ABSTRACT

RELATIONSHIPS BETWEEN SOCIO-ECONOMIC AND LOCATIONAL CHARACTERISTICS OF THE OCCUPANTS AND HOUSING CONDITION

By

Dennis Udell Fisher

The objective of this study was to examine the relationships between the socio-economic and locational characteristics of the occupants and housing condition on a national scale. Using data from the 1960 Census of Population and Housing, it was discovered that five characteristics had the largest effect on housing condition: (1) size of place, (2) occupational classification, (3) type of tenure, (4) education of the household head, and (5) household income. The sets of occupant characteristics which appeared to be most important varied depending upon which measure of housing condition was used. However, these characteristics were usually the most significant. The magnitude and direction of these and other relationships are presented in the study.

The study includes estimates of both gross and net relationships, the net relationship is the effect of one characteristic with the effects of other characteristics removed. The effects of other characteristics are not removed from the gross relationships.

In pursuing the study objective an aggregate measure of housing condition was constructed. INDEX was formed by placing a value on, weighting, and summing the physical housing characteristics that are included in the Census. This measure is thought to be a more accurate national measure of housing condition than those presently used because: (1) it is more accurately determined, (2) it is more representative of general housing condition, and (3) it provides for more precise discrimination over a wider range of housing condition.

During the construction of INDEX, the need to examine presently used measures of housing condition became apparent. It was determined that the Census measure of structural condition and the measure used by HUD, Standard and Substandard, are inadequate for most national policy decisions. They are gross measures, the one having three classifications and the other, two. They are inaccurate. And they may not represent general housing condition.

The work done in this study indicate a need for a more adequate measure of housing condition and in some cases a redirection of present housing policy.

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A THESIS

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

DOCTOR OF PHILOSOPHY

Department of Agricultural Economics

1972

ACKNOWLEDGMENTS

Many people have contributed to the consummation of this study. I wish to express my appreciation to my Guidance Committee: Dr. Dale E. Hathaway (Chairman), Dr. Lester V. Manderscheid, Dr. James T. Bonnen, Dr. Harry M. Trebing, and Dr. John P. Henderson for guidance during my graduate program. Special appreciation is also expressed to my Thesis Committee: Dr. Dale E. Hathaway (Chairman), Dr. Lester V. Manderscheid, and Dr. James T. Bonnen for guidance, criticism, and advise throughout this research project.

Financial assistance for this study was provided through the Department of Agricultural Economics, Michigan State University. The data was provided through the Computer Institute for Social Science Research, Michigan State University.

Thanks are also expressed to Carlton M. Edwards for advise during the study and Laura Robinson, Daniel C. Tsai, and Sylvia J. Samuels for computer programming.

Special gratitude is expressed to my wife, Barbara, and children, Cheryl and Brian, for their patience and encouragement. Gratitude is also due the late Victor Nelson and his wife Elsa for moral and financial support.

Any errors or omissions in this manuscript are solely the responsibility of the author.

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CHAPTER I

INTRODUCTION

Introduction

Food, shelter and clothing are often cited as some of man's basic needs. In an affluent society such as the United States, one would expect that these basic needs would be supplied. However, in 1967, 12.3 percent of all families in the United States had incomes of $3,000 or less with 26.9 percent of all non-white families falling in this category [32, p. 198, Table 246]. Eight percent of the housing occupied by whites and 29 percent of that occupied by non-whites was considered by the United States Bureau of Census as structurally dilapidated or lacking some basic plumbing facilities [32, p. 272, Table 367]. These figures only suggest the well-known fact that some citizens in our society do not enjoy satisfaction of their basic needs. Fulfillment of these basic needs is important both to the individuals directly involved and to society as a whole.

Adequate housing, in particular, can contribute to a man's sense of well being, productivity, income, and general health. The benefits go not just to the individual and his family but to the community as a whole. For example, with adequate housing rural and urban areas are more attractive to the eye, property values are higher, and citizens are less apt to be restless. Also, for many

people there is a certain satisfaction in knowing that other families have adequate housing. Just as the benefits from adequate housing are broadly distributed so are the problems inherent with inadequate housing. The individual and his family may experience discouragement, sickness and loss of income while the community appears blighted, restless, and the economic and social health of the area declines. Certainly housing is a vital part of man's relationship to his world.

Public officials have exhibited a continuing interest in the quality of man's environment as is evident from their activities: zoning, parks, public utility systems, streets, city ordinances, welfare schemes, etc. The provision of adequate housing has been approached through building codes, FHA interest subsidies, rent supplements, slum clearance, urban renewal, and provision of low-rent housing as well as other plans. The President's Commission on Rural Poverty expressed concern over the condition of housing for the rural poor. "They live in dilapidated, drafty, ramshakle houses that are cold and wet in winter, leaky and steaming hot in summer" [13, p. 93].

A number of federal agencies are vitally concerned with housing: Housing and Urban Development, Federal Housing Authority, the U.S. Public Health Service, the Farmers Home Administration, Housing Assistance Administration, the Bureau of Indian Affairs, Veterans Administration, and the Office of Economic Opportunity. This incomplete list of federal agencies could be supplemented by lists of state and local agencies and private groups. It is presented only to illustrate a mounting concern which is calling for an extension of the American tenet of "equal opportunity for all" to both rural and urban housing.

The Problem Statement

In order to develop significant public policy in the housing area, research is needed to evaluate "objectively"[1] the extent of inadequate housing and delineate its determinants. The need for a measure of housing condition is emphasized by the Bureau of the Census:

> The development of reliable measures of housing quality has been one of the major concerns of the Bureau since housing statistics were first collected on a large scale in the 1940 Census of Housing. The concept "state of repairs" was used as an indicator of structural quality in the 1940 Census while the concept of "condition of structure" was used in the 1950 and 1960 Censuses of Housing [30, p. 1].

Presently houses are classified in the Census of Housing as: (a) sound, (b) deteriorating (housing needing more repair than would be provided in the course of regular maintenance), or (c) dilapidated (housing that does not provide safe and adequate shelter and in its present condition endangers the health, safety, or well-being of the occupants). In this study we intend to construct an index of housing condition which includes an increased number of categories into which houses are placed, uses criteria that are more precise, and includes more dimensions of housing condition.

Related to the need for a measure is the need to understand the socio-economic and locational determinants of housing condition. Understanding the causes of a phenomenon usually goes far toward suggesting means of altering it. However, this work is a statistical analysis of Census data and not a micro-level examination of

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[1]Objective evaluation here means one in which the evaluator exercises as little personal judgment as the present state of social science allows.

individual cases. Thus it will analyze relationships some of which are causal and some not. Those relationships between the socio-economic and locational characteristics of the occupants and dimensions of housing condition which are not causal still provide information for policy formation and evaluation. For example, the estimated relationships will help identify the characteristics of the target population. A housing program may be examined to see if, in fact, it is operated in such a way that participation by a portion of the target population is precluded.

Objective of the Study

The objective of this study is to examine the association between selected socio-economic and locational characteristics of the occupants and housing condition. This objective can be broken into two parts: (a) examine both gross[1] and net[2] relationships between selected socio-economic and locational characteristics of the occupants and measures of housing condition that are included in the Census, and (b) examine the net relationships between selected socio-economic and locational characteristics of the occupants and a measure of housing condition to be constructed in this study (INDEX).

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[1]Gross relationships refer to the relationships between two variables with the effects of other variables not removed. In this work these relationships are estimated using cross tabulations.

[2]Net relationships refer to the relationships between two variables with the effects of other variables removed. In this work these relationships are estimated using multiple regression and canonical correlation.

Resume of Previous Investigations

Previous studies have revealed several relationships between socio-economic and locational characteristics of the occupants and measures of housing condition. In this section we present some of those relationships and characteristics of the studies reviewed.

Gross vs. Net Relationships

All of the studies reviewed, except Shurlock's [17], are based on cross tabulations of some socio-economic or locational characteristics of the occupants and measures of housing condition. Cross tabulations provide estimates of the gross relationships between the variables being studied. The effects of other variables are not removed. Thus the estimated gross relationships usually represent the effects of the studied variables and some omitted variables. The objective of this study includes estimating the net effects of the socio-economic and locational characteristics of the occupants on levels of housing condition. These will be compared with gross relationships in order to examine their differences and similarities.

Measures of Housing Condition

The studies reviewed used a variety of measures of housing condition. The works employing Census data used mainly the Bureau of the Census classification of structural condition--sound, deteriorating or dilapidated, or a classification which can be derived from Census data by adding information on plumbing facilities--standard

or substandard. This latter classification system is defined as follows. A house is substandard if it is:

1. Dilapidated, or
2. Lacks one or more of the following facilities: hot running water in the structure, flush toilet for private use, bathtub or shower for private use [30, p. 2].

The housing unit is classified standard if it is not substandard. Two reasons have been suggested for the wide use of this system.

> First, meaningful distinctions can be made on a nationwide scale. Second, the classification embodies the criteria of hazards to health, safety and welfare, the elimination of which has constituted the basic justification for legislation in this field [30, p. 2].

This latter system is more accurate than the Census measure of structural condition due to the addition of the plumbing facilities data which is more objectively determined information.

> Table III--7 reveals that the standard-substandard classification had a built-in correction feature. Of the estimated two million occupied units that should have been classified as dilapidated in the 1960 Census but were not, over one million were accurately reported as lacking plumbing facilities. Thus, the erroneous classifications of structural condition were in effect corrected by the plumbing facilities data [30, p. 19].

The Bureau of the Census classification system for structural condition is known to be relatively unreliable. The inaccuracy of this measure is revealed in the Content Evaluation Study for Housing Characteristics (referred to as CES) [25] reported by the Bureau of the Census. Only 33 percent of the houses classified as deteriorating and 38 percent of those classified as dilapidated in the CES reinterviews were similarly classified in the 1960 Census interviews. Many of the studies examined [13, 14, 15, 23] mentioned the lack of objectivity and crudeness of this measure. The measure of housing condition constructed in this work is assumed to be more

reliable because it contains the Census classification of structural condition, information on plumbing facilities, and other measures of housing condition included in the Census.

An assumption about measures of housing condition appeared in many of the studies reviewed: different measures of housing condition are in fact highly positively correlated. Several single measures of housing condition such as structural condition and age of the structure were consequently viewed as representative measures for general housing condition. This assumption is examined in Chapter IV when the measure of housing condition, INDEX, constructed in Chapter II, is examined for weight sensitivity. The existence of this assumption is documented and a variation of it is examined in Appendix I--"Representativeness of Structural Condition."

Empirical Relationships

The studies reviewed provided empirical evidence regarding some of the relationships between the socio-economic and locational characteristics of the occupants and measures of housing condition which will be examined in this study. They are reported briefly below.

1. Probably the most mentioned relationships when Census data are used are those involving regions of the country. Bird, Beverly, and Simmons using the Census measure of structural condition indicate that housing in the South tends to be less adequate than housing in the North [23, p. 4]. Pavlick and Coltrane note that: "Housing in the Appalachian Region is generally inferior to housing

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in the surrounding area and is below the U.S. average, according to the criteria on which this report is based" [20, p. V]. These studies and others [13, p. 93] indicate regional differences in housing condition. The measures used to represent housing condition were combinations of data on structural condition and plumbing facilities. If different measures had been used, the South may not have exhibited such a high percentage of housing in poor condition.

2. Some commonly used locational variables in any study of national housing condition are the residence categories--rural farm, rural nonfarm, and urban [5, 13]. It was noted in <u>Rural Poverty in the U.S.</u> that a higher percentage of rural housing is dilapidated than urban housing and that, in general, urban housing is more adequate for the old [14, pp. 44, 49]. Consistent with this conclusion, Bird, Beverly, and Simmons noted that 85.4 percent of all urban units were sound, while only 71.5 percent of all rural units were sound [23, p. 4] pointing to a general difference in housing condition between rural and urban areas. A question which could be asked is whether in fact the same standards of housing adequacy are relevant for rural and urban housing.

3. The popular press has repeatedly indicated this third set of relationships: that racial discrimination results in poorer housing conditions for non-whites. Hurst notes in a research publication that non-whites are more likely to occupy substandard housing in South Carolina than whites, indicating that housing condition tends to differ depending upon the occupant's race [21, p. 1]. These relationships were noted in several of the publications reviewed [13, p. 93; 5].

4. Income and housing condition were estimated to be positively but not linearly related [23, p. 5; 6, p. 55; 15, p. 12]. The indications were that the relationship was approximately linear to a certain level of income after which income showed little relationship to housing condition.

5. Bird, Beverly, and Simmons indicated that housing units occupied by owners had more bedrooms than those occupied by renters. They also noted that: "Owned housing was usually newer than rented housing" [23, p. 3]. A similar relationship was noted in The People Left Behind: "Rural families who rent are twice as likely to occupy substandard housing as families who own their homes" [13, p. 93]. The relationships between type of tenure and several measures of housing condition have been documented [5].

6. Another set of relationships presented in The People Left Behind are between the age of the occupants and levels of housing condition. "A disproportionate number of the elderly occupy substandard housing in rural areas" [13, p. 93].

7. Schaeffer and Edwards in a study designed only to construct a measure of housing condition suggest that there may also be a relationship between occupational groupings and housing condition [15, pp. 14, 15]. This hypothesis was not empirically tested.

The relationships that have been listed above except number 7 are supported by evidence from cross tabulations. In only one of the studies reviewed was an attempt made to determine net relationship between the studied variables although this need was

often cited. Using multiple regression techniques Hughes H. Spurlock examined the net relationship between property value, years of education and income, and his measure of housing condition, "complete plumbing" or "incomplete plumbing" [17].

The work undertaken here will include estimates of both gross and net relationships between the socio-economic and locational characteristics of the occupants and measures of housing condition.

Procedure and Outline of the Study

The primary objective of this study is to examine the relationships between characteristics of the occupants and levels of housing condition. We approach this objective by first developing an index of housing condition in Chapter II. This process involved choosing appropriate measures of housing condition from the Census data and combining them in a weighted index. The measure of structural condition was to be used as a criterion for weighing the components of the index. This criterion was chosen for two reasons. No other criterion was found. Secondly, structural condition appeared to be generally accepted in the literature as a representative measure for general housing condition.[1] It was felt that using this procedure an index could be constructed which would be more accurate than the structural condition measure used alone and would allow for more levels of housing condition.

The process of using structural condition as a criteria for weighing the measures of housing condition to be included in the

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[1]The general confidence in the representativeness of structural condition, which is expressed in the literature, is documented in Appendix I.

index revealed empirical evidence that structural condition may not vary consistently with some of these other measures. As a result of this information and the general confidence in the representativeness of this measure expressed in the literature,[1] structural condition was examined as a measure of general housing condition. This work is presented in Appendix I.

Chapter III consists of a presentation of the estimated gross relationships between socio-economic and locational characteristics of the occupants and the individual measures of housing condition which are included in the aggregate measure, INDEX. Cross tabulations were used to estimate the relationships. Chi-square tests were used to test for the existence of a relationship.

Chapter IV contains a presentation of the estimated net relationships between socio-economic and locational characteristics of the occupants and measures of housing condition. The measures of housing condition included in our aggregate measure are converted to binary variable. For example:

Y_1 = 1 if the unit has six or more rooms.
0 otherwise.

Y_2 = 1 if the unit is structurally sound.
0 otherwise.

Y_3 = 1 if hot and cold water are piped inside.
0 otherwise.

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[1]The general confidence in the representativeness of structural condition, which is expressed in the literature, is documented in Appendix I.

These binary variables are then used one at a time as endogenous variables in a multiple regression model with the socio-economic and locational characteristics of the occupants constituting the predetermined variables. Another regression model involves the same set of predetermined variables with the index of housing condition as endogenous variable.

A secondary objective of Chapter IV is to examine the INDEX for weight sensitivity. The weights on components of the INDEX are varied over a limited range while the INDEX is used in the regression model previously mentioned. The variations of the parameter estimates are examined for stability. This limited examination is not a conclusive test but does add some information relative to the question of weight sensitivity.

Chapter V includes a comparison of net and gross relationships that are estimated and presented in Chapters III and IV. Chapter VI contains summary and conclusions regarding gross relationships, net relationships, and needed research.

Appendix I includes an examination of the representativeness of structural condition. Definitions of terms used in the Census data are presented in Appendix II. The statistical models used are described in Appendix III.

In this section we have briefly covered the general procedure and outline of this research. We now consider the data used to approach our objectives.

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The Data Used

The data used in this research come from the 1960 Censuses of Housing and Population. More specifically,

> The basic sample of the 1960 Census of Population and Housing was a 25 percent sample selected from the complete listing of all housing units and group quarters. For housing units and for persons living in housing units, the sampling unit was the housing unit and all its components. For persons living in group quarters, such as barracks and institutions, the sampling unit was the person [33, p. 20].

Specifically the data come from the one-in-a-thousand sample which:

> . . . makes available reels of magnetic tape or sets of punch cards containing the separate records of the characteristics of a 0.1 percent sample of the population of the United States as recorded in the 1960 Census. The names of the respondents and certain of the more detailed items on place of residence and some other characteristics are not revealed. Therefore, it has been determined that making records available in this form does not violate the provision for confidentiality in the law under which the census was conducted [36, p. 2].

The data were made available through the courtesy of the Computer Institute for Social Science Research located at Michigan State University. Further information relative to the data used is available through several Bureau of the Census publications [24, 33, 34, 35, 36]. The accuracy of the Census data is discussed in several Content Evaluation Studies [25, 26, 27]. For purposes of this research, the data on socio-economic and locational characteristics of households are assumed to be reported without "content" error.

Of the 179,563 persons included in the 0.1 percent sample two different groups of households and household heads are used as observation points in this study. This occurs because different parts of the Census observations are used. The total Census is made up of the complete count, and a 25 percent sample which splits into the 5 percent and the 20 percent sample. The Census tapes used here, the 0.1 percent sample, are taken from the 25 percent sample and contain a 5 percent and 20 percent split. The parts of the Census used here are the 25 percent and 20 percent parts. Four thousand nine hundred thirty-four persons or 2.7 percent of the persons in the sample are omitted because they reside in group quarters. Also vacant housing units are omitted. Therefore this analysis is conducted using data representing 97.3 percent of the United States' population. Due to parity errors on the magnetic tapes as many as .4 percent of those observations used have been lost. We are assuming that this in no way biases the results.

Using this data we will approach the problem of measuring housing condition in Chapter II and then move on to examining the characteristics associated with various levels of housing condition.

CHAPTER II

MEASURING HOUSING CONDITION

Introduction

Measuring the quality of things has captured man's imagination for some time. We want to know the quality of our schools, our cities, our automobiles, etc. The more complex the thing being evaluated the more difficult quality assessment becomes. A metal part emerging from a machining process may be checked for dimension hardness and tensile strength. However, put a large number of parts together and the interrelationships between the various parts and the workings of the whole as well as the characteristics of the individual part become subject to evaluation. As one can imagine the complexity of the evaluation process increases rapidly as more pieces are added. The reader will note that housing is one of these things with sufficient component parts, the workings of which are confounded by the human element, that the multi-dimensional evaluation process is difficult.

The primary objective of this chapter is to discuss the construction of an index which will more adequately measure housing condition on a national scale than the measures presently used. This chapter includes a discussion of the theoretical consideration involved in measuring housing condition and a discussion of the construction of a housing condition index.

Theoretical Considerations

A literature review for a theoretical basis for measurement revealed several, some of which will be discussed later as they are relevant to this research. These bases varied in complexity, completeness, and orientation depending upon the purpose for measurement. For example, the American Public Health Association (APHA) measure is designed to assess the healthfulness of housing over a city-wide area or part of a city. The Census of Housing measure, on the other hand, is designed for comparing levels of physical condition between areas of the country, race of the occupants, etc. In each case the dimensions of housing condition included, the relative weights and theoretical basis are different. In fact, there are as many theoretical bases as there are purposes for measuring housing condition.

The measure to be constructed in this study is macro in orientation rather than micro as the APHA method. Because national Census of Housing data are used, the measure will be better suited to answering questions about the relative condition of housing between states or metropolitan areas rather than whether or not one area within a city should or should not be the subject of an urban renewal project. The constraint of national data from the Census of Housing effectively circumscribes the uses of this measure and in turn puts constraints on its theoretical basis.

A Theoretical Basis

In choosing a theoretical basis, we examined the possibility of measuring housing condition relative to the specific occupant's well being. The very term customarily used to describe an assessment of housing condition "housing quality" implies something about the well being of the occupants. This term is being purposely avoided because the measures examined and the one to be constructed in this work are an aggregation of specific housing conditions. In most cases there is no clear evidence that they reflect "housing quality" in general. One exception may be the APHA method which appears to reflect housing quality with respect to its standard, healthful housing.

In this study the satisfying capacity of a housing unit is used as the basis for measuring housing condition. As the satisfying capacity of a housing unit increases, the condition rating of that unit increases.

This basis includes a wide range of the dimensions of housing conditions. Due to data limitations, this study is restricted to the physical characteristics of the housing unit.

These characteristics are examined relative to their satisfying capacity for the occupants of the housing unit. If carried too far, this process leads to difficulty. For example, ceteris paribus, a ten-room house may have a higher housing condition rating than a four-room house for a family of eight people, while the opposite conclusion may hold if the housing unit is occupied by an elderly couple with no family. In the former case, extra rooms has a positive effect on housing condition while in the latter they have a negative effect. Thus, household size and type could effect the condition rating of a housing unit for a specific household. Unfortunately, this type of paradox exists for many of the characteristics of housing units which would likely be included in an index of housing condition. We have not dealt with this paradox by rating each housing unit relative to the specific occupants. Instead each physical characteristic is rated according to how it relates to occupants in general. For "number of rooms," additional rooms are assumed to have a positive effect on housing condition. The assumptions regarding the affects of other physical characteristics are presented later in this chapter.

Appropriateness of the Housing Unit

Another question related to the satisfying capacity of a housing unit for its occupants is the question of general appropriateness of the housing unit. An example of this is furnished by housing units being located in different climatic and topographic regions of the country. The adequacy of any particular type of housing unit construction differs depending upon its location. National data does not assess these differences presently and accounting for them may not be feasible.

The problem of appropriateness also occurs when the housing unit in question is not consistent with its surroundings. Examples of this are: (1) a mobile home in a residential district consisting of traditional housing units, or (2) a single family dwelling unit among a group of multiple family units. In some cases, an inconsistency in location affects the condition level of the housing unit in question.

One final example of the problem of appropriateness occurs when examining the location of the housing unit with respect to the demand. Many homeowners are painfully aware of the financial loss associated with selling a house which is located in an area where demand has decreased relative to supply since the time of purchase. Two similar housing units can be sold for widely different prices, reflecting in part differing satisfying capacities of the two locations and resulting from differing supply and demand conditions. Five thousand housing units in eastern Montana would have a different money value than the same number and condition in New York City. Due to data limitations, no attempt is made to consider differences in housing demand at different locations.

Public Policy vs. Private Demand

Of course the purpose here is to assess housing condition from a public policy rather than a private demand point of view. If private demand were the basis, then our measure would focus only on those items which most affect the market price of the individual unit. As should be evident from the present interest in ecological problems, externalities can make private demand a poor basis for public policy.

In reality, a national housing condition index will do little to measure the appropriateness of a housing unit with respect

to the needs of a specific household, its location relative to the demand for housing, or its geographic or climatic setting. Instead the attempt is to measure housing condition with respect to its satisfying capacity for occupants in general from a public policy point of view and to include items in the measure that are not sensitive to climatic and geographic differences. Unfortunately, this involves omitting many items that are definitely related to housing condition.

Characteristics Included

A review of previous housing condition measures provides insight into the types of characteristics usually included. The American Public Health Association (APHA) method contains the largest number of characteristics. They are divided into two classes: (1) characteristics involving the housing unit itself which may adversely affect safety or essential livability of the unit, and (2) characteristics of the neighborhood. A list of these specific characteristics are presented in Tables II-1 and II-2. Notice that the scope and detail of the measure goes far beyond the data included in the Census. Also the items under "Occupancy" (Table II-1) show that a special emphasis is placed on the appropriateness of the housing unit for its present occupants. An examination of the Environmental Survey (Table II-2) reveals a substantial emphasis on the surrounding neighborhood and the appropriateness of the entire housing situation. In fact the measure includes so much information about the appropriateness of the unit that it might be better referred to as a measure

TABLE II-1.--American Public Health Association, Dwelling Survey: Appraisal Items and Maximum Standard Penalty Scores

Item	Maximum Score
A. Facilities	
1. Structure: Main Access	6
2. Water Supply (Source for Structure)	25
3. Sewer Connection	25
4. Daylight Obstruction	20
5. Stairs and Fire Escapes	30
6. Public Hall Lighting	18
7. Unit: Location in Structure	8
8. Kitchen Facilities	24
9. Toilet[a]	45
10. Bath[a]	20
11. Water Supply (Location and Type for Unit)	15
12. Washing Facilities	8
13. Dual Egress	30
14. Electric Lighting	15
15. Central Heating	3
16. Rooms Lacking Installed Heater	20
17. Rooms Lacking Window	30
18. Rooms Lacking Closet	8
19. Rooms of Substandard Area	10
20. Combined Room Facilities[b]	--
	360
B. Maintenance	
21. Toilet Condition Index	12
22. Deterioration Index[c]	50
23. Infestation Index[c]	15
24. Sanitary Index[c]	30
25. Basement Condition Index	13
	120
C. Occupancy	
26. Room Crowding: Persons per Room	30
27. Room Crowding: Persons per Sleeping Room	25
28. Area Crowding: Sleeping Area per Person	30
29. Area Crowding: Nonsleeping Area per Person	25
30. Doubling of Basic Families	10
	120
Maximum Dwelling Total	600

[a]Item score is total of subscores for location, type, and sharing of toilet or bath facilities.

[b]Item score is total of scores for items 16-19 inclusive. This duplicate score is not included in the total for a dwelling but is recorded for analysis.

[c]Item score is total of subscores for structure and dwelling unit.

Source: [1, p. 12]

TABLE II-2.--American Public Health Association, Environmental Survey: Appraisal Items and Maximum Standard Penalty Scores

Item	Maximum Score
A. Land Crowding	
1. Coverage by Structures	24
2. Residential Building Density	20
3. Population Density	10
4. Frontage Daylight Obstruction[a]	6
	60
B. Nonresidential Land Uses	
5. Areal Incidence of Nonresidential Land Use	13
6. Linear Incidence of Nonresidential Land Use	13
7. Hazards and Nuisances from Industrial or Commercial Sources	30
8. Hazards to Morals and the Public Peace	10
9. Smoke Incidence	6
	72
C. Hazards and Nuisances from Transportation System	
10. Street Traffic	20
11. Railroads and Switchyards	24
12. Airports[a]	20
	64
D. Hazards and Nuisances from Natural Causes	
13. Surface Flooding	20
14. Swamps or Marshes	24
15. Topography	16
	60
E. Inadequate Utilities and Sanitation	
16. Sanitary Sewerage System	24
17. Public Water Supply	20
18. Streets and Walks	10
	54
F. Inadequate Basic Community Facilities	
19. Elementary Public Schools	10
20. Public Playgrounds	8
21. Public Playfields	4
22. Other Public Parks	8
23. Public Transportation--Very Important in Rural Areas	6
24. Food Stores[a]	4
	40
Maximum Environment Total	350

[a]Provisional item, not tested.

Source: [1, p. 13]

of the appropriateness of housing for the area and the household.

Other measures of housing condition have also recognized the interrelationship between characteristics specific to the housing unit and those related to the environment of the housing unit. Schaeffer and Edwards divide up the characteristics included in their measure into environmental systems: (1) inside and outside structure, (2) plumbing, (3) electrical, (4) heating, (5) family activity, and (6) sight characteristics [15, p. 5]. This idea is stated again in a working paper prepared for the United States Bureau of the Census entitled, <u>Measuring the Quality of Housing, an Appraisal of Census Statistics and Methods</u> [30] (referred to subsequently as Working Paper Number 25).

> We believe that indexes of housing quality can be readily constructed on the basis of objective data easily obtainable in a self-enumerative census of population and housing. The raw materials for the indexes are of two types:
>
> 1. Characteristics of the unit and of the structure in which the unit is located. These characteristics should have face validity. They should be readily recognized as housing characteristics. They would be such items as age of structure, lack of central heating, number of units in structure, availability of plumbing facilities, availability of kitchen facilities, degree of crowding, etc.
>
> 2. Characteristics of the neighborhood in which the unit is located. These can be obtained as a composite of two kinds of data. The first is derived by assigning to each unit the average values for the neighborhood in which the unit is located (e.g., the block, enumeration district, or tract) of the characteristics that are obtained for each unit separately. Thus each unit would be classified not only as having all plumbing facilities or lacking one or more of them but as being in an area in which (x) percent or more of the units have all plumbing facilities. The second kind of data might come from direct observation of neighborhood attributes, although in the context of a decennial census there are considerable limitations on what can be feasibly done [30, p. 7].

Most theoretical discussions of housing condition measures include both characteristics of the unit and of the neighborhood. The present Census measure includes only an assessment of the structural condition (sound, deteriorating, or dilapidated) of a housing unit. A measure derived from Census data (standard or substandard) includes only a limited amount of information about plumbing facilities along with the structural condition information. Census data, to date, does not contain information regarding the setting of the unit and thus measures constructed from that data will be lacking those dimensions of housing condition involving the housing unit's environment.

Also limited information on the number and type of conveniences in a housing unit are documented in the Census. The data contains such information as hot and cold running water piped into the unit, just cold water piped in, water piped to the outside or no piped water. Also information is available on year built, toilet facilities, kitchen facilities, heating equipment, etc. Unfortunately, nothing is available regarding the quality of the specific facility and appropriateness to the unit in question. With the data now available, we will not be considering the quality of the original facilities, their present state of repair, aesthetic value or usefulness. Instead the assumption is that in the aggregate assigning a value to physical facilities and including them in a weighted index will be a better measure of housing condition than the measures presently used. This assumption should be tested in further work.

Criteria for Measurement

In order to measure housing condition one must have central criteria against which to compare different housing units. As is the case in this study, the theoretical basis usually suggest the appropriate criteria. However, two which have been used in the past deserve some further examination here. The first is that used by the Bureau of Census in assessing housing structural quality as sound, deteriorating, and dilapidated. The criterion used for this measure is the "health, safety and well-being" of the occupants of the unit. This type of a measure has its greatest discriminatory power when very low levels of housing condition are being considered. However, as interest is shifted to higher levels, one must consider criteria such as that level of housing which society deems desirable. The two criteria are not mutually exclusive but the former usually refers to a much lower level and may be a sub-part of the latter. The former refers to health and safety standards while the latter involves the social desirability of a particular level. The two criteria not only suggest different total levels of condition but also suggest the inclusion of different housing characteristics and different weights on those characteristics. The authors of Working Paper Number 25 stated that both of these criteria should be used.

> In broad terms, we have reached the following position with respect to standards of quality; there are two general standards. The first deals with the question, does the housing unit have any characteristics that are detrimental to health or safety? The second deals with the question, does the housing unit have any characteristics that do not meet minimum standards of well-being for its occupants? [30, p. 7].

Also noted was that the first criterion mentioned--health, safety, and well-being of the housing occupants--is more stable over time and a much more operational criterion for determining which characteristics will be included in the measure, their relative weights and the acceptable level for the aggregate measure. The second criterion relating to the social acceptability of various levels of housing quality is much more difficult to implement. While the first can be constructed by consulting a team of experts in the field of health, and safety as was done with the APHA method, the second relies on some kind of aggregation of the opinions of individuals as to what is more or less desirable in housing condition [30, p. 3].

As one examines higher levels of housing condition, however, the ability of an aggregate measure based on the first criterion, health, safety, and well-being quickly loses its power of discrimination. If we are to differentiate condition levels above the barest subsistence type housing, one must use a condition measure which is based on a criterion such as social acceptability. It seems to this researcher that the higher the level of housing condition at which one wants to discriminate the more difficult the task of obtaining a criterion to be used in selecting characteristics to include, weights to be administered, and levels of housing condition to be distinguished.

The importance of having the "correct" criterion for weighting individual characteristics of housing condition seems to become less important when a large number of characteristics are included in the index. This proposition is generally true because the larger the number of characteristics the smaller the weights on each individual one. However, this ignores the situation where a high proportion of the characteristics included may describe one particular dimension of housing condition to the neglect of others. Therefore, even in an index containing many characteristics attention should be given to the relative weights allotted to the various dimensions of housing condition.

Annette Schaeffer and Carlton M. Edwards attacked the problem of finding a criterion for weighting individual characteristics by defining a number of needs which they felt a housing unit should provide for the occupants, changing these needs into environmental systems and weighting these systems equally. However, they give no justification for their weighting system.

The American Public Health Association assess an individual unit with penalty points for deficiencies found in various characteristics of housing. The number of penalty points assessed, which is their weighting system, was determined by a group of experts, the Committee on the Hygiene of Housing [1, pp. 12-13]. Each reportable deficiency is graded according to the seriousness of that condition as a threat to health or safety or as a deterrent of comfort or general livability, in the judgment of these experts. Thus, the score assigned to each appraisal item represents a consensus of experienced opinions as to the importance of that condition. These penalty points are usually adjusted to meet requirements of the area being surveyed. At this point the specific criterion and resulting

weights are set by the local authorities using the measure. The maximum penalty points recommended are presented in Tables II-1 and II-2. This criterion and weighting system was not used in this research because the characteristics included in the Census data are not easily paired with characteristics included in the APHA method. In fact, a futile attempt was made to transfer the weights to Census data for comparison with the weighting system used in the measure constructed later in this chapter. It seemed that enough was lost in transfer to destroy any usefulness.

Three other criteria, which have been suggested as a basis for choosing weights, will be mentioned here although they are not used in the research. These criteria weight various housing characteristics at: (1) the relative values that are used in assessor's manuals, (2) the importance used in condemnation proceedings, and (3) the relative new component prices. Both the first and the third criterion were not used for two reasons. First, both suggest weights that are subject to the quality of the characteristic itself and the Census data do not include this information. Secondly, both rely to varying degrees on a central criterion of private demand which has already been rejected for our measure. The second criterion, the importance used in condemnation proceedings, is felt to be too narrow for a general measure of housing conditions.

We have chosen to weight equally the characteristics from Census data included in this study's measure of housing condition. Upon examining the data, our system seems as plausible as other systems and not noticeably different from the APHA system. The specific weighting and procedures used to test it will be discussed later.

Problems of Measurement

Several problems make choosing relevant characteristics to measure housing condition difficult. First, as building techniques change, the patterns of defects in housing units change. Home improvement operations which occurred in the decade prior to the 1960 Census serve to obscure many deficiencies which would have caused a housing unit to be listed as dilapidated. These include items such as wall paneling, aluminum siding, contact paper, and a host of other do-it-yourself home improvement materials [30, p. 14]. These changes make condition assessment more difficult. Finally, many characteristics may be poor measures of housing condition because they are included in safety, sanitary, and building codes.

> Some housing analysts believe that, because of the increased enforcement of housing codes since 1960, there has been widespread installation of inferior plumbing facilities in poor housing. This installation may be sufficient to classify low-quality housing as standard [30, p. 13].

The effect of these codes may be to bring into compliance those included characteristics to the neglect of other important characteristics. In this case a housing unit could be rated high based on code characteristics when possibly it should be rated low because of other defects. This would cause no problems if the codes contained all characteristics necessary to insure adequate housing.

However, they probably do not. The only safeguard is to include a cross section of characteristics not all of which are included in the various codes.

Requirements of a Measure

In order to be useful, a measure of housing condition should meet certain requirements. A list of five such requirements are presented in Working Paper Number 25 which was produced as part of an effort to improve the Census measure of housing condition. Since the measure constructed in this study used Census data, it is felt that these requirements are appropriate.

1. The statistics should reflect the "real" as opposed to the "apparent" state of affairs with respect to quality of housing . . . thus the term "real" may be interpreted as "relevant for the present circumstances and present uses."
2. The statistics should reflect real trends in the quality of housing.
3. The statistics should be comparable geographically.
4. The statistics should be built up from data obtained for individual housing units.
5. The statistics should be based on methods that distinguish various levels of quality of individual housing units [30, pp. 9-10].

It must be recognized that these five requirements would be difficult to test. Meeting these requirements depends upon the characteristics chosen to be included in the measure and the relative importance placed upon each item. For purposes of this work, the information included in the Census is assumed to represent "real" housing condition and be comparable geographically. Of course, the data does come from individual housing units fulfilling requirement number 4. The index will be used to distinguish various levels of condition and is assumed to be valid. The validity and nature of this measure will be discussed in more detail later.

Another requirement, which is mentioned in Working Paper Number 25 is that the measure should have a minimum mean square error [30, p. 42]. This requirement is deceptively simple. Minimizing this statistic implies minimizing the sum of the following three items relating to the measure of housing condition: (1) the variance, (2) the square of the bias, (3) the sampling variance. Of course, in a sample as large as the Census, this third component is insignificant. The square of the bias, the second component, has to do with how well the items included in the measure reflect "real" housing condition, as well as the enumerator's ability to record various characteristics in an unbiased fashion. This component can be thought of as a measure of the accuracy with which the Census statistics describes the theoretical value of housing condition. The first component "the variance" has to do with the precision of the measure of housing condition; that is, the consistency with which condition is estimated.

Needless to say meeting all of these requirements would be an impossible task to attempt here. The author will attempt in this study to make significant improvement upon the present census classification of sound, deteriorating, and dilapidated and the classification of standard and substandard while at the same time retaining the advantage of using Census data to construct the measure.

This discussion of theoretical considerations has included such items as: (1) a theoretical basis, (2) appropriateness of the housing unit, (3) public policy vs. private demand, (4) characteristics included, (5) criteria for measurement, (6) problems of measurement, and (7) requirements of a measure. Following this discussion we concentrate on the objective of this chapter--constructing an index which will more adequately measure housing condition on a national scale than the measures presently used.

The Housing Condition Index

The index constructed in this section is believed to be an improvement upon the Census measure of structural condition as a measure of general housing condition for several reasons. First, the index is believed to be more accurate. Bureau of the Census Working Paper Number 25 [30] indicates that the formation of the classification system, standard-substandard, by addition of plumbing information to structural condition markedly improved accuracy. This occurred because information that is more accurately determined was combined with structural condition. The index constructed here would contain the added information on plumbing facilities as well as other measures, all of which are more accurately determined than structural condition [25]. Second, the index is believed to be more representative of general housing condition. The theoretical discussion at the beginning of this chapter indicated that housing condition is a multidimensional concept with structural condition representing only a part. This index contains several dimensions of housing condition in addition to structural condition making it more representative than structural condition alone.

Measures Included in the Index[1]

The measures of housing condition that have been included in the index are presented along with the value assigned for each level of condition in Table II-3. This list represents only a part of the data regarding the housing unit, included in the Census. So few measures are available that choosing those to include and exclude becomes a process of using all measures that are in some way admissable. Some of those items omitted from the index are discussed here with brief definitions where necessary and reasons for their exclusion followed by an explanation of included measures.

One of the variables excluded, persons per room [34, p. LVII], a crowding index, combines both household size and the number of rooms. This variable relates to the adequacy of a housing unit for a particular size household rather than to housing condition in general. The variable number of rooms was included instead.

Characteristics relating to the value of the housing unit such as contract rent, gross rent, and value of property are excluded from the index for several reasons. First, these characteristics are not listed for certain housing units such as farms, nonfarm units with ten or more acres, or single dwelling units with an attached business [36, pp. 71-73]. Secondly, these characteristics respond to market conditions in such a manner that they would not necessarily vary consistently with housing conditions across several markets.

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[1]The definitions of most of the measures included in the index may be found in Appendix II--Census Definitions. The Appendix contains excerpts from several Census publications and these original sources provide more detailed information [24, 33, 34, 35, 36].

TABLE II-3.--Measures of Condition Included in the INDEX of Housing Condition

Number (j)	Condition	Value[a] (Vj)
1	Structural Condition	
	A. Sound	10.00
	B. Deteriorating	6.67
	C. Dilapidated	3.33
2	Telephone	
	A. Telephone Available	2.00
	B. No Telephone Available	1.00
3	Kitchen Facilities	
	A. Direct Access, Exclusive Use	10.00
	B. Direct Shared Access or No Equipment	6.67
	C. Shared Access Through Another Unit	3.33
4	Water Supply	
	A. Hot and Cold Water Piped Inside	10.00
	B. Cold Water Piped Inside	7.50
	C. Water Piped Outside	5.00
	D. No Piped Water	2.50
5	Year Built	
	A. 1959 through March 1960	9.90
	B. 1955 through 1958	9.40
	C. 1950 through 1954	8.50
	D. 1940 through 1949	7.00
	E. 1930 through 1939	5.00
	F. 1929 or before	2.40
6.	Heating Equipment	
	A. Built-in Electric Units	10.02
	B. Steam or Hot Water	8.35
	C. Warm Air Furnace	8.35
	D. Floor, Wall, or Pipeless Furnace	6.68
	E. Other Means, with Flue	5.01
	F. Other Means, No Flue	3.34
	G. Not Heated	1.67

TABLE II-3.--Continued

Number (j)	Condition	Value[a] (Vj)
7	Number of Rooms	
	A. Ten Rooms or More	10.00
	B. Nine Rooms	9.00
	C. Eight Rooms	8.00
	D. Seven Rooms	7.00
	E. Six Rooms	6.00
	F. Five Rooms	5.00
	G. Four Rooms	4.00
	H. Three Rooms	3.00
	I. Two Rooms	2.00
	J. One Room	1.00
8	Bathing Equipment	
	A. Exclusive Use of Bath or Shower	10.00
	B. Shared Use of Bath or Shower	6.67
	C. No Bath or Shower	3.33
9	Toilet Facilities	
	A. Exclusive Use of a Flush Toilet	10.00
	B. Shared Use of a Flush Toilet	6.67
	C. Other or None	3.33
10	Number of Bathrooms	
	A. Two or More	10.00
	B. One and a Partial	7.50
	C. One	5.00
	D. Shared, Partial, or None	2.50

[a]Value is the amount assigned to a housing unit when it possesses one of the listed characteristics.

Source: These measures of housing condition and the levels within each measure are defined in the Technical Documentation [36] and in Appendix II. The value assigned to the levels within each measure represent the author's judgment as to the importance of the levels.

A number of items included in the 5 percent sample were omitted because they were similar to information available in the larger 25 percent sample [36, p. 75]. For example, "number of bedrooms" recorded in the 5 percent sample, is replaced in the index by a similar item "number of rooms" recorded in the 25 percent sample [36, p. 69]. Another item omitted from the index for this reason has to do with the heating system for the housing unit. "Fuel used for heating" [36, p. 75] from the 5 percent sample was omitted while "the type of heating equipment" [36, p. 71] from the 25 percent sample was included.

Another group of items recorded in the 5 percent sample are omitted because they relate to facilities which are not permanently attached to the structure and are typically not left in the housing units when occupants change due to sale or rental. These items include "clothes washers and dryers," "television and radio," and "air conditioners and food freezers" [36, pp. 75-76]. The air conditioners can be permanently attached to the housing unit and thus not removed when the occupants move but their use is specific to certain areas of the country and in cold areas even the highest quality housing units may not contain such facilities.

In summary, the reasons for rejecting the measures just discussed were:

1. The variable did not measure housing condition in general but specifically with respect to a certain type of household.

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2. The variable would not measure consistently housing condition across several markets.

3. The variables from the 5 percent sample measured almost the same condition as was being recorded by other variables in the larger 25 percent sample.

4. The variable records the presence or absence of facilities which are not usually permanently affixed to the unit and therefore should not be considered a part of housing condition in general.

Those measures included in the index do not in general violate these four reasons given for exclusion. The possible exception is the inclusion of the data on availability of a telephone. However, this has been included because of the important part this facility plays in everyday life. The definition in Appendix II indicates that a telephone need not be inside the unit but must be available for incoming calls in order to be recorded as telephone available.

Ranking the Measures in the Index

The levels of housing condition within each measure are ranked ordinally as they appear in Table II-3 with "A" being the highest level and progressing downward through the alphabet for each measure.

1. It is assumed for measure number 1 that a structurally sound housing unit is a higher level condition than a deteriorating unit which is of a higher level than a dilapidated unit.

2. For measure number 2 having a telephone available is assumed to be a higher level condition than no telephone available.

3. The third measure, kitchen facilities, has three distinct levels for different types of access: (1) direct access, exclusive use; (2) direct-shared access or no cooking equipment; and (3) access through another unit. They have been ranked from best condition to worst condition as listed. It is assumed that direct-shared access or no cooking equipment is a higher level of condition than access through another unit.

4. The fourth measure, water supply, has four distinct levels of condition which listed from highest to lowest are, hot and cold water piped inside, cold piped inside, water piped outside, and no piped water.

5. The next measure, year built, has six levels of condition with the newest units representing the highest level, the oldest representing the lowest level, and intermediate ages ranked accordingly.

6. The sixth measure, heating equipment, has seven discrete classifications with the bottom four being easily ranked. However, the top three categories: (1) built-in electric units, (2) steam or hot water, and (3) warm air furnace were not easily ranked. After consultation with Carlton M. Edwards, co-author of <u>A Housing Quality Measuring Scale</u> [15], built-in electric units was ranked first and the next two were ranked equally. It may have been more correct to rank these top three equally. The next level was floor, wall or pipeless furnace; then other means, with flue; followed by other means, no flue, and last not heated.

7. The next measure, number of rooms, is ranked with largest number of rooms being the highest condition down to the smallest number of rooms being the lowest condition level.

8. The highest condition level for bathing equipment was exclusive use followed by shared use with the lowest level being no bath or shower.

9. For the measure, toilet facilities, the highest level was exclusive use of a flush toilet, followed by shared use, and the lowest level was no flush toilet.

10. The last measure of housing condition, number of bathrooms, has four discrete levels of condition. It is assumed that the more bathrooms, the higher the condition level.

Weighting the Measures in the Index

The next problem was choosing values to place on each level of condition. Some of the practical and theoretical problems associated with selecting a system of values or weights have been discussed previously in this chapter. The resulting conclusion was, except for the availability of a telephone, to weight all measures in the index equally for lack of a better weighting system. The availability of a telephone has a maximum possible value of two if one is available and a minimum value of one if a telephone is not available, while the other measures in the index have maximum values of approximately ten. The telephone was weighted less because it was assumed to be less important. Notice that ignorance is assumed with respect to the relative values within each measure of condition. For example, the four measures--(1) kitchen facilities, (2) structural condition, (3) toilet facilities, and (4) bathing equipment--each have three levels of condition within them and the total possible of ten points is divided equally between these levels. The same practice is followed with respect to the other measures which have different numbers of levels in them.

The Index

The index is then formed by summing for each individual housing unit, the value received for each of the housing measures.

$$\text{INDEX}_i = \sum_{j=1}^{10} W_j V_j$$

where:

i = the ith weighting system for the INDEX.

j = the number of the condition measure as listed in Table II-3.

V_j = the value allowed for the jth condition measure as listed in Table II-3.

W_j = the weight given to the jth condition measure.

INDEX 21 is the one described here where all $W_j = 1$, $j = 1,2,\ldots,10$. The maximum and minimum possible scores for this index are 91.92 and 26.99, respectively. The actual maximums and minimums from our sample were 91.42 and 31.06, respectively. The mean score was 71.42 with a standard deviation of 10.26.

INDEX 1 through INDEX 20 will be discussed in Chapter IV where they will be used to examine the INDEX for weight sensitivity.

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Summary and Conclusions

The primary objective of this chapter was to discuss the construction of an index which will more adequately measure housing condition on a national scale than the measures presently available. In pursuing this objective, we have discussed a number of theoretical considerations which indicate the difficulties inherent in attempting to measure housing condition. Particularly troublesome are the problems of finding measures that are comparable between geographic and climatic areas as well as between rural and urban areas. The measures included in the Census need to be tested explicitly for comparability between these areas. We proceed then to develop an index of housing condition asserting that it is an improvement upon the present Census measure of structural condition as a measure of general housing condition for two reasons. First, it is more accurately and objectively determined. Secondly, it is more representative because it contains more of the dimensions of housing condition. Further discussion of this index is included in Chapter IV. Using a regression model which is developed there the index is examined for weight sensitivity and more can be said relative to its validity.

In the next chapter, the gross relationships between the socio-economic and locational characteristics of the occupants and measures of housing condition are examined. The measures used are the ones introduced in this chapter and included in the index.

CHAPTER III

GROSS RELATIONSHIPS BETWEEN SOCIO-ECONOMIC AND LOCATIONAL CHARACTERISTICS AND HOUSING CONDITION

Introduction

The previous chapter dealt with the general topic of measuring housing condition. Selected theoretical matters associated with this illusive measure were considered and the measures of housing condition which are used in this research were discussed. Also the construction of the INDEX which is used in Chapter IV was discussed. In this present chapter we explain the socio-economic and locational characteristics of households that are used throughout the remainder of the work. The estimated gross relationships between these characteristics and the measures of housing condition discussed in Chapter II are also presented. In Chapter V these estimated relationships are compared to the net[1] relationships which are presented in Chapter IV.

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[1]Net relationships refer to the relationships between two variables with the effects of other variables removed. In this work these relationships are estimated using multiple regression and canonical correlation.

The primary focus of this chapter is to estimate and present the gross[1] relationships between socio-economic and locational characteristics of the occupants and various measures of housing condition.

Contingency tables are used to estimate the gross relationships between household characteristics and measures of housing condition. Each of these tables has been tested for the existence of a relationship between the variables but not for the direction of that relationship. The nature of the statistical test used does not provide information on the form, magnitude, or direction of the relationship. The null hypothesis being tested in each case is Ho: The probability of a housing unit having any level of housing condition is not affected by the characteristics of the household. See Appendix III for a further discussion of contingency tables and the statistical test being used.

This chapter is divided into thirteen sections, one for each set of socio-economic and locational characteristics of the households. Each section contains definitions of the household characteristics, hypotheses regarding their relationships to housing condition where necessary, and estimated gross relationships with various measures of housing condition.

Each of the thirteen sets of socio-economic and locational characteristics were cross tabulated with nine different measures of housing condition. One summary table is presented for each of the

[1]Gross relationships refer to the relationships between two variables with the effects of other variables not removed. In this work these relationships are estimated using cross tabulations.

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sets of household characteristics rather than nine cross tabulations. The summaries have been prepared by dividing each of the measures of housing condition at an arbitrary level. The percentage of housing units within a specific socio-economic or locational characteristic that possess the desirable housing characteristics or higher levels of housing condition are then reported. Table III-1 presents the list of desirable housing characteristics that are used in the summary tables and the measures from which they are derived.

TABLE III-1.--Measures of Housing Condition and Desirable Housing Characteristics

Measure of Housing Condition	Desirable Housing Characteristic
The Number of Rooms	Six Rooms or More
The Structural Condition	Structurally Sound
Water Supply	Hot and Cold Water Piped Inside
Access to a Flush Toilet	Exclusive Access to a Flush Toilet
Access to a Bath or Shower	Exclusive Access to a Bath or Shower
Year Built	Built from 1950 to 1960
Number of Bathrooms	One or More Bathrooms
Type of Heating Equipment	Heating Equipment Built-in Electric Steam or Hot Water Warm Air Furnace Floor, Wall, or Pipeless Furnace
Access to Kitchen Facilities	Exclusive Access to Kitchen Facilities

Source: This table was constructed from data on the characteristics of housing included in the 1960 Census of Housing [36].

Using this list of "desirable housing characteristics" we present definitions of household characteristics, hypotheses regarding their gross relationships to housing condition, and estimations of these gross relationships in the next thirteen sections.

Regions of the United States

The first characteristics presented here, regions of the United States, are almost always used in any national assessment of income, education, or housing conditions. As can be seen from Table III-2, Northeast, North Central, South, and West the regional characteristics used, are such large aggregations of diverse areas that they are not adequate proxies for such things as climate, topography, or geography. However, it is felt that in the absence of better indicators, regions of the country should be used.

Most studies which include this set of variables indicate that lower levels of housing condition exist in the South than in other regions of the United States [3, 13, 14, 22, 23]. Empirical results of these same studies indicate that income and educational levels are generally lower and that the population is composed of a higher proportion of rural residents and non-whites, all of which are thought to have a negative effect on housing condition.

One of the questions that will be examined in this research is whether or not, after the effects of other characteristics have been removed, the net effect of the South on housing condition is negative. This will be accomplished through a comparison of the gross effects of regions of the United States with their net effects on levels of housing condition. No direct test of this question

TABLE III-2.--Regions and Geographic Divisions of the United States

NORTHEAST REGION

New England Division

Maine
New Hampshire
Vermont
Massachusetts
Rhode Island
Connecticut

Middle Atlantic Division

New York
New Jersey
Pennsylvania

SOUTH REGION

South Atlantic Division

Delaware
Maryland
District of Columbia
Virginia
West Virginia
North Carolina
South Carolina
Georgia
Florida

East South Central Division

Kentucky
Tennessee
Alabama
Mississippi
Arkansas
Louisiana
Oklahoma
Texas

NORTH CENTRAL REGION

East North Central Division

Ohio
Indiana
Illinois
Michigan
Wisconsin

West North Central Division

Minnesota
Iowa
Missouri
North Dakota
South Dakota
Nebraska
Kansas

WEST REGION

Mountain Division

Montana
Idaho
Wyoming
Colorado
New Mexico
Arizona
Utah
Nevada

Pacific Division

Washington
Oregon
California

Alaska
Hawaii

will be performed but a comparison of the empirical results should suggest an answer.

Empirical Results

These first characteristics of the occupants considered, region of the country, exhibited a significant relationship with each of the housing condition measures at less than the .005 level of significance. Two distinct patterns of relationships are observed (Table III-3), the "traditional" and the "opposite" relationships. The "traditional" or expected one is where the West exhibits the highest percentage of housing units with the desired housing characteristics and the South the lowest with the North East and North Central regions being second third, respectively. This pattern of relationships appears with four of the desirable housing characteristics: hot and cold water piped inside, structurally sound, exclusive access to a bath or shower, and one or more bathrooms. Variations of this relationship appear with three of the other housing characteristics. The North East Region has the highest percentage of units with six or more rooms, followed by the North Central Region and Southern Region and the Western Region having the lowest percentage. The Western Region has the lowest percentage rather than the highest but the other regions follow the "traditional" pattern. A variation of the "traditional" pattern also appears with the housing characteristic, exclusive access to a flush toilet. Here the relationship holds except for the Western Region having the second highest percentage of units with this condition rather than

TABLE III-3.--Percentage of Occupied Housing Units in Each Region of the U.S. With Selected Housing Characteristics

Desirable Housing Characteristics	North East Region	North Central Region	Southern Region	Western Region	Percentage of U.S. Households
		(Percent of Total in Each Region)			
Six Rooms or More	43.0	39.3	32.4	28.2	37.0
Structurally Sound	86.7	84.4	74.9	87.6	82.7
Hot and Cold Water Piped Inside	96.0	90.9	77.2	96.7	89.1
Exclusive Access to a Flush Toilet	94.9	88.9	79.4	94.4	88.5
Exclusive Access to a Bath or Shower	93.6	87.6	77.4	94.2	87.2
Built From 1950 to 1960	20.2	23.7	32.2	27.5	27.5
One or More Bathrooms	92.2	86.0	74.1	93.6	85.3
Heating Equipment Built-in Electric Steam or Hot Water Warm Air Furnace Floor, Wall or Pipeless Furnace	88.0	78.5	40.3	69.5	68.1
Exclusive Access to Kitchen Facilities	98.5	98.8	99.2	98.4	98.8
Percentage of U.S. Households	25.6	28.7	29.5	16.3	

Source: These percentages were calculated from cross tabulations of data on housing units and household heads made available in the one-in-a-thousand sample tapes, 20 percent sample, 1960 Censuses of Population and Housing [36].

the highest. A variation of the traditional pattern appears the third time with the four desired types of heating equipment. Here the relationship holds except the Western Region has the third highest percentage of units with the given condition rather than the highest.

The "opposite" relationships to the "traditional" and a variation to the "opposite" are revealed with two of the desired housing characteristics: exclusive access to kitchen facilities and built from 1950 to 1960. The Southern Region contains the highest percentage of housing units with exclusive access to kitchen facilities, followed by the North Central Region and the North East Region with the Western Region having the lowest percentage. A variation of these "opposite" relationships occurs with the housing characteristic, built from 1950 to 1960. The Western Region has the second highest percentage of units with the desired condition rather than the lowest percentage.

Several conclusions serve to summarize the data presented in Table III-3. First, the "traditional" pattern of relationships between regions of the country and desirable housing characteristics are predominant. Seven out of the nine desired housing characteristics presented demonstrated these relationships or variations of them. Secondly, relationships "opposite" to the "traditional" do occur. And thirdly, the relationships are sufficiently diverse to allow regions of the United States to vary between having the highest, second, third, or lowest percentage of units with the desired characteristics. The North East and Western regions vary from highest percentage to lowest; the North Central Region, between second and third; and the Southern Region between highest, third, and lowest.

These results indicate that by choosing the proper measure of housing condition any region but the North Central can be shown to have the largest positive or negative relationship to housing condition.

Size of Place

The next household characteristics included are referred to as "size of place" variables. They include twelve residence categories which are presented here along with the estimated distribution of United States households among these categories: (1) 6.7 percent rural farm, and (2) 21.0 percent rural nonfarm. The remainder were distributed through urban residence categories in this manner: (3) 5.4 percent in urban territories outside of places, (4) 4.4 percent in places of 2,500-4,999 population, (5) 5.5 percent in places of 5,000-9,999 population, (6) 9.7 percent in places of 10,000-24,999 population, (7) 8.5 percent in places of 25,000-49,999 population, (8) 7.9 percent in places of 50,000-99,999 population, (9) 6.9 percent in places of 100,000-249,999 population, (10) 6.5 percent in places of 250,000-499,999 population, (11) 6.7 percent in places of 500,000-999,000 population, and (12) 11.0 percent in places of 1,000,000 or more population. Notice the estimated household residence distribution is 27.7 percent rural and 72.3 percent urban, and that 788 of every 1,000 rural households are rural nonfarm.

It is hypothesized that the larger the population the higher the level of housing condition will be. This hypothesis is advanced for several reasons. The larger the population in a given area, the more housing units that will likely be for sale and the more buyers available at any one time. It is believed that this would result in a more fluid housing market, better market information, better credit availability, and acquisition prices close to salvage values plus transfer costs. In this type of a housing market, households should be able to satisfy their demand for housing. In low population areas, such as rural farm, no buyers may be available and the salvage value of a housing unit may be zero or negative. There may be no alternatives for recouping the investment in a housing unit except living in it. With acquisition prices greater than salvage values and under conditions of imperfect knowledge, the situation is ripe for housing units to become fixed assets as defined by G. L. Johnson [8]. Households would experience lower levels of housing condition than they would in housing markets where the salvage value and acquisition price differ only by the transfer costs.

In a less fluid housing market one may be reluctant to improve his present housing unit for the same reason that he failed to sell and move. Salvage values are so low that other than living in the unit there are few ways of recovering the costs of improvements.

Another often observed phenomenon is that educational and income levels are usually lower in rural areas and smaller places. Since both income and education are positively related to housing conditions, this would have a negative affect on the level of housing condition. This situation would suggest that the gross

relationships between size of place variables and housing condition will probably be more strongly positive than the net effects which have the effects of these other characteristics removed.

Another causal hypothesis which may exhibit itself through these variables is that the larger the size of place the more likely the place will have building and health codes and zoning ordinances. This would tend to cause improvement in the condition level of housing. As was mentioned in Chapter II, this can have the effect of camouflaging the housing condition level by forcing improvements in obvious items to the neglect of other more serious defects.

Empirical Results

We will next examine the estimated gross relationships between this set of variables referred to as "size of place" and the measures of housing condition included in the INDEX. Table III-4 presents a summary of cross tabulations between these residence categories and nine measures of housing condition. In all cross tabulations the null hypothesis of independence between the relevant variables is rejected at less than the .005 level of significance. The residence category, rural farm, had the highest percentage of occupied housing units with six or more rooms (57.7%). The residence category, urban territory outside of places, had the second highest percentage of housing units with this characteristic. In general, the percentage of units with six or more rooms declines as the population of places increases.

TABLE III-4.--Percentage of Occupied Housing Units in Various Residence Categories With Selected Housing Characteristics

Desirable Housing Characteristics	Rural Farm	Rural Nonfarm	Urban Territory Outside of Places	2,500-4,999	5,000-9,999	10,000-24,999	25,000-49,999	50,000-99,999	100,000-249,999	250,000-499,999	500,000-999,999	1,000,000+
	(Percent of Total in Each Category)											
Six Rooms or More	57.7	37.2	41.4	39.8	39.6	36.6	37.3	35.8	33.2	29.2	30.8	26.0
Structurally Sound	69.5	74.7	91.6	82.4	83.9	86.3	88.0	88.9	84.4	84.2	83.4	87.1
Hot and Cold Water Piped Inside	66.3	74.6	96.3	89.9	92.4	94.2	95.8	96.4	94.5	95.8	95.9	98.7
Exclusive Access to a Flush Toilet	62.7	75.3	96.7	91.9	93.7	94.8	96.4	95.7	95.0	93.3	94.2	94.7
Exclusive Access to a Bath or Shower	63.6	73.8	96.5	89.3	91.9	92.5	94.6	94.4	93.2	91.5	92.5	94.3
Built From 1950 to 1960	13.0	32.3	55.3	28.2	26.9	32.5	31.7	29.3	24.4	23.8	19.4	14.1
One or More Bathrooms	59.9	71.1	95.3	87.0	89.9	91.3	93.2	93.2	90.9	90.0	90.8	93.4
Heating Equipment Built-in Electric Steam or Hot Water Warm Air Furnace Floor, Wall or Pipeless Furnace	37.2	49.0	80.9	62.2	69.3	75.4	79.2	78.7	72.5	71.8	72.4	89.0
Exclusive Access to Kitchen Facilities	99.9	99.5	99.6	99.4	99.0	99.1	98.8	98.4	98.7	97.8	97.3	97.4
Percentage of U.S. Households	6.7	21.0	5.4	4.4	5.5	9.7	8.5	7.9	6.9	6.5	6.7	11.0

Source: These percentages were calculated from cross tabulations of data on housing units and household heads made available in the one-in-a-thousand sample tapes, 20 percent sample, 1960 Censuses of Population and Housing [36].

A different relationship exists between the housing characteristic, structurally sound, and the size of place variables. The rural farm and rural nonfarm residence categories have the lowest and next to lowest percentage of sound housing units. The residence category, urban territory outside of places, has the highest percentage of sound housing units. The percentage of sound housing increases as population increases from 2,500 to 99,999, then decreases as population continues to increase until 999,999 population is reached. The percentage of sound units then increases to 87.1 percent for places of 1,000,000 or more population.

The housing characteristic, hot and cold water piped inside, has a similar relationship to the size of place variables as does the structurally sound characteristic. Rural farm and rural nonfarm have the lowest and next to lowest percentage, respectively, of housing units with hot and cold water piped inside. Also, the percentage of housing units with this characteristic increases as population increases from 2,500 to 99,999 and then decreases from 96.4 percent to 94.5 percent for the category 100,000 to 249,999. The percentage of units with this characteristic then increases with the residence category 1,000,000 population or more having the highest percentage of housing units with hot and cold water piped inside.

The relationships between three other housing characteristics; exclusive access to a flush toilet, exclusive access to a bath or shower, and one or more bathrooms; and size of place variables are almost parallel. In all three cases, rural farm and rural nonfarm residence categories had the lowest and next to lowest percentage of units, respectively, while the residence category, urban territory outside of places had the highest percentage of housing units with the given housing characteristic. The percentage of units with the given characteristic increases as population increases from 2,500 to 49,999, then decreases slowly to a population of 499,999 and finally increases from that point as population increases. The percentage of units with one or more bathrooms remains constant between the residence categories of 25,000 to 49,999 population and 50,000 to 99,999 population rather than decreasing. One would expect these measures which relate to bathrooms and bathroom facilities to exhibit similar relationships.

The next measure of housing condition, built from 1950 to 1960, records whether the housing unit was built in the decade prior to the census. Only 13.0 percent of the units in the rural farm residence category were built in this period. The percentage of units with this characteristic decreases from 32.5 percent to 14.1 percent as population increases from 10,000 to 1,000,000 or more. The percentage of newer units increases as population increases from 2,500 to 24,999. The highest percentage of newer units were in the residence category, urban territory outside of places (55.3%). A surprisingly high percentage of the units in the rural nonfarm residence category were built from 1950 to 1960, 32.3 percent, as compared to the rural farm category.

The next housing characteristic; heating equipment: built-in electric; steam or hot water, warm air furnace; and floor, wall, or pipeless furnace; is related to the size of place variables in a similar manner as the three characteristics previously mentioned; exclusive access to a flush toilet, exclusive access to a bath or shower, and one or more bathrooms. The trends in percentages are the same but lower and the variation is greater. The rural farm and rural nonfarm residence categories have the lowest and next lowest percent of units with the desired housing characteristics (37.2%). The residence category, 1,000,000 or more, had the highest percentage of units with the desired heating equipment (89.0%).

The gross relationships between the housing characteristic, exclusive access to kitchen facilities, and the size of place variables, were similar to those with one other housing characteristic, six rooms or more. The rural farm residence category had the highest percentage (99.9%) of units with the desired characteristic. Ninety-nine and six-tenths percent and 99.5 percent, respectively, of the housing units in the residence categories, urban territories outside of places and rural nonfarm, have exclusive use of housing facilities. Then, with three exceptions, the percentage of units with this characteristic declines to 97.4 percent as the population of places increases.

Viewing Table III-4 as a whole, certain patterns of relationships become evident. Notice that the rural farm residence has the lowest percentage of units with the desired housing characteristic for all but two cases, six rooms or more and exclusive use of kitchen facilities, when this residence category has the highest percentage. The rural nonfarm residence category follows with the next to lowest percentage of units with the desired housing characteristic in six cases--structurally sound, hot and cold water piped inside, exclusive access to a flush toilet, exclusive access to a bath or shower, one or more bathrooms, and desired heating equipment. With the other three desired housing characteristics, the percentage of rural nonfarm housing units ranked third twice and sixth. The residence category, urban territory outside of places, had the highest percentage of units with the desired characteristics in five cases--structurally sound, exclusive access to a flush toilet, exclusive access to a bath or shower, built from 1950 to 1960, and one or more bathrooms. This residence category had the second highest percentage of units in three cases--six rooms or more, desired heating equipment, and exclusive use of kitchen facilities and had the third highest percentage of units with hot and cold water piped inside. The percentage of units with six of the desired housing characteristics--structurally sound, hot and cold water piped inside, exclusive access to a flush toilet, exclusive access to a bath or shower, one or more bathrooms, and heating equipment--increases as population increases to the residence categories of 25,000-49,999 or 50,000-99,999, then decreases and increases again at residence categories 500,000-999,999 or 1,000,000 or more. The percentage of units with two of the desired housing characteristics--six rooms or more and exclusive access to kitchen facilities declines as population increases. The last housing characteristic, built from 1950 to 1960, exhibits a declining percentage as population increases after residence category 10,000-24,999.

Location Within an Urbanized Area

The next set of household characteristics pertains only to those households living in urbanized areas, an estimated 54 percent of United States households. The households in urbanized areas are divided into two categories: those located in central cities (37.0%) and those not in central cities (63.0%). It is hypothesized that being in a central city has a negative effect on the level of housing condition. Two possible reasons for this are suggested. First, communications are thought to be poorer within a central city than in the remainder of an urbanized area causing the housing market to function poorly. Secondly, urbanized areas containing housing units may be closer to conversion to business or commercial use than areas that are not in a central city. In this case, housing unit maintenance and improvements would tend to lag behind that of areas not in a central city. Also, those units outside the central city and in the suburbs may be newer and thus have a higher housing condition level.

Empirical Results

The location within an urbanized area is one of the few socio-economic and locational characteristics of households which appears to have a similar relationship with all measures of housing condition. Not being located in a central city in all cases results in a higher percentage of the housing units with the desirable housing characteristics (Table III-5). The largest difference in the percentage of units with a desirable housing characteristic occurs with the year built. Nineteen and eight-tenths percent and

TABLE III-5.--Percentage of Urban Area Occupied Housing Units Located in Central Cities or in the Remainder of Urbanized Areas With Selected Housing Characteristics

Desirable Housing Characteristics	In Central City	Not In Central City
	(Percent of Total in Each Category)	
Six Rooms or More	29.7	41.0
Structurally Sound	84.9	92.3
Hot and Cold Water Piped Inside	96.2	97.6
Exclusive Access to a Flush Toilet	94.2	97.6
Exclusive Access to a Bath or Shower	92.8	97.1
Built From 1950 to 1960	19.8	43.1
One or More Bathrooms	91.2	96.3
Heating Equipment		
Built-in Electric		
Steam or Hot Water		
Warm Air Furnace		
Floor, Wall or Pipeless Furnace	77.0	86.1
Exclusive Access to Kitchen Facilities	97.8	99.2
Percentage of Urban Area Households	37.0	63.0

Source: These percentages were calculated from cross tabulations of data on housing units and household heads made available in the one-in-a-thousand sample tapes, 20 percent sample, 1960 Censuses of Population and Housing [36].

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43.1 percent of the units in a central city and not in a central city, respectively, were built from 1950 to 1960. The next largest difference occurs with the number of rooms. Twenty-nine and seven-tenths percent and 41.0 percent of the units in a central city and not in a central city, respectively, had six rooms or more. All other percentage differences were less than 10 percent and are presented in Table III-5. For each of the cross tabulations summarized the null hypothesis of independence was rejected at less than the .005 level of significance.

Age of the Household Head

The age of the household head was included because it is hypothesized for a variety of reasons that the housing market may not operate to bring the housing condition level of the old and the young household heads in line with that of household heads in the middle of this range who have similar characteristics. For example, the housing market may not perform this function because the young: (1) are changing occupations, (2) are involved with school, (3) lack established credit, (4) have large demands relative to their budgets. The market may operate poorly for the old because they are: (1) retiring and uncertain of future plans, (2) not likely to enter into long-term contracts, or (3) may be interested in using up past investments in a housing unit and thus not making improvements or performing normal maintenance. Several studies [6, 17] have indicated the relatively lower housing conditions of the old. A comparison between our estimates of gross and net relationships should indicate whether, in fact, age is a major determinant of housing condition level or if it is mainly affected by other characteristics that are associated with the age variable.

Empirical Results

In order to cross tabulate the age of household heads with measures of housing condition, age categories were chosen as shown in Table III-6. Each of the nine cross tabulations summarized in this table were tested for independence between the age categories and levels of housing condition. In each case, the hypothesis of independence was rejected at less than the .005 level of significance. The relationships exhibited in the cross tabulations are well represented in the summary table, i.e., examination of individual cross tabulations reveals little more information. A basic pattern of relationships seems to exist between the age of the household head and each of the measures of housing condition. As one moves from youngest to oldest, the percentage of households with the desired housing characteristics first increases to a point and then decreases. The point of inflection is around 40 years of age for most housing characteristics.

The age of the household head had the largest effects on two desirable housing characteristics, six rooms or more and built from 1950 to 1960. As we go from 15 years of age to 34.9, the percentage of housing units built from 1950 to 1960 increases from 26.4 percent to 44.0 percent. It then decreases to 6.2 percent at 99.9 years of age.

TABLE III-6.--Percentage of Household Heads in Different Age Categories Whose Housing Units Have Selected Housing Characteristics

Desirable Housing Characteristics	Age of Household Head													
	15-19.9	20-24.9	25-29.9	30-34.9	35-39.9	40-44.9	45-49.9	50-54.9	55-59.9	60-64.9	65-69.9	70-74.9	75-79.9	80-99.9
	(Percent of Total in Each Age Category)													
Six Rooms or More	5.3	8.6	21.0	33.5	42.2	43.7	42.6	40.6	38.1	37.9	38.0	36.3	36.0	41.1
Structurally Sound	73.5	80.4	83.4	84.0	83.8	84.9	83.5	84.3	83.7	82.7	80.6	79.7	75.4	74.1
Hot and Cold Water Piped Inside	87.6	89.1	91.1	91.8	91.8	90.8	89.6	89.8	87.7	88.0	86.0	85.4	81.1	80.3
Exclusive Access to a Flush Toilet	80.6	86.4	90.2	91.6	91.3	90.3	88.9	88.9	87.4	87.3	86.0	85.5	82.6	80.1
Exclusive Access to a Bath or Shower	77.6	85.2	88.9	90.6	90.6	89.2	87.8	87.9	86.2	85.6	84.2	83.2	79.8	77.1
Built From 1950 to 1960	26.4	32.1	40.6	44.0	40.7	34.0	25.3	22.6	18.1	15.1	14.6	12.4	9.8	6.2
One or More Bathrooms	74.1	83.7	87.4	89.0	89.0	87.5	86.0	86.0	84.0	83.6	81.7	81.0	76.6	73.6
Heating Equipment Built-in Electric Steam or Hot Water Warm Air Furnace Floor, Wall or Pipeless Furnace	53.0	60.8	68.7	72.5	73.1	71.9	70.6	70.6	67.3	65.5	64.1	62.0	55.7	56.1
Exclusive Access to Kitchen Facilities	95.1	97.8	98.6	99.1	99.3	99.0	99.1	98.7	98.8	98.6	98.6	98.5	98.2	97.1
Percentage of U.S. Households	.4	4.7	8.1	10.1	11.5	11.1	10.7	9.9	8.7	7.5	6.9	5.3	3.3	2.0

Source: These percentages were calculated from across tabulations of data on housing units and household heads made available in the one-in-a-thousand sample tapes, 20 percent sample, 1960 Censuses of Population and Housing [36].

The remaining desirable housing characteristics, with some exceptions, show similar relationships with the age of the household head. The percentage change in housing units possessing these various characteristics is less than for the two characteristics previously mentioned. Also, the percentage of units possessing the desirable housing characteristic is nearly the same for both the young and old.

The age of the household head appears to be related to different measures of housing condition in a consistent pattern. The percentage of housing units possessing a desirable characteristic increases to about age 40 and then decreases. This is consistent with our previous reasoning that both old and young may experience lower levels of housing condition because they may not operate as efficiently in the housing market as household heads falling in the middle age categories. Income varies with age in this same manner and could be accounting for the variation in housing condition.

Sex of Household Head

This variable, female head of household, is included to test the hypothesis that the housing market as well as the credit market discriminates against women. Several causal relationships may be operative here. First, outright discrimination on the basis of sex may cause this variable to be negatively related to levels of housing condition. Or such characteristics as lower income and a higher rate of dependency may combine to cause the gross relationship between female head and measures of housing condition to be negative. A comparison between these gross relationships and the net relationships should provide evidence as to the net effect of sex discrimination on the level of housing condition.

Empirical Results

An estimated 17.3 percent of United States household heads were women in 1960. Summary Table III-7 indicates that a lower percentage of households with female heads enjoyed each of the nine desirable housing characteristics than households with male heads. Each of the nine cross tabulations was tested for independence between the sex of the household head and levels of housing condition. In each case this hypothesis was rejected at less than the .005 level of significance.

The results presented in Table III-7 indicate that households with female heads experience on the average lower levels of housing condition than households with male heads. However, with only one of the desirable housing characteristics, built from 1950 to 1960, does the difference exceed 15 percent. With seven of the remaining desirable housing characteristics the difference ranges between .6 and 6.6 percent.

Race of Household Head

A justification for the inclusion of this next characteristic, the race of the household head, could be found in the popular press. This characteristic is broken into four categories: White with a Spanish Surname, White, Negro, and Other Race which includes Indian, Japanese, Chinese, Filipino, and Other. The common presumption is that racial discrimination has existed in most markets and certainly

TABLE III-7.--Percentage of Occupied U.S. Housing Units With Selected Housing Characteristics by Sex of Household Head

Desirable Housing Characteristics	Male	Female
	(Percent of Total in Each Category)	
Six Rooms or More	38.4	26.6
Structurally Sound	83.9	77.3
Hot and Cold Water Piped Inside	89.7	86.3
Exclusive Access to a Flush Toilet	89.0	86.1
Exclusive Access to a Bath or Shower	88.0	83.5
Built From 1950 to 1960	30.2	14.6
One or More Bathrooms	86.3	80.6
Heating Equipment Built-in Electric Steam or Hot Water Warm Air Furnace Floor, Wall or Pipeless Furnace	69.2	63.0
Exclusive Access to Kitchen Facilities	98.9	98.3
Percentage of U.S. Households	82.7	17.3

Source: These percentages were calculated from cross tabulations of data on housing units and household heads made available in the one-in-a-thousand sample tapes, 20 percent sample, 1960 Censuses of Population and Housing [36].

exists in the housing market. If this is true, then races other than white should exhibit a negative effect on the level of housing condition. Freeman notes that at each level of income minority races have "markedly lower quality of the housing" [22, p. 14]. This would indicate that even with the effects of income removed racial discrimination still has a negative effect. The net relationships estimated in Chapter IV will be examined for negative effects of races other than white after removal of the effects of other variables.

Empirical Results

The race of the household head appeared to have strong gross relationships with levels of housing condition. In all cross tabulations between the race of the household head and measures of housing condition the null hypothesis of independence between the variables was rejected at less than the .005 level of significance. A summary of those estimated gross relationships is presented in Table III-8.

The primary relationships observed are the highest percentage of the housing units with the desirable housing characteristics were found among the housing units occupied by "white" household heads with "other race" next, "white with a Spanish surname" third, and "Negro" last. These relationships exist for five of the nine desirable housing characteristics: structurally sound, hot and cold water piped inside, exclusive access to a flush toilet, exclusive access to a bath or shower, and built from 1950 to 1960. Two of the desirable housing characteristics, structurally sound and heating

TABLE III-8.--Percentage of Occupied U.S. Housing Units With Selected Housing Characteristics by Race of Household Head

Desirable Housing Characteristics	White with Spanish Surname	White	Negro	Other Race
	(Percent of Total in Each Category)			
Six Rooms or More	17.1	38.3	22.6	24.7
Structurally Sound	64.4	85.9	54.0	73.0
Hot and Cold Water Piped Inside	78.5	91.8	63.9	86.5
Exclusive Access to a Flush Toilet	79.8	90.7	69.0	83.2
Exclusive Access to a Bath or Shower	78.2	89.8	63.4	85.1
Built From 1950 to 1960	27.9	28.7	16.3	26.3
One or More Bathrooms	73.9	88.3	58.1	79.4
Heating Equipment Built-in Electric Steam or Hot Water Warm Air Furnace Floor, Wall or Pipeless Furnace	37.7	71.5	40.9	54.7
Exclusive Access to Kitchen Facilities	98.6	98.9	97.5	92.9
Percentage of U.S. Households	1.5	89.2	8.9	.3

Source: These percentages were calculated from cross tabulations of data on housing units and household heads made available in the one-in-a-thousand sample tapes, 20 percent sample, 1960 Censuses of Population and Housing [36].

equipment, exhibit similar relationships to the race of the household head. However, in these cases, the households whose head is "white with a Spanish surname" have the lowest percentage of housing units with the desirable housing characteristics and the next to lowest percentage is found in households headed by "Negroes."

Two other relationships are exhibited between the desirable characteristics, built from 1950 to 1960 and exclusive use of kitchen facilities and the race of the household head. Twenty-eight and seven-tenths percent of the housing units occupied by households with "white" household heads were built from 1950 to 1960, 27.9 percent of those with "white with Spanish surname" household heads, 26.3 percent of those with "other race" household heads, and 16.3 percent of those with "Negro" household heads. The last relationships were observed with the desirable characteristic, exclusive access to kitchen facilities. Ninety-eight and nine-tenths percent of households with "white" household heads, 98.6 percent of households with "white with a Spanish surname" household heads, 97.5 percent of households with "Negro" household heads, and 92.9 percent of households with "other race" household heads enjoyed exclusive access to kitchen facilities.

The relationships presented in Table III-8 indicated the households with white household heads always had the highest percentage of households enjoying the desirable housing characteristics. With six out of the nine characteristics, households with Negro household heads had the lowest percentage of households enjoying the desirable housing characteristics.

Nativity and Parentage

Another set of characteristics used describe the nativity and parentage of the household head: (1) native with native parents, (2) native with one foreign parent, (3) native with foreign parents, and (4) foreign with foreign parents. The hypothesis is that the closer the household head is to being foreign the less likely he will be able to operate effectively in the United States housing market. In this case, higher levels of housing condition would be associated with being native with native parents. Another hypothesis is that people who are foreigners or have close foreign ties may have a higher priority for housing than natives. This, in fact, would suggest the opposite relationship between nativity and parentage and levels of housing condition. The empirical results should suggest which of these forces is predominant.

Empirical Results

These categories describing the nativity and parentage of the household head exhibit a variety of relationships with the measures of housing condition (Table III-9). In each of the nine cases where nativity and parentage was cross tabulated with the measures of housing condition the hypothesis of independence between the cross tabulated variables was rejected at less than the .005 level of significance. The most common pattern of relationships is exhibited with four of the desirable housing characteristics: hot and cold water piped inside, exclusive access to a flush toilet, exclusive access to a bath or shower, and one or more bathrooms.

TABLE III-9.--Percentage of Occupied U.S. Housing Units With Selected Housing Characteristics by Nativity and Parentage

Desirable Housing Characteristics	Native with Native Parents	Native with One Foreign Parent	Native with Foreign Parents	Foreign with Foreign Parents
	(Percent of Total in Each Category)			
Six Rooms or More	35.5	42.0	40.8	32.4
Structurally Sound	80.2	89.6	90.1	87.8
Hot and Cold Water Piped Inside	86.6	96.1	95.3	95.2
Exclusive Access to a Flush Toilet	86.2	94.9	94.9	94.3
Exclusive Access to a Bath or Shower	84.7	94.4	93.6	93.2
Built From 1950 to 1960	28.6	28.1	27.3	19.0
One or More Bathrooms	82.6	93.5	92.3	91.5
Heating Equipment				
Built-in Electric				
Steam or Hot Water				
Warm Air Furnace				
Floor, Wall or Pipeless Furnace	63.0	81.0	82.6	79.6
Exclusive Access to Kitchen Facilities	98.9	98.9	98.6	98.1
Percentage of U.S. Households	72.1	6.8	12.4	8.7

Source: These percentages were calculated from cross tabulations of data on housing units and household heads made available in the one-in-a-thousand sample tapes, 20 percent sample, 1960 Censuses of Population and Housing [36].

In each of these cases, the percentage of housing units possessing the desirable housing characteristics is highest for those households whose household heads are native with one foreign parent, households whose household heads are native with foreign parents are next, households whose household heads are foreign with foreign parents follow, and households whose household heads are native with native parents are last. Three other desirable housing characteristics exhibit similar relationships with nativity and parentage: six rooms or more, structurally sound, and heating equipment. In each of these three cases, the relative position of two of the nativity and parentage categories are reversed. For example, households with household heads that are native with foreign parents had the highest percentage of housing units that are structurally sound and households with household heads that are native with one foreign parent are next. Two other desirable housing characteristics exhibit a different set of relationships with the nativity and parentage of the household head: built from 1950 to 1960 and exclusive access to kitchen facilities. In both cases, the highest percentage of households enjoying the desirable housing characteristics were those whose household heads were native with native parents, the next native with one foreign parent, followed by native with foreign parents, and last foreign with foreign parents.

The variables describing the nativity and parentage of the household head were introduced as discrete measures along a continuum from native to foreign. Two patterns of relationships with measures of housing condition were hypothesized. First, it was hypothesized that the closer to being foreign a household head, the lower his level of housing condition because of a decreasing understanding of the United States housing market. The opposite relationship was also hypothesized because foreigners have different preferences for housing. Neither relationship is strongly supported by the empirical results. However, the latter hypothesized relationship may be responsible for the increased percentage of housing units with the desirable housing characteristics with categories where the household head has some foreign association. The former hypothesized relationship may then be resulting in a decreased percentage of housing units with the desirable housing characteristics as we move from category, native with one foreign parent, to foreign with foreign parents. At best, the relationships appear to be mixed.

Metropolitan Residence in 1955

This set of characteristics is a proxy for the distance a family has moved since 1955. (The question was asked in 1960.) The set of variables represent six categories of residence in 1955: (1) same house, (2) different house same county, (3) different county same state, (4) contiguous state, (5) noncontiguous state, and (6) abroad or at sea. Certainly many instances can be found where a move from county to county was farther than a move from state to state. But in general these are assumed to represent an increasing scale of geographic mobility. It is hypothesized that geographic mobility is positively related to the household's ability to operate in the housing market and thus positively related to the level of housing condition.

Empirical Results

The empirical results indicate that the distance moved was related to all nine measures of housing condition. With each cross tabulation between the six residence categories and measures of housing condition, the null hypothesis of independence between the variables was rejected at less than the .005 level of significance.

Two distinct patterns of relationships are exhibited in summary Table III-10. The first is the same as the hypothesized relationships where the percentage of housing units possessing the desirable housing characteristics increases with increasing geographic mobility. Although the change in percentages is not always consistent between all geographic mobility categories, this general relationship exists for six of the nine desirable housing characteristics: structurally sound, hot and cold water piped inside, exclusive access to a flush toilet, exclusive access to a bath or shower, one or more bathrooms, and heating equipment. In only one case, hot and cold water piped inside, did the percentage of housing units with the desirable housing characteristic increase consistently over the range from same house to abroad or at sea. However, only one inconsistency is observed for each of the other five desirable housing characteristics.

The second pattern of relationships observed in Table III-10 is opposite to the hypothesized relationships previously mentioned. The percentage of housing units with the desirable housing characteristics decreases with increasing geographic mobility. Although some inconsistency exists, these relationships appear with two of

TABLE III-10.--Percentage of Occupied U.S. Housing Units With Selected Housing Characteristics by Metropolitan Residence in 1955

Desirable Housing Characteristics	Same House	Different House, Same County	Different County, Same State	Contiguous State	Non-contiguous State	Abroad or at Sea
	(Percent of Total in Each Category)					
Six Rooms or More	44.1	28.2	31.2	28.6	24.4	18.8
Structurally Sound	82.3	81.2	85.2	85.6	88.6	89.3
Hot and Cold Water Piped Inside	87.3	89.5	92.0	93.1	96.5	97.6
Exclusive Access to a Flush Toilet	87.4	88.7	90.6	91.3	93.2	93.1
Exclusive Access to a Bath or Shower	86.0	87.2	90.0	90.6	92.6	92.4
Built From 1950 to 1960	16.3	36.1	45.5	43.7	50.6	44.2
One or More Bathrooms	83.7	85.4	88.7	89.7	92.1	91.5
Heating Equipment Built-in Electric Steam or Hot Water Warm Air Furnace Floor, Wall or Pipeless Furnace	67.3	68.2	69.5	73.2	69.6	75.7
Exclusive Access to Kitchen Facilities	99.2	98.4	98.5	97.6	97.8	97.6
Percentage of U.S. Households	52.2	31.1	7.3	2.7	5.5	1.3

Source: These percentages were calculated from cross tabulations of data on housing units and household heads made available in the <u>one-in-a-thousand sample</u> tapes, 20 percent sample, 1960 Censuses of Population and Housing [36].

the desirable housing characteristics: six rooms or more and exclusive access to kitchen facilities.

A third set of relationships appears with the desirable housing characteristic, built from 1950 to 1960. The changes in percentages are too varied, however, to represent a distinct pattern.

The existence of two opposite patterns of relationships is demonstrated in Table III-10. This means that depending upon the measure of housing condition chosen, geographic mobility can be shown to have a negative or positive relationship to housing condition.

Occupational Classifications

Next, a set of eleven variables are used to denote different occupational classifications. A list of the specific occupations which constitute these aggregate classifications appear in several publications [24, 35, 36]. The aggregate classifications used in this study are defined here. White collar workers encompass: (1) professional, technical, and kindred workers; (2) managers, officials, and proprietors, except farm; (3) clerical and kindred workers; and (4) sales workers. Blue collar workers encompass: (1) craftsmen, foremen, and kindred workers; and (2) operatives and kindred workers [36, pp. 41-47]. Other categories used are: farmer, farm manager, farm foreman, farm laborer, farm service worker, service worker, laborer, occupation not reported, and no occupation. These variables which also appear in Spurlock's work [17, pp. 21, 33] are used as a crude proxy for the taste of the household regarding housing. Some of the occupational groupings may be too broad to approximate tastes. However, due to the costs in computer time of a large number of observations and variables, we chose to use aggregate classifications except for occupations in which we are most interested. As well as the effects of preferences of households, the gross relationships of occupational classification variables will include some effects of income and educational differences on levels of housing condition.

Empirical Results

The estimated gross relationships between occupational classifications and measures of housing condition are presented in Table III-11. In each of the nine cross tabulations between occupational classifications and measures of housing condition, the null hypothesis of independence between the variables was rejected at less than the .005 level of significance.

The various occupational groups show considerable variation in the percentage of housing units possessing the desired housing characteristics. For example, the largest range of percentages was found with the housing characteristic, heating equipment. Eighty-three and nine-tenths percent of the households in the white collar group enjoyed the desirable types of heating equipment and only 20.0 percent of the households in the farm labor group had this heating equipment, a 63.9 percent range from minimum to maximum. Five other desirable housing characteristics have a range which varied from 51.2 to 56.1 percent in magnitude. The range for six rooms or more is 34.7 percent. For built from 1950 to 1960, the range is 27.0 percent, and for exclusive access to kitchen facilities the range is the smallest, 3.5 percent.

TABLE III-11.--Percentage of Occupied U.S. Housing Units With Selected Housing Characteristics by Occu-

TABLE III-11.--Percentage of Occupied U.S. Housing Units With Selected Housing Characteristics by Occupational Group of the Household Head

Desirable Housing Characteristics	White Collar	Farm Manager	Blue Collar	Not Reported	Farm Foreman	Service	No Occupation	Laborers	Farmer	Farm Labor
	(Percent of Total in Each Category)									
Six Rooms or More	44.7	47.8	32.0	26.9	31.0	24.8	31.9	25.7	58.2	23.5
Structurally Sound	94.0	82.6	82.8	78.8	69.0	76.1	72.0	64.7	72.1	42.8
Hot and Cold Water Piped Inside	98.4	91.3	91.0	89.2	82.8	86.4	78.2	73.5	67.3	44.7
Exclusive Access to a Flush Toilet	97.5	91.3	90.9	85.7	86.2	84.7	79.9	74.6	64.0	46.0
Exclusive Access to a Bath or Shower	97.1	95.7	89.5	84.1	82.8	81.6	77.0	71.4	64.6	44.4
Built From 1950 to 1960	35.9	17.3	30.2	23.7	37.9	19.2	10.9	20.7	12.1	12.8
One or More Bathrooms	96.6	91.3	87.5	82.3	79.3	78.9	73.5	67.6	60.8	40.5
Heating Equipment Built-in Electric Steam or Hot Water Warm Air Furnace Floor, Wall or Pipeless Furnace	83.9	52.1	67.9	66.7	48.2	60.3	55.3	46.9	39.7	20.0
Exclusive Access to Kitchen Facilities	99.0	100.0	99.2	97.0	100.0	96.5	98.4	98.1	100.0	99.0
Percentage of U.S. Households	32.4	.1	35.1	4.0	.1	7.7	9.4	5.2	4.8	1.4

Source: These percentages were calculated from cross tabulations of data on housing units and household heads made available in the one-in-a-thousand sample tapes, 20 percent sample, 1960 Censuses of Population and Housing [36].

The summary relationships reveal some consistency in the way occupational groups relate to measures of housing condition. For six of the desirable housing characteristics, households whose heads are white collar workers have the highest percentage of housing units with those housing characteristics. In other words, the occupational group, white collar, ranked first for six of the desirable housing characteristics. Farm managers ranked second for five characteristics. Blue collar workers ranked third for five characteristics. Not reported ranked fourth for five characteristics. Farm foreman exhibited mixed results. Service workers ranked sixth for four characteristics. No occupation ranked seventh for six characteristics. Laborers ranked eighth for seven characteristics. Farmers ranked ninth for six characteristics. Farm laborers ranked last for seven characteristics.

Only two of the desirable housing characteristics, exclusive access to a bath or shower and one or more bathrooms consistently exhibit this pattern or relationships with the occupational groups. Thus the relationships between these occupational groups and housing condition will vary depending upon the measure of housing condition used.

Type of Tenure

Variables are included to describe the type of tenure the household enjoys: (1) owned, (2) rented, or (3) no cash rent. We hypothesize that the person who rents is less likely to place as much importance on the housing unit as the owner because of the difference in property rights. Thus owners on the average should enjoy a higher level of housing condition than renters. The household that does not own and pays no cash rent for their housing unit is expected to place the least importance on their housing units of the three groups of households and thus experience the lowest level of housing condition.

Empirical Results

The estimated gross relationships between types of tenure and measures of housing condition are presented in Table III-12. For each of the nine cross tabulations summarized in this table, the null hypothesis of independence between the variables was rejected at less than the .005 level of significance.

For seven of the nine desirable housing characteristics presented, the highest percentage of housing units with those characteristics was among the owned units, the next highest percentage was among rented units, and the lowest percentage was in the category no cash rent. This result agrees with our hypothesized relationships between type of tenure and housing condition. Owned housing units tend to have a higher condition level than rented units which have a higher condition level than rented units for which no cash rent is paid.

For two of the desirable housing characteristics, six rooms or more and exclusive access to kitchen facilities, a higher percentage of housing units possessing the desirable housing characteristics are found in the category, no cash rent, than in the category, rented. These are the only two exceptions to the pattern of relationships discussed earlier.

TABLE III-12.--Percentage of Occupied U.S. Housing Units With Selected Housing Characteristics by Type of Tenure

Desirable Housing Characteristics	Owned	Rented	No Cash Rent
	(Percent of Total in Each Tenure Category)		
Six Rooms or More	49.0	14.1	31.2
Structurally Sound	88.3	75.5	58.5
Hot and Cold Water Piped Inside	91.3	88.7	58.2
Exclusive Access to a Flush Toilet	91.6	86.7	57.4
Exclusive Access to a Bath or Shower	91.0	84.1	55.9
Built From 1950 to 1960	34.5	16.5	13.7
One or More Bathrooms	89.4	81.7	53.0
Heating Equipment Built-in Electric Steam or Hot Water Warm Air Furnace Floor, Wall or Pipeless Furnace	72.7	63.6	36.2
Exclusive Access to Kitchen Facilities	99.8	96.9	97.9
Percentage of U.S. Households	61.9	34.1	4.0

Source: These percentages were calculated from cross tabulations of data on housing units and household heads made available in the <u>one-in-a-thousand sample</u> tapes, 20 percent sample, 1960 Censuses of Population and Housing [36].

Education of Household Head

The educational level of the household head is thought to be another characteristic which would likely be related to housing condition. We hypothesize that as education increases, both the desire for housing and ability to function in the housing market increase. Also, we believe that low levels of education are positively associated with a number of other socio-economic and locational characteristics almost all of which have a negative effect on the level of housing condition. For example, education is thought to be positively related to income, old age, rural location, etc. This would result in a positive gross relationship between education and levels of housing condition which is larger than the positive net relationship where the effects of other variables are removed.

Empirical Results

The estimated gross relationships between the education of the household head and measures of housing condition are presented in Table III-13. For each of the nine cross tabulations summarized in that table, the hypothesis of independence between the variables was tested. For eight of the nine cross tabulations, this null hypothesis was rejected at less than the .005 level of significance. For the last cross tabulation, exclusive access to kitchen facilities and education of the household head, the null hypothesis was rejected at less than the .05 level of significance.

The basic pattern of relationships revealed in the summary table is as hypothesized. Education of the household head and the

TABLE III-13.--Percentage of Household Heads in Each Education Category With Selected Housing Characteristics

Desirable Housing Characteristics	Education of Household Head										
	None	Elem. 1-4	Elem. 5,6	Elem. 7	Elem. 8	High S. 1,2	High S. 3	High S. 4	Col. 1-3	Col. 4	Col. 5 or More
	(Percent of Total in Each Educational Category)										
Six Rooms or More	22.3	25.0	28.7	31.4	35.7	33.9	36.4	38.7	43.3	49.8	56.9
Structurally Sound	58.0	55.9	68.5	75.4	80.7	83.8	87.1	89.9	93.5	96.2	97.2
Hot and Cold Water Piped Inside	63.2	61.5	74.9	80.6	87.8	91.9	94.7	96.8	98.4	99.0	99.4
Exclusive Access to a Flush Toilet	67.8	64.1	76.0	80.5	86.6	91.5	93.3	95.4	97.4	97.7	98.8
Exclusive Access to a Bath or Shower	62.7	60.1	72.7	78.8	85.0	90.2	92.7	95.0	97.3	97.7	98.7
Built From 1950 to 1960	9.3	14.5	15.7	18.7	19.0	27.3	29.9	35.2	37.7	43.7	41.7
One or More Bathrooms	57.4	55.7	68.9	75.5	82.8	88.3	91.4	94.1	96.7	97.4	98.4
Heating Equipment Built-in Electric Steam or Hot Water Warm Air Furnace Floor, Wall or Pipeless Furnace	44.2	35.2	47.1	54.9	64.4	67.9	72.1	78.1	83.8	89.6	90.1
Exclusive Access to Kitchen Facilities	98.5	98.0	98.7	98.5	98.9	98.7	99.0	98.9	98.7	98.7	99.2
Percentage of U.S. Households	2.1	6.5	7.5	6.5	17.6	13.8	5.6	21.9	9.1	5.3	4.1

Source: These percentages were calculated from cross tabulations of data on housing units and household heads made available in the <u>one-in-a-thousand sample</u> tapes, 20 percent sample, 1960 Censuses of Population and Housing [36].

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level of housing condition are positively related. Only the desirable housing characteristic, exclusive access to kitchen facilities exhibits a different relationship which does not have any consistent pattern. A substantial exception to the basic pattern appears between the education categories of none and elementary 1-4. In seven cases, out of nine, the category, elementary 1-4, has a lower percentage of housing units with the desirable housing characteristics than the education category, none. Other than the two exceptions mentioned, there are several inconsistencies where the percentage of housing units with the desirable housing characteristics is higher for an educational category which represents less education than another. However, these inconsistencies are few. The basic pattern of a positive relationship between housing condition and educational level of the household head seems to prevail.

Household Income

Income is a variable which economic theory would tell us is positively related to levels of housing condition. In this case, we have considered income of two distinctly different types of households: those consisting of unrelated individuals and those consisting of families. Gross relationships between income and levels of housing condition are examined separately because it was felt that the relationships between household income and housing condition would be different for these two groups. Also, notice that the income figure used was household income or the sum of all income for the household. This was felt to be the relevant figure because the household head may not be the major income recipient and thus household expenditures may depend on another member's income. Having no means of determining which member's income is the primary source for the household budget, we chose to sum total income for all household members feeling this would constitute a more relevant measure than income of the household head. Schaeffer and Edwards noted that this total income figure seemed to be a better explanatory measure: "When the effect of all income sources are added, the correlation is increased to .85 from .82 for heads of family income only" [15, p. 12].

Empirical Results

The estimated gross relationships between household income and measures of housing condition for two types of households, families and unrelated individuals, are presented in Table III-14. For each of the cross tabulations summarized here except one, the null hypothesis of independence between the variables was rejected at less than the .005 level of significance. For the cross tabulation between the housing condition measure, exclusive access to kitchen facilities and household income for unrelated individuals, the null hypothesis could be rejected at less than the .1 level of significance.

The results presented in Table III-14 support the hypothesis that household income and housing condition are positively related. For all of the desirable housing characteristics except exclusive access to kitchen facilities, the percentage of housing units possessing the desirable housing characteristics increases as income

TABLE III-14.--Percentage of Households by Type of Household and Specific Income Categories With Selected Housing Characteristics

Desirable Housing Characteristics	Household Income in Thousands of Dollars													
	G0 L1	G1 L2	G2 L3	G3 L4	G4 L5	G5 L6	G6 L7	G7 L8	G8 L9	G9 L10	G10 L11	G11 L12	G12 L13	G13
	(Percent of Total in Each Income Category)													
Six Rooms or More														
Unrelated Individuals[a]	19.2	15.7	16.5	16.4	15.5	15.0	14.7	19.3	24.3	15.6	31.3	23.3	32.3	31.7
Families[b]	27.9	28.4	27.5	29.7	31.2	35.3	38.2	41.4	44.5	48.1	53.7	51.9	60.2	70.8
Structurally Sound														
Unrelated Individuals[a]	65.4	74.4	79.9	83.4	78.6	88.6	90.1	86.7	86.5	96.9	96.1	100.0	88.2	95.0
Families[b]	58.2	66.2	72.1	75.6	83.9	86.9	90.8	92.2	94.0	93.6	96.3	93.1	96.1	97.6
Hot and Cold Water Piped Inside														
Unrelated Individuals[a]	72.3	85.5	87.5	94.0	92.4	96.7	97.8	97.6	98.2	98.4	100.0	100.0	97.1	99.2
Families[b]	59.4	68.5	78.3	85.4	92.0	95.4	96.9	98.1	98.2	98.4	98.8	98.2	99.2	99.5
Exclusive Access to a Flush Toilet														
Unrelated Individuals[a]	69.9	76.5	79.9	86.2	83.4	87.1	91.2	90.9	95.5	93.8	98.0	96.7	88.2	93.3
Families[b]	61.0	70.8	79.8	86.1	91.5	95.4	96.7	98.1	98.5	98.4	98.5	98.6	99.5	99.6
Exclusive Access to a Bath or Shower														
Unrelated Individuals[a]	65.2	73.4	77.0	85.3	82.4	86.7	90.1	90.9	95.5	95.3	98.0	96.7	88.2	93.3
Families[b]	58.1	67.9	77.8	84.5	90.3	94.5	96.3	97.7	97.8	98.1	98.4	98.2	99.2	99.5
Built From 1950 to 1960														
Unrelated Individuals[a]	10.0	10.9	10.3	12.4	15.3	18.7	22.2	25.4	21.6	37.6	17.7	29.9	44.1	34.9
Families[b]	16.9	17.2	20.0	23.1	26.3	30.6	35.8	37.6	39.1	40.9	41.5	41.4	39.7	42.6
One or More Bathrooms														
Unrelated Individuals[a]	61.3	70.4	74.7	83.4	80.9	86.2	89.4	9019	95.5	93.7	98.0	96.7	85.3	93.3
Families[b]	54.7	63.9	74.1	81.0	88.3	93.4	95.2	97.0	97.3	97.7	98.2	97.6	98.6	99.3

TABLE III-14.--Continued

TABLE III-14.--Continued

Desirable Housing Characteristics	Household Income in Thousands of Dollars													
	G0 L1	G1 L2	G2 L3	G3 L4	G4 L5	G5 L6	G6 L7	G7 L8	G8 L9	G9 L10	G10 L11	G11 L12	G12 L13	G13
	(Percent of Total in Each Income Category)													
Heating Equipment														
Built-in Electric														
Steam or Hot Water														
Warm Air Furnace														
Floor, Wall or Pipeless Furnace														
Unrelated Individuals[a]	49.8	58.9	63.4	69.9	74.7	77.8	77.0	80.0	85.5	92.2	74.6	86.7	85.4	92.5
Families[b]	36.3	41.0	46.6	54.8	64.6	71.7	78.8	83.3	85.2	86.7	89.3	90.3	90.7	92.8
Exclusive Access to Kitchen Facilities														
Unrelated Individuals[a]	94.9	91.8	91.8	93.2	92.8	89.6	92.5	93.8	95.4	96.8	96.0	96.6	90.9	96.6
Families[b]	99.6	99.3	99.5	99.7	99.7	99.8	99.9	100.0	100.0	99.8	99.8	100.0	99.5	100.0
Percentage of U.S. Households														
Unrelated Individuals[a]	30.4	18.9	12.2	10.2	8.2	6.7	4.3	2.6	1.8	1.0	.8	.5	.5	1.9
Families[b]	5.5	7.4	8.4	9.2	11.0	12.3	11.0	8.7	6.7	4.8	3.8	2.5	1.9	6.7

Note: G means greater than. L means less than or equal to.

[a]Households composed of unrelated individuals.

[b]Households composed of families.

Source: These percentages were calculated from cross tabulations of data on housing units and household heads made available in the one-in-a-thousand sample tapes, 20 percent sample, 1960 Censuses of Population and Housing [36].

increases. The empirical results for exclusive access to kitchen facilities could be interpreted as having positive relationships to household income, but the relationships are less pronounced than for the other desirable housing characteristics.

The reader will also notice that in all but one case the percentage of housing units possessing the desirable housing characteristics does not increase consistently over the range of increasing income. The percentage occasionally drops but the pervasive trend is an increasing percentage of housing units with the desirable housing characteristics. The one case where inconsistencies do not appear is the row representing the gross relationships between the desirable types of heating equipment for households consisting of families and household income.

The empirical results also support the general hypothesis that household income is related differently to housing condition for households consisting of unrelated individuals than for those consisting of families. When the minimum percentage of housing units possessing the desirable housing characteristics was subtracted from the maximum, households composed of families exhibited a larger range than households composed of unrelated individuals for seven of the nine desirable housing characteristics. That is household income for households composed of families had a greater effect on housing condition for all desirable housing characteristics except built from 1950 to 1960 and exclusive access to kitchen facilities.

Dependency Ratio

The last variable included is a dependency ratio, the number of household members 14-64 years of age divided into the number younger and older than this range. The intent is to, in some sense, measure the household's relative support load [14, p. 34]. The numerator is an approximation of those members who would likely need to be supported. The denominator is an approximation of those members who would likely support the former group. The hypothesis is that those households who have the heaviest relative support burden will likely have the least adequate housing facilities.

Empirical Results

The estimated gross relationships between the dependency ratio of a household and housing condition are presented in Table III-15. For each of the nine cross tabulations summarized in this table, the null hypothesis of independence between the variables was rejected at less than the .005 level of significance.

The empirical results contain so much variation that determining the direction of the gross relationships is difficult. However, the trend appears to be negative for all of the desirable housing characteristics except possibly exclusive access to kitchen facilities. That is the percentage of housing units possessing the desirable housing characteristics decreases as the dependency ratio increases. Exclusive access to kitchen facilities does not exhibit either positive or negative relationships with the dependency ratio.

TABLE III-15.--Percentage of Households in Specific Dependency Categories With Selected Housing Characteristics

Desirable Housing Characteristics	Dependency Ratio											
	0	G0 L.25	G.25 L.5	G.5 L.75	G.75 L1.0	G1.0 L1.25	G1.25 L1.5	G1.5 L1.75	G1.75 L2	G2 L3	G3 n.e.∞	All Dependent
	(Percent of Total in Each Dependency Category)											
Six Rooms or More	28.2	57.6	39.0	57.9	39.0	50.7	47.8	50.6	47.0	47.4	37.2	30.0
Structurally Sound	85.8	81.3	85.5	79.0	84.1	58.2	82.9	59.1	77.5	66.0	48.5	77.9
Hot and Cold Water Piped Inside	91.4	88.5	91.1	85.8	89.9	68.7	90.5	71.4	86.3	76.2	66.7	83.9
Exclusive Access to a Flush Toilet	88.8	89.2	91.2	86.9	90.7	67.2	91.1	76.0	87.8	78.8	71.6	83.4
Exclusive Access to a Bath or Shower	87.6	87.7	90.3	85.6	89.5	67.2	90.4	72.7	86.7	76.8	69.8	80.6
Built from 1950 to 1960	23.7	19.2	31.9	28.3	33.4	19.4	43.2	18.7	30.3	29.8	20.7	11.7
One or More Bathrooms	86.0	85.6	88.7	83.2	87.5	64.2	88.7	70.1	84.0	73.9	65.1	78.0
Heating Equipment Built-in Electric Steam or Hot Water Warm Air Furnace Floor, Wall or Pipeless Furnace	70.6	66.2	70.6	65.5	69.1	40.3	71.7	44.7	66.1	55.7	42.3	60.9
Exclusive Access to Kitchen Facilities	97.6	99.8	99.8	99.5	99.8	100.0	99.9	98.7	99.8	99.8	99.8	98.1
Percentage of U.S. Households	33.8	2.1	16.9	3.2	18.1	.2	7.3	.4	4.8	2.3	.8	10.2

Note: G means greater than. L means less than or equal to. n.e. means not equal to.

Source: These percentages were calculated from cross tabulations of data on housing units and household heads made available in the one-in-a-thousand sample tapes, 20 percent sample, 1960 Censuses of Population and Housing [36].

Summary and Conclusions

In this chapter the estimated gross relationships between socio-economic and locational characteristics of the occupants and various measures of housing condition have been presented. Some sets of these characteristics appeared to explain more variation in housing condition than others. That is, some sets of characteristics exhibit a larger range of percentages of housing units with selected housing conditions than other sets. The occupational classifications contained the largest range for six of the selected housing characteristics. Household income, educational level of the household head, size of place, and tenure generally exhibit a slightly smaller range of percentages than the occupational classifications. Location within an urbanized area, sex of the household head, and the metropolitan residence in 1955 appear to explain the least amount of variation in housing condition. The four other sets of socio-economic characteristics are between these two extremes. They are listed here from the set with the strongest estimated relationships with housing condition to the weakest: dependency ratio, race of household head, region of the United States, and the nativity and parentage of the household head. This ranking of socio-economic and locational characteristics as to the strength of their estimated gross relationships with housing condition was done through comparing the range of percentages across all of the selected housing characteristics. The ranking may not fit any particular selected housing characteristic. However, the generalization does present some information on the characteristics which seem most highly related to housing condition.

The gross relationships estimated and presented in this chapter will be used again in Chapter V when they are compared to the net relationships. The estimated net relationships between the socio-economic and locational characteristics of the occupants and various measures of housing condition will be presented in the next chapter.

CHAPTER IV

NET RELATIONSHIPS BETWEEN SOCIO-ECONOMIC AND LOCATIONAL CHARACTERISTICS AND HOUSING CONDITION: PREDOMINANT INFLUENCES

Introduction

How do income, sex, race, age, and education relate to levels of housing condition? This is the type of question that will be asked and answers suggested in this chapter and the next. The previous chapter dealt with the gross relationships between thirteen sets of socio-economic and locational characteristics and housing condition. In this chapter and Chapter V we present the estimated net relationships between these same characteristics and housing condition.

Several procedures are employed in order to present these estimated net relationships. First, the set of socio-economic and locational characteristics used in Chapter III are included as regressors in several multiple regression models. Each of these regressions with a common set of regressors, has a different measure of housing condition as the regressand. This procedure is used to estimate the net relationships with each of the measures of housing condition just as cross tabulations or contingency tables were used to estimate the gross relationships in Chapter III. Second, this same set of regressors are used in a regression model with the INDEX

as regressand. This procedure is used to estimate the net relationships between the socio-economic and locational characteristics of the occupants and the measure of housing condition, INDEX, explained in Chapter II. Each of these models is presented separately. The third procedure involves examining the INDEX for weight sensitivity. Twenty different sets of weights are used on the components of the INDEX, while INDEX 1 through INDEX 20 are used as regressands in twenty regressions. The same set of socio-economic and locational characteristics as are used in the other models in Chapter IV are used as regressors here. The resulting parameter estimates are examined to determine if the INDEX is weight sensitive. The presumption is that the estimates should remain relatively constant if the INDEX is not to be judged weight sensitive. The specifics of these three procedures will be developed as the chapter proceeds.

This chapter is organized around the three research procedures just discussed. The first section includes specification of the functional form of the socio-economic and locational characteristics used in the regression models. The second section includes a presentation of the net relationships estimated in the first procedure. Each model is examined in total for the relative importance and direction of relationships between the thirteen sets of socio-economic and locational characteristics and each measure of housing condition. Section three includes the estimated net relationships between the regressors previously used and the INDEX. The fourth section includes an examination of the INDEX for weight sensitivity. This is followed by the summary and conclusions regarding the net relationships between selected socio-economic and locational characteristics and housing condition.

This chapter includes specification, presentation, and discussion of each model indicated above. If the reader is not interested in each individual model, the estimated net relationships are presented in Chapter V in a format similar to that used for the estimated gross relationships in Chapter III. That is each of the models is divided to present the estimated net relationships between each set of socio-economic and locational characteristics and the various measures of housing condition.

Model Specification

This section includes specification of the functional form of the socio-economic and locational characteristics to be used as regressors in the regression models of this chapter. The information used in specifying these independent variables comes from several sources: (1) the estimated gross relationships presented in Chapter III, (2) net relationships estimated using "abbreviated regression models," and (3) previous studies.

Abbreviated Models

The abbreviated regression models were used only to obtain information on the functional form of predetermined variables. Thus they are not presented in detail. They differ from the models used in this chapter in several ways. First, fewer socio-economic and locational characteristics are included. Second, the characteristics included are described by a set of binary variables. Third, the models are estimated with only a portion of the sample ultimately used. The binary regressands used in these eight abbreviated regression models are presented below.

Y_1 = 1 if a telephone is available
0 otherwise

Y_2 = 1 if household has exclusive access to kitchen facilities
0 otherwise

Y_3 = 1 if hot and cold water are piped into the housing unit
0 otherwise

Y_4 = 1 if there is exclusive access to a flush toilet
0 otherwise

Y_5 = 1 if there is exclusive access to a bath or shower
0 otherwise

Y_6 = 1 if the unit was built from 1950 to 1960
0 otherwise

Y_7 = 1 if the unit contained these four better types of heating equipment: (1) built-in electric, (2) steam or hot water, (3) warm air furnace, and (4) floor, wall, or pipeless furnace.
0 otherwise

Y_8 = 1 if the unit has eight rooms or more
0 otherwise

The sole purpose of these models was to provide information about the functional form of variables which would be used in the final models. Variables which would be continuous in the final models were broken into intervals and described with binary variables. The estimated regression coefficients were then plotted to determine the functional form to be used in the final models. Information from this source was used to specify three sets of socio-economic and locational characteristics: size of place, educational level of household head, and household income.

Predetermined Variables

The functional forms of the sets of socio-economic and locational characteristics will be presented in the same order as these characteristics were introduced in Chapter III. The rationale for their inclusion and hypothesized relationships which was included in Chapter III will not be repeated here.

Regions of the United States

The regions of the United States are included as binary variables.

X_1 = 1 if the household resides in the Northeast
 0 otherwise

X_2 = 1 if the household resides in the North Central region
 0 otherwise

X_3 = 1 if the household resides in the South
 0 otherwise

X_4 = 1 if the household resides in the West
 0 otherwise

X_1, X_2, X_3, and X_4 represent an all inclusive set and the regression model has a constant term. Therefore X_2 was dropped so the model could be estimated [36, p. 19].

Size of Place

The next set of variables, size of place, contain a mixture of discrete and continuous variables.

X_5 = 1 if the household is rural farm
 0 otherwise

X_6 = 1 if the household is rural nonfarm
 0 otherwise

X_7 = 1 if the household is in an urban territory outside of places
0 otherwise

X_8 = the logarithm to the base 10 of the population of the household's place of residence

The population of the household's place of residence was included as a logarithm to the base 10 after examining the parameter estimates from the abbreviated models. Binary variables were used to describe various population intervals. When the parameter estimates were plotted on log paper, the size of place variables appeared to have a log linear relationship with each of the binary regressands. Intuitively, these relationships appear plausible. In fact, one would expect an addition of 5,000 population to a place of 10,000 population to have a greater affect on the functioning of the housing market than the same addition to a place of 50,000 population. The log linear specification will allow for this type of relationship [36, pp. 19, 20].

Location Within Urbanized Area

The two residence categories distinguished within an urbanized area are, in a central city and in the remainder of an urbanized area. They are represented by binary variables.

X_9 = 1 if the household resides in a central city
0 otherwise

X_{10} = 1 if the household resides in the remainder of an urbanized area
0 otherwise

These residence categories are determined only for residents of urbanized areas. Only X_9 was included in the models to examine the effects of being in the central city on housing condition. X_{10}

was omitted because of the belief that the additional information it could provide was more completely provided by the size of place variables [36, p. 21].

Age of Household Head

The age of the household head is described by three continuous variables.

X_{11} = the age of the household head

X_{12} = the age of the household head squared

X_{13} = the age of the household head cubed

The age of the household head was included as a cubic function after plotting the percentages estimated in the cross tabulations of Chapter III. An examination of Table III-6 reveals a pattern of relationships between age and housing condition which, it was believed, could be well represented by the cubic form [36, p. 6].

Sex of the Household Head

The sex of the household head is described by two binary variables.

X_{14} = 1 if household head is male
0 otherwise

X_{15} = 1 if household head is female
0 otherwise

Because a constant term is included and X_{14} and X_{15} form an all inclusive set, X_{14} is dropped to provide for estimation of the parameters [36, p. 22].

Race of Household Head

The race of the household head is represented by four binary variables.

X_{16} = 1 if the household head is white with a Spanish surname
0 otherwise

X_{17} = 1 if the household head is white and $X_{16} = 0$
0 otherwise

X_{18} = 1 if the household head is Negro
0 otherwise

X_{19} = 1 if the household head is Indian, Japanese, Chinese, Filipino, or other or $X_{16} = X_{17} = X_{18} = 0$

These binary variables form an all inclusive set. Also, a constant term is included in the models. Thus X_{17} was dropped to allow for estimation of the models [36, p. 14].

Nativity and Parentage

The nativity and parentage of the household head are described by four binary variables.

X_{20} = 1 if the household head is native with native parents
0 otherwise

X_{21} = 1 if the household head is native with one foreign parent
0 otherwise

X_{22} = 1 if the household head is native with foreign parents
0 otherwise

X_{23} = 1 if the household head is foreign
0 otherwise

Because a constant term is included and X_{20}, X_{21}, X_{22}, and X_{23} form an all inclusive set, X_{20} was dropped to provide for estimation of the parameters [36, p. 25].

Metropolitan Residence in 1955

The metropolitan residence of household head in 1955 is described with binary variables.

X_{24} = 1 if the household head occupied the same house
0 otherwise

X_{25} = 1 if the household head resided in the same county but a different house
0 otherwise

X_{26} = 1 if the household head resided in the same state but a different county
0 otherwise

X_{27} = 1 if the household head resided in a contiguous state
0 otherwise

X_{28} = 1 if the household head resided in a noncontiguous state
0 otherwise

X_{29} = 1 if the household head was abroad or at sea
0 otherwise

X_{24} is dropped from this set of variables to provide for estimation of the parameters [36, p. 36].

Occupational Classification

Eleven occupational categories of the household head are described with binary variables.

X_{30} = 1 if the household head is a farmer
0 otherwise

X_{31} = 1 if the household head is a farm manager
0 otherwise

X_{32} = 1 if the household head is a farm foreman
0 otherwise

X_{33} = 1 if the household head is a farm laborer
0 otherwise

X_{34} = 1 if the household head is a farm service worker
0 otherwise

X_{35} = 1 if the household head is a white collar worker. (This category includes: (1) professional, technical, and kindred workers; (2) managers, officials, and proprietors, except farm, (3) clerical and kindred workers; and (4) sales workers.)
0 otherwise

X_{36} = 1 if the household head is a blue collar worker. (This category includes: (1) craftsmen, foremen, and kindred workers; and (2) operatives and kindred workers.)
0 otherwise

X_{37} = 1 if the household head is a service worker. (This category includes: (1) private household workers, and (2) service workers, except private household.)
0 otherwise

X_{38} = 1 if the household head is a laborer
0 otherwise

X_{39} = 1 if the occupation of the household head is not reported
0 otherwise

X_{40} = 1 if the household head has no occupation
0 otherwise

This set of variables is all inclusive so X_{39} is dropped to provide for estimation of the parameters [36, pp. 40-47].

Type of Tenure

Three types of tenure are described by three binary variables.

X_{41} = 1 if the housing unit is owner occupied
0 otherwise

X_{42} = 1 if the housing unit is renter occupied and the renter pays cash rent
0 otherwise

X_{43} = 1 if the housing unit is renter occupied and the renter pays no cash rent
0 otherwise

For most of the models presented, X_{42} has been dropped to provide for estimation of the parameters. However, in some models, both X_{42} and X_{43} have been dropped due to an oversight. Caution must be exercised in comparing the parameter estimates for X_{41} between models where X_{42} has been dropped and those where X_{42} and X_{43} have been dropped. Where X_{42} has been dropped, the parameter estimate for X_{41} describes the difference between the effects of X_{41} and X_{42} on the regressand and the parameter estimate for X_{43} describes the difference between the effects of X_{43} and X_{42} on the regressand. In models where both X_{42} and X_{43} have been dropped, the parameter estimate for X_{41} describes the difference between the effects of X_{41} and the combined effects of X_{42} and X_{43} on the regressand [36, p. 69].

Education of Household Head

The educational level of the household head is described by two variables.

X_{44} = the number of years of formal education if less than or equal to 10.5 years
10.5 otherwise

X_{45} = the number of years of formal education if greater than 10.5 years
0 otherwise

This functional form was chosen after examining parameter estimates from the abbreviated regression models discussed earlier. In these models, binary variables were used to describe the household head's years of formal education. The parameter estimates were then plotted to obtain information on the functional form of the continuous relationships between years of education and the desirable housing characteristics used as regressands in the abbreviated models. Two distinct patterns emerge. The first is approximately linear.

As the educational level of the household head increased, the probability of the housing unit containing the desirable housing characteristic increased linearly. The second pattern included two linear portions. Up to 10.5 years of formal education the probability, that the desirable housing characteristic was present, increased linearly. After 10.5 years of formal education, the probability increased linearly but at a smaller rate. The specification used here allows for this kinked relationship and for the one without the kink.

The data on education are included in the Census as discrete categories, some covering more than one additional year of formal education. The approximate midpoint of these categories was chosen as the value of the continuous variables used here, X_{44} and X_{45}. These are the values used for the various categories:

Category	Value
None	0
Elementary 1-4	2
Elementary 5 or 6	5
Elementary 7	6.5
Elementary 8	7.5
High School 1 or 2	9
High School 3	10.5
High School 4	11.5
College 1-3	13.5
College 4	15.5
College 5 or More	16.5

Specific definitions of the census categories may be found in the technical documentation of the sample [36, pp. 37, 38].

Household Income

Household income is described by five variables, three continuous and two binary.

X_{46} = the logarithm to the base 10 of household income if the household is composed of unrelated individuals
0 otherwise

X_{47} = 1 if the household is composed of a family
0 otherwise

X_{48} = the logarithm to the base 10 of household income if the household is composed of a family
0 otherwise

X_{49} = 1 if the household is composed of a family or families and unrelated individuals, i.e., if the household is "mixed"
0 otherwise

X_{50} = the log of household income if the household is "mixed"
0 otherwise

All negative income is given the value of $4.50. Also, income that is greater than $7,000 is given the value of $7,000.

The evidence for this specification comes from both the contingency tables of Chapter III and the abbreviated regression models. In the abbreviated regression models, household income was entered as a series of binary variables with all types of households lumped together. The plotted parameter estimates revealed relationships between household income and desirable housing characteristics which could be approximated by the log-linear functional form. An examination of the contingency tables of Chapter III also revealed relationship that could be approximated by the log-linear functional form. All types of households were not lumped together in the cross tabulations. Separate contingency tables were constructed for households composed of unrelated individuals and for households composed of families. No cross tabulations were constructed for households that are a mixture of these first two types. An examination of summary Table III-14 reveals that the two types of households have different levels of housing condition at any one income level. A plotting of these relationships also suggests that the relationships between household income and levels of housing condition have different slopes for the two types of households.

Representing household income by a mixture of binary and continuous variables allows for the suspected differences in relationships. Households are divided into three types, households composed of unrelated individuals, those composed of families, and a mixture of the first two. It is assumed that the relationship between household income and housing condition is log-linear, but different for each type of household. The two binary variables, X_{47} and X_{49} allow for differences in the intercepts of the three relationships, while X_{46}, X_{48}, and X_{50} allow for differences in the slopes.

Income is recorded in the Census from $1 to $9,999 by $10 intervals and from $10,000 to $24,999 by $1,000 intervals, with one category for $25,000 or more. The mid-points are used as the values of these intervals. For example: $0-$9 = $4.50, $10-$19 = $14.50, $20-$29 = $24.50, etc. Negative income is assumed to be a temporary phenomenon and is given the value of $4.50. Income over $7,000 is assumed to be $7,000. The abbreviated regression models revealed relationships which appear to be linear in logs to about the $7,000 income level and horizontal thereafter for most of the models estimated [36, pp. 55, 61, 62].

Dependency Ratio

The dependency ratio is described by a binary and a continuous variable.

X_{51} = the number of persons in the household who are less than 15 and over 64 years of age, divided by the number who are 15 through 64 years of age
0 if there is no one in the household who is 15 through 64 years of age

X_{52} = 1 if there is no one in the household who is 15 through 64 years of age
0 otherwise

A linear specification was chosen after plotting some of the relationships from the contingency tables of Chapter III. The relationships exhibited considerable variation. Thus binary variables would probably have described the relationships more accurately but used up valuable computer time. It was assumed that some of the variation would be removed in the multiple regression analysis and that a linear specification would be adequate.

The thirteen sets of variables just described constitute the common group of independent variables that are used throughout the remainder of this study. They are used as independent variables with a series of binary regressands that are discussed next. Then they are used in a multiple regression model with the INDEX discussed in Chapter II. They also serve as independent variables in the twenty regression models used to test the INDEX for weight sensitivity. For further information regarding these variables, see the technical documentation of the Census sample used here [36].

Endogenous Variables

These next variables, presented in Table IV-1, are the ten binary regressands to be used in ten multiple regression models. A discussion of the measures of housing from which these variables are

TABLE IV-1.--Binary Dependent Variables From Selected Measures of Housing Conditions

Housing Condition Measures	Binary Dependent Variables		
Number of Rooms	Y_1	=1	if the housing unit has six or more rooms.
		0	otherwise
Structural Condition	Y_2	=1	if the housing unit is structurally sound
		0	otherwise
	Y_3	=1	if the housing unit is not structurally dilapidated
		0	otherwise
Water Supply	Y_4	=1	if hot and cold water is piped inside the housing unit
		0	otherwise
Access to a Bath or Shower	Y_5	=1	if the housing unit provides exclusive access to a bath or shower
		0	otherwise
Year Built	Y_6	=1	if the housing unit was built from 1950 to 1960
		0	otherwise
Number of Bathrooms	Y_7	=1	if the housing unit has one or more bathrooms
		0	otherwise
Type of Heating Equipment	Y_8	=1	if the housing unit possesses the four preferred types of heating equipment: Built-in Electric Steam or Hot Water Warm Air Furnace Floor, Wall or Pipeless Furnace
		0	otherwise
Access to Kitchen Facilities	Y_9	=1	if the housing unit provides exclusive direct access to kitchen facilities
		0	otherwise
Access to a Telephone	Y_{10}	=1	if the housing unit provides access to a telephone
		0	otherwise

taken was provided in Chapter II. The variables Y_1, Y_2, ..., Y_{10} represent the highest level or levels of housing condition for each measure of housing condition.

Assumptions and Interpretation of the Models

The use of a binary dependent variable calls for a special interpretation of the models and results in violation of some of the classical assumptions of multiple regression. The special interpretation involves viewing the estimated regression coefficients as contributing to or detracting from the probability that the event described by the dependent variable occurs. Thus a negative coefficient reduces the probability that an event occurs while a positive coefficient increases that probability. This interpretation causes a problem when the prediction for an observation is less than zero or exceeds unity. The problem is approached by defining all predictions greater than unity as equal to unity and all predictions less than zero as equal to zero [10, pp. 425-428].

The classical assumptions violated here are the assumptions of homoskedasticity and normality of the error term. For a discussion of the assumptions of this type of model and consequences of these assumptions, see Appendix III. Briefly this results in inefficient and asymptotically inefficient ordinary least squares estimates (OLS) of the regression coefficients. However, these estimates are unbiased and consistent. This means that the OLS estimates of the variances of these coefficients are biased. The direction of this bias was not determined so the OLS estimates of the variances are not presented and no statistical tests are performed.

Empirical Results

The ten models used to estimate these net relationships are presented in the same order that their dependent variables are presented in Table IV-1. The sets of socio-economic and locational characteristics with the strongest relationships to the dependent variable in question are discussed while some of the sets are left for the reader to examine. The strength of the relationship is judged by two measures: (1) the size of the estimated parameter coupled with the range of the independent variable which is referred to as the potential effect, and (2) the relative size of the R^2 delete.

The R^2 delete for a particular variable is the R^2 for the model with that explanatory variable removed. If there were no multicollinearity between the independent variables in the model, the R^2 delete would be a good indicator of the importance of the individual variable. The difference between the total R^2 and the R^2 delete would represent the percentage of the variation in the dependent variable directly attributable to the omitted variable. However, with multicollinearity in the total model part of the effects of the omitted variable are attributed to the included independent variables with which it is correlated. Because the models used in this study have varying degrees of multicollinearity the R^2 deletes are not completely accurate indications of the importance of the omitted variable.

Y_1: Six Rooms or More

The first model presented is used to estimate the net relationships between the socio-economic and locational characteristics previously discussed and the existence of six rooms or more in the housing unit. The empirical results presented in Table IV-2 indicate that the predetermined variables explained 20.4 percent of the variation in the dependent variable.

Several sets of these socio-economic and locational characteristics appear to have a larger effect on the dependent variable than other sets: household income, the dependency ratio, the age of the household head, the education of the household head, and the type of tenure. An examination of the R^2 deletes reveals that the percentage of the dependent variable explained decreases by 4.48 when the variable designating owner occupancy is dropped from the model. The probability that the housing unit possesses six rooms or more increases by .254 if the unit is owner occupied rather than renter occupied. The probability increases by .114 when the occupants pay no cash rent rather than the more typical renter status. The category, no cash rent, is usually associated with lower levels of housing condition than the renter category.

The variables describing household income appear to have the largest estimated effect on the probability that the housing unit has six rooms or more. If the household consists of a mixture of families and unrelated individuals, the initial effect on the probability of occupying a larger housing unit is -.657. The estimated effect of household income for this group is a positive .924 with $7,000 income or more. The intercept for the income of households consisting of families is not as negative (-.127) as that for mixed households but the slope is also less. Both intercepts represent the difference

TABLE IV-2.--Estimated Net Relationships Between Socio-economic and Locational Characteristics of the Occupants and the Presence of Six Rooms or More

	Predetermined Variables[c]	Regression Coefficient	R^2 Deletes
	Constant Term	-.6944	
Region of the United States			
X_1	Northeast[a]	.0858	.2000
X_2	North Central[d]	----	----
X_3	South[a]	-.0438	.2029
X_4	West[a]	-.0800	.2013
Size of Place			
X_5	Rural Farm[a]	.0342	.2040
X_6	Rural Nonfarm[a]	-.0970	.2038
X_7	Urban Territory Outside of Places[a]	-.1083	.2037
X_8	Log. of the Size of Place (Population)[b]	-.0250	.2037
Location Within Urbanized Area			
X_9	In a Central City[a]	.0237	.2039
X_{10}	In Remainder or Urbanized Area[d]	----	----
Age of Household Head			
X_{11}	Age[b]/10	.3926	.2014
X_{12}	Age Squared[b]/1,000	-.6309	.2024
X_{13}	Age Cubed[b]/100,000	.3384	.2029
Sex of Household Head			
X_{14}	Male[d]	----	----
X_{15}	Female[a]	-.0233	.2038
Race of Household Head			
X_{16}	White With Spanish Surname[a]	-.0444	.2039
X_{17}	White[d]	----	----
X_{18}	Negro[a]	-.0160	.2039
X_{19}	Other Race[a]	.0317	.2040
Nativity and Parentage of Household Head			
X_{20}	Native With Native Parents[d]	----	----
X_{21}	Native With One Foreign Parent[a]	-.0026	.2040
X_{22}	Native With Foreign Parents[a]	-.0116	.2040
X_{23}	Foreign Born[a]	-.0346	.2037
Metropolitan Residence in 1955			
X_{24}	Same House[d]	----	----
X_{25}	Different House Same County[a]	-.0434	.2027
X_{26}	Different County Same State[a]	-.0281	.2038
X_{27}	Contiguous State[a]	-.0437	.2038
X_{28}	Noncontiguous State[a]	-.0447	.2036
X_{29}	Abroad or at Sea[a]	-.0498	.2039

TABLE IV-2.--Continued.

Predetermined Variables[c]	Regression Coefficient	R^2 Deletes
Occupational Classification		
X_{30} Farmer[a]	.1084	.2033
X_{31} Farm Manager[a]	.1227	.2040
X_{32} Farm Foreman[a]	.0058	.2040
X_{33} Farm Laborer[a]	-.0144	.2040
X_{34} Farm Service Worker[a]	-.0488	.2040
X_{35} White Collar Worker[a]	.0714	.2034
X_{36} Blue Collar Worker[a]	-.0072	.2040
X_{37} Service Worker[a]	-.0005	.2040
X_{38} Laborer[a]	-.0075	.2040
X_{39} Occupation Not Reported[d]	----	----
X_{40} No Occupation[a]	.0583	.2037
Tenure		
X_{41} Owned[a]	.2541	.1592
X_{42} Rented[d]	----	----
X_{43} No Cash Rent[a]	.1141	.2023
Educational Level of Household Head		
X_{44} Educational Level if $\leq$10.5 Years[b]	.0109	.2022
X_{45} Educational Level if >10.5 Years[b]	.0059	.2009
Log. of Household Income for Households of Various Types		
X_{46} Unrelated Individuals (Slope)[b]	-.0098	.2040
X_{47} Family (Intercept)[a]	-.1274	.2036
X_{48} Family (Slope)[b]	.0570	.2017
X_{49} Mixed (Intercept)[a]	-.6568	.2033
X_{50} Mixed (Slope)[b]	.2403	.2027
Dependency Ratio		
X_{51} Dependency Ratio[b]	.0658	.1958
X_{52} No One 14-64[a]	-.0119	.2040
R^2 = .2040		

[a]This variable is dichotomous equalling one if the stated condition holds, zero otherwise.

[b]This variable is continuous.

[c]The observation unit is the household and the variables pertain either to the household or to the head of household.

[d]This variable was omitted to avoid singularity.

Source: One-in-a-thousand sample tapes, 20 percent sample, 1960 Censuses of Population and Housing [36].

from the intercept for households of unrelated individuals. These empirical results for household income indicate that for households consisting of unrelated individuals income has little relationship to the probability that they occupy housing units with six rooms or more. Households consisting of families initially have a lower probability of occupying a larger housing unit but that probability increases as income increases. Households that are mixed initially have the lowest probability of occupying a larger housing unit but show a larger positive relationship with household income. At household income of $7,000 or more the probability that mixed households occupy a larger housing unit exceeds that for families which exceeds that for unrelated individuals.

The dependency ratio exhibits an estimated positive relationship to the probability that the household occupies a housing unit with six rooms or more. The maximum value of this ratio is ten which would indicate a possible estimated increase in the probability that the household occupies a larger housing unit of .658 over a household with no one under 15 or over 64 years of age.

The variables describing the age of the household head exhibit a substantial positive relationship to the probability that the household occupies a larger housing unit. Between the ages of 15 and 100 the probability is estimated to increase by .543. Table V-3 in Chapter V presents the estimates of this relationship. The probability first increases at a decreasing rate, goes through a point of inflection at about 60 years of age then increases at an increasing rate. This estimated net relationship indicates that as age increases people tend to live in larger homes, other variables held constant.

The set of variables describing the education of the household head exhibit an estimated potential increase of .212 in the probability that the household occupies a larger housing unit. It was hypothesized that the educational level of the household head up to ten and a half years would have a greater positive relationship to housing condition than education beyond that point. The estimated net relationships support that hypothesis.

The sets of socio-economic and locational characteristics just discussed each can have a potential effect greater than .200 on the probability that the housing unit possesses six rooms or more. These characteristics appear to be the primary explanatory variables. Three other sets of characteristics have potential effects of greater than .150: size of place, occupational classification, and region of the United States. Due to space limitations these variables are not discussed. The reader may examine Table IV-2 for the effects of these variables.

Y_2: Structurally Sound and Y_3: Not Structurally Dilapidated

These two models are discussed together because their dependent variables represent the highest and lowest levels of structural condition. The independent variables explained 19.29 percent of the variation in Y_2 and only 10.82 percent in the variation in Y_3 as indicated in Tables IV-3 and IV-4. An examination of the R^2 deletes indicate that four variables if omitted reduce the R^2 the most: X_{18} Negro, X_{41} owned, X_{44} educational level, and X_{51} dependency ratio.

TABLE IV-3.--Estimated Net Relationships Between Socio-economic and Locational Characteristics of the Occupants and a Structurally Sound Housing Unit

Predetermined Variables[c]	Regression Coefficient	R^2 Deletes
Constant Term	.3364	
Region of the United States		
X_1 Northeast[a]	.0109	.1928
X_2 North Central[d]	----	----
X_3 South[a]	-.0216	.1925
X_4 West[a]	.0119	.1928
Size of Place		
X_5 Rural Farm[a]	.0655	.1928
X_6 Rural Nonfarm[a]	.0886	.1926
X_7 Urban Territory Outside of Places[a]	.1740	.1918
X_8 Log. of the Size of Place (Population)[b]	.0375	.1918
Location Within Urbanized Area		
X_9 In a Central City[a]	-.0220	.1928
X_{10} In Remainder of Urbanized Area[d]	----	----
Age of Household Head		
X_{11} Age[b]/10	-.0397	.1929
X_{12} Age Squared[b]/1,000	.0766	.1929
X_{13} Age Cubed[b]/100,000	-.0392	.1929
Sex of Household Head		
X_{14} Male[d]	----	----
X_{15} Female[a]	.0077	.1929
Race of Household Head		
X_{16} White With Spanish Surname[a]	-.1176	.1916
X_{17} White[d]	----	----
X_{18} Negro[a]	-.1737	.1796
X_{19} Other Race[a]	-.1253	.1926
Nativity and Parentage of Household Head		
X_{20} Native With Native Parents[d]	----	----
X_{21} Native With One Foreign Parent[a]	.0209	.1928
X_{22} Native With Foreign Parents[a]	.0291	.1924
X_{23} Foreign Born[a]	.0683	.1909
Metropolitan Residence in 1955		
X_{24} Same House[d]	----	----
X_{25} Different House Same County[a]	.0238	.1923
X_{26} Different County Same State[a]	.0377	.1924
X_{27} Contiguous State[a]	.0399	.1927
X_{28} Noncontiguous State[a]	.0570	.1920
X_{29} Abroad or at Sea[a]	.0617	.1926

TABLE IV-3.--Continued.

Predetermined Variables[c]	Regression Coefficient	R^2 Deletes
Occupational Classification		
X_{30} Farmer[a]	-.0023	.1929
X_{31} Farm Manager[a]	.0648	.1929
X_{32} Farm Foreman[a]	-.0508	.1929
X_{33} Farm Laborer[a]	-.1574	.1914
X_{34} Farm Service Worker[a]	-.0908	.1929
X_{35} White Collar Worker[a]	.0387	.1926
X_{36} Blue Collar Worker[a]	-.0083	.1929
X_{37} Service Worker[a]	-.0052	.1929
X_{38} Laborer[a]	-.0825	.1920
X_{39} Occupation Not Reported[d]	----	----
X_{40} No Occupation[a]	-.0328	.1928
Tenure		
X_{41} Owned[a]	.1305	.1736
X_{42} Rented[d]	----	----
X_{43} No Cash Rent[a]	-.0108	.1929
Educational Level of Household Head		
X_{44} Educational Level if $\leq$10.5 Years[b]	.0220	.1811
X_{45} Educational Level if >10.5 Years[b]	.0011	.1928
Log. of Household Income for Households of Various Types		
X_{46} Unrelated Individuals (Slope)[b]	.0282	.1923
X_{47} Family (Intercept)[a]	-.0178	.1929
X_{48} Family (Slope)[b]	.0489	.1901
X_{49} Mixed (Intercept)[a]	-.2717	.1927
X_{50} Mixed (Slope)[b]	.1043	.1925
Dependency Ratio		
X_{51} Dependency Ratio[b]	-.0440	.1870
X_{52} No One 14-64[a]	-.0180	.1928
R^2 = .1929		

[a]This variable is dichotomous equalling one if the stated condition holds, zero otherwise.

[b]This variable is continuous.

[c]The observation unit is the household and the variables pertain either to the household or to the head of household.

[d]This variable was omitted to avoid singularity.

Source: <u>One-in-a-thousand sample</u> tapes, 20 percent sample, 1960 Censuses of Population and Housing [36].

TABLE IV-4.--Estimated Net Relationships Between Socio-economic and Locational Characteristics of the Occupants and a Housing Unit That is Not Structurally Dilapidated

	Predetermined Variables[c]	Regression Coefficient	R^2 Deletes
	Constant Term	.8340	
Region of the United States			
X_1	Northeast[a]	.0023	.1082
X_2	North Central[d]	----	----
X_3	South[a]	-.0117	.1078
X_4	West[a]	-.0043	.1082
Size of Place			
X_5	Rural Farm[a]	.0661	.1076
X_6	Rural Nonfarm[a]	.0298	.1081
X_7	Urban Territory Outside of Places[a]	.0509	.1079
X_8	Log. of the Size of Place (Population)[b]	.0130	.1077
Location Within Urbanized Area			
X_9	In a Central City[a]	.0021	.1082
X_{10}	In Remainder of Urbanized Area[d]	----	----
Age of Household Head			
X_{11}	Age[b]/10	-.0517	.1079
X_{12}	Age Squared[b]/1,000	.0910	.1080
X_{13}	Age Cubed[b]/100,000	-.0468	.1081
Sex of Household Head			
X_{14}	Male[d]	----	----
X_{15}	Female[a]	.0097	.1080
Race of Household Head			
X_{16}	White With Spanish Surname[a]	-.0291	.1079
X_{17}	White[d]	----	----
X_{18}	Negro[a]	-.1015	.0929
X_{19}	Other Race[a]	-.0588	.1080
Nativity and Parentage of Household Head			
X_{20}	Native With Native Parents[d]	----	----
X_{21}	Native With One Foreign Parent[a]	.0039	.1082
X_{22}	Native With Foreign Parents[a]	.0039	.1082
X_{23}	Foreign Born[a]	.0160	.1078
Metropolitan Residence in 1955			
X_{24}	Same House[d]	----	----
X_{25}	Different House Same County[a]	.0119	.1077
X_{26}	Different County Same State[a]	.0161	.1078
X_{27}	Contiguous State[a]	.0177	.1080
X_{28}	Noncontiguous State[a]	.0209	.1078
X_{29}	Abroad or at Sea[a]	.0107	.1082

TABLE IV-4.--Continued.

Predetermined Variables[c]	Regression Coefficient	R^2 Deletes
Occupational Classification		
X_{30} Farmer[a]	-.0084	.1082
X_{31} Farm Manager[a]	.0713	.1081
X_{32} Farm Foreman[a]	.0534	.1081
X_{33} Farm Laborer[a]	-.0871	.1066
X_{34} Farm Service Worker[a]	-.2234	.1080
X_{35} White Collar Worker[a]	.0149	.1080
X_{36} Blue Collar Worker[a]	.0095	.1081
X_{37} Service Worker[a]	.0107	.1081
X_{38} Laborer[a]	-.0277	.1078
X_{39} Occupation Not Reported[d]	----	----
X_{40} No Occupation[a]	-.0084	.1082
Tenure		
X_{41} Owned[a]	.0427	.1013
X_{42} Rented[d]	----	----
X_{43} No Cash Rent[a]	-.0320	.1074
Educational Level of Household Head		
X_{44} Educational Level if $\leq$10.5 Years[b]	.0096	.1006
X_{45} Educational Level if >10.5 Years[b]	-.0004	.1081
Log. of Household Income for Households of Various Types		
X_{46} Unrelated Individuals (Slope)[b]	.0108	.1079
X_{47} Family (Intercept)[a]	-.0163	.1082
X_{48} Family (Slope)[b]	.0210	.1064
X_{49} Mixed (Intercept)[a]	-.1731	.1079
X_{50} Mixed (Slope)[b]	.0611	.1077
Dependency Ratio		
X_{51} Dependency Ratio[b]	-.0200	.1041
X_{52} No One 14-64[a]	-.0014	.1082
R^2 = .1082		

[a]This variable is dichotomous equalling one if the stated condition holds, zero otherwise.

[b]This variable is continuous.

[c]The observation unit is the household and the variables pertain either to the household or to the head of household.

[d]This variable was omitted to avoid singularity.

Source: <u>One-in-a-thousand sample</u> tapes, 20 percent sample, 1960 Censuses of Population and Housing [36].

With both of these dependent variables the white household head is associated with the highest level of housing condition, white with a Spanish surname next, followed by other race, and Negro last. The Negro household head has an estimated .174 lower probability of occupying a structurally sound housing unit than a white household head. He has an estimated .102 lower probability of occupying a housing unit that is not structurally dilapidated.

The owner occupied housing units are more likely to possess higher levels of structural condition than renter occupied units which possess higher condition levels than units where the occupants pay no cash rent.

The educational level of the household head is positively related to structural condition. A household head with ten and a half years education or more is an estimated .249 more likely to occupy sound housing than one with no education. The hypothesized decrease in the positive relationship between education of the household head and housing condition at ten and a half years of education is supported by parameter estimates of the first model. The second model with not structurally dilapidated as a dependent variable exhibits a small negative relationship with housing condition after ten and a half years of education.

The dependency ratio exhibits a relatively strong negative relationship with structural condition. As the dependency ratio varies over its observable range from 0 to 10, the probability that the housing unit is structurally sound decreases by .440 and the probability that it is not dilapidated increases by .200. These estimated net relationships indicate that the higher the proportion of household members under 15 and over 64 the lower the structural condition of the unit.

Three other sets of characteristics appear to have relatively strong relationships to structural condition: age, household income, and occupational classification. The different occupational classifications exhibited an estimated .222 probability range between the classification where the household is most likely and the classification where the household is least likely to occupy a structurally sound housing unit. Listed from the occupational classification where the household is most likely to the one where the household is least likely to occupy sound housing, the classifications are arranged in this order: farm manager, white collar worker, no occupation reported, farmer, service worker, blue collar worker, no occupation, farm foreman, laborers, farm service workers, and farm laborers. The relationships between occupational classifications and structural condition are different but follow the same basic pattern for the second model, the model with not structurally dilapidated as dependent variable. The occupational classifications exhibit an estimated .295 range in the probability that the household does not occupy dilapidated housing.

The household income of various types of households exhibit a similar pattern of relationships to structurally sound and structurally dilapidated as was exhibited with the dependent variable, six rooms or more. Households composed of unrelated individuals exhibit a positive relationship between household income and structural condition. This relationship is smaller than that for households composed of families and smaller yet than the relationship for households composed of families and unrelated individuals. However, initially households composed of unrelated individuals have a higher probability of occupying housing units with higher levels of structural condition than households composed of families. These family type households in turn have a higher probability of occupying structurally desirable housing than mixed households.

The last set of socio-economic and locational variables to be discussed here, age of the household head, exhibits an unusual relationship to structural condition. The probability that the household occupies structurally sound housing first decreases at a decreasing rate, reaching a minimum at approximately 35 years of age, then increases first at an increasing rate and later at a decreasing rate reaching a peak at about 95 years of age. These estimated relationships have been calculated and are presented in Table V-3 of Chapter V. The relationships between age of the household head and structurally dilapidated are similar to those for structurally sound with maximums and minimums occurring at different age levels.

Tables IV-3 and IV-4 may be examined to determine the direction and magnitude of relationships between other socio-economic and locational characteristics and structural conditions.

Y_4: Hot and Cold Water Piped Inside the Housing Unit

Five sets of socio-economic and locational characteristics appear to have the predominant effects on the presence of hot and cold water piped into the housing unit: household income, occupational classifications, education of the household head, race, the region of the United States, and the size of place. The empirical results from this model are presented in Table IV-5.

The household income variables exhibit a pattern of relationships with the water supply measure of housing condition which is the same as the pattern exhibited with the number of rooms and structural condition. This set of characteristics is not discussed other than to note the range of effects of household income for the various types of households. As income goes from 0 to $7,000 or more, the effect on the probability that the housing unit has hot and cold water piped inside goes from 0 to .096 for households composed of unrelated individuals, from -.068 to .152 for households composed of families, and from -.398 to .165 for mixed households.

The occupational classifications exhibit a .308 probability range between the classification where the household has the highest probability of having the desirable water supply conditions and the classification where the household has the lowest probability. Listed from the highest to the lowest probability the classifications relate to water supply in this order: farm manager, farm foreman, white collar worker, service worker, occupation not reported, blue collar worker, no occupation, farmer, laborers, farm service worker, farm laborer.

The educational level of the household head exhibits a positive relationship to hot and cold water being piped inside the housing unit between 0 and ten and a half years' education. After that point

TABLE IV-5.--Estimated Net Relationships Between Socio-economic and Locational Characteristics of the Occupants and Hot and Cold Water Piped Inside the Housing Unit

	Predetermined Variables[c]	Regression Coefficient	R^2 Deletes
	Constant Term	.4131	
Region of the United States			
X_1	Northeast[a]	.0260	.3055
X_2	North Central[d]	----	----
X_3	South[a]	-.0660	.3004
X_4	West[a]	.0254	.3057
Size of Place			
X_5	Rural Farm[a]	-.0372	.3063
X_6	Rural Nonfarm[a]	-.0235	.3063
X_7	Urban Territory Outside of Places[a]	.1126	.3056
X_8	Log. of the Size of Place (Population)[b]	.0277	.3055
Location Within Urbanized Area			
X_9	In a Central City[a]	.0136	.3063
X_{10}	In Remainder of Urbanized Area[d]	----	----
Age of Household Head			
X_{11}	Age[b]/10	.0262	.3063
X_{12}	Age Squared[b]/1,000	-.0477	.3063
X_{13}	Age Cubed[b]/100,000	.0336	.3063
Sex of Household Head			
X_{14}	Male[d]	----	----
X_{15}	Female[a]	.0163	.3061
Race of Household Head			
X_{16}	White With Spanish Surname[a]	-.0533	.3060
X_{17}	White[d]	----	----
X_{18}	Negro[a]	-.1708	.2875
X_{19}	Other Race[a]	-.0808	.3062
Nativity and Parentage of Household Head			
X_{20}	Native With Native Parents[d]	----	----
X_{21}	Native With One Foreign Parent[a]	.0060	.3063
X_{22}	Native With Foreign Parents[a]	-.0112	.3062
X_{23}	Foreign Born[a]	.0378	.3054
Metropolitan Residence in 1955			
X_{24}	Same House[d]	----	----
X_{25}	Different House Same County[a]	.0263	.3052
X_{26}	Different County Same State[a]	.0441	.3052
X_{27}	Contiguous State[a]	.0444	.3059
X_{28}	Noncontiguous State[a]	.0612	.3047
X_{29}	Abroad or at Sea[a]	.0551	.3060

TABLE IV-5.--Continued

Predetermined Variables[c]	Regression Coefficient	R^2 Deletes
Occupational Classification		
X_{30} Farmer[a]	-.0503	.3060
X_{31} Farm Manager[a]	.1397	.3063
X_{32} Farm Foreman[a]	.0442	.3063
X_{33} Farm Laborer[a]	-.1680	.3038
X_{34} Farm Service Worker[a]	-.1074	.3063
X_{35} White Collar Worker[a]	.0093	.3063
X_{36} Blue Collar Worker[a]	-.0009	.3064
X_{37} Service Worker[a]	.0013	.3064
X_{38} Laborer[a]	-.0716	.3054
X_{39} Occupation Not Reported[d]	----	----
X_{40} No Occupation[a]	-.0400	.3060
Tenure		
X_{41} Owned[a]	.0536	.3016
X_{42} Rented[d]	----	----
X_{43} No Cash Rent[a]	-.0901	.3038
Educational Level of Household Head		
X_{44} Educational Level if $\leq$10.5 Years[b]	.0240	.2858
X_{45} Educational Level if >10.5 Years[b]	-.0008	.3062
Log. of Household Income for Households of Various Types		
X_{46} Unrelated Individuals (Slope)[b]	.0249	.3057
X_{47} Family (Intercept)[a]	-.0682	.3061
X_{48} Family (Slope)[b]	.0573	.3007
X_{49} Mixed (Intercept)[a]	-.3977	.3057
X_{50} Mixed (Slope)[b]	.1463	.3052
Dependency Ratio		
X_{51} Dependency Ratio[b]	-.0199	.3046
X_{52} No One 14-64[a]	-.0027	.3064
R^2 = .3064		

[a]This variable is dichotomous equalling one if the stated condition holds, zero otherwise.

[b]This variable is continuous.

[c]The observation unit is the household and the variables pertain either to the household or to the head of household.

[d]This variable was omitted to avoid singularity.

Source: One-in-a-thousand sample tapes, 20 percent sample, 1960 Censuses of Population and Housing [36].

the relationship is negative but small. The probability that the housing unit has hot and cold water piped inside increases by .252 as the educational level increases from 0 to ten and a half years.

The race variables account for an estimated .171 change in the probability that the housing unit contains hot and cold water piped inside. The R^2 deletes indicate that the individual variable X_{18}, Negro, if omitted would reduce R^2 by almost as much as X_{44}, education. The Negro household head has the lowest estimated probability of occupying a housing unit with the desirable water supply; the other race household head has the next higher; then the household head who is white with a Spanish surname; and the white household head has the highest estimated probability of occupying a housing unit with the desirable type of water supply.

The region of the United States variables account for only .092 change in the probability of the desirable water supply. However, the R^2 deletes indicate that omitting the variable designating the South would reduce R^2 by more than is indicated for most of the other variables. The Northeast and the West have the highest estimated probability of having the desirable water supply. The North Central region exhibited a lower estimated probability and the South exhibited the lowest probability of a housing unit having hot and cold water piped inside.

The size of place variables account for an estimated .203 change in the probability of a unit having hot and cold water piped inside. Rural farm has the lowest probability and rural nonfarm next. Then as the size of place increases the change in the probability that a housing unit has the desirable water supply increases from .166. The residence category, urban territory outside of places shows an increase in this probability over the residence categories of rural farm and rural nonfarm.

Relationships between other sets of socio-economic and locational characteristics and water supply can be observed in Table IV-5.

Y_5: Exclusive Access to Bath or Shower

The next model presented has exclusive access to a bath or shower as dependent variable. Four sets of socio-economic and locational characteristics exhibit substantial estimated net relationships with this binary variable: household income, occupational classification, educational level, and the size of place.

Household income exhibits relationships similar to those exhibited with other measures of housing condition previously discussed. That is income is positively related to the probability that the household has exclusive access to a bath or shower. The slope of this log-linear relationship is greatest for mixed households, less for households composed of families, and the smallest for households composed of unrelated individuals. These relationships differ from the relationships previously discussed. With zero or negative income the probability of having exclusive access to a bath or shower is greater for households composed of families than for households composed of unrelated individuals. This has not been the case with previous models.

The occupational classification of farm manager exhibits a probability of having exclusive access to a bath or shower which is .366 greater than that for farm laborers. The pattern of relationships is similar to the estimated net relationships with the probability that a housing unit has hot and cold water piped inside and the probability that a housing unit has one more bathroom.

The educational level of the household accounts for an estimated .253 increase in the probability that a household has exclusive access to a bath or shower from the zero educational level to ten and a half years of education. After that point the relationship is slightly negative, decreasing .010 for each additional year of education beyond ten and a half years. The R^2 delete indicates that if X_{44} were dropped from the model the percent of the variation in the dependent variable explained would decrease by 1.83.

The size of place variables can account for an estimated .214 change in the probability that a household has exclusive access to a bath or shower. As could be expected the rural farm and rural nonfarm categories exhibit the lowest estimated probability of possessing this desirable housing characteristic. Urban territory outside of places has a higher estimated probability. The logarithm of the size of place has a positive relationship and increases the estimated probability of exclusive access to a bath or shower by .124 for places of one million or more population.

These sets of characteristics--household income, occupational classifications, educational level, and size of place--exhibit the strongest estimated net relationships with the dependent variable.

However, two other individual variables indicate by their R^2 deletes that they explain a substantial proportion of the observed variation in the dependent variable. They are X_{18}, Negro and X_{14}, owned. Other relationships can be observed in Table IV-6.

Y_6: Built from 1950 to 1960

The dependent variable for this next model indicates whether the housing unit was built within the decade previous to the Census. As indicated in Table IV-7, 23.1 percent of the variation in this regressand is explained by the independent variables used. A different mix of regressors appear to be the primary explanatory variables in this model than in the previous models: metropolitan residence in 1955, tenure, and age of the household head.

The metropolitan residence in 1955 variables account for an estimated .311 change in the probability that the housing unit was built from 1950 to 1960. However, the relationship is somewhat irregular. As one moves from the variable indicating no move through the variables indicating moves of increasing distance, the probability does not increase smoothly. It increases from X_{24}, same house, to X_{26}, different county same state; decreases to X_{27} contiguous state; reaches a maximum at X_{28}, noncontiguous state; and decreases to X_{29}, abroad or at sea.

The tenure variables can account for an estimated .248 change in the probability that the housing unit was built from 1950 to 1960. According to the R^2 deletes, if the owned tenure category, X_{41}, were omitted from the model the percentage of the dependent variable explained would decrease by 4.96. The rented tenure category, X_{42}

TABLE IV-6.--Estimated Net Relationships Between Socio-economic and Locational Characteristics of the Occupants and Exclusive Access to a Bath or Shower

	Predetermined Variables[c]	Regression Coefficient	R^2 Deletes
	Constant Term	.3038	
Region of the United States			
X_1	Northeast[a]	.0336	.2720
X_2	North Central[d]	----	----
X_3	South[a]	-.0323	.2720
X_4	West[a]	.0363	.2722
Size of Place			
X_5	Rural Farm[a]	-.0899	.2729
X_6	Rural Nonfarm[a]	-.0542	.2732
X_7	Urban Territory Outside of Places[a]	.0882	.2729
X_8	Log. of the Size of Place (Population)[b]	.0206	.2729
Location Within Urbanized Area			
X_9	In a Central City[a]	.0079	.2733
X_{10}	In Remainder of Urbanized Area[d]	----	----
Age of Household Head			
X_{11}	Age[b]/10	-.0038	.2733
X_{12}	Age Squared[b]/1,000	.0269	.2733
X_{13}	Age Cubed[b]/100,000	-.0206	.2733
Sex of Household Head			
X_{14}	Male[d]	----	----
X_{15}	Female[a]	.0535	.2711
Race of Household Head			
X_{16}	White With Spanish Surname[a]	-.0410	.2731
X_{17}	White[d]	----	----
X_{18}	Negro[a]	-.1440	.2616
X_{19}	Other Race[a]	-.0454	.2732
Nativity and Parentage of Household Head			
X_{20}	Native With Native Parents[d]	----	----
X_{21}	Native With One Foreign Parent[a]	.0143	.2732
X_{22}	Native With Foreign Parents[a]	.0003	.2733
X_{23}	Foreign Born[a]	.0545	.2716
Metropolitan Residence in 1955			
X_{24}	Same House[d]	----	----
X_{25}	Different House Same County[a]	.0228	.2726
X_{26}	Different County Same State[a]	.0396	.2725
X_{27}	Contiguous State[a]	.0371	.2730
X_{28}	Noncontiguous State[a]	.0402	.2727
X_{29}	Abroad or at Sea[a]	.0279	.2732

TABLE IV-6.--Continued

Predetermined Variables[c]	Regression Coefficient	R^2 Deletes
Occupational Classification		
X_{30} Farmer[a]	-.0411	.2731
X_{31} Farm Manager[a]	.2210	.2731
X_{32} Farm Foreman[a]	.0719	.2733
X_{33} Farm Laborer[a]	-.1453	.2716
X_{34} Farm Service Worker[a]	-.0517	.2733
X_{35} White Collar Worker[a]	.0257	.2731
X_{36} Blue Collar Worker[a]	.0143	.2732
X_{37} Service Worker[a]	-.0113	.2733
X_{38} Laborer[a]	-.0617	.2727
X_{39} Occupation Not Reported[d]	----	----
X_{40} No Occupation[a]	-.0179	.2732
Tenure		
X_{41} Owned[a]	.0781	.2644
X_{42} Rented[d]	----	----
X_{43} No Cash Rent[a]	-.0751	.2717
Educational Level of Household Head		
X_{44} Educational Level if $\leq$10.5 Years[b]	.0241	.2550
X_{45} Educational Level if >10.5 Years[b]	-.0001	.2733
Log. of Household Income for Households of Various Types		
X_{46} Unrelated Individuals (Slope)[b]	.0303	.2724
X_{47} Family (Intercept)[a]	.0118	.2733
X_{48} Family (Slope)[b]	.0659	.2668
X_{49} Mixed (Intercept)[a]	-.2923	.2730
X_{50} Mixed (Slope)[b]	.1462	.2723
Dependency Ratio		
X_{51} Dependency Ratio[b]	-.0105	.2729
X_{52} No One 14-64[a]	.0191	.2732
R^2 = .2733		

[a]This variable is dichotomous equalling one if the stated condition holds, zero otherwise.

[b]This variable is continuous.

[c]The observation unit is the household and the variables pertain either to the household or to the head of household.

[d]This variable was omitted to avoid singularity.

Source: One-in-a-thousand sample tapes, 20 percent sample, 1960 Censuses of Population and Housing [36].

TABLE IV-7.--Estimated Net Relationships Between Socio-economic and Locational Characteristics of the Occupants and the Housing Unit Being Built From 1950 to 1960

Predetermined Variables[c]		Regression Coefficient	R^2 Deletes
	Constant Term	-.4905	
Region of the United States			
X_1	Northeast[a]	-.0129	.2311
X_2	North Central[d]	----	----
X_3	South[a]	.0935	.2254
X_4	West[a]	.0863	.2276
Size of Place			
X_5	Rural Farm[a]	-.0273	.2312
X_6	Rural Nonfarm[a]	.0779	.2310
X_7	Urban Territory Outside of Places[a]	.2117	.2300
X_8	Log. of the Size of Place (Population)[b]	.0139	.2311
Location Within Urbanized Area			
X_9	In a Central City[a]	-.0734	.2299
X_{10}	In Remainder of Urbanized Area[d]	----	----
Age of Household Head			
X_{11}	Age[b]/10	.2987	.2294
X_{12}	Age Squared[b]/1,000	-.6768	.2290
X_{13}	Age Cubed[b]/100,000	.4210	.2292
Sex of Household Head			
X_{14}	Male[d]	----	----
X_{15}	Female[a]	-.0325	.2308
Race of Household Head			
X_{16}	White With Spanish Surname[a]	-.0411	.2311
X_{17}	White[d]	----	----
X_{18}	Negro[a]	-.0050	.2312
X_{19}	Other Race[a]	.0061	.2312
Nativity and Parentage of Household Head			
X_{20}	Native With Native Parents[d]	----	----
X_{21}	Native With One Foreign Parent[a]	.0155	.2311
X_{22}	Native With Foreign Parents[a]	.0449	.2302
X_{23}	Foreign Born[a]	.0506	.2304
Metropolitan Residence in 1955			
X_{24}	Same House[d]	----	----
X_{25}	Different House Same County[a]	.2186	.1930
X_{26}	Different County Same State[a]	.2602	.2120
X_{27}	Contiguous State[a]	.2552	.2234
X_{28}	Noncontiguous State[a]	.3109	.2106
X_{29}	Abroad or at Sea[a]	.2681	.2269

TABLE IV-7.--Continued

Predetermined Variables[c]	Regression Coefficient	R^2 Deletes
Occupational Classification		
X_{30} Farmer[a]	-.0612	.2309
X_{31} Farm Manager[a]	-.1075	.2312
X_{32} Farm Foreman[a]	-.0079	.2312
X_{33} Farm Laborer[a]	-.0981	.2308
X_{34} Farm Service Worker[a]	-.0914	.2312
X_{35} White Collar Worker[a]	.0199	.2312
X_{36} Blue Collar Worker[a]	-.0163	.2312
X_{37} Service Worker[a]	-.0206	.2312
X_{38} Laborer[a]	-.0610	.2309
X_{39} Occupation Not Reported[d]	----	----
X_{40} No Occupation[a]	-.0115	.2312
Tenure		
X_{41} Owned[a]	.2477	.1816
X_{42} Rented[d]	----	----
X_{43} No Cash Rent[a]	.0604	.2306
Educational Level of Household Head		
X_{44} Educational Level if $\leq$10.5 Years[b]	.0035	.2310
X_{45} Educational Level if >10.5 Years[b]	.0037	.2298
Log. of Household Income for Households of Various Types		
X_{46} Unrelated Individuals (Slope)[b]	.0032	.2312
X_{47} Family (Intercept)[a]	-.0777	.2310
X_{48} Family (Slope)[b]	.0319	.2304
X_{49} Mixed (Intercept)[a]	-.0832	.2312
X_{50} Mixed (Slope)[b]	.0155	.2312
Dependency Ratio		
X_{51} Dependency Ratio[b]	.0063	.2311
X_{52} No One 14-64[a]	.0454	.2307
R^2 = .2312		

[a]This variable is dichotomous equalling one if the stated condition holds, zero otherwise.

[b]This variable is continuous.

[c]The observation unit is the household and the variables pertain either to the household or to the head of household.

[d]This variable was omitted to avoid singularity.

Source: One-in-a-thousand sample tapes, 20 percent sample, 1960 Censuses of Population and Housing [36].

exhibits the lowest estimated probability that the housing unit was built during the decade prior to the Census. The tenure category, no cash rent, has a higher probability of having this desirable housing characteristic and the tenure category, owned, exhibits the highest probability.

The variables describing the age of the household head can account for an estimated .220 change in the probability that the occupied housing unit was built from 1950 to 1960. The relationship which is also presented in Table V-3 increases to a maximum at 31 years of age, decreases to a minimum at 76 years of age, and then increases. The maximum and minimum are specified within the range 15 to 95 years of age. The first portion of this relationship seems plausible. The last portion which turns up, however, appears suspect. This relationship will be discussed further in Chapter V where the relationships between the age of the household head and all of the dependent variables are considered.

With this dependent variable the R^2 deletes point to these same sets of characteristics as the primary explanatory variables. The estimated relationships between other sets of socio-economic and locational characteristics and the probability that the housing unit was built from 1950 to 1960 may be examined in Table IV-7.

Y_7: One or More Bathrooms

The dependent variable for this next model records the presence of one or more bathrooms in the housing unit. As Table IV-8 indicates the independent variables explain 29.3 percent of the variation in this

TABLE IV-8.--Estimated Net Relationships Between Socio-economic and Locational Characteristics and One or More Bathrooms in the Housing Unit

	Predetermined Variables[c]	Regression Coefficient	R^2 Deletes
	Constant Term	.2142	
Region of the United States			
X_1	Northeast[a]	.0336	.2921
X_2	North Central[d]	----	----
X_3	South[a]	-.0425	.2913
X_4	West[a]	.0429	.2918
Size of Place			
X_5	Rural Farm[a]	-.0594	.2931
X_6	Rural Nonfarm[a]	-.0183	.2932
X_7	Urban Territory Outside of Places[a]	.1312	.2925
X_8	Log. of the Size of Place (Population)[b]	.0308	.2924
Location Within Urbanized Area			
X_9	In a Central City[a]	-.0010	.2932
X_{10}	In Remainder of Urbanized Area[d]	----	----
Age of Household Head			
X_{11}	Age[b]/10	-.0037	.2932
X_{12}	Age Squared[b]/1,0-0	.0268	.2932
X_{13}	Age Cubed[b]/100,000	-.0202	.2932
Sex of Household Head			
X_{14}	Male[d]	----	----
X_{15}	Female[a]	.0479	.2917
Race of Household Head			
X_{16}	White With Spanish Surname[a]	-.0642	.2928
X_{17}	White[d]	----	----
X_{18}	Negro[a]	-.1684	.2790
X_{19}	Other Race[a]	-.0914	.2930
Nativity and Parentage of Household Head			
X_{20}	Native With Native Parents[d]	----	----
X_{21}	Native With One Foreign Parent[a]	.0172	.2931
X_{22}	Native With Foreign Parents[a]	-.0011	.2932
X_{23}	Foreign Born[a]	.0556	.2917
Metropolitan Residence in 1955			
X_{24}	Same House[d]	----	----
X_{25}	Different House Same County[a]	.0287	.2922
X_{26}	Different County Same State[a]	.0483	.2922
X_{27}	Contiguous State[a]	.0486	.2928
X_{28}	Noncontiguous State[a]	.0534	.2923
X_{29}	Abroad or at Sea[a]	.0390	.2931

TABLE IV.8.--Continued

Predetermined Variables[c]	Regression Coefficient	R^2 Deletes
Occupational Classification		
X_{30} Farmer[a]	-.0507	.2930
X_{31} Farm Manager[a]	.1926	.2931
X_{32} Farm Foreman[a]	.0559	.2932
X_{33} Farm Laborer[a]	-.1461	.2917
X_{34} Farm Service Worker[a]	-.0369	.2932
X_{35} White Collar Worker[a]	.0293	.2931
X_{36} Blue Collar Worker[a]	.0091	.2932
X_{37} Service Worker[a]	-.0141	.2932
X_{38} Laborer[a]	-.0730	.2924
X_{39} Occupation Not Reported[d]	----	----
X_{40} No Occupation[a]	-.0256	.2931
Tenure		
X_{41} Owned[a]	.0889	.2830
X_{42} Rented[d]	----	----
X_{43} No Cash Rent[a]	-.0607	.2923
Educational Level of Household Head		
X_{44} Educational Level if $\leq$10.5 Years[b]	.0261	.2743
X_{45} Educational Level if >10.5 Years[b]	.0000	.2932
Log. of Household Income for Households of Various Types		
X_{46} Unrelated Individuals (Slope)[b]	.0321	.2923
X_{47} Family (Intercept)[a]	.0031	.2932
X_{48} Family (Slope)[b]	.0710	.2865
X_{49} Mixed (Intercept)[a]	-.3269	.2929
X_{50} Mixed (Slope)[b]	.1572	.2922
Dependency Ratio		
X_{51} Dependency Ratio[b]	-.0137	.2926
X_{52} No One 14-64[a]	.0178	.2931
R^2 = .2932		

[a]This variable is dichotomous equalling one if the stated condition holds, zero otherwise.

[b]This variable is continuous.

[c]The observation unit is the household and the variables pertain either to the household or to the head of household.

[d]This variable was omitted to avoid singularity.

Source: One-in-a-thousand sample tapes, 20 percent sample, 1960 Censuses of Population and Housing [36].

dependent variable. The sets of socio-economic and locational characteristics which have the strongest estimated relationships with the regressand are: size of place, occupational classification, education of the household head, and household income.

The size of place variables exhibit an estimated .244 net effect on the probability that the housing unit contains one or more bathrooms. The rural farm residence category has the lowest probability and the rural nonfarm residence category has .041 greater probability for possessing the desirable housing characteristics. Housing units in urban territories outside of places have a .191 greater probability of possessing the desirable housing characteristics than units in the rural farm residence category. The logarithm of the size of place exhibits a positive relationship with the regressand. Housing units in places of one million and more population have a .244 greater probability of containing one or more bathrooms than units in the rural farm residence category.

The occupational classifications can explain an estimated .339 change in the probability that a housing unit contains one or more bathrooms. The farm manager classification exhibits the highest probability and the farm laborer, the lowest. The occupational classifications exhibit almost the same relationships with this dependent variable as they exhibit with two other dependent variables: Y_4, hot and cold water piped inside and Y_5, exclusive access to a bath or shower. Notice that both the farm manager and farm foreman classifications exhibit a higher probability of one or more bathrooms than the white collar worker classification.

The education of the household head shows a familiar estimated net relationship to this measure of housing condition. The estimated probability that the occupied housing unit contains one or more bathrooms increases from zero to .274 as the education of the household head goes from zero to ten and a half years. Beyond that amount of education the estimated relationship is zero. The R^2 deletes indicate that dropping this first education variable from the model would reduce the total R^2 by .019.

The household income variables also exhibit a familiar relationship with this measure of housing condition. The logarithm of income exhibits a positive relationship with the probability that the housing unit contains one or more bathrooms. The logarithm of household income for mixed households showed the largest estimated relationship with the regressand, households consisting of families next, and households consisting of unrelated individuals showed the smallest relationship. With zero or negative income households consisting of families had the highest probability of enjoying the desirable housing characteristics, unrelated individuals next, and mixed households last.

An examination of the R^2 deletes reveals two variables not discussed above which appear to be important: X_{18}, Negro and X_{41}, owned. Households with Negro household heads have a .188 lower probability of occupying housing with one or more bathrooms than households with white household heads. Also owner occupied housing has a .150 higher probability of having this desirable housing characteristic than housing occupied by tenants who pay no cash rent.

These and other estimated net relationships may be observed in Table IV-8.

Y_8: Heating Equipment

The dependent variable in this model indicates the presence of one of four types of heating equipment: (1) built-in electric, (2) steam or hot water, (3) warm air furnace, or (4) floor, wall, or pipeless furnace. Table IV-9 indicates that the independent variables explained 33.4 percent of the total variation in this dependent variable. This regression model has the highest R^2 of the ten multiple regression models used in this study that have binary dependent variables. Five sets of socio-economic characteristics have an estimated net effect greater than .200 on the probability that the housing unit possesses the desirable types of heating equipment. They are: region of the United States, size of place, race of household head, education, and household income.

The region of the United States variables exhibit an estimated .367 effect on the dependent variable. The South has the lowest estimated probability that housing units contain the desirable types of heating equipment. The West has an estimated .178 greater probability. Housing units in the North Central region are .129 more likely than those located in the West to have the desirable types of heating equipment. Housing units located in the Northeast have an estimated .367 greater probability than those located in the South--the region with the lowest probability. The R^2 deletes indicate that the percentage of the dependent variable explained would drop by .058 if South, X_3 were omitted from the model.

TABLE IV-9.--Estimated Net Relationships Between Socio-economic and Locational Characteristics of the Occupants and Four Desirable Types of Heating Equipment

	Predetermined Variables[c]	Regression Coefficient	R^2 Deletes
	Constant Term	-.2722	
Region of the United States			
X_1	Northeast[a]	.0599	.3319
X_2	North Central[d]	----	----
X_3	South[a]	-.3072	.2762
X_4	West[a]	-.1293	.3265
Size of Place			
X_5	Rural Farm[a]	.1677	.3333
X_6	Rural Nonfarm[a]	.2350	.3324
X_7	Urban Territory Outside of Places[a]	.4431	.3290
X_8	Log. of the Size of Place (Population)[b]	.0955	.3292
Location Within Urbanized Area			
X_9	In a Central City[a]	-.0668	.3330
X_{10}	In Remainder of Urbanized Area[d]	----	----
Age of Household Head			
X_{11}	Age[b]/10	.1614	.3335
X_{12}	Age Squared[b]/1,000	-.2791	.3336
X_{13}	Age Cubed[b]/100,000	.1457	.3338
Sex of Household Head			
X_{14}	Male[d]	----	----
X_{15}	Female[a]	-.0075	.3340
Race of Household Head			
X_{16}	White With Spanish Surname[a]	-.1472	.3326
X_{17}	White[d]	----	----
X_{18}	Negro[a]	-.0961	.3313
X_{19}	Other Race[a]	-.2180	.3333
Nativity and Parentage of Household Head			
X_{20}	Native With Native Parents[d]	----	----
X_{21}	Native With One Foreign Parent[a]	.0230	.3338
X_{22}	Native With Foreign Parents[a]	.0097	.3339
X_{23}	Foreign Born[a]	.0543	.3331
Metropolitan Residence in 1955			
X_{24}	Same House[d]	----	----
X_{25}	Different House Same County[a]	.0400	.3328
X_{26}	Different County Same State[a]	.0541	.3332
X_{27}	Contiguous State[a]	.0784	.3333
X_{28}	Noncontiguous State[a]	.0506	.3335
X_{29}	Abroad or at Sea[a]	.0872	.3336

TABLE IV-9.--Continued

Predetermined Variables[c]	Regression Coefficient	R^2 Deletes
Occupational Classification		
X_{30} Farmer[a]	-.0385	.3339
X_{31} Farm Manager[a]	.0225	.3340
X_{32} Farm Foreman[a]	-.0234	.3340
X_{33} Farm Laborer[a]	-.1117	.3335
X_{34} Farm Service Worker[a]	.0836	.3340
X_{35} White Collar Worker[a]	.0468	.3337
X_{36} Blue Collar Worker[a]	-.0188	.3339
X_{37} Service Worker[a]	-.0325	.3339
X_{38} Laborer[a]	-.1032	.3331
X_{39} Occupation Not Reported[d]	----	----
X_{40} No Occupation[a]	-.0142	.3340
Tenure		
X_{41} Owned[a]	.1415	.3191
X_{42} Rented[d]	----	----
X_{43} No Cash Rent[a]	.0280	.3339
Educational Level of Household Head		
X_{44} Educational Level if ≤ 10.5 Years[b]	.0172	.3292
X_{45} Educational Level if >10.5 Years[b]	.0057	.3308
Log. of Household Income for Households of Various Types		
X_{46} Unrelated Individuals (Slope)[b]	.0275	.3336
X_{47} Family (Intercept)[a]	-.0981	.3337
X_{48} Family (Slope)[b]	.0643	.3308
X_{49} Mixed (Intercept)[a]	-.2877	.3338
X_{50} Mixed (Slope)[b]	.1106	.3337
Dependency Ratio		
X_{51} Dependency Ratio[b]	-.0125	.3337
X_{52} No One 14-64[a]	.0103	.3340
$R^2 = .3304$		

[a]This variable is dichotomous equalling one if the stated condition holds, zero otherwise.

[b]This variable is continuous.

[c]The observation unit is the household and the variables pertain either to the household or to the head of household.

[d]This variable was omitted to avoid singularity.

Source: One-in-a-thousand sample tapes, 20 percent sample, 1960 Censuses of Population and Housing [36].

The size of place exhibits an estimated .405 effect on the probability that a housing unit has the desirable types of heating equipment. The rural farm and rural nonfarm residence categories have the lowest probability. The logarithm of the size of place is positively related to the probability that housing units have the desirable types of heating equipment. Housing units located in places of one million or more have an estimated .405 greater probability than those in the rural farm residence category. The housing units located in urban territories outside of places have an estimated .275 greater probability of possessing the desirable types of heating equipment than those located in the rural farm residence category.

The race of the household head variables account for an estimated .218 effect on the probability that a housing unit has the desirable types of heating equipment. The housing units occupied by white household heads have the highest probability followed by these race categories listed from the highest probability to the lowest: Negro, white with a Spanish surname, and other race. The race category, Negro household head, results in the lowest probability that the housing unit has desirable housing characteristics for most measures of housing condition. However, with this measure, Negro has the next to highest probability for the housing units containing the desirable types of heating equipment.

The education of the household head exhibits an estimated .275 effect on the probability that the housing unit has the desirable types of heating equipment. The effect on the probability ranges from zero with no education to .275 with five or more years of college. The relationship between zero and ten and a half years of education is greater than for education beyond that point.

The household income for various types of households exhibits a pattern of estimated net relationships which has been observed before. The logarithm of household income for mixed households exhibits the strongest positive relationship with the probability that the housing unit has the desirable type of heating equipment, followed by households composed of families and then households of unrelated individuals. At zero levels of household income, mixed households exhibit the lowest, households composed of families next, and households of unrelated individuals the highest estimated probability of enjoying this desirable housing characteristic.

An examination of the R^2 deletes reveals that one other variable, not discussed above, has a substantial effect on the percentage of the dependent variable explained. If owned, X_{41} were omitted from the model the total R^2 would decrease by .015. The estimated net relationships between these and other variables and the probability that a housing unit contains the desirable types of heating equipment may be observed in Table IV-9.

Y_9: Exclusive Access to Kitchen Facilities

The dependent variable for this next model indicates if the housing unit provides exclusive access to kitchen facilities. As indicated in Table IV-10, only 7.12 percent of the total variation in this dependent variable was explained by the predetermined

TABLE IV-10.--Estimated Net Relationships Between Socio-economic and Locational Characteristics of the Occupants and Exclusive Access to Kitchen Facilities

Predetermined Variables[c]		Regression Coefficient	R^2 Deletes
	Constant Term	.9273	
Region of the United States			
X_1	Northeast[a]	.0007	.0712
X_2	North Central[d]	----	----
X_3	South[a]	.0038	.0711
X_4	West[a]	.0011	.0712
Size of Place			
X_5	Rural Farm[a]	-.0141	.0711
X_6	Rural Nonfarm[a]	-.0118	.0712
X_7	Urban Territory Outside of Places[a]	-.0133	.0712
X_8	Log. of the Size of Place (Population)[b]	-.0035	.0711
Location Within Urbanized Area			
X_9	In a Central City[a]	.0013	.0712
X_{10}	In Remainder of Urbanized Area[d]	----	----
Age of Household Head			
X_{11}	Age[b]/10	-.0185	.0711
X_{12}	Age Squared[b]/1,000	.0429	.0711
X_{13}	Age Cubed[b]/100,000	-.0307	.0710
Sex of Household Head			
X_{14}	Male[d]	----	----
X_{15}	Female[a]	.0417	.0592
Race of Household Head			
X_{16}	White With Spanish Surname[a]	-.0030	.0712
X_{17}	White[d]	----	----
X_{18}	Negro[a]	-.0068	.0710
X_{19}	Other Race[a]	-.0390	.0709
Nativity and Parentage of Household Head			
X_{20}	Native With Native Parents[d]	----	----
X_{21}	Native With One Foreign Parent[a]	-.0003	.0712
X_{22}	Native With Foreign Parents[a]	-.0023	.0712
X_{23}	Foreign Born[a]	-.0004	.0712
Metropolitan Residence in 1955			
X_{24}	Same House[d]	----	----
X_{25}	Different House Same County[a]	-.0020	.0712
X_{26}	Different County Same State[a]	-.0038	.0712
X_{27}	Contiguous State[a]	-.0119	.0710
X_{28}	Noncontiguous State[a]	-.0082	.0710
X_{29}	Abroad or at Sea[a]	-.0043	.0712

TABLE IV-10.--Continued

Predetermined Variables[c]	Regression CCoefficient	R^2 Deletes
Occupational Classification		
X_{30} Farmer[a]	.0147	.0710
X_{31} Farm Manager[a]	.0195	.0712
X_{32} Farm Foreman[a]	.0208	.0712
X_{33} Farm Laborer[a]	.0156	.0710
X_{34} Farm Service Worker[a]	.0372	.0712
X_{35} White Collar Worker[a]	.0095	.0710
X_{36} Blue Collar Worker[a]	.0106	.0710
X_{37} Service Worker[a]	-.0095	.0711
X_{38} Laborer[a]	.0057	.0712
X_{39} Occupation Not Reported[d]	----	----
X_{40} No Occupation[a]	.0077	.0711
Tenure		
X_{41} Owned[a]	.0169	.0675
X_{42} Rented[d]	----	----
X_{43} No Cash Rent[a]	.0043	.0712
Educational Level of Household Head		
X_{44} Educational Level if $\leq$10.5 Years[b]	-.0001	.0712
X_{45} Educational Level if >10.5 Years[b]	.0001	.0712
Log. of Household Income for Households of Various Types		
X_{46} Unrelated Individuals (Slope)[b]	.0007	.0712
X_{47} Family (Intercept)[a]	.0654	.0691
X_{48} Family (Slope)[b]	.0060	.0707
X_{49} Mixed (Intercept)[a]	.0469	.0712
X_{50} Mixed (Slope)[b]	.0087	.0712
Dependency Ratio		
X_{51} Dependency Ratio[b]	.0011	.0712
X_{52} No One 14-64[a]	.0132	.0706
R^2 = .0712		

[a]This variable is dichotomous equalling one if the stated condition holds, zero otherwise.

[b]This variable is continuous.

[c]The observation unit is the household and the variables pertain either to the household or to the head of household.

[d]This variable was omitted to avoid singularity.

Source: One-in-a-thousand sample tapes, 20 percent sample, 1960 Censuses of Population and Housing [36].

variables. Four sets of socio-economic and locational characteristics exhibit effects which exceed .040 on the probability that the housing unit contains this desirable housing characteristic. They are: age of the household head, sex, occupational classification, and household income. For the other models discussed in this chapter which have binary dependent variables, the criterion of a .200 estimated effect or greater was used to choose those sets of characteristics which have the greatest effects.

The age of the household head exhibits a relationship to the probability that the household enjoys exclusive access to kitchen facilities which first decreases and then increases as age increases from 15 to approximately 65. This first variation in probability stays within narrow limits, a range of less than .006. After age 65 the probability that the household enjoys this desirable housing characteristic decreases at an increasing rate. This relationship is computed and presented in Table V-3.

The sex of the household head exhibits an estimated .042 net effect on this desirable housing characteristic. A household with a female head has a .042 higher probability of enjoying exclusive access to kitchen facilities than a household with a male head.

The occupational classifications of the household head exhibit a different estimated pattern of relationships than those exhibited with other dependent variables. The classifications are listed here from the one with the highest estimated probability to the lowest: farm service worker, farm foreman, farm manager, farm laborer, farmer, blue collar worker, white collar worker, no occupation, laborers, occupation not reported, and service worker. These classifications represent an estimated .047 probability range from highest to lowest.

Household income also exhibits a different pattern of relationships with the probability of exclusive access to kitchen facilities than has occurred previously. At zero income households composed of families have the lowest estimated probability, households composed of unrelated individuals next, and mix households exhibited the highest probability. The relative magnitudes between the logarithm of household income and the probability of this desirable housing characteristic, however, is the same as the pattern commonly observed. It is the greatest for mixed households, less for households composed of families, and the least for households composed of unrelated individuals.

These sets of socio-economic and locational characteristics have the strongest estimated relationships with this dependent variable. These and other relationships may be observed in Table IV-10.

Y_{10}: Telephone Available

The dependent variable for the last model of this section indicates the availability of a telephone. As presented in Table IV-11, 23.0 percent of variation in this dependent variable is explained by the regressors. Four sets of socio-economic and locational characteristics exhibit an estimated effect on the probability that the household has a telephone available greater than that of other sets of characteristics. They are: age of the household head,

TABLE IV-11.--Estimated Net Relationships Between Socio-economic and Locational Characteristics of the Occupants and Telephone Available

Predetermined Variables[c]		Regression Coefficient	R^2 Deletes
	Constant Term	-.1920	
Region of the United States			
X_1	Northeast[a]	-.0223	.2296
X_2	North Central[d]	----	----
X_3	South[a]	-.1063	.2209
X_4	West[a]	-.0318	.2293
Size of Place			
X_5	Rural Farm[a]	-.0990	.2296
X_6	Rural Nonfarm[a]	-.1038	.2296
X_7	Urban Territory Outside of Places[a]	.0075	.2299
X_8	Log. of the Size of Place (Population)[b]	.0008	.2299
Location Within Urbanized Area			
X_9	In a Central City[a]	.0134	.2299
X_{10}	In Remainder of Urbanized Area[d]	----	----
Age of Household Head			
X_{11}	Age[b]/10	.2768	.2281
X_{12}	Age Squared[b]/1,000	.4859	.2286
X_{13}	Age Cubed[b]/100,000	.2798	.2289
Sex of Household Head			
X_{14}	Male[d]	----	----
X_{15}	Female[a]	.0520	.2286
Race of Household Head			
X_{16}	White With Spanish Surname[a]	-.1234	.2287
X_{17}	White[d]	----	----
X_{18}	Negro[a]	-.1201	.2245
X_{19}	Other Race[a]	-.0150	.2299
Nativity and Parentage of Household Head			
X_{20}	Native With Native Parents[d]	----	----
X_{21}	Native With One Foreign Parent[a]	.0283	.2296
X_{22}	Native With Foreign Parents[a]	.0227	.2296
X_{23}	Foreign Born[a]	.0332	.2295
Metropolitan Residence in 1955			
X_{24}	Same House[d]	----	----
X_{25}	Different House Same County[a]	-.0183	.2296
X_{26}	Different County Same State[a]	-.0260	.2297
X_{27}	Contiguous State[a]	-.0352	.2298
X_{28}	Noncontiguous State[a]	-.0467	.2294
X_{29}	Abroad or at Sea[a]	-.0294	.2299

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TABLE IV-11.--Continued

Predetermined Variables[c]		Regression Coefficient	R^2 Deletes
Occupational Classification			
X_{30}	Farmer[a]	.0199	.2299
X_{31}	Farm Manager[a]	.1042	.2299
X_{32}	Farm Foreman[a]	.1433	.2298
X_{33}	Farm Laborer[a]	-.1505	.2287
X_{34}	Farm Service Worker[a]	.0060	.2299
X_{35}	White Collar Worker[a]	.0829	.2288
X_{36}	Blue Collar Worker[a]	.0284	.2298
X_{37}	Service Worker[a]	.0258	.2298
X_{38}	Laborer[a]	-.0519	.2296
X_{39}	Occupation Not Reported[d]	----	----
X_{40}	No Occupation[a]	-.0018	.2299
Tenure			
X_{41}	Owned[a]	.1481	.2087
X_{42}	Rented[d]	----	----
X_{43}	No Cash Rent[a]	.0338	.2297
Educational Level of Household Head			
X_{44}	Educational Level if $\leq$10.5 Years[b]	.0219	.2199
X_{45}	Educational Level if >10.5 Years[b]	.0034	.2285
Log. of Household Income for Households of Various Types			
X_{46}	Unrelated Individuals (Slope)[b]	.0385	.2290
X_{47}	Family (Intercept)[a]	-.0633	.2298
X_{48}	Family (Slope)[b]	.0884	.2221
X_{49}	Mixed (Intercept)[a]	-.3545	.2296
X_{50}	Mixed (Slope)[b]	.1650	.2291
Dependency Ratio			
X_{51}	Dependency Ratio[b]	-.0215	.2287
X_{52}	No One 14-64[a]	-.0008	.2299
R^2 = .2299			

[a]This variable is dichotomous equalling one if the stated condition holds, zero otherwise.

[b]This variable is continuous.

[c]The observation unit is the household and the variables pertain either to the household or to the head of household.

[d]This variable was omitted to avoid singularity.

Source: One-in-a-thousand sample tapes, 20 percent sample, 1960 Censuses of Population and Housing [36].

occupational classification, education of the household head, and household income.

The age of the household head exhibits a .392 increase in the probability that the household has a telephone available for a 100-year-old household head over a 15-year-old household head. The relationship, which is presented in Table V-3, first increases at a decreasing rate, reaches a plateau at about age 45 where it decreases slightly, and finally increases from about age 75 on.

The occupational classification of the household head exhibits an estimated .294 range between the occupational classification with the highest probability of having a telephone available, farm foreman, and the one with the lowest, farm laborer. The pattern of relationships with this dependent variable is different from that with any of the other dependent variables and will be discussed in Chapter V.

The education of the household head accounts for an estimated .286 increase in the probability that a telephone is available as education goes from zero to five years of college or more. The positive relationship is linear with a greater slope between zero and ten and a half years of education than beyond ten and a half years. The R^2 deletes indicate that the percentage of the variation in the dependent variable that is explained would decrease by 1.00 if X_{44} were removed.

Household income exhibits a very familiar pattern of relationships with this dependent variable. The relationships between the logarithm of the household income and the probability that a telephone is available is positive with the greatest slope for mixed households, next for households composed of families and the smallest for households composed of unrelated individuals. At zero or negative income households composed of unrelated individuals have the highest probability of having a telephone available, households composed of families next, and mixed households, the lowest probability.

The R^2 deletes indicate that two variables, not previously discussed, may explain a substantial proportion of the total variation in the dependent variable. Omitting owned, X_{41} from the model would reduce R^2 by .021. Owner occupied housing units have a .148 greater probability of having a telephone available than renter-occupied units. The other variable which indicates the South, X_3 and has a negative relationship with the dependent variable, if omitted from the model would reduce R^2 by .009.

The estimated relationships just discussed and others which appear less substantial are presented in Table IV-11.

Conclusions

The ten models discussed in this section have a common set of independent variables. These independent variables included thirteen sets of socio-economic and locational variables which were defined in the first part of the chapter. The ten binary dependent variables, which were also defined earlier, are derived from the measures of housing condition which are included in our INDEX discussed in Chapter II. The purpose of this section has been to examine the estimated net relationships between the socio-economic and locational characteristics of the occupants and measures of housing condition.

Specifically we have examined the relationships between those four, five, or six sets of socio-economic and locational characteristics which exhibit the strongest estimated net relationships with the measures of housing condition.

In nine of the ten models examined, household income was among the sets of variables with the strongest estimated net relationships. Only in the model with the binary dependent variable, built from 1950 to 1960, was household income not among the sets of primary explanatory variables. The set of variables describing household income was defined to allow for a different intercept and slope for each of the three types of households--unrelated individuals, families, and mixed. The relationships were generally strongest for mixed households, next for households composed of families, and weakest for households composed of unrelated individuals.

Another set of variables which exhibited consistently strong relationships with the measures of housing condition was the occupational classification of the household head. This set was listed among the sets of primary explanatory variables for all but two of the dependent variables--six rooms or more and built from 1950 to 1960.

The set of variables describing the education of the household head were also frequently among the primary explanatory variables, for seven of the ten models.

Several other sets of socio-economic and locational characteristics which appeared among the primary explanatory variables less frequently are listed here from the ones which appeared more frequently to those which appeared less frequently: age of the household head (five of the ten models), size of place (four of the ten models), dependency (three of the ten models), type of tenure (two of the ten models), and race (one of the ten models).

The three sets of characteristics which appear to consistently have the strongest estimated net relationships with measures of housing condition are: household income, occupational classification and education of the household head.

The form of these and other relationships with the different measures of housing condition will be presented and discussed in Chapter V. At the same time these estimated net relationships will be compared to the estimated gross relationships presented in Chapter III. In the next section of this chapter, a model, which includes the same explanatory variables as were used in the ten models of this section and the INDEX constructed in Chapter II as dependent variables, is discussed.

Net Relationship with INDEX

In this section we will be examining the estimated net relationships between the socio-economic and locational variables defined in the first part of this chapter and the measure of housing condition constructed in Chapter II--INDEX. This model has more desirable properties than the models of the previous section. The error terms for this model are assumed to be both homoskedastic and normally distributed in addition to the desirable assumptions of the previous models. The assumptions of this model are described more fully in Appendix III. The resulting OLS estimates of the regression coefficients are unbiased, efficient, and consistent.

The empirical results presented include OLS estimates of the regression coefficients, estimated standard errors for the coefficients, the level of significance at which the null hypothesis that the coefficient is equal to zero is rejected, and the R^2 delete for each coefficient. As was the case with the ten previous models the R^2 deletes are somewhat misleading. Because a certain amount of multicollinearity exists between the predetermined variables, the R^2 deletes are overstated. When an R^2 delete is calculated for a particular variable, only part of the effect of that variable is removed. Depending upon the degree of multicollinearity varying proportions of the effect of the omitted variable are picked up by the included variables with which it is correlated.

Several statistics are included which relate to the total model: R^2, F, and significance level for the null hypothesis that all estimated coefficients equal zero and the standard error of estimate.

Empirical Results

The empirical results presented in Table IV-12 indicate that 44.9 percent of the total variation in INDEX was explained by the predetermined variables. This means that more than half of the variation in the dependent variable is not explained. The relationship between the predetermined variables and INDEX is significant at <.0005 level of significance.

TABLE IV-12.--Estimated Net Relationships Between Socio-economic and Locational Characteristics of the Occupants and INDEX

	Predetermined Variables[c]	Regression Coefficient	Standard Error	Level of Significance	R^2 Deletes
	Constant Term	42.7146	1.1226	<.0005	
Region of the United States					
X_1	Northeast[a]	1.0109	.1049	<.0005	.4475
X_2	North Central[d]	---	---	---	---
X_3	South[a]	- 1.6701	.1025	<.0005	.4452
X_4	West[a]	.5942	.1199	<.0005	.4484
Size of Place					
X_5	Rural Farm[a]	- 2.2784	.5122	<.0005	.4485
X_6	Rural Nonfarm[a]	- .8000	.4835	.094	.4487
X_7	Urban Territory Outside of Places[a]	4.6818	.5065	<.0005	.4476
X_8	Log. of the Size of Place (Population)[b]	.8189	.1115	<.0005	.4480
Location Within Urbanized Area					
X_9	In a Central City[a]	- .5635	.1725	.001	.4486
X_{10}	In Remainder of Urbanized Area[d]	---	---	---	---
Age of Household Head					
X_{11}	Age[b]/10	4.9949	.5945	<.0005	.4478
X_{12}	Age Squared[b]/1,000	- 8.7851	1.2153	<.0005	.4481
X_{13}	Age Cubed[b]/100,000	4.8088	.7876	<.0005	.4483
Sex of Household Head					
X_{14}	Male[d]	---	---	---	---
X_{15}	Female[a]	.6401	.1281	<.0005	.4484
Race of Household Head					
X_{16}	White With Spanish Surname[a]	- 2.8069	.3219	<.0005	.4477
X_{17}	White[d]	---	---	---	---
X_{18}	Negro[a]	- 4.5974	.1491	<.0005	.4362
X_{19}	Other Race[a]	- 3.8722	.6931	<.0005	.4483
Nativity and Parentage of Household Head					
X_{20}	Native With Native Parents[d]	---	---	---	---
X_{21}	Native With One Foreign Parent[a]	.5540	.1518	<.0005	.4486
X_{22}	Native With Foreign Parents[a]	.4240	.1215	.001	.4486
X_{23}	Foreign Born[a]	1.7184	.1496	<.0005	.4470
Metropolitan Residence in 1955					
X_{24}	Same House[d]	---	---	---	---
X_{25}	Different House Same County[a]	2.0423	.0935	<.0005	.4424
X_{26}	Different County Same State[a]	2.8674	.1571	<.0005	.4443
X_{27}	Contiguous State[a]	2.8926	.2409	<.0005	.4468
X_{28}	Noncontiguous State[a]	3.2813	.1812	<.0005	.4444
X_{29}	Abroad or at Sea[a]	2.8801	.3420	<.0005	.4478

TABLE IV-12.--Continued

Predetermined Variables[c]	Regression Coefficient	Standard Error	Level of Significance	R^2 Deletes
Occupational Classification				
X_{30} Farmer[a]	- 1.0870	.3148	.001	.4486
X_{31} Farm Manager[a]	5.0836	1.6100	.002	.4486
X_{32} Farm Foreman[a]	2.9087	1.4351	.040	.4487
X_{33} Farm Laborer[a]	- 5.3991	.3969	<.0005	.4463
X_{34} Farm Service Worker[a]	- .2788	2.8897	.886	.4488
X_{35} White Collar Worker[a]	1.5713	.2283	<.0005	.4481
X_{36} Blue Collar Worker[a]	- .0063	.2261	.927	.4488
X_{37} Service Worker[a]	- .3585	.2554	.156	.4487
X_{38} Laborer[a]	- 2.7170	.2737	<.0005	.4474
X_{39} Occupation Not Reported[d]	---	---	---	---
X_{40} No Occupation[a]	- .3381	.2643	.198	.4487
Tenure				
X_{41} Owned[a]	5.8115	.0930	<.0005	.3971
X_{42} Rented[d]	---	---	---	---
X_{43} No Cash Rent[a]	- .9059	.2116	<.0005	.4485
Educational Level of Household Head				
X_{44} Educational Level if ≤10.5 Years[b]	.7527	.0200	<.0005	.4301
X_{45} Educational Level if >10.5 Years[b]	.1018	.0081	<.0005	.4467
Log. of Household Income for Households of Various Types				
X_{46} Unrelated Individuals (Slope)[b]	.7579	.1129	<.0005	.4482
X_{47} Family (Intercept)[a]	- 2.1757	.4796	<.0005	.4485
X_{48} Family (Slope)[b]	2.5145	.0914	<.0005	.4387
X_{49} Mixed (Intercept)[a]	-14.3745	1.9147	<.0005	.4480
X_{50} Mixed (Slope)[b]	5.7945	.5108	<.0005	.4470
Dependency Ratio				
X_{51} Dependency Ratio[b]	- .1677	.0564	.003	.4486
X_{52} No One 14-64[a]	.4948	.1764	.005	.4486

$R^2 = .4488$

F = 770.0456

Significance Level = <.0005

Standard Error of Estimate = 7.6206

[a]This variable is dichotomous equalling one if the stated condition holds, zero otherwise.

[b]This variable is continuous.

[c]The observation unit is the household and the variables pertain either to the household or to the head of household.

[d]This variable was omitted to avoid singularity.

Source: <u>One-in-a-thousand sample</u> tapes, 20 percent sample, 1960 Censuses of Population and Housing [36].

Most of the individual coefficient estimates are significantly different from zero at <.0005 level of significance. Only four estimates are not significantly different from zero at <.05 level of significance: farm service worker (X_{34}), blue collar worker (X_{36}), service worker (X_{37}), and no occupation (X_{40}). All of these variables are within the set called occupational classification. Thus even though less than half of the variation in the dependent variable is explained, most variables have an estimated effect which is significantly different from zero.

The sets of variables which are the primary explanatory variables as would be expected are the same as those for the ten models of the last section: household income, occupational classification, and education of the household head. Four other sets of characteristics have relatively strong relationships to INDEX. They are listed here from the sets with the larger to the sets with smaller relationships: size of place, type of tenure, race and age of the household head. The direction and magnitude of these relationships will be discussed in Chapter V where comparisons will be made between the relationships exhibited in this model and the ten models of the previous section. In the next section of this chapter, the INDEX will be examined for weight sensitivity. This process will provide some information about the validity of the estimated coefficients for the model presented in Table IV-12 as well as the validity of INDEX as a measure of housing condition.

Weight Sensitivity of the INDEX

Ideally we would like to examine the basic question of how well INDEX measures housing condition. However, we will instead examine this INDEX for weight sensitivity. More specifically we will be asking if the INDEX is weight sensitive, as used in this study. The INDEX is the regressand in a multiple regression model (previous section of this chapter) which is used to estimate the net relationships between thirteen sets of socio-economic and locational characteristics of the occupants and housing condition. The question is, "Are the estimated net relationships dependent upon the weighting system used to construct the INDEX?"

Procedure

In order to examine this question, we use the regression model of the previous section. Twenty different weighting systems are used to construct twenty versions of the INDEX. These are then used one at a time as regressands with the common set of socio-economic and locational characteristics of the occupants as regressors. The differences in parameter estimates are used as an indication of the sensitivity of the INDEX to weight changes.

Hypothesis

We assume that if the INDEX is not weight sensitive that the parameter estimates will change very little as weighting systems are changed. This hypothesis creates a measurement problem. How much should a parameter vary and how many parameters can vary before the INDEX is judged weight sensitive?

A measure was developed to describe the relative size of the range in parameter estimates. For a specific range in parameter estimates

$$\left| \frac{M_x - M_n}{(M_x + M_n)/2} \right| \equiv R/M$$

where:

M_x = the maximum parameter estimate, and

M_n = the minimum parameter estimate.

R/M is the absolute value of the range divided by the mid-point of the range. Thus it measures the size of the range relative to its mid-point. This is justified on the assumption that the approximate importance of a certain size range is inversely proportional to the absolute value of the parameter estimates. R/M does not provide any answers as to how large a change should be tolerated but does provide a way of measuring the relative change.

The Models

We will next discuss the models used to examine the question of weight sensitivity. First, the dependent variables used in the multiple regression models are presented, then the predetermined variables.

Endogenous Variables

Twenty different sets of weighting systems are used to form twenty different regressands, INDEX 1 through INDEX 20. The measures of housing condition and the values allotted for the levels of housing condition are presented in Table II-3. INDEX 1 through INDEX 20 are constructed as follows:

$$\text{INDEX } i = \sum_{j=1}^{10} W_j V_j$$

where:

i = the ith weighting system for the INDEX.

j = the number of the condition measure as listed in Table II-3.

V_j = the value allowed for the jth condition measure as listed in Table II-3.

W_j = the weight given to the jth condition measure.

The weighting system for INDEX 1 through INDEX 20 are presented below.

INDEX 1	$W_1 = 0$	$W_j = 1$	$j \neq 1$
INDEX 2	$W_2 = 0$	$W_j = 1$	$j \neq 2$
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INDEX 10	$W_{10} = 0$	$W_j = 1$	$j \neq 10$
INDEX 11	$W_1 = 3$	$W_j = 1$	$j \neq 1$
INDEX 12	$W_2 = 3$	$W_j = 1$	$j \neq 2$
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.			
.			
INDEX 20	$W_{10} = 3$	$W_j = 1$	$j = 10$

In INDEX 1 through INDEX 10, referred to as the first group, each of the measures of housing condition is set to zero in one INDEX. Each INDEX i represents the sum of all measures of housing condition, except the ith. In INDEX 11 through INDEX 20, referred to as the second group, the value assigned for each measure is multiplied, one at a time, by a factor of three. For this group, INDEX i is three times the (i - 10)th measure of housing condition plus the sum of the other measures. These twenty different weighting systems are used to form the twenty regressands, INDEX 1 through INDEX 20, used in the models here.

Predetermined Variables

A common set of predetermined variables is used for all twenty models. This set is with two exceptions identical to the regressors presented in the Model Specification section of this chapter. The two differences have to do with the specification of the income variables and the education variables.

Education is described by two binary variables:

X_{44} = the number of years of formal education if less than or equal to 10.5 years
0 otherwise

X_{45} = the number of years of formal education if greater than 10.5 years
0 otherwise

This error in the specification of X_{44} results in the estimation of two linear relationships between housing condition and the education of the household head, one for less than or equal to 10.5 years of education and one for greater than 10.5 years of education. This is not a realistic specification because both relationships are forced through the same intercept. The specification discussed in the section, Model Specification, provides for a continuous relationship with a change in the slope at 10.5 years of education.

This error in specification means that the parameter estimates are not valid descriptions of the relationships between education and housing condition. However, it is believed that they will provide information on the weight sensitivity of the INDEX with respect to education.

The other specification error in these models involves the variables used to describe income. X_{47} and X_{49} have been omitted from the models. As was discussed in the section, Model Specification, the intention was to allow for a slope and intercept difference in the log-linear relationships between household income and housing condition for each type of household. The omission of these two binary variables forces the relationships for each of the three types of households through the same intercept.

This error in specification means that the resulting parameter estimates are not representative of the structural relationship between household income and housing condition. However, as is the case with the education variables, the parameter estimates are believed to provide information on the weight sensitivity of the INDEX with respect to household income.

The assumptions regarding the error terms for these models and the properties of the ordinary least squares estimates of the regression parameters are presented in Appendix III. The parameter estimates are assumed to have the desirable small sample and large sample properties.

Empirical Results

The parameter estimates presented here are the maximum and the minimum estimates for each variable for INDEX 1 through INDEX 10, the first group, and for INDEX 11 through INDEX 20, the second group. Also, R/M has been calculated and is presented for each maximum and minimum. Each model produced at least one maximum or minimum. Two models produced three maximums or minimums and the other sixteen models produced six or more maximums or minimums. The empirical results are presented in Table IV-13 and Table IV-14.

Six of the thirteen sets of socio-economic and locational characteristics contain variables whose parameter estimates are sensitive to weight changes in INDEX. (1) Among the region of the United States variables, West exhibits a parameter sign change with the first and second groups of indexes. South exhibits a parameter sign change with the second group of indexes. (2) Among the size of place variables, the rural nonfarm residence category exhibits a parameter sign change with the second group of indexes and a R/M value of 1.998 with the first group of indexes. (3) Among the location within an urbanized area variables, in a central city exhibits a parameter sign change with the first group of indexes and a R/M value exceeding one with the second group of indexes. (4) Among the occupational classification variables, two exhibit parameter sign changes with both the first and second groups of indexes, farm service worker and blue collar worker. The variable, no occupation, exhibits a parameter sign change with the second group of indexes. The variables, farmer and service worker, both exhibit R/M values

TABLE IV-13.--Maximum and Minimum Multiple Regression Parameter Estimates from the Twenty Models With Changing Index Weights, Condition Index = f (Socio-economic and Locational Characteristics of the Occupants)

Predetermined Variables[c]		First Group INDEX 1--INDEX 10			Second Group INDEX 11--INDEX 20		
		Maximum	Minimum	Range/ Mid-Point of Range	Maximum	Minimum	Range/ Mid-Point of Range
	Constant Term	42.7661	32.3170	.278	61.9425	41.0442	.406
Region of the United States							
X_1	Northeast[a]	1.2098	.7477	.472	1.4768	.5527	.911
X_2	North Central[d]	0	0	0	0	0	0
X_3	South[a]	- .1072	- 2.9094	1.858	.5651	- 5.0393	2.505[e]
X_4	West[a]	1.6080	- .4310	3.465[e]	2.7278	- 1.3502	5.5920[e]
Size of Place							
X_5	Rural Farm[a]	- 1.1309	- 3.0500	.918	- .9786	- 4.8169	1.325
X_6	Rural Nonfarm[a]	- .0007	- 1.7101	1.998	.7984	- 2.6204	3.753[e]
X_7	Urban Territory Outside[a]	5.3324	2.9383	.579	7.9597	3.1714	.860
X_8	Log. of the Size of Place (Population)[b]	.9611	.4999	.631	1.4105	.4880	.972
Location Within Urbanized Area							
X_9	In a Central City[a]	.1489	- .6970	3.087[e]	- .1825	- 1.8743	1.645
X_{10}	In Remainder of Urbanized Area[d]	0	0	0	0	0	0
Age of Household Head							
X_{11}	Age[b]	.5174	.3334	.403	.7873	.4193	.610
X_{12}	Age Squared[b]	- .0053	- .0092	.538	- .0075	- .0153	.684
X_{13}	Age Cubed[b]	.0001	.0000	2.000	.0001	.0000	2.000
Sex of Household Head							
X_{14}	Male[d]	0	0	0	0	0	0
X_{15}	Female[a]	1.0007	.5031	.662	1.3810	.3858	1.127
Race of Household Head							
X_{16}	White With Spanish Surname[a]	- 1.9144	- 2.9083	.412	- 2.9579	- 4.9457	.503
X_{17}	White[d]	0	0	0	0	0	0
X_{18}	Negro[a]	- 3.7892	- 4.7364	.222	- 4.8035	- 6.6978	.329
X_{19}	Other Race[a]	- 2.4825	- 3.9857	.465	- 4.0420	- 7.0485	.542

TABLE IV-13.--Continued

Predetermined Variables[c]	First Group INDEX 1--INDEX 10			Second Group INDEX 11--INDEX 20		
	Maximum	Minimum	Range/ Mid-Point of Range	Maximum	Minimum	Range/ Mid-Point of Range
Nativity and Parentage of Household Head						
X_{20} Native With Native Parent[d]	0	0	0	0	0	0
X_{21} Native With One Foreign Parent[a]	.6013	.4730	.239	.8504	.5938	.355
X_{22} Native With Foreign Parents[a]	.4922	.1446	1.092	.9747	.2794	1.109
X_{23} Foreign Born[a]	1.7226	1.3650	.232	2.2196	1.5045	.384
Metropolitan Residence in 1955						
X_{24} Same House[d]	0	0	0	0	0	0
X_{25} Different House Same County[a]	2.1942	.7789	.952	4.4953	1.6647	.919
X_{26} Different County Same State[a]	2.8691	1.1714	.840	5.7875	2.3922	.830
X_{27} Contiguous State[a]	2.8912	1.2786	.773	5.5133	2.2881	.827
X_{28} Noncontiguous State[a]	3.2768	1.2479	.897	6.5943	2.5365	.889
X_{29} Abroad or at Sea[a]	2.9810	1.0995	.922	5.8269	2.0640	.954
Occupational Classification						
X_{30} Farmer[a]	- .7293	- 1.6481	.773	- .1203	- 1.9579	1.768
X_{31} Farm Manager[a]	5.8473	3.5869	.479	7.6502	3.1294	.839
X_{32} Farm Foreman[a]	3.0884	2.0727	.394	4.2810	2.2496	.622
X_{33} Farm Laborer[a]	- 4.2709	- 5.5451	.260	- 5.3834	- 7.9320	.383
X_{34} Farm Service Worker[a]	1.0283	- .7879	15.110[e]	1.6038	- 2.0286	17.102[e]
X_{35} White Collar Worker[a]	1.3249	.9913	.288	1.9658	1.2986	.409
X_{36} Blue Collar Worker[a]	.1790	- .0065	2.151[e]	.2399	- .1311	6.820[e]
X_{37} Service Worker[a]	- .1637	- .4134	.865	- .1989	- .6983	1.113
X_{38} Laborer[a]	- 2.2707	- 2.7568	.193	- 2.7006	- 3.6728	.305
X_{39} Occupation Not Reported[d]	0	0	0	0	0	0
X_{40} No Occupation[a]	- .1495	- .7244	1.316	.3149	- .8349	4.422[e]
Tenure						
X_{41} Owned[a]	5.7902	4.2217	.313	9.1029	5.9660	.416
X_{42} Rented[d]	0	0	0	0	0	0
X_{43} No Cash Rent[a]	- .1859	- 1.5690	1.576	.1062	- 2.6600	2.166[e]
Educational Level of Household Head						
X_{44} Educational Level if $\leq$10.5 yrs.[b]	.7238	.5910	.202	.9903	.7247	.310
X_{45} Educational Level if >10.5 yrs.[b]	.6840	.5662	.188	.9212	.6857	.293

TABLE IV-13.--Continued

Predetermined Variables[e]	First Group INDEX 1--INDEX 10			Second Group INDEX 11--INDEX 20		
	Maximum	Minimum	Range/ Mid-Point of Range	Maximum	Minimum	Range/ Mid-Point Range
Log. of Household Income for Households of Various Types						
X_{46} Unrelated Individuals[b]	1.1885	.9328	.241	1.5959	1.0845	.382
X_{48} Family[b]	2.2711	1.9305	.162	3.0905	2.4093	.248
X_{50} Mixed[b]	2.2701	1.8567	.200	3.2071	2.3805	.296
Dependency Ratio						
X_{51} Dependency Ratio[b]	- .0091	- .5100	1.930	.3343	- .6675	6.013[e]
X_{52} No One 14-64[a]	.6648	.3066	.737	1.2140	.4974	.837

[a]This variable is dichotomous equalling one if the stated condition holds, zero otherwise.

[b]This variable is continuous.

[c]The observation unit is the household and the variables pertain either to the household or to the head of household.

[d]This variable was omitted to avoid singularity.

[e]The parameter estimates changed sign as the INDEX weights were changed.

Source: One-in-a-thousand sample tapes, 20 percent sample, 1960 Censuses of Population and Housing [36].

TABLE IV-14.--Frequency Distribution of the Parameter Ranges From Table IV-13 by Their R/M Value

R/M	GE 0 L .25	GE .25 L .5	GE .5 L .75	GE .75 L 1	GE 1 L 1.5	GE 1.5 L 2	No Parameter Changed Sign and GE 2	Parameter Changed Sign and GE 2	Total
First Group INDEX 1-10									
No. of Ranges	9	10	5	8	2	4	1	4	43
Percent of Ranges	20.9	23.3	11.6	18.6	4.7	9.3	2.3	9.3	100
Accumulative Percentage	100.0	79.1	55.8	44.2	25.6	20.9	11.6	9.3	
Second Group INDEX 11-20									
No. of Ranges	1	12	5	10	4	2	1	8	43
Percent of Ranges	2.3	27.9	11.6	23.3	9.3	4.7	2.3	18.6	100
Accumulative Percentage	100.0	97.7	69.8	58.2	34.9	25.6	20.9	18.6	
Total									
No. of Ranges	10	22	10	18	6	6	2	12	86
Percent of Ranges	11.6	25.6	11.6	20.9	7.0	7.0	2.3	14.0	100
Accumulative Percentage	100.0	88.4	62.8	51.2	30.3	23.3	16.3	14.0	

Note: GE means greater than or equal to. L means less than.

Source: This table is compiled from the information in Table II-L.

exceeding one with the second group of indexes. Other variables within this set have R/M values that are less than one. (5) Among the tenure variables, no cash rent, exhibits a R/M value of 1.576 with the first group of indexes and a parameter sign change with the second group of indexes. The R/M value for owned is less than .5 for both groups of indexes. (6) And last, among the dependency ratio variables, dependency ratio exhibits a R/M value of 1.930 with the first group of indexes and a parameter sign change with the second group of indexes.

Table IV-14 has been included to demonstrate the distribution of the R/M values. Thirty percent of the ranges of parameter estimates were wider than the absolute value of their mid-points. Sixteen and three-tenths percent of the parameters changed sign and had ranges greater than or equal to twice the absolute value of their mid-points.

Conclusions

In this section of Chapter IV, we have presented some evidence on the weight sensitivity of the INDEX as used in this study. Due to a measurement problem, we are unable to provide definitive tests of any hypotheses regarding the sensitivity of the INDEX. However, it is believed that the evidence presented indicates the INDEX is weight sensitive. The parameter estimates should not change sign and the R/M values probably should be less than one if the INDEX is not to be judged weight sensitive.

The fact that some parameter estimates changed very little indicates that those variables are related to each of our measures of housing condition in the same manner. It may also indicate that those parameter estimates are an accurate reflection of the relationships between those variables and housing condition in general.

Summary and Conclusions

The purpose of this chapter was a statistical presentation of the estimated net relationships between socio-economic and locational characteristics of the occupants and measures of housing condition. Several multiple regression models were used to estimate these relationships. The first regressions were used to estimate the net relationships with some of the individual measures of housing condition that constitute INDEX. Three sets of socio-economic and locational characteristics appear to be the primary determinants of housing condition: household income, occupational classification, and education of the household head. However, an examination of each model reveals that the primary determinants are different for each measure of housing condition.

In another model, INDEX was used as the dependent variable. The purpose was to examine the net relationships between socio-economic and location characteristics of the occupants and our measure of general housing condition. The same three sets of characteristics were found to be the primary explanatory variables.

This model, for which all of the classical assumptions of multiple regression are assumed to hold, provides for separate and collective statistical tests of the estimated coefficients. An examination of Table IV-12 reveals that most of the explanatory variables included exhibit a relationship significantly different from zero at <.0005 level of significance. For those which do not test different from zero, the relevant test is against one of the other estimated coefficients rather than zero. This is the case with the estimated coefficients for the variables describing occupational classifications. For example one may want to test the difference between the effects of the farm and white collar worker classifications rather than the difference between the effects of the farm classification and omitted variables.

This model was re-run twenty times while the weights on the measures of housing condition constituting INDEX were varied and the sets of parameters examined for weight sensitivity. It was found that INDEX is weight sensitive for several variables. That is as the weights were varied within INDEX, the estimated regression coefficients for some variables exhibited large changes and some changed sign.

Finding that INDEX is weight sensitive for some variables leads to several conclusions. First, research is needed to determine the set of weights which would make INDEX representative of general housing condition. There is no clear evidence that the set of weights presently used is that set. Secondly, the relationships with general housing condition for the variables whose coefficients changed sign or exhibited large variations are still unknown. Thirdly, for the variables whose coefficients exhibited little variation, the hypothesis that their coefficients represent the relationships with general housing condition is not refuted. However, this cannot be taken as strong evidence that the true relationships have been estimated. INDEX may not contain or represent some other important dimensions of housing condition.

In this chapter attention has been given to those sets of socio-economic and locational characteristics which appear to be the major determinants of housing condition. In Chapter V the nature of these relationships will be examined and compared to the estimated gross relationships.

CHAPTER V

NET RELATIONSHIPS BETWEEN SOCIO-ECONOMIC AND LOCATIONAL CHARACTERISTICS AND HOUSING CONDITION: NATURE OF THE RELATIONSHIPS

Introduction

In the previous chapter we have discussed the net relationships between socio-economic and locational characteristics of the occupants and several measures of housing condition including the aggregate measure of housing condition INDEX. Attention was given to those sets of characteristics which appeared to be major determinants of housing condition and how they varied depending upon the measure of housing condition used. Little attention was given to the specific nature of those relationships.

In this chapter attention is given to the nature of the estimated net relationships presented in Chapter IV between each set of socio-economic and locational characteristics and measures of housing condition. This process includes comparisons between these net relationships and the estimated gross relationships presented in Chapter III.

The estimated net relationships examined here are the regression coefficients presented in Chapter IV. The models used are specified and properties presented in that chapter and Appendix III. The binary dependent variables used in the models are presented in Table IV-1. INDEX which is used as the dependent variable in one of the models is defined in Chapter II.

Only eight of the ten binary dependent variables used to estimate net relationships are comparable with the desirable housing characteristics (Table III-1) used in Chapter III to estimate the gross relationships. As a consequence, only eight of the ten regression models with binary dependent variables are used in the comparisons between these relationships. The eight comparable housing characteristics are: six rooms or more (Y_1), structurally sound (Y_2), hot and cold water piped inside (Y_4), exclusive access to a bath or shower (Y_5), built from 1950 to 1960 (Y_6). one or more bathrooms (Y_7), heating equipment (Y_8), and exclusive access to kitchen facilities (Y_9).

As was noted in Chapter IV, care must be exercised when interpreting the estimated coefficients for binary independent variables. The coefficient for a particular binary variable represents the difference between the effect of the characteristic indicated by that variable and the effect of the characteristic indicated by the omitted variable. In each case where binary independent variables are used, the omitted variable will be indicated.

Empirical Results

The net relationships are presented in the same order that the thirteen sets of socio-economic and locational characteristics appear in the models of Chapter IV.

Regions of the United States

The estimated net relationships between the region of the United States and desirable housing characteristics are presented in Table V-1. The North Central region (X_2) has a coefficient of zero because this variable was dropped from each of the multiple regressions used to estimate these net relationships.

These estimated net relationships exhibit patterns similar to those exhibited by the estimated gross relationships. The "traditional" pattern of relationships is observed with structurally sound, exclusive access to a bath or shower and one or more bathrooms. With these three dependent variables, housing units located in the West (X_4) have the highest probability of possessing the desirable housing characteristics, those located in the Northeast (X_1) next, followed by those located in the North Central (X_2), and those located in the South (X_3) have the lowest probability. With five other dependent variables--six rooms or more (Y_1), not structurally dilapidated (Y_3), hot and cold water piped inside (Y_4), heating equipment (Y_8), and INDEX--the patterns observed are a variation of the "traditional" pattern. The housing units in the Northeast have the highest estimated probability of possessing the desirable housing characteristics, then those located in the North Central region, and last those located in the South. These patterns differ from the "traditional" because the housing units located in the West do not have the highest probability of possessing the desirable housing characteristics but have the second, third, or lowest probability.

TABLE V-1.--Estimated Net Relationships Between Regions of the United States and Measures of Housing Condition

	Measures of Housing Condition[a]	Regions of the United States		
		X_1 North East	X_3 South	X_4 West
Y_1	Six Rooms or More	.0858	- .0438	-.0800
Y_2	Structurally Sound	.0109	- .0216	.0119
Y_3	Not Structurally Dilapidated	.0023	- .0117	-.0043
Y_4	Hot and Cold Water Piped Inside	.0260	- .0660	.0254
Y_5	Exclusive Access to a Bath or Shower	.0336	- .0323	.0363
Y_6	Built From 1950 to 1960	- .0129	.0935	.0863
Y_7	One or More Bathrooms	.0336	- .0425	.0429
Y_8	Heating Equipment	.0599	- .3072	-.1293
Y_9	Exclusive Access to Kitchen Facilities	.0007	.0038	.0011
Y_{10}	Telephone Available	- .0223	- .1063	-.031
INDEX		1.0109	-1.6701	.5942

[a]These measures of housing condition are the binary dependent variables for the regressions from which the estimated coefficients are taken. Variables Y_1 - Y_{10} are presented in Table IV-1 and INDEX is defined in Chapter II.

Source: These estimated net relationships are the regression coefficients taken from Tables IV-2 through IV-12.

The second type of pattern is the "opposite" to the "traditional." Two variations of this pattern are exhibited. With the one the probability that the unit was built from 1950 to 1960 is highest in the South, next for the West followed by the North Central region, with units in the Northeast having the lowest probability. The second variation appears with the dependent variable, exclusive access to kitchen facilities. In this variation the relative positions of the Northeast and North Central regions are reversed.

A third pattern of relationship exhibits itself with only one of the dependent variables, telephone available (Y_{10}). Housing units located in the North Central region have the highest probability of having a telephone available, those located in the Northeast next, followed by those located in the West and those located in the South having the lowest probability.

Depending upon which measure of housing condition is chosen, housing units located within any one of the regions of the United States can be shown to have either the highest or lowest probability of possessing the desirable housing characteristic. This was true as well for the estimated gross relationships. With the varied patterns of relationships between the regions of the United States and measures of housing condition, it is not surprising to find the estimated coefficients for South and West changing sign as the weights on the components of the INDEX are varied in the last section of Chapter IV.

Although this variety of relationships exists, the pattern of relationships exhibited with INDEX, the aggregate measure of housing condition, seems to predominate.

Comparison Between Estimated Gross and Net Relationships

Only a portion of these estimated net relationships (Table V-1) can be compared to the estimated gross relationships (Table III-3). This is true because gross relationships were not estimated with not structurally dilapidated, telephone available, or INDEX. Of the eight measures of housing for which there are estimated gross and net relationships, six exhibit identical patterns of relationships. That is housing units located in the same regions have the highest probability of possessing the desirable housing characteristics and so on. With two of the desirable housing characteristics, hot and cold water piped inside and exclusive access to kitchen facilities, the estimated net and gross relationships are close to being the same.

In general, the estimated gross effects of regions of the United States upon measures of housing conditions are greater than the estimated net effects. The concept, "range of effects," was developed to assess the relative magnitude of the estimated gross and net effects. The "range of effects" for the gross relationships is the difference between the highest and the lowest percentage of housing units possessing the desirable housing characteristics. For example, 87.6 percent of the units located in the West and 74.9 percent of the units located in the South are structurally sound. The gross "range of effects" for structurally sound is the difference, or 12.7 percent. Although this number is in percent, it is interpreted as a probability for comparison with the net "range of effects." Units located in the West have a .127 greater probability of being structurally sound than units located in the South. The "range of effects" for the net relationships, which is already expressed as a probability, is the difference between the highest and the lowest probability that the housing unit possesses the desirable housing characteristics. For example, the net "range of effects" is .034 for structurally sound. That is, units located in the West have a .034 greater probability of being sound than units located in the South.

The "range of effects" of regions of the country are greater than the net "range of effects" for all desirable housing characteristics except six rooms or more.

Size of Place

The estimated net relationships between the size of place variables and measures of housing condition are presented in Table V-2 along with the estimated net relationships for location within an urbanized area. The two sets of relationships will be discussed separately.

Two patterns of relationships emerge with the three binary explanatory variables within the set of size of place variables. With six of the desirable housing characteristics--structurally sound, hot and cold water piped inside, exclusive access to a bath or shower, built from 1950 to 1960, one or more bathrooms, and heating equipment--the pattern of relationships is the same as exhibited with INDEX. That is housing units located in urban territories outside of places (X_7) have the highest probability of possessing the

TABLE V-2.--Estimated Net Relationships Between Size of Place and Location Within an Urbanized Area and Measures of Housing Condition

Measures of Housing Condition[a]	Size of Place				
	X_5 Rural Farm	X_6 Rural Nonfarm	X_7 Urban Territories Outside Places	X_8 Logarithm of the Size of Place	X_9 In a Central City
Y_1 Six Rooms or More	.0342	- .0970	- .1083	- .0250	-.0237
Y_2 Structurally Sound	.0655	.0886	.1740	.0375	-.0220
Y_3 Not Structurally Dilapidated	.0661	.0298	.0509	.0130	.0021
Y_4 Hot and Cold Water Piped Inside	- .0372	.0235	.1126	.0277	.0136
Y_5 Exclusive Access to a Bath or Shower	- .0899	- .0542	.0882	.0206	.0079
Y_6 Built From 1950 to 1960	- .0273	.0779	.2117	.0139	-.0734
Y_7 One or More Bathrooms	- .0594	- .0183	.1312	.0308	-.0010
Y_8 Heating Equipment	.1677	.2350	.4431	.0955	-.0668
Y_9 Exclusive Access to Kitchen Facilities	- .0141	- .0118	- .0133	- .0035	.0013
Y_{10} Telephone Available	- .0990	- .1038	.0075	.0008	.0134
INDEX	-2.2784	- .8000	4.6818	.8189	-.5635

[a]These measures of housing condition are the binary dependent variables for the regressions from which the estimated coefficients are taken. Variables Y_1 - Y_{10} are presented in Table IV-1 and INDEX is defined in Chapter II.

Source: These estimated net relationships are the regression coefficients taken from Tables IV-2 through IV-12.

desirable housing characteristics, those with rural nonfarm (X_6) residency next, and those with rural farm (X_5) residency having the lowest. Variations of this pattern are found with two of the dependent variables--exclusive access to kitchen facilities and telephone available.

The second pattern of relationships is the opposite of the first. Housing units in the rural farm residence category have the highest probability of possessing the desirable housing characteristics, those located in the rural nonfarm residence category next, and those located in urban territories outside of places have the lowest probability. This pattern of relationships is observed with the desirable housing characteristics, six rooms or more. A variation of this pattern of relationships is observed with the housing characteristic, not structurally dilapidated.

The continuous variable among the size of place variables, the logarithm of the size of place (population) (X_8) exhibits a positive relationship to the probability, that the desirable housing characteristics exist, for eight of the ten binary dependent variables. However, the estimated coefficients range from .0008 for the housing characteristic, exclusive access to kitchen facilities, to .0955 for the desirable types of heating equipment. For two of the dependent variables, six rooms or more, and exclusive use of kitchen facilities, the relationship between the logarithm of the size of place and housing condition is negative.

Comparison Between Estimated Gross and Net Relationships

A comparison between the estimated gross relationships presented in Table III-4 and the estimated net relationships presented in Table V-2 reveals very similar patterns of relationships. For the population measure, X_8, the directions of the relationships are the same for seven of the eight comparable housing characteristics. Opposite relationships are estimated for the housing characteristic, built from 1950 to 1960. The gross relationship is negative and the net relationship is positive. For the three discrete residence categories--rural farm, rural nonfarm, and urban territories outside of places--the patterns of relationships are the same for six of the eight comparable housing characteristics. For one of the housing characteristics the pattern of relationships is similar. For the last housing characteristic--exclusive access to kitchen facilities--the estimated gross pattern of relationships differ from the net but both patterns have a small "range of effects." The empirical results also revealed that the "range of effects" for the estimated net relationships was smaller for all comparable housing characteristics than the "range of effects" for the estimated gross relationships.

Location Within an Urbanized Area

The estimated net relationships for the variable, in a central city (X_9), is presented in Table V-2 along with the estimated net relationships for size of place variables. The variable, in the remainder of an urbanized area (X_{10}), was omitted from all regression models. Thus its coefficient is set to zero.

In a central city exhibits mixed estimated net relationships with the various measures of housing condition. With six of the binary dependent variables, location in a central city exhibits positive relationships with housing condition. With the other four binary dependent variables--structurally sound, built from 1950 to 1960, one or more bathrooms, and heating equipment--location in a central city has negative relationships. It is not surprising, with these mixed relationships to find at the end of Chapter IV that INDEX is weight sensitive with respect to this independent variable.

Comparison Between Estimated Gross and Net Relationships

A comparison between estimated gross (Table III-5) and net (Table V-2) relationships reveals that all of the gross relationships exhibit negative relationships with housing condition if the unit is in a central city. The estimated net relationships with four of the comparable housing characteristics are positive. The empirical results also indicate that the range of estimated net relationships is always less than the range of estimated gross relationships.

Age of the Household Head

Several patterns of relationships are exhibited between the age of the household head and the various measures of housing condition. Due to the cubic functional form used for this characteristic, the relationships are difficult to visualize by examining the estimated regression coefficients. Consequently, the estimated relationships have been calculated and are presented in Table V-3.

..ed Net Relations Between Age of the Household Head and Measures of Housing Condition

11, X_{12} and X_{13} Age of the Household Head	Y_1 Six Rooms or More	Y_2 Structurally Sound	Y_3 Not Structurally Dilapidated	Y_4 Hot & Cold Water Piped Inside	Y_5 Exclusive Access to a Bath or Shower	Y_6 Built From 1950 to 1960	Y_7 One or More Bathrooms	Y_8 Heating Equipment	Y_9 Exclusive Access to Kitchen Facilities	Y_{10} Telephone Available	INDEX
	Measures of Housing Condition[a]										
15	.458	-.044	-.059	.030	.000	.310	.000	.184	-.019	.315	5.678
20	.560	-.052	-.071	.036	.002	.360	.002	.223	-.022	.382	6.860
25	.640	-.058	-.080	.041	.004	.390	.004	.252	-.024	.432	7.748
30	.701	-.061	-.086	.045	.007	.401	.008	.272	-.025	.469	8.376
35	.746	-.062	-.090	.048	.011	.397	.011	.285	-.025	.494	8.782
40	.778	-.061	-.091	.050	.015	.381	.015	.292	-.025	.509	9.001
45	.797	-.059	-.091	.052	.019	.357	.019	.294	-.024	.517	9.069
50	.809	-.056	-.090	.054	.022	.328	.023	.291	-.024	.519	9.023
55	.814	-.052	-.087	.056	.026	.296	.027	.286	-.023	.518	8.898
60	.815	-.047	-.084	.058	.030	.265	.031	.278	-.023	.516	8.730
65	.816	-.042	-.080	.061	.032	.238	.034	.270	-.023	.515	8.556
70	.818	-.037	-.077	.065	.035	.219	.036	.262	-.025	.516	8.411
75	.823	-.032	-.073	.070	.-36	.209	.038	.255	-.027	.523	8.333
80	.836	-.028	-.071	.076	.036	.214	.038	.251	-.031	.537	8.356
85	.857	-.025	-.069	.084	.036	.235	.038	.250	-.036	.560	8.516
90	.890	-.023	-.069	.094	.034	.275	.037	.254	-.043	.595	8.851
95	.937	-.022	-.071	.106	.030	.339	.034	.264	-.052	.643	9.395
100	1.001	-.023	-.075	.121	.025	.429	.029	.280	-.063	.707	10.186

[a]These measures of housing condition are the binary dependent variables for the regressions from which the estimated coefficients are taken. Variables Y_1 - Y_{10} are presented in Table IV-1 and INDEX is defined in Chapter II.

Source: These estimated net relationships are the regression coefficients taken from Tables IV-2 through IV-12.

One pattern of relationships is exhibited with four of the desirable housing characteristics and with INDEX. As the age of the household head increases, this pattern of relationships first increases at decreasing rate, levels off or decreases and then increases. With the desirable housing characteristic, six rooms or more, the pattern of relationships does not decrease between the ages of 50 and 75 but increases only slightly. For the dependent variable, telephone available, the relatively flat portion of the relationships is between the ages of 45 and 75. With the dependent variable, heating equipment, the pattern of relationships decreases between the ages of 45 and 85 increasing only slightly beyond that age. With the dependent variables, built from 1950 to 1960 and INDEX, the pattern of relationships decreases sharply in the middle range of ages. This estimated pattern of relationships indicates that the age of the household head is positively associated with these measures of housing condition for the young household heads and the old but has a negative or no effect on housing condition for the middle range of ages.

Another estimated pattern of relationships was exhibited with the dependent variable, hot and cold water piped inside. The pattern has a curvilinear form which is almost linear. As the age of the household head increases, the probability that the housing unit has hot and cold water piped inside increases.

The third pattern of relationships occurs with the housing characteristics, structurally sound and not structurally dilapidated. As the age of the household head increases, the probability that the housing unit has the desirable housing characteristics first decreases until about age 35 and then increases until about age 90.

Two other patterns of relationships are observed. The probability, that a housing unit has either exclusive access to a bath or shower or one or more bathrooms, increases as the age of the household head increases to about 80 years of age decreasing thereafter.

The last pattern of relationships is observed with the dependent variable, exclusive access to kitchen facilities. The probability that the housing unit possesses this desirable housing characteristic first decreases slightly to about age 35 then increases slightly to about age 60 and decreases at an increasing rate thereafter.

The variety in patterns of relationships between various measures of housing condition and the age of the household head is surprising. The "range of effects" for estimated net relationships with three of the housing characteristics exceeds .300--six rooms or more, not structurally dilapidated, and telephone available. With four of the housing characteristics, the "range of effects" is less than or equal to .044--structurally sound, exclusive access to a bath or shower, one or more bathrooms, and exclusive access to kitchen facilities. With the other three housing characteristics--built from 1950 to 1960, heating equipment, and hot and cold water piped inside--the "ranges of effects" are .220, .110, and .091, respectively.

Comparison Between Estimated Gross and Net Relationships

When comparing these patterns of estimated net relationships (Table V-3) with the estimated gross relationships (Table III-6), the results are mixed. The desirable housing characteristic, structurally sound, exhibits an estimated net pattern of relationships which is almost opposite the estimated gross pattern. The housing characteristics, six rooms or more, built from 1950 to 1960, and heating equipment, exhibit net patterns of relationships which are similar to the gross patterns. With the other housing characteristics, the gross and net patterns of relationships vary substantially. In general, the "ranges of effects" for estimated gross relationships are greater than the ranges of effects for estimated net relationships. However, the reverse holds for the housing characteristic, six rooms or more.

In general, the hypothesis that the old and young will experience difficulty in the housing market and will have lower levels of housing condition is not supported by the estimated net relationships. These estimated relationships do indicate that the young are more likely to have lower housing conditions and that the old are more likely to experience higher levels of housing condition than the household heads in the middle age categories with the effects of other characteristics removed.

Sex of the Household Head

The estimated net relationships for the sex of the household head are presented in Table V-4. The binary variable indicating a

TABLE V-4.--Estimated Net Relationships Between Sex of the Household Head and Measures of Housing Condition

Measures of Housing Condition[a]	Sex of Household Head
	X_{15} Female Head
Y_1 Six Rooms or More	-.0233
Y_2 Structurally Sound	.0077
Y_3 Not Structurally Dilapidated	.0097
Y_4 Hot and Cold Water Piped Inside	.0163
Y_5 Exclusive Access to a Bath or Shower	.0535
Y_6 Built From 1950 to 1960	-.0325
Y_7 One or More Bathrooms	.0479
Y_8 Heating Equipment	-.0075
Y_9 Exclusive Access to Kitchen Facilities	.0417
Y_{10} Telephone Available	.0520
INDEX	.6401

[a]These measures of housing condition are the binary dependent variables for the regressions from which the estimated coefficients are taken. Variables Y_1 - Y_{10} are presented in Table IV-1 and INDEX is defined in Chapter II.

Source: These estimated net relationships are the regression coefficients taken from Tables IV-2 through IV-12.

male household head (X_{14}) was dropped from all of the multiple regressions. Therefore the coefficient is set to zero and the estimated coefficient for X_{15}, female head, indicates the difference between the effect of the presence of a female head of household and the effect of a male head.

The presence of a female household head has a positive effect on housing condition for seven of the ten binary dependent variables. They are listed here from the housing characteristic on which female head has the largest effect to the characteristic on which female head has the smallest effect: exclusive access to a bath or shower, telephone available, one or more bathrooms, exclusive access to kitchen facilities, hot and cold water piped inside, not structurally dilapidated, and structurally sound. With three of the desirable housing characteristics, the presence of a female household head has a negative effect: six rooms or more, built from 1950 to 1960, and heating equipment. The presence of a female household head has a positive effect on the aggregate measure of housing condition, INDEX.

Comparison Between Estimated Gross and Net Relationships

A comparison between the estimated gross relationships in Table III-7 and the estimated net relationships in Table V-4 reveals substantial differences. The estimated gross relationships all indicate that the presence of a female head of household decreases the probability that the household enjoys the desirable housing characteristics. However, the estimated net relationships reveal positive relationships between the presence of a female household head and housing condition for several housing characteristics. This occurs because for those characteristics the presence of a female head is positively correlated with other socio-economic and locational characteristics which are negatively related to housing condition. For example, female household heads may have lower income, lower education, etc. which would cause the gross relationships to all be negative. When the effects of these characteristics are removed, some of the net relationships are positive.

The "ranges of effects" for estimated net relationships are generally smaller than the "range of effects" for estimated gross relationships except for two desirable housing characteristics--exclusive access to a bath or shower and exclusive access to kitchen facilities. These larger net "ranges of effects" are surprising because the relationships with these two housing characteristics changed sign from the gross to the net relationships.

The estimated net relationships reveal that households with female heads have a higher probability of living in smaller, older units with less adequate heating facilities than households headed by males. These households with female heads have a higher probability of having the other desirable housing characteristics included in Table V-4. These net relationships are estimated with the effects of other variables removed.

Race of the Household Head

The estimated net relationships between the race of the household head and measures of housing condition are presented in Table V-5. The variable X_{17}, white, has been dropped from all

TABLE V-5.--Estimated Net Relationships Between Race of the Household Head and Measures of Housing Condition

	Measures of Housing Condition[a]	Race of Household Head		
		X_{16} White With Spanish Surname	X_{18} Negro	X_{19} Other Race
Y_1	Six Rooms or More	- .0444	- .0160	.0317
Y_2	Structurally Sound	- .1176	- .1737	- .1253
Y_3	Not Structurally Dilapidated	- .0291	- .1015	- .0588
Y_4	Hot and Cold Water Piped Inside	- .0533	- .1708	- .0808
Y_5	Exclusive Access to a Bath or Shower	- .0410	- .1440	- .0454
Y_6	Built From 1950 to 1960	- .0411	- .0050	.0061
Y_7	One or More Bathrooms	- .0642	- .1684	- .0914
Y_8	Heating Equipment	- .1472	- .0961	- .2180
Y_9	Exclusive Access to Kitchen Facilities	- .0030	- .0068	- .0390
Y_{10}	Telephone Available	- .1234	- .1201	- .0150
INDEX		-2.8069	-4.5974	-3.8722

[a]These measures of housing condition are the binary dependent variables for the regressions from which the estimated coefficients are taken. Variables Y_1 - Y_{10} are presented in Table IV-1 and INDEX is defined in Chapter II.

Source: These estimated net relationships are the regression coefficients taken from Tables IV-2 through IV-12.

regression models. Therefore the coefficient for this variable is set equal to zero. The estimated coefficients for the other race variables represent the difference between the effect of each variable and the effect of this variable that has been dropped.

The estimated net relationships reveal that in all but two cases the white household head has the highest probability of enjoying the desirable housing characteristics. With the two housing characteristics where this pattern does not hold, six rooms or more and built from 1950 to 1960, other race exhibits the highest probability of possessing the desirable housing characteristic, white (X_{17}) next, followed by Negro (X_{18}), and last white with a Spanish surname (X_{16}). The most frequently observed pattern of relationships occurs with five of the binary dependent variables and with INDEX. These five desirable housing characteristics are: structurally sound, not structurally dilapidated, hot and cold water piped inside, exclusive access to a bath or shower, and one or more bathrooms. In this pattern the white household head exhibits the highest probability that the housing unit possesses the desirable housing characteristics, followed by white with a Spanish surname, then other race, and Negro having the lowest probability.

Three other patterns of relationships may be observed with the last three binary dependent variables--heating equipment, exclusive access to kitchen facilities, and telephone available.

Comparison Between Estimated Gross and Net Relationships

A comparison between the estimated gross relationships presented in Table III-8 and the estimated net relationships presented in Table V-5 reveals that with only one of the comparable housing characteristics, exclusive access to kitchen facilities, is the pattern of gross and net relationships the same. For four of the eight comparable housing characteristics--structurally sound, hot and cold water piped inside, exclusive access to a bath or shower, and one or more bathrooms--the relative probabilities attributed to white with a Spanish surname and other race are reversed. In the estimated net relationship the higher probability is estimated for white with a Spanish surname while the reverse is true for the estimated gross relationships. Other differences appear with the three remaining comparable housing characteristics.

A comparison of the "ranges of effects" for the estimated gross relationships and the estimated net relationships reveals that the ranges are always greater for the gross relationships.

Nativity and Parentage

The estimated net relationships between the nativity and parentage of the household head and measures of housing condition are presented in Table V-6. The variable indicating that the household head is native with native parents (X_{20}) was dropped from all regression models. Thus the coefficient for this variable is set equal to zero. The regression coefficients for the included variables are then interpreted as estimated differences between the effects of each included variable and the variable that has been dropped.

An examination of Table V-6 reveals two predominant patterns of relationships. With three of the binary dependent variables the

TABLE V-6.--Estimated Net Relationships Between Nativity and Parentage of the Household Head and Measures of Housing Condition

	Measures of Housing Condition[a]	Nativity and Parentage of Household Head		
		X_{21} Native With One Foreign Parent	X_{22} Native With Foreign Parents	X_{23} Foreign With Foreign Parents
Y_1	Six Rooms or More	-.0026	-.0116	- .0346
Y_2	Structurally Sound	.0209	.0291	.0683
Y_3	Not Structurally Dilapidated	.0039	.0039	.0160
Y_4	Hot and Cold Water Piped Inside	.0060	-.0112	.0378
Y_5	Exclusive Access to a Bath or Shower	.0143	.0003	.0545
Y_6	Built From 1950 to 1960	.0155	.0449	.0506
Y_7	One or More Bathrooms	.0172	-.0011	.0556
Y_8	Heating Equipment	.0230	.0097	.0543
Y_9	Exclusive Access to Kitchen Facilities	-.0003	-.0023	- .0004
Y_{10}	Telephone Available	.0283	.0227	.0332
INDEX		.5540	.4240	1.7184

[a]These measures of housing condition are the binary dependent variables for the regressions from which the estimated coefficients are taken. Variables Y_1 - Y_{10} are presented in Table IV-1 and INDEX is defined in Chapter II.

Source: These estimated net relationships are the regression coefficients taken from Tables IV-2 through IV-12.

households with heads who are foreign with foreign parents (X_{23}) have the highest probability of enjoying the desirable housing characteristics, native with foreign parents (X_{22}) next, followed by native with one foreign parent (X_{21}) and native with native parents (X_{20}) last. The binary variables with which this pattern of relationships holds are: structurally sound, not structurally dilapidated, and built from 1950 to 1960.

The second pattern of relationships also is exhibited with three of the binary dependent variables--exclusive access to a bath or shower, heating equipment, and telephone available. With these three desirable housing characteristics the relative probability estimates for native with one foreign parent and native with foreign parents are reversed from the first pattern described. This second pattern is also exhibited with the dependent variable INDEX.

A third pattern of relationships exhibits itself with two of the binary dependent variables--hot and cold water piped inside and one or more bathrooms. In this pattern the relative probability estimates for native with foreign parents and native with native parents are reversed from the first pattern of relationships. Two different patterns of relationships are exhibited with the binary dependent variables, six rooms or more, and exclusive access to kitchen facilities.

An examination of Table V-6 reveals that for six of the ten binary variables the household head who is native with native parents has the lowest estimated probability of enjoying the desirable housing characteristics. For eight of the binary dependent variables, the household head who is foreign with foreign parents has the highest probability and the one who is native with one foreign parent has the second highest probability of enjoying the desirable housing characteristics.

Comparison Between Estimated Gross and Net Relationships

A comparison between the estimated gross relationships presented in Table III-9 and the estimated net relationships presented in Table V-6 reveals that none of the patterns of relationships are the same for the comparable housing characteristics. In general, the differences are accounted for by a reversal of the relative probabilities estimated for the two variables, native with one foreign parent and foreign with foreign parents. With the net relationships, the household head who is foreign with foreign parents has the highest probability of enjoying the desirable housing characteristics and the one who is native with one foreign parent has a lower probability. The relative probability estimates for these two variables are just reversed in the estimated gross relationships.

For all of the comparable desirable housing characteristics, the "ranges of effects" of the estimated gross relationships are greater than for the estimated net relationships.

Metropolitan Residence in 1955

The estimated net relationships between the metropolitan residence in 1955 variables and various measures of housing condition are presented in Table V-7. Variable X_{24}, indicating that the

TABLE V-7.--Estimated Net Relationships Between the Metropolitan Residence in 1955 and Measures of Housing Condition

Measures of Housing Condition[a]	Metropolitan Residence in 1955				
	X_{25} Different House Same County	X_{26} Different County Same State	X_{27} Contiguous State	X_{28} Non-contiguous State	X_{29} Abroad or at Sea
Y_1 Six Rooms or More	-.0434	-.0281	-.0437	-.0447	-.0498
Y_2 Structurally Sound	.0238	.0377	.0399	.0570	.0617
Y_3 Not Structurally Dilapidated	.0119	.0161	.0177	.0209	.0107
Y_4 Hot and Cold Water Piped Inside	.0263	.0441	.0444	.0612	.0551
Y_5 Exclusive Access to a Bath or Shower	.0228	.0396	.0371	.0402	.0279
Y_6 Built From 1950 to 1960	.2186	.2602	.2552	.3109	.2681
Y_7 One or More Bathrooms	.0287	.0483	.0486	.0534	.0390
Y_8 Heating Equipment	.0400	.0541	.0784	.0506	.0872
Y_9 Exclusive Access to Kitchen Facilities	-.0020	-.0038	-.0119	-.0082	-.0042
Y_{10} Telephone Available	-.0183	-.0260	-.0352	-.0467	-.0294
INDEX	2.0423	2.8674	2.8926	3.2813	2.8801

[a]These measures of housing condition are the binary dependent variables for the regressions from which the estimated coefficients are taken. Variables Y_1 - Y_{10} are presented in Table IV-1 and INDEX is defined in Chapter II.

Source: These estimated net relationships are the regression coefficients taken from Tables IV-2 through IV-12.

household head resided in the same house, was dropped from all regression models. Thus the coefficient for that variable is set equal to zero.

An examination of Table V-7 reveals two patterns of relationships between the distance moved and the probability that the housing unit contains the desirable housing characteristics. As was explained in Chapter IV, X_{24} through X_{29} are assumed to measure an increasing distance moved. The primary pattern of relationships is observed with seven of the ten binary dependent variables. The probability that the housing unit contains the desirable housing characteristics increases with increased distance moved. This pattern, which does not hold between X_{28} and X_{29}, appears with these binary dependent variables: structurally sound, not structurally dilapidated, hot and cold water piped inside, exclusive access to a bath or shower, built from 1950 to 1960, one or more bathrooms, and heating equipment. This pattern of relationships also appears with the aggregate measure of housing condition, INDEX, as could be expected.

The second pattern of relationships is opposite to the first. The probability that the housing unit possesses the desirable housing characteristics decreases with increases in the distance moved. This pattern is not consistently observed between all six of the independent variables. It appears with three of the binary dependent variables: six rooms or more, exclusive access to kitchen facilities, and telephone available.

The "ranges of effects" for estimated net relationships are all less than .088 except for one dependent variable. For built from

1950 to 1960 the range is .311. This disparity in ranges is not surprising given the nature of this dependent variable. X_{24} through X_{29} indicates whether the household moved from the 1955 place of residence. The dependent variable indicates that the housing unit was built in the decade preceding the Census. As a consequence one would expect these independent variables to explain a large proportion of the variation in this dependent variable.

Comparison Between Estimated Gross and Net Relationships

A comparison of the estimated gross relationships presented in Table III-10 with the estimated net relationships in Table V-7 reveals that the patterns of relationships for the comparable housing characteristics are similar. The "ranges of effects" for estimated gross relationships are greater than the "ranges of effects" for estimated net relationships except for one dependent variable. In the case of heating equipment, the net "range of effects" is larger.

Occupational Classification

The estimated net relationships between occupational classifications of household heads and measures of housing condition are presented in Table V-8. The independent variable designating occupation not reported (X_{39}) has been omitted from all regression models. Thus the coefficient for this variable is set equal to zero and becomes a basing point for the other estimated coefficients. That is the estimated coefficients for the other variables represent the difference in effect between the variable in question and the omitted variable.

TABLE V-8.--Estimated Net Relationships Between Occupational Classifications and Measures of Housing Condition

	Measures of Housing Condition[a]	Occupational Classification for the Household Head				
		X_{35} White Collar Worker	X_{31} Farm Manager	X_{36} Blue Collar Worker	X_{32} Farm Foreman	X_{37} Service Worker
Y_1	Six Rooms or More	.0714	.1227	- .0072	.0058	-.0005
Y_2	Structurally Sound	.0387	.0648	-.0083	- .0508	-.0052
Y_3	Not Structurally Dilapidated	.0149	.0713	.0095	.0534	.0107
Y_4	Hot and Cold Water Piped Inside	.0093	.1397	-.0009	.0442	.0013
Y_5	Exclusive Access to a Bath or Shower	.0257	.2210	.0143	.0719	-.0113
Y_6	Built From 1950 to 1960	.0199	- .1075	-.0163	- .0079	-.0206
Y_7	One or More Bathrooms	.0293	.1926	.0091	.0559	-.0141
Y_8	Heating Equipment	.0468	.0225	-.0188	- .0234	-.0325
Y_9	Exclusive Access to Kitchen Facilities	.0095	.0195	.0106	.0208	-.0095
Y_{10}	Telephone Available	.0829	.1042	.0284	.1433	.0258
INDEX		1.5713	5.0836	-.0063	2.9087	-.3585

TABLE V-8.--Continued

Measures of Housing Condition[a]	Occupational Classification for the Household Head				
	X_{40} No Occupation	X_{38} Laborers	X_{30} Farmer	X_{34} Farm Service Worker	X_{33} Farm Laborer
Y_1 Six Rooms or More	.0583	- .0075	.1084	-.0488	- .0144
Y_2 Structurally Sound	-.0328	- .0825	- .0023	-.0908	- .1574
Y_3 Not Structurally Dilapidated	-.0084	- .0277	- .0084	-.2234	- .0871
Y_4 Hot and Cold Water Piped Inside	-.0400	- .0716	- .0503	-.1074	- .1680
Y_5 Exclusive Access to a Bath or Shower	-.0179	- .0617	- .0411	-.0517	- .1453
Y_6 Built From 1950 to 1960	-.0115	- .0610	- .0612	-.0914	- .0981
Y_7 One or More Bathrooms	-.0256	- .0730	- .0507	-.0369	- .1461
Y_8 Heating Equipment	-.0142	- .1032	- .0385	.0836	- .1117
Y_9 Exclusive Access to Kitchen Facilities	.0077	.0057	.0147	.0372	.0156
Y_{10} Telephone Available	-.0018	- .0519	.0199	.0060	- .1505
INDEX	-.3381	-2.7170	-1.0870	-.2788	-5.3991

[a]These measures of housing condition are the binary dependent variables for the regressions from which the estimated coefficients are taken. Variables Y_1 - Y_{10} are presented in Table IV-1 and INDEX is defined in Chapter II.

Source: These estimated net relationships are the regression coefficients taken from Tables IV-2 through IV-12.

An examination of Table V-8 reveals mixed patterns of estimated net relationships. In fact, the pattern of relationships between housing condition and occupational classifications is different for each of the measures of housing condition used. With the dependent variable, INDEX, a pattern of relationships is exhibited which appears to be representative of the other patterns. The occupational classifications are listed here from the one with the highest level of housing condition to the one with the lowest: farm manager (X_{31}), farm foreman (X_{32}), white collar worker (X_{35}), occupation not reported (X_{39}), blue collar worker (X_{36}), service worker (X_{37}), no occupation (X_{40}), farmer (X_{30}), farm service worker (X_{34}), laborer (X_{38}), and farm laborer (X_{33}).

Examining the classifications which have the largest positive relationships with housing condition, we see that the effect of the household heads being a white collar worker is always positive over having the classification, occupation not reported. Having the farm manager classification has a positive effect on housing condition for all measures except the year built. In this case, household heads who are farm managers have the lowest probability of residing in a housing unit that was built from 1950 to 1960.

At the other end of the spectrum, we see that laborers and farm laborers negatively related to housing condition for all measures except exclusive access to kitchen facilities. The classification, farmer, exhibits negative relationships with housing condition for all of the dependent variables except six rooms or more, exclusive access to kitchen facilities, and telephone available.

Comparison Between Estimated Gross and Net Relationships

A comparison between the estimated net relationships presented in Table V-8 and the estimated gross relationships presented in Table III-11 reveals that none of the patterns of relationships for comparable housing characteristics are the same. The general pattern of relationships also appears to differ. The estimated gross relationships indicate that the white collar worker has the highest positive relationship to housing condition, farm manager has the second highest, and blue collar worker has third highest. The occupational classifications which are associated with lower levels of housing condition exhibited more similarities between their estimated gross and net relationships. Farm laborer was associated with the lowest level of housing condition in both gross and net relationships.

In general, the "ranges of effects" for estimated gross relationships are greater than the "ranges of effects" for estimated net relationships. The only exception occurs with exclusive access to kitchen facilities where the situation is reversed.

Type of Tenure

The estimated net relationships between the type of tenure variables and measures of housing condition are presented in Table V-9. The tenure category rented (X_{42}) has been omitted from all regression models. Thus the coefficient for this variable is set equal to zero.

The tenure category owned (X_{41}) exhibits positive relationships with housing condition over the rented category for all measures

TABLE V-9.--Estimated Net Relationships Between Type of Tenure and Measures of Housing Conditions

Measures of Housing Condition[a]		Type of Tenure	
		X_{41} Owned	X_{43} No Cash Rent
Y_1	Six Rooms or More	.2541	.1141
Y_2	Structurally Sound	.1305	-.0108
Y_3	Not Structurally Dilapidated	.0427	-.0320
Y_4	Hot and Cold Water Piped Inside	.0536	-.0901
Y_5	Exclusive Access to a Bath or Shower	.0781	-.0751
Y_6	Built From 1950 to 1960	.2477	.0604
Y_7	One or More Bathrooms	.0889	-.0607
Y_8	Heating Equipment	.1415	.0280
Y_9	Exclusive Access to Kitchen Facilities	.0169	.0043
Y_{10}	Telephone Available	.1481	.0338
INDEX		5.8115	-.9059

[a]These measures of housing condition are the binary dependent variables for the regressions from which the estimated coefficients are taken. Variables Y_1 - Y_{10} are presented in Table IV-1 and INDEX is defined in Chapter II.

Source: These estimated net relationships are the regression coefficients taken from Tables IV-2 through IV-12.

of housing condition. The no cash rent (X_{43}) category exhibits positive relationships with housing condition for five of the ten binary dependent variables: six rooms or more, built from 1950 to 1960, heating equipment, exclusive access to kitchen facilities, and telephone available. With the other five binary dependent variables, the no cash rent category has negative relationships to housing condition relative to the renter category. The no cash rent category has a negative relationship with the aggregate housing condition measure, INDEX.

Comparison Between Estimated Gross and Net Relationships

A comparison between the estimated net relationships presented in Table V-9 and the estimated gross relationships presented in Table III-12 reveals that for six of the eight comparable housing characteristics the patterns of relationships are the same. The two housing characteristics which exhibit different patterns are built from 1950 to 1960 and heating equipment. In both cases, the relationships between the tenure categories, renter and no cash rent, and housing condition are reversed.

The "ranges of effects" for estimated gross relationships are greater than the "ranges of effects" for estimated net relationships for all binary dependent variables except built from 1950 to 1960. In this case, the reverse is true.

Education of the Household Head

The estimated net relationships between the education of the household head and measures of housing condition are presented in

Table V-10. The relationships between education and housing condition are positive with only three exceptions. With the binary dependent variable, exclusive access to kitchen facilities, the relationship is negative but small up to ten and a half years of education. With two other binary dependent variables--hot and cold water piped inside and exclusive access to a bath or shower--the estimated relationships are negative but small for greater than ten and a half years of education.

The two variables describing the education of the household head allow for a linear relationship which has one slope between zero and ten and a half years of education (X_{44}) and another slope between ten and a half and sixteen and a half years of education or more (X_{45}). This specification allows for a kink at ten and a half years of education in an otherwise continuous linear relationship. The empirical results indicate that this was a valid specification. For example, with all of the binary dependent variables except built from 1950 to 1960 and exclusive access to kitchen facilities, the first slope is positively related to housing condition and of greater magnitude than the slope for greater than ten and a half years of education. With the dependent variable, built from 1950 to 1960, the second slope is slightly greater than the first. With the dependent variable, exclusive access to kitchen facilities, the first slope is negative and the second slope is positive. Both are very small.

For several of the dependent variables the first slopes are close to the same magnitude: structurally sound, hot and cold water

TABLE V-10.--Estimated Net Relationships Between the Education of the Household Head and Measures of Housing Condition

	Measures of Housing Condition[a]	Education of Household Head: X_{44} Educational Level if $\leq$10.5 Years	Education of Household Head: X_{45} Educational Level if >10.5 Years
Y_1	Six Rooms or More	.0109	.0059
Y_2	Structurally Sound	.0220	.0011
Y_3	Not Structurally Dilapidated	.0096	-.0004
Y_4	Hot and Cold Water Piped Inside	.0240	-.0008
Y_5	Exclusive Access to a Bath or Shower	.0241	
Y_6	Built From 1950 to 1960	.0035	.0037
Y_7	One or More Bathrooms	.0261	.0000
Y_8	Heating Equipment	.0172	.0057
Y_9	Exclusive Access to Kitchen Facilities	-.0001	.0001
Y_{10}	Telephone Available	.0219	.0034
INDEX		.7527	.1018

[a]These measures of housing condition are the binary dependent variables for the regressions from which the estimated coefficients are taken. Variables Y_1 - Y_{10} are presented in Table IV-1 and INDEX is defined in Chapter II.

Source: These estimated net relationships are the regression coefficients taken from Tables IV-2 through IV-12.

piped inside, exclusive access to a bath or shower, one or more bathrooms, and telephone available. The first slopes for other binary dependent variables are smaller.

Comparison Between Estimated Gross and Net Relationships

A comparison of the estimated net relationships presented in Table V-10 and the estimated gross relationships presented in Table III-13 revealed similar patterns of relationships for the housing characteristic, built from 1950 to 1960. The gross relationships were approximately linear but had a greater slope than the net relationships.

The gross and net relationships with the housing characteristic, six rooms or more, were similar. The gross relationships are approximately linear and have approximately the same slope as the net relationships from zero to ten and a half years of education. After that point, the gross relationships have a greater slope than the net relationships.

Comparisons between the estimated net and gross relationships did not reveal similar patterns of relationships for other comparable housing characteristics. For the dependent variables--structurally sound, hot and cold water piped inside, exclusive access to a bath or shower, one or more bathrooms, and heating equipment--the gross relationships are positive, approximately linear with the slope decreasing slightly at higher levels of education. The net relationships are positive with less slope than the gross and after ten and a half years of education a smaller slope yet.

The ranges of effects for estimated net relationships are in all cases smaller than the "ranges of effects" of estimated gross relationships.

Household Income

The estimated net relationships between household income and measures of housing condition are presented in Table V-11. The variables describing household income allow for a different slope and intercept for each of the three types of households distinguished. The parameter described as the "slope coefficient" is the estimated coefficient for the logarithm of household income. Variables X_{46}, X_{48}, and X_{50} are specified so that each equals the logarithm of household income up to $7,000 for the three types of households. Any income over this amount is treated as though it were $7,000 based on the empirical results of the abbreviated models, presented in Chapter IV. X_{47} and X_{49}, the two variables included to allow for different intercepts, should be interpreted as the difference in intercept between the household type in question and households of unrelated individuals.

Household income exhibits positive relationship with the desirable housing characteristics for all ten dependent variables and the three types of households with one exception. The relationship between household income for unrelated individuals and six rooms or more is slightly negative. With all of the desirable housing characteristics except built from 1950 to 1960, the slopes of the relationships are greater for mixed households than for families and the slopes for the relationships for families are greater than

TABLE V-11.--Estimated Net Relationships Between Household Income and Measures of Housing Condition

	Measures of Housing Condition[a]	Household Income for Households of Various Types				
		X_{46} Unrelated Individuals Log. of Household Income[b]	X_{47} Families (Intercept)	X_{48} Families Log. of Household Income[b]	X_{49} Mixed (Intercept)	X_{50} Mixed Log. of Household Income[b]
Y_1	Six Rooms or More	-.0098	- .1274	.0570	- .6568	.2403
Y_2	Structurally Sound	.0282	- .0178	.0489	- .2717	.1043
Y_3	Not Structurally Dilapidated	.0108	- .0163	.0210	- .1731	.0611
Y_4	Hot and Cold Water Piped Inside	.0249	- .0682	.0573	- .3977	.1463
Y_5	Exclusive Access to a Bath or Shower	.0303	.0118	.0659	- .2923	.1462
Y_6	Built From 1950 to 1960	.0032	- .0777	.0319	- .0832	.0155
Y_7	One or More Bathrooms	.0321	.0031	.0710	- .3269	.1572
Y_8	Heating Equipment	.0275	- .0981	.0643	- .2877	.1106
Y_9	Exclusive Access to Kitchen Facilities	.0007	.0654	.0060	.0469	.0087
Y_{10}	Telephone Available	.0385	- .0633	.0884	- .3545	.1650
INDEX		.7579	-2.1757	2.5145	-14.3745	5.7945

[a]These measures of housing condition are the binary dependent variables for the regressions from which the estimated coefficients are taken. Variables Y_1 - Y_{10} are presented in Table IV-1 and INDEX is defined in Chapter II.

[b]Household income greater than $7,000 is set equal to $7,000.

Source: These estimated net relationships are the regression coefficients taken from Tables IV-2 through IV-12.

for unrelated individuals. For all but three of the desirable housing characteristics--exclusive access to a bath or shower, one or more bathrooms, and exclusive access to kitchen facilities--the intercept for mixed households is less than the intercept for families which is less than the intercept for unrelated individuals. For two of these desirable housing characteristics--exclusive access to a bath or shower and one or more bathrooms, the intercept for families is greater than the intercept for unrelated individuals. For the desirable housing characteristic, exclusive access to kitchen facilities, the intercept for families is greater than the intercept for mixed households which is greater than the intercept for unrelated individuals.

Comparison Between Estimated Gross and Net Relationships

A comparison between the estimated net relationships presented in Table V-11 and the estimated gross relationships presented in Table III-14 reveals that the slopes of the estimated gross relationships appear to be greater than the estimated net slopes for all comparable housing characteristics except exclusive access to kitchen facilities. Here the slopes of the estimated gross relationships appear to be close to zero but the slopes of the estimated net relationships are greater than zero for both families and unrelated individuals. With the estimated gross relationships the slopes for families are greater than the slopes for unrelated individuals except for the dependent variable, built from 1950 to 1960. Here the reverse is true. With the estimated net relationships, the slopes for families are all greater than the slopes for unrelated individuals.

Less agreement is found between the intercepts of the gross and net relationships than was found between the slopes of the relationships. The intercepts are the effects of zero or negative income on the probability that the household enjoys the desirable housing characteristic. With four of the comparable housing characteristics, the intercept for families is lower than for unrelated individuals for both estimated gross and net relationships. With one of these four characteristics, six rooms or more, linearity must be imposed upon the gross relationship if this condition is to hold. With a fifth characteristic, exclusive access to kitchen facilities, the intercept for families is greater than the intercept for unrelated individuals for both net and gross relationships. With the other three comparable housing characteristics--exclusive access to a bath or shower, built from 1950 to 1960, and one or more bathrooms--the relative position of the intercept for families and for unrelated individuals is reversed between the estimated gross and net relationships. With these three housing characteristics the estimated gross relationships exhibit patterns which do not reflect the estimated net relationships because the effects of variables other than income are not held constant.

Dependency Ratio

The net relationships between the dependency ratio for the household and measures of housing condition are presented in Table V-12. The dependency ratio (X_{51}), which was defined in Chapter III, is the number of household members 14 through 64 years of age divided into the number younger and older than this range.

TABLE V-12.--Estimated Net Relationships Between Dependency and Measures of Housing Condition

Measures of Housing Condition[a]		Dependency	
		X_{51} Dependency Ratio	X_{52} No One 14-64
Y_1	Six Rooms or More	.0658	-.0119
Y_2	Structurally Sound	-.0440	-.0180
Y_3	Not Structurally Dilapidated	-.0200	-.0014
Y_4	Hot and Cold Water Piped Inside	-.0199	-.0027
Y_5	Exclusive Access to a Bath or Shower	-.0105	.0191
Y_6	Built From 1950 to 1960	.0063	.0454
Y_7	One or More Bathrooms	-.0137	.0178
Y_8	Heating Equipment	-.0125	.0103
Y_9	Exclusive Access to Kitchen Facilities	.0011	.0132
Y_{10}	Telephone Available	-.0215	-.0008
INDEX		-.1677	.4948

[a]These measures of housing condition are the binary dependent variables for the regressions from which the estimated coefficients are taken. Variables Y_1 - Y_{10} are presented in Table IV-1 and INDEX is defined in Chapter II.

Source: These estimated net relationships are the regression coefficients taken from Tables IV-2 through IV-12.

The dependency ratio has negative effects on all but three of the desirable housing characteristics. That is as the dependency ratio increases, the estimated probability that the household enjoys the desirable housing characteristics decreases. The dependency ratio is also negatively related to INDEX. The three desirable housing characteristics which exhibit positive relationships to the dependency ratio are six rooms or more, built from 1950 to 1960, and exclusive access to kitchen facilities.

A binary independent variable was used to describe the situation where the dependency ratio is infinite (X_{52}). This occurs when the household contains no one who is from 14 to 64 years of age. This binary variable exhibits positive relationships with five of the ten desirable housing characteristics examined and with INDEX. With the dependent variable, six rooms or more, the dependency ratio is positively related to housing condition but negatively related when the household contains no one from 14 to 64 years of age.

With three of the binary dependent variables--exclusive access to a bath or shower, one or more bathrooms, and exclusive access to kitchen facilities--the dependency ratio is negatively related to the desirable housing characteristics but the condition, no one from 14 to 64 years of age, is positively related. It would seem that this condition should exhibit relationships of the same sign as exhibited by the dependency ratio.

Comparison Between Estimated Gross and Net Relationships

A comparison between the estimated gross relationships presented in Table III-15 and the estimated net relationships presented in Table V-12 reveals very similar patterns of relationships. The gross relationships for five of the eight comparable housing characteristics with the dependency ratio are negative as are the net relationships. With these same characteristics--structurally sound, hot and cold water piped inside, exclusive access to a bath or shower, one or more bathrooms, and heating equipment--the estimated gross and net relationships between the condition, no one from 14 to 64 years of age and the desirable housing characteristics are positive.

Two of the other desirable housing characteristics exhibit positive net relationships and slightly positive or no gross relationships. They are six rooms or more and built from 1950 to 1960. For both of these characteristics the estimated gross effects of having no one from 14 to 64 years of age are negative. The estimated net relationship with six rooms or more is consistent with the gross relationship but the estimated net relationship with built from 1950 to 1960 is positive. The estimated net and gross relationships for exclusive access to kitchen facilities are not considered because both are close to zero.

Summary and Conclusions

In this chapter we have examined the nature of the estimated net relationships between 13 sets of socio-economic and locational characteristics of the occupants and various measures of housing condition. Part of this examination process involved comparisons between the estimated gross relationships presented in Chapter III and these estimated net relationships.

For the most part the estimated net relationships revealed patterns of relationships similar to those exhibited by the estimated gross relationships. Most exhibited small deviations from the estimated gross relationships but some exhibited patterns of relationships which are opposite to the patterns of the estimated gross relationships. For example the estimated gross relationships reveal that the presence of a female household head has a negative effect on each of the desirable housing characteristics. However, according to the estimated net relationships, the presence of a female household head has a positive effect on housing condition with seven of the ten binary dependent variables and INDEX. Examples of this occurred with two other sets of socio-economic and locational characteristics, location within an urbanized area and dependency.

As with the estimated gross relationships presented in Chapter III, opposite patterns of relationships are observed with different desirable housing characteristics. For example, the presence of a female household head has a positive effect on seven of the binary dependent variables but a negative effect on six rooms or more, built from 1950 to 1960 and the desirable types of heating equipment. This occurs with six other sets of socio-economic and locational characteristics: region of the United States, size of place, nativity and parentage, metropolitan residence in 1955, occupational classification, and dependency.

Another phenomenon observed is that the "range of effects" for the estimated net relationships are in some cases greater than for the estimated gross relationships. This occurred between the dependent variable six rooms or more and sets of explanatory variables: region of the United States, age of the household head, and dependency. It also occurred between structurally sound and dependency and hot and cold water piped inside and dependency. This phenomenon occurred between several other sets of variables: between exclusive access to a bath or shower and sex of the household head; between built from 1950 to 1960 and type of tenure; between heating equipment and metropolitan residence in 1955; and between exclusive access to kitchen facilities and sex of the household head, occupational classification, and household income for families. In most cases with the estimated gross relationships other variables tended to increase the effects attributed to the variable in question. That is the combined effect of allowing other explanatory variables to fluctuate, reinforced the effect of the explanatory variable in question. However, in the situations just listed allowing other explanatory characteristics to vary decreased the estimated gross relationships. Stated another way, the combined effects of allowing other explanatory variables to fluctuate decreased the effect of the explanatory variable being studied. In situations where the estimated gross and net relationships are opposite, allowing other variables to fluctuate completely masks the effect of the studied variable.

The policy implications of these empirical results will be covered in the next chapter.

CHAPTER VI

SUMMARY AND CONCLUSIONS

The objective of this study has been to examine the relationships between the socio-economic and locational characteristics of the occupants and housing condition. Several steps were involved in approaching this objective:

1. First an aggregate measure of housing condition, INDEX, was constructed which is discussed in Chapter II. Some of the work done on measurement led to an examination of the census measure, which is presented in Appendix I.

2. The next step in the study was the estimation of the gross relationships between thirteen sets of socio-economic and locational characteristics and nine of the ten measures of housing condition which constitute INDEX. These estimated gross relationships are summarized in Chapter III.

3. Net relationships were then estimated between this same set of characteristics and eleven measures of housing condition including the aggregate measure, INDEX. These relationships are presented in Chapters IV and V.

This chapter includes a summary and policy implications of the research results obtained in the previously listed steps.

Measuring Housing Condition

The first step involved measuring housing condition on a national scale using data from the 1960 Census of Housing. The basis of the measure constructed is the satisfying capacity of the housing unit from a public policy perspective. Data limitations confined INDEX to physical housing characteristics. As a consequence many dimensions of housing were not included: the effect of environment on housing condition, as well as many physical characteristics of the unit itself. The nature of the characteristics that entered our measure confined the discriminatory power of INDEX to relatively low levels of housing condition.

Some work presented at the end of Chapter IV indicates that INDEX is weight sensitive. That is, varying the weights on the physical characteristics included in INDEX changes the way housing units are rated. A set of weights which appeared reasonable was used in the measure. However, the work on sensitivity suggests that additional study is needed to determine the appropriate weights.

Even with the difficulties cited above, we believe INDEX is a superior measure of housing condition on a national scale than those presently used. First, INDEX is more objective because its components are more objectively determined. Second, it is more representative because it contains more of the dimensions of housing condition than the measures presently used. And third, it allows for more precise measurement over a wider range of housing condition.

The work presented in Appendix I suggests that the two measures most commonly used are inadequate for policy decisions. The first is the Census measure of structural condition: sound, deteriorating (housing needing more repair than would be provided in the course of regular maintenance), or dilapidated (housing that does not provide safe and adequate shelter, and, in its present condition, endangers the health, safety, or well-being of the occupants).

The second and more commonly used measure of housing condition is the dichotomous classification, standard or substandard. Although the Bureau of the Census disclaims any usage of this measure, it is officially used by HUD and other agencies and is derived from published Census classifications. A housing unit is substandard if it is: (1) dilapidated, or (2) lacks one or more of the following facilities: hot running water in the structure, flush toilet for private use, bathtub or shower for private use. The housing unit is classified standard if it is not substandard.

These measures are inadequate for several reasons:

1. They are very gross measures, the one having three classifications and the other only two. An examination of the definitions presented reveals that the measures allow differentiation only at the very lowest levels of housing condition. A sound or standard housing unit could still violate most building codes and be virtually unfit for human habitation. A measure, to be effective for policy use should provide for finer discriminatory power over a wider range of housing condition.

2. These current measures of housing condition are also inaccurate. A Bureau of the Census Content Evaluation Study (CES) revealed that in 1960 only 33 percent of the houses classified as deteriorating and 38 percent of those classified as dilapidated in the CES reinterview were similarly classified in the 1960 Census

interview [25]. The second measure presented is more accurate than the first because of the addition of more accurately determined data. However, considerable error still remains.

3. A third shortcoming of these two measures is that they may not be representative of general housing condition. As has been previously indicated, a housing unit which has been designated as standard or sound may not be liveable. The literature concerning the measurement of housing condition is permeated with the assumption that these measures are representative. Evidence presented in Appendix I suggests that although the Census measure of structural condition represents an important dimension of housing condition, it may not be representative.

It is believed that one of the first requirements for adequate housing policy is a description of the problem. The work presented here suggests that present measures are not adequate but that improved measures can be constructed.

Relationships Between Socio-economic and Locational Characteristics of the Occupants and Housing Condition

The examination of the relationships between socio-economic and locational characteristics of the occupants and housing condition, which is the end objective of this study, confirmed and extended many of the conclusions suggested by previous studies. Among the estimated gross relationships presented in Chapter III, five of the thirteen sets of socio-economic and locational characteristics appear to have the largest effects on housing condition. They are: (1) size of place, (2) occupational classification, (3) type of tenure, (4) education of the household head, and (5) household income. Of course, each of the nine desirable housing characteristics is most closely related to a different mix of socio-economic and locational characteristics. However, these five sets have the largest explanatory power most of the time.

The estimated net relationships presented in Chapters IV and V revealed that three of these sets of socio-economic and locational characteristics had the largest effects on housing condition: (1) occupational classification, (2) education of the household head, and (3) household income. As was true with the estimated gross relationships, each of the measures of housing condition used exhibits strongest relationships with a different mix of socio-economic and locational characteristics. However, these three sets have the largest effect most of the time.

Opposite Patterns

The estimations of both the net and gross relationships exhibit some opposite patterns of relationships. That is a characteristic of the occupants will have a positive effect on one measure of housing condition and a negative effect on another. For example, with both gross and net relationships the effect of population increase on the number of rooms in housing units is negative. The effect of this characteristic of the occupant on other desirable housing characteristics is positive with one exception--the estimated net relationships with exclusive access to kitchen facilities. For the gross and net relationships opposite patterns occur with occupant characteristics: (1) occupation of the household head, (2) region of the country, (3) size of place, and (4) metropolitan residence in 1955. Such is also the case with housing characteristics: (1) six rooms or more, (2) exclusive access to kitchen facilities, and (3) the year built. These opposite patterns also occur in the net relationships with three more occupant characteristics: (1) nativity and parentage of the household head, (2) sex of the household head, and (3) dependency ratio. The specifics of these opposite patterns can be examined in Chapters III and V.

These opposite patterns illustrate the need for an appropriate measure of housing condition. Depending upon which housing characteristics are emphasized, size of place could be shown to be positively or negatively related to housing condition. For these and other occupant characteristics which exhibit opposite patterns of relationships an appropriate measure of housing condition is needed to estimate the true relationships with housing conditions.

These opposite patterns justify questions about the true relationships between certain characteristics of the occupants and housing condition. However, for six of the thirteen occupant characteristics, opposite patterns were not observed in the net relationships and for seven of the thirteen occupant characteristics, opposite patterns were not observed in the gross relationships. For these characteristics we have more confidence in the estimated relationships. In some instances the opposite patterns that were observed were not large in magnitude. It is believed that the net relationships estimated using INDEX as the measure of housing condition are reasonably accurate. This is based on the belief that INDEX approximates housing condition. As has been mentioned earlier, this belief needs to be tested.

Although the estimated gross and net relationships are presented in Chapters III, IV, and V, some of the more interesting ones will be discussed here with relevant policy considerations.

Household Income

The effect of household income on housing condition was found to be positive and large relative to other characteristics in both gross and net relationships. The estimated net relationships with our measure of housing condition, INDEX, revealed that households composed of unrelated individuals enjoyed a higher level of housing condition at zero income level than the other two types of households. Households composed of families experienced a lower level and households that are mixed (a combination of the first two types) experienced the lowest initial level of housing condition. The relative effects of income on housing condition was just the opposite. Household income had the largest positive effect for mixed households, next for families, and the smallest for unrelated individuals. This indicates that the income elasticity for housing is greatest for mixed households, next for families and smallest for unrelated individuals. Since only 15 percent of the households in the United States in 1960 were composed of unrelated individuals, changing income levels would have a relatively larger effect for 85 percent of the total households [34].

It was found in estimating some preliminary models that the marginal effect of income was zero beyond $7,000. Therefore in the final models, where income was entered as a logarithm to the base 10, all income above $7,000 was set equal to $7,000. Thus while the effect of income on housing condition is relatively large for families and mixed households, it is thought to approach zero beyond $7,000.

These findings only add to other information indicating that low levels of housing condition are associated with low income levels. It suggests that public efforts in housing should be focused at the lower income levels. However, evidence summarized in Senate document, Promises to Keep: Housing Need and Federal Failure in Rural America [19], indicates that housing assistance; either through direct assistance, guaranteed loans, or income tax deductions; goes disproportionately to households with greater than $3,000 annual income. Both the incidence and the total amount of poor housing occupied by households with low incomes indicate the need to redirect national housing policy.

Education

The gross and net effects of education of the household head on housing condition were also found to be large relative to the effects of other characteristics. Information obtained from estimating the abbreviated models (presented in Chapter IV) suggested that the effect of education was different when ten and a half years or less had been attained than when the household head had more than ten and a half years of education. This hypothesis was found to be true. Using the measure, INDEX, the positive linear effects of education in the first range ($\leq$ ten and a half years) were found to be approximately seven and a half times greater than the effects in the second range (> ten and a half years). Even so, the effects of education in the second range on housing condition (INDEX) were significantly different from zero at the < .0005 level (positive).

It was not surprising to find education having relatively large gross effects on housing condition. Low levels of education are known to be associated with low income levels which in turn are associated with poor housing conditions. However, even with the effects of income and other occupant characteristics removed, education still has a substantial effect on housing condition.

Occupational Classification

The occupation of the household head was the third occupant characteristic found to explain a relatively large proportion of the variation in housing condition in both the gross and net relationships. Certain classifications were found to have opposite effects depending upon the housing characteristic in question. Farmers are likely to occupy a housing unit with six rooms or more but not likely to enjoy most of the other desirable housing characteristics. Most of the other classifications do not exhibit opposite relationships. The net relationships reveal that service workers, farmers, laborers, and farm laborers experience the poorest housing conditions. Estimates from this same model indicate that farm managers, farm foremen, and white collar workers enjoy the better housing conditions.

Size of Place

The residence categories, called here "size of place," exhibited relatively smaller net effects than gross effects on measures of housing condition. As was noted earlier these characteristics exhibited some opposite gross and net relationships. As the population increased the likelihood that the household enjoyed a unit with six or more rooms or exclusive access to kitchen facilities decreased. For the other measures increasing population has a positive effect on housing condition.

The plumbing and heating characteristics of housing are the most strongly affected by these residence categories. Rural farm and rural nonfarm residents are the least likely to enjoy any of the four more desirable types of heating equipment. The estimated net relationships with INDEX also indicate this pattern of relationships. The rural farm residents have the lowest levels of housing condition, followed by rural nonfarm residents. Then the condition of housing increases as the population increases from places of 2,500 population to places of 1,000,000 and more. Residents of urban territories outside of places experience almost the same levels of housing condition as residents of places that have 1,000,000 and more population.

This evidence only adds to the already substantial volume of evidence pointing to the higher incidence and large total amount of poor housing in rural areas and smaller places. According to the Census in 1960, 63.7 percent of all substandard housing units were located outside of Standard Metropolitan Statistical Areas (SMSA), while only 37.6 percent of all housing units fall in this residence category [34]. By 1968, the Current Population Survey indicates that the percentage of all units located outside SMSAs decreased slightly to 36.8 percent while the percentage of all substandard units located outside of SMSAs increased to 67.3 percent. This evidence suggests that government programs to improve housing should be focused in rural areas and smaller places. However, government programs presently are not focused this direction.

The United States government response to housing problems began in the mid-1930's with some public housing under public works and related programs. Since that time the annual output of federally assisted housing starts has increased. Through 1969 the number of assisted starts totaled 1,440,300. Thirty-four percent of these were in non-metropolitan areas. Of the 803,700 public housing units only 21 percent were located in non-metropolitan areas. Twenty-one and three-tenths percent of the total number of assisted starts were handled through FHA programs. Only 11 percent of these FHA starts were in rural areas. FHA assisted starts totaled 329,300 and 87 percent of these were in non-metropolitan areas [19].

Also presently the two agencies primarily responsible for implementing housing policy miss a significant proportion of the United States population located in smaller places. The Farmer's Home Administration (FmHA) has a legislative mandate to operate in places with 5,500 population or less. The Federal Housing Administration (FHA) is said to be ineffective in places of less than 25,000 population [19]. According to the 1970 Census 16.9 percent of our population live in places of 5,000 to 25,000 population.

This means that significant federal housing programs are not available to almost 16.9 percent of United States citizens.

The evidence on housing conditions and government response indicate that national housing policy needs to be directed toward residents of rural areas and smaller places.

Type of Tenure

The type of tenure variables were also important in explaining the variation in several measures of housing condition. Even with the multicolinearity involved, the dummy variable indicating owner occupancy explained 5 percent of the total variation in INDEX, according to the R^2 delete. With each of the measures of housing condition and for both gross and net relationships the effect of owner occupancy relative to renter status was always positive. These results support the past and present housing policy emphasis on home ownership. They also could be used to support an effective home ownership policy for low income families.

Race of the Household Head

The estimated gross and net effects of the race variables on housing condition add support to previous evidence regarding racial disparities. With each of the measures, household heads who were Negro or had a Spanish surname experienced lower levels of housing condition than white household heads. The finding that the net relationships were also negative indicates that even with the effects of lower educational and income levels removed, household heads who are from a minority background still experience lower levels of housing condition. If these disparities are to be ameliorated, housing policy must be directed disproportionately toward minority groups.

Statistical Significance

The multiple regression models used to estimate the net relationships between the socio-economic and locational characteristics of the occupants and measures of housing condition, have binary dependent variables. As a consequence statistical tests of the regression coefficients using ordinary least squares estimates of the variances are not valid. The only multiple regression model for which tests using OLS estimates are valid then is the one with INDEX as the dependent variable.

A surprisingly large number of the coefficients tested significantly different from zero at $< .005$ level of significance. Only five of the estimated coefficients were not statistically different from zero at $< .05$ level of significance. In most cases the relevant statistical test would be a test for the equality of two coefficients. However, the test against zero does indicate that a high percentage of variables exhibit a statistically significant relationship with INDEX.

It should also be noted that less than half of the variation (.4488) of INDEX was explained by our independent variables. However, with national, cross-sectional and single household data a large variation within the sample could be expected.

Net versus Gross

Most of the estimated net relationships with individual desirable housing characteristics differed from the estimated gross relationships only in magnitude. However, for three sets of socio-economic and locational characteristics--sex of household head, metropolitan residence in 1955, and dependency--the net relationships were in a different direction than the gross relationships. The changes with the variable female head of household are most noticeable. All of the estimated gross relationships between the presence of a female household head and the desirable housing characteristics are negative. However, seven of the ten estimated net relationships with the binary dependent variables exhibit a positive relationship with housing condition.

In most cases the estimated gross relationships have greater "ranges of effects" than the estimated net relationships. The excluded variables, which vary consistently with the explanatory variable which is being studied, cause the range of the estimated gross relationships to be overstated. However, in several cases, which are presented in the summary of Chapter V, the "range of effects" are greater for the estimated net relationships than for the estimated gross relationships. For these cases the "ranges of effects" for the estimated gross relationships were decreased by the uncontrolled explanatory variables.

Further Research Needs

The suggestions for further research fall into two categories: (1) those concerning the relationships between socio-economic and locational characteristics of the occupants and housing condition, and (2) those concerning the measurement of housing condition.

Measurement of Housing Condition

Work presented in Appendix I indicates that present measures of housing condition are probably inadequate for most policy decisions. The measure constructed in this study (INDEX), although an improvement over those presently used, has significant deficiencies. Other measures are needed in order adequately to describe housing conditions and then formulate national housing policy. A limited list of research topics is suggested here:

1. Research is needed to determine the physical characteristics which should be included in a nationally used measure of housing condition.

2. A scale study of satisfaction levels is needed to determine the importance of various physical housing characteristics relative to housing condition.

3. A socially acceptable level of housing condition needs to be determined and a methodology devised to re-estimate this level as social conditions dictate.

The second category of research needs concern the relationships between socio-economic and locational characteristics of the occupants and housing condition.

1. The relationships examined in this study and others could be used to evaluate the effectiveness of United States housing policies. Specifically housing programs should be examined in the light of their stated objectives, their actual impact, and these studied relationships. Some of the evidence presented in <u>Promises to Keep: Housing Need and Federal Failure in Rural America</u> [19] indicate that national policies may be directed away from rather than toward their stated target populations.

2. Work is also needed to examine the administrative framework for and the cost of administering housing programs which would meet presently stated goals. A cursory examination of present housing program performance [19] indicates that the costs of meeting stated goals have not been totally reckoned with. Added information is needed to facilitate bringing funding in line with stated goals.

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APPENDICES

APPENDIX I

REPRESENTATIVENESS OF STRUCTURAL CONDITION

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REPRESENTATIVENESS OF STRUCTURAL CONDITION

Examining the Census measure of structural condition for representativeness of general housing condition was not part of the initial research proposal. However, as the work progressed, it became apparent that this should be included as a secondary objective for several reasons. First, evidence was discovered which indicated that structural condition may not be representative of general housing condition. This evidence will be presented later on in this appendix. Secondly, the literature exhibits an acceptance of the assumption that structural condition is representative of general housing condition.

The Assumed Hypotheses

An obvious indication of this belief is the common reference to structural condition as a measure of housing "quality."

> The U.S. Bureau of the Census, in an attempt to rate the quality of housing in 1960, used three classifications of housing quality--sound, deteriorating, and dilapidated [23, p. 4].

Also, it is suggested that housing units that are sound and have complete plumbing facilities have other good housing qualities.

> The Bureau of the Census has adopted a combination of soundness of structure and completeness of plumbing facilities as a partial standard for measuring quality. Such factors ad adequate lighting and ventilation, and the neighborhood also are recognized as quality factors, but the Bureau points out that these qualities are difficult to measure in a broad Census enumeration. Also, these qualities are generally found packaged-in with houses that are sound and have complete plumbing [16, p. 23].

A related assumption is that various other characteristics of housing are, in fact, representative of general housing condition. For example, if age of housing or plumbing facilities are representative of general housing condition which would include structural condition, then structural condition should represent plumbing facilities, the age of housing, and general housing condition. Spurlock states some of these assumptions.

> To obtain an operational indicator of adequate housing, the 1,413 respondents were grouped into three categories. The category with complete plumbing includes all housing units in the sample with the following: hot and cold running water, inside; a flush toilet, inside; a bathtub or shower; a commercial water supply or drilled well; and access to a public sewer or septic tank. Such housing units were designated as adequate. It was assumed that such housing would generally be structurally sound and adequate in other quality aspects, though there are undoubtedly exceptions. . . .
>
> . . . .
>
> In this report, the terms with complete plumbing, with partial plumbing, and with no plumbing are used interchangeably with adequate housing, partially adequate housing, and inadequate housing, respectively [17, p. 6].
>
> The age of housing may be indicative of its quality. As a general rule, older houses have fewer modern features, are more likely to be dilapidated, and are often in need of extensive remodeling or repair [16, p. 13].

Bird, Beverly and Simmons also state the assumption regarding the age of housing:

> An inventory on the age of housing units can be a rough measurement of the adequacy of housing and of trends in housing construction [23, p. 3].

Two other assumptions for which there is some empirical evidence tend to support the general assumption that structural condition is representative of general housing condition. One is that an index of general housing condition including structural condition is insensitive to weight changes. And the second is that individual measures of housing condition are highly positively correlated. Weisgerber, when constructing an index of housing condition from 17 separate measures, stated that:

> In trying to arrive at a satisfactory weighting system for combining the various factors into a single index, several variations based on relative factor importance were tested. The net rating for each dwelling was found not to change a great deal as several plausible weighting systems were tried [37, p. 101].

The indicated insensitivity to changing weights would suggest that the included measures are positively correlated. Two other studies indicate the existence of a high positive correlation between individual measures of housing condition [6, 15].

It is not my contention that any of the individual studies cited argues strongly for the assumption that structural condition is representative of general housing condition but that a review of these works can lead to the conclusions that: (1) the "important" measures of housing condition are highly-positively correlated, and (2) some of those mentioned including structural condition are representative of general housing condition.

The assumption to be examined here--structural condition as measured by the Census represents general housing condition--is difficult to test using Census data for several reasons. First, only a small number of other measures are included. As a consequence, structural condition could be highly correlated with each one and still not be representative. A second difficulty is a measurement problem. What level of correlation must structural condition have with each other measure or combination of measures in order to be either highly correlated or, the more basic question, to be representative? Lacking definitive solutions to these difficulties we will provide information on but not test the basic question specifically.

Assumptions

Several assumptions are presented to establish the basis for examining representativeness.

1. Housing condition is a multi-dimensional concept including more than just structural condition. This has been brought out clearly in our discussion of theoretical considerations in Chapter 2.

2. Other measures of housing conditions included in Census data are a part of general housing condition. An examination of the Census measures (Table A-I-1) will reveal that they are similar to some of the items included in other measures--Schaeffer and Edwards [15] and the APHA method [3].

3. Each of the other Census measures and the measure of structural condition can be ranked ordinally with respect to their relationship to general housing condition. This has been done in Table A-I-1.

TABLE A-I-1.--Parameter Estimates from Canonical Correlation: Structural Condition = f (Other Measures of Housing Condition)

	Variables Included[b]	Parameter Estimates a_j and b_j
1.	Structural Condition	
X_1	Sound	1.1631
X_2	Deteriorating	- .9599
X_3	Dilapidated	-2.5474
2.	Telephone	
Y_1	Telephone Available	.5089
	No Telephone	0[a]
3.	Kitchen Facilities	
	Direct Access, Exclusive Use	0[a]
Y_3	Direct Shared Access or No Equipment	.1021
Y_4	Access Through Another Unit	- .3225
4.	Water Supply	
	Hot and Cold Piped In	0[a]
Y_5	Cold Piped Inside	-1.1608
Y_6	Water Piped Outside	-2.0941
Y_7	No Piped Water	-1.7850
5.	Year Built	
Y_8	1959 through March 1960	.7266
Y_9	1955 through 1958	.6734
Y_{10}	1950 through 1954	.6202
Y_{11}	1940 through 1949	.4538
Y_{12}	1930 through 1939	.2789
	1929 or earlier	0[a]
6.	Heating Equipment	
Y_{13}	Built-in Electric Units	.3649
Y_{14}	Steam or Hot Water	.6023
Y_{15}	Warm Air Furnace	.4669
Y_{16}	Floor, Wall or Pipeless Furnace	.4684
	Other Means, With Flue	0[a]
Y_{17}	Other Means, No Flue	- .0769
Y_{18}	Not Heated	- .3771

TABLE A-I-1.--Continued

Variables Included[b]		Parameter Estimates a_j and b_j
7. Number of Rooms		
Y_{19}	10 or More Rooms	.1651
Y_{20}	9 Rooms	.1579
Y_{21}	8 Rooms	.1489
Y_{22}	7 Rooms	.1759
Y_{23}	6 Rooms	.1625
Y_{24}	5 Rooms	.0931
Y_{25}	4 Rooms	.0022
Y_{26}	3 Rooms	- .0591
Y_{27}	2 Rooms	- .1904
	1 Room	0[a]

		9. Access to a Flush Toilet					
		Exclusive		Shared		None	
8. Access to a Bath or Shower	Exclusive	Y_{28}	.6758	Y_{31}	- .7630		0[a]
	Shared	Y_{29}	.8523	Y_{32}	- .1117	Y_{34}	-1.8506
	None	Y_{30}	-.1461	Y_{33}	-1.2430	Y_{35}	.2426

[a]This variable was omitted to avoid singularity.

[b]All variables are dichotomous equalling one if the condition holds and zero otherwise.

Source: Census tapes from the one-in-a-thousand sample, 1960 Censuses of Population and Housing, 25 percent sample portion [36].

It is assumed that having a telephone available is a higher level of condition than no telephone. With respect to kitchan facilities, it is believed that having direct access with exclusive use is the highest level of condition with direct shared access or no equipment being the next level and access to facilities through another unit being the lowest level of condition. For the measure called water supply hot and cold water piped inside is designated the highest level of condition, cold water piped inside, next, followed by water piped outside and the lowest level being no piped water. For the measure, year built, it is assumed that the newer the higher the condition level. The highest level of heating equipment is assumed to be built-in electric units; the next level, steam or hot water; followed by warm air furnace; then by floor, wall or pipeless furnace; next, other means with flue; then other means, no flue; and the lowest level of condition, not heated. It is assumed with the next measure that the more rooms in the housing unit, the higher the condition level. The next two measures of housing condition, access to a flush toilet and access to a bath or shower, each have three levels of condition going from highest to lowest, exclusive, shared and none respectively. Also these two measures have been combined to make nine relative condition levels. Exclusive use of a bath or shower and flush toilet is assumed to be a higher level than shared use of both which is higher than no access to either one. Condition levels are also ranked from highest to lowest as the access to one item is held constant while the other is varied from exclusive to none.

4. Structural condition should vary consistently with the ordinal ranking of most of these other housing condition measures or it does not generally reflect housing condition.

Canonical Correlation

It is believed as stated in Assumption 4 above that structural condition should exhibit a positive relationship with other measures of housing condition if it is to be representative of general housing condition. Therefore, the three research methods employed here examine the data for a positive relationship.

The first, canonical correlation, is used to estimate net relationships between structural condition and other measures of housing condition. Each of the levels of housing condition is represented by a binary variable as presented in Table A-I-1. For example:

$X_1 = 1$ if the unit is sound

$\quad\;\; 0$ otherwise

$X_2 = 1$ if the unit is deteriorating

$\quad\;\; 0$ otherwise

$X_3 = 1$ if the unit is dilapidated

$\quad\;\; 0$ otherwise

The Y_i $(i = 1, 2, \ldots, 35)$ are also binary variables equalling 1 if the condition holds and zero otherwise. These binary variables are then combined linearly. The i^{th} observation would look like this:

$$a_1X_{i1} + a_2X_{i2} + a_3X_{i3} = \hat{X}_i$$

$$b_1Y_{i1} + b_2Y_{i2} + \ldots + b_{35}Y_{i35} = \hat{Y}_i$$

Where:

X_{ij} and Y_{ij} are the binary variables presented in Table A-I-1, b_j and a_j are the coefficients to be estimated, and $\hat{X}_i$ and $\hat{Y}_i$ are the linear combinations of the X's and Y's, respectively, or canonical variates.

a_j and b_j are estimated such that the correlation between $\hat{X}_i$ and $\hat{Y}_i$ is maximized.

Canonical correlation was used for several reasons. First, it can provide estimates of the unique set of net relationships between two sets of variables which provides maximum correlation. Secondly, it allows for all variables to be binary. And lastly, it allows for a stochastic component in both sets of variables. A further discussion of this model and its characteristics can be found in Appendix III.

Empirical Results

The results of the canonical correlation analysis are presented in Tables A-I-1 and A-I-2. Only the parameter estimates for the first canonical correlation coefficient are presented even though all were significant at <.005 level of significance as can be seen in Table A-I-2. This was done because we are interested in that set of coefficients which yields the maximum correlation between structural condition and other measures of housing condition.

TABLE A-I-2.--Tests[a] for Linear Relationships Between Structural Condition and Other Measures of Housing Condition

Null Hypotheses	Chi-Square	Degrees of Freedom	Significance Level Ho Rejected
1. Ho: The combined relationships R_{c1},[b] R_{c2} and R_{c3} are equal to zero.			<.005[c]
2. Ho: The combined relationships R_{c2} and R_{c3} are equal to zero.	7440.161	66	<.005
3. Ho: The relationship R_{c3} is equal to zero.	963.257	32	<.005

[a] R_{c1}, R_{c2}, and R_{c3} are the largest, next largest, and smallest canonical correlations, respectively. $R_{c1} = .5465$ $R_{c2} = .3401$ $R_{c3} = .1346$

[b] The statistical tests used here are explained in Appendix III, the section on canonical correlation.

[c] The chi-square was not determined for this test, but the reader will note from Appendix III and references cited that Ho being rejected at <.005 level of significance implies Ho is rejected at <.005 level of significance in the first test.

Source: Census tapes from the one-in-a-thousand sample, 1960 Censuses of Population and Housing, 25 percent sample portion [36].

1. Structural Condition

Notice that the parameter estimates for the levels of structural condition are consistent with their ordinal rankings presented earlier in Assumption 3. It follows, then, from Assumption 4 that parameter estimates for the other measures of structural condition should also be consistent with their ordinal rankings. We will examine each other measure of housing condition in turn.

2. Telephone

This condition holds for telephone as telephone available, the higher condition level, has a larger parameter than no telephone available.

3. Kitchen Facilities

One of the three possible comparisons within the measure, kitchen facilities, shows a negative relationship. Direct access, exclusive use, a higher condition level, has a lower parameter estimate than direct shared access or no equipment.

4. Water Supply

One of the possible comparisons within this measure exhibits a negative relationship. Water piped outside, a higher condition level, has a lower parameter estimate than no piped water.

5. Year Built

All possible comparisons within the measure, year built, exhibit positive relationships.

6. Heating Equipment

Several negative relationships are exhibited within this measure: (1) built-in electric units and steam or hot water; (2) built-in electric units and warm air furnace; (3) built-in electric units and floor, wall or pipeless furnace; and (4) warm air furnace and floor, wall or pipeless furnace. In each of these four cases, the higher condition level has the lower estimated parameter.

7. Number of Rooms

The number of rooms is another measure which exhibited several negative relationships with structural condition: (1) 10 rooms or more and 7 rooms; (2) 9 rooms and 7 rooms; (3) 9 rooms and 6 rooms; (4) 8 rooms and 7 rooms; (5) 8 rooms and 6 rooms; (6) 3 rooms and 1 room; and (7) 2 rooms and 1 room. In each of these seven cases, the higher level of condition has the lower estimated parameter.

8. Access to a Bath or Shower and

9. Access to a Flush Toilet

The combined measures, access to a flush toilet and access to a bath or shower also exhibited several negative relationships with structural condition. In each of these cases, the higher condition level exhibited a lower level parameter estimate: (1) exclusive access to a bath or shower with shared access to a flush toilet (Y_{31}) and exclusive access to a bath or shower with no flush toilet; (2) no bath

5. Year Built

All possible [illegible] exhibit positive [illegible]

6. Heating Equipment

Several [illegible] measure: (1) [illegible] (2) built-in [illegible] units and floor, [illegible] and floor, wall [illegible] higher condition [illegible]

7. Number of Rooms

The number [illegible] negative relationship[illegible] more and 7 rooms, (2) [illegible] (4) 8 rooms and 7 rooms [illegible] room; and (7) 2 rooms [illegible] higher level of condition [illegible]

8. Access to a Bath or Shower and

9. Access to a Flush Toilet

The combined measures, access to a flush toilet and access to a bath or shower also exhibited several negative relationships with structural condition. In each of these cases, the higher condition level exhibited a lower level parameter estimate: (1) exclusive access to a bath or shower with shared access to a flush toilet (Y_{51}) and exclusive access to a bath or shower with no flush toilet; (2) no bath or shower with shared access to a flush toilet (Y_{33}) and no bath, shower or flush toilet (Y_{35}); (3) exclusive access to bath or shower with exclusive access to a flush toilet (Y_{28}) and shared access to a bath or shower with exclusive access to a flush toilet (Y_{29}); (4) exclusive access to a bath or shower with shared access to a flush toilet (Y_{31}), and shared access to a bath or shower with shared access to a flush toilet (Y_{32}); (5) shared access to a bath or shower with no flush toilet (Y_{34}) and no bath, shower or flush toilet (Y_{35}); (6) exclusive access to a bath or shower with no flush toilet and shared access to a bath or shower with no flush toilet (Y_{34}); and (7) shared access to a bath or shower with shared access to a flush toilet (Y_{32}) and no bath, shower or flush toilet (Y_{35}).

The empirical results indicate that negative relationships exist within six of the eight other measures of housing condition when correlated to structural condition. None of the other measures has an overall negative net relationship to structural condition. However, the existence of negative relationships within a high proportion of the other measures of housing condition does cast doubt on the assumption that they are highly positively related to structural condition.

Contingency Tables

The second research tool, contingency tables, was used to examine the gross relationships between structural condition and each of the other measures of housing condition. The resulting tables were used to test for a relationship between the measures and to examine the nature of that relationship. In testing for a relationship between the measures, the null hypothesis being tested was:

Ho: The probability of a housing unit having any particular level of structural condition is not affected by the level of housing condition that the housing unit has according to another measure.

In each contingency table where structural condition was cross tabulated with other measures of housing condition, the null hypothesis was rejected at the .05 level of significance. See Appendix III for further discussion of this research method and the hypothesis tested.

Empirical Results

The results of the contingency table analysis presented in Tables A-I-3 through A-I-8 are consistent with the results from the canonical correlation. Only percent distribution of observations for various levels of housing condition are given to illustrate situations where the other measures of housing condition do not vary consistently with structural condition. The ordinal rankings used are the same as in Table A-I-1 and are specified in Assumption 3, page 239. The reader will notice that the condition, availability of a telephone, is included in the canonical correlation analysis but excluded from the contingency table analysis. Also, the number of bathrooms which is included in the contingency table analysis is not in the canonical correlation. This occurs because the canonical correlation utilizes the 25 percent sample which does not contain information on the number of bathrooms for all 52,699 households. It was later decided to use this information. Thus, the remainder of the research utilizes the 20 percent sample where the number of bathrooms is reported for

all 41,605 households. The change in samples, which resulted in dropping some of the observations of the 25 percent sample, should not bias the analysis.

Eight contingency tables were constructed. They involved cross tabulations between structural condition and eight other measures of housing conditions: (1) Access to Kitchen Facilities, Table A-I-3; (2) Number of Bathrooms, Table A-I-4; (3) Water Supply, Table A-I-5; (4) Year Built, Table A-I-6; (5) Number of Rooms, Table A-I-7; (6) Type of Heating Equipment, Table A-I-8; (7) Access to a Flush Toilet; and (8) Access to a Bath or Shower. Data from the first six cross tabulations are presented. The last two cross tabulations exhibited only positive relationships between structural condition and access to a flush toilet and access to a bath or shower. The first cross tabulation, Access to Kitchen Facilities, Table A-I-3, exhibited only a weak positive relationship with structural condition. The percentage of dilapidated units having exclusive use of kitchen facilities is 97.5. This increases to only 97.7 percent for deteriorating housing and 99.0 percent for sound housing. The other five cross tabulations exhibit some negative relationships with structural condition.

The second cross tabulation, Table A-I-4, reveals a negative relationship between housing units with two or more bathrooms and one and a partial. Of the units with two or more bathrooms, 96.6 percent are sound. The percent of units that are sound increases as you move to the next lower condition level for number of bathrooms: 96.7 percent of the units with one bathroom and a partial are sound. Also,

TABLE A-I-3.--Structural Condition by Access to Kitchen Equipment

Structural Condition	Kitchen Access: Direct Access Exclusive Use	Direct-Shared Access or None	Shared Access Through Another Unit	Total
	(Percent)			
Sound	99.0	.9	.1	100.0
Deteriorating	97.7	2.1	.2	100.0
Dilapidated	97.5	2.3	.2	100.0

χ^2 = 90.606 d.f. = 4 Ho rejected at <.005 level of significance.

Source: Census tapes from the one-in-a-thousand sample, 1960 Censuses of Population and Housing, 20 percent sample portion [36].

TABLE A-I-4.--Structural Condition by the Number of Bathrooms

Structural Condition	Number of Bathrooms: Two or More	One and Partial	One	Shared Partial or None
	(Percent)			
Sound	96.6	96.7	88.1	42.8
Deteriorating	3.0	3.0	10.1	36.1
Dilapidated	0.4	0.2	1.9	21.1
Total	100.0	99.9[a]	100.1[a]	100.0

χ^2 = 9171.862 d.f. = 6 Ho rejected at <.005 level of significance.

[a]Does not sum to 100 because of rounding error.

Source: Census tapes from the one-in-a-thousand sample, 1960 Censuses of Population and Housing, 20 percent sample portion [36].

one would expect the percent of dilapidated units to increase when moving from the highest condition level to the lowest for number of bathrooms. However, the percentage drops from .4 percent to .2 percent between two or more bathrooms and one and a partial.

A careful examination of the other four tables reveals similar results. The cross tabulation between water supply and structural condition reveals a negative relationship as one moves from water piped outside to no piped water (Table A-I-5). We would expect the percentage of units that are sound to drop as we move from a higher level of water supply condition to a lower one, but between the two in question, it increases from 27.8 percent to 31.8 percent. Over this same range, we would expect the percentage of dilapidated units to increase, but it decreases from 38.0 to 28.2 percent. Also, in this table the percent of deteriorating units first increases, then decreases, and increases again which is not consistent with a strong positive relationship.

The cross tabulation between year built and structural condition (Table A-I-6) reveals a consistent negative relationship between the structural levels of deteriorating and dilapidated. One would expect a high positive relationship to result in a higher percentage of the deteriorating units to be newer than dilapidated units. In fact, this relationship does not hold. Prior to 1930, 68.1 percent of the deteriorating units were built, while 66.2 percent of the dilapidated units were built before that time. The percentages are calculated in a different direction in Table A-I-6 than in the other tables to illustrate the negative relationship more clearly.

TABLE A-I-5.--Structural Condition by Type of Water Supply

Structural Condition	Water Supply			
	Hot and Cold Water Piped In	Cold Piped In	Water Piped Outside	No Piped Water
	(Percent)			
Sound	88.5	42.1	27.8	31.8
Deteriorating	9.6	37.6	34.2	40.0
Dilapidated	1.9	20.3	38.0	28.2
Total	100.0	100.0	100.0	100.0

χ^2 = 9308.918 d.f. = 6 Ho rejected at <.005 level of significance.

Source: Census tapes from the one-in-a-thousand sample, 1960 Censuses of Population and Housing, 20 percent sample portion [36].

TABLE A-I-6.--Structural Condition by the Year Built

Structural Condition	Year Built						
	1959-1960	1955-1958	1950-1954	1940-1949	1930-1939	1929 or Before	Total
	(Percent)						
Sound	3.9	12.7	15.1	15.3	10.9	42.0	99.9[a]
Deteriorating	.4	1.9	4.4	12.4	12.7	68.1	99.9[a]
Dilapidated	.8	2.3	4.6	12.9	13.3	66.2	100.1[a]

χ^2 = 2231.279 d.f. = 10 Ho rejected at <.005 level of significance.

[a]Does not sum to 100 because of rounding error.

Source: Census tapes from the one-in-a-thousand sample, 1960 Censuses of Population and Housing, 20 percent sample portion [36].

Table A-I-7 reveals some similar negative relationships between structural condition and the number of rooms in a housing unit. A positive relationship is exhibited over the range of two rooms through six rooms. However, for categories, seven rooms through ten or more rooms, the percentage of sound units in each category is less than that for six rooms. Over the range from eight rooms through ten or more rooms, the percentage of dilapidated units in each category increases. There is also a negative relationship over the range, one room through two rooms. As one moves from one room to two rooms, percentage of sound units decreases and the percent of dilapidated units increases.

The last table, Table A-I-8, demonstrates a number of negative relationships between the type of heating equipment and structural condition. The levels of heating condition are listed from left being the highest level to the far right as the lowest level. Notice the large number of negative relationships exhibited. As you move to a lower level of heating equipment, the percentage of sound units increases in three cases: (1) from steam, hot water or warm air to floor, wall or pipeless furnace; (2) from other means with a flue to other means no flue; and (3) from other means with a flue to not heated. In the second of these cases, the percentage of dilapidated units drops from 12.2 percent to 9.3 percent.

The results of the contingency tables are similar to those of the canonical correlation. A substantial proportion of the measures of housing condition cross tabulated with structural condition exhibited some negative relationships within their levels of condition,

TABLE A-I-7.--Structural Condition by the Number of Rooms

Structural Condition	Number of Rooms									
	Ten or More	Nine	Eight	Seven	Six	Five	Four	Three	Two	One
	(Percent)									
Sound	88.1	86.2	86.4	88.6	88.7	87.1	78.5	73.2	65.4	66.4
Deteriorating	9.0	11.5	11.1	9.7	9.2	9.8	16.3	18.4	20.6	21.0
Dilapidated	2.9	2.3	2.5	1.8	2.1	3.1	5.2	8.4	14.0	12.6
Total	100.0	100.0	100.0	100.1[a]	100.0	100.0	100.0	100.0	100.0	100.0

χ^2 = 1669.194 d.f. = 18 Ho rejected at <.005 level of significance.

[a]Does not sum to 100 because of rounding error.

Source: Census tapes from the one-in-a-thousand sample, 1960 Censuses of Population and Housing, 20 percent sample portion [36].

TABLE A-I-8.--Structural Condition by Type of Heating Equipment

Structural Condition	Heating Equipment					
	Built-in Electric	Steam, Hot Water or Warm Air	Floor, Wall or Pipeless	Other Means With Flue	Other Means No Flue	Not Heated
	(Percent)					
Sound	94.1	91.8	93.1	60.9	67.5	62.8
Deteriorating	4.5	7.1	5.7	26.8	23.3	21.0
Dilapidated	1.4	1.2	1.2	12.2	9.3	16.2
Total	100.0	100.1[a]	100.0	99.9[a]	100.1[a]	100.0

χ^2 = 5675.405 d.f. = 10 Ho rejected at <.005 level of significance.

[a]Does not sum to 100 because of rounding error.

Source: Census tapes from the one-in-a-thousand sample, 1960 Censuses of Population and Housing, 20 percent sample portion [36].

five out of eight. Also, none of the contingency tables exhibited a totally negative relationship between structural condition and any of the other measures of housing condition. Thus, while the empirical evidence does not support a negative relationship between any of the other measures of housing condition and structural condition, it does cast doubt upon the assumption of a strong positive relationship.

Weight Sensitivity

The next empirical evidence comes from the testing of our housing condition measure, INDEX, for weight sensitivity in Chapter IV. Recall that our INDEX was a linear combination of the measures of housing condition listed in Table I-J. This INDEX was then used as the endogenous variable in a regression model with socioeconomic and locational characteristics as the predetermined variables. As the weights on the components of the INDEX were varied, it was noted that some of the regression parameter estimates changed sign. It is our contention that this should not have happened if, in fact, the different measures of housing are positively related. The mathematics of this contention have not been worked out here. It is believed that this should not have happened if the Census measure of structural condition is representative of the other measures of housing condition and general housing condition. If structural condition closely approximated these other measures, then varying the weights in the housing condition measure over a positive range should not cause a change in the direction of relationship between the socio-economic and locational characteristics of occupants and the INDEX.

Summary and Conclusions

The objective of this appendix was to examine the Census measure of structural condition for representativeness of general housing condition. We did not test directly for representativeness. Instead, evidence was presented on the net and gross relationships between structural condition and other measures of housing condition. This evidence demonstrated that a high proportion of other measures were not highly positively related to structural condition in either net or gross relationships. These results should raise serious questions about the representativeness of structural condition. The last evidence presented was derived from testing our measure of housing condition, INDEX, for weight sensitivity in Chapter IV. The finding that this INDEX is highly weight sensitive casts further doubt on the representativeness of structural condition. If structural condition was, in fact, representative, then changing weights on components of the index should have made little difference in the parameter estimates.

The empirical evidence presented here suggests that structural condition as measured in the Census is not representative of general housing condition or some of the other measures of housing condition to which it was compared. The belief was expressed in Chapter II that housing condition is multi-dimensional and includes those measures of housing condition found in the Census. Thus, work is needed to determine that combination of measures which would adequately measure housing condition.

APPENDIX II

DEFINITION OF TERMS

APPENDIX II

DEFINITION OF TERMS

The Bureau of the Census uses a number of terms whose technical meaning differs from their common usage. Their definitions are included here in order to avoid confusion.

Housing Unit.--This term assumes added importance because the household and the housing unit are used as the observation in this study.

> A house, an apartment or other group of rooms, or a single room is regarded as a housing unit when it is occupied or intended for occupancy as separate living quarters, that is, when the occupants do not live and eat with any other persons in the structure and there is either (1) direct access from the outside or through a common hall, or (2) a kitchen or cooking equipment for the exclusive use of the occupants of the unit. The occupants of a housing unit may be a family or other group of persons, or a person living alone [34, p. LIV].

This definition may, under special circumstances, include hotels, motels, rooming houses, boarding houses and institutions as housing units [34, p. LV].

Group Quarters.--Group quarters are excluded from the sample used.

> Occupied quarters which do not qualify as housing units are considered group quarters. They are located most frequently in institutions, hospitals, nurses' homes, rooming and boarding

houses, residential clubs, missions and flophouses, military and other types of barracks, college dormitories, fraternity and sorority houses, convents, and monasteries. Group quarters are also located in a house or apartment in which the living quarters are shared by the head and five or more persons unrelated to him [34, p. LVI].

Household.--The household is the observation point in the sample used.

Household--A household consists of all the persons who occupy a housing unit. A house, an apartment or other group of rooms, or a single room, is regarded as a housing unit when it is occupied or intended for occupancy as separate living quarters. Separate living quarters are those in which the occupants do not live and eat with any other persons in the structure and in which there is either (1) direct access from the outside or through a common hall, or (2) a kitchen or cooking equipment for the exclusive use of the occupants [35, p. XXII].

Family.--

A family was defined as two or more persons living in the same household who were related to each other by blood, marriage, or adoption [24, p. 185].

Primary Family.--

A primary family was composed of the head of the household and all other persons in the household related to the head [24, p. 185].

Subfamily.--

A subfamily consisted of a married couple with or without children, or one parent with one or more children under 18 years old, living in a household and related to, but not including, the head of the household or his wife. The most common example of a subfamily was a young married couple sharing the home of the husband's or wife's parents. Members of a subfamily were also members of a primary family, by definition; therefore, the number of subfamilies was not included in the number of families [24, p. 185].

Secondary Family.--

A secondary family was composed of persons related to each other but not related to the head of the household [24, p. 185].

Unrelated Individual.--

An unrelated individual was defined as a person living alone in a household, a person living in a household with other persons none of whom were related to him, or a person living in group quarters who was not an inmate of an institution [24, pp. 185, 186].

Primary Individual.--

A primary individual was an unrelated person who was head of the household [24, p. 186].

Secondary Individual.--

A secondary individual was an unrelated person who was not head of the household [24, p. 186].

Head of Household.--

The "head of household" is the member reported as the head by the household respondent. The instructions to enumerators defined the head as the person considered to be the head by the household members. However, if a married woman living with her husband was reported as the head, her husband was classified as the head for the purpose of these tabulations.

Household heads are either heads of primary families or primary individuals. The head of a primary family is a household head living with one or more persons related to him by blood, marriage, or adoption [35, pp. XXII-XXIII].

Place.--

The term "place" as used in census reports refers to a concentration of population, regardless of the existence of legally prescribed limits, powers, or functions. Most of the places listed are incorporated as cities, towns, villages, or boroughs. In addition, the large unincorporated places outside the urbanized areas were delineated, and those places with a population of 2,500 or more are treated as urban in the same manner as incorporated places of equal size. Each unincorporated place possesses a definite nucleus of residences and has its boundaries drawn so as to include, if feasible, all the surrounding closely settled area. . . .

. . . .

As it did for the 1950 Census, the Bureau delineated, in advance of enumeration, boundaries for densely settled population centers without corporate limits to be covered in the 1960 Census [35, pp. VII-IX].

Urban.--

In addition to its central city or cities, an urbanized area also contains the following types of contiguous areas, which together constitute its urban fringe:

1. Incorporated places with 2,500 inhabitants or more.

2. Incorporated places with less than 2,500 inhabitants, provided each has a closely settled area of 100 housing units or more.

3. Towns in the New England states, townships in New Jersey and Pennsylvania and counties elsewhere which are classified as urban.

4. Enumeration districts in unincorporated territory with a population density of 1,000 inhabitants or more per square mile. (The areas of large nonresidential tracts devoted to such urban land uses as railroad yards, factories, and cemeteries, were excluded in computing the population density of an ED.)

5. Other ED's, provided that they served one of the following purposes:

   a. To eliminate enclaves.

   b. To close indentations in the urbanized areas of one mile or less across the open end.

   c. To link outlying ED's of qualifying density that were no more than 1-1/2 miles from the main body of the urbanized area [35, p. VII].

Rural Farm and Rural Nonfarm.--

The rural population is subdivided into the rural-farm population, which comprises all rural residents living on farms, and the rural-nonfarm population, which comprises the remaining rural population. In the 1960 Census, the farm population includes persons living in rural territory on places of 10 or more acres from which sales of farm products amounted to $50 or more in 1959 or on places of less than 10 acres from which sales of farm products amounted to $250 or more in 1959. . . .

. . . .

Persons were also classified as nonfarm if their household paid rent for the house but their rent did not include any land used for farming [35, p. VII].

Race.--

Race--The concept of race, as it has been used by the Bureau of the Census, is derived from that which is commonly accepted by the general public. It does not reflect clear-cut definitions of biological stock, and several categories obviously refer to national origin.

Negro--In addition to persons of Negro and of mixed Negro and white descent, this classification includes persons of mixed Indian and Negro descent, unless the Indian ancestry very definitely predominates or unless the individual is regarded as an Indian in the community.

Other races--The category "other races" includes all nonwhite races other than Negro.

Mixed parentage--Persons of mixed racial parentage are classified according to the race of the nonwhite parent, and mixtures of nonwhite races are classified according to the race of the father, with the special exceptions noted above [35, p. XIII].

Occupational Classifications.--

Classification system--The occupational classification system is organized into 12 major groups. It consists of 494 items, 297 of which are specific occupational categories and the remainder are subgroupings (mainly on the basis of industry) of 13 of the occupational categories [35, p. XXVIII].

A complete list of the occupational classification systems used by the U.S. Bureau of the Census in 1960 can be found in the Census of Population, 1960, "Detailed Characteristics, United States Summary" [35].

Income.--

Information on income for the calendar year 1959 was requested from all persons 14 years old and over in the sample. "Total income" is the sum of the amounts reported in P32 (wage or salary income), P33 (self-employment income), and P34 (other income). Earnings were obtained by summing wage or salary and self-employment income. The figures represent the amount of income received before deductions for personal income taxes, Social Security, bond purchases, union dues, etc.

Receipts from the following sources were not included as income: money received from the sale of property, unless the recipient was engaged in the business of selling such property;

the value of income "in kind," such as free living quarters or food produced and consumed in the home; withdrawals of bank deposits; money borrowed; tax refunds; gifts and lump sum inheritances or insurance benefits.

Wage or salary income--this is defined as the total money earnings received for work performed as an employee. It includes wages, salary, pay from Armed Forces, commissions, tips, piece-rate payments, and cash bonuses earned.

Self-employment income--this is defined as net money income (gross receipts minus operating expenses) from a business, farm, or professional enterprise in which the person was engaged on his own account. Gross receipts include the value of all goods sold and services rendered. Expenses include the costs of goods purchased, rent, heat, light, power, depreciation charges, wages and salaries paid, business taxes, etc.

Income other than earnings--this includes money income received from sources other than wages or salary and self-employment, such as net income (or loss) from rents or receipts from roomers or boarders; royalties; interest, dividends, and periodic income from estates and trust funds; Social Security benefits; pensions, veterans' payments, military allotments for dependents, unemployment insurance, and public assistance or other governmental payments; and periodic contributions for support from persons who are not members of the household, alimony, and periodic receipts from insurance policies or annuities. . . .

. . . .

In the statistics on family income, the combined incomes of all members of each family are treated as a single amount; whereas in the statistics on the income of unrelated individuals and in those on the income of persons 14 years old and over the classification is by the amount of their own income. Although the time period covered by the income statistics is the calendar year 1959, the characteristics of persons and the composition of families refer to the time of enumeration. Thus, the income of the family does not include amounts received by persons who were members of the family during all or part of the calendar year 1959 if these persons no longer resided with the family at the time of the interview. On the other hand, family income includes amounts reported by related persons who did not reside with the family during 1959 but who were members of the family at the time of enumeration. For most of the families, however, the income reported was received by persons who were members of the family throughout 1959 [35, pp. XXXIX-XL].

The variables used in this research are family income and the sum of individual incomes for households of unrelated individuals.

Owner vs. Renter.--

Tenure (H12)--A housing unit is "owner occupied" (reported as "owned or being bought" on the enumeration forms) if the owner or co-owner lives in the unit, even if it is mortgaged or not fully paid for. The owner need not be the head of the household. A cooperative apartment unit is "owner occupied" only if the owner lives in it.

All other occupied units are classified as "renter occupied," including units rented for cash as well as units occupied without payment of cash rent. Units rented for cash (reported on the direct-interview form as "rented") are units for which any money rent is paid or contracted for. Such rent is commonly paid by the occupants but may be paid by persons not living in the unit--for example, a welfare agency. Units for which no cash rent is paid include units provided by relatives not living in the unit and occupied without rental payment, units provided in exchange for services rendered, and units occupied by a tenant farmer or sharecropper who does not pay any cash rent. "No cash rent" appears as a category in the rent tabulations. In county tables for rural-farm units in the State chapters, the category appears under "rent status" [34, p. LVIII].

Condition.--Census enumerators in the 1960 Census of Population and Housing classified housing units by condition as sound, deteriorating, or dilapidated. Information as to how this classification was performed can be found in the Census of Housing, 1960, "Volume 1: States and Small Areas, Part 1: United States Summary" [34]. A brief description of the system is included here.

Condition (H6)--The enumerator determined the condition of the housing unit by observation, on the basis of specified criteria related to the extent or degree of visible defects. The types of defects the enumerator was to look for are associated with weather tightness, extent of disrepair, hazards to the physical safety of the occupants, and inadequate or makeshift construction. These are signs of other structural defects which may be hidden. Defects which would be revealed only by a more careful inspection than is possible during a census, such as the presence of dampness or infestation, inadequate wiring, and ropted beams, are not included in the criteria for determining the condition of a unit.

Sound housing is defined as that which has no defects, or only slight defects which normally are corrected during the course of regular maintenance. Examples of slight defects are:

Lack of paint; slight damage to porch or steps; slight wearing away of mortar between bricks or other masonry; small cracks in walls, plaster or chimney; cracked windows; slight wear on floors, doorsills, doorframes, window sills, or window frames; and broken gutters or downspouts.

Deteriorating housing needs more repair than would be provided in the course of regular maintenance. Such housing has one or more defects of an intermediate nature that must be corrected if the unit is to continue to provide safe and adequate shelter. Examples of intermediate defects are: Holes, open cracks, rotted, loose, or missing material over a small area of the foundation, walls, roof, floors, or ceilings; shaky or unsafe porch, steps, or railings; several broken or missing windowpanes; some rotted or loose window frames or sashes that are no longer rainproof or windproof; broken or loose stair treads, or broken, loose, or missing risers, balusters, or railings of inside or outside stairs; deep wear on doorsills, doorframes, outside or inside steps or floors; missing bricks or cracks in the chimney which are not serious enough to be a fire hazard; and makeshift chimney such as a stovepipe or other uninsulated pipe leading directly from the stove to the outside through a hole in the roof, wall, or window. Such defects are signs of neglect which lead to serious structural deterioration or damage if not corrected.

Dilapidated housing does not provide safe and adequate shelter and in its present condition endangers the health, safety, or well-being of the occupants. Such housing has one or more critical defects; or has a combination of intermediate defects in sufficient number or extent to require considerable repair or rebuilding; or is of inadequate original construction. The defects are either so critical or so widespread that the structure should be extensively repaired, rebuilt, or torn down.

Critical defects result from continued neglect or lack of repair, or indicate serious damage to the structure. Examples of critical defects are: Holes, open cracks, or rotted, loose, or missing material (clapboard siding, shingles, bricks, concrete, tile, plaster, or floorboards) over a large area of the foundation, outside walls, roof, chimney, or inside walls, floors, or ceilings; substantial sagging of floors, walls, or roof; and extensive damage by storm, fire, or flood.

To be classified as dilapidated on the basis of intermediate defects, a housing unit must have such defects in sufficient number or extent that it no longer provides safe and adequate shelter. No set number of intermediate defects is required.

Inadequate original construction includes: Shacks, huts, or tents; structures with makeshift walls or roofs, or built of packing boxes, scrap lumber, or tin; structures lacking foundations (walls rest directly on the ground); structures with dirt floors; and cellars, sheds, barns, garages, or other places not originally intended for living quarters and inadequately converted to such use.

The enumerator was instructed to judge each unit on the basis of its own characteristics, regardless of the neighborhood, age of the structure, or the race or color of the occupants. He was cautioned, for example, that although lack of paint is only a slight defect, this and other signs of neglect are warnings to look closely for more serious defects. Also, exterior covering may improve the appearance of a structure but not its condition, and the sturdiness of brick or other masonry walls can be misleading if there are defects in other parts of the structure.

Condition of the unit, however, was determined by the enumerator on the basis of his observation; the respondent was not to be questioned about the condition of his living quarters.

The enumerator was provided with detailed written instructions and with photographs illustrating the levels of condition. In addition, audio-visual techniques were used in training the enumerator. A filmstrip of photographs in color depicted various types of defects and a recorded narrative explained how to determine the classification of condition on the basis of these defects. Photographs and instructions from the Enumerator's Reference Manuals are reproduced in the appendix to the United States Summary chapter of Volume I [34, pp. LXIII-LXIV].

Telephone.--

Telephone available (H35)--A unit is classified as having a telephone if there is a telephone available to the occupants of the unit for receiving calls. The telephone may be located inside or outside the housing unit, and one telephone may serve the occupants of several units. The number of housing units with telephones, available, therefore, does not indicate the number of subscribers or the number of telephones installed in homes [34, p. LXVI].

Kitchen.--

A kitchen is defined as a room used primarily for cooking and the preparation of meals. Cooking equipment is defined as (1) a range or stove, whether or not it is regularly used, and (2) other equipment such as a hotplate or electrical appliance if it is used for the regular preparation of meals. Equipment is for exclusive use if it is used only by the occupants of one unit (see also section on "Exclusive or shared use"). Vacant units are considered to have cooking equipment if the last occupants had such equipment [34, p. LV].

Toilet Facilities.--

Toilet Facilities (H10)--A housing unit has a flush toilet (supplied with piped water) if it is inside the structure and available for the use of the occupants of the unit. Flush toilets for exclusive use are differentiated from those that are shared with occupants of other units. Units with other toilet facilities, such as privy, chemical toilet, or outside flush toilet, and units with no toilet facilities are included in the category "other toilet facilities or none" (reported "none" or "no flush toilet for the use of this household" on the enumeration forms) [34, p. LXIV].

Bathing Facilities.--

Bathing facilities (H11)--A housing unit has a bathtub or shower if either facility, supplied with piped water (not necessarily hot water), is inside the structure and available for the use of the occupants of the unit. Bathing facilities for exclusive use are differentiated from those that are shared with occupants of other units. The category "no bathtub or shower" (reported "none" or "no bathtub or shower for the use of this household" on the enumeration forms) consists of units with only portable facilities, as well as units having no bathing facilities inside the structure and available for the use of the occupants [34, p. LXIV].

Exclusive vs. Shared Use.--

Exclusive or shared use--Facilities are "for exclusive use" if they are used only by the occupants of the one housing unit, including lodgers or other unrelated persons living in the housing unit.

Facilities are "shared" if they are used by occupants of two or more housing units, or if they would be shared with the occupants of a unit now vacant. Shared facilities may be inside one of the units in the structure or may be centrally located where they can be reached by occupants of all units that share them.

Inside or outside structure--Facilities are located "inside the structure" if they are located inside the same structure as the housing unit. They may be located within the housing unit itself, or they may be located in a hallway or in a room used by occupants of several units. It may even be necessary to go outdoors to reach that part of the structure in which the facilities are located. Facilities located in the basement or on an enclosed porch, or enclosed by partitions on an otherwise open porch, are "inside the structure." Facilities on an open porch (for example, piped water) are "outside the structure" [34, p. LXIV].

Water Supply.--

Water supply (H9)--A housing unit is classified in the tables as having "piped water inside structure" if there is running water inside the structure and it is available to the occupants of the unit. A unit has piped hot water even though the hot water is not supplied continuously; for example, it may be supplied only at certain times of the day, week, or year. Units with "piped water outside structure" have no running water inside the structure but have running water available on the same property, either outdoors or in another structure. In the category "no piped water" are units for which the only source of water is a hand pump, open well, spring cistern, etc., and units in which the occupants obtain water from a source which is not on the same property [34, p. XIV].

Heating Equipment.--

Heating equipment (H21)--"Steam or hot water" refers to a central heating system in which heat from steam or hot water is delivered through radiators or other outlets. "Warm air furnace" refers to a central system which provides warm air through ducts leading to the various rooms.

"Floor, wall, or pipeless furnace" includes permanently installed heating units which deliver warm air to the room directly above the furnace or to the room (or rooms) on one or both sides of the wall in which the furnace is installed. These devices do not have ducts leading to other rooms.

"Built-in electric units" are heating units which are permanently installed in floors, walls, or ceilings. Heat pumps are included in this category. In some tables in the State chapters, housing units having a "floor, wall, or pipeless furnace" and those having "built-in electric units" are combined into the one category "built-in room units."

"Other means with flue" (shown on the self-enumeration form as "room heater connected to chimney or flue") describes stoves, radiant gas heaters, fireplaces, and other equipment connected to a chimney or flue which carries off the smoke or fumes. "Other means without flue" (shown on the self-enumeration form as "room heater not connected to chimney or flue") describes electric heaters, electric steam radiators, kerosene heaters, radiant gas heaters, and other portable or plug-in devices not connected to a chimney or flue.

The main type of heating equipment was to be reported even if it was temporarily out of order at the time of enumeration. If two types of heating equipment were used to about the same extent, the type appearing first in the sequence above was to be reported. For vacant units from which the heating equipment had been removed, the equipment used by the last occupants was to be reported [34, p. LXV].

Rooms.--

Rooms (H8)--The number of rooms in the unit is the count of whole rooms used for living purposes, such as living rooms, dining rooms, bedrooms, kitchens, finished attic or basement rooms, recreation rooms, lodgers' rooms, and rooms used for offices by a person living in the unit. Not considered as rooms are bathrooms; halls, foyers, or vestibules; closets, alcoves; pantries; strip or pullman kitchens; laundry or furnace rooms; unfinished attics, basements, and other space used for storage; porches, unless they are permanently enclosed and suitable for year-round use; and offices used only by persons not living in the unit. A partially divided room, such as a dinette next to a kitchen or living room, is considered a separate room if there is a partition from floor to ceiling. Rooms equipped with movable partitions from floor to ceiling are separate rooms. If a room is shared by occupants of more than one unit, it is included with the unit from which it is most easily reached [34, p. LXI].

These definitions cover most of the variables used in this research. However, much of the information included in the Census publications has been omitted here due to space constraints. The most complete single source of definitions is 1960 Censuses of Population and Housing: Procedural History [24]. However, some other sources are necessary for more detailed information [28, 33, 34, 35].

APPENDIX III

STATISTICAL MODELS

APPENDIX III

STATISTICAL MODELS

Several statistical tools have been used in this study--contingency tables or cross tabulations, multiple regression analysis, and canonical correlation. Each of these will be described in turn with the special assumptions used for this study.

Contingency Tables[1]

Two-way contingency tables are used in this work.

1--The n observations are classified according to two criteria, A and B.

2--A has r classifications.

3--B has s classifications.

4--The number of observations in Classification A_i and B_j is n_{ij}.

5--$\sum_{i}^{r} \sum_{j}^{s} n_{ij} = n$

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[1]The computer program used was made available through the Computer Institute for Social Science Research at Michigan State University. It is described in the Institute's Technical Report No. 14, Analysis of Contingency Tables: ACT II [11]. A theoretical discussion of this tool is available in Mood and Graybill [12, pp. 311-319].

6--$\sum_{i}^{r} n_{ij} = n_{.j}$ column totals.

7--$\sum_{j}^{s} n_{ij} = n_{i.}$ row totals.

In Chapter III, socio-economic and locational characteristics are cross tabulated with measures of housing condition. In this case, A can be viewed as a socio-economic or locational characteristic and A_i can be viewed as categories within this characteristic. For example, A might represent race, A_1 might represent white, A_2 negro, etc. B can be viewed as a measure of housing condition and B_j as a level of housing condition. For example, B might represent structural condition, B_1 might represent sound, B_2 deteriorating and B_3 dilapidated.

This tool has also been used in Appendix I. Here other measures of housing condition have been cross tabulated with structural condition. A might represent structural condition and B might represent another measure of housing condition.

The null hypothesis which is tested using this tool is that the classifications of A and B are independent. That is, the probability of falling into A_i is not affected by the classification of B to which the observation belongs. If the null hypothesis is true, the test statistic, U, has approximately the chi-square distribution with (r-1) (s-1) degrees of freedom. Where:

$$U = \sum_{i}^{r} \sum_{j}^{s} \frac{[n_{ij} - (n_{i}.n._{j}/n)]^2}{n_{i}.n._{j}/n}$$

[12, pp. 312-318]

This procedure provides only for a test for independence between the classifications of A and B. Consequently, the nature of the relationships as discussed in the text are not tested for statistical significance.

Multiple Regression Analysis

Several multiple regression models are used in this study but the set of predetermined variables is common to all models. The model is described as:

$$Y_i = \beta_1 + \beta_2 X_{i2} + \beta_3 X_{i3} + \ldots + \beta_k X_{ik} + \varepsilon_i$$

Where:

(1) Y represents the endogenous variable.

(2) X represents predetermined variables.

(3) i represents the i^{th} observation.

(4) ε_i is the stochastic disturbance.

(5) The second subscript on the X's represents the variable number. There are k-1 predetermined variables in the model.

The models used can be categorized as the group having a binary endogenous variable, and the group having a continuous endogenous variable with limited range. The first group of models uses a dichotomized measure of housing condition as endogenous variable:

$$Y_i = 1 \text{ if the condition holds.}$$
$$= 0 \text{ otherwise.}$$

With this type of model, some of the classic assumptions do not hold. Instead, the assumptions are:

1) ε_i is not normally distributed but has the discrete distribution:

ε_i	$f(\varepsilon_i)$
$-\beta_1 - \sum_{j=2}^{k} \beta_j X_{ij}$	$1 - \beta_1 - \sum_{j=2}^{k} \beta_j X_{ij}$
$1 - \beta_1 - \sum_{j=2}^{k} \beta_j X_{ij}$	$\beta_1 + \sum_{j=2}^{k} \beta_j X_{ij}$

[10, pp. 425-28]

2) $E(\varepsilon_i) = 0$

3) $E(\varepsilon_i^2) = \sigma_i^2 \neq \sigma^2$

4) $E(\varepsilon_i \varepsilon_j) = 0 \ (i \neq j)$

5) Each of the predetermined variables is nonstochastic with values fixed in repeated samples and such that, for any sample size, $\sum_{i=1}^{n} (X_{ik} - \overline{X}_k)^2/n$ is a finite number different from zero for every k = 2, 3, . . . , k [10, p. 348].

With this model the ordinary least squares estimates of the β_j's are unbiased, and consistent. The heteroskedasticity indicated in Assumption 3 results in inefficient and asymptotically inefficient estimates. Because the direction of the association between σ_i^2 and $(X_{ij} - \overline{X}_j)^2$ is not known, the direction of bias in the estimation of σ^2 has not been determined. Therefore, no attempt has been made to statistically test any of the estimates of β_j's in this model [10, pp. 249-256].

The next group of models uses an index of housing condition for the endogenous variable and the same predetermined variables as the other models. This index has a limited range which introduces some heteroskedasticity. It is assumed that this heteroskedasticity is slight and can be ignored. Thus all of the classical assumptions hold. The assumptions would be the same as listed above except for two changes: (1) ε_i is normally distributed and (2) $E(\varepsilon_i^{\,2}) = \sigma^2$. With this model where all of the classical assumptions hold, the ordinary least squares estimates of the β_j's are unbiased, asymptotically unbiased, efficient, and consistent [10, pp. 205-216 and pp. 345-357].

Three types of statistical hypotheses are tested. The first is that none of the predetermined variables has an influence.

$$Ho: \quad \beta_2 = \beta_3 = \ . \ . \ . = \beta_k = 0$$

The test statistic has the F distribution if the null hypothesis is true.

$$\frac{SSR/(k-1)}{SSE/(n-k)} \sim F_{k-1,\, n-k} \qquad [9, \text{ pp. } 119\text{-}122]$$

Where: SSR is the sum of squares due to regression and SSE is the error sum of squares.

The second hypothesis is that one β_j is greater than another.

$$Ho: \quad \beta_i > \beta_j \ (i \neq j)$$

The test statistic has the students t distribution if the null hypothesis is true.

$$\frac{\hat{\beta}_i - \hat{\beta}_j}{S_{\hat{\beta}_i - \hat{\beta}_j}} \sim t_{n-k} \qquad [9, \text{ p. } 372]$$

some heteroskedasticity. It is ...

is slight and can be ...

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two changes: (1) ...

With this model ...

ordinary least squares ...

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pp. 345-357].

Three types ...

is that none of the ...

Ho: ...

The test statistic has ...

true.

$$\frac{SSR/(K-1)}{SSE/(n-K)} \sim F_{K-1,\, n-K}$$

Where: SSR is the ...

is the error sum of squares ...

The second hypothesis is that one β_i is greater than another.

Ho: $\beta_i > \beta_j \quad (i \neq j)$

The test statistic has the students t distribution if the null hypothesis is true.

$$\frac{\hat{\beta}_i - \hat{\beta}_j}{S_{\hat{\beta}_i - \hat{\beta}_j}} \sim t_{n-K} \qquad [9, p. 372]$$

Where: (1) $\hat{\beta}_i$ and $\hat{\beta}_j$ are ordinary least squares estimates of β_i and β_j, respectively.

(2) $S_{\hat{\beta}_i - \hat{\beta}_j}$ is the estimated standard deviation of the difference between the two parameters.

The last hypothesis is that one β_j is equal to zero. $H_o:\beta_j = 0$. The test statistic has the students t distribution if the null hypothesis is true.

$$\frac{\hat{\beta}_j}{S_{\hat{\beta}_j}} \sim t_{n-k} \qquad [9, p. 118]$$

Where: (1) $\hat{\beta}_j$ is an ordinary least squares estimate of β_j.

(2) $S_{\hat{\beta}_j}$ is the estimated standard deviation of β_j.

Canonical Correlation[2]

The third statistical tool used is canonical correlation. It has some similarities with regression analysis. Multiple regression can be used to estimate the net relationships between a set of variables, the predetermined variables, and a single variable, the endogenous variable. Canonical correlation, on the other hand, can be used to estimate the net relationships between two sets of variables. Also, canonical correlation assumes that both sets of variables have a stochastic component. In the case where one set of variables is reduced to only one variable, canonical correlation

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[2]The computer program used was made available through the Computer Institute for Social Science Research at Michigan State University. The program, described in the Institute's Technical Report 32, Canonical Analysis: CANON [38], is also available in Multivariate Procedures for the Behavioral Sciences by W. W. Cooley and P. R. Lohnes [4].

reduces to multiple regression with stochastic predetermined variables. Cooley and Lohnes indicate that:

> The interrelations between two sets of measurements made on the same subjects can be studied by canonical-correlation methods. As developed by Hotelling (1935, 1936), the canonical correlation is the maximum correlation between linear functions of the two sets of variables. Several linear combinations of the two sets are frequently possible. Each pair of functions is so determined as to maximize the correlation between the new pair of canonical variates, subject to the restriction that they be independent of previously derived linear combinations [4, p. 35].

This tool is used in Appendix I to examine the net relationships between the set of binary variables representing the structural condition of housing and the set of binary variables representing the other measures of housing condition. The model is described as:

$$\hat{X}_i = a_1X_{i1} + a_2X_{i2} + a_3X_{i3} \qquad \hat{Y}_i = b_1X_{i1} + b_2X_{i2} + \ldots + b_{35}X_{i35}$$

Where: (1) $\hat{X}_i$ = a linear combination of the X_{ij} for the i^{th} observation and is called a canonical variate.

(2) $\hat{Y}_i$ = a linear combination of the Y_{ij} for the j^{th} observation and is called a canonical variate.

(3) X_{ij} and Y_{ij} are binary variables describing the i^{th} observation.

(4) a_j and b_j are the coefficients used in the linear combination of the X's and Y's, respectively.

A set of coefficients, a_j's and b_j's, are estimated such that the correlation between $\hat{X}_i$ and $\hat{Y}_i$ is maximized. Since the smaller set, the X's, contains three variables, three independent sets of coefficients can be estimated. That is, each pair of canonical variates is uncorrelated with the other pairs of canonical variates and has maximum correlation [2, p. 295]. In the model used in this research, we have three canonical correlation coefficients--R_{c1}, R_{c2}, and R_{c3} with R_{c1} being the largest, R_{c2} next and R_{c3} the smallest. It should be noted that in the case discussed above where canonical correlation reduces to multiple regression, the one canonical correlation coefficient is the multiple correlation coefficient [2, p. 298]. The tests of R_{c1}, R_{c2} and R_{c3} are nested sequential tests using a statistic with a chi-square distribution [18; 4, p. 37]. The first null hypothesis is Ho: The two sets of variables are unrelated. If this is rejected, then the second null hypothesis is Ho: With the effects of the largest canonical correlation coefficient removed the two sets of variables are unrelated. If this one is rejected, then the smallest canonical correlation coefficient is tested with the effects of the larger ones removed.

For addition discussion of and references to this statistical tool, see Anderson [2], Cooley and Lohnes [4], and Srikantan [18].

APPENDIX IV

ACCURACY OF MEASURES OF HOUSING CONDITION

APPENDIX IV

ACCURACY OF MEASURES OF HOUSING CONDITION

This appendix is included to compare the accuracy of the Census measure of structural condition to other measures of housing condition. Some information is also included relative to sources of information on the accuracy of data pertaining to the socio-economic and locational characteristics of households. However, for purposes of this study the data on the characteristics of households are assumed to be measured without error.

Measurement Error

The 1960 Censuses of Population and Housing contain measurement errors from several sources.

> . . . the missing of people by enumerators will result in undercounts, personal characteristics may be erroneously reported, people fail to report some of the information requested of them and adjustments for these persons may introduce errors, and so forth [27, p. 1].

A number of studies have been conducted by and for the Bureau of the Census to determine the extent of such errors. Of these studies, one, Evaluation and Research Program of the U.S. Censuses of Population and Housing, 1960: Accuracy of Data on Housing Characteristics [25] (referred to as CES, Content Evaluation Study)

will be used to describe some of the housing condition measures included in the Census. Two other studies from the Evaluation and Research Program of the U.S. Censuses of Population and Housing, 1960 may be of interest to the reader who would like to examine the accuracy of population characteristics: Accuracy of Data on Population Characteristics As Measured by CPS [26] and Accuracy of Data on Population Characteristics As Measured by Reinterviews [27].

Content Error Vs. Coverage Error

These three studies pertain to "content error" rather than the "coverage error." I am assuming that the "coverage error" causes some undercounting of households having low housing condition. Where this is true there will be underestimates of the gross relationships between socio-economic and locational characteristics of the households and measures of housing condition. Coverage error, however, should not bias our estimates of net relationships between socio-economic and locational characteristics of households and measures of housing condition. It would only result in fewer observations among the groups undercounted. We are ignoring the bias created by omitted information. But the "content error" pertains to the accuracy of the individual record and is of concern here.

The U.S. Bureau of the Census uses a number of special statistics to analyze the reinterview information. The following is a description of those statistics, how they are constructed and what they mean.

Census Measures of Accuracy

Indexes of Response Variance and Bias

The response errors of a particular census or sample survey result from the joint effects of response bias and response variance. Measures of these two items can therefore be used as indexes of the accuracy of the data. A brief description of response bias is that it represents systematic errors in reporting data, or the effect of types of errors that are consistent in direction and that would be consistent if it were possible to do independent repetitions of the survey under the same general conditions. Response variance, on the other hand, can be categorized as the effect of errors which tend to cancel out when a large number of observations are made. The paragraphs which follow give a more complete description of these terms. For a fuller description, see the report Series ER 60, No. 1, Evaluation and Research Program of the U.S. Censuses of Population and Housing, 1960: Background, Procedures, and Forms and the references in the bibliography of that report.

Under certain fairly general survey conditions, matching information from two sources for identical persons can provide estimates of response variance, and to the extent that one of these sources is based on more adequate measurement methods and is acceptable as a standard, it can also provide estimates of bias. Various measures of response variance and bias can then be constructed from the results of this kind of match. The CES, compared with the census, gives two measurements for each person reinterviewed for selected items of information and roughly satisfies the conditions given above. A group of such measures, which appear to be useful for analytic purposes, have been computed for each characteristic studied and are shown in Table A-IV-1.

TABLE A-IV-1.--General Representation of Results of Original and Reinterview Surveys of Identical Persons

Results of the CES	Results of Census		
	1	0	Total
1	a	b	a+b
0	c	d	c+d
Total	a+c	b+d	n = a+b+c+d

Table A-IV-1 illustrates the results of the comparison of the census with the CES where the value 1 is assigned to a person classified as having some specified characteristic and the value 0 otherwise. (Persons who have no response in either interview for the characteristic being studied are excluded.) Table A-IV-1 shows that "a" of the persons were classified as having the specified characteristic in both the census and CES, "a+c" were classified as having the characteristic in the census, and "a+b" were classified as having the characteristic in the CES.

1. Gross difference rate: $g = \frac{b+c}{n} = \frac{(n-1)s_e^2}{n} + \frac{(c-b)^2}{n^2}$

When n is large, the first component of the gross difference rate is approximately equal to the simple response variance of the census statistic when the difference between the CES and the census is used as a measure of the bias. The second component is the square of the estimated bias of the census statistic. If the bias is small, the gross difference rate can be used as a measure of the simple response variance of the response differences.

It can be shown that if the census and a second survey were independently conducted under the same general conditions, the simple response variance of the response difference as developed above would be twice the simple response variance of the census (or of the second procedure). Therefore, under these conditions g/2 would be an approximate measure of the response variance of the census, and is in fact the measure used in this report. However, the CES was not conducted independently. As pointed out earlier differences between information reported in the census and the reinterview were reconciled. This would imply that the measurement g/2 tends to be an underestimate of the variance of the census.

2. Index of inconsistency: $\hat{I} = \frac{g}{2pq} = \frac{g}{p_1q_1+p_2q_2}$

This index shows the ratio of the simple response variance g/2, to pq where p is the average proportion in the census and CES having the specified characteristic. If the CES is viewed as being a repetition of the census, then pg can be estimated by

$\frac{p_1q_1+p_2q_2}{2}$[1/] $\quad p_1 = \frac{(a+c)}{n}$ is the proportion of matched persons

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[1/] Under other conditions (for example, where there is knowledge that the reinterview survey is subject to much less response variability than the census and it is desired to compare the quality of two censuses) it would be more appropriate to use a different estimate of pq. In the example mentioned, the comparison in the CES sample having a specified characteristic in the census, $p_2 = \frac{(a+b)}{n}$ is the proportion of matched persons in the CES sample having that same characteristic in the CES, $q_1 = 1 - p_1$ $q_1 = 1 - p_1 = \frac{(b+d)}{n}$ and $q_2 = 1 - p_2 = \frac{(c+d)}{n}$. Therefore, $\hat{I}$ is estimated in the following way:

$$\hat{I} = \frac{(b+c)/n}{\frac{a+c}{n}\ \frac{b+d}{n} + \frac{a+b}{n}\ \frac{c+d}{n}}$$

A simple interpretation of $\hat{I}$ is as follows:

Assume that a sample of n elements is drawn with equal probability and with replacement. Also, assume that the between element covariance of response deviations is zero--that is, that the quality of response of one person is independent of the quality of response for any other person. Then, for a sample of one element, the total variance can be expressed as the binomial variance, pq. The total variance is, then, the sum of the simple response variance and the "pure" sampling variance. Therefore, the simple response variance is equal to or less than pq. As stated above, g/2 is an estimate of the simple response variance.

As the measurement of the specified characteristic becomes less reliable, but remains unbiased, the simple response variance increases and the sampling variance decreases. When the measurement process becomes equivalent to tossing the same coin for each element ($0<p<1$ and constant for all trials) the response variance is equal to the total variance. The index of inconsistency is useful in determining the consistency or reliability of a zero-one variate included in the census.

The estimated maximum value for the gross difference rate between the census and CES is $p_1q_1 + p_2q_2$. This maximum value is obtained on the assumption that the census and CES were conducted independently or that the results are positively correlated to the extent that they were not conducted independently. A second assumption is that the CES is a repetition of the census process and the expected value obtained in the CES is the same as the expected value obtained in the census. Under these assumptions,

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may be improved if the values of p and q are taken from the surveys responsible for most of the response variability. For the sake of uniformity the same estimator $\frac{p_1q_1+p_2q_2}{2}$ will be used in all of the basic reports in the ER 60 series. For some later analyses of the data, and comparisons of the 1960 Census with other censuses or surveys, a different estimate of pq may be used for some characteristics. For the vast majority of items, the various forms of the estimates produce almost identical data [27, pp. 2-4].

$p_1q_1 + p_2q_2$ is very nearly equal to 2pq where p is the average proportion in the census and CES having the specified characteristic.

The index of inconsistency lies between 0 and 1, if the assumptions given above hold. However, the estimator of the index can be greater than 1. Such items have been starred in Table 24. In all cases, the closer the $\hat{I}$ is to 1, the less reliable is the item.

5. Percent of population units identically distributed relative to CES results:

$$r = \frac{a}{a+b}$$

Since the CES is taken as the standard, this index gives an indication of the stability of the response relative to the standard. This index has an interesting relationship to the index of inconsistency. When the proportion of persons with the specific characteristic in the CES is small, the two indexes are complementary. When the proportion of persons with the specific characteristic in the CES is large, the index of inconsistency provides a more reliable measure of the stability of response. However, "r" appears to be a useful index because its form is simpler than the index of inconsistency. Furthermore, its meaning and implication can be grasped more easily.

Structural Condition Compared

Two statistics are presented, the index of inconsistency and the percentage of the population units identically distributed relative to the CES results, as a basis for comparing the Census measure of structural condition with other measures of housing condition (Table A-IV-2).

Notice that the inconsistency indexes for the three levels of structural condition are higher than the indexes for the other measures included. This condition holds even though 92 percent of the housing units classified as sound by the CES were similarly classified in the Census. $\hat{I}$, according to the CES [25] is a better measure of the reliability of the individual response than the percentage. Also, the percent of population units identically distributed relative to CES results is higher for number of rooms than

TABLE A-IV-2.--Measures of the Accuracy of Housing Characteristics

Measures of Housing Condition	$\hat{I}$ [a]	Percentage [b]
Number of Rooms		
One Room	.339	64.0
Two Rooms	.337	66.0
Three Rooms	.251	76.4
Four Rooms	.306	73.1
Five Rooms	.364	72.1
Six Rooms	.421	65.4
Seven Rooms	.438	65.7
Eight Rooms or More	.349	81.3
Bath or Shower		
Exclusive Access	.115	98.6
Shared Access	.252	70.3
None	.094	93.0
Flush Toilet		
Exclusive Access	.146	98.9
Shared Access	.394	57.5
None	.121	86.1
Structural Condition		
Sound	.512	92.0
Deteriorating	.753	33.4
Dilapidated	.573	37.8

[a] $\hat{I}$ is the index of inconsistency.

[b] Percentage is the percent of population units identically distributed relative to CES results.

Source: These calculations were made from data included in the CES [25].

deteriorating or dilapidated. This situation also holds for the measure, bath or shower and flush toilet. With the measure, bath or shower, the levels of exclusive access and none exhibit a higher percentage than all levels of structural condition. Exclusive access to a flush toilet has a higher percentage than all levels of structural condition. This evidence supports the contention that structural condition is less accurately reported than the three other measures to which it is compared.