HOUSING CONSUMPTION IN A HOUSING ALLOWANCE PROGRAM

JOHN E. MULFORD, JAMES L. McDOWELL, LAWRENCE HELBERS,
MICHAEL P. MURRAY, ORHAN M. YILDIZ

R-2779-HUD JULY 1982

A FINAL REPORT OF THE

HOUSING ASSISTANCE SUPPLY EXPERIMENT

Sponsored by

The Office of Policy Development and Research
U.S. Department of Housing and Urban Development

Rand
SANTA MONICA, CA. 90406

The research reported here was performed pursuant to Contract No. H-1789 with the Office of Policy Development and Research, U.S. Department of Housing and Urban Development. Statements and conclusions in this report are those of Rand's research staff and do not necessarily reflect the views of the sponsoring agency.

ISBN 0-8330-0440-9

The Rand Publications Series: The Report is the principal publication documenting and transmitting Rand's major research findings and final research results. The Rand Note reports other outputs of sponsored research for general distribution. Publications of The Rand Corporation do not necessarily reflect the opinions or policies of the sponsors of Rand research.

Published by The Rand Corporation

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PREFACE

This report was prepared for the Office of Policy Development and Research, U.S. Department of Housing and Urban Development (HUD). It analyzes the effects of HUD's experimental housing allowance program (which operated in Brown County, Wisconsin, and St. Joseph County, Indiana) on the housing consumption and budgetary decisions of allowance recipients. It is the final report of the Housing Assistance Supply Experiment on those topics.

Suggestions from reviewers Paul T. Hill, Ira S. Lowry, and R. E. Park significantly improved the organization and exposition of the report and tightened its technical arguments. C. Peter Rydell developed the framework for the program comparisons in Sec. V. A companion report, C. Peter Rydell and John E. Mulford, *Consumption Increases Caused by Housing Assistance Programs* (The Rand Corporation, R-2809-HUD, April 1982) makes the comparisons in more detail.

Gwen Sheperdson prepared the draft typescript. Toby O'Brien typed the final copy. Charlotte Cox edited the report.

The report was prepared under HUD Contract H-1789, Tasks 2.16.3 and 2.16.7.

SUMMARY

This report analyzes how the housing allowance program, conducted as part of the Housing Assistance Supply Experiment (HASE), affected the housing consumption and budgetary allocation of allowance recipients. The focus reflects the program's dual purpose of increasing the housing consumption of low-income households who lived in substandard housing as well as raising the nonhousing consumption (equivalently, easing the housing expense burdens) of those already occupying standard housing.

The allowance program was open to virtually all low-income households living in the experimental sites--Brown County, Wisconsin, and St. Joseph County, Indiana. Those who enrolled in the allowance program were offered monthly cash payments that began as soon as they were certified as eligible and their dwellings certified as meeting the housing allowance office (HAO) housing standards; payments continued as long as the participants passed regular eligibility and housing recertifications.

The HAO housing standards combined with recipients' housing preferences to alter their housing consumption and budgets in the following ways:

- As measured by expenditures, both renters and owners increased their housing consumption by about 8 percent. Nearly a third of each group who would otherwise have occupied substandard housing instead occupied dwellings that met generally accepted standards of decency, safety, and sanitation.
- Renters increased their housing consumption mainly by moving to better dwellings or by not moving to worse ones; homeowners increased their housing consumption mainly by repairing or otherwise improving their homes.
- Renter recipients spent about a sixth and owner recipients a fifth of their allowance to increase their housing consumption;

the remainder went to increase their consumption of other goods and services.

- Allowance payments caused about half of renters' increase in housing consumption and an eighth of homeowners'; housing standards and other program features caused the remainder.

The implications of those findings for federal housing policy are clarified by a comparison of the consumption and housing-quality effects of housing allowances with the corresponding effects of public housing or unrestricted cash grants to low-income families:

- Although housing allowances cause only modest increases in recipients' housing consumption, the increase per program dollar is twice that caused by either public housing or unrestricted cash grants.
- Both public housing and housing allowances dramatically increase the quality of recipients' housing as measured by housing code standards. Unrestricted grants have virtually no effect on that measure of quality because they are not contingent on the recipient's compliance with such standards.
- Per program dollar, recipients of housing allowances receive twice the benefits (increased total consumption) that accrue to occupants of public housing, but slightly fewer benefits than do recipients of unrestricted grants. The relative inefficiency of public housing results mainly from its above-market development costs. The relative efficiency of unrestricted grants results mainly from their administrative simplicity.

In short, housing allowances are much more efficient than public housing in using public funds to benefit low-income families--specifically, to improve their housing. Unrestricted grants are even more efficient as income transfers, but they are much less efficient at increasing housing consumption and only negligibly affect housing quality.

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I. INTRODUCTION

The Housing Assistance Supply Experiment (HASE) was designed to evaluate the effects of a full-scale housing allowance program on its participants and their local housing markets. Those who enrolled in the program were offered monthly cash payments that began as soon as they were certified as eligible and their dwellings certified as meeting the housing allowance office (HAO) housing standards; payments continued as long as the participants passed regular eligibility and housing recertifications. About 80 percent of all enrollees eventually qualified for payments, and in the two sites combined, more than 20,000 households became allowance recipients during the first five program years. Drawing on HAO participation records and the HASE countywide household surveys, this report estimates how the program affected those who were recipients at the end of the third program year--a group we think fairly represents the mix of participants that would characterize a mature, permanent allowance program.

Our assessment of the program's effects concentrates on changes in housing consumption and in household budgeting. The focus reflects the program's dual purpose of both increasing the housing consumption of low-income households who lived in substandard housing, and raising the nonhousing consumption (equivalently, easing the housing expense burdens) of those already occupying standard housing. The HAO housing standards, in combination with recipients' housing preferences, determined the balance between the two aims.

EXPERIMENT

In Section 504 of the Housing Act of 1970, Congress authorized the U.S. Department of Housing and Urban Development (HUD) to test the feasibility and desirability of the housing allowance concept by mounting the Experimental Housing Allowance Program (EHAP). HASE, a component of EHAP, subsequently began operating a full-scale experimental allowance program in two sites--Brown County, Wisconsin, whose main city is Green Bay; and St. Joseph County, Indiana, whose main city is

South Bend. The experiment collected five years of records relating to program participants and conducted four "waves" (series) of county-wide surveys relating to households, landlords, and their residential properties. The surveys began just before the program started and continued through the third year in Brown County and the fourth in St. Joseph County.

The original HASE research charter addressed itself exclusively to marketwide effects of the program on housing prices, neighborhoods, residential mobility, and market intermediaries. A separate component of EHAP, the Housing Allowance Demand Experiment (HADE), was designed to test the effects of various housing allowance program designs on the participants. However, preliminary HASE and HADE findings showed that the Supply Experiment also offered opportunities for analyzing the program's effects on its participants: the HASE allowance program enrolled about ten times the number of households as in the Demand Experiment; and only HASE enrolled homeowners, tracked participants for more than two years, and gathered detailed data on the housing-market context of participants' decisions. We therefore incorporated those issues into a revised research agenda for HASE. We then faced the methodological problem of estimating effects on program participants without having a formal control group; we discuss that issue on pp. 4-7 below.

ALLOWANCE PROGRAM

The HASE allowance program made cash payments to low-income households contingent on their occupying housing units that met standards of spaciousness, facilities, and condition. Eligible households living in substandard dwellings had to either repair them to standard or move before they could receive allowance payments. The allowance payment equalled the typical cost of adequate housing (determined from market data) minus a quarter of nonallowance gross income (adjusted for standard deductions and extraordinary expenses such as large medical bills).

The HAOs, nonprofit corporations Rand established in each site to administer the program, enrolled eligible households, evaluated

their housing according to comprehensive housing standards, disbursed payments to enrollees occupying adequate housing, and periodically recertified the eligibility of households and the adequacy of their housing.

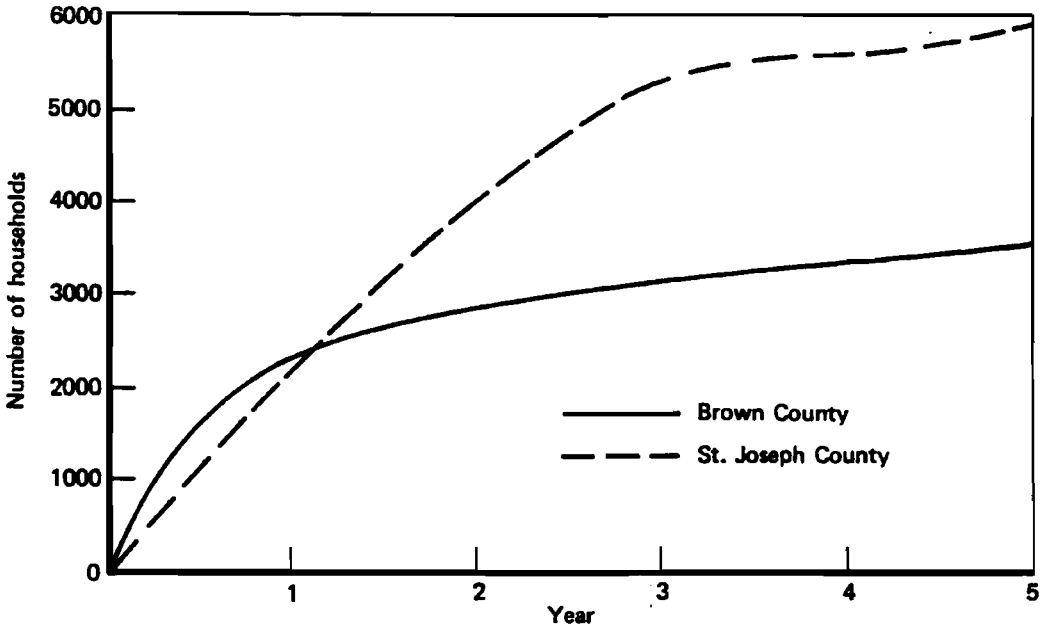
Participation in the housing allowance program was achieved by a two-step process. Step 1--the enrollment interview--determined a household's eligibility and its willingness to join the program. Eligible households that signed participation agreements were considered program participants, although they did not receive any allowance payments until their dwellings passed the HAO housing evaluation (step 2), which followed a 38-item list of housing standards (see Appendix E for details).

Some households began receiving payments within a few weeks of enrollment, others took months, and some (about 20 percent) terminated from the program without ever receiving payments. This report assesses the program's effect only on households that received payments; other HASE reports address the issues of eligibility and participation.

The allowance program began operating in July 1974 in Brown County and in January 1975 in St. Joseph County. During the first five years (the period Rand monitored), the number of households receiving allowance payments at any time grew rapidly, then leveled off (as shown in Fig. 1.1) at about 3,600 households in Brown County, and at almost 6,000 in St. Joseph County.

New households qualified for allowance payments each month; others terminated from the program, usually because of changed household circumstances or housing conditions. During the first five years, more than 20,000 households received at least one allowance payment. As shown in Table 1.1, renter recipients outnumbered homeowners two-to-one in Brown County; there were roughly equal numbers of each in St. Joseph County.

In St. Joseph County, roughly a third of the recipients were single-parent households, another third were elderly households, and the remaining third included all other groups. Brown County numbered comparatively fewer elderly households among recipients and more



SOURCE: Housing Allowance Office records from July 1974 through June 1979 in Brown County; and from January 1975 through December 1979 in St. Joseph County.

Fig. 1.1 — Number of households receiving allowance payments, beginning of program through year 5

nonelderly, non-single-parent households. The fraction of elderly households was particularly high among homeowner recipients.

RESEARCH METHOD

We define the program's effect on the housing consumption of recipients as equal to their consumption while in the program* minus what their consumption would have been without it. We observed recipients' consumption while they were in the program, but had to estimate what it would have been without the program.

Ordinarily, we would have estimated without-program behavior by observing a control group of subjects who received no experimental treatment but who had characteristics identical to those of the treated subjects. However, because open enrollment was important to other HASE

*The program may also have affected the housing consumption of those who expected to become recipients or who formerly were recipients. The effects on nonrecipients are included in our comparison of alternate assistance programs.

Table 1.1

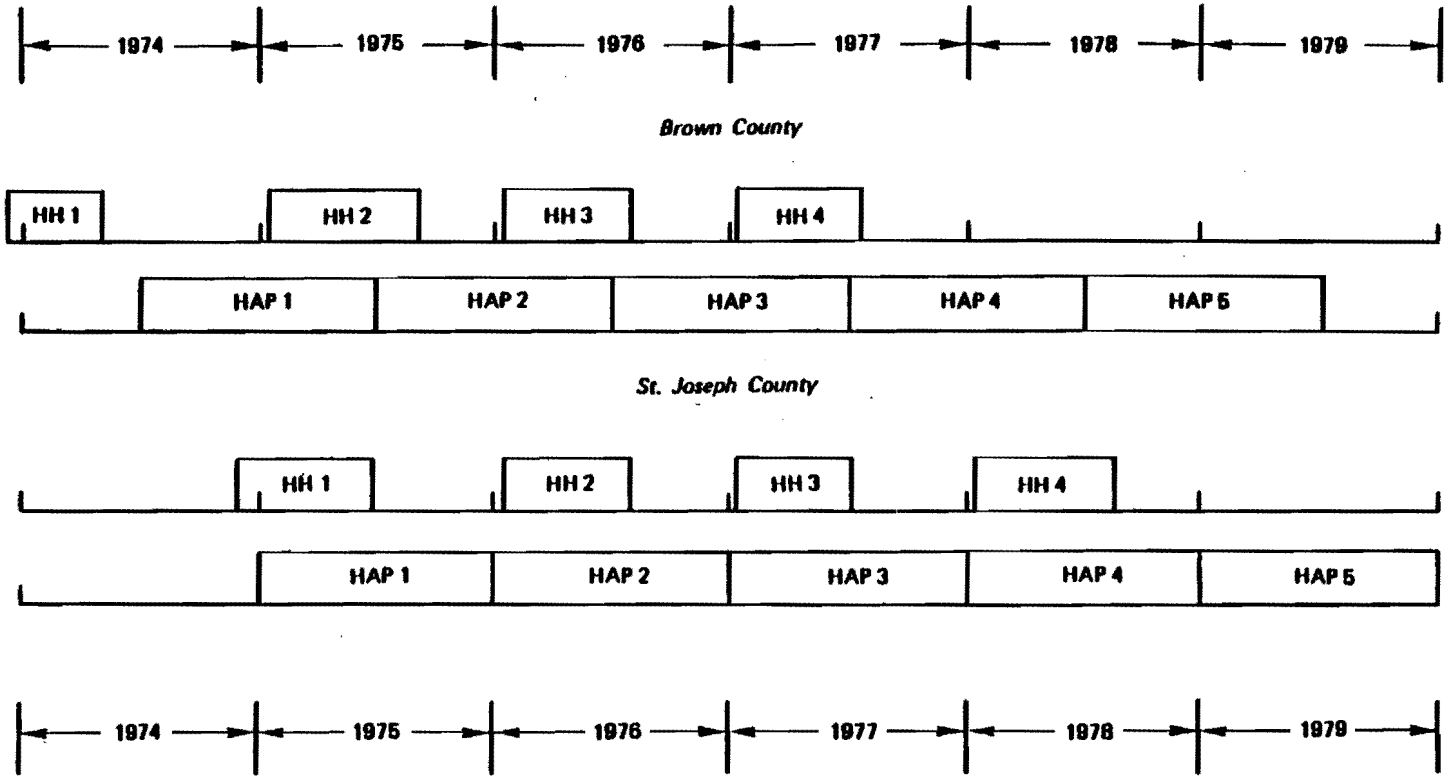
DISTRIBUTION OF RECIPIENT HOUSEHOLDS BY TENURE AND TYPE THROUGH YEAR 5

Tenure Group	Type of Household						Total	
	Single Parent		Elderly		Other			
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Brown County								
Renters	1,777	34	975	19	2,406	47	5,158	100
Homeowners	521	21	1,043	41	958	38	2,522	100
All households	2,298	30	2,018	26	3,364	44	7,680	100
St. Joseph County								
Renters	2,799	44	950	15	2,557	41	6,306	100
Homeowners	1,198	20	3,178	52	1,686	28	6,062	100
All households	3,997	32	4,128	34	4,243	34	12,368	100

SOURCE: Tabulated by HASE staff from HAO records for July 1974 through June 1979 in Brown County and for January 1975 through December 1979 in St. Joseph County.

research objectives, the experiment did not designate a group of eligible households as a formal control group. We overcame the problem by using household survey data, which span the period from before the program began through program year 3 (see Fig. 1.2), to construct a control model for recipients.

To serve their function, the control households had to behave the same as recipient households (or have had known differences that could be corrected for), and they had to have been observed while the program was operating, yet been unaffected by it. Using baseline survey data, which predate the allowance program, we determined that households who never enrolled in the allowance program during the five years we monitored it--including both ineligibles and eligibles who chose not to enroll--responded to the determinants of housing consumption in the same way as did future allowance recipients, except for a multiplicative constant. In other words, the two groups had statistically indistinguishable coefficients (except for an intercept shift) in a log-linear regression of housing expenditures on income and demographic



LEGEND :

HH = Household survey

HAP = Housing allowance program

1, 2, 3, 4, 5 = Survey wave or program year

Fig. 1.2 — Relationship between household surveys and allowance program years: Brown and St. Joseph counties, 1974 - 80

characteristics. Given identical incomes and demographic characteristics, future recipients would have spent 1 to 3 percent (depending on the site) more for housing than those who never enrolled.*

We did not use the baseline housing consumption of future recipients as an estimate of their without-program consumption--it was not contemporaneous with observed program behavior and could therefore err in the amount of any general trend in housing consumption between baseline and program year 3 (the year in which we measured recipients' consumption). Instead, we used contemporaneous wave 4 survey data for households that never enrolled in the program as a benchmark for recipients' without-program housing behavior. Those who never enrolled were unaffected by the allowance program because the program gave them no money, had virtually no effect on the price they paid for housing (see Rydell, Neels, and Barnett, forthcoming), and had very little effect on the kind or quality of housing available to them (see Hillestad and McDowell, 1982).

To adjust for the large income and demographic differences between recipients and those who never enrolled, we fitted a regression model to wave 4 survey data for the second group. It yielded estimates of the determinants of the group's housing expenditures at the end of program year 3. Evaluating that model using income values (excluding the allowance amount) and demographic characteristics of program year 3 recipients and multiplying by the constant relative difference between recipients and those who never enrolled (estimated from baseline data) gave the estimated housing expenditures of recipients without a program. Dividing recipients' average observed expenditures by their expected average expenditures without the program yielded the estimated percentage increase in recipients' housing consumption caused by the program.

REPORT ORGANIZATION

Section II discusses the program's effect on recipients' housing consumption. Details of the procedures used to estimate the effects are given in Appendixes A (renters) and B (homeowners).

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*Reference is to renter recipients.

Section III discusses the program's effect on the budget allocation of recipients, dividing it into housing and other consumption. It also attributes program-induced housing increase to its various causes--allowance payments, housing standards, and other program features.

Section IV discusses the program's effect on nonrecipients' consumption (housing and other) and on housing quality. It draws on models outlined in Appendix C to estimate program-induced housing increases for future as well as former recipients, and on models developed in Rydell and Mulford (1982) to estimate marketwide effects. The program's effect on housing quality is estimated from the model reported in Appendix D. Section IV compares the effects of housing allowances with those of public housing and unrestricted cash grants.

II. CHANGES IN HOUSING CONSUMPTION OF RECIPIENTS

We estimate that the allowance program caused recipients to consume about 8 percent more housing than they would have without the program, and that the proportion living in dwellings of standard quality increased from about half to over four-fifths. Renters achieved their housing improvements partly by repairing but mostly by moving; owners achieved theirs almost entirely by repairing their homes.

CONSUMPTION INCREASES

Table 2.1 reports estimates of the percentage increase in housing consumption for both renters and owners in each county. Although the point estimates differ slightly, none of the differences is statistically significant; a rounded average of 8 percent reasonably summarizes the evidence.

Table 2.1

PROGRAM-INDUCED INCREASE IN HOUSING CONSUMPTION FOR RECIPIENTS

Site	Consumption Increase (%)			
	Renters		Owners	
	Point Estimate	Standard Error	Point Estimate	Standard Error
Brown County	7.8	3.1	8.9	4.0
St. Joseph County	8.2	4.3	7.9	5.0
Average	8.0	2.7	8.4	3.2

SOURCE: Estimated by HASE staff from HAO records and models fit to household survey data. For details, see Appendixes A and B.

NOTE: Estimates are based on the characteristics of those receiving payments at the end of program year 3 in each site.

The estimates are similar for renters and owners, although different measures of housing consumption change were used for each group. For renters, we measured housing consumption changes by comparing gross rent with and without the program. For homeowners, we compared only

repair and improvement expenditures, assuming that other housing expenses were the same with or without the program.

The average program-induced gross rent increase of renter recipients accurately measures the program's effect on their consumption of housing services: rent equals the unit price of housing service times the quantity purchased; and recipients paid the normal market price for housing before they joined the program and only slightly more after becoming recipients (see Rydell, Neels, and Barnett, forthcoming). We corrected the estimated rent increases for that slight premium (see Appendix A) so they would measure quantity increases.

Homeowners' housing expenses were hard to measure directly because some (opportunity cost of equity investment, unpaid labor devoted to home maintenance) had to be imputed. To estimate without-program housing expenses for a homeowner recipient, we transformed the market value of his home using relationships estimated by regressing the sum of cash and imputed expenses on property value and dwelling characteristics for all homeowners in the two sites (Helbers, 1980). However, to estimate the *change* in an owner's housing expenses due to the program, we compared only his annual cash expenses for repairs and improvements with and without the program (repairs and improvements being the major input to the production of housing services that an owner would likely change in response to the allowance program).*

QUALITY IMPROVEMENTS

The modest program-induced increase in housing consumption, evaluated in terms of market rents and repair expenditures, contrasts sharply

*Using repair data as a measure of consumption change implicitly assumes that (a) a dollar of repair expenditure yields a dollar's worth of housing service in the year the expenditure was made, and none thereafter; (b) owners never change housing consumption by moving or through nonrepair expenditures; and (c) owners' labor applied to repairs and improvements has no value. None of those assumptions is strictly true, but the biases work in opposite directions. Repairs made in one year are partly consumed in later years; so current repair expenses overestimate current consumption. Some owners move or change nonrepair outlays in response to the allowance program; so omitting those changes underestimates the program-induced housing consumption increase. Omitting unpaid labor causes underestimates of the value of program-induced repairs by 7 to 12 percent, depending on the site. When repair expenditures by recipients reach a steady state, as approximated in our year 3 data, assumption (a) is not required.

with the 30 point increase the program caused in the percentage of recipients occupying dwellings that would pass the HAO housing standards (see Table 2.2).* The large increase in the proportion of recipients occupying standard housing was not accompanied by a large increase in their housing consumption because many housing-code violations are inexpensive to remedy. With housing allowances as an incentive, enrollees fixed many such defects, which they otherwise would probably have ignored. Not all recipients lived in standard housing, however; even though they had to occupy standard housing to begin receiving payments, their dwellings developed defects between annual inspections.

Table 2.2

PERCENT OF RECIPIENTS OCCUPYING STANDARD HOUSING WITHOUT AND WITH PROGRAM

Site	Percent Occupying Standard Housing			
	Renters		Owners	
	Without Program[a]	With Program[b]	Without Program[a]	With Program[b]
Brown County	50	87	56	91
St. Joseph County	47	70	58	84
Average	48	78	57	87

SOURCE: Estimated by HASE staff from HAO housing evaluation records and a housing deterioration model fit to HAO data. For details, see Appendix D.

NOTE: Estimates are based on the characteristics of those receiving payments at the end of program year 3 in each site.

[a]Percent of year 3 recipients whose enrollment dwellings passed their initial evaluations.

[b]Percent of year 3 recipients whose dwellings would pass evaluations administered randomly between regularly scheduled evaluations.

DETAILS OF CHANGES

The allowance program affected recipients' housing consumption by altering both their repair and their moving behavior. Moving offers

*We estimated improvement in the quality of recipients' housing by fitting enrollment and annual housing evaluation data to a Markov model of housing deterioration and upgrading (see Appendix D).

much wider possibilities for housing change than does repairing. When a household moves, it can change all the attributes of its housing--space, quality, and location. Repairs, on the other hand, primarily address dwelling quality. Adding rooms is expensive and often inefficient, and a repair cannot change the location of a dwelling.

Because their characteristics and circumstances differ greatly, owners and renters use much different combinations of moving and repairing to change their housing consumption. For owners, who control their own repair decisions, moving entails selling one house and buying another. Owners therefore make modest housing adjustments by changing their repair behavior rather than by moving. Renters have less influence over repairs and lower moving costs than owners. Therefore, if tenants want even modestly different housing, they are likely to move rather than improve a landlord's property at their own expense.

Program-Induced Repairs

Both owners and renters made some repairs in response to the program. Violations of the HAO housing standards were often so easy and inexpensive to remedy that virtually all owner recipients and three-quarters of renters repaired them rather than move. We call such repairs *required* because they remedied violations of the housing standards that were explicitly cited by the HAO evaluators. Both owners and renters did other repairs while receiving payments, but only owners did more than they would have without the allowance program. We call those repairs *voluntary* because they were not prompted by a housing evaluation--they occurred during the year between evaluations--and they did not affect a recipient's payment status during the period in which they occurred.

Required Repairs. Housing defects were measured by the HAO housing standards, which were derived from the current housing codes in the two HASE sites, the Building Officials and Code Administrators model code, and minimum housing standards developed by organizations such as

the American Public Health Association. The standards consist of a 38-item checklist that required each dwelling to

- Contain essential facilities in good working condition.
- Be free from hazards to health and safety.
- Provide essential space and privacy.

At enrollment, future recipients in Brown County had almost 80 defects per 100 dwellings evaluated, and even more in St. Joseph County (89 per 100 homeowners and 127 per 100 renters). The most common reasons for failure were interior stairway hazards, lead-based paint hazards, and unsafe (broken or damaged) windows. Missing or inoperable toilets, washbasins, and bathing facilities, and unsafe plumbing, heating, and electrical systems were also common. Various other hazardous conditions, inadequate kitchen facilities, and inadequate living space constituted the remaining defects in recipients' enrollment dwellings.

Required repairs that were completed by enrollees and recipients (as itemized in Table 2.3) ranged from clearing unsanitary debris to re-siding or reroofing an entire building. To qualify for allowance payments, enrollees and recipients installed stairway handrails, replaced broken windows, sealed leaky vent pipes, fixed plumbing leaks, and repaired walls and roofs. A few installed kitchen or bathroom facilities, added fire exits, or rewired their dwellings. Some undertook several such actions, and a few virtually rehabilitated an entire dwelling.

Nonprofessionals--owners, occupants and their friends--made most of the required repairs. The owners did 82 percent of the work on owner-occupied homes. Tenants did 55 percent of the work on rental dwellings, and their landlords did 35 percent. Less than 15 percent of the required repairs for either owners or renters were made by professional contractors.

Table 2.3

DISTRIBUTION OF REPAIRS MADE BY ALLOWANCE RECIPIENTS IN RESPONSE TO EVALUATION FAILURE

Item Repaired	Percent of All Repair Actions			
	Brown County		St. Joseph County	
	Renters	Owners	Renters	Owners
Handrail, steps	16	25	12	20
Window, door	37	31	37	34
Structure	16	16	19	16
Plumbing system	11	12	13	14
Heating system	2	2	4	3
Electrical system	4	4	4	3
Refrigerator, range	2	(a)	2	1
Outbuildings, grounds	6	6	4	5
Other	6	4	5	4
Total	100	100	100	100

SOURCE: Tabulated by HASE staff from HAO housing evaluation records for January 1976 through June 1979 in Brown County and through December 1979 in St. Joseph County.

NOTE: Data include both repairs made by enrollees seeking to qualify for payments and those made by recipients in response to subsequent annual evaluation failures. For renters, entries include repairs undertaken by either the landlord or the tenant. Distributions may not add exactly to totals because of rounding.

[a]Less than 0.5 percent.

Fixing defects once does not guarantee standard housing thereafter, as attested by the percent of recipients who failed their annual housing evaluation:*

	Brown County	St. Joseph County
Renters	22.7	43.2
Homeowners	15.8	26.2

*Recipients usually failed not because previously repaired defects recurred but because of new defects due to general deterioration and despite a high level of voluntary repair activity.

As a result of those failures, households already receiving payments as well as new enrollees faced the necessity of making required repairs. About a third of the recipient households (32 percent of renters, 29 percent of homeowners) did some required repairs during the course of a year, either in connection with their initial qualification for payments or in order to avoid suspension. The required repairs cost nearly $100 on the average, or about $30 per recipient when averaged over all those evaluated, whether or not they repaired (see Table 2.4).

Table 2.4

COST OF REPAIRS MADE BY ALLOWANCE RECIPIENTS IN RESPONSE TO EVALUATION FAILURE

Site	Average Cost ($/yr)	
	Per Recipient Making Repairs	All Recipients[a]
Renters		
Brown County	111	27
St. Joseph County	95	38
Average	103	33
Owners		
Brown County	95	23
St. Joseph County	77	27
Average	86	25

SOURCE: Estimated by HASE staff from HAO housing evaluation records for January 1976 through June 1979 in Brown County and through December 1979 in St. Joseph County; and from records of a special 1979 survey of recipients' landlords.

NOTE: Data include both repairs made by enrollees seeking to qualify for payments and those made by recipients in response to subsequent annual evaluation failures. Repair costs include unpaid labor evaluated at the minimum wage, as well as cash expenditures. For renters, both landlord and tenant expenses and labor are included.

[a]Not all recipients made repairs; see accompanying text.

Voluntary Repairs. Only owners made a measurable number of voluntary repairs in response to the allowance program. Those repairs tended to address structural problems that posed no immediate hazard or to provide amenities not required by the HAQs. As Table 2.5 shows, about half the repair actions dealt with walls, floors, ceilings, roofs, or foundations. The largest category--wall repairs--included patching

Table 2.5

DISTRIBUTION OF VOLUNTARY REPAIRS MADE BY HOMEOWNER RECIPIENTS

Item Repaired	Percent of All Voluntary Repair Actions	
	Brown County	St. Joseph County
Handrail, steps	3	3
Window, door	12	11
Structure:		
Walls	27	25
Floor, ceiling	14	10
Roof	8	11
Foundation	2	2
Plumbing system	14	19
Heating system	4	5
Electrical system	3	3
Refrigerator, range	2	2
Outbuildings, grounds	8	7
Other	4	2
Total	100	100

SOURCE: Tabulated by HASE staff from HAO housing evaluation records for January 1976 through June 1979 in Brown County and through December 1979 in St. Joseph County.

NOTE: Data include repairs made by recipients during the year preceding an annual housing evaluation, except repairs required by the last previous evaluation. Distributions may not add exactly to totals because of rounding.

holes, painting, wallpapering, paneling, and installing aluminum siding. About half the structural repairs were painting jobs that averaged about $80 per action, or about 20 percent of the annual voluntary repair bill.

The remaining voluntary repairs distribute fairly evenly over the range of housing components. The data thus suggest that recipients used allowances for basic maintenance. Most repairs either fixed something--a broken window, a leaking roof, leaky plumbing--or made aesthetic improvements--painting--that may also have extended the life of a dwelling.

Almost three-quarters of the owners made some voluntary repairs each year. Averaged over all owner recipients, the annual cash expense was $403 per recipient (see Table 2.6). That figure includes both repairs they would have made even without the program ($263 average for the two sites) and voluntary repairs that were caused by the program ($140 average), but not required repairs ($25 average). Comparing owners' total annual repair expenses while in the program to our

Table 2.6

ANNUAL REPAIR EXPENSES OF HOMEOWNER RECIPIENTS

Site	Average Annual Amount ($)				
		With Program			
	Without Program[a]	Required Repairs[b]	Voluntary Repairs[c]	Total	Program-Induced Total[d]
Brown County	236	23	391	414	178
St. Joseph County	290	27	416	443	153
Average	263	25	403	428	165

SOURCE: Estimated by HASE staff from HAO housing evaluation records for January 1976 through June 1979 in Brown County and through December 1979 in St. Joseph County, and from repair expenditure models fit to household survey data.

NOTE: Except as indicated, repair costs reported here do not allow for unpaid labor. When valued at the minimum wage, such labor adds about 12 percent to repair costs in Brown County, 7 percent in St. Joseph County.

[a]Estimated without-program repair expenses of year 3 homeowner recipients.

[b]From Table 2.4; includes a small amount of unpaid labor, valued at the minimum wage.

[c]Voluntary repairs equal total minus required repairs.

[d]Total with-program repairs minus total without-program repairs.

estimate of their expenses without the program, we conclude that the program caused them to increase their cash outlays for repairs and improvements by $165 annually--partly required, but mostly voluntary.

Program-Induced Moves

Among year 3 allowance recipients, many more renters than owners moved after joining the program, as shown here:

	Percent That Moved	
	Renters	Owners
Brown County	42.3	4.9
St. Joseph County ...	37.9	3.8
Average	40.1	4.4

The allowance program affected both the timing of recipients' moves and the amount of their housing changes when they moved. On the one hand, it caused some households to cancel or delay moves that would have decreased their housing consumption; on the other, it caused some to hasten moves that increased their housing consumption. On the whole, therefore, when recipients moved, the program caused them to increase their housing consumption by more than they would have in its absence.

Renters' Moves. With normal mobility rates (i.e., without a program), we estimate that 54 percent of the renter recipients would have moved during the 18 month (average) period from their enrollment to the end of year 3. At least 14 percent delayed moves because of the program--the 54 percent who would have moved without a program minus the 40 percent who actually moved. (If the program also stimulated some to move who would not otherwise have done so, the percentage of delayed moves would be correspondingly larger.)

Once an enrollee's dwelling had been certified as acceptable, the program's housing standards tended to deter moves in that any destination unit might fail the standards, causing suspension of payments

until repairs were made.* The average housing change of those who moved while receiving payments was greater than that of similar households observed before the program started, suggesting that the program delayed moves involving housing decreases more than it delayed moves involving increases. Therefore, delayed moves contributed positively to the program's effect on current recipients' housing.

Although the program appears to have reduced the overall mobility of recipients, the 40 percent who moved after enrolling accounts for most of the increased housing consumption due to the program. As shown in Table 2.7, the typical year 3 recipient who moved after enrolling increased his gross rent expenditure (in constant dollars) by 16.5 percent, whereas those who did not move increased their expenditures by only 1.1 percent--presumably for repairs. (Both figures are based on rent at enrollment rather than in the program's absence.)

The average preenrollment consumption increase of 1.5 percent shown in Table 2.7 suggests that some renter recipients altered their moving behavior before enrolling (since renters change their housing consumption primarily by moving). The changes were probably motivated by the anticipation of receiving allowance payments. For example, households in financial trouble might have moved to less expensive housing if an allowance had not been available. But with the allowance program, some of those households may have factored anticipated allowance payments into their preenrollment housing decisions and remained in their dwellings. Households that moved before enrolling for nonprogram reasons (job change, troubles with landlord, wanted larger or smaller house) may also have factored anticipated allowances into their decisions, choosing more housing than they would otherwise have, to avoid another move after enrolling. Finally, some households may have moved from a dwelling they thought would fail the housing standards to one they thought would pass to avoid the embarrassment of being told they lived in substandard housing.

Housing evaluation data lend further support to the hypothesis that the program affected renter recipients' housing consumption

*When a recipient's dwelling failed an annual evaluation, or when a recipient moved to a dwelling that failed its initial evaluation, he was allowed 60 days to make repairs before his payments were suspended.

Table 2.7

PROGRAM-INDUCED HOUSING CONSUMPTION INCREASES FOR RENTER RECIPIENTS BEFORE AND AFTER ENROLLMENT, BY MOBILITY STATUS

Site	Consumption Increase (%)				
	Before Enrollment[a]	After Enrollment[b]			Overall
		Nonmovers	Movers	Average	
Brown County	.4	1.7	16.4	7.4	7.8
St. Joseph County	2.6	.5	16.6	5.6	8.2
Average	1.5	1.1	16.5	6.5	8.0

SOURCE: Estimated by HASE staff from HAO records for households receiving payments at the end of program year 3 and from models (presented in Appendix A) fit to household survey data.

[a]Ratio of average gross rent at enrollment to average gross rent without the program, expressed as a percentage. Both rent variables were adjusted to year 3 dollars.

[b]Ratio of average gross rent at the end of year 3 to average gross rent at enrollment, expressed as a percentage. Both rent variables were adjusted to year 3 dollars. Mobility status indicates whether a recipient moved between enrollment and the end of year 3.

before they enrolled. Initial housing evaluation failure rates (for recipients) declined over program time--from 45 to 29 percent in Brown County and from 59 to 41 percent in St. Joseph County between program years 1 and 5--suggesting that as knowledge of program standards spread, households began considering the standards in their preenrollment housing decisions.

Even though moves offer more opportunity than repairs for housing change, renter recipients who moved did not much change the attributes unique to moving--total space and location. Movers' destination dwellings had the same number of rooms (on the average) as their original dwellings, and the small fraction of movers who changed neighborhoods --a third in Brown County and a fifth in St. Joseph County--chose new neighborhoods that resembled the old ones in quality of buildings and landscaping, general cleanliness, and access to employment. The things movers changed related to habitable space (rooms meeting HAO standards) and dwelling quality (high ratings on the HAO checklist items).

Owners' Moves. The program affected the moves of owners much less than those of renters. Because transaction costs for owners are high, few increased their housing consumption by making unscheduled (program-induced) moves to better houses. The program might have caused some to delay moving to less expensive housing (e.g., from single-family homes to apartments); but because homeowners move infrequently (fewer than 10 percent of all homeowners in our sites normally move each year), there were few moves to be delayed. Controlling for stage in the household "life cycle" (e.g., single, parents with young children, elderly), homeowner recipients in program year 3 moved slightly less frequently than homeowners surveyed at baseline (preprogram), suggesting that the program delayed moves for perhaps 2 percent of the year 3 recipients.

Assuming that the program caused no unscheduled moves by owners, that it delayed moves for roughly 2 percent, and that it had some effect on housing choices among the 4 percent who moved after enrollment, the program affected the moving behavior of 6 percent of the year 3 owner recipients. We cannot accurately estimate how much housing consumption changed for those cases because our data on premove and postmove housing consumption are less precise for homeowners than for renters. But the moving effect must have been quite small on the average because it involved only 6 percent of the recipients. In our final accounting, we therefore ignore move-related consumption changes for homeowner recipients.

III. BUDGET ALLOCATION OF RECIPIENTS

For both renters and homeowners in the experimental sites, the results show that housing consumption had a high budgetary priority; but once a minimum level of consumption was achieved, additional housing had a low priority relative to other forms of consumption. In the jargon of economists, that behavior corresponds to a low income elasticity of demand for housing. We have estimated income elasticities of approximately 0.2 for renters and 0.5 for owners in our sites (see Mulford, 1979). With those elasticities, a 10 percent increase in income would cause only a 2 percent increase in renters' housing consumption, a 5 percent increase for owners.

ALLOCATION WITHOUT PROGRAM

As Table 3.1 shows, without the aid of a housing allowance the average renter recipient would have spent 49 percent of his gross income on housing; the average owner recipient would have spent 43 percent of his. By spending such large fractions of their income for housing, renter recipients were on the average consuming 94 percent as much housing as nonrecipient renters, whose incomes were more than twice as high. Owner recipients consumed about 55 percent as much housing as nonrecipient owners, whose incomes were triple those of recipients.

ALLOCATION OF ALLOWANCES

Because when they enrolled most recipients occupied adequate or nearly adequate housing, the HAO standards did not force them to increase their housing consumption by much. And because their income elasticities of housing demand were so low, they did not voluntarily use much of the allowance payment for additional housing consumption. As Table 3.2 shows, of a $1,014 average allowance, renter recipients spent only $161 (16 percent) on additional housing; the remaining $853 (84 percent) offset housing expenses they would have incurred without the program, freeing an equivalent amount for increased nonhousing

Table 3.1

HOW ALLOWANCE RECIPIENTS WOULD HAVE ALLOCATED THEIR INCOME WITHOUT THE PROGRAM

Site	Expenditure Item					
	Housing		Other		Total	
	Amount ($/yr)	Percent	Amount ($/yr)	Percent	Amount ($/yr)	Percent
Renters						
Brown County	2,053	45	2,516	55	4,569	100
St. Joseph County	1,975	54	1,657	46	3,632	100
Average	2,014	49	2,087	51	4,101	100
Owners						
Brown County	2,004	39	3,077	61	5,081	100
St. Joseph County	1,944	46	2,254	54	4,198	100
Average	1,974	43	2,666	57	4,640	100

SOURCE: Estimated by HASE staff from HAO records for households receiving payments at the end of year 3 and from housing expenditure models fit to household survey data.

NOTE: Expenditure entries in this table are estimates of recipients' allocation of the incomes they would have received had there been no allowance program. The HAO recorded only income and housing expenses, so that expenditure for "Other" items is a residual that could include additions to savings or omit subtractions from savings.

consumption. Homeowners divided their $781 average annual allowance into $165 (21 percent) for additional housing consumption and $616 (79 percent) for nonhousing consumption.

ACCOUNTING FOR INCREASED HOUSING CONSUMPTION

Had the allowance been an unrestricted cash grant, our estimates show that recipients would have used even less of the allowance for increased housing. Table 3.3 shows that factors other than the allowance payment accounted for nearly half the housing increase for renter recipients and for seven-eighths of the increase for owners.

Table 3.2

HOW RECIPIENTS ALLOCATED THEIR ALLOWANCE

Site	Expenditure Item					
	Housing		Other		Total	
	Amount ($/yr)	Percent	Amount ($/yr)	Percent	Amount ($/yr)	Percent
Renters						
Brown County	159	17	802	83	961	100
St. Joseph County	162	15	904	85	1,066	100
Average	161	16	853	84	1,014	100
Owners						
Brown County	178	22	618	78	796	100
St. Joseph County	153	20	614	80	767	100
Average	165	21	616	79	781	100

SOURCE: Estimated by HASE staff from HAO records for households receiving payments at the end of year 3 and from housing expenditure models fit to household survey data.

NOTE: The HAO recorded each recipient's allowance amount and housing expenditure for year 3. For renters, expenditure entries are the difference between the recorded expenditure and the estimated without-program expenditure reported in Table 3.1; for owners, entries are the estimated expenditure for program-induced repairs and improvements. "Other" items are a residual that could include additions to savings or omit subtractions from savings.

Allowance Payments

We calculate the effect of allowance payments on recipients' housing consumption as the ratio of allowance-augmented income to nonallowance income, raised to the power of the income elasticity. Table 3.4 reports that for renters, allowance payments caused a 4 percent average increase in gross rent expenditures, which amounts to $83 annually. For owners, allowances caused an 8 percent average increase in repair and improvement expenditures, which amounts to $22 annually.

Housing Standards

We expected housing standards, which are the major differentiation between housing allowances and unrestricted cash transfers, to cause

Table 3.3

CAUSES OF HOUSING CONSUMPTION INCREASE FOR YEAR 3 ALLOWANCE RECIPIENTS

Site	Amount of Increase, by Attributed Cause					
	Allowance Payments		Other[a]		Total	
	Amount ($/yr)	Percent	Amount ($/yr)	Percent	Amount ($/yr)	Percent
Renters						
Brown County	88	55	71	45	159	100
St. Joseph County	78	48	84	52	162	100
Average	83	52	78	48	161	100
Owners						
Brown County	17	10	161	90	178	100
St. Joseph County	26	17	127	83	153	100
Average	22	13	143	87	165	100

SOURCE: Estimated by HASE staff from HAO records for households receiving payments at the end of year 3 and from housing expenditure models fit to household survey data.

[a]Possible causes include HAO housing standards; "Hawthorne effect" of participation in an experiment; housing inspections that call attention to incipient problems; and a sense of obligation to spend the allowance money on housing.

most of the housing consumption increase not owing to allowance payments. That may be true for renters; but for owners, other factors played a role.

We judge that housing standards induced virtually all the required repairs done by recipients.* But required repairs, which accounted for expenditures of $33 for renters and $25 for owners annually (refer to Table 2.4), accounted for only a fraction of the housing consumption increases caused by nonallowance factors.

*Although some of the repairs might have eventually been done without the program, they tended to remedy defects such as broken electrical switchplates, stuck windows, and chips of paint on the ground, about which recipients and their landlords seemed either unaware or unconcerned.

Table 3.4

INCOME AND HOUSING EXPENDITURE EFFECTS OF ALLOWANCE PAYMENTS

Site	Increase in Gross Income (%)[a]	Income Elasticity[b]	Allowance-Induced Expenditure Increase	
			Percent[c]	Amount ($/yr)[d]
Renters				
Brown County	21.0	.22	4.3	88
St. Joseph County	29.4	.15	3.9	78
Average	*(e)*	*(e)*	4.1	83
Owners				
Brown County	15.7	.49	7.4	17
St. Joseph County	18.3	.52	9.1	26
Average	*(e)*	*(e)*	8.4	22

SOURCE: Estimated by HASE staff from HAO records for households receiving payments at the end of year 3 and from housing expenditure models fit to household survey data.

[a]Average allowance payment (Table 3.2) as a percentage of non-allowance gross income (Table 3.1) at the end of year 3.

[b]Elasticity of gross rent expenditure for renters, as estimated by Mulford (1979, Table 5); elasticity of repair and improvement expenditures for owners, as estimated by Helbers and McDowell (forthcoming, Table 5).

[c]Percentage increase computed from entries in first two columns; average percentage computed from amount in last column (see note *d*).

[d]Calculated by applying percentage increase to without-program gross rent for renters (Table 3.1), without-program repair expenditures for owners (Table 2.6).

[e]Not applicable.

However, the housing standards also affected moves and voluntary repairs. Renter recipients who moved after failing a housing evaluation had to overcome more extensive and serious defects than those who repaired. Movers from failed dwellings averaged 3.6 defects, compared with 2.4 for those who repaired. About 43 percent of movers from failed dwellings had failed the occupancy standard, compared with 15 percent of those who repaired. Remedying an occupancy failure usually required

adding at least one additional room, which added about 9 percent to rent.* Those who were able to correct an occupancy failure without moving usually had adequate space but needed to improve its heating, lighting, ventilation, or privacy.

Overall, the failed dwellings from which enrollees moved had 7 percent lower rents relative to R^* (the average cost of standard housing of a size appropriate for that household) than those of stayers. In addition, renter recipients who moved from substandard dwellings increased their rent by 21 percent, compared with 9 percent for those who moved from standard units.

For owners, some voluntary repairs may have been prompted by the housing standards. In Table 3.5, we estimate lower and upper bounds for the amount of program-induced housing consumption increase caused by the housing standards.

Assuming that no voluntary repairs were induced by the standards gives the lower bound estimates, which indicate that almost three-fourths of program-induced repairs are attributable to causes other than allowance payments and housing standards. But recipients probably made some voluntary repairs to prevent future dwelling failures. Comparing deficiency and voluntary repairs by type, McDowell (1979, p. 46) estimates that up to 15 percent of voluntary repairs may have fixed items that would have failed at the next annual evaluation.** Under the upper bound assumption, housing standards caused half the housing consumption increase for owners.

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*We computed the percentage increases in rent caused by adding a fifth room (occupancy-deficient dwellings averaged four rooms) from hedonic indexes for Brown County (Barnett, 1979) and St. Joseph County (Noland, 1980) and averaged them.

**Even if those 15 percent of voluntary repairs would have been required at the year's end had they not been done voluntarily during the year, attributing them to housing standards probably misplaces causality for some of them--that is, recipients would have done some of them without the standards. Considering that 15 percent is the upper bound for voluntary repair of items resembling those repaired in response to failing an evaluation, and that the housing standards probably did not cause all the voluntary repairs, the upper bound for standards given in Table 3.5 is clearly just that.

Table 3.5

CAUSES OF REPAIR EXPENDITURE INCREASE FOR YEAR 3 HOMEOWNER RECIPIENTS

Site	Amount of Annual Increase, by Attributed Cause							
	Allowance Payments		Housing Standards		Other[a]		Total	
	Amount ($)	Percent	Amount ($)	Percent	Amount ($)	Percent	Amount ($)	Percent
At Lower Bound for Housing-Standard Effect[b]								
Brown County	17	10	23	13	138	78	178	100
St. Joseph County	26	17	27	18	100	65	153	100
Average	22	13	25	15	118	72	165	100
At Upper Bound for Housing-Standard Effect[c]								
Brown County	17	10	82	46	79	44	178	100
St. Joseph County	26	17	89	58	38	25	153	100
Average	22	13	86	52	58	35	165	100

SOURCE: Estimated by HASE staff from HAO housing evaluation records for January 1976 through June 1979 in Brown County and through December 1979 in St. Joseph County; and from repair expenditure models fit to household survey data.

NOTE: Repair expenditures include both voluntary repairs and those required by the HAOs. Estimates are for owners receiving payments at the end of year 3. Increases may not add to totals because of rounding.

[a]Possible causes include "Hawthorne effect" of participating in an experiment; housing inspections that call attention to incipient problems; and a sense of obligation to spend the allowance money on housing.

[b]Assumes that no voluntary repairs were caused indirectly by housing standards.

[c]Assumes that 15 percent of all voluntary repairs were caused indirectly by housing standards.

Other Program Effects

Even the upper bound leaves a third of owners' housing consumption increase unaccounted for. The HAO's data collection activities, and its advertising that stressed the *housing* objectives of the program, may explain the residual increase. Regular housing evaluations and questions about repairs may have stimulated recipients to do more repairs so they would "look good" at the next evaluation. Calling the program the *housing* allowance program and advertising it extensively as a means to help people with their housing might also have increased repair expenditures, in the following way. Many recipients--particularly elderly homeowners--

might never have joined a welfare program but joined the housing allowance program because its advertising convinced them that the money was for a socially acceptable purpose--improved housing. After joining the program, they might have felt morally obligated to spend their allowances on housing even though they already met the program's housing standards.

HOUSING EXPENDITURE BURDEN

Although allowances substantially increased a recipient's income --by an average of 17 percent for homeowners and 25 percent for renters --the augmented income was still far below the average nonrecipient's income. Dividing recipients' housing expenditures by their allowance-augmented incomes yields housing expenditure burdens (Table 3.6) that are well above the legislative standard of 25 percent (the maximum share of income a household should have to spend to acquire decent, safe, and sanitary housing). To achieve an average 25 percent burden would require quadrupling the current program's average allowance payment.

Most federal housing assistance programs actually calculate expense burdens differently, treating the federal subsidy as an offset to housing expenses rather than as an increment to income. As shown in the last column of Table 3.6, by that calculation, housing expense burdens for allowance recipients decrease to 28 percent for renters and 29 percent for owners. That measure has enjoyed wide use, probably because it was natural for public housing, the nation's oldest and largest low-income housing assistance program. In public housing, the government supplies program participants with a housing unit and charges them a below-market rent equal to 25 percent of their income. Thus, their with-program housing expense burden is 25 percent. For allowance recipients, subtracting the allowance payment from with-program housing expenditures and dividing by nonallowance income results in burdens slightly higher than 25 percent: allowances equal the standard cost

of adequate housing (R^*) minus 25 percent of income, but many recipients choose to live in dwellings that cost more than R^*.

Table 3.6

EFFECT OF ALLOWANCE ON RECIPIENTS' HOUSING EXPENDITURE BURDEN

Site	Housing Expenditure/Gross Income (%)		
		With Program	
	Without Program[a]	Allowance Added to Income[b]	Allowance Subtracted from Housing Expense[c]
Renters			
Brown County	45	40	27
St. Joseph County	54	45	29
Average	49	43	28
Owners			
Brown County	39	37	27
St. Joseph County	46	42	32
Average	43	39	29

SOURCE: Estimated by HASE staff from HAO records for households receiving payments at the end of year 3 and from housing expenditure models fit to household survey data.

NOTE: Entries are ratios of average housing expenditure to average gross income, expressed as percentages.

[a]Estimated without-program housing expenditures of year 3 recipients, divided by nonallowance gross income.

[b]Actual year 3 housing expenditures, divided by gross income including allowances.

[c]Actual year 3 housing expenditures minus allowance, divided by nonallowance gross income.

IV. CHANGES IN HOUSING CONSUMPTION AND QUALITY FOR NONRECIPIENTS

The allowance program affected nonrecipients in two ways. First, it affected future and former recipients through their expected or actual contact with the program. Second, it affected everyone through general market mechanisms. Both effects were small relative to the effects on current allowance recipients, however.

As a consequence of small nonrecipient effects, variables in our countywide surveys, such as residential moves, neighborhood racial and socioeconomic composition, and neighborhood landscaping and housing quality, showed no measurable program-induced change (see Hillestad and McDowell, 1982). Instead of directly observing them, we estimated changes in housing and nonhousing consumption and in housing quality for nonrecipients by observing what recipients did and then modeling their interaction with the rest of the market. For consumption, we treated renters in more detail than owners--partly because the interprogram comparisons in Sec. V* are limited to renters, but mainly because data on the price and quality of housing services are much better for renters than for owners. For housing quality, we treated renters and owners equally because the housing-quality data are the same for each.

RENTER CONSUMPTION

Some future recipients increased their housing consumption in anticipation of receiving allowance payments, and some former recipients maintained above-normal housing consumption even after they left the program. Everyone (nonrecipients and recipients as well) cut back his housing consumption in response to marketwide housing price increases caused by the allowance program. Because they received no allowances, nonrecipients had to balance changes in their housing

*Because one of the three programs in the comparison--public housing--serves only renters, we limited the comparison to renters.

expenditures with changes in expenditures for other goods and services (or with savings). Because housing prices increased and other prices remained unchanged, the total consumption of nonrecipient renters decreased, as shown by the following breakdown of their housing and nonhousing consumption changes per program dollar:

	Housing Consumption	Nonhousing Consumption	Total
Brown County	.009	-.023	-.014
St. Joseph County ..	.015	-.027	-.012
Average	.012	-.025	-.013

Those values were derived as described in the following paragraphs.

Housing Consumption Changes

Future and Former Recipients. In Sec. II, we estimated that renter recipients increased their housing consumption by 1.5 percent (over what j would have been without a program) before they enrolled. Therefore, at any time, some future recipients were consuming above-normal amounts of housing. We argued that future recipients consumed above-normal amounts by altering their moving behavior--such as cancelling moves to less expensive housing or increasing their housing consumption more than normal when they moved. Future recipients factored the allowance program into their preenrollment moving decisions primarily so they would not have to move again right after enrollment. The closer they were to enrolling, the more likely they were to factor housing allowances into their mobility decisions.

Each year, about a third of the recipients became former recipients by terminating from the program, for a variety of reasons--including increased income, increased assets, disenchantment, moving out of the site, and death. Some households that remained in their program unit after termination consumed more housing than they would have had they never been in the program--that is, they carried a residual program effect.

Households who terminated because their income exceeded the eligibility limit probably carried no residual program effect: their

income after termination was almost twice their nonallowance recipient income. The income effect would account for the entire program effect, meaning that their housing while in the program, including the effect of the housing standards, would just about equal their desired postprogram housing.

But a substantial number of recipient households terminated from the program while remaining eligible on the basis of income (about half of those were fully eligible). Some became ineligible on the basis of assets; others failed an evaluation but did not want to move. Those households carried their program effect with them, eventually shedding the program-induced housing by moving to lesser housing.

We call the program-induced housing consumption of future recipients *anticipation* and that of former recipients *inertia*. We assume that anticipation begins and inertia ends only when a household moves. We model both quantities using data on mobility, enrollment, termination, and participation rates, in addition to estimates of program effects on current recipients. The modeling details--assumptions and mathematical derivations--are given in Appendix C; here, we simply present the results.

The top panel of Table 4.1 reports estimated housing consumption increases due to anticipation and inertia, in dollars per current recipient.* The table shows that at any time after the program reached maturity, all households that would have enrolled in the future consumed about $3 more housing per year per current recipient than they would have without the program; former recipients consumed $19 more.

Compared with the $161 increase per household actually receiving payments, those numbers are small. The bottom panel of the table normalizes the values by the recipient increase, showing a $0.141 increase for future and former recipients per dollar of increase for current recipients.

All Nonrecipients. In contrast to the housing consumption increases of future and former recipients, households that never received

*To facilitate comparison with current recipient increases in units that abstract from program size, we divided aggregate housing consumption increases for future and former recipients by the number of current recipients.

Table 4.1

PROGRAM-INDUCED HOUSING CONSUMPTION INCREASE FOR FUTURE AND FORMER RENTER RECIPIENTS

Site	Housing Consumption Increase ($/yr)		
	Future Recipients[a]	Former Recipients[b]	Total
Per Recipient			
Brown County	2.94	15.79	18.73
St. Joseph County	3.64	22.86	26.50
Average	3.29	19.33	22.62
Per-Dollar Increase for Current Recipients[c]			
Brown County	.019	.099	.118
St. Joseph County	.022	.141	.163
Average	.021	.120	.141

SOURCE: Estimated by HASE staff from HAO records and models fit to household survey data.

[a]Estimated increase results from anticipation by nonrecipients at year 3 who will become recipients sometime after year 3.

[b]Estimated increase results from inertia by nonrecipients at year 3 who formerly received payments.

[c]Recipient increases were $159 in Brown County, $162 in St. Joseph County (see Table 3.2).

allowances are estimated to have reduced their housing consumption in response to marketwide housing-price increases caused by the program.* Rydell and Mulford (1982) derive formulas (presented below) for calculating cutbacks due to the price increases. To facilitate the interprogram comparisons in Sec. V, values are in dollars of housing change by nonrecipients per dollar of program costs, where program costs equal the annual allowance amount plus administrative expenditures per recipient.

*Households who received allowances at some time also reacted to the housing-price increases by increasing their housing consumption less than if there had been no price increase. That price effect is accounted for in the program-induced housing increase calculations (Appendix A).

The total housing change for nonrecipients can be expressed as follows:

$$\Delta H_n = gh - \left(\frac{S}{Y + S} \right) \left(h + gh \right) , \qquad (4.1)$$

where ΔH_n = housing consumption change for nonrecipients per program dollar,

g = housing consumption increases for future and former recipients per dollar increase for current recipients,

h = housing consumption increase for current recipients per program dollar,

S = price elasticity of housing demand,

Y = price elasticity of housing supply.

The first term on the right side is the housing consumption increase for future and former recipients. The second term is the housing consumption cutback made by other nonrecipients in response to the price increase caused by the housing increases of current, future, and former recipients (h and gh).

Evaluating Eq. (4.1) for $S = 0.5$ (median of the estimates in the literature), for $Y = 11.3$ (estimated in Rydell, 1979), and for values of g and h taken from the present report gives the program's effect on the housing consumption of all nonrecipient renters (as reported in Table 4.2). The positive effects for future and former recipients slightly outweigh the negative price effects on those who never received payments, to give a small housing increase of $0.012 per program dollar.

Nonhousing Consumption Changes

In light of the above, the allowance program necessarily caused all recipients to reduce their nonhousing consumption. Former and future recipients cut back on it to pay for their increased housing consumption, and those who never became recipients cut back on both housing and nonhousing consumption in response to housing-price increases. Because housing is price-inelastic, the housing-price increase caused an

increase in housing expenditures (even though housing consumption decreased); thus, nonhousing expenditures (and consumption) had to decrease. The formula for the nonhousing consumption cutback by nonrecipients is

$$\Delta N_h = -\left(\frac{1 - S}{Y + S}\right) h - \left(\frac{Y + 1}{Y + S}\right) g\dot{h} \quad , \qquad (4.2)$$

where ΔN_n = nonhousing consumption change for nonrecipients per program dollar.

Equation (4.2) is not as straightforward as Eq. (4.1), but as long as S is less than one, both terms are negative. Evaluating Eq. (4.2) for the same parameter values used earlier for Eq. (4.1) gives estimated nonhousing consumption decreases of \$0.023 for Brown County and \$0.027 for St. Joseph County, for an average of \$0.025 per program dollar.

HOMEOWNER CONSUMPTION

We estimated that homeowner recipients made about \$165 worth of repairs a year in response to the allowance program. Different repairs had different lifetimes, but most probably lasted more than a year; homeowners therefore consumed housing services from one year's repairs in later years. They also consumed services from a past year's repairs without paying for them currently. If we assume that the longest-lived repair lasted X years, that all current recipients were receiving payments for at least X years, and that the level and mix of program-induced repairs was constant over time, then each year, owner recipients consumed repair-generated housing services of a value equal to the amount of program-induced repair expenditures that year.

But the program had turnover even after it reached a steady state. Some owners enrolled each year and did not consume all the services from their first year's program-induced repairs in that year. Others terminated and consumed some of their last few years' repairs after they became nonrecipients. Allocating repair-generated services to current and former recipients would require knowledge about the expected

Table 4.2

PROGRAM-INDUCED HOUSING CONSUMPTION CHANGE
FOR NONRECIPIENT RENTERS

Site	Consumption Change ($ per program $)		
	Future and Former Recipients[a]	Never Recipients[b]	All Nonrecipients[c]
Brown County	.016	-.007	.009
St. Joseph County	.021	-.006	.015
Average	.019	-.007	.012

SOURCE: Estimated by HASE staff from Eq. (4.1) and models fit to HAO records and countywide household survey data.

NOTE: Values of g are .118 (Brown County), .163 (St. Joseph County), and .141 (average) from Table 4.1. Values of h--.139 (Brown County), .129 (St. Joseph County), and .134 (average)--equal housing increases by recipients (Table 3.2) divided by program costs. Program costs equal allowances (Table 3.2) plus administrative costs of $183 (Brown County), $190 (St. Joseph County), and $187 (average), where the administrative costs reported in Kingsley and Schlegel (1982) were adjusted from 1976 dollars to program year 3 dollars by the national CPI--i.e., Brown County costs were multipled by 1.0645, St. Joseph County costs by 1.1056.

[a] The quantity gh from Eq. (4.1).

[b] Calculated as $-\left(\frac{S}{Y+S}\right)\left(h+gh\right)$ from Eq. (4.1).

[c] Total of first two columns.

lives of repairs and about their timing in relation to enrollments and terminations. We did not attempt that disaggregation, reporting only the total value of housing services consumed per program dollar--which equals program-induced repair expenditures made by recipients divided by program costs.*

*We assumed that owners did not make repairs in anticipation of receiving payments--waiting to see what repairs were required would be more sensible. In light of the small anticipation effect for renters, who would be more likely than owners to consider future enrollment because they move more often, the error in omitting the effect for owners should be small.

Housing consumption of current and former owner recipients increased by $0.17 per program dollar, slightly more than the rental market housing increase of $0.15 per program dollar (see Table 5.3).* The owner figure equals program-induced repair expenditures (Table 2.6) divided by total program costs per recipient year. The program costs are allowance payments (see Table 3.2) plus administrative costs (Kingsley and Schlegel, 1982).**

HOUSING-QUALITY IMPROVEMENT

The program caused a negligible improvement in nonrecipients' housing quality, as measured by the HAO housing standards. At most, 1 percent of nonrecipient renters and 0.5 percent of nonrecipient owners switched from substandard to standard housing because of the program. We could not observe such small program effects directly; rather, we estimated them from models fit to allowance recipient data, as described in Appendix D.

We assumed that nonrecipients were unharmed by recipients' upgrading their homes. That is, the standard dwellings obtained by recipients who previously occupied substandard dwellings (either their enrollment units or ones that deteriorated between housing evaluations) were net additions to the standard stock. Since three-quarters of the renter recipients and virtually all owner recipients whose enrollment dwellings failed the HAO standards repaired rather than moved, the net addition assumption is a safe one. Even if all of the renters who moved from substandard dwellings to standard ones simply swapped dwellings with nonrecipients--that is, causing no net addition to the standard stock--it would only amount to a half-point decrease in the percentage of nonrecipient renters occupying standard housing. (For owners, swapping would have had virtually no effect because so few moved to gain standard housing.)

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*Because we did not allocate the housing increase to current and former recipients, we cannot analyze nonhousing or total consumption change for nonrecipients.

**We adjusted the owner administrative costs of $153 (both sites) from 1976 dollars to program year 3 dollars by multiplying by 1.0645 for Brown County and by 1.1056 for St. Joseph County.

Housing improvement in our simple model is driven by the following mechanism: recipients upgrade from substandard housing to standard housing (either by repairing or by moving) and turn that standard housing over to the nonrecipient market, either by vacating the dwelling or by terminating from the program.* The upgraded housing gradually deteriorates until the fraction substandard is the same as it would have been without the program.

Using the Markov model in Appendix D, we estimated a marketwide improvement in the percentage of households occupying standard housing. We attributed the improvement to recipients who occupied standard housing but would have occupied substandard housing without the program, and to former recipients who turned upgraded housing over to the nonrecipient market. We found that the program caused little marketwide improvement in housing quality--5 percentage points for renters, 2 for owners--and that only a quarter of the improvement came from nonrecipients (the results are reported in appendix Table D.2). In other words, the program caused only a one-half (owners) to one (renters) point improvement in the percentage of nonrecipient households occupying standard housing.

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*Moves by recipients who always occupied standard housing could conceivably have increased standard housing in the market if nonrecipients in substandard housing moved to the vacated standard dwellings and if no one moved into the substandard dwellings. That effect would be the opposite of the "swapping" effect. We could not observe either effect directly, but judge that their joint net influence on housing quality was small.

V. PROGRAM EVALUATION

As shown in the preceding sections, those who participated in the experimental housing allowance program benefited with respect to both housing consumption and budgetary relief. Their overall housing consumption increased by about 8 percent; nearly a third shifted from substandard to standard dwellings; and the funds available to recipients for nonhousing consumption increased by 41 percent for renters and by 23 percent for homeowners. Those measures of program effectiveness are qualified, however, by the fact that benefits were received by less than half of all eligibles and by only 80 percent of all enrollees.

The efficiency of the program can be measured by comparing the benefits actually bestowed with the cost of the program. We have excellent data on the costs, and the benefits to participants are readily measured. We are confident that the incidental costs and benefits to nonparticipants are small, although we have estimated them only indirectly.

Because allowances are of interest as an alternative to other housing aids, we present parallel assessments of the efficiency of the public housing program (whose low-income participants live in dwellings owned and operated by local housing authorities but subsidized by the federal government) and of a hypothetical program of unrestricted cash grants to low-income households (such as has been studied by the Office of Economic Opportunity and the Department of Health, Education, and Welfare).

PROGRAM COSTS AND BENEFITS TO PARTICIPANTS

Our analysis treats the public housing program as fully specifying its participants' housing consumption; the housing allowance program as merely setting minimum standards for housing consumption; and the unrestricted grant program as leaving consumption choices entirely to recipients. Although those are the essential differences between the three programs, others could be created by varying eligibility or entitlement standards.

To measure how program structure affects efficiency, we apply all three programs to a standard case (even though they may actually serve somewhat different populations and have somewhat different benefit schedules), such that each delivers approximately the same benefit ($73.55 per month) to a typical renter recipient having an income of $4,000 (see Table 5.1). We use data from HASE and from a concurrent study of public housing (Mayo et al., 1980) to estimate (a) the total program cost entailed in supplying the benefit, (b) how the recipient divides it between housing and other consumption, and (c) how households not in the program are affected. Implicitly, we assume that all three programs operate in the HASE sites, and that they are open only to the renters eligible for assistance under the HAO rules.*

The top panel of Table 5.1 illustrates the principal consequence of the differences between programs: to deliver the specified benefit, the public housing program incurs 2.5 times the cost of the housing allowance or the unrestricted grant program. The main reason, according to our source, is that public housing authorities are inefficient real estate developers; they pay about $2 for every $1 of housing service they produce. The housing allowance program spends about $14 per recipient month to administer eligibility tests and housing evaluations; whereas the unrestricted transfer program would need only the eligibility test, estimated at $9 per recipient month.

The bottom panel of the table shows how a recipient uses his benefit. To make the programs comparable, we assume that public housing provides somewhat better dwellings than it actually does; both the public housing and the housing allowance programs thus cause recipients to increase their housing consumption by about $12, taking the rest of their benefit in cash. The unrestricted grant recipient spends about $6 extra on housing, using the rest for other purposes.

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*The models and assumptions underlying the comparison of the alternative programs are detailed in Rydell and Mulford (1982).

Table 5.1

PROGRAM COSTS AND PARTICIPANT BENEFITS
FOR ALTERNATE ASSISTANCE PROGRAMS

Item	Monthly Costs and Benefits per Standard Case ($)		
	Public Housing	Housing Allowances	Unrestricted Cash Grants
Program Cost to Deliver Equal Participant Benefit			
Benefit to participant	73.55	73.55	73.55
Administration, other costs	141.60	13.55	9.22
Total	215.15	87.10	82.77
End Use of Benefit by Standard Participant			
Housing consumption	11.68[a]	11.68[a]	6.04
Other consumption	61.87	61.87	67.51
Total	73.55	73.55	73.55

SOURCES: Estimated by HASE staff. Entries for public housing are based on data in Mayo et al. (1980); entries for housing allowances and unrestricted grants are based on HAO records and models of housing expenditure fit to household survey data, averaged across HASE sites.

NOTE: The standard case is a renter recipient whose adjusted gross income is $4,000 annually. Without the program, he would spend $146.34 monthly for housing. The public housing authority provides him with a dwelling whose market rental value is $158.02, the amount he would choose to spend if given a housing allowance. With an unrestricted grant, he chooses to spend $152.38. In fact, the typical public housing tenant has a lower income and is provided with a dwelling whose market rental value is $145.00.

[a]Participants in the public housing and housing allowance programs would evaluate this portion of the benefit at less than $11.68 because of constraints on its use.

MARKETWIDE CONSUMPTION CHANGES

The costs and benefits of the programs are not necessarily limited to those participating in them; they may affect the housing choices of others in the same marketplace. Below, we compare the marketwide consumption changes caused by the three programs, dividing consumption into housing and other goods. We consider housing consumption changes

first from society's perspective--that is, in terms of housing-quality standards--then from the individual's perspective--that is, in terms of his total housing consumption. We also distinguish between consumption changes for program participants and those for nonparticipants (who are affected through market mechanisms).

Housing Quality

In the HASE sites, about 59 percent of all renter households lived in standard dwellings (as judged by the HAO standards) when the allowance program began.* Among those who later became recipients, less than half lived in standard dwellings. Among nonrecipients, who accounted for about 90 percent of all households, about three-fifths lived in standard dwellings.

We estimate that both public housing and housing allowances cause a 30 point increase in the percentage of participants who occupy standard housing (see Table 5.2).** Under housing allowances, nonparticipant housing improves slightly--from 61 to 62 percent standard--as participants transfer their standard dwellings to the nonparticipant market, either by moving while in the program or by terminating from the program and becoming nonparticipants themselves. The effect is small because participants turn only a few upgraded dwellings over to the nonparticipant market each year (relative to the size of the latter), and the effects do not accumulate much over time because the upgraded dwellings deteriorate quite rapidly to a substandard level (see Sec. IV and Appendix D). Public housing causes no improvement in nonparticipants' housing quality because no public housing units are turned over to them. Marketwide, both programs cause about a 5 point increase in the percentage of households occupying standard housing.

*That figure indicates much more substandard housing than census-based estimates; but the HAO standards were both broader in scope and more rigorous in detail than those of the Census Bureau.

**Because we standardized the two housing programs (i.e., assumed the recipients occupied dwellings with equal market rents), we assume they impose the same housing standards in the same way. However, even with the same housing standards, different inspection policies could lead to different housing-quality improvements.

Table 5.2

HOUSING-QUALITY CHANGES CAUSED BY ALTERNATE ASSISTANCE PROGRAMS, BY PARTICIPATION STATUS

Participation Status	Percent Occupying Standard Housing			
	No Program	Public Housing	Housing Allowances	Unrestricted Cash Grants
Participants[a]	48	78	78	50
Nonparticipants	61	61	62	61
All households	59	64	64	59

SOURCE: Estimated by HASE staff from HAO records for Brown and St. Joseph counties and from models of market effects fit to household survey data and HAO data for both sites.

NOTE: Program assumptions are the same as were used in Table 5.1. Housing standards for all programs are those used by the HAOs; the incidence of standard housing for participants is based on HASE experience.

[a]In the "no program" case, prospective participants.

In contrast to the housing programs, unrestricted cash grants do little for housing quality, even for the recipients. The percentage of participants occupying standard housing increases by only 2 points as a consequence of their increased housing expenditures. Without the housing standards and the regular inspections, recipients are not attentive to many violations of HAO standards. Marketwide, the increase in standard housing is less than half of a percentage point.

In the analysis below, we normalize dollar increases in housing and other consumption by program costs (in dollars) to facilitate interprogram comparisons. Because it is difficult to attribute a dollar value to improvements in substandard housing, we do not normalize there. However, housing allowances are clearly more efficient at improving quality than public housing--they cause slightly more improvement for less than half the cost. For almost any value attributable to substandard dwellings being upgraded to standard, allowances do much more than unrestricted grants at only slightly greater cost.

Consumption Changes per Program Dollar

Table 5.3 shows that participants' consumption increases per program dollar are always less than 1.0. The reason is administrative and other nonsubsidy program costs. Delivering unrestricted cash grants entails the least administrative cost; therefore, they provide the greatest consumption increase per program dollar--0.89 for participants. Housing allowances, which require modest costs for enforcing housing standards, deliver almost as much subsidy to participants as unrestricted cash grants. Public housing's high development costs combine with administrative expense to absorb nearly two-thirds of the federal subsidy without benefit to participants: only 0.34 of each program dollar goes for participants' consumption increases.

The high development costs of public housing have been well known for years (see Rydell and Mulford, 1982, pp. 1-2). But supporters of public housing have argued that the addition of public housing units benefits nonparticipants as well as participants. If an increased supply of housing leads to lower marketwide prices, nonparticipants' benefits could outweigh the higher cost per participant of the supply-side strategy. In contrast, housing allowances and unrestricted cash grants stimulate demand, possibly pushing up prices for nonparticipants.

Having modeled the market effects of each program, using HASE and other data (see Sec. IV; and Rydell and Mulford, 1982), we conclude that none of the programs much affects nonparticipants' consumption of housing or any other goods. In response to supply programs, the market response offsets most of the public housing units that are added: either new construction is deferred or demolitions increase. In response to demand programs, housing prices increase only slightly, causing only a small reduction in nonparticipant demand. Nonparticipant housing consumption actually increases with housing allowances. That is because future participants increase their consumption in anticipation of joining the program, and because the housing standards cause some recipients to consume above-normal housing after they terminate from the program.

Altogether, our estimates show that housing allowances cause about twice as much increase in marketwide housing consumption per program

Table 5.3

CONSUMPTION CHANGES CAUSED BY ALTERNATE ASSISTANCE PROGRAMS, BY PARTICIPATION STATUS AND TYPE OF CONSUMPTION

Type of Consumption	Consumption Change per Assistance Program Dollar ($)		
	Public Housing	Housing Allowances	Unrestricted Cash Grants
Participants			
Housing	.05	.13	.07
Other	.29	.71	.82
Total	.34	.84	.89
Nonparticipants			
Housing	.03	.01	*(a)*
Other	.03	-.02	-.01
Total	.06	-.01	-.01
All Households			
Housing	.08	.15	.07
Other	.32	.68	.81
Total	.40	.83	.88

SOURCE: Rydell and Mulford (1982, Table 4.1).

NOTE: Population characteristics for all programs are averages across HASE sites.

[a]Rounds to zero; calculated value is -0.002.

dollar as either of the other programs. Compared with public housing, housing allowances cause both more housing consumption increase and more nonhousing consumption increase per program dollar.

The comparison between the demand programs does not yield a clearly superior choice. Housing allowances cause more housing consumption increase than unrestricted cash grants; but they cause less increase in the consumption of other goods, and less total consumption increase. Because increased housing consumption--particularly if it rids dwellings of health and safety hazards--has social as well as personal value, the extra housing consumption caused by housing allowances might

outweigh the cost of enforcing the housing standards--which is what distinguishes housing allowances from unrestricted cash grants.

Appendix A

ESTIMATING PROGRAM EFFECTS ON HOUSING CONSUMPTION OF RENTER RECIPIENTS

This appendix provides the methodological details underlying the program-induced housing consumption estimates for renters (presented in Table 2.1). Recall that the program effect equals recipients' consumption with the program minus their estimated consumption without it. Here, we describe how we measured the former and estimated the latter. We also describe how we calculated the program-effect point estimates and their standard errors.

HOUSING CONSUMPTION MEASUREMENT

Gross Rent

The HAOs asked recipients about their housing expenses at semi-annual eligibility recertifications. For renters, they recorded contract rent and noted which utilities the tenants paid for. Using standard utility cost tables (developed for each site), the HAOs computed total tenant-paid utility expenses and added them to contract rent to yield their measure of gross rent.

In our countywide surveys, we relied on tenant-reported utility expenses. Those tended to be larger than the HAO's standard amounts in a sample of dwellings for which we had both sets of data (Table A.1). To fit a gross rent regression model to household survey data for use as a benchmark of recipients' without-program rents, we arbitrarily inflated the HAO data on tenant utility expenses (rather than deflating the values obtained in our surveys) to make the two data sources comparable. We multiplied the HAO tenant utility expenses by 1.114 for Brown County and by 1.153 for St. Joseph County, then added the result to contract rent to yield gross rent.

Gross Rent Adjusted for Recipient Price Increase

The housing allowance program caused housing demand to increase gradually as enrollment increased after the program started. Housing

Table A.1

DIFFERENCES BETWEEN HAO AND SURVEY UTILITY MEASUREMENTS

Utility Measurement	Monthly Dollars per Dwelling Unit			
	Brown County		St. Joseph County	
	Mean	Standard Error	Mean	Standard Error
Survey	32.75	1.23	41.24	2.52
HAO	29.39	.88	35.76	1.76
Ratio[a]	1.114	.053	1.153	.090

SOURCE: Estimated by HASE staff from baseline through wave 4 household survey data and year 3 HAO records.

NOTE: The sample consists of 456 units in Brown County and 248 units in St. Joseph County for which we had both survey and HAO data that were collected contemporaneously (no more than 6-month gap) and that agreed on the unit's contract rent. Average monthly contract rents were $119.31 in Brown County and $115.35 in St. Joseph County.

[a]Mean survey utilities divided by mean HAO utilities.

supply did not keep pace with the growing demand, so housing prices rose at first and then fell as supply caught up. However, even in the long run, housing prices slightly exceeded their normal without-program level because longrun supply had a price elasticity of less than infinity (see Rydell, Neels, and Barnett, forthcoming).

Housing prices changed differently in different parts of the market. Allowance recipients shopped in the submarket of nonluxury standard or near-standard (inexpensively reparable) housing. Prices increased in that submarket; but they decreased in the submarket containing nonluxury substandard housing, because recipients' demand had been removed. All recipients faced housing-price increases. Nonrecipients in the nonluxury standard housing submarket faced the same price increase as recipients, but those in the rest of the market enjoyed price decreases.

Because the program-induced price changes were small, they were difficult to observe and estimate accurately. To support an a fortiori argument, the HASE final report on housing prices (Rydell, Neels,

and Barnett, forthcoming) estimates upper bounds on recipient price increases. Here, we use rough estimates of average price increases.

Let Q represent housing services consumed, P be the relative price of housing services, and R be gross rent--that is, $R = PQ$. We would like to measure recipients' consumption in the long run ($Q(\infty)$) at the price prevailing then ($P(\infty)$); instead, we observe year 3 rents ($R(3)$). Recipients consume less housing at year 3 than they would in the long run because $P(3) > P(\infty)$. They cut back consumption according to the relation

$$\frac{Q(3)}{Q(\infty)} = \left[\frac{P(\infty)}{P(3)}\right]^{S} , \qquad \text{(A.1)}$$

where S = price elasticity of demand for housing. Solving Eq. (A.1) for $Q(\infty)$ and substituting R for PQ yields

$$Q(\infty) = R(3)\left[\frac{P(3)}{P(\infty)}\right]^{S-1} . \qquad \text{(A.2)}$$

We estimate $[P(3)/P(\infty)]^{S-1}$ by first assuming that $P(\infty) = 1.0$ (i.e., that there is no price increase in the long run), then estimating $P(3)$ from the rent increase between enrollment and payment authorization (typically one month) for recipients who neither moved nor repaired their enrollment dwelling (because it passed the housing evaluation). We solve for the rent-adjustment factor in Eq. (A.2) by substituting 1.0 for $P(\infty)$, 0.5 for S (the median estimate found in the literature), and 1.016 and 1.007 for $P(3)$ in Brown County and St. Joseph County, respectively.* The resulting adjustment factors--0.992 for Brown County and 0.997 for St. Joseph County--hardly change the observed year 3 rents; we include them only for completeness.

*The no-move, no-repair rent increase figures come from Rydell, Mulford, and Helbers (1980, Table 3). Using estimates of 1.03 for $P(3)$ and 1.01 for $P(\infty)$, the averages reported in Rydell, Neels, and Barnett (forthcoming), gives an adjustment factor of 0.995.

WITHOUT-PROGRAM HOUSING CONSUMPTION ESTIMATION

Control Group

We estimate what recipients would have spent for housing without a program by substituting their characteristics into a regression control model. We use baseline survey data (collected before the allowance program began) to identify a control group of households with the same housing behavior as recipients (or with known differences that can be corrected for).

Those who joined the program self-selected themselves from among all eligibles; we therefore consider the possibility that participants had unusual housing tastes. Self-selection occurred at each stage of the two-step (enrollment and qualifying for payments) participation process. Households who enrolled in the program had housing tastes indistinguishable from those of households who never enrolled (including ineligibles). But among enrollees, those who dropped out without receiving allowance payments had significantly lower housing expenditures than those who received payments. Below, we describe the statistical tests that lead to those conclusions.

We divide the baseline sample of households into those who never enrolled in the allowance program during the five years we monitored it, those who enrolled but never received payments, and those who actually received payments. (The latter two groups form the future-enrollee group.) We then test the hypothesis that both future enrollees and those who never enrolled had identical housing behavior by performing two regressions and comparing their residual sums of squares. First, we estimate a model that restricts the parameters for both groups to be equal; then we estimate the unrestricted model:

$$\ln R = \alpha_0 + \alpha_1 \ln Y + \alpha_2 \ln N + \alpha_3 L_1 + \alpha_4 L_2 + \alpha_5 L_3 + \alpha_6 D \qquad \text{(A.3)}$$

$$+ \beta_0 F + \beta_1 F \ln Y + \beta_2 F \ln N + \beta_3 F L_1 + \beta_4 F L_2 + \beta_5 F L_3$$

$$+ \beta_6 F D + \varepsilon \quad ,$$

where R = monthly gross rent.

Y = annual household gross income,

N = number in household,

L_1 = 1 if single-parent household, 0 otherwise,

L_2 = 1 if young couple with young children, 0 otherwise,

L_3 = 1 if elderly, 0 otherwise,

D = 1 if nonwhite head of household, 0 otherwise,

F = 1 if future enrollee, 0 otherwise (i.e., never enrolled),

ϵ = disturbance term assumed to be $N(0, \sigma^2)$.

Equation (A.3) differs from the restricted model in that the latter has no terms in which future enrollees (F) interact with the independent variables.*

The F-statistic given in Eq. (A.4) tests the hypothesis that future enrollees behaved the same as those who never enrolled with regard to rent expenditures:

$$F[(df_r - df_u), df_u] = \frac{\frac{SSR_r - SSR_u}{df_r - df_u}}{\frac{SSR_u}{df_u}}, \qquad (A.4)$$

where SSR_r = residual sum of squares of restricted model,

SSR_u = residual sum of squares of unrestricted model,

df_r = degrees of freedom of restricted model,

df_u = degrees of freedom of unrestricted model.

A large F-statistic indicates that future enrollees differed from those who never enrolled; a small statistic, that the groups behaved the same (i.e., all $\beta_i = 0$). Evaluating Eq. (A.4) gives $F(6,2204) = 0.73$ for Brown County and $F(7,1574) = 1.68$ for St. Joseph County. For

*Mulford (1979) discusses the choice of independent variables and functional form for the rent-expenditure model.

Brown County, we cannot reject the hypothesis of equality even at the 75 percent confidence level ($F = 1.31$). For St. Joseph County, we cannot reject the hypothesis of equality at the 90 percent confidence level ($F = 1.72$). Those results are consistent with the hypothesis that those who never enrolled and future enrollees had the same housing behavior.

Next we compare the two groups within future enrollees. Repeating the F-test for future recipients as against households who enrolled but never received payments (F equals 1 for households in the former group and 0 for those in the latter) yields statistics of $F(6,425) = 4.51$ for Brown County and $F(7,324) = 1.88$ for St. Joseph County. The groups are statistically different at the 99 percent confidence level in Brown County and at the 90 percent level in St. Joseph County.

If all coefficients except the intercept are constrained to be the same for both future recipients and enrollees who did not receive payments, then the coefficient on a dummy variable for future recipients equals 0.122 with a t-statistic of 4.0 for Brown County and 0.071 with a t-statistic of 2.1 for St. Joseph County. Thus, those who enrolled and received payments had a greater taste for housing (13 percent and 7 percent in the two sites respectively) than those who enrolled but dropped out without receiving payments.

Because we would expect enrollees with a lesser housing taste to drop out of the program rather than move from or repair defective dwellings, and because the evidence supports that hypothesis, we excluded enrollees who never received payments from the control group for recipients.

Those who never enrolled had indistinguishable behavior from all enrollees; we would therefore expect them to have less housing taste than recipients (the greater-taste part of the enrollee group). Table A.2 presents regression results comparing the housing behavior of those who never enrolled with that of future recipients. Testing for equality of behavior--unrestricted versus restricted, no-difference model--yields $F(6,2128) = 0.98$ for Brown County and $F(7,1488) = 2.08$ for St. Joseph County. The results indicate no significant difference for Brown County; but for St. Joseph County, the difference is significant at the 95 percent confidence level.

Table A.2

REGRESSION RESULTS FOR RENTERS' HOUSING EXPENDITURES: FUTURE RECIPIENTS AND THOSE NEVER ENROLLED

Independent Variable		Brown County			St. Joseph County		
			Restricted Model			Restricted Model	
Description	Symbol	Unrestricted Model[a]	Intercept Shift[b]	No Difference[c]	Unrestricted Model[a]	Intercept Shift[b]	No Difference[c]
Income	Y	.096	.097	.096	.093	.098	.094
		(.010)	(.010)	(.009)	(.012)	(.011)	(.011)
Household size	N	.169	.161	.162	.197	.201	.202
		(.015)	(.013)	(.013)	(.017)	(.015)	(.015)
Young couple with children	L_1	-.057	-.054	-.054	-.043	-.041	-.039
		(.019)	(.017)	(.017)	(.024)	(.023)	(.023)
Single parent	L_2	.043	.079	.082	-.018	.002	.010
		(.028)	(.022)	(.021)	(.029)	(.024)	(.024)
Elderly	L_3	-.078	-.076	-.073	-.162	-.135	-.129
		(.022)	(.019)	(.018)	(.027)	(.023)	(.023)
Nonwhite	D	--	--	--	-.070	-.051	-.047
					(.022)	(.019)	(.019)
Future recipient	F	-.079	.010	--	-.165	.034	--
		(.241)	(.016)		(.262)	(.020)	
F · Income	FY	.011	--	--	.011	--	--
		(.029)			(.031)		
F · Household size	FN	-.042	--	--	.026	--	--
		(.036)			(.042)		
F · Young couple with children	FL_1	.022	--	--	.055	--	--
		(.050)			(.068)		
F · Single parent	FL_2	.102	--	--	.091	--	--
		(.049)			(.058)		
F · Elderly	FL_3	.016	--	--	.151	--	--
		(.046)			(.057)		
F · Nonwhite	FD	--	--	--	.072	--	--
					(.043)		
Intercept	--	3.918	3.904	3.915	3.964	3.915	3.954
Statistics:							
Sample size		2,140	2,140	2,140	1,502	1,502	1,502
R^2 (adjusted for degrees of freedom)		.21	.21	.21	.27	.27	.27
Standard error of estimate		.253	.253	.253	.262	.263	.263
Residual sum of squares		136.710	137.063	137.088	102.403	103.201	103.405

SOURCE: Estimated by HASE staff from baseline household survey data.

NOTE: Sample excludes households that enrolled in the program but never received payments. Entries in parentheses are standard errors.

[a] All coefficients allowed to differ between future recipients and those who never enrolled.

[b] All coefficients, except intercept, restricted to be the same for future recipients and those who never enrolled.

[c] All coefficients, including intercept, restricted to be the same for future recipients and those who never enrolled.

The model that constrains the slope coefficients to be equal but allows a different intercept for future recipients (see Table A.2) estimates that recipients spent about 1 percent more on housing than those who never enrolled in Brown County and almost 3.5 percent more in St. Joseph County (see the coefficient for F). Neither difference is statistically significant at the 95 percent confidence level. We nevertheless use the point estimate of that "selection-bias factor" because logic agrees with the sign of the difference and because the correction factor leads to a conservative estimate of the program effect (smaller than without the correction).

Without-Program Rent at Year 3

The baseline survey data showed that those who never enrolled behaved like recipients would have without the program, except for a multiplicative constant. Using wave 4 survey data, we reestimated the expenditure model for those who never enrolled to make it contemporaneous with year 3 recipient data. We applied the selection-bias correction factor, estimated at baseline, to the wave 4 model, assuming no change in the relative without-program behavior of the two groups over time.

Table A.3 gives the results of the control model fit to wave 4 survey data. Table A.4 gives the mean values of the variables of the model for the sample of those who never enrolled. To estimate without-program rent for allowance recipients at year 3, we evaluate the model in Table A.3 using the independent variables computed for year 3 recipients (as given in Table A.5), exponentiate the predicted logarithm of rent for each household, and multiply by the self-selection-bias correction factor. Exponentiating for each household and averaging the result causes a downward bias in the estimated average rent:

$$E(R_i) = exp\ (X_i\hat{\beta})\ E(e^{\varepsilon}) \quad , \qquad (A.5)$$

where $E(R_i)$ = expected value of gross rent for household i,

Table A.3

REGRESSION RESULTS FOR GROSS RENT CONTROL MODEL

Independent Variable	Brown County		St. Joseph County	
	Coefficient	t-value	Coefficient	t-value
Annual income $(ln)^a$	.102	7.54	.112	5.79
Household size (ln)	.232	12.06	.260	9.38
Young couple, young children	-.067	2.49	-.067	1.54
Single head with children	.052	1.44	.007	.15
Elderly household	-.052	1.86	-.003	.07
Intercept	4.072	33.44	3.933	22.86
Statistics:				
Sample size	1,015		646	
Adjusted R^2	.26		.25	
Standard error of estimate	.2476		.2959	

SOURCE: Estimated by HASE staff from wave 4 survey data for households that never enrolled in the allowance program during its first 5 years.

NOTE: The dependent variable is the logarithm of monthly gross rent. Rents and incomes are in end-of-program-year-3 dollars (June 1977 for Brown County, December 1977 for St. Joseph County).

[a]The sample was restricted to households with incomes between $500 and $20,000. Lower incomes are not believable and powerfully affect the estimated income elasticity in a log model. Higher incomes are sometimes misreported and are never found in the program.

Table A.4

VARIABLE MEANS AND STANDARD DEVIATIONS FOR GROSS RENT CONTROL MODEL

Variable	Brown County		St. Joseph County	
	Mean	Standard Deviation	Mean	Standard Deviation
Gross rent ($/month)	174.5	51.3	169.6	61.3
Gross rent (ln)	5.12	.29	5.07	.34
Income ($/year)	10,364	4,807	9,469	4,862
Income (ln)	9.10	.61	8.98	.65
Household size (ln)	.58	.54	.56	.57
Single parent	.06	.23	.11	.31
Other nonelderly	.85	.36	.77	.42
Elderly	.09	.29	.12	.32

SOURCE: Tabulated by HASE staff from wave 4 survey data for households that never enrolled in the allowance program during its first 5 years.

NOTE: Gross rents were adjusted to end-of-program-year-3 dollars using HASE gross rent inflation rates from Rydell, Neels, and Barnett (forthcoming, Table 2.1). Incomes were adjusted to end-of-program-year-3 dollars using the U.S. consumer price index (all items).

$X_i\hat{\beta}$ = predicted logarithm of gross rent for household i,

$E(e^{\varepsilon})$ = expected value of residuals for all households.

$$\widehat{E(\bar{R})} = \hat{\phi}\left[\frac{1}{m}\sum_{i=1}^{m} exp\ (X_i\hat{\beta})\right] , \qquad (A.6)$$

where $\widehat{E(\bar{R})}$ = our estimate of the expected value of average gross rent,

$\hat{\phi} = E(e^{\varepsilon})$,

m = number of recipients,

X_i = characteristics of recipient i,

$\hat{\beta}$ = control model coefficients, estimated from survey data for those who never received payments.

Table A.5

VARIABLE MEANS AND STANDARD DEVIATIONS FOR YEAR 3 RENTER RECIPIENTS

Variable	Brown County		St. Joseph County	
	Mean	Standard Deviation	Mean	Standard Deviation
Gross rent	185.8	55.2	178.7	56.6
Gross rent (ln)	5.17	.34	5.13	.34
Nonallowance income	4,569	1,784	3,632	1,750
Nonallowance income (ln)	8.35	.40	8.09	.48
Household size (ln)	.71	.58	.66	.58
Single parent	.38	.48	.46	.50
Other nonelderly	.31	.46	.25	.43
Elderly	.31	.46	.29	.45

SOURCE: Tabulated by HASE staff from year 3 HAO records.

NOTE: Gross rent = contract rent + (utilities) (adjustment factor). The adjustment factor--1.114 in Brown County, 1.153 in St. Joseph County--makes the HAO utility schedule comparable to household survey utility data. Rent and income are in dollars at end of year 3 in each site. Samples are 1,848 in Brown County and 1,945 in St. Joseph County.

Transforming back to natural units underestimates the mean because $\hat{\phi}$, which we evaluate with $exp(\sigma^2/2)$--the standard procedure when ε is approximately $N(0, \sigma^2)$--is always greater than 1. The standard error of the estimate for the regression control model (Table A.3) is used for σ. The transformation-bias correction factors are 1.031 $[exp\ (\frac{.2476^2}{2})]$ for Brown County and 1.045 $[exp\ (\frac{0.2959^2}{2})]$ for St. Joseph County.

PROGRAM-EFFECT CALCULATION

Point Estimates

Table A.6 combines the observed and estimated rents and the adjustments discussed above to yield the estimated program effect on recipients' housing consumption. The difference between with-program and without-program adjusted rent equals the program's effect on

Table A.6

CALCULATIONS BEHIND PROGRAM-INDUCED HOUSING CONSUMPTION INCREASE FOR RENTER RECIPIENTS

Item	Brown County	St. Joseph County
With-program rent:		
Mean observed ($/mo.)[a]	185.83	178.70
Price correction factor	.9921	.9965
Adjusted ($/mo.)	184.36	178.08
Without-program rent:		
Mean predicted[b] ($/mo.)	164.23	152.18
Transformation-bias correction factor	1.0311	1.0447
Self-selection-bias correction factor	1.0103	1.0350
Adjusted ($/mo.)	171.08	164.55
Consumption increase:		
Amount ($/mo.)	13.28	13.53
Percentage	7.76	8.22

SOURCE: Estimated by HASE staff from HAO records and models fit to household survey data.

NOTE: Estimates are for renters receiving allowances at the end of program year 3. All correction factors multiply the values they correct.

[a]Adjusted for HAO-survey utility expenditure differences.

[b]Wave 4 control model prediction of logarithm of rent for each household was exponentiated; result was averaged.

recipients' monthly housing consumption--$13.28 for Brown County and $13.53 for St. Joseph County. Those amounts correspond to 8 percent increases in housing consumption with the program over what it would have been without it.

Standard Errors

We account for several sources of uncertainty in the point estimates, although some sources of error may remain undetected either because they cannot be measured or because the conceptual framework is incorrect. The error analysis shows that the program effect signal is not "swamped" by either sampling noise--even though we exercise the control model far from the means of the independent variables for those who never enrolled (the group on whom the model was fit)--or by the compounding of errors in our adjustments and corrections--even though the corrections are many and sometimes quite uncertain.

We use standard theory of the propagation of errors through multiplication and division (see, for example, Wilson, 1952, p. 273) to compute standard errors for the program-effect point estimates. The program-effect calculation represents each source of error by a separate factor:

$$H = \frac{X_1 X_2 X_3}{Y_1 Y_2 Y_3} \quad , \tag{A.7}$$

where H = ratio of with-program to without-program rent at program equilibrium,

X_1 = observed program rent at year 3, measured by HAO,

X_2 = factor that adjusts HAO measured rent to survey measure of rent (actually, we multiplied HAO utilities by a factor and added them to contract rent, but that process can be represented by a multiplication factor--different from the utility factor--for HAO gross rent, because we know the fraction of gross rent composing utilities),

X_3 = price adjustment for recipients, which transforms year 3 to equilibrium,

Y_1 = without-program rent predicted by control model,

Y_2 = control-model-bias correction factor,

Y_3 = transformation-bias correction factor.

Let x_i be the relative error of X_i and y_j be the relative error of Y_j (x_i is the standard deviation of $\overline{X}_i$ divided by $\overline{X}_i$). The standard deviation of H is then

$$\overline{H}\left(\sum_{i=1}^{3} x_i^2 + \sum_{j=1}^{3} y_j^2\right)^{1/2} . \qquad \text{(A.8)}$$

Table A.7 presents our estimates of the relative errors from each source (the x_i and the y_j) and the compound standard error of the program effect--that is, the standard deviation of H, which comes from evaluating Eq. (A.8). Prediction error and bias in the control model, plus the HAO utility correction, introduce considerable uncertainty in the results for both sites.

Even when we include error estimates from every measurable source (most analyses consider only measurement and prediction errors), the point estimates of the program effect are still significantly different from zero at the 95 percent confidence level for Brown County and at the 90 percent level for St. Joseph County. Moreover, recipients' observed behavior is close to our point estimates of the

Table A.7

STANDARD ERROR OF PROGRAM EFFECT ON RENTER RECIPIENTS' HOUSING CONSUMPTION

Source of Error		Relative Error of Mean	
Description	Symbol	Brown County	St. Joseph County
Observed HAO rent	X_1	.008	.008
HAO utilities	X_2	.011	.018
Recipient price	X_3	.010	.012
Control model prediction	Y_1	.017	.024
Control model bias	Y_2	.016	.021
Transformation bias	Y_3	.002	.003
All sources[a]	H	.031	.043

SOURCE: Estimated by HASE staff from HAO records, models fit to household survey data, and Eq. (A.8).

[a]Apply Eq. (A.8) to x_1, x_2, x_3, y_1, y_2, and y_3.

program's effect--their rent increases after they join the program average 6.5 percent for the two sites (see Table 2.7). (Recall that we explained the small difference by prepositioning before enrollment.) Below we discuss each source of error and the derivation of its entry in Table A.7.

Observed HAO Rent. Although we have an average rent figure for the entire recipient population, we treat recipients as a sample from the population that might be served by an allowance program anywhere in the United States. The relative error of the mean is simply the standard deviation of observed gross rent divided by the square root of number of recipients.

HAO Utilities. The estimated adjustment factor for HAO utilities given in Table A.1 has some uncertainty, which causes uncertainty in the HAO figure for gross rent (R_A). We compute an adjusted gross rent as

$$R_A = C + \lambda U \ , \tag{A.9}$$

where C = contract rent, U = utility expenses, and λ = utility inflation factor from Table A.1. The variance of observed HAO rent is accounted for above. Treating C and U as known with certainty, the variance in R_A introduced by uncertainty in λ is

$$var\ (\overline{R}_A) = var\ (\overline{C}) + var\ (\lambda\overline{U}) \tag{A.10}$$

$$= 0 + \overline{U}^2\ var\ \lambda \ .$$

The relative error of R_A from that source is then

$$\frac{\sigma_{\overline{R}_A}}{\overline{R}_A} = \frac{\sigma_\lambda \overline{U}}{\overline{R}_A} \ . \tag{A.11}$$

Because utilities account for approximately 20 percent of gross rent, the relative error of R_A caused by uncertainty in λ is simply 0.2 times the standard error of λ (Table A.1).

Price Adjustment. We calculate the standard error in recipients' average housing-price increase (estimated as rent when payments began divided by rent at enrollment) by using Eq. (A.8), but substitute rent when payments began divided by rent at enrollment for H and the standard errors of x_i and y_j for those values.

	Brown County		St. Joseph County	
	Mean	Standard Error	Mean	Standard Error
Rent at enrollment	163.9	1.19	156.9	1.35
Rent when payment began.	166.5	1.17	158.0	1.32
Price increase	1.016	.010	1.007	.012

Samples numbered 1,547 for Brown County and 1,218 for St. Joseph County.

Control Model Prediction. The control model was fit to wave 4 data for those who never enrolled and whose characteristics (X) differed from those of recipients (X_*). The variance of the predicted without-program rent for recipients is

$$var\ \widehat{ln\ R} = \sigma^2 X_*'(X'X)^{-1}X_* \quad , \tag{A.12}$$

where R = gross rent,

σ = standard error of estimate of control model.

Because the mean of the vector X_* lies several standard deviations from the mean of X, the prediction standard error at X_* is about twice that at X.

Equation (A.12) gives the prediction error of the logarithm of rent. However, we want to calculate the standard error of

$$exp\left(\frac{1}{n}\sum_{i=1}^{n}\widehat{ln\ R_i}\right) \quad , \tag{A.13}$$

where n = the number of year 3 recipients. To do so, we estimate an approximate relative error of (A.13) by

$$\frac{exp\left(\frac{1}{n}\sum_{i=1}^{n}\widehat{ln\ R_i} + \delta\right) - exp\left(\frac{1}{n}\sum_{i=1}^{n}\widehat{ln\ R_i}\right)}{exp\left(\frac{1}{n}\sum_{i=1}^{n}\widehat{ln\ R_i}\right)}, \qquad (A.14)$$

which then simplifies to $e^{\delta} - 1$, where $\delta = (var\ \widehat{\overline{ln\ R}})^{1/2}$ from Eq. (A.12).

Control Model Bias. The restricted model with an intercept shift (Table A.2) shows that future recipients spent more for housing than those who never enrolled. The coefficient for future recipients (a dummy variable) estimates the control model bias; its standard error estimates the relative error of that bias estimate.

Transformation Bias. We multiply the exponentiated predicted logarithm of rent by $exp(\sigma^2/2)$ to correct for transformation bias, estimating σ with the standard error of estimate from the control model regression (Table A.3). The variance of σ^2 is estimated as

$$var\ \sigma^2 = \frac{2\hat{\sigma}^4}{df}, \qquad (A.15)$$

where df = degrees of freedom from the control model regression (1,009 for Brown County, 640 for St. Joseph County).

We estimate the relative error of $exp(\hat{\sigma}^2/2)$ using the following expression:

$$\frac{exp(\hat{\sigma}^2/2) + (\hat{\sigma}^4/df)^{1/2} - exp(\hat{\sigma}^2/2)}{exp(\hat{\sigma}^2/2)}. \qquad (A.16)$$

Equation (A.16) then simplifies to the following:

$$exp\left[(\hat{\sigma}^4/df)^{1/2}\right] - 1 \ . \qquad \text{(A.17)}$$

Appendix B

ESTIMATING PROGRAM EFFECTS ON REPAIRS MADE BY HOMEOWNER RECIPIENTS

This appendix provides the methodological details underlying the program-induced repair estimates for homeowners (Table 2.6), on which we based the estimates of owners' housing consumption changes (Table 2.1). It describes how we measured repairs, how we chose a control group, and how we estimated the program's effects--both point estimates and standard errors.

MEASURING RECIPIENTS' REPAIRS

If a household failed a housing evaluation, either it could move or it could repair the defective items and request a reevaluation. At deficiency reevaluations, the HAO inspectors asked what repairs were done and how much they cost. The HAO also inspected recipients' housing each year and asked for a description of nonrequired repairs and cash expenditures for the preceding one.*

In recipients' repair expenditures we include all cash repair expenditures reported at the annual evaluation that was closest to the end of program year 3 and all repairs of HAO-cited defects made during the year before the annual evaluation. All expenditures are adjusted to year 3 dollars.

WITHOUT-PROGRAM REPAIR ESTIMATES

The model that controls for recipients' without-program repair expenditures includes as explanatory variables income, number of rooms in the dwelling, whether the household head is elderly, and the average age of residential buildings in the neighborhood (see Table B.1)--variables similar to but not identical with the set used by Helbers and McDowell (forthcoming, Table 5) in analyzing the determinants of repairs. Those investigators chose the best set of variables

*The HAO recorded both repairs and improvements; our term *repairs* includes both.

Table B.1

REGRESSION RESULTS FOR HOMEOWNER REPAIR EXPENDITURE CONTROL MODEL

Independent Variable	Brown County		St. Joseph County	
	Coefficient	t-value	Coefficient	t-value
Income (ln)[a]	.45	3.19	.41	2.28
Rooms (ln)	.05	.19	.38	1.19
Elderly[b]	-.22	-1.20	-.21	-1.00
Neighborhood age[c]	-.02	-2.58	-.02	-2.63
Intercept	1.92	1.44	2.29	1.34
Statistics:				
Sample size	361		264	
Adjusted R^2	.09		.11	
F-statistic	8.78		8.09	

SOURCE: Estimated by HASE staff from baseline through wave 4 survey data for households that never enrolled in the allowance program during its first 5 years.

NOTE: The dependent variable is the logarithm of annual repair expenditures (averaged over the waves for which we had complete data). We included only properties with at least two waves of complete data.

[a]Average annual gross household income (averaged over the same waves as repair expenditures).

[b]Dummy variable indicating household head 62 years of age or older.

[c]Average age of residential buildings in a neighborhood.

from the HASE survey files. We, however, required variables present in both survey and HAO data. (The means and standard deviations of the explanatory variables for the sample of those who never enrolled are given in Table B.2.)

HAO data on buildings lack age and square-footage information. Because building age is an important determinant of repairs, we approximated it for recipients with average age in a neighborhood, which we calculated from survey data and applied by neighborhood to the HAO files. The negative coefficient on neighborhood age (Table

Table B.2

VARIABLE MEANS AND STANDARD DEVIATIONS FOR HOMEOWNER REPAIR EXPENDITURE CONTROL MODEL

Variable	Brown County		St. Joseph County	
	Mean	Standard Deviation	Mean	Standard Deviation
Repair expenditures (ln)[a]	5.73	1.13	5.86	1.20
Income (ln)[b]	9.68	.51	9.50	.53
Rooms (ln)	1.73	.22	1.71	.24
Elderly[c]	.18	.36	.24	.41
Neighborhood age[d]	36.01	9.68	47.98	9.96

SOURCE: Tabulated by HASE staff from baseline through wave 4 survey data for households that never enrolled in the allowance program during its first 5 years.

[a]Average repair expenditures (averaged over the waves for which we had complete data).

[b]Average gross household income (averaged over the same waves as repair expenditures).

[c]Dummy variable indicating head of household 62 years of age or older.

[d]Average age of residential buildings in a neighborhood.

B.1), however, suggests that rather than dwelling age, it captures either neighborhood market condition (older neighborhoods are losing demand so homeowners there cut back on repairs) or average amount of physical capital (older neighborhoods have less capital per dwelling so those dwellings need fewer repairs). The coefficients for elderly households and logarithm of income are nearly equal in ours and the Helbers-McDowell models, suggesting that the loss of explanatory variables does not seriously bias the coefficients on the remaining variables. Moreover, the loss in explanatory power (R^2) in going from the Helbers-McDowell model to our control model is only 3 or 4 percentage points.

Because the Helbers-McDowell model is more complete, we use it to test whether without-program repair behavior differed between those who ever enrolled and those who never did so. Helbers and McDowell cannot

reject equality of the coefficients for the two groups at the 95 percent confidence level; they report F-values of 1.74 for Brown County and 0.99 for St. Joseph County for the test of equality of coefficients. Based on those tests, we use the model for those who never enrolled to control for recipients' without-program repair expenditures.

PROGRAM-EFFECT CALCULATION

Point Estimates

Plugging program year 3 recipients' characteristics (Table B.3) into the control model, we predict the logarithm of their without-program repair expenditures. As with renters, exponentiating the predicted logarithm of repairs leads to a biased estimate of average without-program repairs [refer to Eqs. (A.5) and (A.6)]. We estimate the transformation bias (ϕ) as the mean value of the exponentiated residuals in the control model regression:

$$\hat{\phi} = \frac{1}{n} \sum_{i=1}^{n} exp\ (\hat{\varepsilon}_i) \ , \qquad \text{(B.1)}$$

where n = number of those who never enrolled, and

$$\hat{\varepsilon}_i = \widehat{ln\ Y_i} - X_i \hat{\beta} \ . \qquad \text{(B.2)}$$

We estimate $\hat{\phi}$ as 1.52 for Brown County and 1.56 for St. Joseph County. Although that correction factor, which does not depend on the normality assumption, is slightly less efficient than the usual $exp(\sigma^2/2)$ when ε is almost normal, it protects against inconsistency the farther ε departs from normal. Since the repair-expenditure models deviate from normality more than the rent-expenditure models, we use different methods of estimating the bias.*

*Both methods give the same result for renters. For owners, the renter method gives $\hat{\phi}$ equal to 1.81 in Brown County and 1.91 in St. Joseph County.

Table B.3

VARIABLE MEANS AND STANDARD DEVIATIONS FOR YEAR 3 HOMEOWNER RECIPIENTS

Variable	Brown County		St. Joseph County	
	Mean	Standard Deviation	Mean	Standard Deviation
Repair expenditures[a]	415	540	441	523
Income (ln)[b]	8.37	.45	8.27	.48
Rooms (ln)	1.67	.25	1.68	.25
Elderly[c]	.65	.48	.71	.45
Neighborhood age[d]	39.57	9.29	51.96	10.69

SOURCE: Tabulated by HASE staff from HAO housing evaluation records through year 4.

NOTE: Sample sizes were 763 in Brown County and 2,056 in St. Joseph County.

[a]Annual repair expenditures in end-of-program-year-3 dollars.

[b]Annual gross household income in end-of-program-year-3 dollars.

[c]Dummy variable indicating head of household 62 years of age or older.

[d]Average age of residential buildings in a neighborhood.

Applying the transformation-bias correction factors to the average of the exponentiated logarithm of repairs (from the results in Table B.1) gives estimates of average annual without-program repairs --$236 for Brown County and $290 for St. Joseph County. Subtracting average estimated without-program repairs from observed repairs made by recipients gives our estimate of program-induced repairs--$178 for Brown County and $153 for St. Joseph County.

Standard Errors

In computing the standard errors for our estimates of the program's effect on homeowner recipients' repair expenditures, we account for

three sources of error--observed HAO repairs, control model prediction, and transformation bias. We use the same procedure as we did for renters (described in Appendix A). Table B.4 presents the estimated relative errors from each source and the combined relative error of estimated program-induced repairs [see Eq. (A.8)]. The estimated program effect on repairs is 1.76 ± 0.34 for Brown County and 1.52 ± 0.34 for St. Joseph County.

Table B.4

STANDARD ERROR OF PROGRAM EFFECT ON HOMEOWNER RECIPIENTS' REPAIR EXPENDITURES

Source of Error	Relative Error of Mean	
	Brown County	St. Joseph County
Observed HAO repairs	.047	.026
Control model prediction	.175	.208
Transformation bias	.070	.085
All sources	.342	.344

SOURCE: Estimated by HASE staff from HAO records, models fit to household survey data, and Eq. (A.8).

Observed HAO Repairs. As in the case of observed HAO rent (Appendix A), we treat recipients as a sample from the population that might be served by an allowance program anywhere in the United States. The standard deviation of mean observed repair expenditures is simply the standard deviation of repair expenditures divided by the square root of the number of recipients.

Control Model Prediction. We compute the control model prediction error for HAO recipient renters the same way we computed the error for renters (Appendix A).

Transformation Bias. We estimate the variance of the transformation-bias correction factor as the sample variance of the exponentiated residuals from the control model, divided by sample size:

$$var\ \hat{\phi} = \frac{\sum_{i=1}^{n} \left[exp\ (\hat{\varepsilon}_i) - \hat{\phi} \right]^2}{n} \quad , \qquad \text{(B.3)}$$

where $\hat{\phi}$ = transformation-bias correction factor (see Eq. B.1),

$\hat{\varepsilon}_i$ = residual for houshold i from control model regression,

n = number of households in sample to which control model was fit.

The relative error of $\hat{\phi}$ is the square root of its estimated variance.

Appendix C

MODELING PROGRAM-INDUCED HOUSING INCREASES FOR FUTURE AND FORMER RECIPIENTS

ANTICIPATION

The increase in program-induced housing consumption for future recipients (ΔH_F) equals the increase per household that adjusted to the program times the number that adjusted. The model of the adjustment process we develop below makes several simplifying assumptions for analytical convenience; none seriously differs from reality, in our judgment:

- Adjustment to the program by future recipients occurs only when they move into their enrollment unit.
- The program has no effect on preenrollment mobility rates.*
- When a household moves before enrolling, it has some probability of adjusting to the future program benefits. That probability is 1.0 at enrollment and declines smoothly toward zero with increasing time until enrollment.
- The adjustment to the program is complete--i.e., anyone who adjusts to the program does so by the full program effect (8.0 percent on the average).**

The amount of program-induced housing consumption for future recipients is given by

---

*Future recipients' mobility rates are slightly above normal just before enrollment. We ignore this slight effect.

**Because moving is costly, future recipients are likely to adjust fully to the program if they move just before enrolling. They might still adjust after joining the program, such as by making minor housing repairs to meet standards or by moving if they seriously miscalculated their benefits, so the assumption of complete adjustment gives an upper bound estimate of the anticipation effect.

$$\Delta H_F = \int_{t=0}^{\infty} cnf(t)\, dt \ , \qquad \text{(C.1)}$$

where c = amount of program-induced housing change per future recipient who adjusts to the program,

n = number of households that become recipients per year (assumed constant over time after program has operated for many years),

$f(t)$ = fraction of a cohort of future recipients (with t years left before enrolling) that has moved into the enrollment dwelling (i.e., that will not move again before enrolling) and that has adjusted to the program.

Equation (C.1) is clearer in its discrete form:

$$\Delta H_F = \sum_{0}^{\infty} cf(t)n\ \Delta t \ . \qquad \text{(C.2)}$$

The product $n\ \Delta t$ is equal to the number of future recipients that have between t and $t + \Delta t$ years left before they enroll. According to Eq. (C.2), the total program-induced housing change for future recipients equals housing change given adjustment (c) times the fraction of future recipients who have adjusted at time t [$f(t)$] times the number of future recipients t years from enrollment ($n\ \Delta t$), summed over all possible times to enrollment.

The quantity c comes from the analysis of current recipients and n from other HASE work. The remaining job is to specify and estimate $f(t)$ in order to solve Eq. (C.1).

We assume that future recipients have zero probability of adjusting to the program until they move into their enrollment units, and a

probability of adjusting given a move into their enrollment units that is 1.0 at enrollment and decreases as time to enrollment increases. The probability of adjusting, given a move into the enrollment unit at time t, may be expressed as

$$h(t) = e^{-\beta t} , \tag{C.3}$$

where β = speed of adjustment through anticipation.

The fraction of a cohort of future recipients t years from enrollment that has adjusted to the program by then $[f(t)]$ equals the probability $[g(t)]$ of moving into the enrollment unit at t times the probability $[h(t)]$ of adjusting to the program given a move into the enrollment unit t years before enrollment, integrated from t to ∞:

$$f(t) = \int_{x=t}^{\infty} g(x)h(x)\, dx . \tag{C.4}$$

To calculate $g(t)$, let $P(t)$ equal the probability of being in the enrollment unit at t (i.e., no move occurs between t and enrollment at $t = 0$):

$$P(t + \Delta t) = P(t) - \alpha P(t)\, \Delta t . \tag{C.5}$$

According to Eq. (C.5), the probability of being in the enrollment unit at $t + \Delta t$ equals the probability of being there at t less the probability of moving during Δt. If $P(t)$ is the number of households who do not move between t and enrollment at time $t = 0$, then $\alpha P(t)\, \Delta t$ is the number who move into the enrollment unit during Δt, and α is the move-in rate.

The number of future recipients who move into their enrollment units during Δt $[\alpha P(t)\, \Delta t]$ transforms to the probability of moving into the enrollment unit at time t, which is $g(t)$:

$$g(t) = \alpha P(t) . \tag{C.6}$$

Transforming the difference equation (C.5) into a differential equation yields

$$\frac{P'(t)}{P(t)} = -\alpha \ , \tag{C.7}$$

which, with the initial condition $P(0) = 1$, has the solution

$$P(t) = e^{-\alpha t} \ . \tag{C.8}$$

Substituting Eq. (C.8) into Eq. (C.6) yields

$$g(t) = \alpha e^{-\alpha t} \ . \tag{C.9}$$

Next, substituting Eqs. (C.3) and (C.9) intc Eq. (C.4) yields

$$f(t) = \int_{x=t}^{\infty} \alpha e^{-\alpha x} \, e^{-\beta x} \, dx \ , \tag{C.10}$$

which integrates to

$$f(t) = \frac{\alpha}{\alpha + \beta} \, e^{-(\alpha+\beta)t} \ . \tag{C.11}$$

Finally, substituting Eq. (C.11) into Eq. (C.1) yields

$$\Delta H_F = \int_{t=0}^{\infty} cn \, \frac{\alpha}{\alpha + \beta} \, e^{-(\alpha+\beta)t} \, dt \ , \tag{C.12}$$

which integrates to*

*We integrate to ∞ to simplify the resulting formula. Obviously, households would not have infinite time to adjust before they joined; nor

$$\Delta H_F = \frac{cn\alpha}{(\alpha + \beta)^2} \quad . \tag{C.13}$$

We now estimate the parameters needed to solve Eq. (C.13). For computational ease we estimate n/R rather than n alone:

$$\frac{n}{R} = \theta \left(\frac{E - R}{R} \right) \tag{C.14}$$

$$= \theta \left(\frac{1}{\phi} - 1 \right) \quad ,$$

where R = number of current recipients,

E = number of eligible households,

θ = enrollment rate (new recipients per year divided by eligible nonrecipients at midyear),

ϕ = participation rate (current recipients divided by eligibles).

Dividing Eq. (C.13) by the number of current recipients and substituting for n/R from Eq. (C.14) yields

$$\frac{\Delta H_F}{R} = c\theta \left(\frac{1}{\phi} - 1 \right) \frac{\alpha}{(\alpha + \beta)^2} \quad . \tag{C.15}$$

We obtain the value $\alpha = 0.6$ from a previous HASE analysis (Rydell, 1979, Table 3.1). We estimate β using Eq. (C.11) and the estimate from Table 2.7 of how much recipients at enrollment consumed above normal. The fraction of recipients who adjust to the program at the time of

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would a program operate that long. But most of the ΔH_F happens to recipients who are near enrollment. If we integrated from 0 to 3 instead of from 0 to ∞, we would lose only 0.5 percent of ΔH_F .

enrollment ($f(0) = \alpha/\alpha + \beta$) multiplied by the program-induced consumption change per household (C = \$13.41) equals the average preenrollment program effect for current recipients (\$2.52)*:

$$\frac{.6}{.6 + \beta}(13.41) = 2.52 \quad . \qquad \text{(C.16)}$$

Solving Eq. (C.16) gives $\beta = 2.6$.**

Evaluating Eq. (C.15) gives the estimated program effect on future recipients per current recipient--$\frac{\Delta H_F}{R}$. Table C.1 presents the parameter estimates and the resulting estimated program effect. The anticipation effect is very small. The aggregate housing increase of all future recipients who anticipate receiving payments is only a fiftieth of the increase for current recipients (0.274/13.41).

INERTIA

The model for former recipients (terminees) is similar to but simpler than that for future recipients. It assumes that

- Terminees do not speed up their moving rate to shed their program effect.
- Terminees carry the average program effect.

Both assumptions err in making the residual program effect for former recipients too large. First, if a terminee consumes much more housing than he wants, he will likely move sooner than if his residual program effect is small. However, an average program effect of 8 percent is not likely to appreciably alter the moving rates of renters, whose

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*The preenrollment program-induced housing increase equals a recipient's average monthly enrollment rent (in year 3 dollars)--\$171.77 for Brown County, \$168.89 for St. Joseph County--minus his average without-program rent (from Table A.6).

**We estimate only one β (average for the two counties) because we judge it a basic parameter that should not vary between sites, and that the variation we have is noise around the true value. Substituting $\beta = 2.6$ into Eq. (C.3) gives plausible probabilities of adjusting to the program given a move into the enrollment dwelling at t: 0.81 for one month before enrolling ($t = 1/12$), 0.07 for one year before enrolling ($t = 1$).

Table C.1

PROGRAM-INDUCED HOUSING CONSUMPTION INCREASE FOR FUTURE RENTER RECIPIENTS: PARAMETER ESTIMATES AND RESULTS

Site	c^a	θ^b	ϕ^c	α^d	β^e	$(\Delta H_P)/R^f$
Brown County	13.28	.45	.59	.6	1.2	.245
St. Joseph County	13.53	.35	.48	.6	1.2	.303
Average	13.41	.40	.54	.6	1.2	.274

SOURCE: Estimated by HASE staff from models fit to five years of HAO records and four waves of household survey data.

[a]Program-induced housing consumption increase ($/mo) for households receiving allowances at the end of program year 3 (from Table A.6).

[b]Enrollment rate from Rydell, Neels, and Barnett (forthcoming, Table 4.4).

[c]Equilibrium participation rate from Rydell, Neels, and Barnett (forthcoming, Table 4.5).

[d]Move-in rate from Rydell (1979, Table 3.1).

[e]Parameter measures speed with which future recipients adjust their housing consumption in anticipation of joining the program. Estimated in Eq. (C.16).

[f]Program-induced housing consumption increase ($/mo) for all future recipients after the program has reached steady state, per recipient at year 3. Estimated by evaluating Eq. (3.15) for the values of the parameters given here.

turnover rate is 60 percent a year anyway. Second, if terminees received enough allowance to stimulate the average program effect, why would they terminate while remaining eligible? (Surprisingly, before terminating, those terminees received only slightly less than the average allowance.) A third factor might offset such biases. Perhaps the program, through its educational function, altered housing tastes and caused terminees to consume more housing (especially safety features) than had there been no program.

We express former recipients' program-induced housing consumption with an equation analogous to that for future recipients [Eq. (3.1)]:

$$\Delta H_P = \int_0^\infty cmkP(t)\, dt \ , \qquad \text{(C.17)}$$

where ΔH_P = program-induced increase in housing consumption for all former recipients,

c = program-induced housing consumption per terminee who retains a program effect (assumed to equal average program effect per current recipient),

m = number of terminees per year (assumed constant over time after program has operated for many years),

k = fraction of terminees who remain income-eligible after termination (i.e., fraction of terminees who carry a program effect),

$P(t)$ = probability of occupying program dwelling t years after termination (i.e., probability of not moving between termination and t years after termination).

The $P(t)$ in Eq. (C.17) is exactly analogous to $P(t)$ in Eq. (C.7), so $P(t) = e^{-\alpha t}$. Substituting for $P(t)$ and dividing by R in Eq. (C.17), as with future recipients, yields

$$\frac{\Delta H_P}{R} = \int_0^\infty \frac{cmk}{R} e^{-\alpha t}\, dt \ . \qquad \text{(C.18)}$$

Recognizing that m/R is the definition of the termination rate, which we represent by γ, and integrating Eq. (18) gives

$$\frac{\Delta H_P}{R} = \frac{c\gamma k}{\alpha} \ . \qquad \text{(C.19)}$$

Table C.2 presents the parameter estimates for and solutions of Eq. (C.19), for both sites. The program-induced housing consumption for all past recipients in Brown County, for example, is about one-tenth of that for current recipients (1.316/13.28).

Table C.2

PROGRAM-INDUCED HOUSING CONSUMPTION INCREASE FOR FORMER RENTER RECIPIENTS: PARAMETER ESTIMATES AND RESULTS

Site	c^a	γ^b	κ^c	α^d	$(\Delta H_p)/R^e$
Brown County	13.28	.308	.193	.6	1.316
St. Joseph County	13.53	.384	.220	.6	1.905
Average	13.41	.346	.207	.6	1.611

SOURCE: Estimated by HASE staff from models fit to five years of HAO records and four waves of household survey data.

[a] Program-induced housing consumption increase ($/mo) for households receiving allowances at the end of program year 3 (from Table A.6).

[b] Termination rate from Rydell, Neels, and Barnett (forthcoming, Table 4.4).

[c] Fraction of terminees who remain income-eligible, derived from termination reasons for all terminees through program year 5.

[d] Move-in rate from Rydell (1979, Table 3.1).

[e] Program-induced housing consumption increase ($/mo) for all former recipients after the program has reached steady state, per recipient at year 3. Estimated at the values of the parameters in this table.

Appendix D

MODELING PROGRAM-INDUCED HOUSING-QUALITY IMPROVEMENT

The housing allowance program could have changed the proportion of substandard housing in the sites by increasing the amount of new construction (assumed to be standard), by increasing the number of removals (assumed to be substandard), or by increasing the number of existing dwellings upgraded from substandard to standard. We could not trace each component accurately with our data. Instead, we modeled the effect on substandard housing, using data from the enrollment and the annual housing evaluations.

STATIC MODEL

About half the recipients at program equilibrium occupied substandard housing when they enrolled. In a static view, the program therefore caused the half of recipients who would have occupied substandard housing to live in standard housing, and did not affect nonrecipients. At equilibrium, recipients represented about 6 percent of the population. Changing their housing from 50 percent substandard to zero percent substandard then lowered the marketwide percent of substandard housing by about 3 percentage points [(0.5) (0.06) - (0) · (0.06) = 0.03]. Without the program, we judge that about 33 percent of the dwellings in the market would have failed the HAO standards; with the program, about 30 percent would have failed.

According to the static model, substandard housing for recipients decreased dramatically (50 percent to zero percent), but substandard housing in the market decreased only slightly (33 percent to 30 percent), because recipients were a small fraction of the market. Below, we make the model more realistic, but the qualitative conclusion does not change.

The static model assumes that all recipients occupied standard housing. In fact, at any time some occupied substandard housing, because dwellings slipped from standard to substandard between yearly

evaluations. Incorporating that condition lowers our estimate of the program-induced improvement in housing quality.

The static model also assumes that the program did not affect nonrecipient housing. In fact, when recipients terminated from the program, they brought to the nonrecipient submarket housing of better quality (of which a lower percentage was substandard) than they would have occupied had there never been an allowance program; the upgrading from substandard to standard lasted awhile. Over time, the housing of former recipients will deteriorate to the equilibrium, without-program proportion substandard. However, at any time, the average condition of former recipients' housing will be better than its equilibrium condition. The difference between the equilibrium and the actual substandard percentages for former recipients' housing is the program-induced improvement in housing quality.

The above modifications to the static model work in opposite directions. On the one hand, allowing for the fact that recipients lived in substandard housing lowers the program-induced improvement in housing quality; accounting for the fact that upgrading by former recipients lasted after they left the program, on the other hand, raises the amount of improvement. The Markov model developed below incorporates those modifications.

MARKOV MODEL

The change in the number of substandard dwellings over time equals the number of dwellings that deteriorated from standard to substandard, minus the number of substandard dwellings that were either upgraded to standard or removed from the housing stock:

$$\frac{dS(t)}{dt} = v[N - S(t)] - [u + l]S(t) \quad , \qquad \text{(D.1)}$$

where $S(t)$ = number of substandard dwellings at time t,

N = number of dwellings (assumed constant over time),

v = rate at which standard units deteriorate to substandard,

u = rate at which substandard units are upgraded to standard,

l = rate at which dwellings are removed from housing stock (all removals assumed to be substandard).*

We apply Eq. (D.1) to the allowance program by setting N equal to the number of recipients in the program at equilibrium and starting at $S(0) = 0$. Solving Eq. (D.1) for $S(t)$ and dividing by N yields the fraction of recipient units that are substandard as a function of time $[s(t)]$:

$$s(t) = \frac{S(t)}{N} = \frac{v}{v + u + l}\left[1 - e^{-(v+u+l)t}\right]. \qquad (D.2)$$

Rewriting Eq. (D.2), letting $v + u + l = z$, yields

$$s(t) = \frac{v}{z}\left[1 - e^{-zt}\right]. \qquad (D.3)$$

Evaluating Eq. (D.3) at $t = \infty$ gives $s(\infty) = v/z$. Substituting $s(\infty)$ for v/z in Eq. (D.3) yields

$$s(t) = s(\infty)\left[1 - e^{-zt}\right]. \qquad (D.4)$$

The program effect on a household's "substandardness" is the difference between substandardness without a program $[s(\infty)]$ and with the program $[s(t)]$.** Figure D.1 shows the program effect as a function of time since a household began receiving allowance payments (i.e., since passing its initial housing evaluation).

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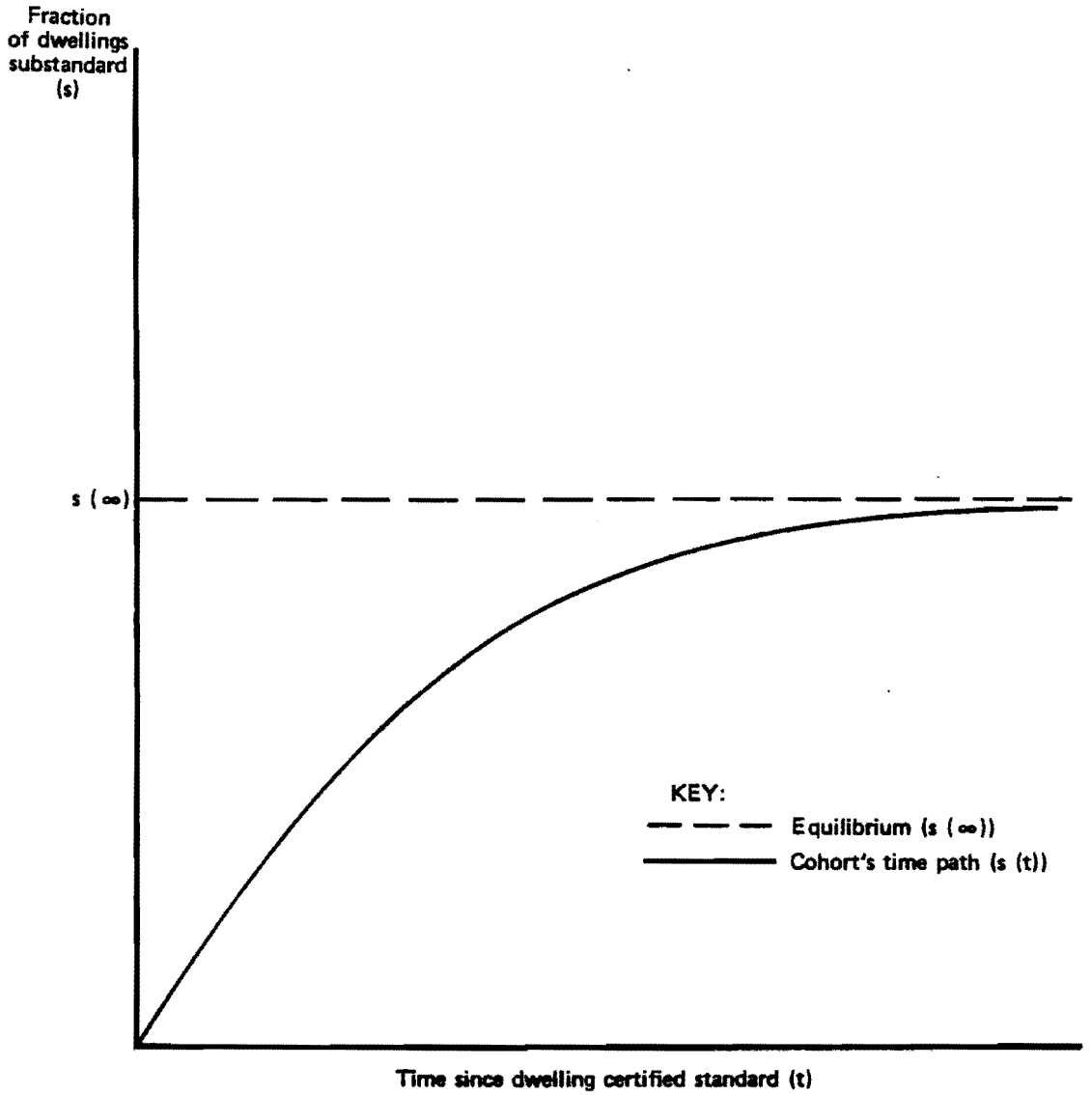
*We assume that all additions to the housing stock (needed to balance losses because N is constant) met the HAO housing standards.

**Our usual definition of program effect is with-program minus without-program value. We reverse them here so that the effect--reduction in the substandard percentage--is a positive number.



SOURCE: Eq. (D. 4)

Fig. D.1 — Decay of cohort of standard dwellings to equilibrium fraction substandard

We estimate the program's effect on marketwide substandardness as the sum of the effects on current and former recipients (we assume that the program did not affect either the substandardness of those who never received payments or recipients' housing quality before they enrolled). For both current and former recipients, we estimate the number of standard dwelling units that would have been substandard without the program and divide them by the number of recipients at program equilibrium. Multiplying those quantities by the ratio of recipient households to households in the site transforms them to marketwide program effects.

We assume that recipients at program equilibrium had a uniform distribution of time (over the interval zero to one year) since their last housing evaluation. Therefore, we estimate the number of current recipients' dwellings the program caused to be standard (ΔS_C) by the relation

$$\Delta S_C = \int_0^1 N[s(\infty) - s(t)]\, dt \ . \qquad \text{(D.5)}$$

Substituting Eq. (D.4) for $s(t)$ and integrating Eq. (D.5) yields

$$\frac{\Delta S_C}{N} = \frac{s(\infty)}{z}\left[1 - e^{-z}\right] . \qquad \text{(D.6)}$$

For former recipients, we observe that about half terminated after a semiannual recertification and half after an annual recertification, implying that, on the average, 0.75 years [(1/2) (0.5 yr) + (1/2) (1 yr)] elapsed since a terminee's dwelling was certified as standard. Terminees' dwellings deteriorated some during the 0.75 years after they were certified standard, but the average percentage substandard was still below its equilibrium value. Over time, terminees' dwellings deteriorated to the equilibrium percentage substandard.

We estimate the program-induced reduction in substandard dwellings for all former recipients (ΔS_P) by integrating the number of

former recipients whose dwellings were certified t years ago times the amount below equilibrium substandardness given t $[s(\infty) - s(t)]$. We integrate over time since a terminee's unit was last certified (using the average for all terminees--0.75 years--as the starting value):

$$\Delta S_P = \int_{.75}^{\infty} \gamma N[s(\infty) - s(t)]\, dt \ , \qquad \text{(D.7)}$$

where γ = termination rate from the program.

Substituting Eq. (D.4) for $s(t)$ and integrating Eq. (D.7) yields

$$\frac{\Delta S_P}{N} = \gamma \frac{s(\infty)}{z} e^{-.75z} \ . \qquad \text{(D.8)}$$

The marketwide reduction in the percentage of housing that is substandard is

$$\frac{\Delta S_M}{P} = \frac{N}{P}\left[\frac{\Delta S_C}{N} + \frac{\Delta S_P}{N}\right], \qquad \text{(D.9)}$$

where P = number of occupied housing units in the site (Brown or St. Joseph County).

To compute numeric estimates of $\Delta S_M/P$, we need estimates of the parameters in Eqs. (D.6), (D.8), and (D.9). We assume that the initial evaluation failure rate of recipients who joined the program during its first two years is their equilibrium, without-program percentage substandard $[s(\infty)]$. We estimate the termination rate from data on terminations through five program years. We estimate z using the estimate of $s(\infty)$ and observations on the failure rate of recipients at their annual evaluation--$s(1)$. Solving Eq. (D.4) for z and evaluating the result at $t = 1$ yields

$$z = -ln\left[\frac{s(\infty) - s(1)}{s(\infty)}\right]. \qquad (D.10)$$

Table D.1 presents estimates of the parameters needed to estimate the program effect on substandardness. Table D.2 presents estimates of the marketwide decrease in the substandard percentage allocated to current and former recipients using Eq. (D.9).

Table D.1

PARAMETERS FOR ESTIMATING PROGRAM'S EFFECT ON SUBSTANDARD HOUSING

Parameter	Brown County		St. Joseph County	
	Renter	Owner	Renter	Owner
$s(1)^a$	.23	.16	.43	.26
$s(\infty)^b$	.50	.44	.53	.42
γ^c	.31	.27	.38	.24
N/P^d	.12	.04	.11	.05
z^e	.61	.44	1.69	.98

SOURCE: Estimated by HASE staff from models fit to HAO records and countywide household survey data.

[a]Fraction of recipients failing annual housing evaluation.

[b]Equilibrium, without-program fraction of recipients occupying substandard housing.

[c]Termination rate from program.

[d]Number of recipient households at program equilibrium (N) divided by number of households in the population (P).

[e]Speed of adjustment parameter at which a cohort of dwellings all brought up to standard will deteriorate to the equilibrium fraction substandard.

Table D.2

PROGRAM-INDUCED IMPROVEMENT IN HOUSING QUALITY FOR CURRENT RECIPIENTS, FORMER RECIPIENTS, AND ALL HOUSEHOLDS

Site	Housing-Quality Improvement[a] (Percentage Points)		
	Current Recipients	Former Recipients	All Households
Renters			
Brown County	4.3	1.9	6.1
St. Joseph County	2.9	.3	3.3
Average	3.6	1.1	4.7
Owners			
Brown County	1.3	.7	1.9
St. Joseph County	1.4	.3	1.7
Average	1.4	.5	1.8

SOURCE: Equations (D.8), (D.9), and (D.10), with parameters from Table D.1.

NOTE: We assume that the allowance program does not affect the standardness of dwellings never occupied by a recipient; therefore, the improvement for all households equals the sum of the improvements for current and former recipients. (Figures do not add exactly because of rounding.)

[a]Number of households occupying housing that meets the HAOs' standards who would have occupied substandard housing without a program, divided by the number of households in the sites--result expressed as a percentage.

COMPARISON OF MODELS

Table D.3 compares the predictions from the static and the Markov models. On the average, the two predict about the same program-induced reduction in the percentage of substandard housing stock. The static model predicts slightly less of a reduction than the Markov model in Brown County and substantially more of a reduction in St. Joseph County. Both models predict the same reduction when the decay rate

Table D.3

PROGRAM-INDUCED MARKETWIDE IMPROVEMENT IN HOUSING QUALITY: STATIC VERSUS MARKOV MODEL

Site	Predicted Housing-Quality Improvement (Percentage Points)	
	Static Model	Markov Model
Renters		
Brown County	5.8	6.1
St. Joseph County	6.0	3.3
Average	5.9	4.7
Owners		
Brown County	1.5	1.9
St. Joseph County	2.2	1.7
Average	1.9	1.8

SOURCES: For static model, HAO records; for Markov model, Table D.2.

(standard to substandard) is such that the first model's overprediction for current recipients just matches its underprediction for past recipients. That condition holds roughly in all cases except for St. Joseph County renters, whose decay rate (43 percent failed the annual evaluation) far exceeds the rate for the other three groups.

Even the small reductions in Table D.3 represent upper bounds on the program's effect on substandardness. The Markov model assumes that all recipient changes from substandard to standard were net additions to standard housing, whether they resulted from repairs or from moves. But nonrecipients may have swapped standard dwellings for the substandard dwellings vacated by recipients. The high marketwide fraction of substandard dwellings (about a third) suggests that some nonrecipients chose to live in the substandard dwellings vacated by recipients.

Appendix E

HAO DEFICIENCY CHECKLIST

The housing evaluators inspected dwellings to determine if they met HAO standards regarding the following:

- Hazards to health and safety.
- Essential facilities.
- Occupancy (sufficient space for inhabitants).
- Lead-based paint.

The checklist used to rate dwellings is reproduced below.

Hazards to Health and Safety

EXTERIOR PROPERTY AREA

1. Sanitation and Storage
   Heavy accumulations of litter, trash, garbage, or other debris that may harbor insects, rodents, or other pests; that are combustible; that hamper emergency access, or that create a safety or health hazard.
2. Grading and Drainage
   Presence of hazardous conditions, including cases in which topography and the absorptive capacity of the soil cause drainage or seepage into the building or standing water that might damage the structure of its contents or create unsanitary conditions.
3. Trees and Plant Material
   Presence of hazardous conditions, including heavy overgrowth that blocks natural light from the structure and impedes normal access; noxious plants that endanger the health of the occupants; or vines or trees that threaten the building or endanger its occupants.

4. Accessory Structures and Fences

   Presence of hazardous conditions, including accessory structures and fences that have severe structural defects and are located close enough to the main building or to areas of normal human activity on the lot so that their collapse would endanger the occupants.

BUILDING EXTERIOR

5. Foundation

   Presence of hazardous conditions, including foundations with severe structural defects or that are penetrable by water, such that the structural safety of the building is threatened.

6. Walls and Exterior Surfaces (building exterior)

   Presence of hazardous conditions relating to the walls and exterior surfaces of the building, including severe leaning, buckling, or sagging; major holes or missing sections; or excessive cracking such that there is danger of structural collapse or of significant damage to the interior of the structure from the elements.

7. Roofs (chimneys, gutters, and downspouts)

   Presence of hazardous conditions on the roof, chimney, gutters, or downspouts of the building, including sagging or buckling, major holes, or missing sections, such that there is danger of collapse or of significant damage to the interior of the structure from the elements.

8. Stairs, Porches, and Railings

   Presence of hazardous conditions, including severe structural defects, broken or missing steps, or the absence of a handrail for six or more consecutive steps or the absence of railings around a porch that is 4 feet or more from the ground.

9. Windows

   Presence of hazardous conditions, including missing or broken window panes and heavily damaged or rotted sashes, such that there is severe weather damage to the interior of the unit, loss of heat, or threats to safety.

10. Doors and Hatchways

Presence of hazardous conditions, including missing or broken doors, such that severe weather damage to the interior of the unit, loss of heat, or threats to safety are created.

BUILDING AND UNIT INTERIOR

11. Exits

Presence of hazardous conditions, including no exit from the unit and fewer than two safe exits from the building leading to open space outside.

12. Sanitation and Storage

Presence of hazardous conditions, including significant accumulations of litter, trash, garbage, or other debris that may harbor insects, rodents, or other pests, that are combustible, or that hamper emergency entrance or exit. Also includes unsafe storage of flammable materials.

13. Walls

Presence of hazardous wall conditions (in the unit or in public spaces of the building), including severe buckling, major holes, or missing sections, or evidence of persistent moisture, dry rot, or insect damage such that there is a potential for structural collapse or other safety threats.

14. Ceiling

Presence of hazardous conditions, including severe buckling, sagging, major holes, or missing sections, or evidence of persistent moisture, dry rot, or insect damage such that there is a potential for structural collapse or other safety threats.

15. Floors

Presence of hazardous floor conditions in the unit or in public spaces in the building, including severe buckling, noticeable movement under stress of walking, major holes or missing sections, or evidence of persistent moisture, dry rot, or insect damage, such that there is a potential for structural collapse or other safety threats. Bathroom and kitchen floors must be of properly installed impervious materials so as to prevent water leakage

that would damage the structural system or create other safety threats.

16. Stairs and Railings

Presence of hazardous conditions in the stairs or railings in the unit or in public spaces in the building outside the unit, including severe structural defects, broken or missing steps, absence of a railing around open steps, or absence of a handrail for six or more consecutive steps.

17. Toilet and Bath Facilities

Presence of hazardous conditions, including severely damaged, broken, or cracked fixtures that endanger the users or that may result in leakage or flooding. Includes major leaks around toilet base.

18. Kitchen Facilities

Presence of hazardous conditions, including severely damaged or broken stove, sink, or refrigerator, that endanger the users or that may result in gas or water leakage, fire, or electrical shock.

19. Water Heater

Presence of hazardous conditions, including absence of a hot water heater or inadequate hot water, gas leakage, or danger of flooding. Appliance may not be hooked up, not functional, broken or damaged, making it inoperable; the vent pipe may be seriously cracked or broken, allowing unexpended gases to escape into the unit; there may be improper or no venting for exhaust gases; and a temperature pressure valve may be lacking. It may be tagged by the utility company as unsafe; partial or complete replacement may be necessary.

20. Plumbing System

Presence of hazardous conditions relating to the plumbing system (in the unit or in public areas in the building), including the absence of a plumbing system or any condition in which clean water and waste are not distributed effectively to and from all fixtures in the unit to a public system or other disposal mechanism; where there are major cracks or broken pipes, improperly sealed joints,

and other deficiencies that cause leakage and threats to health and safety.

21. Heating System

Presence of hazardous conditions in the heating system (in the unit or in the building), including absence of an acceptable primary source of heat or any breakage or damage to the source of heat, ducts, or fixtures such that heat is nonexistent or not adequately distributed to the unit or that there is a potential for fire or other threats to safety; vent pipe seriously cracked or broken allowing unexpended gases to escape into unit; portable electric room heaters serving as primary sources of heat; unvented room heaters that burn gas, oil, or other flammable liquids used as heating facilities.

22. Electrical System

Presence of hazardous conditions in the electrical system (in the unit, in public areas in the building, or in the exterior property area), including absence of an electrical system or exposed, noninsulated, or frayed wires; improper connections, insulation, or grounding of any component of the system; or the overloading of capacity such that there is the immediate hazard of electrocution or fire. Includes wires lying in or located near standing water or other unsafe places, electrical cable and equipment outside of the building, and all components of the electrical system within the unit.

Essential Facilities

KITCHEN FACILITIES

23. Ceiling Height

The ceiling of the room in which the kitchen facilities are located must be at least 6'6" high over at least 35 sq ft of room area.

24. Natural Light

There must be sufficient light in the kitchen, from either natural or artificial sources, to permit normal domestic activities.

25. Ventilation

    There must be at least one openable window or other device that provides ventilation for the kitchen.

26. Fixtures and Outlets

    The kitchen must have two separate, properly installed electrical convenience outlets or one electrical convenience outlet and one ceiling or wall electrical light fixture with a safe switching device.

27. Hot and Cold Sink

    The kitchen must contain a sink with hot and cold running water.

28. Cooking Range

    The kitchen must contain a working cooking range consisting of at least one burner and an oven.

29. Refrigerator

    The unit must have a working refrigerator.

BATHROOM FACILITIES

30. Ventilation

    There must be an operable window or a mechanical system to provide ventilation for the bathroom.

31. Fixtures and Outlets

    The bathroom must contain a properly installed electrical convenience outlet or one ceiling or wall light fixture with a safe switching device.

32. Heating

    The bathroom must have a permanent source of heat.

33. Flush Toilet

    The bathroom must contain a working flush toilet.

34. Hot and Cold Sink

    The bathroom must contain a working sink complete with hot and cold running water fixtures.

35. Hot and Cold Tub or Shower

    The bathroom must contain either a bathtub or shower with operating hot and cold running water fixtures.

36. Privacy

The toilet and bathtub or shower must have some form of enclosure to ensure privacy.

Occupancy

37. Unit Size

The definition of a habitable room is one that has:

- Seventy square feet or more of floor area.
- Ceiling height of at least 6'6" over at least 35 sq ft of floor area.
- Natural light, from at least one window facing directly outdoors or onto a sunporch, that is strong enough during daylight hours to permit normal domestic activities without artificial light.
- Adequate ventilation from at least one openable window or mechanical device.
- At least one properly installed and working electrical convenience outlet.
- Adequate heat from a source other than a portable electric heater.
- No special adaptations for use as a kitchen, bathroom, or utility room.

In addition, a bedroom must have rigid walls, secured in position from floor to ceiling, including a doorway with a door, curtain, or other screening device.

To pass the occupancy standard, there must be one bedroom for every two persons, except that seven or more persons require only four bedrooms. If three or more persons occupy the unit, there must be one habitable room in addition to the kitchen, bathroom, and bedrooms that serves as a general living area.

Lead-Based Paint

38. Lead-Based Paint Hazards (authorized January 1977)
The hazard is defined as cracking, scaling, chipping, peeling, or loose paint, which possibly contains dangerous amounts of lead and hence may endanger children under seven years of age who reside in or frequently visit the dwelling. This provision includes all interior surfaces and exterior stairs, decks, porches, railings, windows, and doors that are readily accessible to children.

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