various levels of subsidized construction are simulated. The remaining households examine the existing private stock and new dwellings, but their ranking of private dwellings incorporates the fact that some zones contain subsidized dwellings. Thus the location and quality of the subsidized dwelling, as well as the racial composition of the participating households, influences choice in the private market.

SIMULATION RESULTS

This section presents the results of 18 simulations with the U.I. housing market model. Base case results (where no subsidized housing is constructed) as well as results for four different levels of subsidized construction are presented for the two prototypical cities. Two construction programs resembling low-income public housing and Section 236 housing are analyzed.

Base Case Simulations

Selected results for simulating the 1970-1980 decade with no subsidized housing construction are presented for two reasons. They allow comparison of model results to published actual data for some of the model's

output, giving a sense of how well the simulations represent metropolitan housing markets today. At the same time, these simulations serve as the base from which simulations involving subsidized construction can be compared.

Despite differences in the population growth rates, results for the two prototypes are very similar. The overall price per unit of housing services increases just over 75 percent over the course of the decade. The rise in the Consumer Price Index of housing for urban dwellers over the same period (with 1979 projected) is about 83 percent. The increase is greater for owners than for renters, both as measured by the CPI and from the model simulations. Housing consumption (measured in units of housing services) increased by about 37 percent in each prototype. Thus price increases outstrip increases in consumption. Two of the model's outputs related to the price and quantity of housing that can be compared to published data for SMSA's are renter expenditures on housing and the value of owner-occupied housing. From the 1970 Census of Housing and the 1976 Annual Housing Survey (projected to 1980), average monthly rent is $124.00 in 1970, and $248.00 in 1980, an increase of 100 percent. Model results for HH are $132.00 in 1970, $250.00 in 1980 (an 89 percent increase). Results for HL show a similar increase. From the same Census sources, the value of owner-occupied housing increases 153 percent from 1970 to 1980. Increases in the model simulations range from 160 (HL) to 180 (HH) percent.

The model also gives the spatial variation in housing prices and consumption. Average housing consumption is greatest in the zones where housing constructed since 1960 is located. These zones contain a

significant amount of the occupied housing stock. Just over 30 percent of the 1970 occupied stock in each prototype was built between 1960 and 1970. For the 1980 occupied stock, 30 percent was built between 1970 and 1980. These figures can also be compared to published data. About 25 percent of the 1970 occupied stock was built between 1960 and 1970 in SMSAs. For 1976, only 15 percent of the stock was built since 1970. However, this figure includes several years of below-average housing construction, and construction has picked up dramatically in 1977-79. It is reasonable to assume that the 15 percent figure should rise by 1980. In each prototype, all black households live in two zones, the low-quality central city and suburban zones. Average housing consumption is lower in these zones than in any white zone, although the average price of housing is higher in the black zones than in white zones, save for the zone containing housing built since 1970.

The final result to be derived from the base case simulations is the amount of substandard housing in 1980 for each prototype. The problem is to relate inadequacy to some number of units of housing services, our measure of housing quality. This is accomplished by assuming approximately 15 percent of the 1970 occupied stock is substandard, based on various measures of inadequacy. By comparing this to the distribution of housing services in each prototype, we can find the number of units corresponding to the poorest 15 percent of the stock. These figures are then applied to the 1980 occupied stock. As an illustration, assuming 15 percent of the occupied stock in HH is substandard, then 12 model dwellings are substandard. The best of these dwellings offers 65 units of housing services. Thus 65 units becomes the

standard-substandard dividing line. Looking at the 1980 occupied stock, six dwellings yield less than 65 units of services. Thus six dwellings, or 6.5 percent of the occupied stock, is substandard in HH. This same calculation yields 4.2 percent of the 1980 stock in HL being substandard. As we would expect, the prototype with more low-income households (HH) has a greater substandard stock. The decrease in the amount of substandard housing in each prototype is consistent with other measures of inadequacy over time.

Policy Simulations

Simulations are carried out under four different levels of subsidized housing construction, ranging from about 2 percent of all households subsidized to almost 9 percent. The programs are designed to resemble low-income public housing and Section 236 housing. They are differentiated by the income and race of the participants, but the quality of the unit is assumed to be the same under each program. In general, the public housing programs have households with lower incomes, and a higher percentage of black participants. Table 2 contains the specific information on each policy simulation.

The important results from these policy simulations are:

(1) Increases in subsidized housing construction are effective in reducing the percentage of the occupied stock which is subsidized. Subsidized construction which reaches lower income households (public housing programs vs. Section 236 programs) is more effective in reducing the substandard stock. However, as can be seen from Figures 2(a) and 2(b), adding additional subsidized housing has a decreasing influence

on the substandard stock. In fact, increasing subsidized housing from 6 to 9 percent of all households has no effect on the substandard stock in either prototype, or under either program. Subsidized housing can reduce the number of substandard dwellings in two ways. First, it can take people directly from a substandard unit to a subsidized unit, with the substandard unit dropping from the occupied stock. Or, it can take a household in a low-quality, but standard unit, and place it in subsidized housing. This unit then becomes available for occupancy by a household presently in a substandard unit. This type of filtering, however, assumes that the low-income household can pay a price sufficient to keep the unit above the substandard level. While this is true for some low-income households, it is not true for all. As a result, for those unable to pay a price sufficient to maintain a standard unit, the availability of more low-quality units which are potentially above standard does not improve their housing condition. With this option removed, the only way to eliminate the last of the substandard stock is to identify the households living there and place them directly in subsidized dwellings.

(2) There are some significant differences between subsidizing public housing and Section 236 housing on the housing conditions of lower income households. These can be seen by examining Tables 3 and 4. Table 3 gives the change in housing consumption and expenditure for all low-income quintile (the poorest 20 percent) households under various levels of subsidized public housing for each prototype. It also gives changes in the price and quantity of housing for households in the lowest quintile that are not in subsidized units. Thus we can

examine both the direct and indirect effects on low-income households. Looking at Table 3, we see that substantial increases in housing consumption for low-income households (up to 25 percent) can be brought about through subsidizing public housing with only a small increase in expenditures by low-income households. Housing consumption for unsubsidized low-income households also increases, but this indirect or filtering effect is not nearly as important. Table 4 shows changes for both low-income households and lower-middle income households. Since Section 236 serves somewhat higher income households, both groups must be examined to discern the program's full effect. The effect on low-income housing consumption of subsidizing Section 236 housing is only about half as great as that of public housing. The indirect effects on the housing consumption of unsubsidized low-income population are also somewhat less under Section 236. However, the 236 program does increase the housing consumption of the lower-middle income households, both those directly subsidized and those households not directly affected. There is no comparable increase in the housing consumption of this income class by subsidizing public housing programs. The differences between the two programs can be stated as follows: public housing construction results in a greater increase in housing consumption than 236 housing, but reaches a smaller percentage of the population.

(3) There are also some significant differences in the effects of the two programs between the two prototypes. These can be seen by again looking at Tables 3 and 4. Changes in housing consumption are extremely consistent between the two prototypes for either program. However, there are striking differences in the behavior of housing prices and

expenditures, especially for the 236 program. Focusing on Table 4, we see that prices and expenditures tend to rise much more in the low-growth prototype for any given level of subsidized construction. This is consistent with other applications of the U.I. housing model; for example, simulations of housing allowance programs found prices for low-income groups rising more in the low-growth cities than in high-growth cities. Since there is greater competition in the high-growth prototype for the lower quality dwellings, their price is pushed up in the base case simulations. As a result, housing policies have little additional influence on the price of lower quality housing there.

(4) The effect of locating subsidized housing in any given zone is in general to reduce the overall average income in that zone. However, adding additional subsidized units does not lead to further decreases in income. This is true for both white and black zones. All households rank dwellings based on the racial composition and relative wealth of the zone where the dwelling is located. Low- to middle-income households can only choose between two or three zones, since none want to live in a zone made up of households of another race if they can't afford a new dwelling. Thus all movement occurs when the first subsidized unit is located in a zone.

TABLE 2

CHARACTERISTICS OF POLICY SIMULATIONS

I. High-Minority/High-Growth Prototype

A. Public Housing Simulations

1. --2.2% of all households subsidized
   --average household income: $1700
   --1 black household in central city
   --1 white household in suburbs
   --racial composition: 50% black

2. --4.3% of all households subsidized
   --average household income: $2700
   --2 black households in central city
   --2 white households in suburbs
   --racial composition: 50% black

3. --6.5% of all households subsidized
   --average household income: $3370
   --3 black households in central city
   --3 white households in suburbs
   --racial composition: 50% black

4. --8.7% of all households subsidized
   --average household income: $4650
   --3 black, 1 white household in central city
   --1 black, 3 white households in suburbs
   --racial composition: 50% black

B. Section 236 Simulations

1. --2.2% of all households subsidized
   --average household income: $5860
   --1 black household in central city
   --1 white household in suburbs
   --racial composition: 50% black

2. --4.3% of all households subsidized
   --average household income: $6240
   --1 black, 1 white household in central city
   --2 white households in suburbs
   --racial composition: 25% black

3. --6.5% of all households subsidized
   --average household income: $6920
   --2 black, 1 white household in central city
   --3 white households in suburbs
   --racial composition: 33% black

TABLE 2 (continued)

4. --8.7% of all households subsidized
   --average household income: $7080
   --3 black, 1 white household in central city
   --4 white households in suburbs
   --racial composition: 38% black

II. High-Minority/Low-Growth Prototype

A. Public Housing Simulations

1. --1.4% of all households subsidized
   --average household income: $2290
   --1 black household in central city
   --racial composition: 100%

2. --4.2% of all households subsidized
   --average household income: $2290
   --2 black households in central city
   --1 white household in suburbs
   --racial composition: 67% black

3. --6.9% of all households subsidized
   --average household income: $3080
   --3 black households in central city
   --2 white households in suburbs
   --racial composition: 60% black

4. --8.3% of all households subsidized
   --average household income: $3430
   --3 black households in central city
   --3 white households in suburbs
   --racial composition: 50% black

B. Section 236 Simulations

1. --1.4% of all households subsidized
   --average household income: $5380
   --1 white household in central city
   --racial composition: 0% black

2. --4.2% of all households subsidized
   --average household income: $4875
   --1 white, 1 black household in central city
   --1 white household in suburbs
   --racial composition: 33% black

TABLE 2 (continued)

3. --6.9% of all households subsidized
   --average household income: $5730
   --1 white, 2 black households in central city
   --2 white households in suburbs
   --racial composition: 40% black

4. --8.3% of all households subsidized
   --average household income: $6270
   --2 white, 2 black households in central city
   --2 white households in suburbs
   --racial composition: 33% black

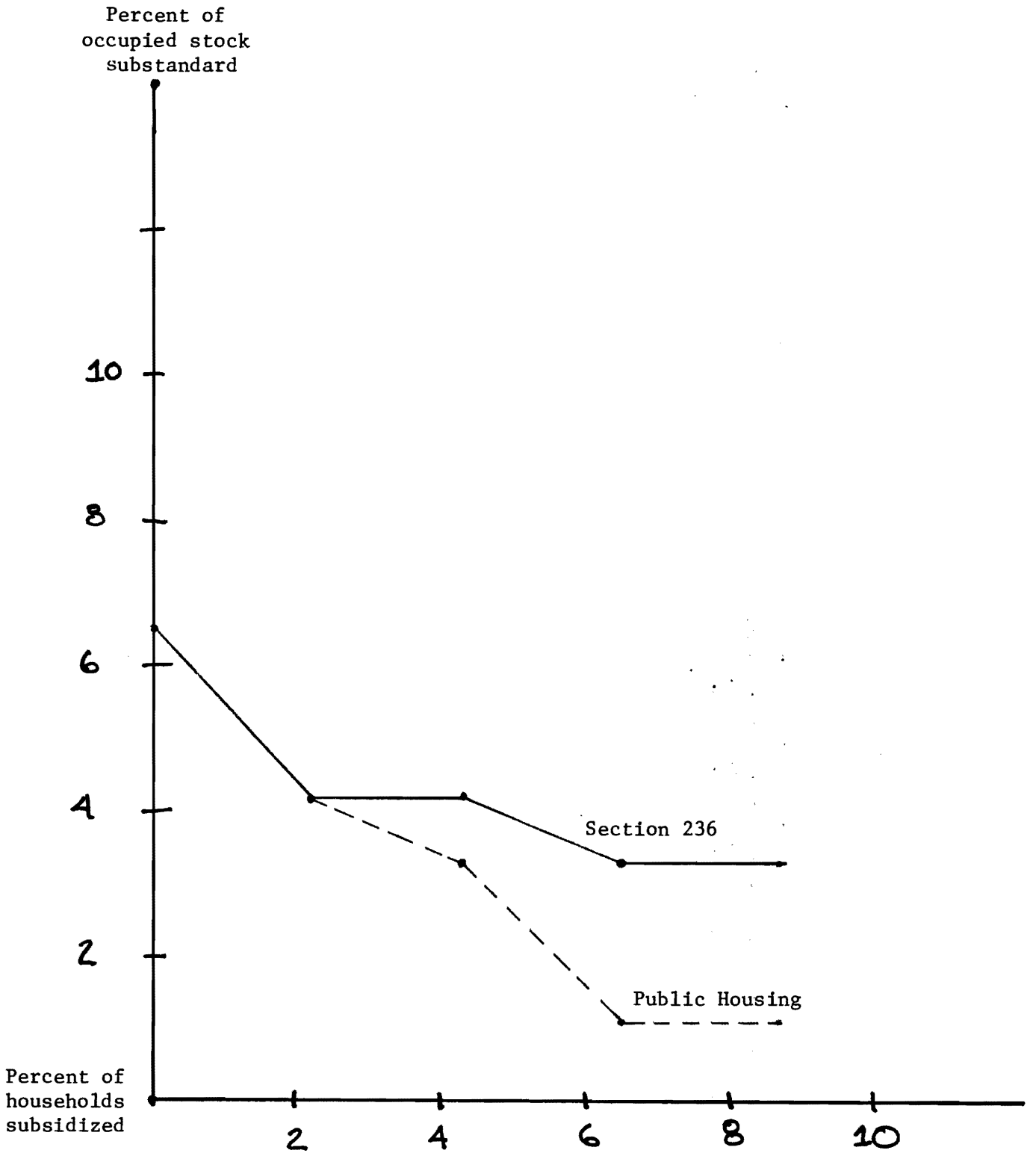

Figure 2(a). Changes in Substandard Stock: High Growth Prototype

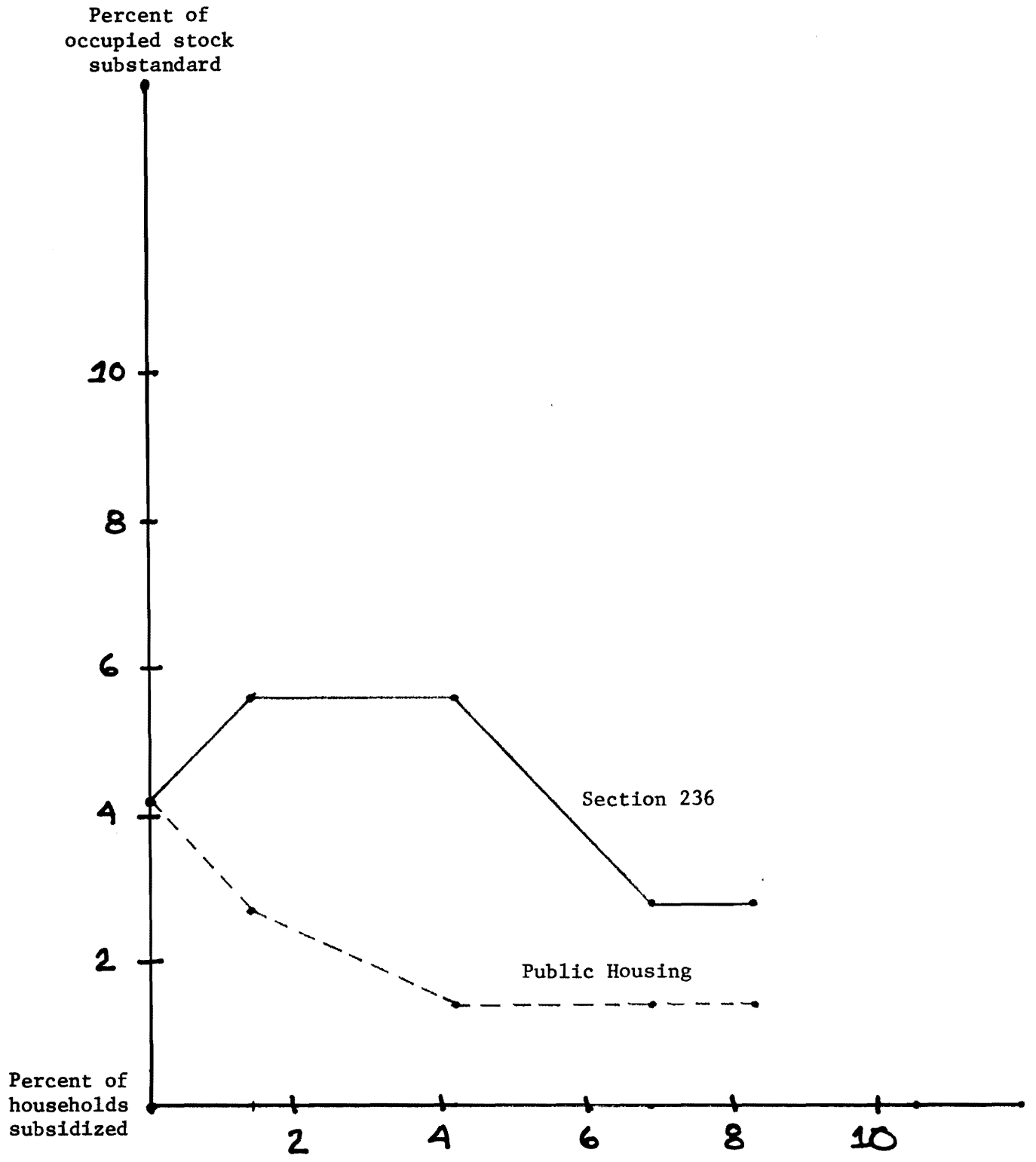

Figure 2(b). Changes in Substandard Stock: Low Growth Prototype

TABLE 3

PERCENTAGE CHANGE IN HOUSING CONSUMPTION AND EXPENDITURE: PUBLIC HOUSING SCENARIO

Percent of Households Subsidized	Lowest Y Quintile (all households)		Lowest Y Quintile (unsubsidized households only)	
	Q	PQ	Q	P
Low-Growth City				
1.4	+4.8	+1.8	+1.9	+0.9
4.2	+13.1	+4.8	+5.7	+5.7
6.9	+19.0	+6.6	+6.9	+4.5
8.3	+21.4	+6.0	+5.0	+3.2
High-Growth City				
2.2	+7.6	+1.8	+2.0	+4.2
4.3	+13.9	+5.1	+3.9	+3.9
6.5	+20.3	+5.8	+5.1	+0.8
8.7	+24.1	+4.7	+6.5	-5.3

KEY

Q - housing consumption
PQ - housing expenditure
P - price
Y - income

TABLE 4

PERCENTAGE CHANGE IN HOUSING CONSUMPTION AND EXPENDITURE: SECTION 236

Percent of Households Subsidized	Lowest Income Quintile				Lower-Middle Income Quintile			
	All Households		Unsubsidized Households		All Households		Unsubsidized Households	
	Q	PQ	Q	P	Q	PQ	Q	P
Low-Growth City								
1.4	-2.3	+0.4	-2.3*	+1.7*	--	+2.4	--	+3.2
4.2	+4.8	+1.7	-1.0	-2.1	+0.9	+2.1	+0.8	+3.2
6.9	+9.5	+7.3	+1.4	-7.3	+4.4	+5.1	+4.9	+3.1
8.3	+10.7	+7.1	+2.3	-8.0	+4.1	+4.2	+4.7	+3.3
High-Growth City								
2.2	+5.1	+0.9	-0.8	-2.9	-1.1	+0.4	-1.1*	+1.2*
4.3	+6.3	+0.4	+1.0	-4.9	--	+1.3	--	+2.2
6.5	+7.6	-0.3	+2.8	-7.5	+1.9	+1.5	+1.8	+1.7
8.7	+10.1	-1.0	+5.1	-11.0	+5.1	+3.2	+6.5	-0.9

*No subsidized households

KEY

Q - housing consumption
PQ - housing expenditure
P - price

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