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THE TENANT'S CHOICE OF SUBSIDIZED HOUSING IN HAWAII

University of Hawaii

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THE TENANT'S CHOICE OF SUBSIDIZED HOUSING IN HAWAII

A DISSERTATION SUBMITTED TO THE GRADUATE DIVISION OF THE UNIVERSITY OF HAWAI'I IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY IN ECONOMICS

MAY 1980

By

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I wish to thank the chairman of my dissertation committee, Dr. Louis Rose and all the other committee members for their unfailing guidance and advice. I am indebted to the Hawaii Housing Authority (particularly Ellie Nagaro and Mike McElroy) for making this research possible. To Leok-Har Chan and Sirilaksana Chutikul, my sincere thanks for their assistance in editing. My graduate work at the University of Hawaii was supported by the East-West Center Population Institute. I am grateful for this assistance.
Recently, a considerable number of studies have been focused on housing markets. The literature on housing can be broadly classified into three categories: the determination of housing expenditures, the choice of residential location and the characteristics of a dwelling, and the choice of owner-occupancy or rental. No work has yet been done on the choice of two "close" substitutes—public rental housing and subsidized privately-owned rental housing. To initiate an effort in this area, the principal objective of this study is to examine some of the determinants in the choice of these two types of subsidized rental housing. The other objective is to draw policy implications from the empirical results.

The logit model (estimated by the maximum likelihood method) is used because of its superiority over the linear probability model. The likelihood ratio test is used instead of the t test because the former appears to be more statistically appropriate. Using primary data compiled from tenants' records and census data, the model was applied to estimate tenants' choice of public housing and privately-owned subsidized housing. The estimation equations are stratified according to elderly or nonelderly, working or nonworking status. Results of the estimation equations show that rent, crime rates, race, and distance to work are statistically significant with the expected signs. While income has been found to be negatively related to the choice of public housing (and statistically significant), there is no significant correlation between the number of minors and choice of public housing.
The own and cross elasticities of housing choice are also estimated. Both these elasticities are found to be relatively small in most cases for the crime, race, and distance to work variables. On the other hand, the elasticities for the rent and income variables are relatively greater. The implication of these findings is that rent is an important policy variable among others. The result has also shed some light on some specific policies.

By their nature, the estimates obtained are specific to Hawaii. The degree of generality of these results can be tested only by repeating the application of the model to other jurisdictions.
# TABLE OF CONTENTS

ACKNOWLEDGMENTS ................................................................. iii

ABSTRACT .................................................................................. iv

LIST OF TABLES .......................................................................... vii

LIST OF FIGURES ......................................................................... ix

CHAPTER I INTRODUCTION ....................................................... 1

CHAPTER II REVIEW OF LITERATURE ....................................... 3

CHAPTER III HAWAII SUBSIDIZED HOUSING PROGRAMS ............. 10

CHAPTER IV CHOICE THEORY .................................................. 35

CHAPTER V EQUATION SPECIFICATION AND MEASUREMENT OF VARIABLES ......................................................... 46

CHAPTER VI EMPIRICAL RESULTS ............................................ 57

CHAPTER VII POLICY IMPLICATIONS ....................................... 71

BIBLIOGRAPHY ........................................................................... 95
# LIST OF TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-1</td>
<td>Explanatory Variables, Regression Models, and Significance Tests of Owner-Renter Studies</td>
<td>5</td>
</tr>
<tr>
<td>3-1</td>
<td>Annual Income Limits for Admission to Low-Rent Housing, as of August 1977</td>
<td>15</td>
</tr>
<tr>
<td>3-2</td>
<td>Low-Rent Projects on Oahu: Name, Initial Occupancy Year, and Number of Bedrooms</td>
<td>18</td>
</tr>
<tr>
<td>3-3</td>
<td>Monthly Rent Payable in Low-Rent Housing, as of August 1977</td>
<td>20</td>
</tr>
<tr>
<td>3-4</td>
<td>Low-Rent Projects for the Elderly on Oahu: Name, Initial Occupancy Year, and Number of Bedrooms</td>
<td>21</td>
</tr>
<tr>
<td>3-5</td>
<td>State Housing on Oahu: Name, Initial Occupancy Year, and Number of Bedrooms</td>
<td>24</td>
</tr>
<tr>
<td>3-6</td>
<td>Annual Income Limits for Admission to State Housing, as of August 1977</td>
<td>25</td>
</tr>
<tr>
<td>3-7</td>
<td>Monthly Rent Payable in State Housing, as of August 1977</td>
<td>25</td>
</tr>
<tr>
<td>3-8</td>
<td>Types of Dwelling Under Section 8</td>
<td>29</td>
</tr>
<tr>
<td>3-9</td>
<td>Annual Income Limits for Admission to Section 8 Housing, as of August, 1977</td>
<td>30</td>
</tr>
<tr>
<td>3-10</td>
<td>Annual Income Limits for Admission to the Rent Supplement, as of August 1977</td>
<td>31</td>
</tr>
<tr>
<td>3-11</td>
<td>Total Number of Beneficiaries, Expenditures, Total Number of Applicants on the Waiting List, and Waiting Time</td>
<td>33</td>
</tr>
<tr>
<td>3-12</td>
<td>Main Features of Public and Private Housing</td>
<td>34</td>
</tr>
<tr>
<td>5-1</td>
<td>Variables Used in the Analysis</td>
<td>56</td>
</tr>
<tr>
<td>6-1</td>
<td>Estimated Coefficients of the Housing Type Choice Model.</td>
<td>63</td>
</tr>
<tr>
<td>6-2</td>
<td>Marginal Rates of Substitution Between Explanatory Variables</td>
<td>68</td>
</tr>
<tr>
<td>Table</td>
<td>Title</td>
<td>Page</td>
</tr>
<tr>
<td>-------</td>
<td>----------------------------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>7-1</td>
<td>Elasticities of the Probability of Choosing Private Housing</td>
<td>76</td>
</tr>
<tr>
<td>7-2</td>
<td>Total Number of Households on Waiting List, and Total Number of Households Living in Various Housing</td>
<td>78</td>
</tr>
<tr>
<td>7-3</td>
<td>Percentage of Racial Composition in Low Rent, State Housing, and Low-Rent Elderly Projects</td>
<td>88</td>
</tr>
</tbody>
</table>
LIST OF FIGURES

Figure | Description | Page
--- | --- | ---
3-1 | Location of Low-Rent Housing Projects on Oahu | 19
3-2 | Location of Low-Rent Housing Projects for the Elderly on Oahu | 22
3-3 | Location of State Housing Projects on Oahu | 26
CHAPTER I
INTRODUCTION

1.1 Background

In recent years, considerable attention has been focused on housing studies. Despite the large and growing volume of literature on housing, it is surprising to discover that the demand for and choice of housing by individual decision units has largely been neglected. The omission is a serious one since the aggregate demand for housing is formed by the decisions of individual households.

For example, many studies have concentrated on the "need" for and the costs and benefits of public housing. There is also some discussion on the choice of being an owner-occupier versus being a renter, and the choice of residential location at the micro level. Although public rental housing and subsidized private rental housing are substitutes, to the best of my knowledge, no work has been done yet on the choice of selecting the two alternative types of housing.

1.2 Objectives of the Study

The present study will examine, using Oahu, Hawaii as a case study, the main factors that affect the choice of subsidized rental housing based on decision units at the micro level. The main question we seek to answer is the following: given the option that a tenant could choose to live in public or private rental housing (with housing assistance, such as rent supplement) to what extent can his (by which we mean his or her) decision be explained by the housing and household characteristics? Also, what policy implications could we draw from the empirical result?
The main regression technique used in this study is the logit model.

1.3 The Outline of the Study

The literature on housing is reviewed in Chapter II, and in Chapter III the various subsidized housing programs in Hawaii are discussed. The theory of choice is developed in Chapter IV, and in Chapter V equation specification and measurement of variables are given. In Chapter VI, empirical results are presented and evaluated. Chapter VII contains policy implications drawn from this study.
2.1 Introduction

In this chapter we will indicate how some of the housing literature is related to our present research.

2.2 Studies on Housing Demand or Expenditures

The literature on housing can be classified into three main categories: the determination of housing expenditures; the choice of owner-occupancy or rental; and the choice of residential location and the characteristics of a dwelling.¹

A disproportionately large number of housing studies is of the first category. According to King (1975), 'Paldam (1970) lists some 50 recent studies and this is by no means exhaustive.² A subset of topics under these studies is the estimation of price and income elasticities of "demand" for housing. (See a summary by de Leeuw, 1971.)³ Since our study is concerned with the "split" between public

¹These categories are closely related to some of the questions in housing decision. For example, King (1975) postulates that a household faces three interrelated questions when purchasing a dwelling. They are: What characteristics should the dwelling have? Where should the dwelling be located? and How much should be spent? (p. 451). King apparently ignores the question of buying or renting a dwelling.

²p. 451, footnote 1.

³de Leeuw's work is not unchallenged. See for example, Carliner (1973), Lee and Hong (1977), Polinsky (1977), and Smith and Campbell (1978), among others.
and private housing, the determination of housing expenditures bears only a remote relationship to our study.

2.3 Studies on Tenure Choice

Note that the "pure" studies on housing expenditures assume that the household has already determined whether to buy or rent a dwelling at the outset. It can be argued that an individual household may first decide whether to own or rent and then determine the quantity of housing services demanded.\(^4\) (See Rosen, 1979, pp. 6-7.) The studies on tenure choice explore the determinants of the decisions to own or rent a dwelling unit. A summary of some of the studies on the split between owning and buying a dwelling is shown in Table 2-1.

In the studies of demand for or expenditures on housing, housing is treated as a homogeneous good, and thus the ordinary least squares (OLS) estimation techniques can be applied. The salient point that emerged from the table is that the main explanatory variables selected for these studies are household characteristics. Also the empirical estimates of some of the studies in the same table rely on crude and sometimes incorrect regression techniques and statistics (such as linear probability model, and t statistic).

Not satisfied with the omission of housing characteristics in regression equations and with the introduction of Lancastrian "new demand theory" (Lancaster, 1966a, 1966b, 1971), some studies thereafter incorporated housing characteristics in the models. (See for example, King

\(^4\)Of course the decision of whether or not to own and how much to spend can be jointly determined as in Lee and Trost (1978).
Table 2-1. Explanatory Variables, Regression Models, and Significance Tests of Owner-Renter Studies

<table>
<thead>
<tr>
<th>Author(s)</th>
<th>Explanatory Variables Included</th>
<th>Regression Model</th>
<th>Significance Test Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td>McAllister (1967)</td>
<td>Age*, Race*, Family Size, Income**</td>
<td>OLS**</td>
<td></td>
</tr>
<tr>
<td>Ohls (1971)</td>
<td>Race, Region dummy, Income, Rental Price, and Price of Owner Housing</td>
<td>Probit</td>
<td></td>
</tr>
<tr>
<td>Vipond and Walker (1972)</td>
<td>Income, Number of Workers, Number of nonworking dependents</td>
<td>OLS</td>
<td></td>
</tr>
<tr>
<td>Straszheim (1973)</td>
<td>Income, Monthly Cost of Owning Dwelling, Monthly Rent</td>
<td>Linear Probability</td>
<td></td>
</tr>
<tr>
<td>Granfield (1974)</td>
<td>Income, Census Tract Income, Occupational Class dummy</td>
<td>OLS</td>
<td></td>
</tr>
<tr>
<td>Marantz et al. (1976)</td>
<td>Income, Race, Sex*, Education, Family Size, Employment Status dummy, Veteran Status dummy</td>
<td>Logit</td>
<td>t Statistic</td>
</tr>
<tr>
<td>Struyk (1976)</td>
<td>Income, Family Size dummies, Subsidy, Age, Sex</td>
<td>OLS</td>
<td></td>
</tr>
<tr>
<td>Li (1977)</td>
<td>Income, Age, Family Size, Race</td>
<td>Logit</td>
<td>Asymptotic Standard Error</td>
</tr>
<tr>
<td>Lee and Trost (1978)</td>
<td>Age, Race, Sex, Mover dummy, City Size, Distance from City, Family Size, Income</td>
<td>Probit</td>
<td>Standard Error</td>
</tr>
<tr>
<td>Rosen (1979)</td>
<td>Income, Age of Household dummies, Number of Children under the age of 17 dummies, Race, Sex</td>
<td>Probit</td>
<td>Standard Error</td>
</tr>
</tbody>
</table>

* Age, Race, and Sex refer to the head of household. Race and Sex are dummy variables.
** Income here refers to measured (current) or permanent (normal) income. Sometimes both types of income are included.
*** Since OLS model uses the t test, it is not indicated in the last column.
In connection with this, the works on hedonic price equations emerged from the new demand theory.\(^5\) (See Kain and Quigley (1970); Ball (1973); Rosen (1974); Berry and Bednarz (1975); and Smith (1978).) King (1975) advances the analysis one step further by using the hedonic price equations to estimate the demand for housing characteristics. We will not attempt to list here all the variables used in a typical hedonic equation where often over 30 independent variables are included. (See for example, Kain and Quigley (1970).)

In sum, the Lancastrian approach to housing and the hedonic price equation studies constitute the mainstream of the literature on the choice of residential location and the characteristics of dwelling.\(^6\)

Statistical methods used in the housing studies included simple tests of differences between means, factor analysis, discriminant analysis, principal component regression analysis, least squares, linear probability, and probit and logit models.\(^7\) The last two types of regression techniques gained added popularity among economists after the pioneering work of Domencich and McFadden (1972). The use of the models was extended

\(^5\) But note Murray's (1978) arguments about the generality of the hedonic price model.

\(^6\) Other uses of the hedonic price equation include for instance, the estimation of differences in rent between controlled and uncontrolled rental dwelling units (Olsen, 1972) and the estimation of market value of public housing units (Murray, 1977). Palfin (1977) uses the hedonic price equation to estimate the difference between leasehold and fee simple property values.

\(^7\) For the merits of using logit (or probit) instead of linear probability model, see pp. 59–61. Watson (1974) concludes that in a choice among the discriminant, multiple regression, probit and logit analysis, logit is the most appropriate method of analysis for use in binary choice studies.
later to the studies of decision making of government bureaucracy, voting
in presidential elections, minimum wage legislation, voting on the Equal
Rights Amendment, occupational choice and others. The models are equally
applicable to the study of home ownership. From Table 2-1, it appears
that more recent studies on home ownership are using either the probit or
logit model. We note, however, that all the studies listed in Table 2-1
still used the standard error, which strictly speaking is not the
appropriate statistics to test the significance of explanatory variables.

2.4 Study of Split Between Public and Private Housing

The studies of Lee and Trost (1978) and Rosen (1979) do integrate
the tenure choice and expenditure decisions. However, their models do
not consider the possibility of choosing public versus private rental
units. To the best of my knowledge, there have been no previous studies
of this issue.

However, there are two studies which are more related to our present
research. First is a study by Kau and Floyd (1974, and Reply, 1975). By
using the multiple discriminant analysis, they examine the character­
istics of those individuals most likely to enter public housing. In
their study households not in public housing include those living in sub­
standard housing. In Hawaii, privately owned substandard housing units
cannot be used by tenants to qualify for subsidized (private) housing
programs. Thus, we suspect that a similar regulation pertaining to the
housing standard in subsidized (private) housing programs is also imposed
by the Local Housing Authority in the city (Savannah, Georgia) where
their study was conducted. Therefore, their study does not concern a
choice between (subsidized) public and subsidized private housing. In
other words, in their study, a household has a choice of living in public housing or private housing without housing assistance. Our study considers a more realistic choice of living in public versus private housing with assistance.

Quigley (1976) examines the choice of 18 types of rental housing, classified according to residential density (or lot size), interior size, and "quality." It is not clear whether these housing units include public housing or not. Therefore, differentiation between private and public housing cannot be made. However, his study clearly departs from the traditional framework which treats housing as a homogeneous good. It is explicitly stated in the study that utility is a function of housing characteristics, and thus, the choice of housing is dependent upon these underlying Lancastrian characteristics.

A multinomial logistic model (estimated by the maximum likelihood method) was used in Quigley's study, and asymptotic t ratios were used to test the significance of coefficients. Although he calculated the predicted probabilities of housing type choices for different stratifications, no elasticities (of choice probabilities) were presented.

Acknowledging the fact that public and private housing are "close" substitutes and that no study has been done on the choice between these two types of housing, the main purpose of our study is to inquire into the choice between these two housing types. Thus our study complements and enhances the knowledge on the choice of dwelling. Second, it will be a decision behavior study which is based on individual decision units. Third, we will explicitly treat housing as a bundle of characteristics and thus depart from the traditional approach. Fourth, the logit model
will be used because it is a more "correct" method of estimation (relative to the linear probability model). Some relatively more "correct" statistics (relative, that is, to the t statistic) and tests will also be reported or used. Finally, for policy purposes, some estimation of elasticities and the uses of the regression results will be demonstrated.

---

8 But see Oum's (1979) comments on the logit model.

9 Because the exact properties of the variance-covariance matrix are not known, the t-test may not be accurate (Silberman and Durden (1976, p. 325). The chi-square likelihood-ratio test will be used in our study.
CHAPTER III
HAWAII SUBSIDIZED HOUSING PROGRAMS

3.1 Introduction

Hawaii has a long history of housing legislation and assistance programs. The Hawaii Housing Authority (HHA) is a state agency that has administered housing activities since 1935. Initially it was granted power to clear slums and build rental housing for low income families. Currently HHA's functions are much broader.¹ In this chapter, a discussion of the rationale and a detailed presentation of some of the subsidized housing programs are provided.

3.2 Rationale for Some of the Programs

The main subsidized housing programs offered by the HHA are:

(1) Federally aided low-rent housing,
(2) Federally aided low-rent housing for the elderly,
(3) State permanent (non-subsidized) housing,
(4) Federally subsidized Section 23 leased housing,
(5) Federally subsidized Section 8 rental program, and
(6) State rent supplement program.

It is important to note at the outset that it is sometimes difficult to comprehend what is the rationale behind these subsidized housing programs, because the history of the government role in housing was

¹For a full description of these functions, see HHA (1979), pp. II-17 to II-59.
intricate and tangled. Generally, there are seven goals pursued by the Federal housing program, and according to a U.S. Department of Housing and Urban Development (HUD) report, it is stated that "The multiple goals are perhaps the greatest reason for the proliferation and the confused state of housing laws and housing programs." (HUD (1974), p. 23) Nevertheless, we will attempt to explain some of the rationale for these programs.

Federally Aided Low-Rent Housing

The first program involving Federal subsidies was the low rent public housing program authorized by the U.S. Housing Act of 1937. This program had three purposes:

(1) To provide decent, safe, and sanitary housing for people whose incomes were too limited to pay for it;

(2) To create employment; and

(3) To eliminate slum housing. (Schechter (1972, p. 601))

The construction of public housing experienced great fluctuation because the political fortunes of public housing were mixed. There was a continuing lack of political consensus about the objectives of public housing. One thing, however, was clear that "During the fifties, partly because of rising prosperity, public housing projects were seen as undesirable housing accommodation. Neighborhoods were increasingly

---

2 For detail, see HHA (1979), p. II-8.

3 However, according to the HUD, the low-rent housing program was basically an anti-Depression measure to stimulate employment (1974), p. 123.

4 For detail, see Aaron (1972), pp. 109-121.
reluctant to provide space for housing with 'troublesome' tenants.'"

(HUD, 1978b, p. 36)

In Hawaii a similar concern was expressed by the legislators when a Housing Concurrent Resolution (56) relating to a study of public housing was passed on April 24, 1965. The concern was:

... the concentration of large numbers of low-income families in high-density public housing units appears to have the effect of isolating these people from the rest of the community, limiting their opportunities to improve their own and their family's well-being, and contributing to the continuance of a socially disadvantaged subculture within our society; ... (Journal of the Housing Representatives of the Third Legislature, State of Hawaii, General Session of 1965, p. 961)

This ghettoization of low-rent housing is perhaps the main reason for the introduction of other housing programs.

**Federally Aided Low-Rent Housing for the Elderly**

In the 1950s Federal housing policies became increasingly directed toward meeting the needs of special groups, such as servicemen and the elderly (HUD, 1974, p. 11). The Housing Act of 1956 authorized the construction of new housing specifically designed for the elderly. Ironically, "The main impetus of the spectacular growth of public housing for the elderly, however, was the growing disenchantment of both Federal and local officials with the public housing program of the fifties ... [and] public housing specifically designed for the elderly was the beneficiary of this disenchantment." (HUD, 1978b, p. 36)

**Federally Subsidized Section 23 Leased Housing**

The rationale for the leased housing program is broadly stated as being "For the purpose of providing a supplementary form of low-rent housing which will aid in assuring a decent place to live for every
citizen and promote efficiency and economy in the program under this Act by taking full advantage of vacancies or potential vacancies in the private housing market . . ." (United States Statutes at Large, 1965, p. 455). According to de Leeuw and Leaman (1972), "Because the leasing program uses the private real estate market to a much greater extent than other housing programs, it can be viewed as a test of what the market can deliver in the way of decent but not luxurious housing services when effective demand for such services is increased." (p. 644) It would therefore seem that the underlying rationale of the leased housing program was the intention of the Federal government to make use of the private housing market to provide housing to the low-income tenants instead of becoming directly involved in building new housing units.  

Federally Subsidized Section 8 Rental Program

The rationale for this program is "For the purpose of aiding lower-income families in obtaining a decent place to live and of promoting economically mixed housing, . . ." (United States Statutes at Large, 1974, p. 663). This program departs from other programs because of the explicit objective of "promoting economically mixed housing." There are two possible ways to increase the economic mix in housing. One is to get low income households into higher income neighborhoods. The other is to bring high income households into low-rent housing. It is clear that Section 8 attempts to achieve a greater income mix through the

5 Other goals conceived include penetration of more affluent neighborhoods, a mix of subsidized and unsubsidized units. (Taggart, 1970, p. 43).
dispersion of low income households by utilizing the working of private housing market.

State Permanent (Non-Subsidized) Housing and Rent Supplement Program

The rationale for these two programs is not clearly stated in the Hawaii Revised Statutes. However, it is reasonable to assume that the purpose of the first housing program is similar to that of the Federally aided low-rent housing program and the rent supplement program, leased housing or Section 8 program.

3.3 Alternative Subsidized Housing Programs

Since our present study is on the subsidized housing choice, we will give a rather detailed description of these programs.

(1) Federally aided low-rent housing

Enacted under United States Housing Act of 1937, as amended, 42 U.S.C. section 1401 et seq., this program is designed to provide rental units at below market rents for low-income groups, with the subsidies reimbursed from the Federal government. These housing units are developed, owned and operated by the HHA. In other words, HHA is the "landlord" of all the federally aided low-rent housing in Hawaii. There are nine district offices run by HHA housing managers or its agency. Each district office is located at one of the housing projects of the district under its management. Complaints, supervisions, maintenance, repair of dwellings, etc. are handled by these offices.

For example, Taggart (1970) stated that one of the aims of the (Federal) rent supplement program was to disperse low-income families (p. 56).
The conditions governing eligibility for living in low-rent housing are:

(a)* An applicant is qualified as a "family."  
(b)* An applicant's income is within the limits set forth by HHA.  

These limits are shown in Table 3-1.

Table 3-1

Annual Income\textsuperscript{a} Limits for Admission to Low-Rent Housing,  
as of August 1977

<table>
<thead>
<tr>
<th>No. of Persons</th>
<th>Income Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$ 8,100</td>
</tr>
<tr>
<td>2</td>
<td>9,300</td>
</tr>
<tr>
<td>3</td>
<td>10,450</td>
</tr>
<tr>
<td>4</td>
<td>11,600</td>
</tr>
<tr>
<td>5</td>
<td>12,350</td>
</tr>
<tr>
<td>6</td>
<td>13,050</td>
</tr>
<tr>
<td>7</td>
<td>13,800</td>
</tr>
<tr>
<td>8+</td>
<td>14,500</td>
</tr>
</tbody>
</table>

\textsuperscript{a}The annual income refers to the annual total family income. This is true for all housing programs. Total family income includes wages and salaries, interest, dividends, profits, annuities, unemployment compensation, social security benefits, periodic allowances, etc. (For detail, see HHA, Rule 17, pp. 4-5, or Rule 18, pp. 149-151.)  
Source: HHA information sheet, August 1, 1977.

\textsuperscript{7}Since many of the eligibility conditions are equally applicable to all the other subsidized housing programs, we denote these conditions by asterisks.

\textsuperscript{8}HHA defines "family" as (1) a group of persons regularly living together consisting of two or more persons related by blood, marriage or adoption; (2) a single person who has attained the age of 62 years or over; and (3) a single person who is disabled or handicapped. (See, for example, HHA, Rule 18, pp. 163-164.)

\textsuperscript{9}This same set of income limits applies to federally aided low-rent housing for the elderly, and federal leased housing.
An applicant's assets are within the limits set forth by HHA. These limits are:

(i) The elderly family\(^{10}\) may have assets valued within two times its applicable income limit.

(ii) The non-elderly family may have assets valued within one-and-a-half times its applicable income limit.

An applicant does not own a housing unit on the island in which he (or she) is seeking subsidized housing (i.e., on Oahu in this study).

An applicant does not have an outstanding balance due to HHA.

An applicant's conduct would not be detrimental to the project or its residents.

It might be worth mentioning here the formula that determines the eligibility of households for dwelling units of different sizes in low-rent housing. To avoid overcrowding and waste of space, the HHA established the occupancy standard for all types of housing programs as below:\(^{11}\)

<table>
<thead>
<tr>
<th>Number of Bedrooms</th>
<th>Number of Persons For Admission</th>
<th>Number of Persons For Continued Occupancy</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>3</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>4</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>5</td>
<td>10</td>
<td>12</td>
</tr>
</tbody>
</table>

\(^{10}\)"Elderly family" means a family the head of which (or his spouse) (1) has attained the age of 62, or (2) a single individual who is disabled or handicapped. (See for instance, HHA, Rule 18, p. 164.)

Since the occupancy standard is the same for all types of programs, it will not be repeated in the discussion of other types of programs.

The low-rent housing units are highly concentrated in most of the project locations. The number of housing units per project ranged from 36 to 614 with various numbers of bedrooms available (Table 3-2). With the exception of the Kuhio Park project, which consists of two high-rise apartment buildings, all the low-rent housing buildings are two- or three-storey walk-up, multiple-family dwelling units.

Kalakaua Homes consists of frame buildings. Kamehameha Homes construction is part-frame and part-concrete. The rest of the low-rent housing is concrete or concrete and hollow tile construction. The physical appearance of this housing is not very different from that of private rental housing. Maintenance is good and the grounds are well kept. Water supply, sewage systems, and other facilities are checked before a tenant moves in to ensure the dwelling unit has met the living conditions established by HHA.

Since only tenants with income lower than the admissible income limits could be admitted to this housing, all the tenants living in low-rent housing are households whose income is relatively low.

---

12 The implication of this is that, if the standard is strictly enforced, the number of bedrooms is not an explanatory variable in the choice of housing. (It will also be highly correlated with the number of minors variable if both appear as explanatory variables in a regression equation.)

13 See HHA, Rule 17, pp. 10-11 for a detailed description of these conditions.

14 Although the income limits for continued occupancy are higher than the income limits for admission, tenants still have to move out of low-rent housing (as well as low-rent housing for the elderly, and state housing) if their income exceeds the continued occupancy income limits.
### Table 3-2

Low-rent Projects on Oahu: Name, Initial Occupancy Year, and Number of Bedrooms

<table>
<thead>
<tr>
<th>Name</th>
<th>Year</th>
<th>Number of Bedrooms</th>
<th></th>
<th></th>
<th></th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>0 1 2 3 4 5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Kamehameha</td>
<td>1940</td>
<td>0 62 123 36 0 0</td>
<td>221</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Kalakaua</td>
<td>1942</td>
<td>0 0 58 15 0 0</td>
<td>73</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Mayor Wright</td>
<td>1952</td>
<td>0 24 114 168 50 8</td>
<td>364</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Kalihi Valley</td>
<td>1953</td>
<td>0 58 60 135 118 29</td>
<td>400</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Kuhio Homes</td>
<td>1953</td>
<td>0 20 32 37 37 8</td>
<td>134</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Palolo Valley</td>
<td>1957</td>
<td>0 8 34 40 32 4</td>
<td>118</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Kaahumanu</td>
<td>1958</td>
<td>0 0 116 36 0 0</td>
<td>152</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Kuhio Park</td>
<td>1965</td>
<td>0 48 318 206 42 0</td>
<td>614</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Wahiawa Terrace</td>
<td>1966</td>
<td>0 12 16 24 8 0</td>
<td>60</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Waimanalo</td>
<td>1967</td>
<td>0 0 20 24 6 0</td>
<td>50</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. Maili I &amp; II</td>
<td>1969</td>
<td>0 0 19 13 12 0</td>
<td>44</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. Puuwai Momi</td>
<td>1969</td>
<td>0 48 86 88 22 16</td>
<td>260</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13. Koolau Village</td>
<td>1969</td>
<td>0 8 24 36 12 0</td>
<td>80</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14. Nanakuli</td>
<td>1969</td>
<td>0 0 0 36 0 0</td>
<td>36</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15. Waipahu I &amp; II</td>
<td>1970</td>
<td>0 0 27 12 0 0</td>
<td>39</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Total                 |      | 0 288 1,047 906 339 65 | 2,645 |       |       |       |


Figure 3-1 shows the location of the low-rent housing projects on Oahu. Numbers refer to Table 3-2 (above). It is clear that the majority of the projects are located in Honolulu.
The rent payable by tenants living in low-rent housing is shown in Table 3-3.  

Table 3-3  
Monthly Rent Payable in Low-Rent Housing, as of August 1977

<table>
<thead>
<tr>
<th>Minimum Rents&lt;sup&gt;a&lt;/sup&gt;</th>
<th></th>
<th></th>
<th>Maximum Rents&lt;sup&gt;a&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bedrooms</td>
<td>Welfare</td>
<td>Non-Welfare</td>
<td>Those not subjected</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>to the minimum rents</td>
</tr>
<tr>
<td>0</td>
<td>$ 95</td>
<td>1/12 of</td>
<td>shall pay rents 1/12</td>
</tr>
<tr>
<td>1</td>
<td>115</td>
<td>5% of</td>
<td>of 25% of adjusted</td>
</tr>
<tr>
<td>2</td>
<td>135</td>
<td>total</td>
<td>income&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>3</td>
<td>155</td>
<td>family</td>
<td>as defined</td>
</tr>
<tr>
<td>4</td>
<td>175</td>
<td>income&lt;sup&gt;b&lt;/sup&gt;</td>
<td>by HHA</td>
</tr>
<tr>
<td>4-1/2</td>
<td>185</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>200</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: HHA information sheet, August 1, 1977

<sup>a</sup>Because of the way the adjusted income is calculated (see note <sup>c</sup> below), it is possible that a household with very low total family income (e.g., $2,400) and many children (e.g., 8) may end up paying zero or very low rent under the (maximum) 25% formula. The (minimum) 5% formula is designed to ensure that some positive amount of rent is paid by this family. In fact, any tenant's rent payable is the larger of the 5% and 25% formula.

<sup>b</sup>See footnote <sup>a</sup> of Table 3-1 (page 15).

<sup>c</sup>Adjusted income (or net family income) means total family income less deductions and exemptions. The usual item for deduction is a 5% deduction of total family income. The main item for exemption is an exemption of $300 for each member who is under eighteen years of age or who is eighteen years of age or older and disabled, handicapped or a full-time student. (For detail, see HHA, Rule 17, p. 6; Rule 18, pp. 151-153.

---

15 This same set of rent structures applies to federally aided low-rent housing for the elderly.
(2) Federally aided low-rent housing for the elderly

This program is exactly the same as the low-rent housing, except that the housing is exclusively designated for elderly people. In other words, nonelderly people are not eligible for this type of housing.

Name of projects, total housing units, number of bedrooms, and initial occupancy years are summarized in Table 3-4. With the exceptions of Makamae and Kupuna Home' O' Waialua, which are four-storey elevator buildings and ground floor duplexes, respectively, all the other projects are high-rise apartment buildings.

Table 3-4
Low-Rent Projects for the Elderly on Oahu: Name, Initial Occupancy Year, and Number of Bedrooms

<table>
<thead>
<tr>
<th>Name</th>
<th>Year</th>
<th>Number of Bedrooms</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>0     1   2   3   4   5</td>
</tr>
<tr>
<td>1. Punchbowl Homes</td>
<td>1960</td>
<td>0 97 58 1 0 0</td>
</tr>
<tr>
<td>2. Makua Alii</td>
<td>1967</td>
<td>0 210 0 1 0 0</td>
</tr>
<tr>
<td>3. Kalanihuia</td>
<td>1967</td>
<td>60 90 0 1 0 0</td>
</tr>
<tr>
<td>4. Paoakalani</td>
<td>1970</td>
<td>90 60 0 1 0 0</td>
</tr>
<tr>
<td>5. Makamae</td>
<td>1971</td>
<td>108 16 0 0 0 0</td>
</tr>
<tr>
<td>6. Pumehana</td>
<td>1972</td>
<td>98 40 1 0 0 0</td>
</tr>
<tr>
<td>7. Kupuna Home' O' Waialua</td>
<td>1977</td>
<td>24 16 0 0 0 0</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>380 529 59 4 0 0</td>
</tr>
</tbody>
</table>


All these concrete buildings are relatively new, well maintained and thus can hardly be differentiated from private apartments. However, housing projects for the elderly feature grab-bars in the bathrooms, low thresholds, wide doors to accommodate wheelchairs, and special emergency precautions, such as call lights in all units and chime systems for those
Figure 3.2 Location of Low-Rent Housing Projects for the Elderly on Oahu.
constructed since 1970. Furthermore, relatively more social gatherings, outings, and recreation activities are found in these projects. Occasionally, "free lunch" programs are organized.

Like the low-rent housing, the tenants of low-rent housing for the elderly consist of relatively low income households.

Figure 3-2 shows the location of these projects. Numbers refer to Table 3-4. With the exception of Kupuna Home' O' Waialua project, all the other projects are located in Honolulu.

The income limits and rent structure of these housing units are the same as those of low-rent housing, which are shown in Tables 3-1 and 3-3.

(3) State Permanent (non-subsidized)16 housing

Built from funds derived from the revenues of the emergency units,17 this housing was authorized by state legislation. These homes are owned by the state. They are rented to low and moderate income families, providing enough revenue to meet operational costs.

Some of the state housing units are highly concentrated. Table 3-5 shows the total number of units in these projects, and the number of bedrooms.

16The word "non-subsidized" means that (unlike the first two housing programs) the HHA does not receive any subsidies from the Federal government for the operation of state housing. It is still a type of subsidized housing in the sense that it is intended to provide rental units at below market rents for low-income tenants.

17These projects were developed at the end of World War II when emergency housing was desperately needed. Although such projects still exist today, they are gradually being phased out or replaced.
The state housing projects consist of concrete and hollow tile, two-storey, multi-family dwelling units. In fact, the structure, design and physical appearance of these projects are very similar to those of the low-rent housing. The management of state housing is in the hands of the HHA district managers (who also manage the low-rent housing). The housing units are also well-kept and maintained.

Table 3-5
State Housing on Oahu: Name, Initial Occupancy Year, and Number of Bedrooms

<table>
<thead>
<tr>
<th>Name</th>
<th>Year</th>
<th>Number of Bedrooms</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>0 1 2 3 4 5 Total</td>
</tr>
<tr>
<td>1. Palolo I</td>
<td>1951</td>
<td>0 9 64 9 0 0 82</td>
</tr>
<tr>
<td>2. Palolo II</td>
<td>1953</td>
<td>0 16 64 76 64 8 224</td>
</tr>
<tr>
<td>3. Puahala I &amp; II</td>
<td>1952</td>
<td>0 0 12 8 14 14 48</td>
</tr>
<tr>
<td>4. Puahala III &amp; IV</td>
<td>1959</td>
<td>0 14 46 20 0 0 80</td>
</tr>
<tr>
<td>5. Hauiki</td>
<td>1964</td>
<td>0 0 20 16 10 0 46</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>0 39 206 129 84 22 480</td>
</tr>
</tbody>
</table>


The tenants living in these projects are also of the relatively low income groups. However, because of the higher income limits for admission, the average income of state housing tenants is higher than that of the low-rent tenants. Table 3-6 shows the income limits of this housing.

Figure 3-3 shows the location of these housing projects. Numbers refer to Table 3-5. They are mainly located in Honolulu.
Table 3-6

Annual Income Limits for Admission to State Housing, as of August 1977

<table>
<thead>
<tr>
<th>No. of Persons</th>
<th>Income Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$ 9,800</td>
</tr>
<tr>
<td>2</td>
<td>11,200</td>
</tr>
<tr>
<td>3</td>
<td>12,500</td>
</tr>
<tr>
<td>4</td>
<td>13,900</td>
</tr>
<tr>
<td>5</td>
<td>14,800</td>
</tr>
<tr>
<td>6</td>
<td>15,700</td>
</tr>
<tr>
<td>7</td>
<td>16,600</td>
</tr>
<tr>
<td>8+</td>
<td>17,500</td>
</tr>
</tbody>
</table>

Source: HHA information sheet, August 1, 1977.

Unlike the low-rent housing program, rent payable for the state housing depends on the number of bedrooms. The rent structure of the state housing is shown in Table 3-7.

Table 3-7

Monthly Rent Payable in State Housing, as of August 1977

<table>
<thead>
<tr>
<th>No. of Bedrooms</th>
<th>Rent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$ 104</td>
</tr>
<tr>
<td>2</td>
<td>121</td>
</tr>
<tr>
<td>3</td>
<td>145</td>
</tr>
<tr>
<td>4</td>
<td>171</td>
</tr>
<tr>
<td>5</td>
<td>197</td>
</tr>
</tbody>
</table>

Source: HHA information sheet, August 1, 1977.
(4) Federal Leased housing\textsuperscript{18}

The federal leased housing program was authorized under the U.S. Housing and Urban Development Act of 1965. Under Section 23, HHA may lease private dwelling units in any community which has a vacancy rate of at least 3 percent.\textsuperscript{19} The maximum number of apartments the HHA can lease is 5 percent of the whole building, except in the case of the elderly, where HHA can lease the whole structure.

Unlike the first three types of housing programs, where the HHA builds, owns, and manages dwelling units for low-income groups, the leased housing program uses private housing to assist low-income groups in their housing "needs." HHA leases privately owned housing units and then sublets them to low-income tenants, with the Department of Housing and Urban Development (HUD) paying the difference between the full rents of the housing units and the rents actually paid by the tenants. Although the HHA leases the private rental units, it is still the private landlords who own the units.

We have no information about the physical appearance and condition of these leased housing units, therefore we cannot tell whether they are as good as other unsubsidized private rental units. However, the private landlords also rent their units to other tenants who are not participating in HHA housing programs (except housing leased exclusively for the

\textsuperscript{18}Starting July 1, 1976, the federal leased housing program was supplemented and will eventually be replaced by the federally subsidized Section 8 rental program.

\textsuperscript{19}This is to prevent the local housing authority from pushing up rents in private housing. (Carliner (1972), p. 411)
elderly). In this connection, there is probably a greater income mix of tenants in these housing units (again, with the exception of housing exclusively for the elderly).

Unlike the low-rent and state housing tenant—often stigmatized as a ward of the state—the recipient of leased housing assistance obtains and occupies his home in complete anonymity. His subsidy is a confidential matter between himself, the landlord, and the HHA. It is forfeited once he moves out from the units he initially occupied. As the tenant's income exceeds the income limit, the subsidy ceases, but he is not required to leave the dwelling unit as he would if he were living in state housing. 20

The income limits and the rent structure of leased housing are identical with those of low-rent housing.

(5) Federally subsidized rental

Federally subsidized Section 8 rental program was authorized under the Housing Community Development Act of 1974. This federal assistance program was implemented on March 29, 1977 by the HHA.

Like the leased housing program, the Section 8 program uses private housing for low-income tenants, that is, it is the private landlords who own the subsidized dwelling units.

We have only limited information on these dwelling units, they are as follows in Table 3-8.

20 As of December 1, 1977, HHA eliminated income limits for continual occupancy in low-rent housing. However, the income limits for continual occupancy in state housing are still in effect.
Table 3-8

Types of Dwelling Under Section 8

<table>
<thead>
<tr>
<th>Types of Dwelling</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Detached</td>
<td>31</td>
</tr>
<tr>
<td>Duplex</td>
<td>29</td>
</tr>
<tr>
<td>Garden Apartment</td>
<td>20</td>
</tr>
<tr>
<td>High Rise Apartment</td>
<td>11</td>
</tr>
<tr>
<td>Town House</td>
<td>3</td>
</tr>
<tr>
<td>Two-Storey Apartment</td>
<td>3</td>
</tr>
<tr>
<td>Row House</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

Source: Compiled from data collected.

Again we cannot tell whether these housing units are as good as other unsubsidized private rental units. However, for reasons stated above, we would expect that there will be less concentration of low-income tenants in the rental building.

Since a family is given the opportunity to find any residential area or type of housing that suits its preference\(^21\) there is more choice on the location and type of housing than only those programs listed above. Also, a tenant under Section 8 program is receiving housing assistance in anonymity. Like the leased housing program, tenants are not required to move out of their present dwelling units if their income increases to the limit where they are no longer eligible for Section 8 assistance.

\(^{21}\)This is true as long as the rent, including utilities, is within the limits of fair market rents set by HHA.
The income limits of the Section 8 program are shown in Table 3-9.

Table 3-9
Annual Income Limits for Admission to Section 8 Housing, as of August, 1977

<table>
<thead>
<tr>
<th>Number of Persons</th>
<th>Low Income</th>
<th>Very Low Income&lt;sup&gt;a&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$ 9,800</td>
<td>$ 6,100</td>
</tr>
<tr>
<td>2</td>
<td>11,200</td>
<td>6,900</td>
</tr>
<tr>
<td>3</td>
<td>12,500</td>
<td>7,800</td>
</tr>
<tr>
<td>4</td>
<td>13,900</td>
<td>8,700</td>
</tr>
<tr>
<td>5</td>
<td>14,800</td>
<td>9,400</td>
</tr>
<tr>
<td>6</td>
<td>15,700</td>
<td>10,100</td>
</tr>
<tr>
<td>7</td>
<td>16,600</td>
<td>10,800</td>
</tr>
<tr>
<td>8</td>
<td>17,500</td>
<td>11,500</td>
</tr>
</tbody>
</table>

Source: HHA information sheet, August 1977.

<sup>a</sup>As long as a family's income is below the low income limit (depending on the number of persons), that family can apply for Section 8 housing. The reason for having very low income figures is for selection purposes, since 30 percent of the Section 8 housing units are reserved for such families.

A family's contribution toward rent will be either 15 percent of his total family income or 25 percent of his adjusted income, whichever is greater. The difference between market rent and the tenant's contribution towards rent is absorbed by the HHA. The HHA pays the difference directly to the private landlords.

(6) State rent supplement

This program was enacted by the State Legislature in 1967 (SLH 278) to help families who are required to vacate their dwellings because their income exceeds the maximum limit permitted in low-rent or state housing, or through other government action, or for any other family
meeting the income and assets limits established by the HHA. However, persons who are receiving money payments for public assistance from the Department of Social Services and Housing are not eligible for the rent supplement program. Like both the leased housing and Section 8 programs, rent supplement is a form of housing assistance which subsidized rentals of existing privately owned dwellings.

Again, we have no information on the physical appearance or the conditions of these private rental units. However, as explained before, we could probably conclude that the dwelling conditions are as good as the "average" private rental units. It is also less likely that a dwelling building will mainly consist of low income groups.

Under this program tenants are not required to vacate the dwelling if their income exceeds the limit. Like the Section 8 program, families participating in the rent supplement program have complete choice over residential location and type of housing. As in the two former housing programs, tenants are receiving rent supplement in anonymity.

Table 3-10 shows the income limits for admission to the rent supplement program.

<table>
<thead>
<tr>
<th>Number of Persons</th>
<th>Income Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$ 12,200</td>
</tr>
<tr>
<td>2</td>
<td>14,850</td>
</tr>
<tr>
<td>3</td>
<td>17,500</td>
</tr>
<tr>
<td>4</td>
<td>17,500</td>
</tr>
<tr>
<td>5</td>
<td>20,100</td>
</tr>
<tr>
<td>6</td>
<td>20,100</td>
</tr>
<tr>
<td>7</td>
<td>22,750</td>
</tr>
<tr>
<td>8+</td>
<td>22,750</td>
</tr>
</tbody>
</table>

Source: HHA information sheet, August 1, 1977.
A tenant's share of rent is 20 percent of his adjusted income. The maximum supplement payment is $70 per family, or $90 in the case of an elderly family.

3.4 Additional Information

To assess the importance and popularity of these housing programs, additional information is summarized in Table 3-11.

3.5 Summary

For reasons to be explained later (Chapter V), it is necessary to combine the federally aided low-rent housing and the state permanent housing and to refer to them as public housing. On the other hand, subsidized private rental housing, referred to henceforth simply as private housing, refers to privately owned rental units where tenants (and landlords) are participating in leased housing, or Section 8, or rent supplement program. The main features of the two types of housing were summarized in Table 3-12.

Federally aided low-rent housing for the elderly, or simple elderly public housing, has all the features of public housing. There are two additional features of elderly public housing: They are (1) all the tenants are elderly people; and (2) special construction devices, as described on page 21.

\[\text{Note that some of the features have already been explained in the text. Other features are not explained because they are not important. They are included here for completeness.}\]
Table 3-11. Total Number of Beneficiaries, Expenditures, Total Number of Applicants on the Waiting List, and Waiting Time

<table>
<thead>
<tr>
<th></th>
<th>Low-Rent</th>
<th>Elderly</th>
<th>State Housing</th>
<th>Leased Housing</th>
<th>Section 8</th>
<th>Rent Supplement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total number of beneficiaries</td>
<td>2,629a</td>
<td>966a</td>
<td>480b</td>
<td>419a</td>
<td>1,178c</td>
<td>974d</td>
</tr>
<tr>
<td>Average subsidy per family per month ($)</td>
<td>139e</td>
<td>171e</td>
<td>139e</td>
<td>145f</td>
<td>162c</td>
<td>67d</td>
</tr>
<tr>
<td>Total subsidy ($)</td>
<td>365,431g</td>
<td>165,186g</td>
<td>66,720g</td>
<td>60,755g</td>
<td>190,836g</td>
<td>65,244d</td>
</tr>
<tr>
<td>Average number of applicants on the waiting list</td>
<td>800h</td>
<td>900h</td>
<td>36i</td>
<td>282i</td>
<td>693j</td>
<td>545d</td>
</tr>
<tr>
<td>Average waiting time to be admitted to program (month)k</td>
<td>10</td>
<td>37</td>
<td>6</td>
<td>4</td>
<td>6</td>
<td>2</td>
</tr>
</tbody>
</table>

Note:  
- e. See page 49 for the derivation of these values.  
- g. Products of the figures of first and second row.  
- h. Source: HHA Composite Report, 1977, p. 34 and verbal information from HHA.  
- k. Calculated from data collected.
Table 3-12. Main Features of Public and Private Housing

<table>
<thead>
<tr>
<th>Feature</th>
<th>Public Housing</th>
<th>Private Housing</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Anonymous housing assistance</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>2. Stigma</td>
<td>Possible</td>
<td>No</td>
</tr>
<tr>
<td>3. Required to move out of housing if over income limit(^a)</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>4. Required to move out of housing if number of family members increases over the occupancy standard set by HHA</td>
<td>Yes</td>
<td>No, if does not plan to receive any further housing assistance</td>
</tr>
<tr>
<td>5. Concentration of low-income families within a housing block or project</td>
<td>Yes</td>
<td>Less likely</td>
</tr>
<tr>
<td>6. Who owns the dwelling</td>
<td>HHA</td>
<td>Private landlord</td>
</tr>
<tr>
<td>7. Landlords' willingness to participate</td>
<td>Yes</td>
<td>Varies with landlord(^b)</td>
</tr>
<tr>
<td>8. Discrimination by the landlords</td>
<td>No</td>
<td>Could be, by some</td>
</tr>
<tr>
<td>9. Public resistance</td>
<td>Yes(^c)</td>
<td>Less likely(^d)</td>
</tr>
<tr>
<td>10. Choice of location and other dwelling characteristics (to tenants)</td>
<td>Relatively restrictive</td>
<td>Relatively less restrictive</td>
</tr>
<tr>
<td>11. Unregistered guests and sharing with or subletting to other households or individuals</td>
<td>Not allowed</td>
<td>Not allowed(^e)</td>
</tr>
<tr>
<td>12. Animals, fowls, or pets on premises</td>
<td>No</td>
<td>Varies with landlords</td>
</tr>
<tr>
<td>13. Fences to yards</td>
<td>Not allowed</td>
<td>Depends on landlords</td>
</tr>
</tbody>
</table>

Note:  
a. This is because the income limits for continual occupancy in state housing are still in effect. (See footnote 20, page 28).

b. About 10 to 20 percent of landlords still decline to participate in the Section 8 program (HHA (1979), p. II-47).

c. Except for elderly public housing projects. (See, for example, Wolman (1975), p. 35).


e. It is difficult to detect violation of this rule in the private housing, and thus the enforcement costs will be formidable.
CHAPTER IV

CHOICE THEORY

4.1 Introduction

In the standard theory of consumer behavior, goods are assumed to be indefinitely divisible and the arguments entering into the individual's utility function are the quantities of the various goods consumed.

The standard theory of housing treats "housing" as a homogeneous good which the household purchases in an amount which depends on income, prices, and family characteristics. Thus, a large portion of the empirical studies on the demand for housing address the effect of changes in income or prices on the consumption of housing. These studies are applicable only to households that are already home-owners or tenants and have no intention to change their tenure status. Before that, decisions have to be made whether or not to become home-owners (or tenants). Households that rent can further choose to live in public housing or private rental housing, with or without housing assistance. These choices are discrete rather than continuous, so the standard theory of choice among an infinite number of alternatives is no longer suitable. An increase in the rent of public housing will either leave the tenant initially living in public housing unaffected (i.e., he will continue to live there) or it will cause him to switch to another type of housing altogether.

For the remainder of this chapter we will discuss rational choice behavior and present the derivation of the estimation. It can be seen
that during the process of derivation, the logit model, which we will use for the empirical studies, is consistent with the theory of utility maximizing choice.

4.2 Rational Choice Behavior

The appropriate model for the basis of housing choice is the theory of rational choice within the Becker-Lancaster consumption-activity-household-production framework. In this model it is assumed that the individual has a series of basic wants to satisfy (by using his production technology). It is further assumed that the individual has a utility function defined for levels of satisfaction of these wants. The rational theory asserts that an individual (tenant) can rank all possible alternatives in order of preference, and he is assumed to select the alternative from a set of feasible choices that maximize his utility. Feasibility here means that the alternatives are bounded by his resource constraints.

In addition, a theory of rental housing choice needs to take account of the following considerations:

(1) A "house" is a bundle of Lancastrian "characteristics."

When a renter chooses a dwelling unit, he considers not only the dwelling characteristics, but also a wide range of neighborhood characteristics associated with the site of the dwelling unit. These characteristics are arguments in a tenant's utility function.

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1See, for example, Green's (1971) chapters 1 and 2 for the conditions of the existence of preference.
(2) The tastes and preferences and thus the utility functions, differ among households, according to the households' characteristics.

(3) The Hicksian type of composite commodity, C (consisting of all other commodities except housing) does exist, and

(4) The household's knowledge about the costs and benefits of all types of subsidized housing open to him is not perfect. The utilities of the alternatives are thus not certain, but are random variables determined by a specific distribution. This implies that the housing choice can be described as a probabilistic choice from a set of alternatives.

4.3 The Theory

The tenant is visualized as choosing the alternative which maximizes his utility. The assumption that the utilities of the alternatives are not certain leads to a probabilistic behavior configuration. Thus, if we denote the utility of alternative "i" (in our case, a particular type of subsidized housing type) to tenant "a" as $U_{ia}$, the choice probability of alternative $i$ is:

$$P(i:I_a) = \text{pro} \left[ U_{ia} \geq U_{ja}, \forall i, j \in I_a \right]$$ (4-1)

where $I_a$ is the set of housing alternative choices open to tenant $a$.\(^2\) (Recall that the alternatives are both mutually exclusive and

\(^2\)To some tenants who desperately need housing, the word "choose" or "choice" may have a different meaning from what we define here.
collectively exhaustive.) This expression indicates that the probability of choosing the alternative $i$ out of the complete set of possible alternatives equals the probability of the utility of alternative $i$ being greater than or equal to the utility of any of the other alternatives in that set. The deterministic equivalent of the theory is thus the choosing of the alternative that has the greater utility.

We assume that the tenant knows the rents of each type of subsidized housing at each location. If $R_i$ is the monthly rent of housing type $i$, the budget constraint of tenant $a$ is:

$$Y = R_i + P_c C$$

where $C$ is the amount of composite commodity consumed at price $P_c$, and $Y$ is income.

A tenant living in any subsidized housing is, implicitly, receiving a subsidy. If he is living in a public housing unit, he is paying lower than private rents of comparable units. The subsidy is directly sent to the landlord in the case of private housing, but, anyway, the tenant is effectively paying lower rent than he would if he were to live in private housing without housing assistance. This has the effect of increasing a tenant's real income.\(^4\)

\(^3\)The federal guideline is that the rent must be at least 20 percent lower. (Schreiber et al. (1976), p. 183).

\(^4\)It can be argued that the tenant perceives his (or her) income increased by less than the amount of subsidy paid by HFA. (For a discussion of philanthropy, see Alchian (1969), pp. 166-172.) However, this does not deny the fact that his income has increased.
Thus, we write,

\[ Y = Y_r + S \]

where \( Y_r \) is the reported income of tenant \( a \), and \( S \) is the amount of subsidy. As tenant \( a \) living in different housing is receiving different amount of subsidy, we further write \( S = S(i) \), to obtain

\[ Y = Y_r + S(i) = R_i + P_c. \]

We further assume that tenant \( a \) has \( I \) discrete types of subsidized housing alternatives. Let \( X_i \) be the row vector of the housing characteristics 1, 2, \( \ldots \) \( n \) of housing type \( i \), i.e., \( X_i = (x_{i1}, x_{i2}, \ldots x_{in}) \).

In our study, tenant \( a \) has a choice of public and private housing. The \( X \) for public housing may include such characteristics as crime rates, distance to work, etc.

Tenant \( a \) is assumed to choose housing alternatives on the basis of his preference for the underlying housing characteristics, and the composite commodity \( C \), i.e., his utility function, is of the form

\[ U_{ia} = U_{ia}(X_i, C_i). \]

For tenant \( a \) with a given reported income \( Y_r \), knowledge of the housing type chosen determined his income \( Y \). The income \( Y \) together with the rents of housing type \( i \) chosen further determined the amount of the composite commodity that can be consumed. Thus for a given \( Y \), each housing bundle and its price (rents) \( R_i \) determined the choice of composite commodity. In other words, the indirect utility function

\[ U_{ia} = U_{ia}(R_i, X_i) \]
represents the budget-constrained level of utility of tenant \( a \) with income \( Y \) living in subsidized housing type \( i \).

A household's preferences for particular underlying characteristics defining subsidized housing types depend upon the characteristics of the tenants, notably income, and the number of children. In general, the household characteristics of tenant \( a \) can be summarized in a row vector \( Z \). The utility function thus becomes

\[
U_{ia} = U_{ia}(R_i, X_i, Z_a).
\]

Thus, the utility \( U_{ia} \) is an indirect utility function of the characteristics of housing alternative \( i \) and the household characteristics of tenant \( a \) for given prices (including rents) and income.\(^5\)

It should be noted here that we implicitly assume that the income level is fixed. However, income is dependent upon the housing type chosen. In some types of studies it is possible to specify an additional equation to explain income; then solve the equations simultaneously. Apparently that is not possible in a logit program. Thus, our empirical result may be biased. Unfortunately, there is no clear solution to this problem other than to be aware of it.

An example of such a function is a utility subsidized housing choice model composed only of crime rates and number of minors. The crime rate in neighborhoods of alternative dwelling units can be

\(^5\)This form of utility function is not unrealistic. Consider the question: "If you were deciding to accept housing assistance, what type of housing would you choose?" The answer implied by the utility function is that it depends on the characteristics and rents of the different available housing, on household characteristics, and income.
expected to vary between alternatives, while the number of minors remains
canstant for a tenant. The crime rates would explain the choice of
housing for a tenant, and the number of minors would account for differ-
cences in tastes and in housing choice among tenants.

The vectors $X_i$ and $Z_i$ do not capture all the factors that determine
his choice of housing type $i$. Let $\varepsilon_{ia}$ be an unobserved and unobservable
random component that contains all the characteristics which are not
included or are unable to be measured in $X_i$ and $Z_i$. If we further
assume that $\varepsilon_{ia}$ can be expressed as additive disturbances, we then
have

$$U_{ia} = V_{ia}(R_i, X_i, Z_a) + \varepsilon_{ia}. \quad (4-2)$$

Substituting equation (4-2) in equation (4-1), we have:

$$P(i:I) = \text{Prob} \{ V_{ia}(R_i, X_i, Z_a) + \varepsilon_{ia} > V_{ja}(R_j, X_j, Z_a) + \varepsilon_{ja} \},$$

for $i \neq j$, $\forall i, j \in I_a$.\]

$$= \text{Prob} \{ \varepsilon_{ia} - \varepsilon_{ja} < V_{ia}(R_i, X_i, Z_a) - V_{ja}(R_j, X_j, Z_a) \},$$

for $i \neq j$, $\forall i, j \in I_a$.\]

It has been demonstrated,\textsuperscript{6} if $\varepsilon_i$ and $\varepsilon_j$ (with the tenant a sub-
script suppressed) are independently and identically distributed with
a reciprocal exponential distribution $\text{Prob}(\varepsilon_i < k) = e^{-\frac{k_i}{\varepsilon}}$, then

\textsuperscript{6}For example, Domencich and McFadden (1972), Chapter 5.
\[
\text{Prob}(c_i - s_i < k) = \frac{\sum_{i=2}^{I} e^{k_i}}{1 + \sum_{i=2}^{I} e^{k_i}} = \frac{1}{1 + \sum_{i=2}^{I} e^{-k_i}} , \text{ and}
\]

\[
P_i = \frac{e^{V_i(R_i, X_i, Z)}}{\sum_{j=1}^{I} e^{V_j(R_j, X_j, Z)}}. \tag{4-3}
\]

From equation (4-3), the odds of choosing i over j alternative can be expressed as

\[
\frac{P_i}{P_j} = \frac{e^{V_i(R_i, X_i, Z)}}{e^{V_j(R_j, X_j, Z)}} , \text{ or}
\]

\[
\ln(P_i/P_j) = V_i(R_i, X_i, Z) - V_j(R_j, X_j, Z). \tag{4-4}
\]

In the empirical analysis that follows, we assume that the V's are linear in their parameters. Thus, we derive the following linear function:

\[
\ln(P_i/P_j) = B_0 + B_1(R_i - R_j) + B_2(x_i - x_j) + \ldots + B_m z_i \ldots , i, j \in I. \tag{4-5}
\]

Since we do not observe probabilities but only the actual choice, we need first to estimate \(P_i\) and \(P_j\) by using grouped data.\(^7\) If we aggregate

\(^{7}\) It bears noting that this grouping process is not strictly appropriate. (See Pindyck and Rubinfeld (1976), pp. 250-251.)
groups of tenants within a "cell" of similar values of all explanatory variables, then we can calculate sample probabilities \( P_i \) and \( P_j \). For \( G \) such groups of tenants, the function (4-5) becomes:

\[
\ln(\frac{\tilde{P}_i}{\tilde{P}_j})_g = B_0 + B_1 (R_i - R_j)_g + B_2 (x_{1i} - x_{1j})_g + \ldots + B_m (z_i)_g \\
+ \ldots, i, j \in I
\]  

(4-6)

where \( g = 1, 2, \ldots G \) and \( \tilde{P}_i, \tilde{P}_j \) are sample probabilities. The parameters (B's) can then be estimated by generalized least squares.\(^8\)

However, this procedure is possible only if we have large samples. For a non-experimental study like subsidized housing choice, calculation of sample probability from observations within a cell of similar values of all explanatory variables may not be feasible, especially when the sample is small. Many cells may contain only one observation. Thus, we need an estimation method that allows one observation per cell. The maximum likelihood method, which will be briefly described below, has this property and was applied in this study.

Let \( y_1, y_2, \ldots y_n \) be sample observations taken on corresponding random variables, \( Y_1, Y_2, \ldots Y_n \). Then, if \( Y_1, Y_2, \ldots Y_n \) are discrete random variables, the likelihood of the sample, \( L \), is defined to be the joint probability of \( y_1, y_2, \ldots y_n \). If \( Y_1, Y_2, \ldots Y_n \) are continuous random variables, the likelihood, \( L \), is defined to be the joint density evaluated at \( y_1, y_2, \ldots y_n \). Application of the method of maximum likelihood estimates those values of the parameters that maximize the likelihood \( L \).

To apply the method of maximum likelihood to our study, we rewrite equation (4-3) as follows:

For each individual, define a variable \( D_{in} = 1 \) if housing \( i \) is chosen by the \( n \)th tenant, and \( D_{in} = 0 \) otherwise. Then

\[
\sum_{j=1}^{I} D_{in} = 1.
\]

To estimate the parameter \( B \)'s, we observe that the likelihood of a given sample is

\[
L = \prod_{n=1}^{N} \prod_{i=1}^{I} D_{i} P_{i}.
\]  \tag{4-7}

We note that \( \ln L \) is a monotonically increasing function of \( L \) and hence both \( \ln L \) and \( L \) will be maximized for the same parameter values. But since \( L \) is a product of functions of the parameters (and finding the derivative of products is tedious) we find the values of parameters that maximize \( \ln L \) instead.

From equation (4-7)

\[
\ln L = - \sum_{n=1}^{N} \sum_{i=1}^{I} \left\{ D_{in} \ln \left( \frac{1}{\sum_{j=1}^{I} e^{V_{j}(R_{j}, X_{j}, Z)} - V_{i}(R_{i}, X_{i}, Z)} \right) \right\}
\]

\[
+ \ln [B_{0} + B_{1}(R_{1n} - R_{jn}) + B_{2}(x_{1in} - x_{1jn}) + \ldots \ln \ldots]
\]

where \( N_{i} \) is the sample size for each type of housing and \( n = 1, 2, \ldots N \),

and \( i \) is the index of observation of housing type \( i = 1, 2, \ldots I \).
The conditions for a maximum are the \((T + 1)^9\) equations that result from finding the partial derivatives of \(\ln L\) with respect to the parameters, and setting them equal to zero. The \((T + 1)\) equations are nonlinear and their solution requires an iterative process. The estimation computer program used in this study was developed by Nerlove and Press (1973).

\(^9T \) is the subscript of the last parameter in equation (4-6).
CHAPTER V
EQUATION SPECIFICATION AND MEASUREMENT OF VARIABLES

5.1 Introduction

We specified in the last chapter that the odds of choosing housing alternative i over j can be expressed as a function of the household characteristics and the differences between housing characteristics and rents (p. 42). In this chapter, we will first discuss how the housing alternatives are stratified for actual estimation. Second, we will discuss the household and housing characteristics included in the regression equations. Lastly, we will explain the sources of data.

5.2 Ideal and Actual Strata

Initially, we planned to explain choices among all possible types of housing under the six housing programs. This would be possible if we had enough observations of individuals, (1) rejecting one housing type offered and accepting another, or (2) accepting and living in one type of housing but later switching to another, for all the possible combinations of housing types. It was later discovered that the actual number of observations of either case is too small for estimation.

We note that when a tenant applies for housing assistance, he is given a preapplication form which allows him to indicate his preference among alternative types of housing. If a tenant indicates only one type of housing, for example, if an elderly tenant checks only low-rent housing for the elderly, the individual's choice implied is unambiguous. In this case, we infer that if the elderly tenant were offered any
housing other than the elderly project, he would reject it. It is possible to draw such an inference because it is costless to check more than one preference on the application form. Failure to check therefore is tantamount to refusal, if offered. The inference is necessary for regression purposes, since we need to know not only the housing type he has chosen but also what type(s) of housing he has rejected.

However, even with this adjustment, we still could not estimate the choice among all the combinations of housing types, because the sample size of each pair of combinations was still too small. We decided to pool the observations to increase the sample size. One logical way to pool the observations is to combine the choice of low-rent housing and state housing as public housing; and rent supplement and Section 8 as private housing. Since nonelderly tenants are not eligible for low-rent housing for the elderly (i.e., elderly public housing), we leave it as a separate alternative exclusively for the elderly. Also, because we wish to test the importance of the distance between residential and work sites, we stratified one equation for the working tenants.

After numerous trials to test for convergence of the regression equations, we arrived at the following sets of stratifications:

1 Logit estimation\(^2\) for nonelderly, working tenants choosing public housing and private housing.

\(^1\)See footnote 22 on page 32 on why we excluded the observations of leased housing. Also, additional observations which indicated preference for either "public" or "private" housing (e.g., not just rent supplement but also rent supplement and Section 8) were included to conform with the new classification of housing choice.

\(^2\)Initially the probit model in the SHAZAM computer package was used to test the convergence of the regression equation because of its very low
(2) Logit estimation for nonelderly, nonworking tenants choosing public housing and private housing.

(3) Logit estimation for elderly, nonworking tenants choosing elderly public housing and private housing, and

(4) Logit estimation for elderly, nonworking tenants choosing public housing and private housing.

5.3 Explanatory Variables Problems

From equation (4-5), we need to know the values of housing characteristics of the alternative rejected in order to estimate the coefficients. Here we are faced with a formidable problem. We cannot measure most of the characteristics of the rejected alternatives because this information is not available.

As a remedy, we calculated the average values of housing characteristics for public and private housing, and we assumed that for a tenant who is residing in private (public) housing, the average values of public (private) housing characteristics will be the public (private) housing characteristics if he had chosen public (private) housing.

Note that the housing characteristics are all entered as differences between private and public housing in regression equations. This is to computing cost. (In addition, the probit model seems to converge better. In one instance, with 66 observations, the logit model fails to converge with six explanatory variables, but the probit model still converges with seven variables.) It was learned that the probit and logit models yielded very close results. This is because the probit and logit specifications differ only to the extent that the standard logistic and normal densities differ, which is slight except at the extreme tails of each. (Snow (1977), p. 5) Also, the probit program package directly produces some statistics, and the estimates are very similar to those of the logit model, several estimates are estimated by the probit model. The probit estimates are indicated in the footnotes of the tables that present the empirical results.
ensure consistency with equation (4-5). A similar treatment is followed by Watson (1974) who, in his study of travel mode choice, believes that the commuter considers costs more in terms of differences.

5.4 Explanatory Variables, Expected Signs

This section explains the selection and expected signs of the explanatory variables included in the regression equations. The explanatory variables are rent, crime rates, race homogeneity, distance to work, number of minors and income. The strongest empirical and sometimes a priori knowledge which we have about the estimated values of the coefficients is with regard to their signs.

(1) Rents

There is little doubt that rents affect the choice of housing. Everything being equal, a priori one would expect that as rent payments of one type of housing increase the probability of choosing that type of housing would decrease, and thus, the probability of choosing other types of housing would increase. One would therefore expect that the coefficient of rents variable would be negative as predicted by the law of demand. An empirical study by Quigley (1976) reaffirmed that "... the choice of housing types for the overwhelming proportion of rental households ... is strongly influenced by relative prices." (p. 95)

(2) Crime rates

With regard to the signs of some of the housing characteristics, we would expect that an increase in the magnitude of an "undesired" ("desired") characteristic, such as greater crime rates, greater distance
to work, (greater race homogeneity), of a particular type of housing would decrease (increase) the probability of choosing that particular type of housing.

Smith's study (1978) shows that a reduction of crime tends to increase the premium paid on housing (p. 382). The Charlotte Observer took a survey in 1974 and found that the main reason for over half of the respondents moving out of Charlotte to surrounding suburbs was to avoid the high incidence of crime (January 6, 1974, p. 1). Using proportion of reported crimes cleared, Leven and Mark (1977) also conclude that households reveal a preference for neighborhoods with higher proportions of reported crime cleared (p. 153). Thus, it can be expected that in our study also, the coefficient of crime rates variable will be negative.

(3) Race homogeneity

Race homogeneity is the proportion of a particular race to the total population in a public housing project or a census tract. If tenants like to live in housing or location where there is a relatively large percentage of people of their races, we would then expect a positive sign for the race homogeneity variable.

(4) Distance to work

A longer distance to work will incur larger commuting costs. Since commuting itself is a displeasure to be avoided, we would expect a negative sign for the distance to work variable.

We acknowledge that simultaneous equations bias may exist for this variable if the decisions concerning where to live and where to work are not made sequentially.
Straszheim (1973, p. 3) and Leven and Mark (1977, p. 153), among others, support the evidence of the effect of distance to work on the housing choice.

(5) Number of minors

It is agreed that the "life cycle" attribute, such as the number of minors (or family size, number of nonworking dependents, etc.) is an important element that determines the choice of housing. Thus, the life cycle is commonly selected as an explanatory variable in empirical studies. Granfield (1974) has shown that as a family grows in size it will demand more space and tend towards residing in a single family residence (p. 99).

Recall that all public housing structures are multi-family, apartment buildings. A tenant has to live in this type of dwelling if he chooses public housing. On the other hand, a tenant always has an option of choosing private housing of single family residence, with larger yard space or lot size,4 or an area which has lower crime rates and less exposure of children to drugs. The number of minors in this case would have a negative effect on the probability of choosing public housing.

On the other hand, a family with a large number of minors might be more likely to live in a public housing unit. The reason is that private landlords tend to discriminate against families with many minors.5 This

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4This is in fact reflected by the types of Section 8 housing (as compared to public housing), see page 29.

5This is because children may deface the building and thus raise maintenance cost. Additionally, families with a larger number of minors are usually extended families. The extended family life style is more popular in the Samoan, Filipino, and Korean households, especially if
implies that lower search costs of public housing for households with larger number of minors. In this case, the number of minors is positively related to the probability of choosing public housing. However, as indicated before, people with a larger family might feel a greater desire for space, privacy, detached house, etc. Thus, the coefficient for this variable is not at all clear a priori.

(6) Income

Income has long been recognized as an important element in housing or nonhousing consumption and tenure choice. It has been argued and shown that as income increases households tend to (i) demand more lot size (King, 1976, p. 1086; Straszheim, 1973, p. 6; Quigley, 1976, p. 90), (ii) more likely be owner-occupiers, because as their incomes increase they demand (and owner-occupied dwelling can provide) greater choice of residential location and type of dwelling. (Viper and Walker, 1972, p. 175), and (iii) wish to live in single-family or single detached rental units (Grandfield, 1974, p. 177; Quigley, 1976, p. 45).

We already noted that private housing allows wider choice of dwelling and location, and thus it is possible for tenants to choose between private housing which has more yard space or larger lot size or/and a single-family dwelling unit. We would then expect a negative relationship between income and the probability of choosing public housing.

5.5 Measurement of Variables and Data Sources

We were given access to tenants' personal folders on file at HHA. These folders contain information such as age, sex, race of family they are new immigrants to Hawaii. However, mainly because of the language, local landlords tend to discriminate against these families.
members, residential and employment addresses, project(s) or program(s) preference and rejection(s), if any, dates of application and admission, income and assets, tenant's and HHA's share of total rent, etc.

Below is a description of the measurement and data sources of the explanatory variables used in the analysis.

Rent is the tenant's share of total market (contract) rent. It is calculated according to the rent structure mentioned in Chapter III, and is recorded on one of the forms in the tenant's folder.

Crime rates constitute the total number of Part I offenses\(^6\) in that beat where the public housing project, or rent supplement, or Section 8 housing is located. To arrive at the crime rates per capita, we divide the total crime rates by total population in that beat. The source of crime rates data is the Annual Statistical Report 1976, Honolulu Police Department, City and County of Honolulu, Hawaii. The source of population information is the Community Services Administration (formerly Office of Economic Opportunity) 1975 Census Update Survey; Oahu.\(^7\)

Race homogeneity variable is defined as the proportion of the number of a particular race to the total population in a public housing project or a census tract where the subsidized private housing is located. The

\(^6\)Part I offenses are: murder/manslaughter, negligent homicide, forcible rape, robbery, assault—1st and 2nd, burglary, larceny—over $200, —over $50, —$5 to $50, — under $5, and auto theft. The main reason for using Part I offenses is because they are comparatively more serious offenses and less subject to victims' discretion on whether to report or not.

\(^7\)I am grateful to Dr. Robert Gardner of East-West Population Institute for supplying me the Census Update Survey.
proportion of the number of a particular race to the total number of tenants in a public housing project is calculated from the sample data collected. For tenants living in subsidized private housing, the proportion is readily available from the census tract information. This source of the information is the 1975 Census Update Survey: Oahu.

Distance to work is the distance between working and residential sites measured on a map. The source of working and residential sites information is obtained from the tenants' folders.

Number of minors is the number of household members of age 17 and below. The data source of this variable is the tenants' folders.

In this study, we define income as the total of aggregate yearly family income plus the subsidy arising from the housing type a tenant has chosen. The amount of aggregate yearly family income is readily available from the forms in the tenants' folders.

The subsidy is the difference between yearly market rent and rent actually paid by the tenant for a particular type of housing. For subsidized housing, the information of market rent and tenants' contribution are recorded in the folders. However, since the public housing units are not rented in the market place, we have to estimate the market rent of public housing. This is estimated as below.

Because to some extent public housing is less desirable, a unit public housing may not command as high a rent as a "comparable" private housing unit in the market place. Since leased housing units have a vacancy rate of 3 percent or more they may be rented out at a "discount" price compared to private housing units. However, the information we have

---

8See page 15 for definition.
on leased housing consists of the number of bedrooms and market rent, and thus we can only regress the number of bedrooms on market rent. We use this equation to estimate the market rent of public housing by the number of bedrooms. The estimated market rent of public housing, together with the tenant's contribution towards total market rent, give us the estimated subsidy for each individual tenant. The information on tenant's share of rent is available in the tenants' folders.

A brief summary of the explanatory variables used in the analysis is shown in Table 5-1. We symbolically denote the variables by using abbreviations.

---

9The ordinary least squares regression for this equation is:

\[
\text{Rent} = 184.93 + 33.38 \times \text{Bedroom Number},
\]

\[
\begin{align*}
(14.96) & \quad (7.39)
\end{align*}
\]

adjusted \( R^2 = 0.51 \), and \( F = 20.43 \). (Parenthesized terms are standard errors.)

10With this information, we can calculate the average subsidy of low-rent, low-rent elderly, and state housing as shown in Table 3-11.
Table 5-1

Variables Used in the Analysis

RENTDI: Rent is the tenant's contribution towards total contract rent. It is the monthly purchase requirement that is needed to exchange for the contract rent of a dwelling unit. RENTDI is the difference in rent between private and public (or elderly public) housing, in dollars.

CRATDI: Crime rate is the number of part I offenses per capita in a year (1975) on the beat where the housing unit is located. CRATDI is the difference in crime rate between private and public (or elderly public) housing.

RACED: Race homogeneity variable is the percent of the same race in a public housing project (or a census tract of a private housing unit) as the tenant in a particular observation. RACED is the difference in race homogeneity between private and public (or elderly public) housing, in percent.

DISTDI: Distance to work is the distance between working and residential sites. DISTDI is the difference in distance to work between private and public housing, in miles.

MINORS: Number of household members of age 17 and below.

INCOME: Subsidy is defined by the difference between yearly market rent and rent actually paid by the tenant of a particular type of housing. INCOME is defined as the sum of aggregate yearly family income and subsidy arising from the housing type a tenant has chosen, in dollars.
CHAPTER VI
EMPIRICAL RESULTS

6.1 Introduction

There are several purposes in this chapter. First, we want to explain the estimating equations and the logit function; second, we will present the resulting equations, and to test the coefficients for significance (direction and magnitude) and the equations for their explanatory power; and finally, the results are interpreted.

6.2 Estimating Equations

As developed and explained in Chapter IV, the empirical study in this chapter is based on maximum likelihood estimation of the logit model equation (4-4), which specified the logarithmic odds of the choice between private and public housing as a linear function of rents, and housing and household characteristics. The selection of strata and explanatory variables in Chapter V culminate in these specific models:

(1) for nonelderly, working tenants

\[
\ln \left( \frac{P_{\text{private}}}{P_{\text{public}}} \right) = a + b_1\text{RENTDI} + b_2\text{CRATDI} + b_3\text{RACEDI} + b_4\text{DISTDI} + b_5\text{MINORS} + b_6\text{INCOME} ,
\]

(2) for nonelderly, nonworking tenants

\[
\ln \left( \frac{P_{\text{private}}}{P_{\text{public}}} \right) = a + b_1\text{RENTDI} + b_2\text{CRATDI} + b_3\text{RACEDI} + b \text{MINORS} + b \text{INCOME} ,
\]
(3) for elderly, nonworking tenants

\[
\ln \left( \frac{P_{\text{private}}}{P_{\text{eld pub}}} \right) = a + b_1 \text{RENTDI} + b_2 \text{CRATDI} + b_3 \text{RACEDI} + b_4 \text{MINORS} + b_5 \text{INCOME},
\]

and

\[
\ln \left( \frac{P_{\text{private}}}{P_{\text{public}}} \right) = a + b_1 \text{RENTDI} + b_2 \text{CRATDI} + b_3 \text{RACEDI} + b_4 \text{MINORS} + b_5 \text{INCOME},
\]

where \( P_{\text{private}} \), \( P_{\text{public}} \), and \( P_{\text{eld pub}} \) are the probability of choosing private, public, and elderly public housing respectively. (The abbreviations were explained in Table 5-1.)

6.3 The Logit Function and Additional Statistics

We have shown in Chapter IV that the logit model is consistent with the theory of choice and utility maximization. In addition, the model contains some properties that make it a more appropriate estimating method in the case of dichotomous (or qualitative) dependent variable. In this section, we will summarize these properties and explain some additional statistics that appeared in the resulting equations.

The frequently acknowledged and commonly-practiced way to treat a dichotomous explanatory variable is to assign a dummy variable that takes a value of zero or one. The same method could be applied to two or more sets of dichotomous explanatory variables as long as we can avoid the dummy variable trap. In these cases, ordinary least squares (OLS) and other standard regressions can handle the task without difficulty. However, whenever we have a dichotomous dependent variable, the classical OLS is not the most efficient or correct procedure to use.
The main flaws of using OLS when the dependent variable is dichotomous (that is, the linear probability model) are summarized in Nerlove and Press (1973), among others.¹

Firstly, the error terms are heteroscedastic, and these OLS estimators are inefficient. Secondly, it is possible that the predicted probability is negative or greater than one. Thirdly, the $R^2$ is no longer meaningful, and estimated standard errors are not consistent. Fourthly, because the values of the dependent variable are not normally distributed, no method of estimation that is linear in the dependent variable will in general be fully efficient. Finally, because the estimated variables of the estimations are biased toward zero, the power of the t-test is very limited. (pp. 5-8)

Besides the above argument against the use of OLS, Marantz et al. (1976) offer two additional reasons for using the logit model. First, there is no formal statistical justification for using OLS. Secondly, the slope of the regression line of OLS is constant over the entire range of explanatory variables. Since the slope denotes the rate of change of the predicted probability with respect to the explanatory variable, the implication then is that, for example, a $10 change in rent has the same effect on the probability of housing-choice of a tenant paying $100 as another tenant paying $300 per month. In contrast, the logit relation is larger when the probability is closer to 1/2 and is smaller when the probability is close to one or zero, and thus the rate of change is affected by the current value of the probability. (pp. 37-40)

¹For example, Marantz et al. (1976), pp. 37-40 and pp. 175-179, and Watson (1974).
Several methods have been developed to replace OLS when we have a dichotomous dependent variable. The generalized least-squares model (GLS) has been suggested. However, GLS is able to correct for heteroscedasticity only. The probability predicted using the GLS could still fall outside the zero-one range. (Solomon, 1974, pp. 93-94, footnote 22)²

Two widely used alternative models are the probit and logit. The probit model is associated with the cumulative distribution function of the standard normal distribution, \( F \). Specifically,

\[
P_i = F(BX) = \left( \frac{1}{\sqrt{2\pi}} \right) \int_{-\infty}^{BX} e^{-t^2/2} \, dt
\]

where \( B \) is the parameter vector of the explanatory variables vector \( X \). On the other hand, the logit model is based on the cumulative distribution function of the standardized logistic distribution, \( 1/(1 + e^{-BX}) \). Specifically,

\[
P_i = \frac{1}{1 + e^{-BX}} \quad (6-1)
\]

Equation (6-1) can be transformed into the ln (odds of choosing \( i \)) = BX. The dependent variable of the logit model has a probabilistic interpretation, which makes it better than the probit model.

We will briefly mention some of the desired properties of the logit function. In addition to the logit estimates being more efficient and correct, the function also has the capacity of transforming the original model so that for all values of the dependent variable, the predicted

values will fall inside the zero-one interval. In addition, based on
the logit model we can derive some of "the" correct testing statistics:

(1) Chi-square likelihood ratio test for explanatory power of
individual variable. (Analogous to the 't' test.)

Let likelihood ratio = (likelihood function with variable
omitted/likelihood function with variable included). -2 in
likelihood ratio is asymptotically distributed with one
degree of freedom (d.f.) and tests the null hypothesis that
the coefficient vanishes;3

(2) Chi-square likelihood ratio test for explanatory power of the
equation. (Analogous to the 'F' test.)

Let likelihood ratio = (likelihood function with all
explanatory variables omitted/likelihood function with all
explanatory variables included). -2 In likelihood ratio is
asymptotically distributed with d.f. equal to the number of
multiplicative variables and tests the null hypothesis that
all multiplicative coefficients vanish; and

(3) Likelihood ratio index, $\rho^2$. (Analogous to the 'R^2'.4)

$$\rho^2 = 1 - \frac{\text{log likelihood with all explanatory variables included}}{\text{log likelihood with all explanatory variables excluded}}. \quad 5$$

6.4 Empirical Results

This section contains the parameter estimates of the choice of
housing functions stratified according to the specification listed
earlier in this chapter. The coefficients indicate only how the estimated
values of the log of the odds of choosing private over public (or

3Since -2 in likelihood ratio is asymptotically distributed with
chi-square, these statistics all have asymptotic significance only.

4Since we do not observe probabilities and thus cannot estimate
residuals, there is no "goodness of fit" measure, such as R^2 statistics
in a logit model.

elderly public) housing change when the associated variables change, not how the probability of choosing the private over public (or elderly public) housing changes. However, the coefficients do indicate the direction in which the right hand side variables affect the probability of choosing private over public (or elderly public) housing, because the cumulative logistic probability function is a strictly increasing function.

As noted before, the nature of the observation considerably reduced the sample sizes. This constrains the number of explanatory variables that can be used without introducing the problem of convergence. In spite of these limitations, however, the statistical results of the empirical analysis are rather encouraging. The variables together explain at least 65 percent (at the 99 percent confidence level) of the total variations of binary-choice of housing. The signs of the estimated coefficients are as predicted. With the exception of MINORS and the constant terms, the coefficients are in most cases stable and statistically significant.

The results of column 1 (Table 6-1) of all four equations indicate that the rent coefficient has the anticipated sign and is highly significant. The negative sign of the rent variable indicates that if the rent in private housing is increased vis-à-vis public housing, the probability that a tenant will choose private over public housing is reduced. We noted that the magnitude of the RENTDI coefficient is highest in the second equation. This is probably because the nonelderly, nonworking group has the largest average number of minors (that is, 2.5, see Table 7-1), and 'larger families with greater demands for necessities
Table 6-1. Estimated Coefficients of the Housing Type Choice Model

<table>
<thead>
<tr>
<th>Variable</th>
<th>Equation 1</th>
<th>Equation 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Nonelderly, working tenants</td>
<td>Nonelderly, nonworking tenants:</td>
</tr>
<tr>
<td></td>
<td>Dependent variable is ( \ln \left( \frac{p_{private}}{p_{public}} \right) )</td>
<td>Dependent variable is ( \ln \left( \frac{p_{private}}{p_{public}} \right) )</td>
</tr>
<tr>
<td></td>
<td>Logit Coefficient</td>
<td>( \frac{\partial p_i}{\partial x_{ki}} )</td>
</tr>
<tr>
<td>RENTDI</td>
<td>-0.0160 (18.968)**b</td>
<td>0.00360</td>
</tr>
<tr>
<td>CRATDI</td>
<td>-10.340 (3.3462)</td>
<td>2.32630</td>
</tr>
<tr>
<td>RACEDI</td>
<td>0.0741 (26.788)**</td>
<td>0.01667</td>
</tr>
<tr>
<td>DISTDI</td>
<td>-0.2308 (20.996)**</td>
<td>0.05192</td>
</tr>
<tr>
<td>MINORS</td>
<td>-0.1136 (0.4332)</td>
<td>0.02555</td>
</tr>
<tr>
<td>INCOME</td>
<td>0.0004 (19.646)**</td>
<td>0.00009</td>
</tr>
<tr>
<td>Constant</td>
<td>-1.160 (1.26)c</td>
<td>--</td>
</tr>
<tr>
<td>( \chi^2 )</td>
<td>137.78***</td>
<td>66.27***</td>
</tr>
<tr>
<td>Number of observations</td>
<td>147</td>
<td>66</td>
</tr>
<tr>
<td>Likelihood ratio index</td>
<td>0.69c</td>
<td>0.79c</td>
</tr>
</tbody>
</table>
Table 6-1. Estimated Coefficients of the Housing Type Choice Model (continued)

<table>
<thead>
<tr>
<th>Variable^a</th>
<th>Equation 3</th>
<th>Equation 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elderly, nonworking tenants:</td>
<td>Elderly, nonworking tenants:</td>
<td></td>
</tr>
<tr>
<td>Dependent variable is ln (( p_{\text{private}} / p_{\text{eld pub}} ))</td>
<td>Dependent variable is ln (( p_{\text{private}} / p_{\text{public}} ))</td>
<td></td>
</tr>
<tr>
<td>Logit Coefficient</td>
<td>( \partial p_i / \partial x_{ki} )</td>
<td>Logit Coefficient</td>
</tr>
<tr>
<td>-------------------</td>
<td>-----------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>RENTDI</td>
<td>-0.0222</td>
<td>-0.0251</td>
</tr>
<tr>
<td></td>
<td>(30.548)***</td>
<td>(33.374)***</td>
</tr>
<tr>
<td>CRATDI</td>
<td>-26.49</td>
<td>-30.31</td>
</tr>
<tr>
<td></td>
<td>(5.593)**</td>
<td>(7.332)**</td>
</tr>
<tr>
<td>RACEDI</td>
<td>0.0474</td>
<td>0.0528</td>
</tr>
<tr>
<td></td>
<td>(47.21)***</td>
<td>(42.012)***</td>
</tr>
<tr>
<td>MINORS</td>
<td>15.7698</td>
<td>-3.0335</td>
</tr>
<tr>
<td></td>
<td>(2.132)</td>
<td>(1.06)</td>
</tr>
<tr>
<td>INCOME</td>
<td>0.0003</td>
<td>0.00005</td>
</tr>
<tr>
<td></td>
<td>(8.608)***</td>
<td>(21.152)***</td>
</tr>
<tr>
<td>Constant</td>
<td>0.2476</td>
<td>-0.2422</td>
</tr>
<tr>
<td></td>
<td>(0.134)c</td>
<td>(0.031)c</td>
</tr>
<tr>
<td>( X^2_d )</td>
<td>169.29**</td>
<td>166.18***</td>
</tr>
<tr>
<td>Number of observations</td>
<td>167</td>
<td>153</td>
</tr>
<tr>
<td>likelihood ratio index</td>
<td>0.65c</td>
<td>0.73c</td>
</tr>
</tbody>
</table>

^a. These explanatory variables are defined in the text.

b. \(-2 \ln \) likelihood ratio tests the null hypothesis that the coefficient indicated in every parenthesis vanishes. ** and *** denote significance at 95% and 99% confidence levels, respectively.

c. Based on the probit model.

d. \(-2 \ln \) likelihood ratio tests the null hypothesis that all multiplicative coefficients vanish. The ratio is based on the probit model.
are more responsive to relative prices in their choices among housing types.' (Quigley (1976), p. 95).

The estimated coefficient of the crime variable has the expected sign and is statistically significant in 3 of the 4 equations. The negative sign has the same interpretation as the rent variable. The relatively large coefficient of the nonelderly, nonworking group may be due to the following reason. If compared with nonelderly, working tenants, relatively more of the nonelderly, nonworking families are headed by females. 6 Similarly, the coefficients of the crime variable in equations 3 and 4 are higher than that of equation 1. This is probably because elderly and predominantly female tenants are more crime conscious. 7

The coefficient of the variable for race is also statistically significant in all equations. The positive sign suggests that if the percentage of a particular ethnic group living in the private housing is increased vis-à-vis the public housing, the probability is increased that a tenant of that particular ethnic group will choose private over public housing.

6 The ratio is 16 percent vs. 54 percent. (Calculated from data collected.) There may be an additional reason. The probability of being victimized and the 'cost' to a family as a whole increases as the number of minors increases. But, for a certain kind of crime, e.g., rape, the probability of being victimized may decrease if there are more minors in a family. Note again that the nonelderly, working group, on the average, has less number of minors than the nonelderly, nonworking group. (2.5 vs. 2.0, see Table 7-1.)

7 The percentage of households headed by females is 47 and 34 for equations 3 and 4 respectively. (Calculated from data collected.)
On the other hand, the coefficient of the income variable is stable and is statistically significant. The positive coefficient\(^8\) for this variable indicates that higher income tenants are more likely to choose private housing. The result suggests that the housing services produced by private housing are "normal," and that of public housing, "inferior."\(^9\)

The coefficient of the (monthly) rent is more than twelve times larger than the coefficient of the (yearly) income in all four equations. This implies that an increase of one dollar in rent has more weight than an increase of one dollar in income on the choice of housing. We would expect this result because a rent reduction of one dollar on private housing increases income by one dollar and reduces private rent relative to public rent, whereas a one dollar increase in income has only the first of these two effects.

The usefulness of the empirical results that are displayed in Table 6.1 are not restricted to revelation of the direction and magnitudes of the coefficient as discussed. It could also indicate the relative importance of these explanatory variables. However, it is rather difficult to compare and determine the relative importance of

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\(^8\)We acknowledge the possibility that the coefficient may be biased upward because it is relatively easier to sublet rooms in private housing. Unfortunately, nothing can be done about this problem other than to be aware of it.

\(^9\)In a study of rental-owning choice, Rosen (1979) finds that income has a positive impact on the probability of owning and he suggests that this might be because the 'characteristics' associated with owner-occupied housing are normal. (p. 13)
these explanatory variables. The coefficients refer to different units of measurements, for example, dollars, miles or percentage points. We can, however, evaluate the value of 'marginal rates of substitution' between the variables (MRS) which are the ratios of the coefficients to give us more comprehensive comparisons. These estimates provide a measure of the trade-offs between variables. Some of the MRS are shown in Table 6-2.

The first row of Table 6-2 shows the MRS between crime and related independent variables in equation 1 as shown in Table 6-1. The number $-0.14$ means that a nonelderly working tenant would be indifferent between an increase in type I offenses in their neighborhood of 1 per 1,000 (people) and a decrease of 0.14 percent in race homogeneity. These tenants also appear indifferent between either an increase of 1 per 1,000 increase of type I offenses or an increase in monthly rent of 65 cents. Also, tenants are willing to pay 14 dollars extra in monthly rent if the distance to work is shortened by one mile.

The MRSs between all other pairs of variables in Table 6-2 can be interpreted in a similar manner. The general observation indicates that

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10 For an explanation of the relationship between MRS and the ratio between coefficients, see Leven and Mark (1977), and Domencich and McFadden (1975), p. 179.

11 This number seems quite reasonable. Assume it takes five minutes in vehicle time to travel one mile by bus, and assume that a tenant works 20 days a month. This implies that he will spend 3.4 hours extra commuting time per month. With an average wage rate of four dollars an hour, the monthly monetary cost of these extra hours is 13.6 dollars. Smith (1978) estimates the nearness to employment center is valued at about $350/mile. (p. 381) This figure is relatively low, compared with our estimate.
Table 6-2
Marginal Rates of Substitution Between Explanatory Variables

<table>
<thead>
<tr>
<th>A change of:</th>
<th>Would substitute for:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>% in RACEDI</td>
</tr>
</tbody>
</table>

**Equation 1: Nonelderly Working**

| 1 per 1,000 in CRATDI | -0.14 | + 0.65 | +0.04 |
| 1 % in RACEDI         | -     | - 4.63 | -0.32 |
| 1 mile in DISTDI      | -     | +14.43 | -     |

**Equation 2: Nonelderly Nonworking**

| 1 per 1,000 in CRATDI | -0.43 | + 1.07 |
| 1 % in RACEDI         | -     | - 2.50 |

**Equation 3: Elderly Nonworking**

| 1 per 1,000 in CRATDI | -0.56 | + 1.19 |
| 1 % in RACEDI         | -     | - 2.13 |

**Equation 4: Elderly Nonworking**

| 1 per 1,000 in CRATDI | -0.57 | + 1.21 |
| 1 % in RACEDI         | -     | - 2.10 |

Nonelderly and elderly nonworking tenants have similar valuations of crime, race homogeneity, and rent. Compared to the nonelderly working tenants, the nonworking tenant groups value a decrease in crime more than the former. The nonworking tenants are willing to accept an increase of about 0.5 percent in race homogeneity of a decrease of monthly rent of one dollar for a decrease of 1 per 1,000 in type I ridge.

Again this would seem like a reasonable figure. A decrease of monthly rent of one dollar implies a decrease of 12 dollars per year. With a discount rate of 10 percent per annum, the 'costs' of this
offense; while the working tenants are only willing to accept an increase of about 0.1 percent and a decrease of 65 cents respectively for the same magnitude of decrease of crime. On the other hand, working tenants place a heavier value on race homogeneity than the nonworking tenant groups. For a one percent increase in the race factor, the working tenants are willing to pay an additional four or five dollars in monthly rent; while the nonworking groups are only willing to pay two or so dollars.

The crime variable, type I offenses per capita, can be thought of as the probability of an individual being victimized by a type I crime. Assuming that the average tenant has four family members, the probability of a household being victimized is four times the probability of an individual being victimized. We now wish to estimate the total cost of an increase of one type I offense per thousand from our estimated results. The probability of being victimized by an increase of one type I offense per 1,000 in a family is 0.001 x 4. Assume that the total cost (monetary and nonmonetary) of one type I offense is $X. Then, the expected cost of one type I offense to a household is $0.004X. With a discount rate of 10 percent per annum, the perpetual cost is $0.04X. This expected present value of an additional type I offense cost to a household should be equal to the extra amount of rent that the household is willing to pay.13 The extra $7.80 rent (per year, from Table 6-2)

increased rent forever would be 120 dollars. In terms of a reduction of Type I offenses by 10 per 1,000, it is equivalent to an increase in costs of $1,200. Smith (1978) has estimated a reduction of crime by 10 per 1,000 would command a premium (paid in housing) of about $1,400. (p. 382)

13Assuming risk neutrality.
that a working tenant is willing to pay implies that $X$ is $195$. For
the nonworking (both elderly and nonelderly) group, with an approximately
$12$ extra per year this group of tenants is willing to pay, $X$ is $300$.
Since there are no comparable estimates of the cost of a type I offense
to a family, it is difficult to say whether $195$ or $300$ is larger or
smaller than would be expected.\footnote{To give an idea of the cost of certain crimes, Thaler (1978) estimates the cost of an 'average' property crime is roughly $500$. (p. 144)}
CHAPTER VII
POLICY IMPLICATIONS

7.1 Introduction

In previous chapters we have formulated a housing-type choice model and have estimated the coefficients of the model. In this chapter we will examine the policy implications that can be drawn from the model and the empirical result.

Because housing programs are a part of income distribution programs, the discussion on housing policies should be related to some of the policy criteria of income distribution programs. Such criteria usually include efficiency and equity considerations. The first part of the chapter will address this policy issue; and in the second part of the chapter we will present the specific policy implications that can be drawn from the empirical result.

7.2 Policy Criteria

The housing problem—inequality housing consumption—exists if the "housing service unit" consumption for a family of a given size is below an arbitrarily determined level of housing service units. Since the demand for housing is a positive function of income, low-income families may not be willing to consume the arbitrarily determined minimum amount of housing services. In short, the housing problem is

This theoretical entity was conceived by Muth (1960), p. 32.
basically a problem of poverty which can be alleviated by increasing a family's income through income distribution programs. These include in-kind transfers such as construction of public housing for occupancy by low-income households, subsidy earmarked for private housing consumption, and unrestricted cash grants.

There are many types of problems to be solved in the area of subsidized housing, but we will focus on only two, both of which are problems in public housing. The first problem is related to the construction location of new units, i.e., where to build new public housing units. The second problem is related to the allocation of existing units, i.e., who should reside in these units.

Solutions to these problems usually require some policy objectives. For example, if it is believed that the main problem in public housing is caused by a high concentration of very low-income tenants, and that the problem could be alleviated if a minimum number of relatively higher income tenants could be induced to live in public housing, the policy objective would be to increase the income mix in public housing. There may be alternative means to this objective. For example, the rent payable by relatively higher income tenants in public housing could be lower than that payable by the very low income tenants (ignoring the problem of whether this is politically feasible). Another possible alternative is to increase the rent payable by relatively higher income tenants in private housing. To evaluate alternative means of solving this problem or of achieving an objective, we set forth some criteria. Two common criteria advocated by economists are efficiency and equity (horizontal and vertical). Bureaucrats, legislators, and scholars may
advocate these, too; or they may advocate objectives inconsistent with some of these criteria.

It may be useful to define two types of equity, based solely on the level of income in the content of housing assistance. Horizontal equity means equal treatment for households with equal income. This equity is achieved if households with the same income who applied for housing assistance are receiving an equal amount of subsidies. Vertical equity occurs where lower income households are receiving higher subsidies.

The number of public housing units and funding for private housing programs are always scarce relative to tenants' "wants." Given this scarcity, these units and funding must be used in the most efficient way so that the total amount of benefits received by the eligible tenants is maximized. In practice, efficiency is sometimes evaluated in terms of the difference between social benefit and social cost. For example, to evaluate the alternative means of achieving a policy objective, we could compare the difference between social benefit and social cost among alternative means, where the means with the largest positive or the smallest negative value of the difference is most efficient.

Before we go on to the next section, a few points of clarification must be made here. First, for a given objective, the criteria of a proposed means (to that object) cannot always be simultaneously satisfied. However, some means are more (or less) efficient and or more (or less) equitable than the others. Because of insufficient information, it may sometimes be impossible to discuss and compare the equity or efficiency among alternative means in any case.
Second, we wish to emphasize that the types of policy questions which can be addressed are those with a "split" behavioral study. For example, we can deal with the policy question of how the "split" decision can be used to induce the tenant to switch from one housing type to another to achieve a targeted income mix. We cannot estimate the impact of total housing consumption due to an income change.

Third, because the model does not take into account the choice of participating versus not participating in the housing programs, we cannot predict the additional number of new applications for each type of housing if the rent structure changes. Therefore, the estimates that are presented in the following discussion should be treated with caution.

Finally, throughout the discussion in this chapter we merely take the policies pursued by the various authorities or proposed by academicians as given, that is, we will not be considering the controversy of the normative nature of these policies. Rather, we will only make positive statements (based on our result) about how these policies could be achieved.

7.3 Elasticities of the Estimated Coefficients

Before considering the policy implications proper, it might be useful to briefly present and discuss the elasticities of the estimated coefficients.

In a probability model, elasticity is the percentage change in the probability of choosing an alternative due to a one percent change of an explanatory variable.2 Two kinds of elasticity measure are presented in

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2 For policy purposes it will be useful to reinterpret the elasticity as the percentage change in the proportion of a population choosing an alternative due to a one percent change in the explanatory variable.
this study. The first is "own" elasticities, and the other, "cross" elasticities. Mathematically (based on the logit model), they can be expressed as:

\[
P(\text{L})^E_{x_{ki}} \quad (\text{own elasticity}) = (1-P_i).b_{ik}.x_{ki} \quad (7-1)
\]

\[
P(j)^E_{x_{ki}} \quad (\text{cross elasticity}) = -P_i.b_{ik}.x_{ki} \quad (7-2)
\]

where i, j index alternatives, \( x_{ki} \) is the explanatory variable k of alternative i, \( b_k \) is the coefficient of variable k, and \( P(i) \) and \( P(j) \) are the probability of choosing alternative i and j respectively.4

Based on the results on the logit model and elasticity formulas (7-1) and (7-2), a complete set of own and cross elasticity of all the explanatory variables for all the four equations is given in Table 7-1.5

7.4 Policy Implications

In terms of the values of elasticities in Table 7-1, it is clear that rent is an important factor in the choice of housing type. In three out of four equations, it has an elasticity of greater than unity. This implies that an effective way of influencing housing choice is through the rent payable by tenants.

3Explicitly, \( x_{ki} = (x_{ki} - x_{kj}) \).

4For derivation, see for example, Richards and Ben-Akiva (1975), pp. 34-36; Snow (1977), Table 4, footnote g.

5The \( x_{ki} \)'s values are the means of the explanatory variables in each equation. This is a customary way to estimate the representative values of elasticities.
Table 7-1
Elasticities of the Probability of Choosing Private Housing

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean Value</th>
<th>Own Elasticity</th>
<th>Cross Elasticity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nonelderly, working tenants</td>
<td>(Private housing choice probability is 0.66 at variable mean values)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RENTDI</td>
<td>161.293</td>
<td>-0.882</td>
<td>1.699</td>
</tr>
<tr>
<td>CRATDI</td>
<td>-0.00877</td>
<td>-0.031</td>
<td>0.060</td>
</tr>
<tr>
<td>RACEDI</td>
<td>-0.5578</td>
<td>0.014</td>
<td>-0.027</td>
</tr>
<tr>
<td>DISTDI</td>
<td>-2.2245</td>
<td>-0.175</td>
<td>0.338</td>
</tr>
<tr>
<td>MINORS</td>
<td>2.0204</td>
<td>-0.079</td>
<td>0.151</td>
</tr>
<tr>
<td>INCOME</td>
<td>10156.2</td>
<td>1.389</td>
<td>-2.674</td>
</tr>
<tr>
<td>Nonelderly, nonworking tenants</td>
<td>(Private housing choice probability is 0.10 at variable mean values)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RENTDI</td>
<td>160.53</td>
<td>-6.864</td>
<td>0.786</td>
</tr>
<tr>
<td>CRATDI</td>
<td>-0.00727</td>
<td>-0.333</td>
<td>0.038</td>
</tr>
<tr>
<td>RACEDI</td>
<td>-8.7576</td>
<td>0.935</td>
<td>-0.107</td>
</tr>
<tr>
<td>MINORS</td>
<td>2.4697</td>
<td>-0.695</td>
<td>0.080</td>
</tr>
<tr>
<td>INCOME</td>
<td>7021.35</td>
<td>6.489</td>
<td>-0.743</td>
</tr>
<tr>
<td>Elderly, nonworking tenants</td>
<td>(Private housing choice probability is 0.53 at variable mean values)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RENTDI</td>
<td>138.186</td>
<td>-1.456</td>
<td>1.611</td>
</tr>
<tr>
<td>CRATDI</td>
<td>-0.00174</td>
<td>-0.022</td>
<td>0.024</td>
</tr>
<tr>
<td>RACEDI</td>
<td>0.1138</td>
<td>0.003</td>
<td>-0.003</td>
</tr>
<tr>
<td>MINORS</td>
<td>0.0838</td>
<td>0.627</td>
<td>-0.694</td>
</tr>
<tr>
<td>INCOME</td>
<td>5156.05</td>
<td>0.735</td>
<td>-0.813</td>
</tr>
<tr>
<td>Elderly, nonworking tenants</td>
<td>(Private housing choice probability is 0.13 at variable mean values)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RENTDI</td>
<td>136.386</td>
<td>-2.964</td>
<td>0.460</td>
</tr>
<tr>
<td>CRATDI</td>
<td>-0.00281</td>
<td>-0.074</td>
<td>0.011</td>
</tr>
<tr>
<td>RACEDI</td>
<td>0.8954</td>
<td>0.041</td>
<td>-0.006</td>
</tr>
<tr>
<td>MINORS</td>
<td>0.2614</td>
<td>-0.687</td>
<td>0.106</td>
</tr>
<tr>
<td>INCOME</td>
<td>5126.22</td>
<td>2.131</td>
<td>-0.330</td>
</tr>
</tbody>
</table>
The results displayed in Table 7-1 are stratified according to elderly or nonelderly, and working or nonworking categories. To analyze the effect of changing the values of the rent variable on the occupancy of a specific housing type for these different categories of households, we first need to calculate the total number of households on the waiting list for private and public housing as well as the total number of households currently living in each housing. The breakdown is shown in Table 7-2.

With the information in Table 7-2, we can now elaborate on how HHA could alter the mix of tenants through manipulating rent. However, first we need to take account of queues. Just because HHA lowers tenants' share of private (public) housing rent does not imply that fewer tenants will live in public (private) housing—not as long as there are queues for public (private) housing.

As pointed out before, the model specified in this study examined the "split" choice between public and private housing. We do not incorporate the choice between participating or not participating in housing programs in our analysis. Therefore, from the result we could only predict the "split" decision of the switch from one type of housing to another when the values of one or more of the explanatory variables change. We cannot predict how many households will be induced to participate (or not to participate) as a result of the changes in values of the explanatory variable or variables. To enable us to proceed, we

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6 Nor does it imply there will be more people living in private (public) housing. There may be nothing more than longer queues for private (public) housing.
Table 7-2
Total Number of Households on Waiting List, and Total Number of Households Living in Various Housing

<table>
<thead>
<tr>
<th>Nonelderly Working</th>
<th>Nonelderly Nonworking</th>
<th>Elderly Nonworking</th>
<th>Elderly Nonworking</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public</td>
<td>Private</td>
<td>Public</td>
<td>Private</td>
</tr>
<tr>
<td>1,164(^a)</td>
<td>1,033(^b)</td>
<td>1,343(^a)</td>
<td>387(^c)</td>
</tr>
<tr>
<td>1,473</td>
<td>1,627</td>
<td>1,711</td>
<td>610</td>
</tr>
</tbody>
</table>

- About 48 percent of private housing tenants are nonelderly working. The total number of tenants living in private housing (excluding leased housing) is about 2,152 (=1,178 + 974, see p. 33).
- About 18 percent of private tenants are nonelderly, nonworking.
- See p. 33.
- About 34 percent of private tenants are elderly, nonworking.
- The total number of tenants on the waiting list for public housing is about 836 (= 800 + 36, see p. 33). We assume that the percentages of nonelderly, working; nonelderly, nonworking; and elderly, nonworking are the same as those who are living in public housing, which is 37, 44, and 19 respectively.
- The total number of tenants on the waiting list for private housing (excluding leased housing) is about 1,238 (= 693 + 545, see p. 33). We assume that the percent of nonelderly, working; nonelderly nonworking, and elderly, nonworking are the same as those who are living in private housing, which is 48, 18, and 34 respectively.
explicitly assume that no new applicants will be added to the existing queues. This, of course, is unrealistic and will bias our estimates. Nevertheless, the results permit some cautious conclusions.

Now, to eliminate a queue, the sum of the number of households currently living in housing units plus those on the waiting list, has to be reduced by the number of households on the waiting list. For example, based on Table 7-2, to eliminate the queue for public housing formed by nonelderly, nonworking households, the rent payable by these households has to be raised such that it will result in a reduction of 368 from the total current tenants and the number on the waiting list.

Policy Implication 1: Discourage Nonworking Tenants from Living in Public Housing and Encourage Working Ones to Do So

Star (1971) makes a case for supporting the restriction of non-working tenants from public housing. Fuerst (1973) also proposed that public assistance recipients should not form a greater proportion in any public housing project. Specifically, assume that a policy is to achieve a 40 percent nonworking and 60 percent working tenant mix. We further assume that the total number of public housing units to be occupied by the nonelderly group remains unchanged (that is, 2,507 units). The required number of public housing units to be occupied by the nonelderly, nonworking and nonelderly, working tenants is thus 1,003 and 1,504 respectively. For the nonworking group, the sum of public housing units

---

7Since the elderly are not perceived to "cause problems" themselves (Wolman (1975), p. 35), the opposition is mainly to nonelderly, nonworking tenants living in public housing. The discussion is thus focused on this category of tenants.
occupied by this group of tenants and the number of households on the
waiting list for public housing by the same group of tenants has to be
reduced by 708 (= (1,343 - 1,003) + 368). In other words, the potential
rentalship of nonworking tenants in private housing has to be increased
by 708. This requires the probability of choosing private housing to be
increased to about 57 (= (610 + 708)/(1,711 + 610)) percent. From
equation (6-1), together with the estimates of equation 2 in Table 6-1,
we can calculate the value of the rent variable that will produce a
probability of choosing private housing equal to 57 percent. The
calculated value of the variable is about $109. Thus, ceteris paribus, a
decrease of rent in private housing of about $41 exclusively for the non-
elderly, nonworking households could achieve a possible tenant mix
specified above.

Now, there will be about 340 public housing units available to the
nonelderly, working tenants after a decrease in the rent of private
housing payable by nonelderly, nonworking tenants. This will accommodate
the 309 nonelderly, working tenants on the public housing waiting list.
Because some public housing projects are more popular than others, it is
possible that not all the 309 households on the waiting list will fill up
309 vacant public housing units of the total 340. Let us assume that we
need 360 households on the waiting list to fill up all the 340 vacant
units. This requires a switch of 51 working households from the private
housing units (or the waiting list) to the public housing waiting list.

\[8\] An alternative way is to increase the rent in public housing for the
nonworking group. However, this may not be politically feasible.
To achieve this, the required probability of choosing private housing of the working tenants needs to be equal to about 0.49 ( = (1,473 + 51)/(1,473 + 1,627)). Equation (6-1), together with the estimates of equation 1 in Table 6-1, allow us to calculate the value of the rent variable that will produce a probability of choosing public housing equal to 0.49. The calculated value is about (-$200).\textsuperscript{9} That is, \textit{ceteris paribus}, a decrease of rent in public housing (vis-à-vis private housing) of about $39 exclusively for nonelderly, nonworking households is required to achieve the proposed percentages of tenant mix.\textsuperscript{10}

A question may arise here concerning the problem of the increasing number of nonelderly, nonworking households on the waiting list for private housing. One possible solution is to increase the funding from the Federal or State government for the Section 8 or rent supplement programs. Compared to the solution of building more public housing, the direct costs to the government may be lower if the government adopts the subsidized private housing program. For example, Welfeld (1973) estimated that the annual subsidy for new units in the public housing program is

\textsuperscript{9}To calculate the probability of choosing public housing, equation 1 in Table 6-1 has to be rewritten as:

\[
\ln \left( \frac{P_{\text{public}}}{P_{\text{private}}} \right) = -0.016 \text{RENTDI} - 10.34 \quad \text{CREDITDI} \\
+0.074 \text{RACEDI} - 0.2308 \quad \text{DISTDI} \\
+0.1136 \text{MINORS} - 0.0004 \quad \text{INCOME}
\]

where all the DI's variables are expressed in terms of the value of public minus private. For example,

\[
\text{RENTDI} = (\text{Rent}_{\text{public}} - \text{Rent}_{\text{private}}) = -$161.293.
\]

\textsuperscript{10}Note that there will be 20 households on the queue waiting for some particular public housing projects.
approximately $2,400, whereas it is $1,500 for the rent supplement program.

Another possible way to increase the number of working tenants in the public housing through the switching of working tenants from private housing to public housing is to build new public housing near employment centers. Table 6-1 shows that the distance-to-work variable has a negative effect on the choice of housing. Because all the observations in equation 1 include only tenants who are already working at the time they filed their application forms, a reasonable inference is that, given the option of private and public housing, if the tenant chooses public housing, this may be because a particular public housing project is closer to his work site than another available private housing unit. 11 Note, however, that this interpretation of the relationship between distance-to-work and housing choice could be spurious because place of work and place of residence could be better treated as a simultaneous set of choices. With this in mind, we proceed to estimate the effect of public housing project location (near to employment centers) on the proportion of working and nonworking tenants. To estimate the effect of a decrease of, say, 20 percent in the distance-to-work to public housing resulting from building new public housing closer to employment centers, we first calculate the arc elasticity. The calculated arc elasticity is about 3 percent. This implies that if public housing is built 20 percent (about 1.5 miles) closer to employment centers, then

11 This may also be the case if a nonworking tenant first seeks public housing, and then he looks for a job where the work site is closer to a particular public housing project.
about 3 percent (approximately 43) of the existing working tenants living in the private housing (or households on the waiting list for private housing) would have wanted public housing. The number 43 may be somewhat smaller than the actual increase in rentalship of public housing by nonworking households because there may be new working applicants applying for public housing. Even if we take this into account, building public housing close to employment centers may not be a very effective way of increasing the working/nonworking tenant proportion.

A third possible way to achieve a prescribed percentage between working and nonworking tenants in the public housing is by quota and queue system. This quota and queue system first sets aside fixed percentages of public housing units for nonworking and working tenants. Then, queues are established for the two groups of tenants. Any vacancy created by either group of tenants (e.g., working) could only be replaced by a tenant of the same category (i.e., working) to maintain a constant proportion of tenants' working status mix. The allocation of tenants in both queues is based on a first come, first served basis.

In summary, we have proposed three alternative means to achieve a working status mix of tenants in public housing. These are, first, to simultaneously lower private rent for nonworking tenants and lower public rent for working tenants, second, to locate public housing closer to employment centers and third, the queue system.

In terms of the horizontal equity principle, we cannot evaluate the principle of the first and second means because tenants have a choice

12 To house these additional working tenants, vacant public housing units should first be created.
over different amounts of subsidies by selecting different types of housing. In the queue system, the principle is violated because some eligible tenants are on the queues and not receiving any subsidy. From the vertical equity standpoint, we cannot reach any conclusion because of insufficient information on the number of different income groups which will finally be housed under these three alternative means.

In terms of efficiency, we cannot determine the costs and benefits of these alternatives. However, we can argue that under the first means tenants could be better off if they switch from one type of housing to the other, because otherwise they would not have done so. This is probably also true for the second means. For the third one, the outcome is less certain because some will benefit and some will be hurt by the system.

Policy Implication 2: Income Segregation of Public Housing

One of the main features of public housing is the concentration of low-income families within a housing project. The legislators' view on the income segregation of public housing can be represented by Housing Concurrent Resolution 56 (see page 12). In connection with this, the federal government is contemplating establishing rules governing the income mix in public housing.

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13 Because of a high correlation among working status, race, and income variables each individual policy implication has to be treated separately.

14 Conversation with Mike McElroy, HHA planning officer, June, 1979.
There are about 16 percent of (nonelderly working) tenants living in public housing whose annual income is $8,000 and above \(^{15}\) (henceforth the "relatively high" income group). Consider a policy target to achieve an increase of this relatively high income group to 20 percent (that is, a total of about 622 families). There are about 309 nonelderly, working on the public housing waiting list. Assuming that the percentage of households of the relatively high income group on the public housing waiting list is the same as those currently living in public housing (that is, 16 percent), then, there are about 49 relatively high income households on the waiting list for public housing. Thus, even by advancing these relatively high income group households to the head of the waiting list, and eventually filling up all the 49 vacant housing units available, the total number \((546 = 497 + 49)\) is still less than the targeted number of 622. \(^{16}\)

To increase the number of relatively high income tenants in public housing by another 125, \(^{17}\) we need first to create 125 vacant units in public housing which were initially occupied by tenants with income less

---

\(^{15}\) The source of this information is HHA, Composite Report, 1977, pp. 7 and 12. The absolute number of tenants with income $8,000 and above is 497. Since there are very few elderly tenants who are working and very few welfare families with income $8,000 and above, we focus the discussion on nonelderly, working tenants.

\(^{16}\) Of course, no further measure is necessary if the targeted number is 546, which is about 17.6 percent of the total number of tenants living in public housing.

\(^{17}\) Assume that no priority in the waiting list is given to the relatively high income group.
than $8,000. Then we need to switch 125 relatively high income households on the private housing waiting list to public housing. The way to reach this target is to decrease the rent in private housing exclusively for households whose income is less than $8,000 and simultaneously decrease the rent in public housing exclusively for relatively high income households. Using the result of equation 1 in Table 7-1, and assuming that the mean income value of relatively high income tenants is $9,000, and that of income less than $8,000 is $6,000, we can then estimate the required amount of decrease in private rent for relatively low income tenants and the decrease in public rent for relatively high income tenants. The calculated rent changes are a $4 decrease in private rent exclusively for tenants with income less than $8,000, and a $41 decrease in public rent exclusively for tenants with income $8,000 and above.

An alternative means of achieving a greater income mix is by exclusively advancing all the relatively high income households to the head of the queue until the targeted mix is reached.

In terms of horizontal equity, the second means clearly violated this principle because there are some eligible households not receiving any subsidies. Compared to the initial situation, an increase in the proportion of relatively higher income tenants clearly violates vertical equity because tenants with a relatively higher income are receiving subsidies.

For the first alternative, we cannot evaluate the horizontal equity because tenants are given a choice of shifting from one type of housing to another. Neither could we make a conclusion concerning whether
relatively lower income/relatively higher income tenants formed a greater proportion after the decrease in rent for both types of housing. Furthermore, no comparison of efficiency between the two alternative means is possible because we do not have the information of costs and benefits of these two means.

Policy Implication 3: Racial Segregation of Public Housing

Our results show that if public housing has a higher percentage of a particular ethnic group (relative to private housing) then a tenant of that particular ethnic group is more likely to choose public housing. In other words, tenants belonging to the same ethnic group prefer living together. Racial concentration in public housing is in fact quite obvious as indicated in Table 7-3. The racial segregation has caused some concern to the local housing authority. There may be some interest groups or legislators advocating greater racial mix in public housing. However, our result suggests that social welfare can be increased by allowing people to live with others of their own races. This is because that is what makes them happier according to our findings. Therefore, policies designed to integrate races in public housing are contrary to consumer preference. From Table 6-2 the dollar cost of such integration to the tenant is about $3 per month for every one percent decrease of tenants of his race in the public housing. This implies that if the legislators feel that the extent of segregation is too great, an alternative solution is to introduce rent differential for different racial groups, that is, lower rent for tenants of the same race who

18For example, HHA (1976), p. 14.
Table 7-3. Percentage of Racial Composition in Low Rent, State Housing, and Low-Rent Elderly Projects

<table>
<thead>
<tr>
<th>Project Number</th>
<th>Project Name</th>
<th>Caucasian</th>
<th>Oriental</th>
<th>Polynesian</th>
<th>Mixed</th>
<th>Others</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Non-Portuguese</td>
<td>Portuguese</td>
<td>Japanese</td>
<td>Filipinos</td>
<td>Chinese</td>
</tr>
<tr>
<td>LOW RENT</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I- 1</td>
<td>Kamehameha</td>
<td>4</td>
<td>0</td>
<td>4</td>
<td>46</td>
<td>4</td>
</tr>
<tr>
<td>I- 9</td>
<td>Kaahumanu</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>33</td>
<td>0</td>
</tr>
<tr>
<td>I- 3</td>
<td>Mayor Wright</td>
<td>7</td>
<td>2</td>
<td>0</td>
<td>21</td>
<td>2</td>
</tr>
<tr>
<td>I- 5</td>
<td>Kalihi Valley</td>
<td>2</td>
<td>11</td>
<td>0</td>
<td>15</td>
<td>0</td>
</tr>
<tr>
<td>I-10</td>
<td>Kuhio Park</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Terrace</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>10</td>
<td>7</td>
</tr>
<tr>
<td>I- 7</td>
<td>Kuhio Home</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>38</td>
<td>6</td>
</tr>
<tr>
<td>I- 2</td>
<td>Kalakaua</td>
<td>9</td>
<td>0</td>
<td>27</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>I- 8</td>
<td>Palolo Valley</td>
<td>0</td>
<td>10</td>
<td>0</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>I-25</td>
<td>Waimanalo</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>14</td>
<td>0</td>
</tr>
<tr>
<td>I- 30</td>
<td>Koolau Village</td>
<td>11</td>
<td>11</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<td>Puuwai Momi</td>
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<td>I- 35</td>
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<td>STATE HOUSING</td>
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<td>Palolo Homes</td>
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<td>7</td>
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<td>Puahalo Homes</td>
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<td>Hauiki</td>
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88
Table 7-3 (continued) Percentage of Racial Composition in Low Rent, State Housing, and Low-Rent Elderly Projects

<table>
<thead>
<tr>
<th>Project Number</th>
<th>Project Name</th>
<th>Caucasian</th>
<th>Oriental</th>
<th>Polynesian</th>
<th>Mixed</th>
<th>Others</th>
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</thead>
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<tr>
<td></td>
<td></td>
<td>Non-Portuguese</td>
<td>Portuguese</td>
<td>Japanese</td>
<td>Filipinos</td>
<td>Chinese</td>
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<td>LOW RENT</td>
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<td>ELDERLY</td>
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<tr>
<td>I-11</td>
<td>Punchbowl Homes</td>
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<td>Makua Alii</td>
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<td>6</td>
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<td>I-24</td>
<td>Kalanihuia</td>
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</tr>
</tbody>
</table>

Source: Compiled from data collected
constitute a smaller percentage of total tenants in a particular public housing project and increase rent for the higher racial percentage tenant group.

The HHA may adopt a quota and queue system to achieve a fixed percentage of every race in public housing.

As mentioned before, a queue system is likely to violate the principle of horizontal equity. This is also true in the rent differential system because there still will be some eligible households on the waiting list. We cannot reach a definite conclusion on vertical equity and efficiency.

**Policy Implication 4: Site Selection of New Public Housing Projects and Tenants Welfare**

One of the restrictions on the development of public housing is the restriction on project site. Perhaps the greatest constraint on the location of public housing is resistance from local communities to the proposed site of the public housing project. (See for example, Freeman (1969), pp. 111-115, or HHA (1979), p. 11-28.) In addition, the increasing scarcity of vacant land in some central cities has made site selection a real problem for many local housing authorities (Carliner (1972), pp. 415-416).

In addition to community resistance, there may be budgetary, legislative and other constraints on the construction of new public housing projects. Subject to these constraints, what is the policy implication for the goal to maximize tenants welfare?

HHA can locate new public housing units where projected neighborhood racial composition accommodates the preferences of housing
assistance applicants, where projected crime rates are low, and where the projected applicants' jobs are nearby. (Of course, all these variables change over time, and new units last many years.) All these will undoubtedly improve the welfare of the tenants, but the extent of welfare improvement will be small. This is because our results indicate that to accommodate the preferences of housing assistance applicants for lower crime rates, and to be nearer to employment centers, will cause only a limited shift between private and public housing.

Although the tenants' welfare will be greater when HHA locates new public housing units in accordance with tenants' preferences, we have no information on the cost to the government in both situations and thus cannot conclude which situation is more efficient. Also, we cannot compare the equity principles under these two situations.

Policy Implication 5: Reduction in Waiting Time in Elderly Public Housing

The United States Housing Act of 1937 limited occupancy in low rent housing to low income tenants. Before 1956, elderly single people were not eligible for low rent housing. The Housing Act of 1956 modified the initial legislation to accommodate the specific problems of the elderly, and authorized the construction of new housing specifically designed for elderly families. Elderly public housing has proved successful and popular. As a result, there are about 900 (average) elderly families

19Whereas low crime rates and closeness to jobs are preferences which are consistent with legislation, this is not necessarily true for accommodating racial preference. See policy implication 3.

20Verbal information from HHA.
on the elderly public housing waiting list on Oahu. Among all the housing programs, the elderly public housing has the longest waiting time before finally gaining occupancy (Table 3-11).

There are several ways HHA can reduce the waiting time in elderly public housing. One possible way of eliminating the queue in the elderly housing projects\(^{21}\) is to lower the maximum income eligibility for elderly public housing until the number of eligible elderly is equal to the total housing units. This method is consistent with both horizontal and vertical equity principles. It is consistent with the horizontal equity principle because all who are eligible are living in public housing and receiving subsidies. Likewise, it is consistent with the vertical equity principle because if we consider all the tenants with income lower than the maximum income as a group, this group of tenants is receiving subsidies, while households with income higher than the maximum income limit are not receiving any subsidy. In addition, this is also consistent with the legislative intent to help lower income people and let the relatively higher income people take care of themselves. Note, however, our "split" study does not provide the answer concerning what the appropriate income requirement should be.

The eligibility rule can also be stipulated in terms of age or family size. It can be argued that it is more (vertically) equitable for those who are relatively older to live in elderly public housing. We can then propose increasing the minimum age for eligibility for elderly public housing until there is no one on the waiting list. This method is also

\(^{21}\) All the means discussed here are equally applicable to the elimination of queues of all types of housing.
horizontally equitable because all eligible people (defined in terms of age) are living in public housing and receiving subsidies. Also, this is consistent with legislative intent to help the relatively older people. Similarly, we can argue for eligibility stipulated in terms of family size, that adjusting the minimum family size for eligibility for housing is both horizontally and vertically equitable.

The other means to reduce the waiting time for elderly public housing is to increase the rent in these housing units. To this end, we have first to assume that the units of elderly public housing are fixed. Secondly, we need to increase government subsidies to private housing for the elderly so that there will be no elderly waiting in line for the private housing. Now, to decrease the waiting time in the elderly public housing projects we must make private housing more attractive. The third stratification of Table 7-1 indicates that rent is an effective policy instrument to achieve this objective. To estimate the effect of a decrease of 10 percent in private rent offered exclusively to the elderly households on the waiting list for elderly public housing, we first calculate the arc elasticity of a decrease of private rent of 10 percent. The calculated arc elasticity is 1.6. This implies that if the rent payable by the elderly tenant living in private housing (vis-à-vis public housing) is exclusively reduced by 10 percent (about $21 per month) then about 16.09 percent (approximately 300) of the existing tenants living in the elderly public housing (and households on the waiting list for elderly public housing) would have aimed for other housing. The average number of elderly applicants for elderly public housing is 900, and the average waiting time is 36 months. The possible
reduction of 300 rentalship in elderly public housing could have reduced
the waiting time to about 30 months, ceteris paribus.

We cannot evaluate horizontal and vertical equity in the last
means because tenants have a choice on which type of housing in which to
participate. We cannot compare efficiency among these alternative means
because we cannot estimate the cost to the government and the benefit to
the tenants (as a whole).
BIBLIOGRAPHY


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