U.S. Department of Housing and Urban Development
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Final Comprehensive Report of the Freestanding Housing Voucher Demonstration

Volume II: Appendices

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Appendix A

THE DEMONSTRATION SAMPLE

The sample of observations for the Demonstration consists of a sample of 20 PHAs and, within these PHAs, samples of Section 8 (Existing) Housing Program applicants randomly assigned to either the Housing Voucher or Housing Certificate program. This appendix describes the sampling procedures and the samples actually drawn.

A.1 The Sample of PHAs

The Demonstration sample of 20 PHAs consists of a probability sample of 18 larger urban PHAs, plus two statewide PHAs. The 18 larger urban PHAs comprise a stratified random sample of all larger urban PHAs. The two statewide PHAs were selected by HUD to provide some indication of program experience in smaller and/or less urban PHAs. (In addition, HUD is separately collecting information from a sample of 41 smaller urban and rural PHAs.)

The sample of 18 larger urban PHAs was drawn for HUD by Westat, Inc., from the universe of 106 non-statewide PHAs that were within the contiguous 48 states, had at least 1,000 authorized Section 8 Certificate Program slots in January 1984, and whose jurisdiction included an urban area with a population of at least 50,000.[1] Westat concluded that two of these PHAs--New York and Los Angeles--had such large Section 8 Certificate Programs that they should be included in the sample with certainty (that is, be included simply to represent themselves). The remaining 104 PHAs were then grouped into 28 strata formed by 7 regions and 4 size categories, as shown in Table A.1.

Since the remaining sample allowed for only 16 PHAs, Westat set marginal sampling targets for regions and size categories, and then drew a sample of PHAs to meet these marginal conditions. The marginal sample allocations are shown in Table A.1. The equal allocation by size categories reflected approximately equal numbers of units in each category (Dietz et al., p. 3-3). It was felt that a sample allocation across regions proportional to the number of Certificate slots in the region would lead to too great a concentration of sample in the West. Accordingly, in order to assure greater

[1]See Dietz et al., p. 3-1. HUD excluded, for administrative reasons, 6 of the 112 PHAs that met these criteria, leaving a total sample of 106.

TABLE A.1

STRATIFICATION OF NONCERTAINTY PHAs BY REGION AND SIZE TOGETHER WITH MARGINAL SAMPLING TARGETS

Region	PHA SIZE (Authorized Certificate Program Slots as of January, 1984)				Total Number of PHAs	Total Number of Certificate Slots (000s)	Allocated Sample
	4,000 to 8,000	2,700 to 4,000	1,700 to 2,700	Less Than 1,700			
New England	0	1	1	2	4	8.7	2
New York/New Jersey	1	0	2	3	6	14.2	1
Mideast	1	1	2	5	9	20.2	2
North Central	2	6	6	7	21	50.6	4
Southeast	0	2	3	11	16	28.5	2
South Central	2	2	3	6	13	30.6	2
West	5	7	11	12	35	84.4	3
Total Number of PHAs	11	19	28	46	104	237.2	
Allocated Sample	4	4	4	4	16	NA	16

Source: Dietz, et al., Tables 3-1 and 3-2.

regional variation, the sample targets by region were set to be less than the proportional-to-units allocation in the West and greater in the New England, Midwest, and North Central regions.

As described in Dietz et al., the sample of PHAs was drawn to satisfy the marginal conditions of Table A.1 using a method developed by Bryant, Hartley, and Jessen (1960). This resulted in the sample of PHAs listed in Table A.2.[1]

A.2 Properties of the Bryant/Hartley/Jessen Procedure

Following the original paper by Bryant et al., we summarize the properties of the Bryant/Hartley/Jessen (BHJ) procedure for a case in which we draw a single stage sample of individuals. Within this context, Bryant et al. provide the following facts concerning their procedure.

1. There is an unbiased estimate of the population mean, $\hat{y}_u$, provided by:

$$\hat{y}_u = \frac{1}{n} \sum_{r,j} \frac{P_{rj}}{\Pi_{rj}} (\bar{y}_{rj} n_{rj}) \tag{1}$$

where

$\hat{y}_u$ = Unbiased estimator of population mean

n = Sample size

P_{rj} = The proportion of the population in the $(r,j)^{th}$ stratum

Π_{rj} = The expected proportion of the sample in the $(r,j)^{th}$ stratum

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[1] Two details of the procedure followed may be mentioned. First, Westat used the special methods suggested by Bryant et al. (pp. 121ff.) for cases where the proportion of the population falling into any stratum (in this case measured by the Certificate Program units of PHAs in a stratum) is substantially different from the proportion of the sample that would be expected to fall in that stratum based on the sample targets for the strata marginals. This procedure also, as it happened, excluded one stratum--the smallest size category in the West--from the sample. Following Westat's suggestion, we have assumed that this stratum is represented by the other strata in that region.

Second, of the 18 urban PHAs sampled only one declined to participate. This PHA was replaced with a back-up candidate selected by Westat.

TABLE A.2

SAMPLE OF PHAs

PHA	Region	Authorized Certificate Slots in January 1984	Probability of Selection
New York City, NY	NY/NJ	38,595	1.000
Los Angeles, CA	W	17,505	1.000
Cuyahoga County (Cleveland), OH	NC	5,135	0.600
Houston, TX	SC	5,504	0.600
San Antonio, TX	SC	5,720	0.600
Oakland, CA	W	4,072	0.185
Boston, MA	NE	3,990	0.808
Metro Council (Minneapolis), MN	NC	3,162	0.200
Atlanta, GA	SE	3,723	0.200
San Diego, CA	W	3,065	0.107
Pittsburgh, PA	ME	2,035	0.225
Omaha, NE	NC	1,898	0.143
Dayton, OH	NC	1,278	0.143
Seattle, WA	W	2,116	0.073
New Haven, CT	NE	1,383	0.327
Erie (Buffalo), NY	NY/NJ	1,061	0.074
Montgomery County, MD	ME	1,495	0.132
Pinellas County (St. Petersburg), FL	SE	1,402	0.074
New Jersey	N/A	N/A	N/A
Michigan	N/A	N/A	N/A

Source: Dietz, et al., Table 3-3.

$\bar{y}_{rj}$ = The sample mean for the r,j^{th} stratum

n_{rj} = The sample size in the r,j^{th} stratum.

2. Bryant et al. also present a biased estimator:

(2) $$\hat{y}_B = \frac{1}{n} \sum_{r,j} n_{rj}\bar{y}_{rj} .$$

3. In the special situation in which

(3) $$P_{rj} = (P_{r\cdot})(P_{\cdot j})$$

and in which without rounding

(4) $$\frac{n_{r\cdot}}{n} = P_{r\cdot} \; ; \; \frac{n_{\cdot j}}{n} = P_{\cdot j}$$

where $n_{r\cdot}$ and $n_{\cdot j}$ are integer marginal sample targets, then

(5) $$\Pi_{rj} = P_{rj}$$

(6) $$\hat{y}_B = \hat{y}_u$$

and the BHJ procedure will usually have a lower variance than a procedure that allocates a non-zero sample of the same total size to every stratum (with fewer strata). The relative efficiency in other situations is not known.

4. If true cell means are additive, so that

(7) $$\mu_{rj} = \mu_{r\cdot} + \mu_{\cdot j} - \mu$$

and if the factoring condition of Eq (3) is not met, but the non-rounding condition of Eq (4) is met, then $\hat{y}_B$ is unbiased and has a lower variance than $\hat{y}_u$.[1]

5. Under certain conditions, the sample will provide unbiased estimates of $Var(\hat{y}_u)$ and $Var(\hat{y}_B)$. These conditions were not met in this case.[2]

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[1]Bryant et al., p. 120. Actually Bryant et al. maintain that $\hat{y}_B$ may be biased under these circumstances. However, they give the bias as:

$$\text{(i)} \qquad B = \sum \sum \left[\frac{(n_{r\cdot})(n_{\cdot j})}{n^2} - P_{rj}\right] \mu_{rj}.$$

If

$$\text{(ii)} \qquad \mu_{rj} = \mu_{r\cdot} + \mu_{\cdot j} - \mu$$

then recalling that by the non-rounding assumption of Eq. (4),

$$\text{(iii)} \qquad \sum_r n_{r\cdot} = \sum_j n_{\cdot j} = n$$

$$\text{(individual)} \ \sum_i P_{rj} = P_{r\cdot} = \frac{n_{r\cdot}}{n}; \ \sum_j P_{rj} = P_{\cdot j} = \frac{n_{\cdot j}}{n}$$

we have

$$B = \sum_r \frac{n_{r\cdot}}{n}\mu_{r\cdot} + \sum_j \left(\frac{n_{\cdot j}}{n}\right)\mu_{\cdot j} - \mu - \sum_r P_{r\cdot}\mu_r - \sum_j P_{\cdot j}\mu_j + \mu = 0$$

[2]In cases where some P_{rj} are very different from $(P_{r\cdot})(P_{\cdot j})$, Bryant et al. suggest a procedure to reduce variance. This procedure, which was followed by Westat, can (and in this case did) create a situation in which the variance cannot be directly estimated from the sample.

Accordingly, in approaching the sample of PHAs, we have a choice between a definitely unbiased and potentially biased estimator, and have in either case no unbiased estimate of the variance of estimate. (Asymptotic methods such as bootstrap estimation are, of course, available.) As discussed in more detail in Appendix B, our approach was to adopt yet another estimator and rely on a likely upper bound estimate of the variance. The estimator we adopted would, in the present context, be equivalent to the $\hat{y}_u$ of Eq (1) except that the weights $(P_{rj}n_{rj}/n\Pi_{rj})$ would be normalized so that they always sum to one within the sample (as well as in expectation). If strata means are not correlated with strata weights, normalizing the weights will result in unbiased estimates with lower variance.

In terms of estimating the variance, we used the variance under a simple alternative one-way stratification as an upper bound estimate. As indicated above, the results of Bryant et al. do not allow us to be sure that the BHJ procedure has a smaller variance than a one-way stratification unless strata population proportions are closely approximated by expected strata sample sizes. Dietz et al. do not provide information on this point. However, as discussed in Appendix C, it seems reasonable to use the one-way stratified variance as an upper bound in this case, especially since for key measures inter-PHA variation was expected to be quite small.

A.3 Sampling Households

PHAs selected for the Demonstration were allocated Housing Voucher Program funds. Funding levels for the individual PHAs were set by HUD to support sample sizes that would offset differences in the probability of PHA selection and create approximately self-weighting observations at the individual level (subject to a minimum prospective sample of 100 Housing Voucher slots in each Demonstration PHA). The actual number of Housing Vouchers funded was determined by each Demonstration PHA's estimation of the number of Housing Vouchers that could be supported with these funds, given expected five-year program subsidy costs.

The putative Housing Voucher slots were allocated by bedroom size. These allocations generally followed the PHA's then-current allocation of Certificate units, with some additional slots allocated to larger unit sizes. These are shown in Table A.3. As indicated there, in cases where PHAs had adopted an apparently permanent policy of not issuing Certificates to some

TABLE A.3

DISTRIBUTION OF SECTION 8 UNITS IN URBAN SAMPLE AT THE START OF THE DEMONSTRATION[a]

	Bedroom Size					
Site	0	1	2	3	4 or more	Total
Atlanta	0	497	2,457	552	215	3,721
Boston	0 (31)	0 (623)	1,823 (1,158)	1,589 (1,323)	523 (435)	3,935
Cleveland	33	1,398	2,367	1,222	164	5,184
Dayton	0	134	704	351	89	1,278
Buffalo	0 (4)	383 (382)	456 (454)	171 (170)	31 (31)	1,041
Houston	567	1,648	1,962	984	343	5,504
Los Angeles	1,141	8,433	5,855	1,480	290	17,199
Minnesota	0	741	1,928	452	41	3,162
Montgomery	80	228	541	414	109	1,372
New Haven	90	322	590	408	116	1,526
New York City	4,766	19,804	11,851	4,939	671	42,031
Oakland	1,243	181	1,560	852	236	4,072
Omaha	75	651	726	343	35	1,830
Pinellas	69	488	660	168	20	1,405
Pittsburgh	0 (90)	512 (489)	969 (916)	430 (411)	98 (93)	1,999
San Antonio	101	1,179	2,226	1,496	649	5,633
San Diego	0 (50)	1,555 (1,530)	1,154 (1,135)	275 (270)	81 (80)	3,065
Settle	0 (195)	753 (684)	826 (750)	430 (390)	105 (95)	2,114

[a]Where sites were no longer issuing Certificates in the same bedroom size category, these categories are set equal to zero and the current units in these categories allocated proportionately to other bedroom sizes. Actual current numbers are shown in parentheses.

bedroom size, the allocation for this size was set to zero even if the PHA had some recipients in these bedroom sizes from issuances prior to the current policy. In addition, the actual sample targets set for PHAs also tended, where possible, to allocate a greater than proportional number of sample slots to larger or smaller than average bedroom sizes in order to improve precision for these groups.

The Demonstration Housing Voucher slots were matched by an equal number of Certificate Program slots funded from the PHA's regular Certificate Program funds. These were called flagged Certificates to distinguish them from the rest of the PHA's Certificate Program.

The sample of Demonstration households was then drawn from the regular flow of program applicants. Each Demonstration PHA normally accepted applications for the Section 8 Existing Housing Program at various intervals. Some took applications each day; others once in several years. In any case, applicants were generally placed in a pool, rank-ordered by some combination of date of application, randomly assigned numbers, and/or priority group. Normally, as Certificate Program slots for a particular bedroom size became available, applicants of appropriate household size would be selected from the pool in order, verified eligible, and issued a Certificate. They would then have some number of months in which to find a unit that met program requirements. If they succeeded, they would become recipients. If not, their Certificate would be reissued to another family.

The only modification to this process required for the Demonstration was that instead of all selected applicants being issued Certificates, they were randomly issued either a Housing Voucher or a Housing Certificate, depending on whether the last digit of the applicant's social security number was odd or even. This continued until all of the Housing Voucher or flagged Certificate slots in each bedroom size category had been filled. Once the Demonstration slots in any bedroom size/program category were filled, the succeeding applicants were issued regular Certificates. If a Demonstration Housing Voucher or flagged Certificate recipient terminated, then the next applicant in that bedroom size category (with the appropriate social security number parity) would be issued a Demonstration Housing Voucher or flagged Certificate, respectively.[1]

Not all those issued Housing Vouchers or Certificates became recipients. In order to speed the enrollment process, PHAs issued more Housing Vouchers or Certificates than there were slots to fill. We were, however, still able to associate each Housing Voucher or Certificate holder with a particular slot. Issuances of Housing Vouchers and flagged Certificates were grouped by program, PHA, and bedroom size category and then within each program/PHA/bedroom size cell were ordered by date of issuance and, for issuances in the same day, by slot number.[2] This provided us with a sequential list of all issuances. Some of these expired; others became recipients. The issuances associated with filling the k^{th} recipient slot (in a given program/PHA/bedroom size category) are all issuances between the $(k-1)^{st}$ and k^{th} recipient on the list (including the k^{th} recipient). Similarly, repeating the process using only issuances to a specific demographic group will identify the issuances to that demographic group associated with filling the k^{th} recipient slot of that group. This sequencing in effect allows us to duplicate the process that would have occurred had PHAs in fact issued Certificates and Housing Vouchers for each slot one at a time until they had filled all the available program slots.

The first Demonstration PHA, in San Antonio, began issuing Housing Vouchers and flagged Certificates in April 1985; the last Demonstration PHA began issuing in February 1986. The bulk of the PHAs started Demonstration operations in either June/July or September/October of 1985. Housing Vouchers and/or flagged Certificates continued to be issued as recipients terminated

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[1]As we expected with 20 sites, we had one PHA in which there was a very long run of even social security numbers. The problem this posed at the PHA is that its rules would not allow it to skip ahead on the waiting list and issue for the other program. In order to maintain a calendar balance between the two programs, the current list of applicants was randomly assigned to the two programs by Abt Associates. The PHA issued Housing Vouchers and flagged Certificates according to the randomly assigned list and then returned to the even/odd rule when the list was exhausted.

[2]PHAs issued new Housing Vouchers or flagged Certificates sequentially, using the available slot with the lowest identification number first.

and openings became available. Data collection on issuances and recipients continued to September 15,1988.[1]

A.4 Samples Used in the Analysis

The analyses in this report are based on the sample of two statewide PHAs and 17 of the 18 urban PHAs. Due to past overissuance, one urban PHA, Houston, turned out to have very few Certificate slots available for new issuances. This materially slowed the implementation of the Demonstration in Houston and radically skewed the bedroom size distribution of issuances. As a result Houston was dropped from the analytic sample. Fortunately, both Houston and San Antonio were drawn from the same sampling stratum. Accordingly, we were able to develop national estimates by assigning Houston's weight to San Antonio.

The households available for this analysis consisted of all households issued Housing Vouchers or flagged Certificates prior to April 1, 1987. This cut-off date was necessary to assure that we had full information on outcomes for all issuances in the sample. Table A.4 shows the number of applicants and recipients in the basic analytic sample.

Two other special samples were also defined. First, for some purposes it was interesting to compare program outcomes for recipients who faced the same basic payment schedule in both programs. At the start of the Demonstration the Housing Voucher payment standard was set equal to the Certificate FMRs. As FMRs were changed, PHAs could decide whether or not to adjust their payment standards as well. In some cases, PHAs adjusted payment standards with FMRs, in others they adjusted them later, in still others they adjusted them less or not at all. This created three groups of recipients in terms of payment parity, as shown in Table A.5.

Second, we were interested in comparing the experiences of recipients in the two programs. For this purpose we selected all recipients who entered the program early enough to have an annual recertification if they did not terminate. We keyed our data to the annual recertification since this is the

[1] In the fall of 1987 the data collection process shifted from monthly reports on issuances, new recipients, and changes in recipient status, payments, income, or address to summary reports on each issuance or recipient, which were submitted at termination or the close of data collection in September 1988.

TABLE A.4

ANALYTIC SAMPLES
(URBAN AND STATEWIDE PHAs)[a]

	Housing Voucher Program	Housing Certificate Program	Total
URBAN PHAs			
Issuances	5,706	5,747	11,453
Recipients	3,577	3,406	6,983
STATEWIDE PHAs			
Issuances	444	445	889
Recipients	272	270	542
TOTAL			
Issuances	6,150	6,192	12,342
Recipients	3,849	3,676	7,525

[a]Excluding Houston.

TABLE A.5

ANALYTIC SAMPLE BY PAYMENT PARITY

(URBAN PHAs)[a]

	Housing Voucher Program	Housing Certificate Program	Total	Percent of Total
INITIAL PAYMENT SCHEDULE				
Issuances	2,897	3,208	6,105	53%
Recipients	1,691	1,972	3,663	52
REVISED SCHEDULE, BUT THE SAME IN BOTH PROGRAMS				
Issuances	1,930	1,720	3,650	32
Recipients	1,023	859	1,882	27
DIFFERENT SCHEDULE IN BOTH PROGRAMS				
Issuances	879	819	1,698	15
Recipients	863	575	1,438	21

[a]Excluding Houston.

point at which changes are recorded, although the actual time periods involved may not be exactly 12 months. The sample size for this group (including terminees before annual recertification) is shown in Table A.6.

A.5 The Housing Evaluation Sample

Housing evaluations were conducted by Research Triangle Institute (RTI) for samples of recipients in ten PHAs. This section briefly describes how these housing evaluation samples were selected.[1]

A.5.1 Selecting PHAs for Housing Evaluations

One major use of the housing evaluations was in regression estimation of rents as a function of unit characteristics (hedonic indices). Since these estimates should ideally be developed separately by site, it was decided that each PHA included in the evaluation sample should have at least roughly 100 recipient evaluations in each program. Given the total sample size of about 2,000 evaluations, 10 PHAs could be selected. Unfortunately, due to the small samples allocated to some PHAs and variations in PHA startup, five of the eighteen urban PHAs did not have even 100 recipients in each program when housing evaluations were conducted. We selected the 10 housing evaluation sites purposively and then developed national projections by assigning the weights of unincluded sites to the housing evaluation sites that seemed to be closest in character. We do not pretend that this is a rigorous procedure--none is available in this situation--but we do believe that it yields useful overall summary statistics, at least when combined with careful assessment of the extent to which results appear to vary across PHAs. Table A.7 shows the 10 PHAs selected for the housing evaluation sample and the weights allocated to each sampled PHA.

We then took the list of all households that were recipients as of June 1987 in each PHA included in the housing evaluation sample. These were then divided into the four groups defined by the two programs and by whether or not the household had moved from its pre-program address. Recipients within each group were randomly ordered and the first 50 selected for evaluation. In cases where there were not enough movers or stayers in a program to

[1]For a more detailed description see Leger and Kennedy (1988).

TABLE A.6

SAMPLE OF ONE-YEAR RECIPIENTS[a]

	Housing Voucher Program	Housing Certificate Program	Total
Urban PHAs	2,028	1,873	3,901
Statewide PHAs	211	203	414
All PHAs	2,239	2,076	4,315

[a]Includes terminated recipients whose annual recertification would have been observed if they had not terminated.

TABLE A.7

PHAs SELECTED FOR THE HOUSING EVALUATION SAMPLE

Sample Site Included in Housing Evaluation Sample	Deemed to Represent The Following Sites in The Sample	Weight Number	Weight Percent
Atlanta	Atlanta, Pinellas	38K	13.3%
Los Angeles	Los Angeles and San Diego	47K	16.3%
Minneapolis	Minneapolis, Cleveland	25K	8.6%
Montgomery County	Montgomery County, plus ½ of (Boston, New Haven, and Buffalo)	22K	8.2%
New York City	New York City	39K	13.7%
Oakland	Oakland	22K	7.8%
Omaha	Omaha, Dayton	22K	7.9%
Pittsburgh	Pittsburgh, plus ½ of (Boston, New Haven, and Buffalo)	20K	7.3%
San Antonio	San Antonio, Houston	19K	6.6%
Seattle	Seattle	29K	10.3%

provide 50 cases, the unused sample was allocated to the other mover/stayer stratum within the same PHA and program.

The final samples are shown in Table A.8. As shown there, 1,998 recipients were assigned for evaluation. Of these, 134 had terminated from the program and so were dropped from the sample. Of the remaining 1,864 cases, 95 percent, or 1,770, were completed by RTI. The 94 cases remaining in the sample were not completed for any of a variety of reasons--in most (64) cases because the program recipient refused to allow the evaluation.

TABLE A.8

HOUSING EVALUATION SAMPLE SIZES

BY PHA

Site	No. Cases Assigned	No. Cases Ineligible	No. Cases Eligible	No. Cases Completed	Response Rate
Atlanta	199	27	172	166	95.5%
Los Angeles	200	17	183	177	96.7
Minneapolis	200	17	183	169	92.3
Montgomery Co., MD	200	10	190	182	95.8
New York City	200	5	195	176	90.3
Oakland	200	5	195	179	91.8
Omaha	200	9	191	182	95.3
Pittsburgh	199	21	178	170	95.5
San Antonio	200	9	191	191	100.0
Seattle	200	14	186	178	95.7
TOTAL	1,998	134	1,864	1,770	95.0%

APPENDIX B

DATA SOURCES, DATA BASES, AND DEFINITIONS

This appendix presents an overview of the data collection, data preparation, and data bases used in the preparation of this report. The Housing Voucher Demonstration research forms completed and submitted by PHAs are the major source of data. The forms, the processing of the forms, and basic variables collected in the forms are described in Section B.1. Secondary data, such as poverty thresholds and vacancy rates, were obtained from Census and HUD regional offices. The data were processed and organized in two analytic data bases: the Initial Data Base and the First Year Data Base. The structure and content of these data bases is presented in Section B.2. Section B.3 and B.4 describe the error resolution and derivation procedures for key analytic variables. Section B.5 addresses the issue of changes in Payment Standards and FMRs.

B.1 Data Collection Overview

The overall data collection system for the Housing Voucher Program was designed to mesh with the PHA's regular operating procedures and to rely on PHA operating data as much as possible. As shown in Figure B.1, the majority of the items included in the research data collection forms could be transcribed from PHA documents. The major exception was an interview which PHA members conducted with selected applicants before issuance to obtain information on the family's pre-program unit. These data are not collected routinely by PHAs.

All PHAs were trained to complete the research forms in the Spring of 1985. Actual data collection started in April 1985 in San Antonio. Other PHAs started to submit the research forms from the time they started issuing Certificates and Housing Vouchers until February 1988. At that time, the system was simplified to include only key variables. The pre-program interview, for example, was no longer conducted. Data collection ended in September 1988.

FIGURE B.1

SUMMARY OF DATA COLLECTION

FORM	WHEN	BY WHOM	SOURCE OF INFORMATION	COPY OF HUD FORM REQUIRED
Pre-Program Information Form				
Part I	When the Certificate/Housing Voucher is issued	PHA staff	HUD-50059, Worksheets, Application/Pre-Application Form/Waiting List, Assistance Standard Schedule	Certificate of Participation (HUD-52518), or Housing Voucher (HUD-52646)
Part II	When the Certificate/Housing Voucher is issued	PHA staff	Interview with Certificate/Housing Voucher holder	None
Housing Search Log and Recipient Status Form				
Part I	As services are provided, from the date Certificate/Housing Voucher is issued to the date of HAP/Housing Voucher Contract or date of Certificate/Housing Voucher expiration or surrender	Staff providing services		None
Part II	When unit is submitted for approval and/or inspection is conducted	Staff member	PHA records (Request for Lease Approval, Inspection Log, Inspection Form, Inspection Summary)	None
Part III	When HAP/Housing Voucher Contract is signed or when Certificate/Housing Voucher expires or is surrendered	Staff member	Certificate/Housing Voucher Inspection Form, Inspection Summary	None
Part IV	(SUCCESSFUL FAMILIES ONLY) When HAP/Housing Voucher Contract is signed	Staff member	HUD-50059 HAP/Housing Voucher Contract Lease Lease Addendum	Request for Lease Approval (HUD-52517A)
Part V	(UNSUCCESSFUL FAMILIES ONLY) When Certificate/Housing Voucher expires or is surrendered	Staff member	Family Service Record Contact with Family	None

FIGURE B.1
(continued)

SUMMARY OF DATA COLLECTION (continued)

FORM	WHEN	BY WHOM	SOURCE OF INFORMATION	COPY OF HUD FORM REQUIRED
Continued Participation and Status Change Form				
Part I	As services are provided, from date HAP/Housing Voucher Contract is signed to next event requiring submission of form (first time). Thereafter, for the period between submissions (most often one year)	Staff providing services	None	None
Part II	At time of Annual Certification or Interim Recertification, as applicable	Staff member	HUD-50059, or other Recertification document, Worksheets	None
Part III	(FAMILIES ATTEMPTING TO RELOCATE ONLY) When Family is required to or indicates its intention to move to a new unit	Staff member	(Lease, Inspection Log) Contact with Family or Owner, Family Service Record	None
Part IV	(FAMILIES ATTEMPTING TO RELOCATE ONLY) As new units are submitted for approval and/or inspection is conducted	Staff member	Request for Lease Approval, Inspection Log, Inspection Form, Inspection Summary	None
Part V	(FAMILIES ATTEMPTING TO RELOCATE ONLY) When Family has found a new acceptable unit (HAP/Housing Voucher Contract signed) or when Certificate/Housing Voucher expires or is surrendered	Staff member	Certificate/Housing Voucher, Inspection Form, Inspection Summary	None
Part VI	At time of Annual/Interim Recertification, at time rent/utility adjustment is required by Owner.	Staff member	HUD-50059, HAP/Housing Voucher Contract, Lease, Lease Addendum Payment Ledger	None
	When a HAP/Housing Voucher Contract is signed for a new unit (MOVERS)			Request for Lease Approval (HUD-52517A)
Part VII	(TERMINATED FAMILIES ONLY) When new Certificate/Housing Voucher expires or is surrendered. When a Family that has been receiving assistance is terminated	Staff member	Contact with Family and/or Owner, Payment Ledger, Family Service Record	None

B.1.1 Housing Demonstration Research Forms

Data from three research forms submitted by Demonstration PHAs from April 1985 through September 1987 were used in this report--the Pre-Program Information Form (PPIF), the Housing Search Log (HSL), and the Continued Participation Form (CPF).

The Pre-Program Information Form (PPIF) is used to collect detailed information on the characteristics and housing conditions of families before they were enrolled in the Certificate or Housing Voucher Programs. It is completed by PHA staff, in a face-to-face interview with a representative of the applicant household as part of the Section 8 enrollment process. The interview is held before the applicant has been briefed as to which program they will be enrolled in.

The Housing Search Log (HSL) is used to track the family through the housing search process. The HSL is completed when a family is successful in finding a unit or when the Certificate/Housing Voucher expires or is surrendered. The HSL reflects PHA contacts with applicants or landlords and services provided on behalf of the applicant during the search process. It also lists information on units submitted by the family for approval, the results of inspections and whether the Certificate/Housing Voucher holder eventually became a recipient. For recipients, it provides data on rent, utility allowance, security deposit, and amount of the assistance payments. For unsuccessful applicants, PHAs report the expiration date and the reason for expiration or surrender.

The Continued Participation Form (CPF) is used to track the recipient family after a successful housing search. Given no intervening changes in family circumstances, income or other factors have occurred, a recipient family is followed up on a CPF one year after the contract has been signed. There are five instances in which Abt Associates would receive a CPF: (a) annually, (b) interim, when a recipient's income or family circumstances change and they report these to the PHA, (c) when a recipient moves to a new unit, (d) when utilities have been adjusted, or (e) when a recipient terminates from the program.

B.1.2 Processing, Cleaning and Tracking

Completed forms were sent to Abt Associates by the PHAs. The forms were immediately logged into a monitoring system, which was used to provide a master list for the data base and to track the timely receipt of forms once a Certificate/Housing Voucher had been issued. In particular, PHAs were sent monthly lists of households that had been issued a Housing Voucher or Certificate and for which various subsequent forms had not been received on schedule. Forms were then entered and examined for missing, out-of-range, or internally inconsistent values. An error listing identifying problem cases was prepared once a month and sent to the PHAs for resolution. Cleared forms were accumulated in separate files.

Periodically cases with completed PPIFs and HSLs were merged. This permitted further data cleaning based on comparison of information across the two forms. In particular, payments and recipient rent information from the HSL were compared with income and household size information in the PPIF to assure that they were consistent. Inconsistencies were sent to the PHA for resolution or reviewed with staff members during site visits. The procedures to resolve inconsistencies are described in greater detail in Section B.3 below.

The data cleaning system generally worked quite well, with one exception--cases in which cleaning issues were raised by examination of merged data bases. These tended to generate relatively large lists of cases for checking at a few discrete intervals as compared with the steady flow from the monthly checks of incoming forms. Further, it proved to be relatively difficult for PHA staff to determine the income, rent, or whatever that was in effect on some prior date as opposed to the current values for a case. In retrospect it would have been better for us and for the PHAs if we had added some redundant items to the various forms to allow all key cleaning checks to be made as the forms were submitted instead of when their information was merged with information from other forms.

B.1.3 Basic Variables Used In This Report

The definitions of the basic variables used in this report are listed below alphabetically. As indicated below, some derived variables are explained at greater length in Section B.4.

Bedroom Size is obtained from the Section 8 Certificate of Participation or Housing Voucher submitted by the PHA with the PPIF at the time of issuance. It is the number of bedrooms for which the family is eligible according to the PHA occupancy requirements, at the time of issuance. The variable is updated at the time the family becomes a recipient if the family circumstances have changed. (Cf. household size.)

Birthdate is the birthdate of the head of household. It is entered as MM/DD/YY and is used to create an age variable.

Budding Ratio is a measure of rent burden reflecting the rental allowance implicit in the poverty index (see Section B.4.2).

Disabled or Handicapped. A household head is classified by the PHA as disabled or handicapped if he/she meets the definition in Section 223 of the Social Security Act (42 USC 423) or in Section 102 of the Development Disabilities Services Facilities Construction Amendments of 1970 (42 USC 2691[1]).

Elderly. A household is classified as elderly, following HUD regulations, if the head of household is 62 years of age or older.

Intention to Move is based on answers to a question asked as part of the Pre-Program Interview. It indicates whether the family would rather stay or move if given a choice by the PHA. Families without definite preferences were coded as "don't know."

Household Composition characterizes the applicant family using selected variables such as elderly status, number of adults and the unit size for which the family qualifies. The specific categories used were:

1. One-person household, elderly
2. One-person household, handicapped
3. Others eligible for zero or one-bedroom units
4. Eligible for two bedrooms, only one adult
5. Eligible for two bedrooms, more than one adult
6. Eligible for more than two bedrooms, only one adult
7. Eligible for more than two bedrooms, more than one adult

Household Size is the number of household members for whom a subsidy is being requested. Household size is not always equal to the number of individuals residing in the family's house/apartment when the Certificate/Housing Voucher is issued, which may include attendants, foster children, and other individuals who are not related to the head of the household. Household size also counts individuals who are temporarily absent and plan to return. (Cf. Bedroom Size.)

Housing Adequacy is an index of housing deficiencies based on applicant answer during the PPIF (see Section B.4.3).

Income Data are first reported on the PPIF and reflect the family financial situation at the time of issuance. Any change of income that occurs after issuance but before the family becomes a recipient is reported by the PHA on the HSL. The most recent information from the HSL or the PPIF, as appropriate, is used in defining income for the analysis of initial outcomes. Income data are subsequently reported on the CPF at annual recertification or when a change is reported by the family.

Total income is defined as the sum of:

- Salary (the total dollar amount of wages, salaries, tips, commissions, and other earned income, as projected for the next year to determine eligibility)
- Social Security (the dollar amount of Social Security benefits, veterans pensions, military retirement, and income from other pensions/ annuities, etc, as projected for the next year to determine eligibility)
- Welfare (the total amount received from Aid to Families with Dependent Children (AFDC), General Assistance, Supplementary Security Income, or Tribal Welfare, as projected for the next year to determine eligibility)
- Assets (total income from assets in terms of interest, dividends, rent and other income from net assets, as projected for the next year to determine eligibility)
- Other Income (the sum of all other income, including alimony, child support payments, educational benefits used for subsistence, earned income tax credit, unemployment compensation, and net income from operation of business, as projected for the next year to determine eligibility).
- Deductions (total deductions, which include $480 for each minor--excluding head of spouse; medical expenses in excess of three percent of annual income; cost of allowable child care and allowable care attendent/apparatus for handicapped or disabled; and $400 for households headed by elderly, handicapped, or disabled.)

- Total Income: Family total income before deductions.
- Net Income: Family adjusted income after deductions.

Total income is the sum of the income components, and net income is obtained by subtracting deductions from total income. In some cases, however, total income and net income were modified to correct reporting errors. (See discussion in Section B.3.1 below.)

Payment Amount is the total payment made by the PHA, including both the payment to the landlord and any reimbursement paid to the recipient for utilities.

Payment Standard/FMR is the dollar amount of the Payment Standard applicable to a Housing Voucher holder when the Housing Voucher is issued or the Fair Market Rent (FMR) applicable to a Certificate holder when the Certificate is issued. At the beginning of the Demonstration the Payment Standard equaled the FMR schedule. Later the two schedules diverged, as discussed in Section B.5, below. The amount of the Payment Standard for a family is determined by the Schedule in effect and the Unit Size for which the family is eligible. Payment Standard and FMR may change after issuance, if the family reports a change in family circumstances or if the Payment Standard or FMR schedules changed. Updated Payment Standards or FMRs are reported on the HSL or the CPF as appropriate.

Pre-Program Contract Rent Paid by the Applicant Household is the monthly dollar amount the family pays for rent. It does not include the cost of utilities if they are paid separately. See Section B.4.1 for a discussion of pre-program gross rent. (Cf. Total Contract Rent.)

Pre-Program Gross Rent is an estimate of the monthly gross rent paid by the enrollee for his or her pre-program unit (Section B.4.1.)

Recipient Contract Rent is the total monthly dollar amount paid to the landlord or owner for rent. Contract rent does not include the cost of utilities paid by the tenant.

Recipient Gross Rent is the sum of contract rent and any utility allowance.

Rent Burden is the ratio of pre-program gross rent or tenant contribution to monthly net income (see Section B.4.2).

Subunit. A household is categorized as a subunit if it shares its pre-program unit with another family (parents, friends, relatives).

Tenant Contribution is the amount paid by a recipient for housing from his or her own pocket, including allowances for scheduled utilities not included in the rent (see Section B.4.6).

Total Contract Rent Paid for the Applicant's Pre-Program Unit is the total rent paid to the landlord. It does not include the cost of utilities if they are paid separately. It includes any amount paid regularly by the applicant household, by others sharing the same unit, or by a friend, government agency, church or other organization toward rent. (Cf. Pre-Program Contract Rent.)

Utility Allowance is the scheduled allowance for utilities that are directly paid by the tenant and not included in the contract rent. It is used by the PHA in calculating Gross Rent and is not the actual cost of utilities incurred by the family. It is drawn from a site-specific utility schedule which reflects utility costs in the PHA jurisdiction.

B.2 Data Base Construction

Two data bases were created to conduct the analysis presented in this report:

- The Initial Data Base, which includes data from the PPIF and HSL forms for 12,342 applicant families
- The First Year Data Base, which includes data from Continued Participation forms for 4,315 recipient families that were recertified by the Fall of 1987 or would have been recertified if they had not terminated from the Demonstration Program.

Initial Data Base

The Initial Data Base describes the experience of families issued a Certificate or Housing Voucher by March 31, 1987. It is used to analyze success rates and program effects on families when they first become recipients. The data base includes one record for each family. The variables are drawn from the Pre-Program Information Form and the Housing Search Log. Data from the Housing Search Log include program unit information for recipients (contract date, rent, and subsidy) and reason for expiration for families that did not become recipients. The basic sample and the number of cases included in the analysis are shown in Table B.1. Overall, 80 cases, or less than 1 percent of the cases issued by March 31, 1987, were missing one of the two forms and could not be included in the analysis. Table B.2 presents the number of cases by site.

First Year Data Base

The First Year Data Base includes data from the Continued Participation Form. Each recipient who had been in the program for at least one year by the Fall of 1987 is included in the First Year Data Base sample. Cases in the sample are included in the analysis if a Continued Participation Form (CPF) recording either an annual recertification or a termination was received. PHAs were required to submit a Continued Participation Form report on annual recertification within 14 months of the initial contract date. In principle, the annual recertification was performed on the anniversary date of the contract; the two additional months were added to allow PHAs to complete all paperwork, including verification and contract renewal, before submitting the form. If a family terminated from the program, the PHA was required to submit a CPF to report the termination. An initial contract date of July 14, 1986 was initially selected for all PHAs as a cutoff date for inclusion of a recipient in the First Year Data Base. These families had an anniversary date of July 14, 1987 so that their Continued Participation Form should have been received by September 14, 1987, the planned cutoff date for data collection, and be ready for inclusion in the data base by November 1987.

In fact, the receipt date had to be extended until the end of the year as several PHAs were late in performing scheduled annual recertifications and therefore in submitting the Continued Participation Forms. As a result of the extension of the data receipt, we were able to include annual recertifications scheduled as late as October 15, 1987 in three PHAs. The cutoff dates used for the analysis are shown in Table B.1, as well as the number of cases in the sample and the number of cases with missing data. Overall, five percent of cases were omitted from the analysis for missing data. The percent of the sample with missing CPF forms ranges from zero or one percent in 10 PHAs to 31 and 42 percent respectively in 2 PHAs. Table B.3 presents the number of annual recertifications and Terminations by site.

TABLE B.1

SAMPLES USED IN THE ANALYSIS[a]

		Number of Cases In the Sample		Percent of Cases with Missing Forms[a]		Number of Cases In Sample with Complete Data	
	Number of PHAs	Housing Voucher	Housing Certif.	Housing Voucher	Housing Certif.	Housing Voucher	Housing Certif.
INITIAL INTAKE ANALYSIS							
All families issued Housing Vouchers or Certificates before April 1, 1987	19	6,187	6,235	*	*	6,150	6,192
All recipient families issued Housing Vouchers or Certificates before April 1, 1986	19	NA[b]	NA[b]	NA[b]	NA[b]	3,849	3,676
FIRST YEAR ANALYSIS							
All recipient families issued Housing Vouchers or Certificates before April 1, 1987 with an annual recertification scheduled before:							
July 15, 1987	13	1,438	1,304	9%	8%	1,329	1,216
August 15, 1987	2	118	126	8	12	109	111
September 15, 1987	1	99	95	1	0	98	654
October 15, 1987	3	706	658	*	*	703	95
TOTAL	19	2,361	2,183	5%	5%	2,239	2,076

*Less than 1 percent

[a]For the initial analysis, missing cases are cases issued a Certificate or Housing Voucher prior to April 1, 1987, which are missing a Housing Search Log indicating the outcome. For the first year analysis, missing cases include cases for which a scheduled annual recertification was not reported either because the annual recertification had been delayed (e.g., landlord had not signed the necessary renewal papers) or because the PHA was late in submitting the research form.

[b]The exact number of recipients in this sample cannot be known since a few issuances remain unresolvable. The number of missing cases however is very small, since the number of unresolved cases is less than 1 percent in either program.

TABLE B.2

SAMPLES USED IN THE INITIAL ANALYSIS BY SITE

	Issuances			Recipients		
	Housing Vouchers	Housing Certi-ficates	Total	Housing Vouchers	Housing Certi-ficates	Total
URBAN PHAs						
Atlanta	297	304	601	194	165	359
Boston	151	155	306	72	71	143
Cleveland	86	81	167	72	63	135
Dayton	90	84	174	66	54	120
Erie	171	142	313	139	99	238
Houston	-	-	-	-	-	-
Los Angeles	283	271	554	203	195	398
Minneapolis	310	319	629	228	213	441
Montgomery	200	214	414	133	132	265
New Haven	98	90	188	69	57	126
New York	1,715	1,794	3,509	582	564	1,146
Oakland	455	432	887	369	331	700
Omaha	236	246	482	200	204	404
Pinellas	262	262	524	204	209	413
Pittsburgh	186	192	378	116	135	251
San Antonio	213	237	450	176	182	358
San Diego	575	571	1,146	476	460	936
Seattle	378	353	731	278	272	550
TOTAL	6,150	6,192	11,453	3,577	3,406	6,983
STATEWIDE PHAs						
Michigan	183	193	376	125	125	250
New Jersey	261	252	513	147	145	292
TOTAL	444	445	889	272	270	542

TABLE B.3

SAMPLES USED IN THE FIRST YEAR ANALYSIS BY SITE

	Annual Recertification		Terminations	
	Housing Vouchers	Housing Certificates	Housing Vouchers	Housing Certificates
Urban PHAs				
Atlanta	51	29	9	1
Boston	14	26	1	1
Cleveland	41	22	3	3
Dayton	32	31	2	2
Erie	42	23	4	6
Houston[a]	-	-	-	-
Los Angeles	46	53	3	4
Minneapolis	80	66	14	18
Montgomery	107	95	6	12
New Haven	47	37	2	2
New York	194	210	13	12
Oakland	295	251	21	29
Omaha	81	84	16	13
Pinellas	124	133	50	47
Pittsburgh	100	109	12	13
San Antonio	138	113	19	18
San Diego	333	304	39	39
Seattle	77	61	12	6
Total	1802	1647	226	226
State-Wide PHAs				
Michigan	83	66	15	29
New Jersey	101	92	12	16
Total	184	158	27	45

[a]Not included in the analysis.

Each record in the First Year Data Base includes:

- Selected items from the Initial Data Base (baseline demographic characteristics, initial contract rent, rent, and income at the time the family became a recipient);
- Data pertinent to the annual recertification, unless the family terminated prior to the scheduled recertification. Annual recertification data include recertified income and program unit information (renewal date, rent, subsidy);
- Variables indicating whether the family moved to a new unit after becoming a recipient, how often; and whether the move occurred on the anniversary date or prior to the anniversary date;
- Selected income variables for up to three interim recertifications which occurred prior to the annual recertification; and
- Termination information if the family terminated (date and reason for termination).

Although for simplicity the data base is referred to as the First Year Data Base, it should be noted that the period of observation varies significantly from site to site and from family to family. Generally, the PHAs schedule the annual recertification on the anniversary of the contract date, which in most instances is 12 months after the family becomes a recipient. There are however exceptions to this rule:

- Some landlords have a fixed renewal date for all leases in a specific building. In such cases, the PHA may set the annual recertification date to match the owner's lease renewal date.
- The family moves to a new unit before the anniversary date. Most PHAs in such instances conduct a recertification at the time of the move and reschedule the next annual recertification 12 months after the move.
- The annual recertification is conducted later than scheduled because of delays in the PHA overall recertification process, because of individual families' delays in meeting the recertification requirements, or because of delays on the part of families that are attempting to relocate at the time of annual recertification.

In addition, the date of recertification entered on the Continued Participation Form is not always the effective date of the recertification; it is sometimes the date the recertification activities are initiated and sometimes the date the form was completed.

As a result, it was not possible to systematically define a period of 12 months or even 15 months which would cover the period between receipt and annual recertification. The date of the annual recertification (or termination) defines the length of the period of observation. If there were more than one annual recertification for a recipient family, the closest one to the anniversary date was selected. For example, if an annual recertification was performed at the time of an early move, four months after initial contract, and a second annual recertification was reported twelve months later, the second annual recertification was selected, since it was closer to the anniversary date. If the move had occurred eight months after the initial contract and no other recertification was available for that family, then the eight-month recertification was used in the First Year Data Base. Activities which occur prior to the annual recertification are included in the First Year Data Base, e.g., interim recertification or rent adjustments. Activities which were performed later than the annual recertification are not included. There is one exception, however. PHAs are informed of the families' desire to move at the time of the recertification interview. If the recertification was late, some PHAs would submit the Continued Participation Form to Abt following the income review and would later submit a form reporting the move and program unit information for the new unit. Moves that occurred within 30 days of the date of recertification were included. These cases were recoded as a move that occurred at annual recertification. Similarly, terminations which occurred within 30 days of the annual recertification were used in this analysis.

The distribution of the time elapsed between initial contract and the annual recertification is shown in Table B.4. Overall, 92 percent of the annual recertifications were performed within 3 months of the anniversary date, and 69 percent were performed within one month of the anniversary date. The remaining eight percent reflects special situations and to a certain extent errors in reporting. It should be noted that a significant level of effort was expended to clean the First Year analysis file to insure that the number of sample cases included in the analysis was maximized and that the period of observation was as consistent as possible across sites and across recipients. All sample cases missing an annual recertification were examined manually and corrected after consultation with the PHAs. For example, it was determined that in some sites a recertification was performed at the time of an early move, but the recertification was not recorded on the Continued Participation Form reporting the move. The income data associated with the recertification had to be obtained separately from these PHAs, and were subse-

TABLE B.4

TIMING OF ANNUAL RECERTIFICATION

Time Elapsed Between Date of Initial Contract and Date of Annual Recertification	Number of Cases	Percent
Less than 6 months	9	*
6 to 9 months	121	3%
9 to 11 months	658	17
11 to 13 months	2625	69
13 to 15 months	209	6
15 to 18 months	103	3
More than 18 months	65	2

*Less than one percent.

quently added to the data base. Other PHAs would provide income information on the form reporting the move but would call the activity "interim recertification" because it did not occur on the anniversary date. Cases with more than one annual recertification or with questionable recertification dates were also examined manually and discussed with PHA staff, unless there was an obvious error which could be resolved by Abt staff. All corrections are documented in the data base through the use of special codes.

B.3 Error Resolution for Key Analysis Variables

As mentioned in Section B.1.2 above, the monitoring of data collection and data processing encompassed several cleaning steps, ranging from simple checks for missing or unallowable values to consistency checks across variables. Particular emphasis was placed on the cleaning of key variables such as rent, utilities, income, assistance payment, and payment standard or FMRs. These variables are primary outcome measures or enter the computation of derived outcome measures, such as rent burden.

We used four primary procedures to check the accuracy of those variables:

- We computed subsidy based on the data reported for the family and compared the computed subsidy to the subsidy reported by the PHA; discrepancies of more than two dollars were flagged.
- We compared gross rent to FMR in the Certificate Program and identified cases with rent higher than 110 percent of FMR.
- We compared reported payment standards and FMRs to schedules in effect at the PHAs, using dates and unit size.
- Finally, we looked at the distribution of derived variables such as tenant payment, rent burden, and ratio of gross rent to FMR and identified outliers or otherwise questionable values.

B.3.1 Discrepancies Between Computed and Reported Subsidies

Although the procedures to resolve these discrepancies are similar in the two programs, they differ somewhat because different variables enter the payment calculation formula. In the Housing Voucher Program, the formula is based on Payment Standard and family net income.[1] Therefore, in the Housing Voucher Program, a discrepancy between computed and reported subsidy implies, in general, that the PHA made a mistake in calculating the payment or that we have been provided with an incorrect Payment Standard, income or subsidy amount. In the Certificate Program, the payment formula is based on gross rent and income. A discrepancy therefore suggests a PHA error or a reporting error for gross rent, income, or subsidy amount.

The first step in resolving error in subsidies was to submit the cases in error to the PHAs for resolution. The first error reports were produced in 1986 and were introduced to the PHAs during site visits. PHA staff members were trained to complete these reports when subsequent reports were sent to the sites for resolution. Analysis of the error reports completed by site visitors and subsequent reports returned by the sites showed that the source of errors varied greatly from site to site, but overall, misreporting of income variables accounted for a large number of the discrepancies. Often, PHAs had failed to report changes of income that occurred between issuance and signing of a Housing Voucher or Certificate contract. These changes should have been reported on the Housing Search Log. The second largest error for Housing Voucher cases was incorrect reporting of the Payment Standard, especially if the PHA had recently adopted a new Payment Standard Schedule. Whether the error was due to incorrectly reported income or Payment Standard, the subsidy amount reported by the PHA was correct. The discrepancy could be resolved by using the new information provided by the PHA in calculating subsidy. The remaining discrepancies were errors in the reported subsidy amount, either transcription errors or actual errors in the computation of the subsidy. In the latter case, the error implies that the payment made to the landlord by the PHA was inaccurate. In general, actual errors were few and the frequency of such errors varied greatly from site to site.

By the time the data base was to be finalized to prepare this report, there were still a relatively large number of unresolved discrepancies. Some of the discrepancies were associated with forms received late from the PHAs and could not, in the time remaining, be submitted to the PHAs for resolu-

[1] Unless the recipient's gross rent is very low and the Housing Voucher payment is reduced to insure that the tenant contribution is at least 10 percent of gross income.

tion. Others had been submitted to the PHAs but remained unresolved, either because the PHAs failed to return the corrected reports or because they did not provide the correct information to resolve the errors. There is a significant lag between the time a form is submitted, processed, merged into an analytical data file, and returned to the PHA for corrections. By that time, the family may have been recertified, may have moved to another unit, or may have experienced an increase in rent. Some PHAs as a result had difficulties retrieving the information which applied to the family at the time the form was submitted, six or seven months earlier.

Resolution of these cases was performed in-house to the extent possible. Housing Voucher cases were reviewed for a possible error in the reported Payment Standard as a result of a change in the Payment Standard schedule. In some sites, up to 50 percent of the discrepancies could be resolved by using the revised Payment Standard. In the Certificate Program, gross rent rather than Payment Standard was the focus of the review. Data quality checks conducted during site visits had already found that PHAs sometimes reported contract rent rather than gross rent on both the HSL and CPF. In some cases, the discrepancy could be resolved by recomputing gross rent (reported gross rent plus utilities). Next, both Housing Voucher and Certificate cases were reviewed for any obvious errors, e.g., payment to the landlord greater than contract rent, payment to the landlord equal to the Payment Standard, or use of the effective FMR rather than Payment Standard, indicating that reported payment may be in error rather than the components entering the payment calculation formula. All questionable values were checked against the hard copy. Keypunch errors were corrected. The remaining unresolved cases were flagged as payment error calculations.[1]

Once all possible errors in the reported subsidy amount had been identified, and all Payment Standards had been corrected, remaining discrepancies were assumed to be the results of incorrectly reported income. The subsidy amount was assumed to be correct and income amounts (net and gross) were adjusted to be consistent with the reported subsidy. The adjusted income

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[1]Some discrepancies could be resolved by correcting the reported subsidy amount for cases involving a utility reimbursement to the family. Some PHAs included this amount in the payment to the landlord. The utility reimbursement was double-counted when subsidy was computed as the sum of payment to the landlord and utility reimbursement.

amounts are used in the analysis. Table B.5 shows the number and types of errors remaining in the data bases after completion of the cleaning process. Table B.6 shows the average adjustments made to net income as part of the error resolution process.

B.3.2 Changes in Payment Standards and FMRs

At the onset of the Housing Voucher Demonstration, the Housing Voucher Payment Standard schedule was based on the FMR schedule in effect in each site. Each year, new FMR schedules are published and adopted by PHAs over a period of several months. The first change in FMRs affecting the Demonstration occurred in April 1986. FMRs changed again in the Spring of 1987. Section B.5 of this Appendix shows Payment Standards and FMR changes for each site. PHAs had the option to increase their Payment Standards, at any time, up to the amount of the FMRs in effect at the time of the change. Although Abt was routinely informed of the adoption of new FMRs or Payment Standards, it is difficult to determine the exact effective date of the change and how it relates to each family. The FMR or Payment Standard was first reported on the Pre-Program Information Form. If the applicable FMR or Payment Standard changed by the time the family became a recipient, the change was to be recorded on the Housing Search Log. Unfortunately, PHAs failed to systematically report changes in FMR or Payment Standard.

Unreported changes in Payment Standards can be identified, at least for recipients, since an unreported change yields an apparent error in the subsidy calculations. (See discussion in Section B.2.1 above.) Unreported changes in FMRs, however, are more difficult to identify since the FMR is not used in computing the subsidy. Cases with gross rents above FMRs were examined, especially for dates around the effective date of the change in FMR schedule as reported by the PHA. For PHAs that did not systematically report changes in FMR, the number of cases with gross rents in excess of FMRs tended to increase in the first months following the change. Table B.5, referred to earlier in this section, shows the incidence of changes to Payment Standards and FMRs in the Initial and First Year Data Base. Payment Standards were changed more frequently than FMRs in the First Year Data Base, since they enter the calculation of subsidy for both movers and families recertified in place. The FMRs, on the other hand, are applicable only to families that

TABLE B.5

CASES WITH DISCREPANCIES BETWEEN COMPUTED AND REPORTED SUBSIDY AMOUNT AND CHANGES TO PAYMENT STANDARDS AND FMRs

	Initial Data Base		First Year Data Base	
	Housing Vouchers	Housing Certi-ficates	Housing Vouchers	Housing Certi-ficates
Number of discrepancies[a]	397	484	180	191
As % of all applicable cases	10%	13%	9%	11%
Number of discrepancies resolved	343	473	152	185
By correcting Gross Rent	32	187	9	50
By correcting Subsidy Amount	63	77	70	69
By adjusting Income	248	209	73	66
Number of discrepancies remaining (errors in reported subsidy)	54	11	28	6
As % of all recipients	1%	*	1%	*
Number of changes to Payment Standard or FMRs	193	242	115	40
Recipients	169	201	-	-
Expirees	24	41	-	-

[a]Number of discrepancies after corrections to Payment Standards.

[b]In Initial Data Base, subsidy is computed for all recipients. In the First Year Data Base, discrepancies are reported for all cases with an annual recertification.

*Less than 1 percent.

TABLE B.6

MEAN ADJUSTMENTS TO MONTHLY NET INCOME RESULTING FROM ERROR RESOLUTIONS

	Housing Voucher	Housing Certificate
Initial Data Base		
Number of cases with adjustment[a]	253	224
Mean adjustment per case	$13	$17
Number of recipients	3,849	3,676
Mean adjustment per recipient	$.83	$1.05
First Year Data Base		
Number of cases with adjustment[a]	92	96
Mean adjustment per case	$18	$-28
Number of recipients at annual recertification	1,986	1,805
Mean adjustment per recipient	$.84	$-1.5

[a]The number of cases with income adjustments is larger than the number presented in Table B.5. These statistics were prepared during the cleaning process and include some cases which were subsequently deleted from the data base.

move, since these families' gross rent is constrained by the applicable FMR at the time of the move. Rent increases for families that continue to participate in place are governed by published adjustment factors rather than FMR schedules. In the Certificate Program, we focused our cleaning activities on FMRs for families that moved, rather than on all FMR amounts reported by PHA.

B.4 Analytic Variables

Analytic variables are derived from the basic set of variables collected on the research forms and other secondary data such as Census data. These derivations are described below.

B.4.1 Pre-Program Gross Rent

Gross rent is a key variable in this analysis, since it provides a comprehensive measure of rental costs including both the amount paid to the landlord (contract rent) and the amount paid to utility companies and local agencies for utilities not included in the contract rent, such as fuels, and services (trash, water, and sewer). Collecting accurate data on utilities through interviews is always a challenge, as utility costs vary greatly from month to month and respondents, unless enrolled in a level plan, tend to quote last month's expenses rather than monthly average costs. Furthermore, in the context of the Housing Voucher Demonstration, collection of actual utility costs would have required a special data collection effort by the PHA. PHAs compute a utility allowance for each family, based on the number of bedrooms in the rental unit and the utilities not included in the contract rent. Each PHA maintains one or several utility schedules by bedroom size. The different schedules apply to different housing types: single-family unit, garden apartment, high-rise, and mobile home.[1] The utility schedules reflect utility costs in the PHA jurisdiction and are updated periodically. An example of a PHA utility schedule is presented in Figure B.2.

PHAs use a Request for Lease Approval Form (RLA) which provides data on utilities included in the proposed contract rent. The RLA is to be completed by the landlord and submitted to the PHA before a unit can be inspected

[1] In some instances, schedules may differ by location and/or utility companies providing the service.

FIGURE B.2

EXAMPLE OF A PHA UTILITY SCHEDULE

HUD-52667
April 1975

U.S. DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT

SECTION 8, EXISTING HOUSING ALLOWANCES FOR TENANT-FURNISHED UTILITIES AND OTHER SERVICES

DATE: 11/85

LOCALITY: CUYAHOGA METROPLITAN HOUSING AUTHORITY

UNIT TYPE: ALL

UTILITY OR SERVICE	MONTHLY DOLLAR ALLOWANCES					
	0-BR	1-BR	2-BR	3-BR	4-BR	5-BR
HEATING						
a. Natural Gas	25.00	36.00	39.00	44.00	53.00	62.00
b. Bottle Gas						
c. Oil						
d. Electric	32.00	41.00	49.00	55.00	61.00	67.00
AIR CONDITIONING						
COOKING						
a. Natural Gas	3.00	3.00	4.00	4.00	5.00	5.00
b. Electric	5.00	6.00	8.00	9.00	10.00	11.00
c. Bottle Gas						
OTHER ELECTRIC LIGHTING, REFRIGERATION, ETC.	12.00	17.00	21.00	23.00	26.00	28.00
WATER HEATING						
a. Natural Gas	5.00	5.00	7.00	8.00	9.00	11.00
b. Electric	13.00	17.00	21.00	25.00	29.00	34.00
c. Bottle Gas						
d. Oil						
WATER						
SEWER						
TRASH COLLECTION						
RANGE						
REFRIGERATOR						
OTHER (Specify)						

ACTUAL FAMILY ALLOWANCES (To be used by family to compute allowance. Complete below for Actual Unit Rented)

NAME OF FAMILY

ADDRESS OF UNIT

NUMBER OF BEDROOMS

B-24

UTILITY OR SERVICE	PER MONTH
HEATING	$
AIR CONDITIONING	
COOKING	
OTHER ELECTRIC	
WATER HEATING	
WATER	
SEWER	
TRASH COLLECTION	
RANGE	
REFRIGERATOR	
OTHER (Specify)	
TOTAL	$

and a contract signed. A sample is included as Figure B.3. Based on the utility grid on the RLA and corresponding entries on the appropriate utility schedule, the PHA computes a utility allowance for the unit which is added to the unit contract rent to obtain the gross rent. Gross rents and utility allowances are recorded on the Housing Search Log or Continued Program Participation Form.

Gross rent, however, is not readily available for pre-program units. To allow comparison of program housing expenditures with pre-program expenditures, it is important that gross rent be defined consistently. It was therefore not possible to ask families to provide an estimate of gross rent, including utilities. Instead, respondents to the PPIF interview were asked how much they pay each month to their landlord for their house or apartment (contract rent) and they were asked which utilities are included and which they pay for separately. In addition, because the utility allowance differs with type of fuels, respondents were asked which type of fuel is used to heat and cool their house, to cook, and to operate the hot water heater. The plan was to create a utility allowance variable, based on the interview responses to the utility questions and the PHA utility schedules.

What appeared, during the design phase, to be a relatively straightforward procedure became more and more complex as data became available. First, utility schedules were not as comparable across sites as was expected; neither were utility data collected on the PHA-specific versions of the RLA. The interview questions designed to match the utilities listed on the HUD version of the RLA were not appropriate for those sites that were using a drastically revised version of the RLA.[1] Second, respondents did not always know which utilities were included, and they often had difficulty answering the fuel questions. Even more important, a key variable for the procedure is the number of bedrooms. Families had difficulty distinguishing between number of rooms and number of bedrooms. Discrepancies were identified when the number of bedrooms reported by stayer respondents was compared to the number of bedrooms recorded on the RLA.

[1]The PPIF interview was designed before we had the opportunity to review all PHA operating forms and utility schedules. As a result, we did not have a question asking families in which type of unit they were living.

FIGURE B.3

SAMPLE REQUEST FOR LEASE APPROVAL FORM

HUD-52517A
(6/75)

U S DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Section 8 Housing Assistance Payments Program
Existing Housing

REQUEST FOR LEASE APPROVAL

1 Request The undersigned Owner and Family hereby request the ______________________________
(NAME OF THE PUBLIC HOUSING AGENCY)
to approve the attached lease for the dwelling unit located at ______________________________
(STREET ADDRESS AND APARTMENT NUMBER IF ANY)
for a term of __________ months beginning ____________________ 19_____ The unit consisting of ______ bedrooms, is to be leased at $__________ per month This rent includes maintenance and other services as provided in the lease and the following utilities and appliances

Type of House (Check applicable box)

[ ] Detached [ ] Duplex or Twin [ ] High-Rise Apartment
[ ] Row House [ ] Garden Apartment [ ] Mobile Home

Utilities and Appliances (Insert O if furnished by Owner or T if furnished by Tenant)

ITEM	COAL	OIL	NATURAL GAS	ELEC-TRIC	L P GAS	OTHER
HEAT						
COOKING FUEL						
AIR CONDITIONING						
LIGHTING/REFRIGERATION						
WATER						
SEWER						
TRASH COLLECTION						
RANGE						
REFRIGERATOR						
HOT WATER						

2 Certifications THE OWNER by executing this request certifies that

(a) The most recent rent charged for the above dwelling unit was $__________ per month The reason for the difference if any between this amount and the proposed rent are
____
____
____

(b) This unit is made available managed and operated regardless of race color creed religion sex or national origin

(c) He has inspected the dwelling unit as evidenced by the attached inspection report, and his certification as to the condition of the unit is true to the best of his knowledge and belief

THE FAMILY, by executing this request certifies that it has inspected the dwelling unit as evidenced by the attached inspection report and that its certification as to the condition of the unit is true to the best of its knowledge and belief

3 Dates of Availability for Inspection and Occupancy

(a) The dwelling unit will be available for inspection by the Agency on ______________ 19______

(b) The dwelling unit will be available for occupancy by the Family on ______________ 19______

4 Agency Determination The Owner and the Family understand that the Agency will notify them as to whether or not the proposed lease is approvable, within the time period specified in paragraph 6 of the Certificate of Family Participation

______________________________ (NAME OF OWNER OR OTHER ENTITY AUTHORIZED TO LEASE)	______________________________ (NAME OF FAMILY REPRESENTATIVE)
BY ______________________________ (SIGNATURE)	______________________________ (SIGNATURE OF FAMILY REPRESENTATIVE)
______________________________ (DATE)	______________________________ (DATE)
______________________________ (BUSINESS ADDRESS)	______________________________ (PRESENT ADDRESS OF FAMILY)
______________________________ (TELEPHONE)	______________________________ (TELEPHONE)

HUD 52517A (6/75)

An estimated utility allowance based on the PPIF variable was created in the Spring of 1987. The estimated utility allowance derived from the PPIF data and PHA utility schedules was compared to the utility allowance reported on the HSL for families that became recipients in their pre-program unit. The two numbers differed too much to rely on this computed utility allowance to compare pre-program and program gross rents with a sufficient level of accuracy.

Instead, pre-program gross rent was obtained by multiplying pre-program contract rent by an estimated utility adjustment factor. This utility adjustment factor was estimated from regression of the ratio of gross rent to contract rent for program units on a set of utility and site variables.

The utility allowance computed by the PHA is the sum of separate allowances for each utility that is not included in the rent. For example, a family that occupies a three-bedroom apartment and must pay for its own heat and electricity may receive a utility allowance of $183, including $155 as an allowance towards heat and $28 for electricity. It is therefore reasonable to assume that the utility allowance is directly related to the number and type of utilities included in the contract rent. Thus utility allowance can be estimated as a function of the utility included in contract rent, unit size, and site variables. The estimated coefficients can then be used to compute estimated utility allowances for pre-program units. To avoid using number of bedrooms as a regressor, since this variable is unreliable for pre-program units, the dependent variable is specified as the ratio of gross rent to contract rent, and the regression is specified as:

$$\left(\frac{\text{Gross rent}}{\text{Contract rent}}\right)_i = \sum_{r}\sum_{k} X_{ir} S_k B_{rk} + \varepsilon_i$$

where

$\left(\frac{\text{Gross rent}}{\text{Contract rent}}\right)_i$ = The ratio of gross rent to contract rent for unit i

X_{ir} = A variable indicating that utility r is included in contract rent for unit i

S_k = A variable indicating that the unit is located in site k

B_{rk} = The coefficient to be estimated for variable $X_{ir}S_k$

ε_i = Error term

Units with a contract rent including all utilities are excluded.

Several specifications of the utility variables were tested. The final equation includes the five following variables, each fully interacted with 19 site variables:

X_1=1 If heat and/or air conditioning is included in contract rent; otherwise 0

X_2=1 If heat is not included, but one of the following is included: electricity for lighting and refrigeration, fuel used for cooking, or fuel used to heat water; otherwise 0.

X_3=1 If neither of the above are included, but a stove and/or a refrigerator are provided by the landlord; otherwise 0.

X_4=1 If none of the above are included, but either trash collection, water, or sewer charges are included.

X_5=1 If none of the above are included.

The above variables were created to allow as much comparability as possible among the categories of utilities reported for pre-program units and the categories reported on the Request for Lease Approval. The correspondence between the variables created from data from the pre-program unit interview and the variables created from the data reported on the RLA is shown in Table B.7 for families that became recipients in their pre-program units. Since the two sets of variables refer to the same unit for this group of families, one would expect a close match for the two sets of variables (though it is obviously possible that the recipient's lease provided for inclusion of different utilities). Overall, 29 percent of all cases exhibit some discrepancy between the two sources of data. These discrepancies reflect differences in data collection methods (interview versus transcription of data from PHA operating forms) and undoubtedly some reporting errors by respondents or PHA staff, as well as actual changes in utilities.

To evaluate the precision of the estimation procedure we looked at the regression error and the correlation between the predicted gross rent and the actual gross rent for program units. These statistics are presented in Table B.8. As expected, the error term is small and the covariance between actual and predicted rent is high.

TABLE B.7

COMPARISON OF UTILITY DATA PROVIDED BY RESPONDENT AND PHA STAFF, FOR STAYERS[a]

	PHA Data from RLA					
PPIF Interview Data	All Utility Included	Heat/AC Included	Light, Cooking, Hot Water	Fridge, Stove	Services	None
All utility included	4%	**	0%	0%	**	0%
Heat, air conditioning	7	43%	*	*	*	0
Light, cooking, hot water	*	*	5	4	1%	*
Fridge, stove	*	1	3	16	3	1%
Services (trash, sewer, water)	**	*	*	*	3	*
None of the above	**	0	**	**	**	*

Percentage of all cases with matching data: 71%

---

[a]Excludes families who shared their pre-program units (subunits) or received help with their housing expenditures.

*Less than 1%.

**Fewer than 6 observations.

TABLE B.8

ACTUAL VS. PREDICTED GROSS RENT FOR PROGRAM UNITS

	Mean		Standard Deviation		Covariance of Actual Gross Rent and Predicted Gross Rent
	Gross Rent	Error	Gross Rent	Error	
All recipients	$466	$0.54	$129	$17	.9918
Heat/AC included	418	1.00	102	12	.9940
Light, cooking, hot water	472	0.34	111	13	.9930
Fridge,stove	467	0.53	122	18	.9890
Services	508	0.94	147	20	.9912
None of the above	532	2.65	164	23	.9914
Atlanta	455	1.15	87	19	.9789
Boston	657	3.52	1.23	32	.9771
Cleveland	418	3.02	90	16	.9923
Dayton	395	1.50	74	22	.9617
Erie	378	2.20	68	23	.9528
Los Angeles	594	0.48	131	11	.9970
Minneapolis	466	0.27	88	12	.9910
Montgomery	601	0.25	120	16	.9914
New Haven	490	1.59	99	17	.9988
New York	407	1.56	97	11	.9968
Oakland	588	0.42	159	16	.9949
Omaha	367	0.84	77	13	.9861
Pinellas	403	0.07	65	11	.9862
Pittsburgh	424	1.72	72	22	.9631
San Antonio	405	-0.01	81	17	.9782
San Diego	501	0.28	102	12	.9936
Seattle	437	-1.67	109	20	.9872
Michigan	377	4.85	86	36	.9341
New Jersey	497	2.23	134	20	.9910

We then compared pre-program predicted utilities with program utilities for stayers for whom the reported utilities included in the rent did not change. The result of a regression of reported program utility allowance on the estimated pre-program utility allowance for stayers is shown in Table B.9A. Averages for both utility amounts by site and by type of utility included in the contract rent are presented in Table B.9B. The results suggest that estimated utility allowances are quite accurate on average and individually. The coefficient for estimated pre-program utilities is 0.99, and the intercept is small. In terms of individual accuracy, the R^2 is 0.66, indicating a correlation of 0.81 between estimated and actual allowances.

B.4.2 Measures of Rent Burden

Two measures of rent burden are used in this report, the frequently used ratio of housing expenditures to income and the Budding measure (the ratio of a family's net-of-housing costs income to net-of-housing costs poverty income).[1] This latter measure allows us to examine the extent to which households have enough income, after paying for housing expenses, to meet the basic spending needs indicated by the poverty line.

Rent Burden (Ratio of Housing Expenditures to Income). In the absence of a subsidy, this ratio is generally expressed as gross rent divided by income for renter households. Within the context of the Demonstration, housing expenditures are reduced by the amount of the subsidy. The ratio is expressed in terms of the family's out-of-pocket expenses or Tenant Contribution:

$$(1) \qquad \text{Rent Burden} = \frac{\text{gross rent} - \text{subsidy}}{\text{net income}} = \frac{\text{tenant contribution}}{\text{net income}}$$

The tenant contribution is equal to the portion of contract rent paid by the family to the owner, plus utilities not included in the contract rent. As discussed earlier in this Appendix, utility costs are estimated costs, drawn from site-specific utility schedules for utilities paid by tenants. Pre-program rent burden is similarly derived, using the estimated gross rent discussed in Section B.4.1 above.

[1] Budding, David W., 1980.

TABLE B.9A

UTILITY ALLOWANCE FOR STAYERS[a]

Regression

Dependent variable: Program Utility Allowance

$R^2 = .6609$

F-test 3327.45**

	Coefficient	Standard Error	t-Statistic
Intercept	4.67	.7901	5.9**
Estimated pre-program utility allowance	.99	.0172	57.7**

[a]Excludes cases with discrepancies in reported utilities included in contract rent.

**Significant at 0.01 level.

TABLE B.9B

COMPARISON OF REPORTED UTILITY ALLOWANCE AND ESTIMATED UTILITY ALLOWANCE FOR UNITS OCCUPIED BY STAYERS[a]

	Mean		Standard Deviation		Number of Obser-vations
	Reported	Estimated	Reported	Estimated	
All stayers	$44	$40	$23	$28	
Heat, AC	32	30	12	10	927
Light, cooking, hot water	25	24	13	12	99
Fridge, stove	56	51	30	23	509
Services	60	63	31	27	139
None of the above	103	94	31	38	35
Atlanta	96	76	15	18	8
Boston	80	51	50	30	16
Cuyahoga	69	58	18	18	17
Dayton	102	74	27	22	11
Erie	74	67	35	32	90
Los Angeles	41	32	14	10	41
Minneapolis	23	22	23	18	121
Montgomery	53	46	39	34	27
New Haven	74	58	36	30	43
New York	38	35	8	8	625
Oakland	43	41	23	11	14
Omaha	40	37	31	26	51
Pinellas	45	44	13	12	147
Pittsburgh	104	85	40	35	35
San Antonio	63	51	16	20	9
San Diego	28	25	14	9	197
Seattle	35	36	20	12	74
Michigan	62	61	42	34	89
New Jersey	51	44	31	26	94

[a]Excludes cases with discrepancies in reported utilities included in contract rent.

Net Income is annual net income as reported by the PHA, divided by 12. Net income may be zero and rent burden is not defined in this case.

Budding Measure of Rent Burden. This measure is defined as:

$$\text{(2)} \quad \text{Budding rent burden} = \frac{\text{gross income} - 12 \text{ (tenant contribution)}}{\text{net-of-housing costs poverty income}}$$

where

gross income	=	Annual family income before deductions as reported by PHA
tenant contribution	=	Gross rent - subsidy
net-of-housing costs	=	Poverty threshold minus the implicit rental allowance as defined below.

Poverty thresholds are published by the U.S. Census each year.[1] Thresholds vary by size of household, the age of the head of household, and the number of related children under 18 years of age. The index is updated each year by the Consumer Price Index for that year. Table B.10 shows the schedule of thresholds for 1985.

The original index was based on the Department of Agriculture's 1961 Economy Food Plan and reflects the different consumption requirements of families based on size and household composition. The poverty level was obtained by multiplying the food budget amount by the ratio of total income to food expenditures obtained from the 1955 Survey of Food Consumption and adjusted for smaller households to compensate for the relatively larger fixed expenses of those households.

Accordingly, the poverty threshold implicitly includes a budgeted amount for housing. In 1963, housing costs were set at 25 percent of total income, based on spending patterns of the reference group used to develop the original non-food multiplier. Since poverty level is updated by applying the Consumer Price Index (CPI), it is possible to update the implicit rental allowance by using the Residential Rent component of the CPI.

[1] U.S. Bureau of the Census, 1987.

TABLE B.10

POVERTY THRESHOLDS IN 1985, BY SIZE OF FAMILY AND NUMBER OF RELATED CHILDREN UNDER 18 YEARS OLD

Size of Family Unit	Weighted Average Thresholds	Related Children Under 18								
		None	One	Two	Three	Four	Five	Six	Seven	Eight or More
One person (unrelated individual)	$5,469									
-< 65 yrs	5,593	$5,593								
-≥ 65 yrs	5,156	5,156								
Two persons	6,998									
-Householder < 65 yrs	7,231	7,199	$7,410							
-Householder ≥ 65 yrs	6,503	6,498	7,382							
Three persons	8,573	8,410	8,654	$8,662						
Four persons	10,989	11,089	11,270	10,903	$10,941					
Five persons	13,007	13,373	13,567	13,152	12,830	$12,634				
Six persons	$14,696	15,381	15,442	15,124	14,819	14,365	$14,097			
Seven persons	16,656	17,698	17,808	17,428	17,162	16,667	16,090	$15,457		
Eight persons	18,512	19,794	19,969	19,609	19,294	18,847	18,280	17,690	17,540	
Nine or more persons	22,083	23,811	23,926	23,608	23,341	22,902	22,298	21,753	21,617	$20,785

Starting with the 1985 Poverty Thresholds presented in Table B.10, poverty thresholds were created for 1986 and 1987 to cover the lease-up period for the Demonstration:

$$(3) \quad PY_j(t) = PY_j(85) * \frac{CPI(t)}{CPI(85)}$$

where

$PY_j(t)$ = Poverty threshold for a family of type j in year t

t = 1986 or 1987

$PY_j(85)$ = The entry in the U.S. Table for 1985, for a family of type j

$CPI(t)$ = Consumer Price Index (all items) in year t

$CPI(85)$ = Consumer Price Index (all items) in 1985

Then, the implicit rental allowance was calculated:

$$(4) \quad PR_j(t) = .25 \times \frac{RHI(t)}{RHI(63)} \cdot \frac{CPI(63)}{CPI(t)} PY_j(t)$$

where

$PR_j(t)$ = Implicit Rent Component of the poverty threshold for household of type j, in year t

t = 1985, 1986, 1987

$RHI(t)$ = Residential Rent Component of the CPI in year t

$RHI(63)$ = Residential Rent Component of the CPI in year 63[1]

$CPI(63)$ = Consumer Price Index (all items) in 1963

$CPI(t)$ = Consumer Price Index (all items) in 1963 year t

$PY_j(t)$ = As defined above

As mentioned above, Poverty Thresholds, including housing and non-housing components, are updated each year using the CPI. The appropriate index for the housing component is however the Residential Rent Index. Correction is made using the ratio of the CPI in 1963 to the CPI in year t.

Each family in the sample was assigned the appropriate Poverty Threshold (PY_{jt}) and Poverty Rental Allowance (PR_{jt}) based on family size, number

[1]The 25 percent ratio of housing expenditures to total income was calculated in 1963.

of children, age of head for one- or two-person households, and year of issuance. The Budding measure was then computed as described in Eq. (2), using the Tenant Contribution when the family became a recipient (Initial Data Base) or at annual recertification (First Year Data Base). Estimated gross rent is used instead of tenant contribution to compute the Budding measure for pre-program units.

B.4.3 Measure of Housing Adequacy

Besides family preferences, there are several factors that influence whether a family will remain in its pre-program unit or move to another unit in order to start receiving Section 8 assistance:

- Size of the unit as compared to PHA occupancy requirements
- Gross rent charged by the landlord not in excess of FMR (Certificate Program only)
- Living arrangements; family is living in its own unit
- Physical condition of the unit.

Unit compliance with the first three conditions is easily determined using one or several basic variables described earlier in this section. Determining whether the unit meets the program housing requirements is more complex. The results of a PHA inspection on the pre-program unit would provide the best indication of whether the unit passes the PHA requirements. PHAs, however, for obvious cost reasons, do not systematically inspect all pre-program units. In fact, PHAs encourage applicants who would like to stay in their pre-program unit to conduct a pre-inspection of the unit before requiring a PHA inspection. To this effect, families are briefed on the program housing requirements and are provided with an inspection checklist during the briefing sessions. PHAs reported the results of an inspection on applicants' pre-program unit for 3,210 families, only about 25 percent of all families issued a Certificate or Housing Voucher. Of these 3,210 families, 93 percent became recipients in their pre-program unit with or without repairs, 2 percent became recipients by moving to a new unit, and 5 percent were unsuccessful applicants. For all other families, data on pre-program conditions are not available from PHA records, and had to be collected for the Housing Voucher Demonstration.

All applicant families were asked a series of questions describing the conditions of their unit during the pre-program interview. These questions were reproduced from the 1983 Annual Housing Survey Questionnaire. Several versions of an adequacy index have been developed to use data from the Annual Housing Survey (AHS) and have been tested over the years. These indices are frequently used by HUD and housing researchers. The version of the index selected for this report is presented in Table B.11.[1] This index is not a pass/fail measure of housing quality and does not attempt to test for all Acceptability Criteria enforced by the PHAs. The index is a three-level index of physical problems, which classifies housing units as adequate, moderately inadequate, and severely inadequate, based on a set of basic housing deficiencies, as shown in Table B.11. Because it evaluates a smaller number of housing attributes than the Section 8 inspection, the index tends to be less stringent than the Section 8 Acceptability Criteria.

In the Housing Voucher Demonstration, about 19 percent of all applicants' pre-program units were classified as severely inadequate, and 13 percent as moderately inadequate. The proportion of inadequate units is identical for enrollees in both programs. Table B.12 therefore does not distinguish between programs, but instead presents the adequacy measure for each of three groups: unsuccessful applicants, recipients who moved to another unit, and recipients who stayed in their pre-program unit. This last group further distinguishes between stayers with repairs and stayers without repairs.

As expected, the percent of units with deficiencies, especially severely inadequate units, is highest for unsuccessful applicants (29 percent) and lowest for stayers without repairs (7 percent). (See Table B.12.) This last percentage appears high considering that these units are reported to have passed PHA inspection without any repairs being required. This number, however, is consistent with the results obtained with a comparable adequacy index based on inspection data for a sample of the Housing Voucher Demonstration program units. (See Table B.12.) These inspections were conducted in 10 sites in the Fall of 1987 on approximately 2,000 program units.[2] An adequacy index based on the same criteria as the one used for this report was created

[1]Starting in 1984, this slightly revised version of the index is derived by the Census Bureau for all units in the AHS, and tabulated in AHS publications.

[2]See Leger and Kennedy, 1988.

TABLE B.11

INDEX OF HOUSING ADEQUACY: DEFINITION OF PHYSICAL PROBLEMS[a]

SEVERE.

A unit is considered severely deficient if it has any of the following five problems:

- Plumbing. Lacking hot piped water or a flush toilet, or lacking both bathtub and shower, all for the exclusive use of the unit.
- Heating. Having the heating equipment break down at least three times last winter, for at least six hours each time.
- Upkeep. Having any five of the following six maintenance problems: leaky roof; leaky basement; holes in the floors; holes or open cracks in the walls or ceilings; more than a square foot of peeling paint or plaster; mice or rats in the last 90 days. If the unit has no basement, any four of the remaining five problems would be enough to count the unit as severely deficient.
- Hallways. Having all of the following three problems in public areas: no working light fixtures; loose or missing steps; and loose or missing railings.
- Electric. Having no electricity, or all of the following three electrical problems: exposed wiring; a room with no working wall outlet; and three blown fuses or tripped circuit breakers in the last 90 days.

MODERATE

A unit is considered moderately deficient if it has any of the following five problems, but none of the severe problems:

- Plumbing. Having the toilets all break down at once, at least three times in the last three months, for at least six hours each time.
- Heating. Having unvented gas, oil, or kerosene heaters as the main source of heat; these give off unsafe fumes.
- Upkeep. Having any three of the six upkeep problems mentioned under SEVERE.
- Hallways. Having two of the Hallways problems mentioned under SEVERE.
- Kitchen. Lacking a sink, range, or refrigerator, all for the exclusive use of the unit.

---

[a]This three-level index of physical problems was developed for use with the American Housing Survey data. For more detailed information, see the Codebook of the American Housing Survey Data Base, published by Abt Associates Inc.

TABLE B.12

HOUSING ADEQUACY OF APPLICANTS' PRE-PROGRAM UNITS, BY PARTICIPATION OUTCOME
(Unweighted estimates)

All Sites	N	Severely Inadequate	Moderately Inadequate	Adequate
Adequacy Index Based on Pre-Program Interview				
All applicants	12,342	18.6%	12.9%	68.5%
Unsuccessful applicants	4,817	28.9	14.5	56.6
Recipients--movers	4,567	15.3	15.1	69.6
Recipients--stayers				
With repairs	1,007	7.3	9.9	82.8
Without repairs	1,951	6.7	5.5	87.8
Adequacy Index Based on Inspection of Recipient Units	1,755	7.0	6.8	86.2
EXCLUDING THE TWO HIGH RATE SITES:				
Adequacy Index Based on Pre-Program Interview Data				
Recipients--stayers	8,232	2.5	5.0	92.5
Adequacy Index Based on Inspection of Recipient Units				
Housing Quality sample	1,415	5.1	5.5	89.4

using the data obtained from the inspections. The definitions of a few components of the index had to be slightly modified to use the inspection data, but in general, the two indices are comparable.

The results of both indices for recipients who stay in their pre-enrollment units without repairs are strongly influenced by two sites that have high percentages of severely inadequate units (above 10 percent). Excluding these two sites, the overall percentage is reduced to about 3 percent for the interview-based index and 5 percent for the inspection-based index, as shown in Table B.12.

Most units reported severely inadequate exhibit only one deficiency for both the interview and the inspection-based indices. The type of observed deficiencies is however quite different for the two indices, as indicated in Table B.13. The most frequently reported deficiency for the interview-based sample is breakdown of the heating equipment (59 percent), followed by upkeep problems such as cracks in the walls, broken plaster, and holes in the floor (25 percent). Both types of deficiencies are sensitive to respondent perception of their units. In an index based on interview data, rather than physical inspection of the units, respondents may exaggerate or decrease the importance of an observed condition, depending on their overall satisfaction with the unit or the landlord. Furthermore, heat breakdowns may be properly reported, but the heating equipment may not exhibit any unsafe features or evidence of improper operations. In fact, heat deficiencies based on inspection of the heating equipment accounts for only 9 percent of the severely inadequate units.[1] Similarly, wall and floor defects reported by the respondent may not be considered as hazardous or potentially dangerous according to the Section 8 Acceptability Criteria, although respondents may consider these conditions aesthetically disturbing. The inspection-based index which uses condition and surface ratings of the walls, ceilings and floors, shows the deficiency in only 7 percent of the cases. On the other hand, conditions classified as deficiencies by an inspector may not be reported by the respon-

[1]Heat deficiency is defined as having heating equipment which is rated "not working." If the deficiency is defined to include furnaces rated "apparently unsound" as well as "not working," the number of inadequate units increases to 8.8 percent and heat deficiencies account for 35 percent of the inadequate units.

TABLE B.13

DEFICIENCIES OBSERVED IN MODERATELY AND SEVERELY INADEQUATE UNITS
(Stayers without repairs--unweighted estimates)

	Interview-Based Adequacy Index Recipient (Stayers	Inspection-Based Adequacy Index Housing Quality Sample
Severely Inadequate Units		
Number of units	131	122
Percent with one deficiency only	88%	97%
Type of deficiency:		
Plumbing (lacking or shared)	15%	28%
Heating equipment	59%	9%
Electricity	1%	54%
Upkeep	25%	7%
Hallways	0	2%
Moderately Inadequate Units		
Number of units	109	120
Percent with one deficiency only	95%	95%
Type of deficiency:		
Kitchen (lacking or shared)	22%	38%
Unvented heating equipment	25%	25%
Toilet breakdowns	13%	13%
Upkeep	40%	14%
Hallways	0%	10%

Source: Pre-Program Information Form, Housing Quality Inspection Form dent. Electrical problems are very rarely reported by respondents, while they account for 54 percent of the problems for the inspection-based index. Electrical hazards may be the result of tenant installation of improper extension cords. Lack of plumbing or shared plumbing facilities are reported in 5 percent and 10 percent of the cases respectively. We reviewed these cases separately to investigate whether such units were located in congregate housing or group residences, or whether the deficiencies occurred more frequently for families eligible for studio-type apartments. We also checked whether families were sharing their unit with another family prior to program participation, so that the respondent would report sharing the plumbing facilities with that family rather than with the occupants of another apartment.[1] We did not find any systematic patterns that would justify treating these deficiencies as reporting errors. Such situations were in fact recorded during inspections (28 percent).[2] While the reported deficiencies appear to be real, they exist in one percent of all units occupied by stayers without repairs.[4]

The type of deficiencies reported for moderately inadequate units for stayers without repairs and for the Housing Quality sample are also presented in Table B.13. Again, upkeep problems and presence of unvented heating systems are the most frequently reported deficiencies for the interview-based index. Cases lacking complete kitchen facilities (19 percent) and shared kitchen (3 percent) underwent the same investigation described above without finding any systematic explanation. The inspection-based index also identifies this condition.

[1]Improper responses to this question by families sharing their preprogram units were identified during the early months of the Demonstration.

[2]Units lacking plumbing in the inspection sample either lacked some feature (hot water, flush toilet, tub or shower) or are reported as having facilities outside the unit, but not both.

[3]Inspection data indicate that the plumbing condition is found in about two percent of all recipient units.

B.4.4 Rental Vacancy Rates

We had initially planned to use the postal vacancy survey sponsored by the Federal Home Loan Bank to obtain vacancy rates for this study. This survey had the appealing feature of providing data at the zipcode level and for each year separately since 1980. When actually collecting the data, we learned about two major problems with this data source. First, the survey does not distinguish between rental and homeowner vacancy rates and second, it was not systematically conducted on a yearly basis for all localities referenced in the study. Instead, we relied on SMSA rental vacancy rates from the Census Bureau. The vacancy rates are unpublished data obtained from the Census Bureau.[1] The 1984 and 1985 rates were available for all larger PHAs with the exception of New Haven. In 1986 and 1987, the rates were also missing for Omaha. In addition to the Census data, we obtained vacancy rates and market condition descriptors for the majority of the sites. These data were prepared at HUD, based on HUD Field Office estimates and other sources such as U.S. Housing Markets and Caldwell-Banker Apartment Surveys. These estimates were used for the two sites lacking Census Bureau vacancy rates.

For most sites, the areas covered by the MSA and the PHA jurisdiction do not coincide exactly. In some cases, the PHA jurisdiction is limited to the central city. In others, the PHA jurisdiction excludes the central city and covers the remainder of the SMSA. In still other cases, the MSA includes a county which is outside the PHA jurisdiction or excludes a county which is part of the PHA jurisdiction. More disaggregated data, such as the Annual Housing Survey, which would have permitted a better matching of the areas are not available for recent years. The last AHS MSA survey released by Census refers to 1985 and covers only a few MSAs in the study.

The rental vacancy rates are shown in Table B.14 for 1984 through 1987. The last column shows the mean vacancy rate for each site. This number is a weighted average of family-specific vacancy rates. To create this family-specific vacancy rate, we assumed that each yearly vacancy rate reflected vacancy conditions as of July 1 of each year. A monthly adjustment factor was created:

[1] Unpublished data from the Current Population Survey, Housing Vacancy Survey, Series H-111, Bureau of the Census, Washington, DC 20233.

TABLE B.14

RENTAL VACANCY RATES
(Urban PHAs)

Site	1984	1985	1986	1987	Mean
Atlanta	5.9	6.4	6.3	6.4	6.3
Boston	4.9	3.8	4.3	4.0	4.1
Cleveland	6.7	4.8	5.3	5.3	5.2
Dayton	5.4	5.6	5.3	6.5	5.5
Erie	2.5	3.1	3.5	6.2	3.8
Los Angeles	3.4	3.7	3.5	4.4	3.7
Minneapolis	2.6	3.0	3.9	5.3	4.0
Montgomery	3.4	3.3	3.7	4.8	3.5
New Haven[a]	2.5	2.5	2.5	2.5	2.5
New York	2.2	2.6	2.5	2.4	2.5
Oakland	4.7	3.1	5.9	5.5	4.4
Omaha[b]	5.1	6.3	9.0	9.0	8.2
Pinellas	9.1	11.7	14.7	11.3	13.3
Pittsburgh	7.1	7.7	10.1	9.3	8.4
San Antonio	9.6	11.0	13.9	17.8	12.2
San Diego	2.8	4.4	5.4	6.2	5.2
Seattle	4.1	4.7	3.1	4.7	3.5

[a]The 1988 Field Office estimate was used for all years.

[b]The 1988 Field Office estimate was used for 1986 and 1987.

$$ADJ(m,t)_j = \frac{VR(t+1) - VR(t)}{12} \times m_j$$

where

$ADJ(m,t)_j$ = Adjustment factor for month m in year t for the j^{th} family

$VR(t+1)$ = Vacancy rate in year t+1

$VR(t)$ = Vacancy rate in year t

m_j = Month of issuance for the j^{th} family (July is month 1 and June is month 12)

and the vacancy rate applicable to the j^{th} family issued a certificate or housing voucher in month m of year t is defined as:

$$VR(m,t)_j = VR(t) + ADJ(m,t)_j$$

B.4.5 Reasons for Expiration or Surrender of Housing Certificates and Housing Vouchers

PHAs were asked to report why a family did not become a recipient on the Housing Search Log Form and the reason why a recipient terminated from the program on the Continued Participation Form. A list of reasons was provided on each form, including an "other" category and a "reason not known" as we were aware that unsuccessful families and terminees do not always inform PHAs of their whereabouts. Data entry specifications allowed for four circled reasons to be processed. Four reasons were very rarely checked on the form. The majority of the cases had one or two reasons reported. Recoded variables were created which summarized several reasons into one category. The derivation was performed using a priority system. Tables B.15A and B.15B show the expiration and termination reasons for each of the two programs. The order in which the reasons are listed in the tables reflect the priority system used in the derivation. For example, if the PHA reported "voluntary surrender" and "family moved out of the PHA jurisdiction," the variable was coded as "moved out of the PHA jurisdiction."

Overall, reasons do not differ much by program. As shown in Table B.15A, reasons were reported for only only 50 percent of unsuccessful families. For these families, the most frequently reported reason was difficulty in finding an acceptable unit (31 percent in the Housing Voucher Program and 35 percent in the Certificate Program). In both programs, 11 percent of the

TABLE B.15A

REASONS FOR EXPIRATIONS OR SURRENDER OF HOUSING CERTIFICATES AND HOUSING VOUCHERS
(Unweighted estimates)

	Housing Vouchers	Housing Certificates
Number of cases	2,302	2,470
Family became ineligible	1%	*
Family moved out of PHA jurisdiction		
With portability	1%	NA
Without portability	*	*
Voluntary surrenders	6	5
Family wanted to stay, but pre-program unit did not meet program requirements	11	11
Family wanted to move		
Could not find unit	11	12
Selected unit did not meet program requirements	20	23
Reason not known	50	49

Source: Housing Search Log Form, Part V, Question 2.

*Less than 1 percent.

families wanted to stay in their pre-program unit, but their unit could not meet the program requirements. Only 1 percent of those families had reported an attempt to look for another unit. The number of families that moved out of the PHA jurisdiction is too small to determine the effect of the housing Portability provision.

Table B.15B shows the same data for recipients who terminated from the program during their first year of participation in the program. More than 40 percent of the families in both programs terminated voluntarily, while 30 to 35 percent of the families were terminated at the initiative of the PHA or the landlord. One fifth of the Housing Voucher families that moved took advantage of the Portability provision.

B.4.6 Other Analytic Variables

A family is identified as having special arrangements in its pre-program unit if any of the following was reported in the Pre-Program Unit Interview:

- Family was homeless (living in a tent, car or shelter) or family lived in a hotel or motel
- Family was living in an institution, hospital, rooming/boarding house where the costs such as board or care were included in the rent
- Family was living with another family (subunit)
- Family was receiving help with rent from family, friends or government
- Family rent was reduced because family member was related to landlord or worked for landlord

A family was determined to be unlikely to meet the PHA occupancy requirements if the number of total rooms in the pre-program unit is less than the unit bedroom size specified by the PHA on the Certificate of Participation or Housing Voucher.

The income source variable was defined as follows:

- Salary if income from salary was greater than 66 percent of total gross income
- Social Security if income from Social Security was greater than 66 percent of total gross income

TABLE B.15B

REASONS FOR TERMINATIONS FROM THE CERTIFICATE AND HOUSING VOUCHER PROGRAMS
(Unweighted estimates)

	Housing Voucher Program	Certificate Program
Number of terminations	248	266
Death or institutionalization	6	8
Recertified ineligible	6	5
Moved out of PHA jurisdiction		
With portability	2	NA
Without portability	8	7
Owner initiated (eviction or other good cause)	9	12
Failure to comply with PHA/program requirements	14	14
Other unspecified PHA reasons	6	9
Family attempted to move, but did not find acceptable unit	2	4
Voluntary reason, specified	12	9
Voluntary rason, unspecified	35	32

Source: Continued Participation Form, Part VII, Question 2.

- Welfare if income from welfare was greater than 66 percent of total gross income
- Asset or other income if the sum of assets income or other income was greater than 66 percent of total gross income
- None of the above if none of the above income sources accounted for more than 66 percent of total gross income.

Tenant contribution is defined as the greatest of:

- 30 percent of net income,
- 10 percent of gross income, or
- Welfare rent, in "as-paid" states

in the Certificate Program, and as the greatest of

- Gross rent - (Payment Standard - 30 percent of net income) or
- 10% of gross income

in the Housing Voucher Program.

B.5 Payment Standard and FMR Schedule

At the outset of the Demonstration, the initial Payment Standard was set equal to the FMR, putting the two programs on an equal footing. PHAs are not generally obliged to maintain this equality. Both Fair Market Rents (FMRs) and Payment Standards are primary determinants of subsidy costs. In the Certificate Program, FMRs impose a ceiling on program rents and subsidies. Similarly, in the Housing Voucher Program, the subsidy is the difference between the Payment Standard and 30 percent of net family income. The funding mechanisms for the two programs, however, differ greatly. In the Certificate Program, HUD allocates a specific number of recipient slots to each PHA and then funds the subsidy costs for these slots as they are incurred. Higher subsidy costs as a result of higher FMRs are totally absorbed by HUD and do not affect the number of families that can be assisted. Revised FMRs are routinely adopted by PHAs every year.[1] The situation is different in the Housing Voucher Program. HUD funds a fixed five-year budget. Each PHA must then estimate how many recipients it can fund within the amount and monitor spending and adjust enrollment targets as appropri-

[1] PHAs have the option to file for amended FMRs if they disagree with the published FMRs. Revised FMRs are generally published a few months later.

ate. Increased Payment Standards imply higher average subsidy per recipient, but fewer families to be assisted. PHAs are therefore granted some flexibility in adopting new Payment Standards.

After the first year, PHAs could adopt any Payment Standard for new families (or families that move) as long as it did not exceed the FMR. In addition, PHAs could publish an Adjustment Standard to increase payments for families already in the program. Only two changes in Adjustment Standards were allowed within any five-year period. There was no limit on the number of times the schedules for new families and movers could be changed.[1]

FMRs for each market of the country are published by HUD each year, generally in the spring. The planned start-up date for all PHAs was April 1985. It was therefore expected that full lease-up (or close to full lease-up) would be achieved during the first year, before new FMRs were published. Instead, as a result of delays in start-up and slow lease-up in most PHAs, FMRs changed twice before all Demonstration Housing Vouchers and Certificates were under lease.

The FMRs published in the spring of 1986, along with additional changes that took effect on September 1986, raised FMRs in 16 of the 20 Demonstration sites. They were decreased in four other sites--Erie County, NY, Los Angeles, Seattle, and Alpena County, MI.[2] These changes were sometimes quite substantial. (See Table B.16). Eleven of the 16 PHAs with increased FMRs decided at that time not to raise their Payment Standards. In the Spring of 1987, some PHAs adopted new Payment Standards, but others did not. Overall in early 1987, only half of the PHAs had Payment Standards set to the level of their FMRs. The other sites had kept their Payment Standards at a lower level than their FMRs. (See Table B.17.)

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[1]In February 1987, the regulations were changed to establish a single Payment Standard Schedule, rather than the two earlier schedules (New Family/Mover Standard and Adjustment Standard for continuing occupancy). The new regulations allow two changes to Payment Standards for each unit size in any five-year period.

[2]Since the Payment Standard cannot exceed the FMR, when FMRs decrease, PHAs are required to establish a New Family/Mover Schedule and an Adjustment Standard Schedule at these lower amounts.

TABLE B.16

COMPARISON OF FMRs AND PAYMENT STANDARDS, FALL 1986

	PHA	0BR	1BR	2BR	3BR	4BR	5BR	Change in FMR	Change in P.S.
01	Atlanta								
	FMR	-	375	440	550	615	707	X	
	PS	287	344	397	486	535			
02	Boston								
	FMR	470	570	670	840	940		X	X
	PS	470	570	670	840	940			
03	Cleveland								
	FMR	283	344	404	505	566		X	
	PS	248	299	352	437	482			
04	Dayton								
	FMR	-	305	355	445	495		X	
	PS	-	303	355	439	488			
05	Erie Cty.[1]								
	FMR	263	319	375	469	525		X	X
	PS	263	319	375	469	525			
07	Los Angeles[1]								
	FMR	410	490	570	730	825		X	X
	PS	410	490	567	730	825			
08	Minneapolis								
	FMR	335	405	480	600	670	771	X	
	PS	328	388	451	554	611			
09	Montg. Cty.								
	FMR	408	498	583	714	780			
	PS	408	498	583	714	780			
10	New Haven								
	FMR	336	408	481	601	673	774	X	
	PS	310	369	431	536	591			
11	New York								
	FMR	330	400	470	590	680		X	X
	PS	330	400	470	590	680			
12	Oakland								
	FMR	452	549	646	808	904		X	X
	PS	452	549	646	808	904			
13	Omaha								
	FMR	265	321	378	473	530		X	
	PS	250	301	354	438	485			
14	Pinellas Cty.								
	FMR	286	347	409	511	573		X	
	PS	257	309	380	504	547			
15	Pittsburgh								
	FMR	280	340	400	500	560		X	X
	PS	280	340	400	500	560			
16	San Antonio								
	FMR	275	330	390	490	545	627	X	
	PS	273	330	385	472	524			
17	San Diego								
	FMR	375	460	540	675	755		X	X
	PS	N.A.	460	540	675	755			
18	Seattle[1]								
	FMR	325	395	460	595	655	753	X	X
	PS	325	395	460	595	655			
19	Michigan[3]							X	X
20	New Jersey[4]							X	

[1]FMRs Decreased.
[2]Not implemented yet.
[3]Different FMR schedule established by County. Payment Standard and FMR decreased in Alpena County.
[4]Different FMR schedules established by County. No change in Payment Standard.

TABLE B.17

COMPARISON OF FMRs AND PAYMENT STANDARDS, FALL 1987

	PHA	0BR	1BR	2BR	3BR	4BR	5BR	Change in FMR	Change in P.S.
01	Atlanta								
	FMR	–	407	477	613	705	811	X	X
	PS		375	440	550	615			
02	Boston								
	FMR	--	617	727	904	1,017	--	X	X
	PS	470	570	670	840	940			
03	Cleveland								
	FMR	291	355	415	519	582		X	
	PS	248	299	352	437	482			
04	Dayton								
	FMR	–	314	366	459	510		X	X
	PS	–	305	355	445	495			
05	Erie Cty.[1]								
	FMR	263	319	375	469	525			
	PS	263	319	375	469	525			
07	Los Angeles[1]								
	FMR	443	530	616	789	892		X	X
	PS	443	530	616	789	892			
08	Minneapolis								
	FMR	--	424	502	628	701	806	X	
	PS	328	388	451	554	611			
09	Montg. Cty.								
	FMR	393	478	563	707	792		X	
	PS	408	498	582	714	780			
10	New Haven								
	FMR	418	509	599	749	808	964	X	
	PS	310	369	431	536	591	680		
11	New York								
	FMR	353	428	503	631	706		X	X
	PS	353	428	503	631	706			
12	Oakland								
	FMR	487	591	696	974	1,120		X	X
	PS	487	591	696	974	1,120			
13	Omaha								
	FMR	273	331	390	488	547	629	X	X
	PS	273	331	390	488	547			
14	Pinellas Cty.								
	FMR	294	357	420	525	589		X	X
	PS	257	346	412	522	560			
15	Pittsburgh								
	FMR	--	354	416	520	582		X	X
	PS	291	354	416	520	582			
16	San Antonio								
	FMR	282	339	401	503	560	644	X	X
	PS	282	339	401	503	560	644		
17	San Diego								
	FMR	409	502	589	736	824		X	
	PS	375	460	540	675	755			
18	Seattle[1]								
	FMR	328	399	465	601	662	761	X	
	PS	325	395	460	595	655			
19	Michigan[3]							X	X
20	New Jersey[4]							X	X

[1] FMRs Decreased.
[2] Not implemented yet.
[3] Different FMR schedule established by County. Payment Standard and FMR decreased in Alpena County.
[4] Different FMR schedules established by County. Payment Standards are set to same level as FMR.

Discrepancies between FMRs and Payment Standards during the lease-up period may introduce a systematic difference between the two programs. To test the impact of these discrepancies, we constructed two variables that allow the identification of families that were issued and became recipients while the FMRs and Payment Standards were equal in the two programs. In all PHAs, this condition was met during the early months of issuance and lease-up as the Payment Standards were initially set equal to the FMRs. The period during which the schedules were equal varies from PHA to PHA, depending on the PHA start-up dates. San Antonio, the first PHA to start issuing Housing Vouchers, was in operation for one year when new FMRs were published. New Haven, on the other hand, had barely been in operation for five months when it adopted new FMRs and decided to keep its Payment Standards at their initial level. The PHA maintained two different payment schedules throughout the remainder of the lease-up period. Table B.18 shows when schedules were the same in the two programs for each PHA. The first column shows the months of lease-up activities before the 1986 FMR change became effective. The second column shows whether PHAs adopted Payment Standards equal to their FMRs during subsequent periods. Overall, 7 PHAs out of 17 never had equal payment schedules for the two programs after the Spring of 1986. Four of these PHAs kept their Payment Standards at their initial level throughout the period. All four adopted new Payment Standards in December 1987 or early 1988. The other three PHAs increased their Payment Standards in 1987, but not as much as their FMRs. Five PHAs, on the other hand, had identical schedules throughout the period. These PHAs adopted Payment Standards equal to the new published FMRs both in 1986 and 1987. Two of these five PHAs experienced decreases in FMRs in 1986 and were required to decrease their Payment Standards to the FMR level at that time. In 1987, as their FMRs increased, they decided to also increase their Payment Standards. Finally, some PHAs matched their Payment Standards to their FMRs in one of the two years, but not both. The two statewide PHAs adopted new Payment Standards in 1987. The schedule and effective dates of the changes, both for FMRs and Payment Standards, vary across counties. Matching schedules requires a county identifier which was not available on the data collection forms.

One variable was created to assign cases to the cohorts: (1) issued prior to the 1986 change in FMR, (2) issued later but schedules are the same in both programs, and (3) issued while the programs were maintaining different

TABLE B.18

PAYMENT STANDARD AND FMR SCHEDULES

Site	Initial Payment Standard Set Equal to FMR	Revised FMR Schedule, Payment Standard = FMR
Atlanta	July 1985-April 1986	--
Boston	October 1985-April 1986	September 1985-June 1987
Cleveland	November 1985-April 1986	--
Dayton	July 1985-August 1986	--
Erie*	October 1985-August 1986	September 1986-December 1987
Los Angeles*	November 1985-May 1986	June 1986-December 1987
Minneapolis	September 1985-April 1986	--
Montgomery	July 1985-April 1986	--
New Haven	December 1985-April 1986	--
New York	October 1985-April 1986	May 1986-December 1987
Oakland	July 1985-August 1986	September 1986-December 1987
Omaha	September 1985-April 1986	May 1987-December 1987
Pinellas	July 1985-April 1986	--
Pittsburgh	June 1985-September 1986	October 1986-December 1987
San Antonio	April 1985-April 1986	May 1987-December 1987
San Diego	September 1985-April 1986	May 1986-May 1987
Seattle*	October 1985-May 1986	June 1986-June 1987
Michigan*	October 1985-April 1986	Varies by county
New Jersey	June 1985-April 1986	Varies by county

*PHAs with decreased FMRs in 1986. Michigan was required to decrease its Payment Standard in one county.

schedules. First, each Payment Standard Schedule and FMR Schedule was assigned a sequence number. Second, each case was assigned the sequence number of the corresponding schedule based on the Payment Standard or FMR found in its record. (The corrected Payment Standard or FMR was used; see discussion above in Section B.3.2.) Using the sequence number, the effective date of the corresponding schedule and the issuance date for the case, a variable assigning the case to the appropriate issuance cohort was created and posted to the record. A second variable was created using the date of the Housing Assistance Payment or Housing Voucher contract to assign the case to the appropriate recipient cohort.

Table B.19 shows the proportion of the Demonstration sample that was issued and became recipients while the initial Payment Standards were in effect and during subsequent periods when the schedules were equal in the two programs. Overall, 50 percent of the cases became recipients during the first period, 30 percent under subsequent equal schedules, and 19 percent under different schedules. As expected, these proportions vary greatly across PHAs, as a result of different start-up dates and more or less rapid leasing rates during the early months of operations.

Two additional variables were created to indicate which FMR schedule was in effect for families which were issued a Housing Voucher or became recipients while FMRs and Payment Standards were different. These variables were used to assign Housing Voucher families the FMR which would have been in effect had they been in the Certificate Program, at the time of issuance and at the time they became recipients. These FMRs were used in special analyses reported in this report.

TABLE B.19

PROPORTION OF DEMONSTRATION SAMPLE ISSUED AND LEASED WHILE PAYMENT STANDARDS WERE THE SAME[a]

Site	Prior to Spring 1986		Later, Same Schedules		Later, Different Schedules	
	Issuances	Recipients	Issuances	Recipients	Issuances	Recipients
Atlanta	37%	22%	0%	0%	63%	78%
Boston	42	31	40	53	18	15
Cleveland	52	30	0	0	48	70
Dayton	86	74	0	0	14	26
Erie	54	52	46	48	0	0
Los Angeles	50	46	50	54	0	0
Minneapolis	31	27	0	0	69	73
Montgomery	93	83	0	0	7	17
New Haven	65	45	0	0	35	55
New York City	39	41	61	59	0	0
Oakland	93	93	7	7	0	0
Omaha	46	40	21	21	33	39
Pinellas	57	47	0	0	43	53
Pittsburgh	89	87	11	13	0	0
San Antonio	74	70	0	0	26	30
San Diego	49	47	50	52	*	*
Seattle	30	30	69	69	*	*
Total	52	50	35	30	14	19

[a]PHAs with decreased FMRs in 1986. Michigan was required to decrease its Payment Standard in one county.

*Less than 1 percent.

APPENDIX C

ESTIMATION METHODOLOGY FOR NATIONAL ESTIMATES

This Appendix discusses the technical details of our analytic approach to the Demonstration. While most of the techniques used are quite straightforward, it seemed desirable to document the specifics of the estimates and test statistics. The analysis was in general concerned with three topic areas:

1. Comparison of estimated program outcomes across all large, urban PHAs (referred to as national estimates).
2. Examination of patterns of outcomes across a limited set of demographic and/or locational descriptors.
3. Estimation and analysis of models of behavior.

This appendix concerns the first of these. Appendices E and D deal with topics 2 and 3, respectively.

As described in Appendix A, the 20 PHAs included in the study consist of a sample of 18 large urban PHAs, drawn for HUD by Westat. For the purposes of this section, it is sufficient to say that each of the 106 large urban PHAs had a known probability, P_i, of being included in the sample.[1] These 106 PHAs accounted for over 290,000 certificates--somewhat more than one-third of the Section 8 Existing program slots in 1984.

Once PHAs were selected, a target number of Housing Voucher slots for each bedroom size was established, together with an equal number of Certificate slots. The latter are referred to as flagged Certificate slots to distinguish them from the bulk of the current Certificate program in each PHA. Thereafter, applicants to the Section 8 Housing program were randomly assigned to either the Section 8 Housing Voucher program or the Section 8 Housing Certificate program until the targeted numbers of recipients were achieved.

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[1]The exact sample frame was non-statewide PHAs within the contiguous U.S. containing an urban area of at least 50,000 persons with at least 1,000 authorized Section 8 Existing Housing certificates in January 1984--excluding 6 PHAs which were deemed by HUD to be inappropriate (Dietz et al., p. 3-1).

Results for the two statewide agencies can be regarded as indicative of outcomes in less urban areas. Results for the sample of 18 large urban PHAs can be used to estimate results for the entire population of large urban PHAs. For convenience, we refer to these as national estimates, though it should be recalled that they are national estimates for large urban PHAs only.[1]

The remainder of this section discusses the general methods involved in developing the appropriate national estimates and the specific estimation techniques used in this report.

Section C.1 discusses estimation of the mean and variance of various variables for recipients. Section C.2 discusses test statistics for program differences. Section C.3 considers outcomes such as success rates that involve all participants whether they became recipients or not. Section C.4 discusses estimates for subpopulations.

C.1 National Estimates for Recipients

The sample of recipients is a probability sample of recipients stratified by bedroom size within a sample of PHAs. Accordingly, estimators are developed in stages, as usual. Special attention needs to be paid to the decision to normalize weights. Further, because the sample is drawn in two stages, the error of estimate reflects both the variation of outcomes across individuals within PHAs and the variation across PHAs.

The key estimators are summarized in Table C.1. They are generally quite conventional. The issues involved--principally in deciding whether to normalize weights and in using upper bounds for some variance estimates--are discussed in the following text.

[1]As discussed in Appendix A, one of the PHAs in the urban sample had to be dropped from the analysis. Since there was another sampled PHA in the same stratum, this was accommodated by assigning the full stratum weight to the remaining PHA.

Table C.1

FORMULAS FOR BASIC ESTIMATES

Weights

Weights for bedroom sizes	$a_{jr} = \frac{N_{jr}}{N_j}$
PHA weights	$w_j = \frac{1}{P_j}(N_j/N)/\sum(\frac{1}{P_j})(N_j/N)$

Program Means

Estimated mean for k^{th} program in j^{th} PHA in r^{th} bedroom size category	$\hat{y}^k_{jr} = (\sum_i y^k_{ijr})/n^k_{jr}$
Estimated mean of k^{th} program in j^{th} PHA	$\hat{y}^k_j = \sum_r a_{jr}\hat{y}^k_{jr}$
Estimated mean of k^{th} program	$\hat{y}^k = \sum_j \delta_j w_j \hat{y}^k_j$

Difference Between Programs

Estimated mean difference between programs	$\hat{\Delta}(x) = \hat{x}^v - \hat{x}^c$

Table C.1 (cont.)

FORMULAS FOR BASIC ESTIMATES

Within-PHA Variances

Variance in j^th PHA	$\hat{\sigma}^2_{kj} = \sum_r\sum_i(y^k_{ijr} - \hat{y}^k_{jr})^2/(n^k_j - m_j)$
Errors of estimate given the sample of PHAs	$\hat{V}_2(\hat{y}^k_{jr}) = \hat{\sigma}^2_{kj}/n^k_{jr}$
	$\hat{V}_2(\hat{y}^k_j) = \sum_r a^2_{jr}\hat{V}_2(\hat{y}^k_{jr})$
	$\hat{V}_2(\hat{y}^k) = \sum_j w^2_j\hat{V}_2(\hat{y}^k_j)$

Within-PHA Variances for Difference

Error of estimate for mean difference given a sample of PHAs	$\hat{V}_2(\Delta(x)) = \hat{V}_2(\hat{x}^v)+V_2(\hat{x}^c)$

Across-PHA Variance

Variance across PHAs	$\hat{M}(\hat{z}) = [\sum w\ (\hat{z}_j-\hat{z})^2 - \sum w_j(1-w_j)\hat{V}_2(\hat{z}_j)]\ (\frac{t}{t-1})$
	$\hat{z}_j = \hat{y}_{jr}, \hat{y}a_j, \hat{\Delta}_{jr}, \hat{\Delta}_j$
	$\hat{z} = \hat{y}^k_r, \hat{y}^k, \hat{\Delta}_r, \hat{\Delta}$

Table C.1 (cont.)

FORMULAS FOR BASIC ESTIMATES

Error of estimate associated with selection of PHAs	$\hat{V}_1(\hat{z}) = M(\hat{z})/t$

Total Variance

Total error of estimate	$\hat{V}_0(\hat{z}) = \hat{V}_2(\hat{z}) + \max\,(0, \hat{V}_1(\hat{z}))$

Definitions

a_{jr} = Weight for r^{th} bedroom size category in j^{th} PHA

N_{jr} = The number of Certificate program slots in the j^{th} PHA and r^{th} bedroom size category at the start of the Demonstration (1984)

N_j = Total number of Certificate program slots in the j^{th} PHA at the start of the Demonstration $(=\sum_r N_{jr})$

w_j = Weight for the j^{th} PHA

P_j = The probability of selection of the j^{th} PHA

$\hat{y}^k_{jr}$ = The estimated mean outcome in the k^{th} program in the j^{th} PHA and r^{th} bedroom size category

n^k_j = The number of observations in the k^{th} program in the j^{th} PHA $(= \sum_r n^k_{jr})$

Table C.1 (cont.)

FORMULAS FOR BASIC ESTIMATES

m_j = The number of PHA/bedroom size categories in the sample in the j^{th} PHA

y^k_{ijr} = The outcome of the i^{th} person in the k^{th} program in the j^{th} PHA and r^{th} bedroom size category

n^k_{jr} = Number of observations in the k^{th} program in the j^{th} PHA in the r^{th} bedroom size category

$\hat{y}^k_j$ = The estimated mean outcome for the k^{th} program in the j^{th} PHA

$\hat{\bar{y}}^k$ = The estimated mean outcome for the k^{th} program in all large urban PHAs

δ_j = 1 if the j^{th} PHA is included in the Demonstration, zero otherwise

$\hat{\Delta}(\cdot)$ = Estimated difference in mean program outcomes for $(\cdot)$.

$\hat{\sigma}^2_{kj}$ = The estimated within-PHA variance of outcomes across individuals in the k^{th} program

$\hat{V}_2(\cdot)$ = The estimate of the variance of estimate of $(\cdot)$ given the sample PHAs--that is, the component of variance of $(\cdot)$ arising from variation within PHAs

$\hat{M}(\cdot)$ = The estimated variance in mean outcome $(\cdot)$ across PHAs

$\hat{V}_1(\cdot)$ = The estimated component of the error of estimate due to variation across PHAs.

$\hat{V}_0(\cdot)$ = The estimated total variance of estimate of $(\cdot)$.

C.1.1 Means

We can estimate the mean outcome associated with recipients in the k^{th} program in the j^{th} PHA and r^{th} bedroom size category[1] by

$$(1) \qquad \hat{y}^k_{rj} = \sum_i y^k_{ijr}/n^k_{jr}$$

where

y^k_{jr} = The estimated mean outcome for the k^{th} program in the j^{th} PHA and r^{th} bedroom category

y^k_{ijr} = Actual outcome for the i^{th} sampled recipient in the k^{th} program in the j^{th} PHA and r^{th} bedroom category

n^k_{jr} = The sample size in the k^{th} program in the j^{th} PHA and r^{th} bedroom category.

We then estimate outcomes for the j^{th} PHA and k^{th} program by

$$(2) \qquad \hat{y}^k_j = \sum_r a_{jr}\hat{y}^k_{jr} = \sum_r \sum_{i=1}^{n^k_{jr}} a_{jr}y^k_{ijr}/n^k_{jr}$$

where

$\hat{y}^k_j$ = The estimated average costs for the k^{th} program in the j^{th} PHA

a_{jr} = Weights for the r^{th} bedroom size category in the j^{th} PHA (set equal to the actual proportion of the j^{th} PHA's Section 8 (Existing) units that were in the r^{th} bedroom size category at the beginning of the Demonstration (as reported by the PHA)

[1]The bedroom size categories were 0 or 1, 2, 3, and 4 or more.

$\hat{y}^k_{jr}$ = Estimated average costs for the k^{th} program in the j^{th} PHA and r^{th} bedroom size category (from Eq. (1)).

We can construct national estimates for all large urban PHAs as a weighted average of PHA or PHA/bedroom size estimates:

$$\text{(3)} \qquad \hat{y}^k = \sum_j \delta_j w_j \hat{y}^k_j = \sum_j \sum_r \delta_j w_j a_{jr} \hat{y}^k_{jr}$$

$$\text{(4)} \qquad w_j = (\delta_j N_j / NP_j) / (\sum_{\text{sample}} \delta_j N_j / NP_j)$$

where

$\hat{y}^k$ = The estimated average outcome for the k^{th} program

w_j = The weight for the j^{th} PHA

δ_j = One if the PHA is in the Demonstration sample, and zero otherwise

$\hat{y}^k_j$ = The estimated average outcome for the k^{th} program in the j^{th} PHA (from Eq. (2)

N_j = The number of Certificate program units in the j^{th} PHA at the start of the Demonstration

N = Total number of Certificate units in all Demonstration PHAs $(=\Sigma\delta_j N_j)$

P_j = The probability of selection for the j^{th} PHA.

Alternatively, we can rewrite Eq. (3) in terms of a weighted average of individual outcomes:

$$(5).\qquad \hat{y}^k = \sum_j \sum_r \sum_{i=1}^{n^k_{rj}} \delta_j c^k_{jr} y^k_{ij}$$

$$(6)\qquad c^k_{jr} = \delta_j N_{jr}/(P_j n^k_{jr})/(\sum_j \sum_r N_{jr}/P_j)$$

The sampling took place in two stages: first, PHAs were sampled, then individuals within PHAs. In general, for any random variable, x,

$$(7)\qquad E(x) = E_1(E_2(x))$$

$$(8)\qquad Var(x) = E_1(Var_2(x)) + Var_1(E_2(x))$$

where subscripts refer to the sampling stage over which expectations are taken. First consider the expected value of $\hat{y}^k$.

$$(9)\qquad E_2(\hat{y}^k) = \sum_j w_j \delta_j \sum_4 \frac{N_{jr}}{N_j} \mu^k_{jr} = \sum_j w_j \delta_j \mu^k_j$$

where the summation is over all large PHAs in the universe, and

δ_j = 1 if the j^{th} PHA is included in the sample and 0 otherwise

μ^k_{jr} = The mean outcome for the k^{th} program in the j^{th} PHA and r^{th} bedroom size

μ^k_j = The mean outcome for the k^{th} program in the j^{th} PHA

N_{jr} = The number of units for the k^{th} program in the j^{th} PHA and r^{th} bedroom size

N_j = The number of units for the k^{th} program in the j^{th} PHA

Taking the expectation of Eq. (9) over the first sampling stage, yields

$$(10)\qquad E_1(E_2(\hat{y}^k)) = \sum_j P_j E(w_j | \delta_j = 1) \mu^k_j$$

The troublesome term in this equation is $E(wj|\delta_j=1)$. This reflects the fact that the weights of Eq. (4) are normalized to sum to one; accordingly, the weight for any site will vary across samples (except in the special case in which the probability of selection for each PHA is proportional to size so that the sum of the unnormalized weights is constant across samples of sites).[1] Thus, it is difficult to evaluate $E(w_j|\delta_j=1)$ without detailed examination of the selection process. We can, however, express the expectation of the normalized estimator in terms of the expectation of an estimator based on unnormalized weights, $\tilde{w}_j$.

Let

(11) $\hat{\tilde{y}}^k = \sum \tilde{w}_j \delta_j \hat{y}_j^k$

(12) $\tilde{w}_j = N_j/NP_j$

where

$\hat{\tilde{y}}^k$ = The estimator with unnormalized PHA weights

$\tilde{w}_j$ = The unnormalized weight of the j^{th} PHA

other terms = As in Eq. (9)

Thus, parallel to Eq. (9)

(13) $E_2(\hat{\tilde{y}}^k) = \sum_j \tilde{w}_j \delta_j \mu_j^k = \sum_j (N_j/NP_j)\delta_j \mu_j^k$

Since the sample indicators (δ_j) are equal to one with probability P_j and to zero with probability $(1-P_j)$,

(14) $E_1(E_2(\hat{\tilde{y}}^k)) = \sum_j P_j(N_j/NP_j)\mu_j = \sum_j (N_j/N)\mu_j^k = \mu^k$

where

[1] If the probability of selection is proportional to size then the sum of the weights is constant across samples.

μ^k = The mean outcome in the k^{th} program among all larger urban PHAs.

Thus the unnormalized estimator ($\hat{\tilde{y}}^k$) is unbiased. But we can write the unnormalized estimator as the product of the normalized estimator ($\hat{y}^k$) and the sum of the unnormalized weights ($\Sigma\tilde{w}_j$):

(15) $$\hat{\tilde{y}}^k = (\sum \delta_j \tilde{w}_j)(\hat{y}^k)$$

(16) $$E_2(\hat{\tilde{y}}^k) = (\sum \delta_j \tilde{w}_j) E_2(\hat{y}^k)$$

Thus

(17) $$E(\hat{\tilde{y}}^k) = E(\sum \delta_j \tilde{w}_j) E(\hat{y}^k) + \rho\sigma_w\sigma_y$$

where

ρ = The correlation across samples of sites between $(\Sigma\delta_j\tilde{w}_j)$ and $E_2(\hat{y}^k)$

σ_w = the standard deviation across samples of sites of $(\Sigma\delta_j\tilde{w}_j)$

σ_y = The standard deviation across samples of sites of $E_2(\hat{y}^k)$

Note that $E(\delta_j\tilde{w}_j)$ is one. Accordingly, if $(\Sigma\delta_j\tilde{w}_j)$ is uncorrelated with $E_2(\hat{y}^k)$--that is, if $\rho=0$ in Eq. (17)--then $\hat{y}^k$ is also unbiased. Since $(\Sigma\delta_j\tilde{w}_j)$ is uncorrelated with w_j,[1] this amounts to asserting that high-weight sites are not systematically more likely to have higher or lower outcome levels.

[1]In essence, given a random sample of sites whose unnormalized weights sum to a given value, S, then the expected weight for a sample site chosen at random from the sampled set is S/n. Accordingly the expected normalized weight is 1/n, regardless of the value of S.

C.1.2 Normalizing Weights

The reason for worrying about normalized weights rather than simply adopting the unnormalized estimator is the variance of the two estimators. These are related by[1]

$$(18) \qquad Var(\hat{\tilde{y}}^k) = (\mu_w)^2\sigma_y^2 + (\mu_y)^2\sigma_w^2 + \sigma_y^2\sigma_w^2 + Cov(\sum\tilde{w}_j\delta_j)^2, (E_2(\hat{y}^k))^2)$$

where

μ_w = Mean across samples of sites of $\Sigma\Delta_j\tilde{w}_j$ (=1)

μ_y = Mean across samples of sites of $E_2(\hat{y}^k)$ ($=\mu^k$)

σ_y^2 = Variance across samples of sites of $E_2(\hat{y}^k)$

σ_w^2 = Variance across samples of sites of $\Sigma\Delta_j\tilde{w}_j$

ρ = Correlation across samples of sites between $E_2(\hat{y}^k)$ and $\Sigma\Delta_j\tilde{w}_j$

Recalling that $\mu_w = 1$ and that if $\rho = 0$, then $\mu_y = \mu^k$, we have that if $\rho = 0$:

$$(19) \qquad Var(\hat{y}^k) = \sigma_y^2 \leq \frac{Var(\hat{\tilde{y}}^k) - (\mu^k)\ \sigma_w^2}{1 + \sigma_w^2} < Var(\hat{\tilde{y}}^k)$$

(unless $\Sigma\delta_j\tilde{w}_j$ is one across all samples).

The content of the lower variance of the normalized estimator may be clarified by considering the estimate for total rather than mean outcomes. An unbiased estimate of a total program outcome (for example, total program costs) is given by

$$(20) \qquad \hat{y}^k = \sum(N_j/P_j)(\hat{y}_j^k)$$

where:

[1] Kendall, p. 343.

Y^k = The estimate of total outcomes in the k^{th} program

N_j = The number of program slots in the j^{th} PHA

P_j = The probability of selection of the j^{th} PHA

$\hat{y}_j^k$ = The average outcome for the k^{th} program in the j^{th} PHA

In effect, to arrive at an estimate of, for example, total program costs, we find average costs per recipient in each sampled PHA and then extrapolate these to all (large, urban) PHAs by letting each sampled PHA represent (N_j/P_j) total recipients. When we want to estimate overall average costs per recipient, we have two choices: first, we can use normalized weights and divide the estimated total costs by the implied number of recipients in our extrapolation $(\Sigma N_j/P_j)$; alternatively, we can say that we know the total number of recipients and use unnormalized weights, dividing by the known total number of program recipients in the universe, regardless of the factors used to extrapolate costs. In our particular sample, the PHA weights sum to less than one. Without normalization, we would in effect extrapolate total costs to a universe with 282,616 recipients and then determine average rents paid by dividing by 293,258 recipients, scaling down average costs by a factor of 0.9637. This seems implausible.[1]

Accordingly, we have chosen throughout this report to use normalized weights--assuming that given the design of the sample allocation across PHA size and region (see Appendix A), average outcomes were not systematically related to the probability of selection (and thus the sample weights). Readers who do not wish to adopt this assumption may multiply estimates by a factor of 0.9637.

[1]As indicated in Appendix A, this may be the factor behind Bryant et al.'s suggestion that a potentially biased estimator (whose weights always sum to one) be considered when drawing samples following the procedures and by Westat in drawing the sample of Demonstration PHAs.

C.1.3 Error of Estimate

Now consider the variance of $\hat{y}^k$. Eq. (8) decomposed the variance into two pieces--$E_1(Var_2(\hat{y}^k))$, the expected value across samples of sites of the variance of $\hat{y}^k$ for a given sample of sites, and $Var_1(E_2(\hat{y}^k))$, the variance across samples of sites of the expected value of $\hat{y}^k$ for a given sample of sites. Consider first the variance of $\hat{y}^k$ given the sample of sites selected:

$$(21) \qquad V_2(\hat{y}^k) = \sum_j w_j^2 \delta_j \sum_r \left(\frac{N_{jr}}{N_j}\right)^2 \frac{\sigma_{kjr}^2}{n_{jr}}$$

where

σ_{kjr}^2 = The variance of the outcome across individuals in the k^{th} program and j^{th} PHA and r^{th} bedroom size

n_{jr} = The sample size in the j^{th} PHA and r^{th} bedroom size

$V_2(\cdot)$ = The variance of estimate of $(\cdot)$ over the second sampling stage

This is the variance of $\hat{y}^k$ given the PHAs actually sampled and formed the basis for our calculation of standard errors based on within-PHA variation. To estimate $V_2(\hat{y}^k)$ we need estimates of σ_{kjr}^2. The usual sampling estimator for σ_{kjr}^2 is, of course,

$$(22) \qquad \hat{\sigma}_{kjr}^2 = \sum_i (y_{ijr}^k - \bar{y}_{jr}^k)^2/(n_{jr}^k - 1)$$

However, the sample sizes for individual strata are sometimes small. Given the sensitivity of the error of estimate for variances to sample size, especially for proportions,[1] we chose instead to assume that individual variance was constant across PHAs and bedroom sizes so that

$$\sigma^2_{kjr} = \sigma^2_{kj} \tag{23}$$

In this case the appropriate estimator is

$$\hat{\sigma}^2_{kj} = \sum_i \sum_r (y^k_{ijr} - \bar{y}^k_{jr})^2/(n^k_j - m_j) \tag{24}$$

where

y^k_{ijr} = The outcome of the i^{th} person in the k^{th} program in the j^{th} PHA and r^{th} bedroom size

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[1]If we use the usual estimate of variance for some variable, x, then

$$\hat{\sigma}^2 = (x_i - \bar{x})^2/(n-1)$$

$$E(\hat{\sigma}^2) = \sigma^2$$

$$V(\sigma) = \frac{\mu_4 - \sigma^4}{n} + \frac{2\sigma^4}{(n-1)(n)}$$

where μ_4 is the fourth moment around the mean (Kendall and Stuart, p. 244, ex. 10.13). Accordingly, the squared coefficient of variation (the ratio of $V(\hat{\sigma}^2)$ to $(E(\hat{\sigma}^2)^2)$ is given by

$$(CV)^2 = \frac{1}{n}\left(\frac{q_4}{\sigma^4} - 1\right) + \frac{2}{(n-1)(n)}$$

Thus the CV involves a term in the square of n and at small samples is quite sensitive to increases in sample size. This is most obvious in the case of proportions, where the chances of having a zero estimate ($\hat{p}$ = 0 or 1) are substantial for small n.

If x is normally distributed, this becomes

$$(CV)^2 = \frac{2}{n} + \frac{2}{(n-1)(n)}$$

$\bar{y}^k_{jr}$ = The mean outcome for the k^{th} program in the j^{th} PHA and r^{th} bedroom size

n^k_j = The number of observations in the k^{th} program in the j^{th} PHA

m_j = The number of bedroom size categories in the j^{th} PHA

Our estimator for $E_1(V_2(\hat{y}^k)$ is:

$$(25) \qquad \text{Est } E_1 \; (V_2(\hat{y}^k)) = \sum_j w_j^2 \delta_j^2 \sum_r (\frac{N_{jr}}{N_j})^2 \frac{\hat{\sigma}^2_{kj}}{n^k_{jr}}$$

Under the assumptions of Eq. (30), $\hat{\sigma}^2_{kj}$ is an unbiased estimate of σ^2_{kjr} so that

$$(26) \qquad E_2[\text{Est } E_1(V_2(\hat{y}^k))] = V_2(\hat{y}^k))$$

and, obviously,

$$(27) \qquad E_1(E_2[\text{Est } E_1(V_2(\hat{y}^k))]) = E_1(V_2(\hat{y}^k))$$

The assumption of Eq. (23) is computationally convenient and seems innocuous. Indeed, Eq. (25) will still be satisfied if σ^2_{kjr} is simply uncorrelated with the weights.

The hard part is the second expression in Eq. (8)--$V_1(E_2(\hat{x}))$. This is given by

$$(28) \qquad V_1(E_2(\hat{x})) = E_1(\sum_j w_j \delta_j \mu^k_j - \sum_j P_j w_j \mu^k_j)^2$$

or

$$(29) \qquad V_1(E_2(x)) = (y'Qy)$$

where

$$y' = (w_1 u_1^k, \ldots, w_T u_T^k)$$

$$Q = E_1[(\delta_j - P_j)(\delta_j - P_j)')]$$

$$T = \text{The total number of PHAs in the universe}$$

The problem in evaluating this is that the elements of the vector $(\delta_j - P_j)$ are not independent of each other--that is, under the sampling scheme used to draw the sites, the selection of one site affects the probability of selection of the remaining sites. $Var_1(E_2(x))$ can be estimated by various techniques.[1] For this report, however, we took an especially simple approach. We assumed that the stratifications used by Westat in drawing the sample of large urban PHAs were in fact more efficient than a simple alternative scheme. We then used the variance under this alternative scheme to provide an upper bound on the variance under the sampling method actually used.

Specifically, Westat could have broken the PHAs into 16 strata of equal size (in terms of numbers of units) and sampled one PHA per stratum with probability proportional to size. Under this method, the Q-matrix from Eq. (29) would have been given by

$$(30) \qquad E(\delta_i - P_i)^2 = P_i(1 - P_i)$$

$$(31) \qquad E(\delta_i - P_i)(\delta_j - P_j) = \begin{cases} 0 & \text{if i and j are in different strata} \\ -(P_i P_j) & \text{if i and j are in the same strata} \end{cases}$$

Thus

$$(32) \qquad y'Qy = \sum_s \sum_j y_{js}^2 P_{js} - \sum_s (\sum P_{js} y_{js})^2$$

where

[1]See Dietz et al. Although there is an estimator for $V_1(E_2(x))$ under the general procedures proposed by Bryant et al., this estimator does not apply to the procedure as implemented by Westat. Accordingly only asymptotic estimators are available.

y_{js} = The value of y (Eq. 29) for the j^{th} PHA in the s^{th} stratum

P_{js} = The probability of selection for j^{th} PHA in the s^{th} stratum

Since under the hypothesized sample scheme one site would be selected in each stratum, the values of P_{js} and w_{js} are given by

(33) $$P_{js} = N_{js}/N_s$$

$$w_{js} = \frac{N_{js}}{N} \cdot \frac{1}{P_{js}} = \frac{N_s}{N} = t$$

where

P_{js} = The probability of selection for the j^{th} PHA in the s^{th} stratum

N_{js} = The size of the j^{th} PHA in the s^{th} stratum

N_s = The size of the s^{th} stratum

t = The number of sites in the sample (= N/N_s since all strata have equal sizes by assumption).

Substituting Eq. (32) into Eq. (28) and (32) yields:

(34) $$y'Qy = \sum_s \left(\frac{N_s}{N}\right)^2 \sum_j \frac{N_{js}}{N_s} \mu_{js}^2 - \sum_s \left(\frac{N_s}{N}\right)^2 \left(\sum_j \frac{N_{js}}{N_s} \mu_{js}\right)^2$$

$$= \frac{1}{t^2} \left(\sum_s \sum_j \frac{N_{js}}{N_s} \mu_{js}^2 - \sum_s \left(\sum_j \frac{N_{js}}{N_s} \mu_{js}\right)^2\right)$$

$$= - \left[\frac{\sum_s \sum_j \left(\frac{N_{js}}{N_s}(\mu_{js} - \sum_j \frac{N_{js}}{N_s} \mu_{js})\right)}{t}\right]$$

$$= \frac{\sum\limits_{s}\sum\limits_{j} \left(\frac{N_{js}}{N_s}(\mu_{js} - \frac{1}{t}\sum\limits_{s}\sum\limits_{j} \frac{N_{js}}{N_s}\mu_{js})2\right)}{t} - \frac{1}{t}\sum_{s} \frac{(\sum \frac{N_{js}}{N_s}\mu_{js} - \frac{1}{t}\sum\limits_{s}\sum\limits_{j} \frac{N_{js}}{N_s}\mu_{js})^2}{t}$$

$$\leq \frac{1}{t} \frac{\sum\limits_{s}\sum\limits_{j} \left(\frac{N_{js}}{N_s}(\mu_{js} - \frac{1}{t}\sum\limits_{s}\sum\limits_{j} \frac{N_{js}}{N_s}\mu_{js})^2\right)}{t}$$

$$= \frac{1}{t}\sum_{s}\sum_{j} \frac{N_{js}}{N} (\mu_{js} - \sum_{s}\sum_{j} \frac{N_{js}}{N} \mu_{js})^2$$

But the last expression is simply the inter-site variation. Thus

(35) $V_1(E_2(x)) < \sigma_s^2/t$

where

σ_s^2 = The inter-site variation

t = The number of sites

Given the relationship of Eq. (35), we used an upward biased estimate of σ_s^2 to establish an upper bound on $Var_1(E_2(\hat{x}))$ and hence on $Var(\hat{x})$. Our estimate of σ_s^2, the inter-site variance, was derived as follows. We now want to drop the stratum notation and return to our previous notation, since we have to develop the estimator from the actual sample. Suppressing bedroom size subscripts and considering only PHA-level statistics, we can rewrite Eq. (35) as

(36) $$V_1(E_2(\hat{y})) \leq \frac{\sum (N_j/N)\ (\mu_j - \mu)^2}{t}$$

and estimate the right-hand side of Eq. (36) by

(37) $$\text{Est}\ \left(\frac{\sum (N_j/N)\ (\mu_j - \mu)^2}{t}\right) = \frac{1}{t}\hat{M}$$

(38) $$\hat{M} = \frac{t}{t-1}\ [\sum_j w_j \delta_j \hat{y}_j^2 - \sum w_j(1-w_j)\delta_j \hat{V}_2(\hat{y}_j) - \hat{y}^2]$$

where

$$\mu = \sum (N_j/N)\mu_j$$

$$\hat{y} = \sum w_j \hat{y}_j \delta_j$$

$$w_j = (\frac{N_j}{N})(1/P_j)$$

and

μ_j = The true mean for the j^{th} PHA

$\hat{y}_j$ = An estimator for μ_j distributed $(\mu_j, \sigma_j^2)^1$

$\hat{V}_2(\hat{y}_j)$ = An unbiased estimate of $V_2(\hat{y}_j)$--the variance of $\hat{y}_j$ over the second sampling stage

N_j = The size of the j^{th} PHA

P_j = The probability of selection of the j^{th} PHA

δ_j = 1 if the j^{th} PHA is selected, zero otherwise.

Recall that for any random sample, the sample moments around zero are unbiased estimates of the population moments. In particular, the second moment has the expectation

$$(39) \qquad E(x^2) = [E(x)]^2 + Var(x)$$

Now consider the expected value of the variable $\hat{M}$ defined in Eq. (38).

(40):

$$E_2(\hat{M}) = \frac{t}{t-1} [\sum_j w_j \delta_j E(\hat{y}_j^2) - \sum w_j (1-w_j)\delta_j E(\hat{V}_2(\hat{y}_k) - E(\hat{y}^2)]$$

$$= \frac{t}{t-1}\{\sum w_j\delta_j(\mu_j^2 + V_2(\hat{y}_j) - \sum w_j(1-w_j)\delta_j V_2(\hat{y}_j) - [(\sum w_j\delta_j\mu_j)^2 + \sum w_j^2\delta_j^2 V(\hat{y}_j)]\}$$

$$= \frac{t}{t-1}\ \{\ \sum w_j\delta_j\mu_j^2 - (\sum w_j\delta_j\mu_j)^2\ \}$$

(41) $$E_1(E_2(\hat{M})) = \frac{t}{t-1}\ [\sum P_j w_j\mu_j^2 - (\sum w_j P_j\mu_j)^2 - V_1(\sum w_j\delta_j\mu_j)]$$

$$= \frac{t}{t-1}\ [\sum P_j w_j\mu_j^2 - \mu^2 - V_1(E_2(\hat{y}))]$$

$$= \frac{t}{t-1}\ [\sum \frac{N_j}{N}\ (\mu_j - \mu)^2 - V_1(E_2(\hat{y})]$$

Substituting from Eq. (36) yields:

$$E_1(E_2(\hat{M})) = \frac{t}{t-1}[t(V_1(E_2(\hat{y})) + \varepsilon) - V_1(E_2(\hat{y}))],\ \varepsilon>0$$

$$= tV_1(E_2(\hat{y})) + \frac{t^2}{t-1}\ \varepsilon,\ \varepsilon>0$$

Accordingly, $(\hat{M}/t)$ is an upper bound estimator for $Var_1(E_2(\hat{y}))$ under the stated conditions.[1]

The estimated total variance for an estimate is then bounded by (42):

$$\left\{ \begin{array}{l} \text{Estimated Upper Bound} \\ \text{for Total Variance of} \\ \hat{y}^k \end{array} \right\} = \left\{ \begin{array}{c} \text{Est of } (E_1(Var_2(\hat{y}^k)) \text{ from Eq. (25)} \\ \text{plus} \\ \text{Est of } (Var_1(E_2(\hat{y}^k) \text{ from Eqs. (36) to (38)} \end{array} \right\}$$

In fact, as discussed in Appendix A, the procedure used to draw the sample of PHAs may or may not be more efficient than a simple stratification.

[1]Put another way, $\hat{M}$ is an upper bound estimator for the inter-PHA variance (σ_s^2).

(Unfortunately, Dietz et al. does not provide the information necessary to judge this in more detail for this case.) Thus, the bound for inter-PHA variation established by Eq. (34) may or may not hold in fact. On the other hand, the bound estimated by $\hat{M}$ is definitely larger than the simple stratification variance unless there is no between strata variation, which should increase our confidence in the bound on total variance provided by Eq. (41).

In addition, we have generally presented two errors of estimate. One, based on the expression for $V_2(\hat{y}^k)$ in Eq. (23), reflects only the within-site variation. The other, based on Eq. (41), reflects total variation. This follows our general practice of examining the extent of inter-PHA variation. In particular, it would be important to notice a situation in which significant program differences within PHAs are masked by variations in the size and/or direction of the difference across PHAs. This practice also, of course, allows us to know if our estimate of inter-PHA variation is in fact changing our assessment of program effects and thus whether more elaborate exploration of alternative estimates for total variance might be warranted.

Presenting both errors of estimate based on within-PHA and total variation did lead to one modification of Eq. (42). Because the estimator of between-PHA variation ($\hat{M}$) involves decomposing variance into two components by taking the difference of two sums-of-squares, it is not guaranteed to be non-negative. This is a usual problem in this sort of situation.[1] Indeed, it is not clear that it is avoidable. The inter-site variation may be zero; accordingly, any unbiased estimator (of the upper bound) must be able to take on negative values.

The estimator for total variance will usually be positive, even when the estimator of $V_1(E_2(\hat{y}^k))$ is negative. However, because we frequently present both the error of estimate based on within-site variance alone and the error of estimate based on the total variance, we were reluctant to present estimated total variances that were less than their estimated within-PHA component. Accordingly, we adopted the practice of treating the inter-PHA variance as zero when the estimate was negative. Since the estimated variance

[1] See, for example, the discussion of negative estimates of variance components in Searle, pp. 406-408.

is already an upper bound, this seemed innocuous. Thus the exact estimator for the total error of estimate is:

$$(43) \quad \begin{array}{l}\text{Estimated Upper}\\ \text{Bound for Total}\\ \text{Variance of } \hat{y}^k\end{array} = \begin{array}{l}\text{Estimate of}\\ E_1(V_2(\hat{y}^k))\\ \text{from Eq. (25)}\end{array} + \text{Max}\left(0, \begin{array}{l}\text{Estimate of}\\ V_1(E_2(\hat{y}^k)) \text{ from}\\ \text{Eqs. (36) to (38)}\end{array}\right)$$

C.1.4 Program Differences

As noted in Table C.1, presented at the beginning of this Appendix, estimates of program differences follow immediately from the estimates for the individual programs. Thus for any parameter x,

$$(44) \qquad \hat{\Delta}(x) = \hat{x}^v - \hat{x}^c$$

where

x = Some parameter of interest (such as μ^k_{jr}, μ^k_j, or μ^k)

$\hat{\Delta}$ = The estimated difference in the parameter between the two programs

$\hat{x}^k$ = The estimator of x for the k^{th} program

Accordingly, as usual,

$$(45) \qquad \hat{V}_2(\hat{\Delta}(x)) = \hat{V}_2(\hat{x}^v) + \hat{V}_2(\hat{x}^c)$$

However, because levels of outcomes are likely to be correlated across PHAs, the across-PHA variation must be computed directly:

$$(46) \qquad \hat{V}_1(\hat{\Delta}(x)) = \frac{1}{t-1}[\sum w_j(\hat{\Delta}_j-\hat{\Delta})^2 - \sum w_j(1-w_j)\hat{V}_2(\hat{\Delta}_j) - (\hat{\Delta})^2]$$

C.2 Test Statistics

Table C.2 presents the basic test statistics used in assessing national estimates of program means and differences. Again, the statistics are quite standard, and the formulas are presented here only to document the details of computation and briefly discuss the statistics' properties.

Table C.2

BASIC TEST STATISTICS

1. Within-PHA t-ratio

$$t_w[(\hat{V}_2(\hat{x}))^2/\sum(w_j\hat{V}_2(\hat{x}_j))^2/\ (n_j-m_j)] = \hat{x}\ /\ (\hat{V}_2(\hat{x}))^{\frac{1}{2}}$$

2. Total error t-ratio

$$t_0[(\hat{V}_2(\hat{x}))^2/\sum_j\ ((tw_j-w_j)(\hat{V}_2(\hat{x}_j))^2/(n_j-m_j)(L-1)^2$$

$$+\sum_j\ ((\tfrac{1}{L-1})w_j(\hat{x}_j-\ \sum\ w_j\hat{x}_j)^2)^2/L-1] = \hat{x}\ /\ (\hat{V}_0(\hat{x}))^{\frac{1}{2}}$$

3. F-statistic for inter-PHA variation in x_j

When x_j is a program mean:

$$F_B(t-1),\sum_j(n_j^k-m_j)) = \frac{\sum_j(\hat{x}_j)^2(\sum_r a_{jr}^2/n_{jr}^k)^{-1} - [\sum_j(\sum_r(a_{jr}^2/n_{jr}^k)^{-1}]^{-1}\ (\sum_j(\hat{x}_j)(\sum_r a_{jr}^2/n_{jr}^k)^{-1})^2(1/t-1)}{\sum_j\hat{\sigma}_{kj}^2(n_j^k-m_j)/\sum_j(n_j^k-\ m_j)}$$

Table C.2 (cont.)

BASIC TEST STATISTICS

When X_j is a program difference:

$$F_B(t-1,\sum_k\sum_j(n_j^k-m_j)) = \frac{\sum_j(\hat{x}_j)^2(\sum_k\sum_r a_{jr}^2/n_{jr}^k)^{-1} - [\sum_j[\sum_k\sum_r(a_{jr}^2 \mid n_{jr}^k)^{-1}]^{-1}(\sum_j(\hat{x}_j)(\sum_k\sum_r a_{jr}^2/n_{jr}^k)^{-1})^2(1/t-1)}{\sum_k\sum_j\hat{\sigma}_{kj}^2(n_j^k-m_j)/\sum_k\sum_j(n_j^k-m_j)}$$

4. F-statistic for $X_j=0$ in all PHAs.

When x_j is a program mean:

$$F_0(t,\sum_j(n_j^k-m_j)) = \frac{\sum_j(\hat{x}_j)^2(\sum_r a_{jr}^2/n_{jr}^k)^{-1}}{\sum_j\hat{\sigma}_{kj}^2(n_j^k-m_j)/\sum_k\sum_j(n_j^k-m_j)}$$

When x_j is a program difference:

$$F_0(t,\sum_k\sum_j(n_j^k-m_j)) = \frac{\sum_j(\hat{x}_j)\ (\sum_k\sum_r a_{jr}^2/n_{jr}^k)^{-1}}{\sum_k\sum_j\hat{\sigma}_{kj}^2(n_j^k-m_j)/\sum_k\sum_j(n_j^k-m_j)}$$

Table C.2 (cont.)

BASIC TEST STATISTICS

5. χ^2**-statistic for inter-PHA variation (x_j a proportion)**

When x_j is a program mean:

$$\chi_B^2(16) = \frac{\sum_j(\hat{x}_j-\bar{x})^2(\sum_r a_{jr}^2/n_{jr}^k)^{-1}}{[\sum_j \hat{x}_j(\sum a_{jr}^2/n_{jr}^k)^{-1}(\sum_j(\sum_r a_{jr}^2/n_{jr}^k)^{-1})^{-1}][1-\sum_j \hat{x}_j(\sum_r a_{jr}^2/n_{jr}^k)^{-1}(\sum_j(\sum_r a_{jr}^2/n_{jr}^k)^{-1})^{-1}]}$$

When $\Delta_j = x_j^v - x_j^c$ is the difference in proportions

$$d = \sum_j[(\sum_{k}\sum_{r}(a_{jr})^2/n_{jr}^k)^{-1}(\hat{x}_j^v-\hat{x}_j^c)] \;/\; \sum_j(\sum_{k}\sum_{r}(a_{jr})^2/n_{jr}^k)^{-1}$$

$$I_j^k = (\sum_r a_{jr}^2/n_{jr}^k)^{-1}$$

$$\hat{x}_j^v = \frac{I_j^v\hat{x}_j^v + I_j^c(\hat{x}_j^c + d)}{I_j^v + I_j^c}$$

Table C.2 (cont.)

BASIC TEST STATISTICS

$$\hat{x}_j^c = \frac{I_j^c \hat{x}_j^c + I_j^v(\hat{x}_j^v - d)}{I_j^c + I_j^c}$$

$$\hat{\chi}^2(t-1) = \sum_j \left(\frac{I_j^v(\hat{x}_j^v - \tilde{x}_j^v)^2}{\tilde{x}_j^v(1-\tilde{x}_j^v)} + \frac{I_j^c(\hat{x}_j^c - \tilde{x}_j^c)^2}{\tilde{x}_j^c(1 - \tilde{x}_j^c)} \right)$$

Given estimates of the mean and error of estimate, it is common practice to evaluate the significance of the mean in terms of the t-ratio (the ratio of the mean to the error of estimate), and this is indeed what we do. However, it may be noted that this statistic is at best only asymptotically distributed with the t-distribution and that even this asymptotic distribution cannot always be asserted.

First consider the within-PHA t-ratio defined by:

$$(47)\qquad t_w = \hat{y}^k / (\text{Est } E_1(\text{Var}_2(\hat{y}^k)))^{\frac{1}{2}}$$

As usual, we assume that the observations are normally distributed so that $\hat{y}^k$ is normally distributed independent of the estimated variance in the denominator. However, we need fairly strong conditions to have the square of the denominator distributed as χ^2 (so that the ratio has a t-distribution). Indeed the only plausible conditions would be assumption of a common variance across site and bedroom size categories, plus self-weighting observations. Asymptotically, of course, we can treat t_w as a normal deviate, which is what we do in assessing significance levels of the customary limiting values of 1.65, 1.96, and 2.58 for 0.10, 0.05, and 0.01 test levels. Further, given the fact that estimates of within-PHA variances are based on several thousand observations, this does not seem unreasonable.

Alternatively, Satterthwaite (1946) proposed a commonly used correction for degrees of freedom in such cases.[1] The basic idea is as follows. Say we have a set of independent sums of squares, each of which is a multiple of an χ^2 variable, that is,

$$(48)\qquad S_i = \frac{c_i}{j_i}\chi_i^2(j_i)$$

where

S_i = The i^{th} sum of squares

[1]This was suggested to me by David Hoaglin. See also, for example, Cochran, p. 96.

c_i = Some constant

j_i = Degrees of freedom

χ_i^2 = A chi-squared variate

Say further that there is some linear combination of these sums of squares whose expectation is the variance of interest:

$$S = \sum \theta_i S_i \tag{49}$$

Satterthwaite's suggestion is to treat S as an χ^2 variable and calculate the "degrees of freedom" in terms of the relationship between the first and second moments of S. Specifically, for an χ^2 variable:

$$f = \frac{2[E(\chi^2)]^2}{Var(\chi^2)} \tag{50}$$

Accordingly we calculate the degrees of freedom of S as follows:

$$* = \frac{2[E(S)]^2}{Var(S)} = (\sum \theta_i s_i)^2 / (\sum (\theta_i s_i)^2 / f_i \tag{51}$$

In the specific case of the within-PHA variances, the S_i are the sums of squared deviations within the PHA (see Eq. (24), above) and the degrees of freedom in each case are the number of observations in the PHA (minus the number of bedroom size strata means), accordingly, we evaluate t_w of Eq. (47) in terms of:

$$\begin{pmatrix} \text{Within-PHA} \\ \text{t-statistic} \\ \text{Degrees of Freedom} \end{pmatrix} = \frac{\left[\sum_j w_j^2 \sum_r (a_{jr})^2 \hat{\sigma}_j^2 \right]^2}{\left[\sum \frac{(w_j^2 \sum (a_{jr})^2 \hat{\sigma}_j^2)^2}{n_j - m_j} \right]} \tag{52}$$

where

w_j = Weight for the j^{th} PHA

a_{jr} = Weight for r^{th} bedroom size stratum in j^{th} PHA

$\hat{\sigma}_j^2$ = The estimate of within-PHA variance for the j^{th} PHA (see Eq. (24)

n_j = The number of observations in the j^{th} PHA

m_j = The number of bedroom size strata in the j^{th} PHA.

In fact, given the large number of observations, we had no reason to be concerned that the t-ratio was not approximately distributed as a unit normal distribution and so ignored this issue.

The t-ratio for the total error of estimate is defined by:

(53) $t_t = \hat{y}^k/(\text{Est Total Error})^{\frac{1}{2}}$

The problem here is that two different types of variances are included--the within-PHA variances among individuals and the variation across PHAs. The small sample distribution in this case is not known. Furthermore, while it seems reasonable to rely on asymptotic results for estimates of within-PHA variances involving several thousand program recipients, it seems quite unreasonable to do this for estimates of between-PHA variation based on the sample of 18 large urban PHAs.

We can employ the same sort of calculation used for the within-PHA t-ratio. If we combine the various sums of squares involved we have (for the case of positive inter-PHA variance)

(54)

$$\begin{Bmatrix}\text{Est. of Total}\\ \text{Variance of } \hat{y}\end{Bmatrix} = \sum_j w_j^2 \hat{V}_2(\hat{y}_j) + \frac{1}{t-1}\Big[\sum_j w_j(\hat{y}_j)^2 - \sum w_j(1-w_j)\hat{V}_2(\hat{y}_j) - \big(\sum_j w_j\hat{y}_j\big)^2$$

$$= \sum_j \Big[w_j^2\Big(\frac{1}{t-1}\Big) - w_j\Big(\frac{1}{t-1}\Big)\Big]\Big(\sum_r \frac{a_{jr}^2}{n_{jr}}\Big)\hat{\sigma}_j^2$$

$$+ \Big(\frac{1}{t-1}\Big)\sum_j w_j\big(\hat{y}_j - \sum w_j\hat{y}_j\big)^2$$

where

$$\hat{\sigma}_j^2 = \sigma_j^2 \chi^2(n_j - m_j)$$

$$(\hat{y}_j - \Sigma w_j \hat{y}_j)^2 = (w_j(1-w_j)\sigma_j^2(\Sigma \frac{a_{jr}}{n_{jr}}) + \sigma_B^2)\chi^2(1)$$

The $w_j(\hat{y}_j - \Sigma w_j \hat{y}_j)^2$ are not, of course, independent, so that application of Satterthwaite's formula is not immediate. Since our concern is with cases where the inter-PHA error estimate is large relative to the within-PHA error of estimate, we have chosen to treat the term $(w(1-w_j)\sigma_j^2(\Sigma a_{jr}^2/n_{jr})$ as small relative to σ_B^2 and so regard the entire sum as an χ^2 variate, i.e.,

(55) $$\sum w_j(\hat{y}_j - w_j \hat{y}_j)^2 \sim \sigma_B^2 \chi^2(L-1)$$

where

L = The number of sites

Accordingly,

(56) Degrees of Freedom for Total Variance t-Ratio $= \dfrac{(\text{Est of Total Variance})^2}{A}$

where

$$A = \sum_h \frac{[(w_j^2(\frac{t}{t-1}) - w_j(\frac{1}{t-1}))(\sum_r \frac{a_{jr}^2}{n_{jr}})\hat{\sigma}_j^2]^2}{(n_j - m_j)} + \frac{[\sum_j(\frac{1}{t-1})w_j(\hat{y}_j - \sum w_j \hat{y}_j)^2]^2}{(L-1)}$$

We did not, however, adopt this course and for the purposes of this study, evaluated the total error t-statistic in terms of the unit normal distribution.

If we assume that the within-PHA variance is the same in all PHAs (and for program differences in both programs), we can test the hypothesis of zero across-PHA variance with the usual F-statistics, derived in the usual way. If the vector of site means, x, is distributed $N(\mu e, \sigma^2 s)$ where e is a vector of ones and μ is a scalar, then if

(57) $A = (\frac{1}{\sigma^2})[S \ -(e'S^{-1}e)^{-1}S^{-1}ee'S^{-1}]$

we have

(58) $x'Ax \sim \chi^2(\rho(A))$

As usual, if the individual variance is the same in all sites $(=\sigma^2)$, then the matrix S is known from the sample sizes. Specifically, S is a diagonal matrix with diagonal element equal to $\Sigma_r a_{jr}^2/n_{jr}^k$), and the pooled estimate of σ^2 has a χ^2 distribution independent of $x'Ax$.

When X is a proportion, the estimate of variance is no longer independent of the estimated mean and the usual custom is to use (asymptotic) χ^2 statistics. These in essence express each deviation as an asymptotically unit normal variable (under the hypothesis to be tested) so that the sum of squares is distributed as $\chi^2(t)$, where t is the number of deviations. Specifically, if X is a proportion, then under the hypothesis that x is the same in all PHAs,

(59) $x \sim N(\pi e, \pi(1-\pi)S)$

(60) $[\pi(1-\pi)]^{-\frac{1}{2}}S^{-\frac{1}{2}}\ (X-\pi e) \sim N(0,I)$

and as usual we get an asymptotic distribution by substituting

(61) $\hat{\pi} = (e'S^{-1}e)e'S^{-1}x)$

for π.

When we consider a difference in proportions, the appropriate statistic becomes more complicated; indeed, there does not appear to be any closed-form maximum-likelihood solution. The problem is that the restriction is on the program difference, while the variance of the individual site estimates varies with the level of the proportion in both programs. We adopted the convenient simplification afforded by ignoring the effect on variance of differences in proportions across sites. Thus we estimate the common difference as

(62) $$d = \sum_j \left(\sum_k \sum_r a_{jr}^2/n_{jr}^k\right) \left(\hat{x}_j^v - \hat{x}_j^c\right) / \sum_j \left(\sum_k \sum_r a_{jr}^2/n_{jr}^k\right)^{-1}$$

and then predict each program mean by

(63) $$\tilde{x}_j^v = \frac{I_j^v \hat{x}_j^v + I_j^c(\hat{x}_j^c + d)}{I_j^v + I_j^c}$$

(65) $$\tilde{x}_j^c = \frac{I_j^c \hat{x}_j^c + I_j^v(\hat{x}_j^v - d)}{I_j^v + I_j^c}$$

where

(65) $$I_j^k = \left(\sum_r a_{jr}^2/n_{jr}^k\right)^{-1} .$$

The statistic

(66) $$\sum_j \left[(x^v - \tilde{x}_j^v)^2 + (x_j^2 - \tilde{x}_j^c)^2\right]$$

is then treated as $\chi^2(t-1)$.

When significant inter-PHA variation is present, some further examination of the individual PHA results may be warranted. We can, for example, by assuming a common within-PHA variance, develop an F-statistic of the hypothesis that all of the individual PHA estimates are non-zero. This, of course, suffers from the drawback that it says nothing about the direction of the difference.

C.3 Success Rates and Other Estimates for Certificate or Housing Voucher Holders

As discussed in Chapter 2, eligible applicants for the Housing Voucher or Housing Certificate programs are selected by PHAs and issued Housing Vouchers or Certificates. Housing Voucher/Certificate holders become recipients when they obtain a unit meeting program standards whose landlord agrees to participate in the program. Not all Housing Voucher/Certificate holders succeed in becoming recipients. Accordingly, there is some interest in characterizing all Housing Voucher or Certificate holders, especially in terms of success rates. This section discusses the estimators of success rates for Housing Voucher/Certificate holders.

Given some set of slots to be filled, allocated across PHAs and bedroom sizes, then the overall success rate for a program is defined by the total number of slots divided by the total number of issuances necessary to fill those slots, i.e., by

$$(67) \qquad \pi^k = [\sum \frac{N_{jr}}{N}(1/\pi_{jr}^k)]^{-1}$$

where

π^k = The success rate for the k^{th} program

N_{jr}/N = The proportion of total cases allocated to the r^{th} bedroom size in the j^{th} PHA

π_{jr}^k = The success rate for program k for the r^{th} bedroom size and j^{th} PHA.

The way in which the recipient sample was drawn allows us to estimate issuances per recipient ($1/\pi_{jr}^k$) for each PHA/bedroom-size stratum. PHAs issue Housing Voucher and Certificates against a number of program slots in each bedroom-size category. Thus the issuances in any program/PHA/bedroom-size class are associated with the recipients in that class. If we order issuances within each class by date of issuance, then we can determine the number of issuances needed to obtain each recipient.[1] Thus,

[1]Where there were several issuances on the same date (within a given class), records for that date and class were further ordered by identification number, since identification numbers were assigned consecutively for each bedroom size category.

(68) $$I_{ijr} = N^k_{jr}(i) - N^k_{jr}(i-1)$$

where

I^k_{ijr} = The issuances associated with the i^{th} recipient in the k^{th} program and r^{th} bedroom size in the j^{th} PHA.

$N^k_{ij}(i)$ = The number of issuances in the k^{th} program and r^{th} bedroom size in the j^{th} PHA, up to and including the i^{th} recipient.

Under this sort of sampling scheme (where the sample is drawn until a quota of successes is achieved)[1] we can estimate $(\pi^k_{jr})^{-1}$ by

(69) $$\hat{\mu}^k_{jr} = \sum_i I^k_{ijr}/T^k_{jr}$$

(70) $$E(\hat{\mu}^k_{jr}) = \frac{1}{\pi^k_{jr}} = \mu^k_{jr}$$

(71) $$\mathrm{Var}(\hat{\mu}_{jr}) = \frac{1-\pi^k_{jr}}{T^k_{jr}(\pi^k_{jr})^2} = \frac{\mu^k_{jr}(\mu^k_{jr}-1)}{T^k_{jr}}$$

where

μ^k_{jr} = The true mean issuances per recipient in the k^{th} program and r^{th} bedroom size category in the j^{th} PHA.

π^k_{jr} = The success rate in the k^{th} program and r^{th} bedroom size category in the j^{th} PHA.

I^k_{jr} = The observed number of issuances associated with the i^{th} recipient in the k^{th} program and r^{th} bedroom size category in the j^{th} PHA.

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[1] See, for example, Kendall and Stuart, pp. 225ff. An unbiased estimate of π^k_{jr} is provided by

$$(T^k_{jr}-1)/(\sum_i I^k_{ijr}-1).$$

T^k_{jr} = The total number of recipients in the k^{th} program and r^{th} bedroom size category in the j^{th} PHA.

Accordingly, the overall program rate of issuances per recipient is estimated as for any other recipient outcome.

$$(72) \qquad (\hat{\mu}_k) = (1/\hat{\pi}^k) = \sum_j \sum_r w_j a_{jr} \hat{\mu}^k_{jr}$$

If we wish to characterize success in terms of the success rate (π^k) rather than the average number of issuances per recipient, we can use the inverse of the estimated average number of issuances per recipient. This provides an upward biased estimate of the success rate, but for the sample sizes in involved here, the bias should not be large. In general,[1]

$$(73) \qquad E(1/\hat{\mu}_R) > 1/E(\hat{\mu}_R) = \pi^k$$

A Taylor expansion for $(1/\hat{\mu}^k)$ yields

$$(74) \qquad \frac{1}{\hat{\mu}_k} = \frac{1}{\mu_k} - \frac{\hat{\mu}_k - \mu_k}{(\mu_k)^2} + \frac{(\hat{\mu}_k - \mu_k)^2}{a^3}$$

where

a = A number in the open interval $(\hat{\mu}_k, \mu_k)$

Since $\hat{\mu}_k$ and μ_k (and hence a) are necessarily greater than one, this implies that

$$(75) \qquad E(\frac{1}{\hat{\mu}_k}) < \frac{1}{\mu_k} + (\text{Var } \hat{\mu}_k) = \pi_k + (\text{Var } \hat{\mu}_k)$$

Var $(\hat{\mu}_k)$ turns out to be small in our study.

We should note that the development of estimates in terms of issuance per recipient is required by the weights involved rather than the fact that PHAs issue Housing Vouchers and Certificates to fill program slots. As

[1] See Kendall and Stuart, p. 227, ex. 9.13.

discussed in Section C.1.1, the weights for the recipient sample reflect the sampling probabilities of the PHAs and the allocation of Section 8 Certificate program slots at the beginning of the program. Further, these weights are normalized. Similarly, the weights for all Housing Voucher or Certificate holders reflect the sampling probabilities of the PHAs and the allocation of holders, which in turn reflects the allocation of slots to be filled and the number of issuances needed to fill these slots. Accordingly, the weight for a Housing Voucher or Certificate holder in the j^{th} sampled PHA and r^{th} bedroom size category is

$$(76) \qquad HW(k,j,r) = \frac{w_j a_{jr}}{n^k_{jr} \pi^k_{jr}} \Big/ \sum_j \sum_r \frac{w_j a_{jr}}{\pi^k_{jr}}$$

where

$HW(k,j,r)$ = The weight assigned to an issuance in the k^{th} program in the j^{th} PHA and r^{th} bedroom size category

w_j = The weight of the j^{th} PHA (Eq. 4)

a_{jr} = The weight of the r^{th} bedroom size category in the j^{th} PHA

π^k_{jr} = The success rate for the k^{th} program in the r^{th} bedroom size category in the j^{th} PHA

n^k_{jr} = The sample size for the k^{th} program in the r^{th} bedroom size category in the j^{th} PHA

The quota-sampling scheme allows us to estimate π^k_{jr}, but the weighted combination of the π^k_{jr} that yields the overall success rate is

$$\pi = \sum_{j,r,i} HW(k,j,r)\pi^k_{jr}$$

$$= \sum \frac{w_j a_{jr} \pi^k_{jr}}{n^k_{jr} \hat{\pi}^k_{jr}} \Big/ \sum_{jr} \frac{w_j a_{jr}}{\pi^k_{jr}}$$

$$= \sum w_j a_{jr} \;/\; \sum_{jr} \frac{w_j a_{jr}}{\pi^k_{jr}}$$

(77) $$= \left(\sum_{jr} w_j a_{jr}/\pi^k_{jr}\right)^{-1}$$

C.4 National Estimates for Subgroups

The national estimates discussed in the previous section were based on weighted averages involving weights for bedroom sizes (a_{jr}) and PHAs (w_j). National (large urban PHA) estimates for any subgroup may be obtained, as usual, by using the same formulas, but adjusting the weights to take account of the incidence of the subgroup across the sampled PHAs and bedroom sizes. Specifically, we want to use as weights

(78) $$a^D_{jr} = N^D_{jr}/N^D_j$$

(79) $$w^D_j = (1/P_j)(N^D_j/N^D)/ \sum_j (1/P_j)(N^D_j/N^D)$$

where

a^D_{jr} The weight of the r^{th} bedroom size category in the j^{th} PHA for the D^{th} group

W^D_j = The weight for the j^{th} PHA for the D^{th} group

We estimate N^D_{jr} based on the sample proportions

(80) $$\hat{N}^D_{jr} = d^D_{jr} N_{jr}$$

(81) $$\hat{N}^D_j = \sum_r d^D_{rj} N_{jr}$$

where

$\hat{N}^D_{jr}$ = The estimated number of persons in the D^{th} demographic group in the r^{th} bedroom size category in the j^{th} PHA

d^D_{rj} = The observed proportion of the sample in the r^{th} bedroom size category and j^{th} PHA that falls into the D^{th} group

Accordingly, substituting Eqs. (80) and (81) into Eqs. (78) and (79), the weights used in estimation for subgroups are:

$$(82) \qquad \tilde{a}^D_{jr} = d^D_{jr} N_{jr} / \sum_r d^D_{jr} N_{jr}$$

$$(83) \qquad \tilde{w}^D_j = (1/P_j) \sum_r d^D_{jr} N_{jr} \Big/ \sum_j (1/P_j) \sum_r d^D_{jr} N_{jr}$$

where

$\tilde{a}^D_{jr}$ = The sample weight for the D^{th} demographic group in the j^{th} PHA and r^{th} bedroom size category

$\tilde{w}^D_j$ = The sample weight for the D^{th} demographic group in the j^{th} PHA

All the formulas of C.1 apply using the weights $\tilde{a}^D_{jr}$ and $\tilde{w}^D_{jr}$.

APPENDIX D

EMPIRICAL REVIEW OF THEORETICAL DIFFERENCES BETWEEN THE TWO PROGRAMS

This appendix presents a model of enrollee and recipient behavior under the two programs and examines the extent to which the predictions of the model are met. The key theoretical predictions and findings are that:

1. We would expect that housing requirements might present a barrier to the success of enrollees in becoming recipients, and it is clear that they do so.

2. The Housing Voucher program by definition offers applicants a greater range of housing choice. In theory, the greater range of choice afforded by the Housing Voucher program may or may not lead to higher success rates. Specifically, while Housing Voucher holders may select units that are more likely to meet program requirements than those allowed to Certificate holders, they may also in theory select units that provide a lower success rate but a higher expected utility.

3. In theory, Housing Certificate holders would generally be expected to look for units that rent for the maximum amounts allowed by the program, regardless of individual tastes or program housing requirements. This prediction is strongly confirmed. Compared with pre-enrollment rents, Certificate recipient rents cluster tightly around the FMRs used to limit program rents.

4. Housing Voucher holders, on the other hand, are expected to select units with a wider range of rents. These rents are expected to be higher than the recipient would choose if the program had no housing requirement but also to vary with individual tastes for housing and the local availability and cost of housing that meets program requirements. This prediction is confirmed to some extent. Housing Voucher recipient rents do show greater variation than Certificate Program rents. Further, this variation is related to variation in pre-program rents, suggesting that it is associated with differences in recipients' tastes or needs for using. On the other hand, Housing Voucher recipient rents show a remarkably strong association with FMRs, although weaker than that of the Certificate Program.

   Two explanations were advanced for the strong association of Housing Voucher recipient rents and FMRs; one is consistent with the model, the other requires a modification. The model would predict such clustering if there was a strong association between meeting housing requirements and FMRs, in the sense that the probability that a unit meets requirements rose rapidly as rents approached the FMR levels and then flattened out for further increases in rent above FMRs. Examination of the relationship between pre-program gross rent and the percent of enrollees who qualified in their pre-program units suggested that this might indeed be the case.

The second suggestion was that the model did not adequately take account of the process by which enrollees search for acceptable housing. Evidence was presented that about one-third of recipients found their units through PHA referrals or responses to advertisements that specifically mentioned the Section 8 program. Three-fourths or more of recipients in both programs reported that their landlord was already well acquainted with the Certificate Program. Since apart from the Demonstration the Certificate Program was the existing program and much larger than the Housing Voucher Program in all sites, this suggests that Housing Voucher enrollees may mostly have been operating in a market whose prices were strongly conditioned by the Certificate Program. Unfortunately we have no direct way to test this hypothesis.

5. In theory, given the assistance payment formulas of the two programs and the greater variation in unit rents expected in the Housing Voucher program, tenant out-of-pocket costs for housing are likely to be less exactly related to income in the Housing Voucher program, while assistance payments are likely to be more exactly related to income. In addition, Housing Voucher assistance costs are likely to be higher. The higher expected assistance costs may be offset to the extent that PHAs use the flexibility of the Housing Voucher funding mechanism to hold Housing Voucher payment standards below HUD-established Fair Market Rents (FMRs) and/or allow Certificate program recipients to occupy units above FMRs. These topics are pursued in the main text. They conform to expectations.

6. Housing Voucher and Certificate holders who qualify for assistance without moving from their pre-program units may deviate substantially from these patterns. (See Appendix E.)

7. The Housing Voucher program should lead to more effective shopping. This prediction was not confirmed by a previous analysis of housing quality. Two suggestions were advanced. The first was that the enrollee search process was much less conditioned by FMRs than the model presented here. If enrollees ignore FMRs and bring in units which are rejected by the program if they have rents above FMRs, then the Certificate Program will have lower success rates and lower average prices paid for housing. Alternatively, the PHAs may be able to bargain with landlords more effectively than individual recipients as part of the rent reasonbleness test imposed by the Certificate Program.

8. The theoretical conclusions may be substantially affected by long-term changes in participant and landlord responses to the program.

Comparison of program outcomes is, of course, the focus of the main text. The purpose of this appendix is to aid in the interpretation of those findings and guide their analysis of patterns of outcomes. To this end, the emphasis is on careful development of a theoretical framework and broad testing of its implications to determine whether we seem to have in fact captured the major determinants of program outcomes. As indicated in the summary listing above, in these terms the results are mixed. Certificate households behave largely as predicted by theory in terms of rental expenditures and success rates. The results for Housing Voucher households show deviations from Certificate Program behavior in the expected directions, but the differences are weak and the pattern of outcomes in the Housing Voucher Program seems more strongly related to the pattern in the Certificate Program than we would have expected.

The development of the theoretical model starts in Section D.1 with a description of the two programs. Section D.2 then develops a simple model of housing choice in a world with known, homogenous prices and no uncertainty. This leads to expectations concerning differences in program success rates, recipient rents, and costs. Section D.3 then extends this model to deal with an enrollee's search for housing that meets program requirements. This modifies the expectations of Section D.2. Section D.4 then further extends the model to take account of shopping for housing. Finally, Section D.5 indicates various caveats and extensions to the models, including the possible effect of changes in landlord behavior.[1] As each model is developed, we present data from the Demonstration to test the major predictions of the model.

D.1 The Two Programs

The Housing Voucher and Certificate Programs are each variants of the Section 8 Existing Housing Program and share certain basic features. In both programs, actual program operations are carried out by local public housing agencies (PHAs) under contract to HUD. Enrollees are given from two to four months to find acceptable housing in the private rental market. To be acceptable in either program, a unit must meet program quality and occupancy standards, and the unit's owner must agree to participate in the program. The owner then signs a lease with the applicant and a separate contract with the PHA. These contracts set the rent for the unit and specify the amount that the PHA will contribute towards paying the rent (the program contribution or housing assistance payment) and the amount to be paid by the tenant (the tenant contribution).

---

[1] Much of the theoretical work presented in Sections D.1 to D.4 was developed in previous reports (Kennedy and Finkel, Leger and Kennedy).

The central difference between the two programs is the way in which they determine the size of housing assistance payments. Under the Certificate program, the recipient's out-of-pocket payment for rent, called the tenant contribution, is fixed, and the program pays the difference between this fixed contribution and the recipient's rent. The fixed tenant contribution under the Certificate program is the larger of 10 percent of gross income, 30 percent of net income (gross income net of various deductions), or welfare rent. The welfare rent rule applies only in certain states in which ADC payments include an allowance for rent equal to the ADC family's out-of-pocket expenses for rent up to a maximum amount, called the welfare rent. In these states, housing assistance payments that reduce the tenant contribution of ADC recipients below the welfare rent would be offset dollar for dollar by a reduction in ADC payments. Accordingly, in such "as-paid" states, the Certificate program sets the tenant contribution for ADC recipients equal to the larger of 30 percent of net income, 10 percent of gross income, or the welfare rent. Only two states included in the Demonstration were as-paid states--Michigan and New York--and Michigan has since changed its ADC rules.

As shown in Table D.1, 30 percent of net income was larger than 10 percent of gross income for over 99 percent of Certificate program recipients. The welfare rent rule was more important in the PHAs where it applied. Certificate program tenant contributions were increased by the welfare rent rule for about one-third of the Certificate program recipients in Erie County and New York City. For these households, the welfare rent rule increased the average tenant contribution by just under $28 per month, or 31 percent.

Because assistance payments under the Certificate program are determined by the difference between a recipient's gross rent and his or her fixed tenant contribution, allowable rents must be limited. This is done in two ways, First, rents may not exceed the schedule of Fair Market Rents by bedroom size (FMRs) published annually by HUD for each area of the country. Second, the unit rent must be determined by the PHA to be reasonable, given local market conditions.

PHAs have some flexibility with respect to the FMR ceiling. In general, the gross rent (contract rent plus scheduled amounts for utilities paid by the tenant) cannot exceed the FMR schedule of rents by unit size and type

TABLE D.1

CERTIFICATE PROGRAM TENANT CONTRIBUTIONS

1. Gross and Net Income

Percent of Certificate Program recipients for whom 30 percent of net income exceeded 10 percent of gross income	99.7%
(Sample size)	(6192)

2. Welfare Rent Rule in New York (Erie County and New York City)

	Erie County	New York City	Combined
Percent of Certificate recipients under the welfare rent rule	42.4%	31.0%	32.7%
(Sample size)	(99)	(564)	(663)
Mean increase in tenant contribution due to welfare rent rule			
Dollars	NA	NA	$27.99
Percent	NA	NA	30.59%
(Sample size)	NA	NA	(217)

established by HUD for the PHA jurisdiction. However, (1) the PHA may approve rents of up to 10 percent above the FMR on a case-by-case basis for up to 20 percent of units; (2) the PHA may extend this to more than 20 percent of units with HUD permission; (3) the PHA may obtain HUD approval for either categorical (size-type) or case-by-case increases in payment standard to up to 20 percent above the FMR. In addition, certain subsidized housing projects (e.g. Section 236 projects) have rent schedules that are separately approved by HUD. In these cases, the PHA may agree to accept the HUD-approved schedules for these projects, as long as they are below the FMRs.

We do not know the extent to which PHAs imposed lower rent reasonableness ceilings than the HUD-determined FMRs. In terms of the FMR ceilings, as allowed by Program rules, almost 20 percent of Certificate Program recipients had rents in excess of the FMR, and the average excess was 6 percent of the FMR (Table D.2). About two percent of recipients had reported rents above the 10 percent exception limits. These may represent actual errors, errors in data reporting, or special exceptions. In any case, the size of the excess was small--on average, about $20 per month, or 5.4 percent above the 110 percent of FMR exception ceiling.

Under the Housing Voucher program, in contrast, the maximum assistance payment is fixed, and the tenant contribution varies to make up the difference between the recipient's rent and the assistance payment. Accordingly, the Housing Voucher program places no limits on recipient rents. The maximum assistance payment under the Housing Voucher Program is the difference between the Payment Standard (initially set equal to the FMR) and the larger of 30 percent of net income or 10 percent of gross income. As indicated in Table D.3, as in the Certificate Program, 30 percent of net income was almost always the larger of these two numbers. The Housing Voucher payment is reduced if a recipient rents a unit with a rent so low that the tenant contribution would be less than 10 percent of gross income. As shown in Table D.3, this minimum tenant contribution rule affected 10 percent of Housing Voucher recipients, with a median reduction in payments of about $32 per month. Somewhat over two-thirds of these were cases where the recipient stayed in his or her pre-enrollment unit or, in a few cases, moved to units subject to other subsidies (such as Section 236). For the remaining 96 cases where Housing Voucher recipients moved to unsubsidized units with rents low enough to trigger the minimum contribution rule, the median reduction in payment was $26 per month.

TABLE D.2

RENT LIMITS IN THE CERTIFICATE PROGRAM

Recipients with Reported Rents:	Percent	Mean Difference of Gross Rent From FMR	Mean Ratio of Gross Rent To FMR	N
Less than or equal to FMR	80.9%	$-39	0.92	2975
Greater than FMR	19.1	30	1.06	701
Greater than FMR but less than or equal to 110 percent of the FMR	17.1	26	1.05	627
Greater than 110 percent of the FMR	2.0	66[a]	1.15[a]	74
(Sample size)	3849	(NA)	(NA)	

[a]This is $20 or an average of 5.4 percent above 110 percent of FMR.

TABLE D.3

HOUSING VOUCHER PROGRAM PAYMENT RULES

1. Gross and Net Income	
Percent of Housing Voucher recipients for whom 30 percent of net income exceeded 10 percent of gross income	99.6%
(Sample size)	(6150)
2. Minimum Tenant Contribution	
All Housing Voucher Recipients	
Percent with payments reduced to assure a minimum tenant contribution of 10 percent of gross income	10.4%
(Sample size)	(3887)
Average reduction in payments	$45.96
Median reduction in payments	$32.20
(Sample size)	(308)
Housing Voucher Recipients Moving to Otherwise Unsubsidized Units	
Percent with payments reduced to assure a minimum tenant contribution of 10 percent of gross income	5.6%
(Sample size)	(2327)
Average reduction in payment	$33.71
Median reduction in payment	$24.65
(Sample size)	(131)

Overall, the program payments recorded in the data base conform closely to program rules. As indicated in Table D.4, over 97 percent of reported payments fell within one dollar of the calculated putative payment. Only 23 of 7275 payments appeared to be off by more than \$10. The mean error (for cases with errors of more than one dollar) was quite small. Examination of the errors suggests that some were genuine mistakes, while others are probably the result of misreporting of either payment or the income, bedroom size, and rent information used to calculate putative payments.

The differences in program rules may affect both recipient and landlord behavior and program costs. Sections D.2 through D.4 focus on recipient behavior. Section D.5 then discusses landlord behavior, market influences, and other caveats to the model.

D.2 A Simple Model of Recipient Behavior Under the Two Programs

D.2.1 Recipient Choice

The theoretical effects of these differences in program payments can readily be described in the context of a simple economic model of housing choice. Under the simplest economic model of housing choice, a household is seen as allocating its spending between housing and other expenditures based on its relative preferences for housing and non-housing goods and its available choices given the prices of housing and other goods and the household's income.

Formally, this can be written as

(1) $$\underset{\{H,Z\}}{\text{Maximize}}\ U(H,Z) \text{ subject to } P_H H + P_Z Z \leq Y$$

where

TABLE D.4

APPARENT INCIDENCE OF PAYMENT ERRORS

	Housing Voucher Program	Certificate Program
Percent of cases where the difference between putative and reported payment was:		
More than one dollar	2.6%	2.1%
More than ten dollars	0.5%	0.2%
(Sample size)	(3724)	(3551)
Amount of difference for cases with an absolute difference of more than one dollar		
Mean difference:		
Dollars	$5.25	$-1.69
Percent	4.5%	1.9%
Inter-quartile range of differences:		
Dollars	$-1.80 to $48.50	$-1.03 to $11.00
Percent	-0.7% to 16.0%	-0.3% to 5.4%
(Sample size)	(97)	(75)

$U(H,Z)$ = the households' preference ordering over Housing (H) and non-housing (Z) goods and services[1]

H = housing goods and services,

Z = non-housing goods and services,

P_H = the price per unit of H,

P_Z = the price per unit of Z, and

Y = household income.

This is pictured graphically in Figure D.1. The diagonal line in Figure D.1 represents the pairs of (H,Z) values that satisfy the budget constraint.

(2) $$Y = P_H H + P_Z Z$$

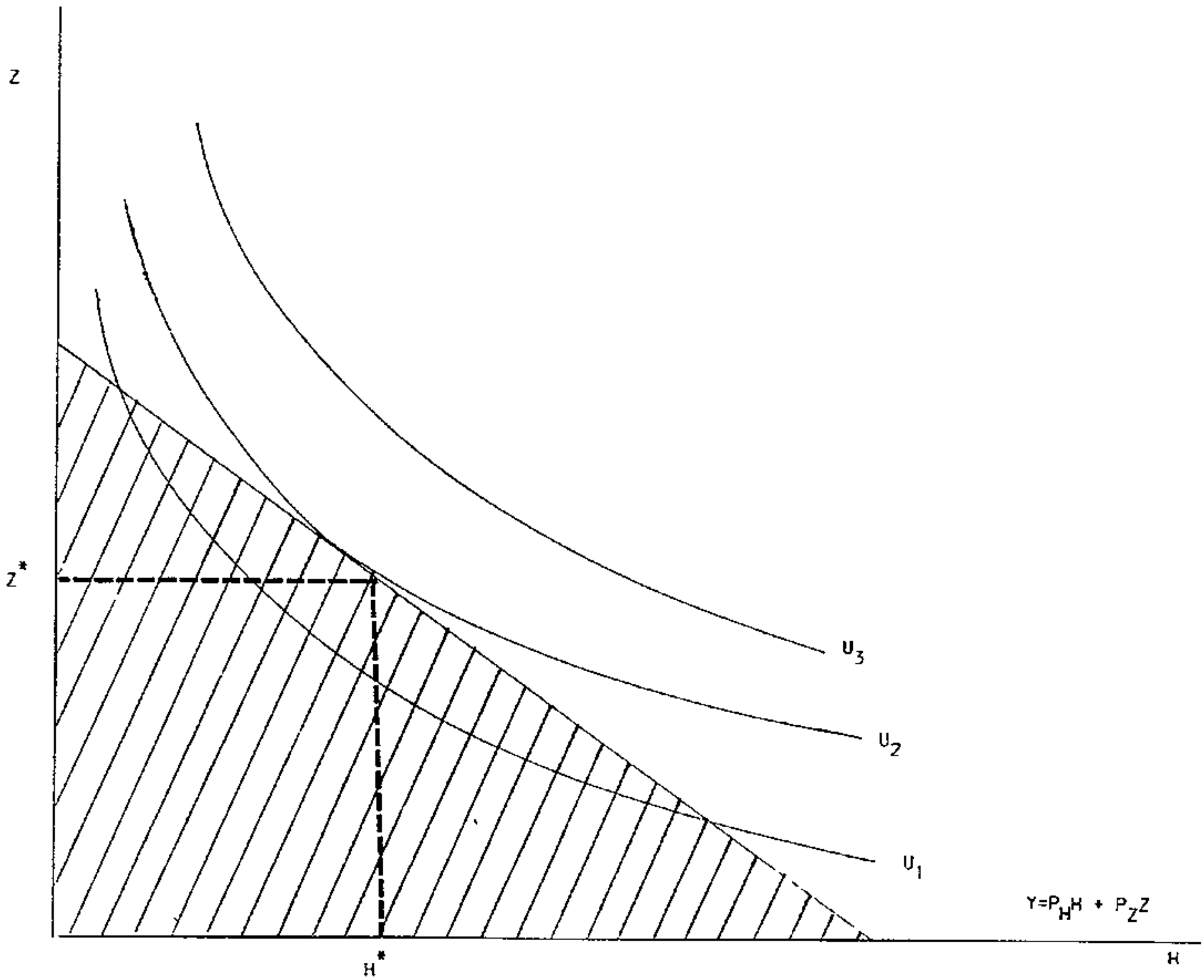
The shaded area below the diagonal line is the feasible set--the set of all (H,Z) combinations that the household can afford. The curved lines in Figure D.1 represent level curves for U(H,Z)--that is, sets of (H,Z) pairs such that the household's level of utility (U) is constant. The household maximizes U by selecting the highest level curve within its feasible set--in this case (H^*,Z^*) tangent to the budget line.

Under the Section 8 Certificate Program, recipient households may rent any unit within the PHA jurisdiction provided that (1) the unit meets program quality and occupancy standards and (2) the unit's gross rent (including scheduled allowances for utilities not included in rent) is below or equal the local HUD-determined Fair Market Rent (FMR) and is determined by the PHA to be reasonable. Recipients pay an amount equal to the larger of 10 percent of

[1]The preference ordering is in effect indexed by U. For convenience, the two classes of goods are defined so that they are in fact "goods"--that is, so that U increases when either H or Z is increased (the partial derivatives U_H, U_Z are positive). The key assumption is that as one good is increased, the individual is willing to give up less of the other in return (the indifference curves or level curves of U are concave from above). In addition, unlike psychologist's models, economists always assume free disposability--that is the individual can never have so much of a good that it becomes a burden.

FIGURE D.1

GRAPHICS OF HOUSING CHOICE



gross income or 30 percent of net income.[1] The program pays the difference between gross rent and recipient contribution. Thus, for Housing that meets program standards, the Certificate program changes the budget constraint of Equation (2) to

$$
(3) \qquad Y = \begin{cases} P_H H + P_Z Z & \text{if } P_H H < \max\,[0.1Y_G, 0.3Y_N] \\ \max\,(0.1Y_G, 0.3Y_N) + P_Z Z & \text{if } \max\,[0.1Y_G, 0.3Y_N] \leq P_H H \leq R^c_{max} \\ P_H H + P_Z Z & \text{if } P_H H > R^c_{max} \end{cases}
$$

where

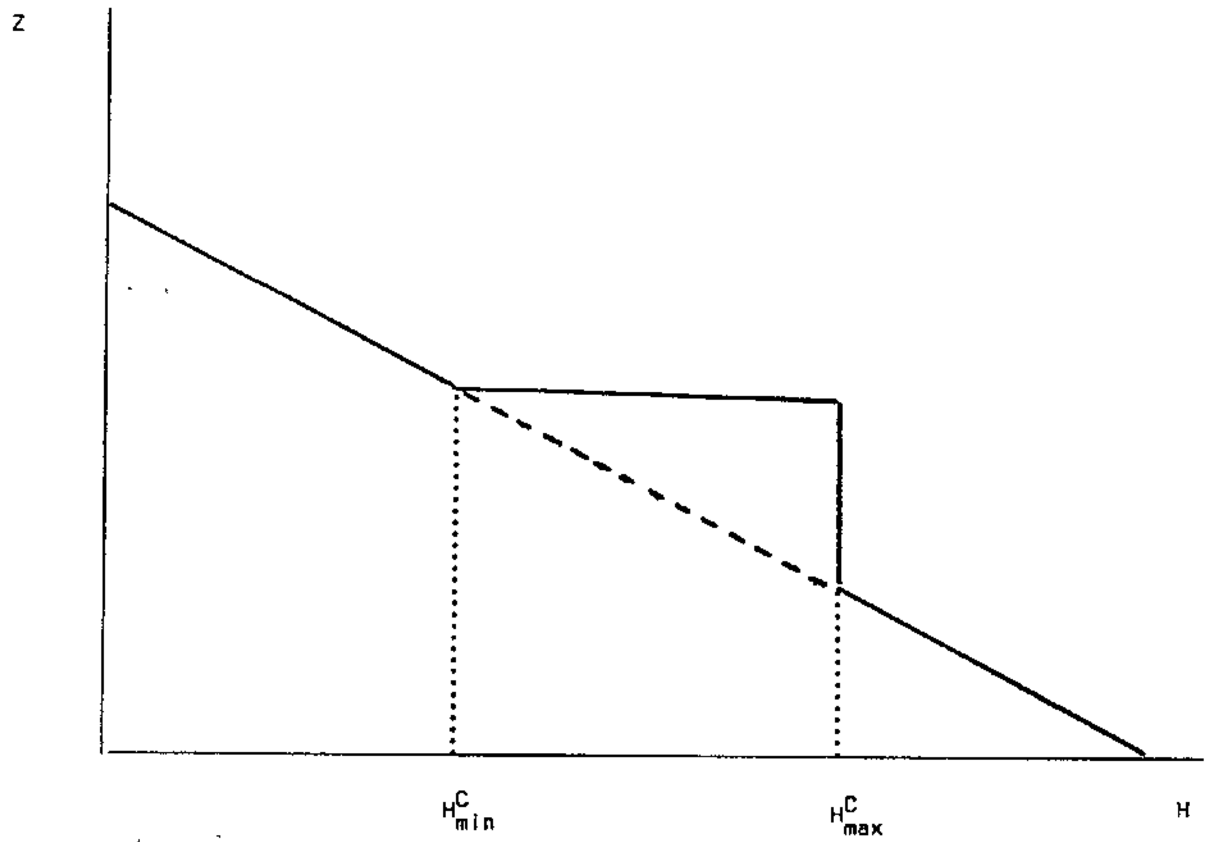
- Y = the measure of household income relevant to household decision making,
- H, Z = housing and non-housing consumption, respectively,
- P_H, P_Z = the price per unit of housing and non-housing consumption, respectively,
- Y_G = household gross income as defined by the program,
- Y_N = household net income as defined by the program, and
- R^c_{max} = the maximum gross rent allowed by the program.

This creates a corner in the budget line as shown in Figure D.2. For housing expenditures below the tenant contribution level (the larger of 10 percent of gross income or 30 percent of rent income), the household receives no assistance and remains on its pre-program budget line. Once expenditures on housing reach the tenant contribution level, the household can increase rent without increasing its out-of-pocket cost (without decreasing other expenditures) until it reaches the maximum allowed rent. Thus, above the tenant contribution level, the budget line is horizontal up to the maximum rent. Units above the maximum rent can only be rented outside the program, so the budget line returns to the original pre-program line.

[1] Or welfare rent. See the note on welfare rent above.

FIGURE D.2

THE CERTIFICATE PROGRAM BUDGET LINE



$H^c_{min} = R^c_{min}/P_H$, $H_{max} = R_{max}/P_H$

$R^c_{min} = \max\ [0.1Y_G,\ 0.3Y_N]$, $R^c_{max} = \min\ [FMR, R_R]$*

P_H = price of housing

H = housing goods and services

Z = non-housing goods and services

R = gross rent

Y_G = gross income

Y_N = net income

FMR = HUD-determined local Fair Market Rent Schedule (by unit size)

R_R = PHA-determined reasonable rent

*The PHA is allowed to set R^c_{max} up to 10 percent above the FMR for up to 20 percent of recipients.

The ceiling on gross rent in the Certificate Program is required by the program's payment formula. Under the Certificate Program, the household's contribution towards rent is fixed at R_{min}, and the program pays the difference between actual gross rent and this fixed household contribution. Since the household has no reason to limit unit rent, the program must set limits in order to limit the assistance payment.

The Housing Voucher Program substitutes a direct ceiling on the program assistance payment for the Certificate Program ceiling on unit rent. Specifically, under the Housing Voucher Program, recipients must still rent units that meet program housing standards, and the minimum tenant contribution is set at 10 percent of gross income.[1] For rents above this amount, the program pays the difference between gross rent and this tenant contribution up to a maximum amount. Thus the budget line becomes

$$(4) \qquad Y = \begin{cases} P_H H + P_Z Z & \text{if } P_H H \leq 0.1Y_G \\ 0.1Y_G + P_Z Z & \text{if } 0.1Y_G \leq P_H H \leq S^v_{max} + 0.1Y_G \\ P_H H - S^v_{max} + P_Z Z & \text{if } P_H H > S^v_{max} + 0.1Y_G \end{cases}$$

where

Y = the measure of household income relevant to household decision making,

H,Z = housing and non-housing consumption, respectively,

P_H,P_Z = the price per unit of housing and non housing consumption, respectively,

Y_G = household gross income as defined by the program, and

S^v_{max} = the maximum allowed assistance payment under the Housing Voucher program.

[1]Current legislation prohibits application of the Certificate program welfare rent rule to Housing Voucher recipients.

This is depicted graphically in Figure D.3. Like the Certificate Program, the Housing Voucher Program creates a corner in the budget line at the point H^v_{cor}.[1] Unlike the Certificate Program, however, the Housing Voucher Program allows recipients to spend more for housing than R_{cor}; thus the budget line above H^v_{cor} does not return to the pre-program level. However, since the program assistance payment does not increase with rents larger than R_{cor}, the cost of housing above H^v_{cor} is paid by the tenant, so that the program budget line above H^v_{cor} is shifted above, but parallel to, the pre-program line.

The maximum assistance payment in the Housing Voucher program is set at the difference between the program payment standard (generally the same as the Certificate Program maximum rent) and 30 percent of net income. Thus

$$S^v_{max} = PS - 0.3Y_N \quad (5)$$

where

S^v_{max} = the maximum assistance payment under the Housing Voucher program

PS = the Housing Voucher payment standard,

Y_N = household net income as defined by the program.

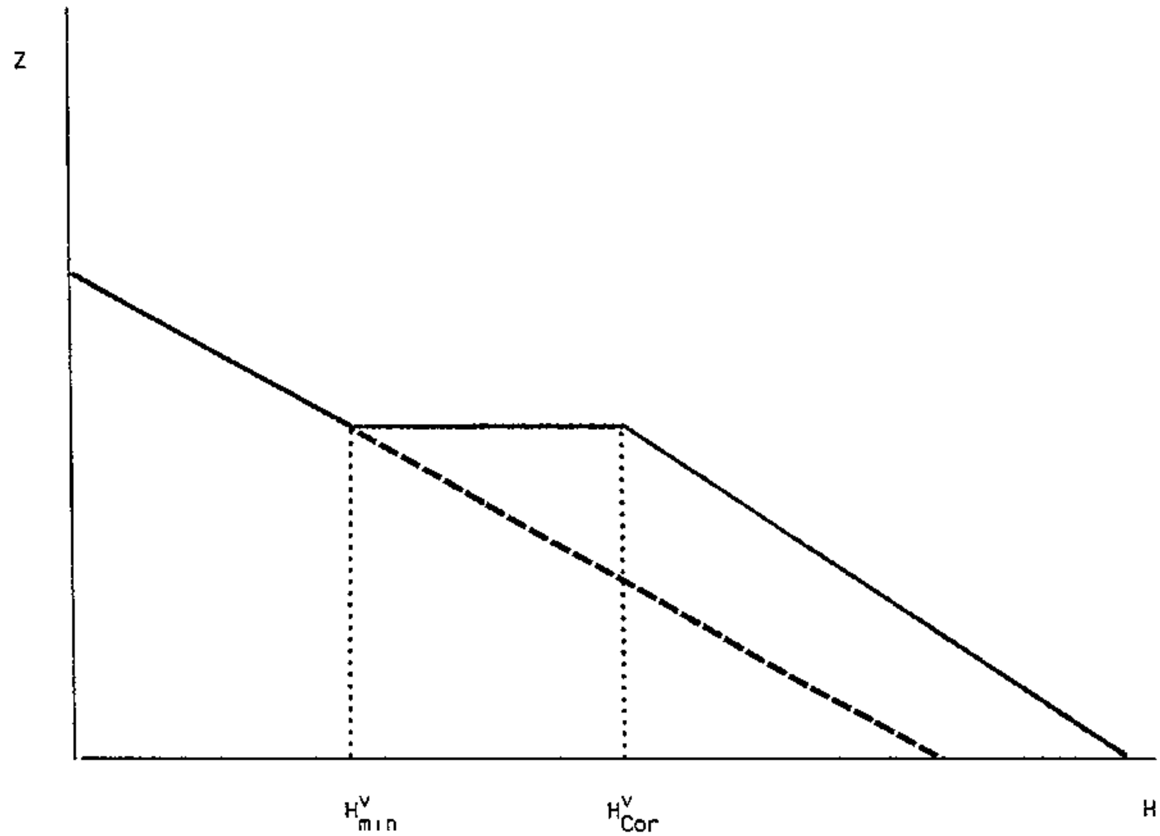
In general, if the Housing Voucher payment standard (PS) equals the Certificate program R^c_{max}, then the maximum assistance payment under the Housing Voucher Program (S^v_{max}) equals the assistance payment under the Certificate Program (S^c_{max}). The Housing Voucher PS may, however, differ from the Certificate Program R^c_{max} for several reasons:

1. Although the Housing Voucher Payment Standard (PS) was set equal to the Certificate Program Fair Market Rent (FMR) at the beginning of the Demonstration, Housing Voucher funding rates allowed PHAs to increase the Payment Standard by less than any subsequent increase in FMRs. Over time, the two schedules diverge in some PHAs.

[1] H^v_{cor} is not, however, usually equal to the H^c_{max} corner for the Certificate Program (see Figure D.4, below).

FIGURE D.3

THE HOUSING VOUCHER PROGRAM BUDGET LINE



$H^{V}_{min} = R^{V}_{min}/P_H$ $H^{V}_{Cor} = R_{Cor}/P_H$

$R^{V}_{min} = 0.1Y_G$ $R_{Cor} = S_{max} + 0.1Y_G$

PH = price of housing

H = housing goods and services

Z = non-housing goods and services

R = gross rent

Y_G = gross income

S^{V}_{max} = the maximum Housing Voucher subsidy

2. PHAs may allow up to 20 percent of Certificate recipients to pay rents up to 10 percent above the FMRs or enforce lower R^c_{max} through application of Certificate program rent reasonableness on a case-by-case basis.

Most importantly, of course, R^c_{max} is actually the maximum rent allowed by the Certificate program, whereas PS simply affects the rent at which the Housing Voucher assistance payment stops increasing.

The difference between the two programs' budget lines is shown in Figure D.4 for the case in which PS equals R^c_{max}. If 30 percent of net income is greater than 10 percent of gross income (Case A), the Housing Voucher budget line lies above the Certificate line for all gross rents above 10 percent of gross income. If 10 percent of gross income is greater than 30 percent of net income (Case B), the two budget lines coincide up to R^c_{max}, but thereafter the Housing Voucher budget line lies above the Certificate line. Case A is the usual one, applying to over 99 percent of recipients.

D.2.2 Expected Differences Between the Two Programs Under the Simple Model

The simple model posed above implies some clear differences in program payments, success rates, and rents.

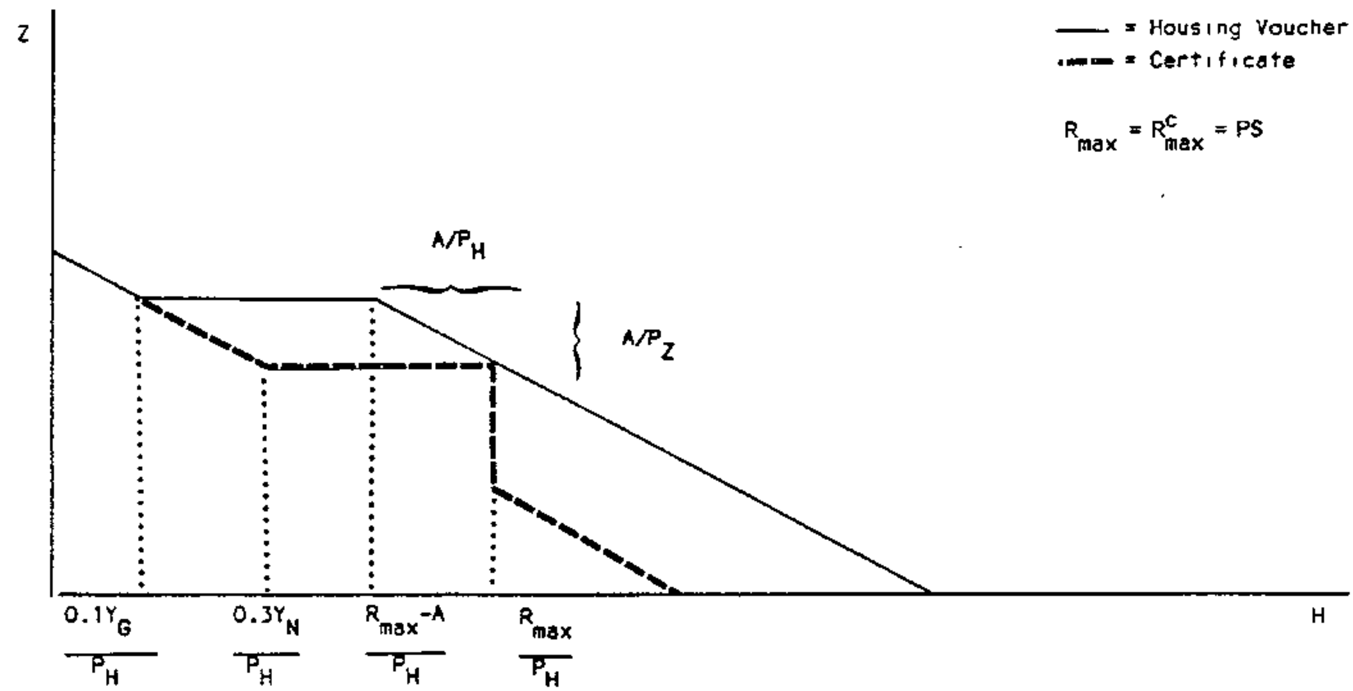
Assistance Payments. Figure D.4 indicates that under the dominant Case A, the Housing Voucher assistance payments for any recipient will be larger than Certificate program assistance payments unless (a) the recipient rents a unit with a gross rent of R^c_{max}, or (b) R^c_{max} is greater than the payment standard for one of the reasons listed earlier.

Success Rates. In order to become recipients, enrollees in either program must obtain housing that meets program occupancy and quality requirements within two to four months of enrollment. A substantial proportion of enrollees do not qualify. Roughly speaking we might expect that the success rate among enrollees in becoming recipients would be higher in a program that allowed a greater range of options. In fact, as long as R^c_{max} is the same as PS, the Housing Voucher Program dominates the Certificate Program in the sense that any consumption pattern that is feasible under the Certificate Program is feasible under the Housing Voucher Program, while the Housing Voucher Program includes points that are not feasible under the Certificate Program. This is

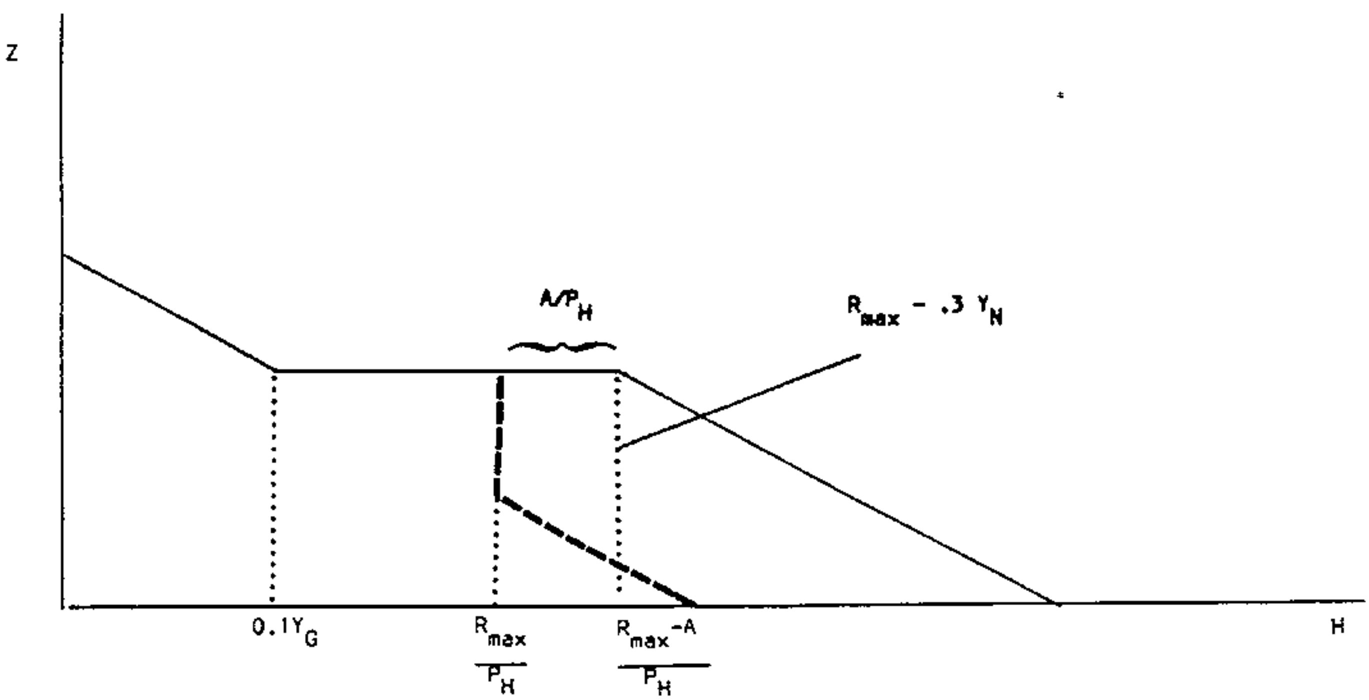
FIGURE D.4

COMPARISON OF HOUSING VOUCHER AND CERTIFICATE PROGRAM BUDGET LINES WHEN R_{max} IS THE SAME IN BOTH PROGRAMS

Case A: $0.3\ Y_N - 0.1\ Y_G = A > 0$



Case B: $0.3\ Y_N - 0.1\ Y_G = A < 0$



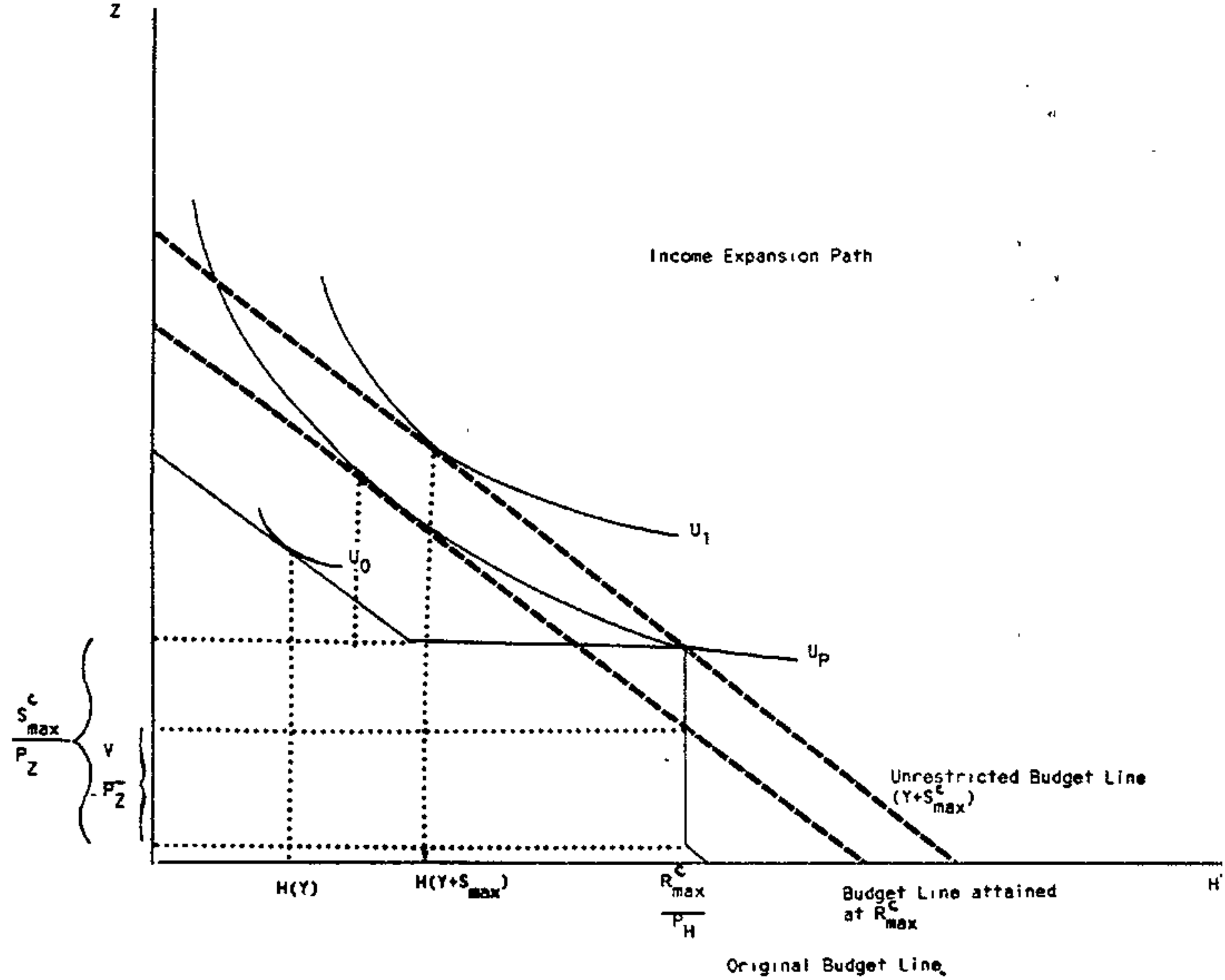
the basis for the belief that the Housing Voucher Program should have higher success rates than the Certificate Program.

Under the model posed here, a household might reject the Housing Certificate program under either of two circumstances. If the household has a low enough pre-program rent level (somewhere below 30 percent of net income), then it might be better off without the Certificate program, which would require some increase in household out-of-pocket costs, though generally offering much better housing. Similarly, if in the absence of the program a household wants much better housing than can be obtained within the Certificate maximum allowable rent, it might also be better off without the program, which would reduce both its out-of-pocket costs and its housing quality.

More generally, the benefits of the Certificate program from the household's viewpoint are reduced to the extent that the corner point in the Certificate budget line requires housing expenditures different from those that the household would itself choose, given additional income equal to the maximum Certificate assistance payment. This is illustrated in Figure D.5. The dashed line shows the budget constraint that the household would face if it were simply given additional income equal to the Certificate assistance payment. If the household were allowed complete freedom of choice, the value of the assistance payment to the household would simply be the amount of the assistance payment--S^c_{max}. To the extent that the household would desire to spend a different amount on housing than R^c_{max} (i.e., to the extent that $R_N(Y+S_{max}) \neq R^c_{max}$), then the value of the program to the household is reduced below S^c_{max}. This suggests that the reduction in value might be empirically specified as a function of the absolute difference between the program-constrained rent and the rent that the household would itself choose given

Figure D.5

HOUSEHOLD VALUATION OF THE CERTIFICATE PROGRAM PAYMENT



H(Y) = desired housing consumption at current income

$H(Y+S^c_{max})$ = desired housing consumption given an increased income of S^c_{max}

S^c_{max} = the maximum Certificate assistance payment

R^c_{max} = the ceiling on allowable rent

P_H = the price of housing

P_Z = the price of other goods

V = the income equivalent value of the assistance payment to the household additional income equal to the maximum Certificate assistance payment ($|R(Y+S_{max})-R^c_{max}|$).[1]

As shown earlier in Figure D.4, the Housing Voucher program allows households to choose to spend above PS and also extends the program budget line for spending below PS to the extent that $(0.3Y_N-0.1Y_G)$ is positive. Where the Housing Certificate offers a single point (at R^c_{max}) on the $(Y+S_{max})$ budget line, the Housing Voucher program offers a section of the $(Y+S_{max})$ budget line. Thus, a Housing Voucher program, by allowing recipients a greater range of choice, should, in principle, appeal to more eligible households and offer greater incentives to participate. In equations, this may be written

$$(6) \qquad \Delta U_p = S_p - L(H_p - H(Y+S_p))$$

where

ΔU_p	=	the value of the program to a recipient
S_p	=	the assistance payment paid by the program
L	=	a loss function due to program requirements or payment structures that force the recipient away from desired consumption patterns
H_p	=	the program level of housing
$H(Y+S_p)$	=	desired housing given at income $Y+S_p$
Y	=	household income

[1]This is, of course, fairly arbitrary. The content for the household of the difference in desired and prescribed rent might be better captured in terms of real housing, which would require adjustment for the local price of housing. In the sites in which housing evaluations will be conducted, regressions of rents on housing characteristics (hedonic regressions) may be used to develop a price index across sites, if the program does not distort shopping behavior. Further, the theoretical impact on value is clearly non-linear, depends on the curvature of the indifference curves, and needs not be symmetrical (nor constant across different incomes).

In terms of the two programs' restrictions we can write ΔU_P from Eq. (6) as

$$(7) \qquad \Delta U_C = S_c - L\,(R^c_{max} - R^*(Y+S) / P_H)$$

$$(8) \qquad \Delta U_V = S_v - \min L\,(R - R^*(Y+S) / P_H^{*})\ \text{s.t.}\ (R \geq PS - (0.3Y_N - 0.1Y_G)$$

Since the minimum value of L in Eq. (8) cannot be greater than the value of L in Eq. (7), the value of the Housing Voucher program to recipients cannot be less than the value of the Certificate program, that is:

$$(9) \qquad \Delta U_V \geq \Delta U_C$$

We should note that this effect might not be observed in the Demonstration sample. The Demonstration sample consists of applicants to the current Section 8 Certificate program. To the extent that applicants were aware of program rules, we would expect that they were people who found the Certificate program worthwhile. The model posed above would still suggest a higher utility for the Housing Voucher program, but the persons with the largest differences may have been excluded.

Recipient Rents. The statement that the Housing Voucher program offers a greater range of choice also implies that we may observe differences in the distribution of recipient rents. In particular, Housing Voucher rents would be expected to be less clustered at the corner in the program budget line. In terms of Figure D.4, all households in the Certificate program would be expected to have expenditures on housing close to the corner of the Certificate program budget line (at R^c_{max}); in the Housing Voucher program, only households whose desired spending on housing is less than the (generally lower) Housing Voucher budget line corner will cluster around the corner.

However, because the corner in the Housing Voucher budget line is frequently below the corner in the Certificate program line, the overall expected effect on average rents is unclear. To see this, the equation for the theoretical range of responses are easily derived.

The household's desired program level of housing and tenant contribution in the Certificate Program are clearly given by renting at the maximum rent. On the one hand, from Figure D.2, the household cannot pay more than this and stay in the program; on the other, the household saves nothing by spending less. Thus, the theoretical housing situation for Certificate recipients should be

$$R_P^c = R_{max}^c$$

$$(10) \qquad B_P^c = \max[0.1Y_G, 0.3Y_N]$$

$$S^c = S_{max}^c = R_{max}^c - \max(0.1Y_G, 0.3Y_N)$$

where

R_P^c = the expected gross rent for the recipient unit under the Certificate program,

B_P^c = the recipient's out-of-pocket cost for rent under the Certificate program, $(R_P^c - S^c)$

S^c = the assistance payment paid under the Certificate Program,

Y_G = recipient gross income.

Y_N = recipient net income.

Similarly, under the Housing Voucher Program, from Figure D.3, the household saves nothing by spending less than $(S_{max}^v + 0.1Y_G)$ for housing. It can, however, elect to spend more than this. Accordingly, the values of program housing and recipient and program contribution for the Housing Voucher Program are given by

$$R_P^v = \max[S_{max}^v + 0.1Y_G, R_N(Y+S_{max})]$$

$$(11) \qquad B_P^v = R_P^v - S_{max}^v$$

$$S^v = S_{max}^v = PS - 0.3Y_N$$

where

R_p^v = the expected gross rent for the recipient unit under the Housing Voucher Program,

$B_p^v = R_p^v - S^v$ = the recipient's out of pocket cost for rent under the Housing Voucher Program,

S^v = the assistance payment paid under the Housing Voucher program,

$R_N(Y+S_{max})$ = normal recipient rental expenditures with income $Y+S_{max}$

If we define

$$A = (0.3Y_N - 0.1Y_G),$$

and assume that

$$R^c_{max} = PS = R_{max},$$

then we can compare outcomes under the two programs by substituting Eqs. (10) into Eqs. (11). If, as is almost always the case, A is positive, we have

$$(12) \qquad S^v = S^c$$

$$(13) \qquad R_p^v = R_p^c + \max[-A, R_N(Y+S^v) - R_{max}]$$

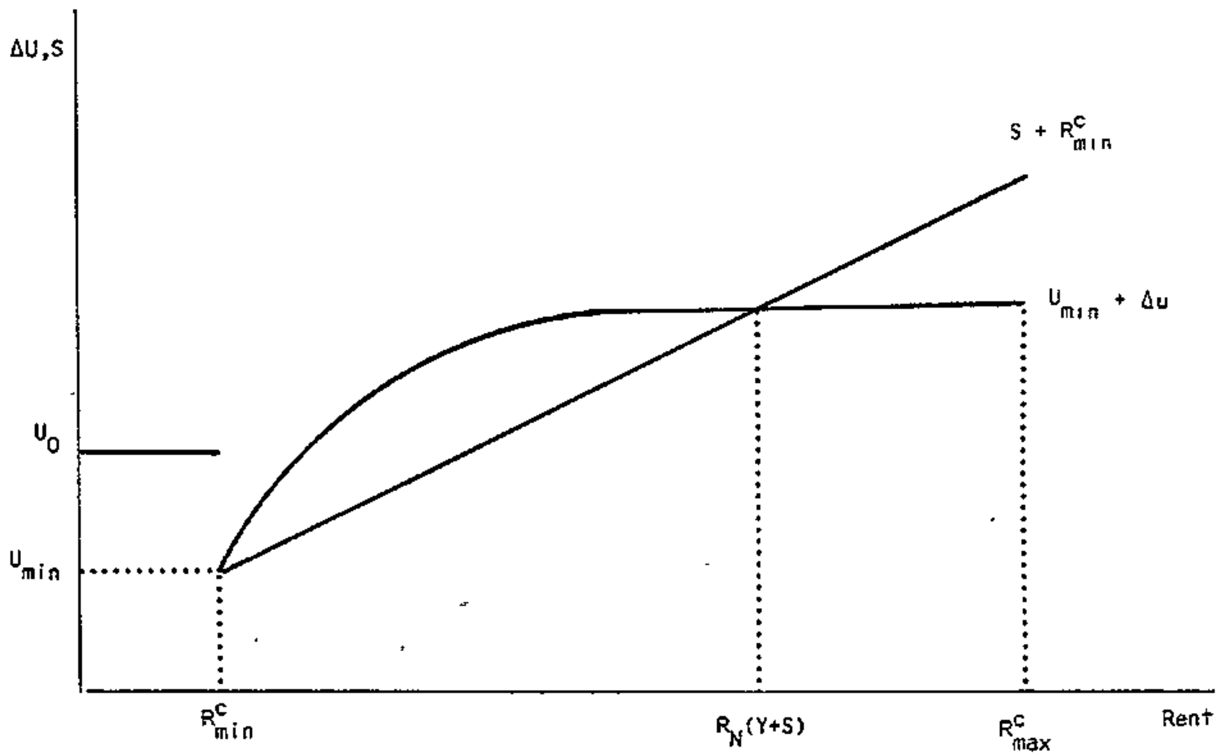
$$(14) \qquad B_p^v = B_p^c + \max[0, R_N(Y+S^v) + A - R_{max}]$$

We can summarize this discussion graphically by showing the relationship between the change in utility (ΔU) and the rent chosen. Figure D.6 portrays this for the Certificate program. If the recipient spends the minimum required amount for housing, he receives a zero subsidy and will obtain a lower level of utility (unless $R_0 = R^c_{min}$). If normal rental expenditures with the subsidy ($R_N(Y+S)$) are greater than R^c_{min}, the program value rises to U_0+S at rental expenditures equal to $R_N(Y+S)$. If this level is below R^c_{max}, value continues to rise thereafter, but less rapidly than the subsidy amount.

Figure D.7 presents the same information for the Housing Voucher program. As with the Certificate program, utility increases with expenditures

FIGURE D.6

VALUE OF THE CERTIFICATE PROGRAM
TO RECIPIENTS AS A FRACTION OF PROGRAM RENT



U_u = Pre-program utility level

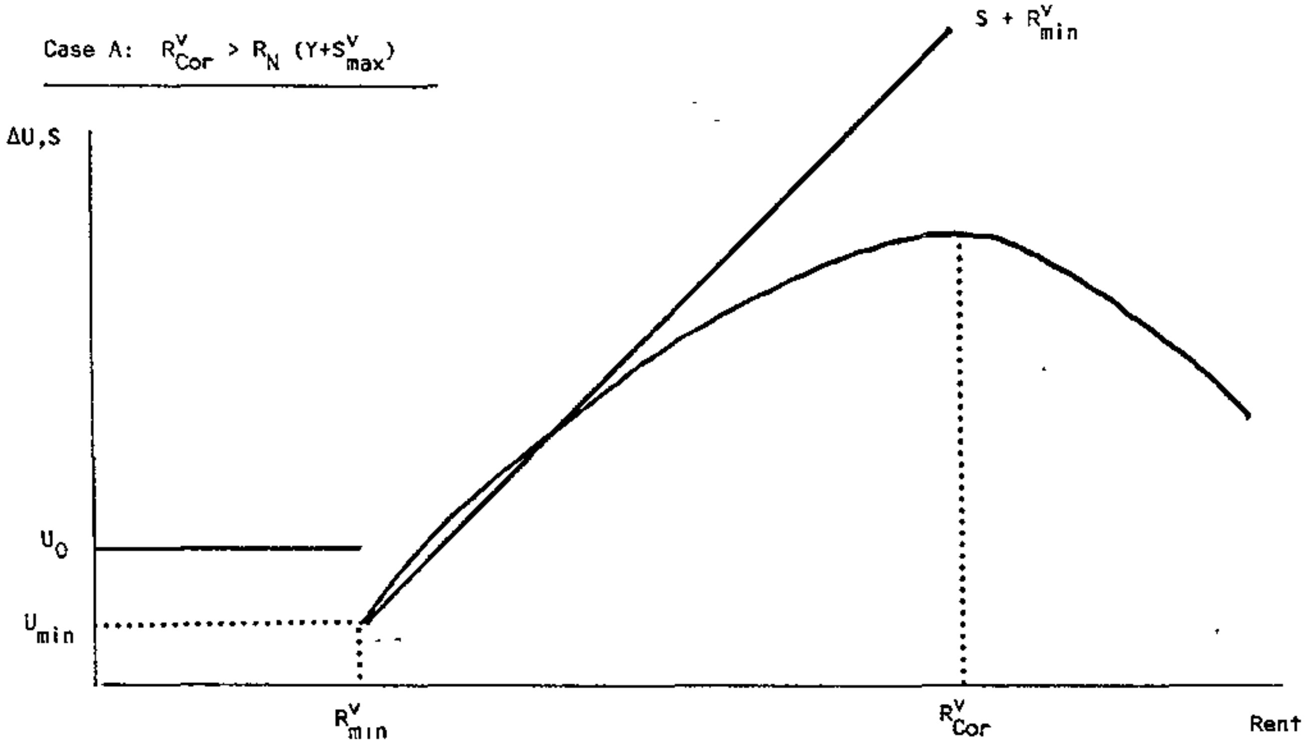
U_{min} = Utility level of program at R^c_{min}

$R_N(Y+S)$ = Normal expenditures with income equal to initial income plus subsidy

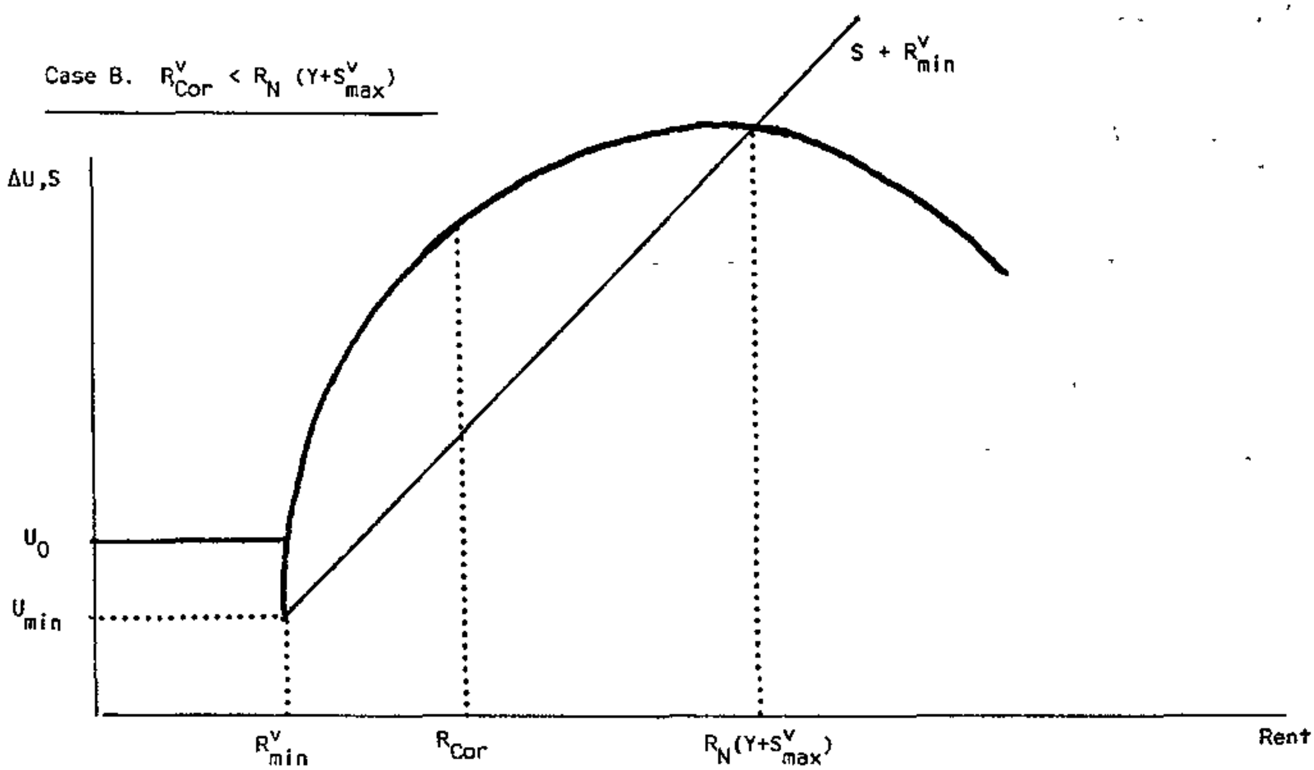
FIGURE D.7

VALUE OF THE HOUSING VOUCHER PROGRAM
TO RECIPIENTS AS A FUNCTION OF PROGRAM RENT

Case A: $R^{v}_{Cor} > R_N\ (Y+S^{v}_{max})$



Case B. $R^{v}_{Cor} < R_N\ (Y+S^{v}_{max})$



U_u = Pre-program utility level

U_{min} = Utility level of program at R^{c}_{min}

$R_N(Y+S)$ = Normal expenditures with income equal to initial income plus subsidy until R^{v}_{cor}; thereafter it increases further if $R_N(Y+S^{v}_{max})$ is greater than R^{v}_{cor}, until rent reaches R_N.

Figure D.8 compares the two programs, showing that the value of the Housing Voucher program to the recipient is greater than that of the Certificate program unless $R_N(Y+S^{v}_{max})$ equals R^{c}_{max}.

D.2.3 Summary of the Simple Model and Empirical Evidence

In words, again, for $A > 0$, the standard model conclusions are

1. The Housing Voucher program should appeal more to eligible households than the Certificate program, though this effect may be masked in the Demonstration sample.

2. The expected assistance payment under the two programs is the same.

3. The expected rent levels in the Certificate program are the maximum allowed rent (the FMRs, modified by PHA exceptions and rent-reasonableness determinations).

4. The expected rent levels under the Housing Voucher are determined by the recipient's normal rental expenditures given the additional income afforded by the subsidy. They will accordingly be more dispersed than Certificate program recipients' rents and will be higher or lower as these normal expenditures are greater or less than the rents allowed by the Certificate program.

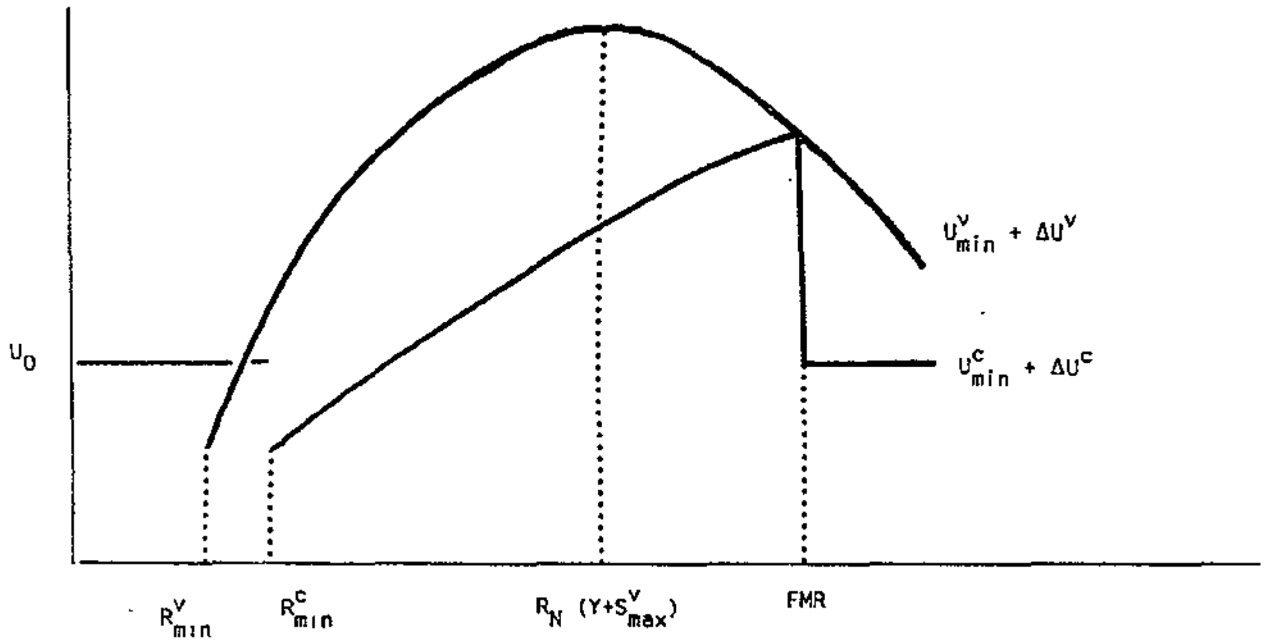
We can immediately qualify the simple model presented in this section by observing that moving from one house to another appears to be costly both in terms of the actual effort and expense involved in physically moving and in terms of the psychological and other costs involved in establishing new ties, finding new grocery stores, schools, commuting routes, and so forth. Accordingly, we may expect that households will maintain positions that seem less than optimal in order to avoid the costs of changing housing. In particular, recipients who do not move from their pre-program units may often have rents well below or above the values predicted by the models. This suggests the usefulness of separate analyses of movers and stayers, since our equilibrium analysis applies only to movers.[1]

[1]Transaction costs can also affect the models for movers. Search decisions and optimal paths may be affected by the need to take future changes into account. These models, however, rapidly become quite complicated.

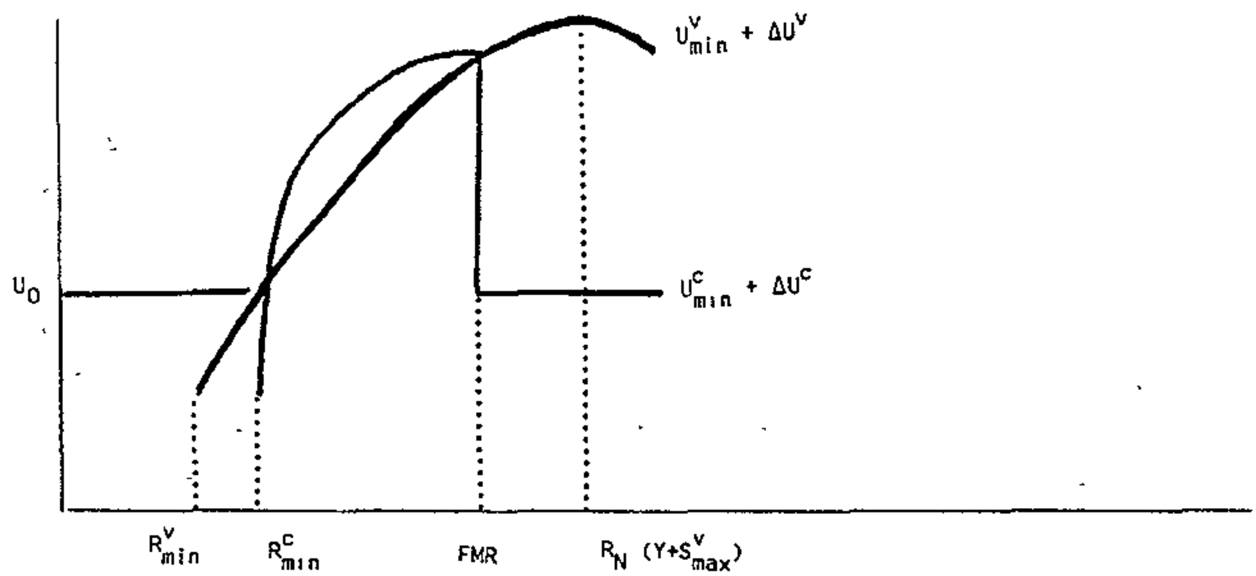
FIGURE D.8

COMPARISON OF THE TWO PROGRAMS

Case A: $0.3Y_N > 0.1\ Y_\sigma$, $PS = R^c_{max} = FMR$, $R_N\ (Y+S^v_{max}) < FMR$



Case B: $0.3\ Y_N > 0.1\ Y_\sigma$, $PS = R^c_{max} = FMR$, $R_N\ (Y+S^v_{max}) > FMR$



Even with this restriction, however, we can readily reject the simple model. Most obviously, under the terms of the simple model every Housing Voucher holder with a value of $R_N(Y)$ greater than the Housing Voucher minimum (R^v_{min}) should become a recipient and choose a unit renting for $R_N(Y+S^v_{max})$. In fact this is far from the case. Among Housing Voucher holders, 80 percent had pre-program rents above the Housing Voucher minimum. As shown in Table D.5, only 65 percent of these actually became recipients. Even among Housing Voucher holders who would have received more than $200 per month had they simply qualified in place, over one-fourth did not in fact become recipients. As indicated in Table D.5, focusing only on holders who were not sharing their pre-enrollment units or otherwise paying less than the full pre-enrollment rent does not materially change the results. There is clearly some barrier to successful participation in the programs, the obvious candidate being the programs' housing quality and occupancy requirements.

Likewise, we can also note that recipient rents are generally well above the levels predicted by the standard model. Consider, for example, the rents paid by Housing Voucher recipients who move to units that are not otherwise subsidized. Under the simple standard model these households should obtain units for a rent corresponding to the rent they would normally pay if their income were increased by the amount of the Housing Voucher subsidy. We can in principle examine this by estimating normal expenditure functions for each site based on the pre-enrollment gross rents of households that were not sharing their unit or otherwise paying less than the full pre-enrollment rents and then forming a predicted normal gross rent. Specifically, we estimated

$$R^0_{ijr} = \sum_{rj} \alpha_{rj} d_{irj} + \sum_j \beta_j c_{ijr} Y_{irj} + \varepsilon_{irj}$$

$$\hat{R}^N_{ijr} = \sum_{rj} \hat{\alpha}_{rj} d_{irj} + \sum_j \hat{\beta}_j c_j (Y_{irj} + S_{irj})$$

where:

R^0_{ijr} = Pre-enrollment rent of i^{th} Housing Voucher recipient in j^{th} PHA and r^{th} bedroom size category

TABLE D.5

SUCCESS RATE BY IN-PLACE ASSISTANCE PAYMENT

Monthly Assistance Payment Household Would Receive If Qualified At Its Estimated Pre-Enrollment Gross Rent	Housing Voucher Program		Certificate Program	
	N	Success Rate	N	Success Rate
All applicants				
Less than or equal to 0	1234	52.8	1300	50.2
Greater than 0, less than or equal to 100	1239	58.5	1276	57.1
Greater than 100, less than or equal to 200	1876	61.1	1863	57.3
Greater than 200, less than or equal to 300	1371	72.9	1331	69.2
Greater than 300	430	75.8	421	72.9
All Applicants Paying Full Pre-Enrollment Rent[a]				
Less than or equal to 0	348	47.4	391	44.3
Greater than 0, less than or equal to 100	661	54.9	645	53.5
Greater than 100, less than or equal to 200	1495	61.2	1482	57.0
Greater than 200, less than or equal to 300	1222	73.3	1218	69.6
Greater than 300	389	76.1	379	72.6

[a]Excluding households that were sharing their pre-enrollment unit or otherwise paying less than the full rent.

d_{ijr} = A dummy variable equal to one if the recipient is in the j^{th} PHA and r^{th} bedroom size category and zero otherwise

c_{ijr} = A dummy variable equal to one if the recipient is in the j^{th} PHA and zero otherwise

Y_{ijr} = Income of i^{th} recipient in j^{th} PHA and r^{th} bedroom size category

R^N_{ijr} = The estimated normal rent given the increase in income provided by the assistance payment, using estimates of α_{jr} and β_j based on pre-enrollment rents of recipients who moved to non-subsidized units and who were paying their full pre-enrollment rent

S_{ijr} = The maximum assistance payment offered to the i^{th} Housing Voucher recipient in the j^{th} PHA and r^{th} bedroom size category

α,β = Unknown coefficients

As shown in Table D.6, actual gross rents for these Housing Voucher recipients were well above the estimated normal rent with larger differences in higher normal rents. This evidence may be unpersuasive however. The response of rental expenditures to income estimated from a cross-sectional sample of current incomes may well underestimate the response to the relatively permanent shift in income represented by the housing assistance payment. This is especially likely when we consider that we are basing the estimates in Table D.6 on a sample of recipients who subsequently moved and who may have experienced a recent drop in income (if they only recently became eligible). Accordingly, Table D.6 also shows the average income elasticity implied by the change in rents for Housing Voucher households that moved, both for all recipients in the group with reported prospective total incomes greater than \$100 per year and for recipients with reported prospective total incomes of at least \$3600 per year. As can be seen, the implied subsidy elasticities are very high and well above any estimate of normal income elasticities.

TABLE D.6

CHANGE IN GROSS RENT RELATIVE TO ASSISTANCE PAYMENT

1. Comparison of actual and predicted gross rent (for Housing Voucher recipients who were paying their full pre-enrollment rent and then moved to units not otherwise subsidized)

Mean Gross Rent	$527/month
Mean difference between actual gross rent and the rent predicted by the simple model	$175/month

Regression:[a]

$$\text{Gross Rent} = \underset{(13.35)}{50.83} + \underset{(0.04)}{0.35}\, R^N \qquad R^2 = 0.07$$

2. Relation of Change in Gross Rent to Payment (for Housing Voucher recipients who were paying their full pre-enrollment rent and did not occupy otherwise subsidized units as recipients)

	Implied Elasticity of Rental Expenditures with Respect to Assistance Payments[b]	
	Mean	Inter-Quartile Range
All movers	1.24	0.54 to 1.64
Movers with gross incomes of at least $3,600 per year	2.53	1.32 to 3.19

[a]Standard error in parentheses.

[b]Implied elasticity is defined by:

$$\text{Log}\left(\frac{\text{Recipient Gross Rent}}{\text{Pre-Enrollment Gross Rent}}\right) / \text{Log}\left(\frac{\text{Total Monthly Gross Income Plus Payment}}{\text{Total Monthly Gross Income}}\right)$$

The next sections develop extensions of the standard model and indicate how these extensions may change the results of Eqs. (12) to (14).

D.3 Extending the Model to Take Account of Program Requirements

The discussion of the previous section focused solely on recipients' desired spending levels under the two programs, as if becoming a recipient was simply a matter of choosing to enter the program and selecting the appropriate rent level given the program rules. In fact, of course, households in both the Housing Voucher and Certificate programs must find units that meet the program quality and occupancy standards. This section focuses on individual decision making in searching for housing that meets program requirements.

Finding units that meet such program standards is not always easy. If the household simply searches in the private rental market, it may have few clues with which to work. Unit size requirements in terms of number of rooms are more or less set by the occupancy standards. Otherwise, unit rents tend to be positively, but imperfectly associated with meeting requirements and customary descriptions of units provide little information. Indeed, recognizing this, some landlords directly advertise units as suitable for Section 8 Existing Housing, and some PHAs post lists of landlords whose units tend to meet requirements and who are willing to participate in the program.

Imagine that households set rental targets in searching among units--for example, that they use rents to screen advertisements and decide which units to inspect or that they offer rent levels as a guide to realtors. If the probability of finding a unit that meets program requirements is positively associated with unit rents, then the household might select a search rent that would maximize the expected payoff. If this process is expressed as selecting the search rent level that maximizes expected utility, then the problem may be described as

(15a) $$\underset{\{R\}}{\text{Maximize}}\ E(U) = \pi(R)\ U_P(R) + (1-\pi(R))\ U_N$$

$$= U_N + \pi(R)\ (\Delta U(R))\ .$$

(15b) $$U_P(R) = U[R/P_H, (Y-R+S)/P_Z]$$

where

U_P = the level of utility obtained under the program with rent R,

U_N = the utility level obtained by the household without the program,

$\Delta U(R)$ = $U_P - U_N$

$\pi(R)$ = the probability of finding a unit that meets requirements, if the household searches at rent R,

R = the rent specified in search,

S = the assistance payment given R.

P_H, P_Z = the price of housing and non-housing goods, respectively.

We should note that in this model, we do not concern ourselves with an individual's ability to influence the $\pi(R)$ schedule through, for example, more or less intensive search. This does not seem to be a serious omission. We only need to realize that such a capacity on an individual's part would tend to flatten the $\pi(R)$ schedule and reduce differences in $\pi(R)$ across markets. The first order conditions of Eq. (15) are given by:

(16) $$\frac{d\pi}{dR}\frac{1}{\pi} = -\frac{d\Delta U}{dR}\frac{1}{\Delta U}$$

$$= -\frac{\partial U_p/\partial H}{P_Z \Delta U}\left[\frac{P_Z}{P_H} - \frac{\partial U_p/\partial H}{\partial U_p/\partial Z}\right]$$

(17) $$= \left[\left.\frac{\partial Z}{\partial H}\right|_{U_P} - \left.\frac{\partial Z}{\partial H}\right|_{Y}\right]\left[\frac{\partial U_p/\partial H}{P_Z\ \Delta U}\right]$$

where, as usual,

$$\left.\frac{\partial Z}{\partial H}\right|_{U_P} = \text{the slope of the indifference curve at level } U_P$$

$$\left.\frac{\partial Z}{\partial H}\right|_{Y} = \text{the slope of the budget line } (-P_Z/P_H)$$

The content of Eq. (17) can be developed graphically. The curve $(d\pi/dR)(1/\pi)$ is the ratio of a density function to its parent distribution function.[1] Thus for most standard distributions we have

(18) $\lim_{R \to \infty} (d\pi/dR)\ (1/\pi) = 0$ (or at least becomes small)

Otherwise, it is difficult to characterize $(-d\pi/dR)(1/\pi)$ in general, but two examples--the logistic and normal distribution are shown in Figure D.9.

We can characterize $(-d\Delta U/dR)(1/\Delta U)$ by looking at the expression in the left-hand brackets of Eq. (17) and recalling that this is zero when the household is on its normal consumption path for income $(Y+S_{max})$. Further, as R moves sufficiently far away from this level, ΔU goes to zero. Accordingly, we can sketch the $(d\pi/dR)(1/\pi)$ and $(-d\Delta U/dR)(1/\Delta U)$ curves as shown in Figure D.10. R* always lies above $R_N(Y+S_{max})$, reflecting the fact that increases in R affect both U_P and the probability of obtaining U_P.

One interesting implication of the model of Eq. (15) is that the Housing Voucher program could in theory reduce success rates. Under the Certificate program, all households are in theory induced to spend close to R^C_{max}. As indicated in the previous section, the Housing Voucher program is more likely to induce choices of search R below PS (to the extent that $A=(0.3Y_N-0.1Y_G)$ is positive). Accordingly, Housing Voucher applicants may choose a lower value of R* and hence lower $\pi(R^*)$. If the search R's are more dispersed in the Housing Voucher program, we would expect a corresponding spread in success rates, with higher success rates among households that normally wish to spend more on housing.

Indeed, there seems no reason why the Housing Voucher program could not simultaneously result in lower success rates (due to an increase in the

FIGURE D.9

EXAMPLES OF $(d\pi/dR)(1/\pi)$

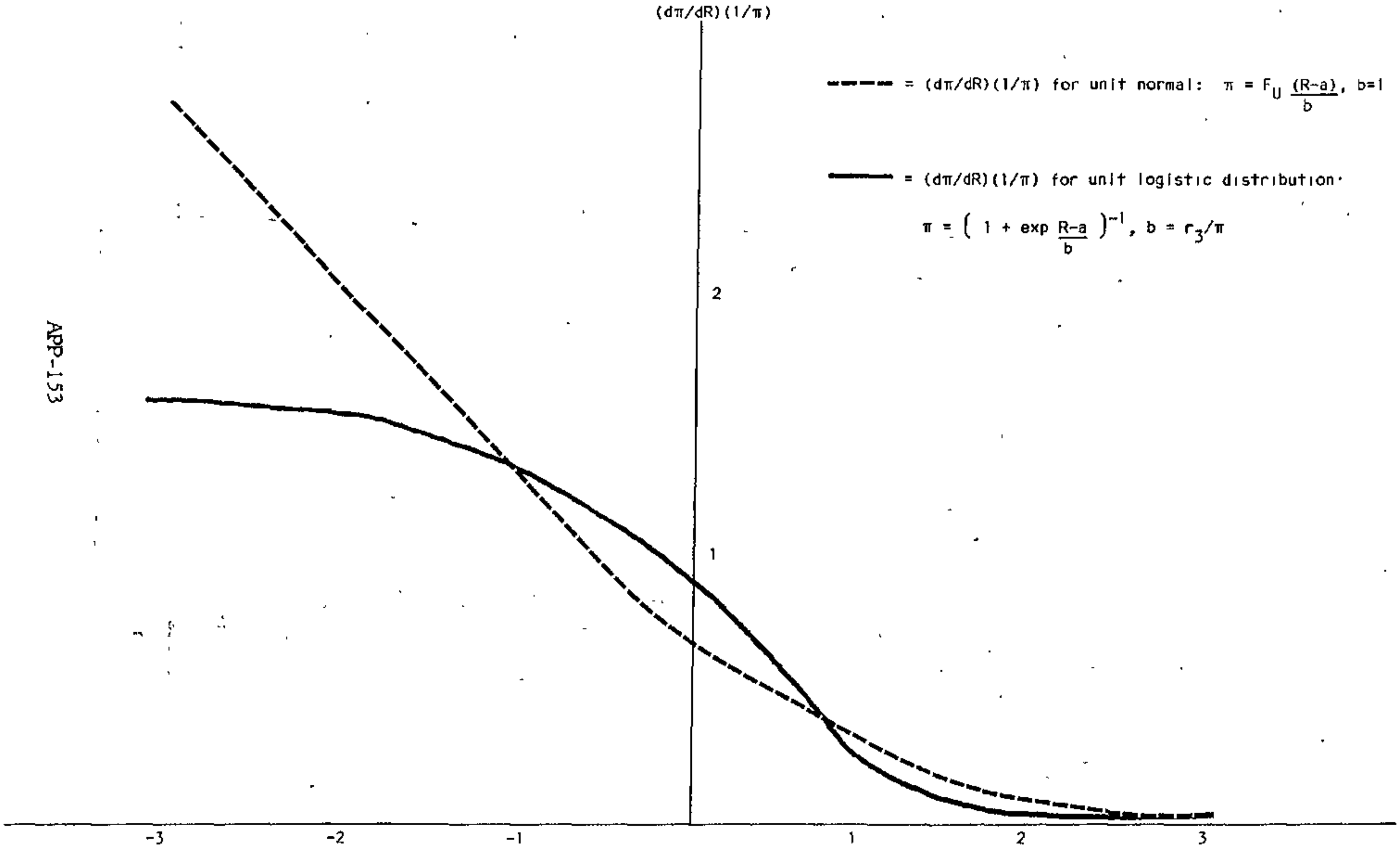
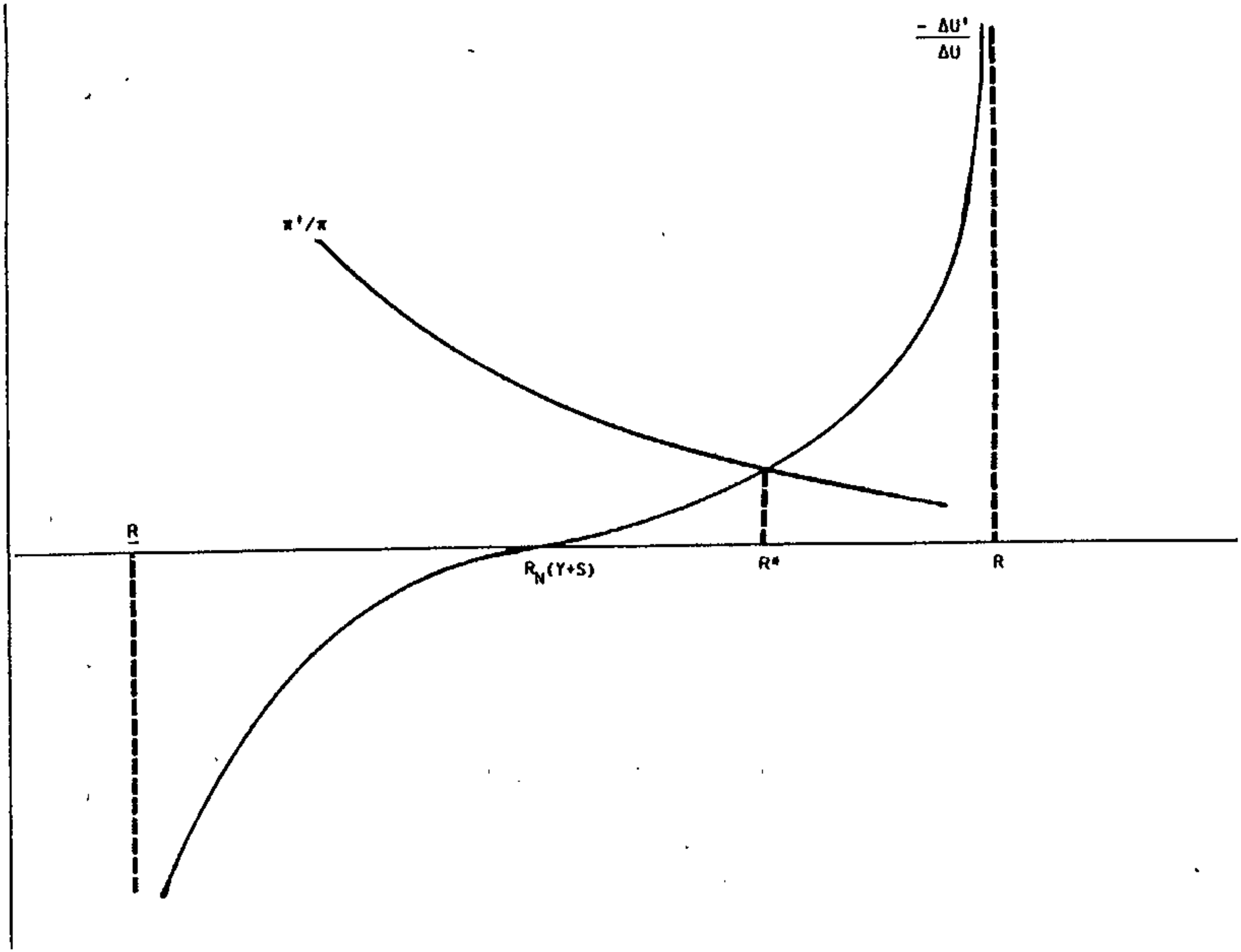


FIGURE D.10

π'/π AND $\Delta U'/U$



proportion of holders adopting search rents below R^c_{max}) and higher average recipient rents (due to an increase in the proportion of holders adopting search rents above R^c_{max}, weighted by their probability of success).

In terms of recipient rents, the model of Eq. (15) immediately yields the prediction that

1. As in the standard model, recipient rents in the Certificate program are expected to cluster around the maximum allowable values.

2. As in the standard model, recipient rents in the Housing Voucher Program should lie above the point at which the Housing Voucher payment is reduced (R^v_{cor}). Unlike the standard model, recipient rents in the Housing Voucher Program should lie above $R_n(Y+S^v_{max})$.

Again, both predictions apply only to recipients who move (or more exactly for Housing Voucher holders, who have to move in order to qualify).

We have already confirmed the second prediction for the Housing Voucher Program. As Table D.3 showed, among Housing Voucher recipients who moved (to otherwise non-subsidized housing), only 5.3 percent had rents below the R^v_{cor} value. As Table D.6 showed, recipient gross rents were well above estimated normal rents.

Concerning the first prediction, we test this as follows. The Payment Standard and FMR schedules vary with PHA and household size (expressed in terms of number of bedrooms). We would expect some connection between rents and such a schedule because average rents vary from city to city and among different household sizes. Accordingly, Table D.7 presents results for a regression of pre-program and program rents on: (a) dummy variables for each PHA and bedroom size category within PHA (76 categories), and (b) a constant and the Payment Standard or FMR schedule that applied to the recipient.

Consider first the results for the Certificate program. The first entries show the results of regressions of pre-program rents for all applicants (excluding applicants who were sharing a unit or receiving other help in paying their rent). There is a modest relationship between pre-program rent and the PHA/bedroom size dummies, and a somewhat weaker relationship to FMRs. If we look only at recipients who moved to otherwise non-subsidized units, we find a somewhat stronger but still weak relationship between pre-program rents and either the PHA/bedroom size dummies or FMRs. In contrast,

TABLE D.7

REGRESSION OF PRE-PROGRAM AND PROGRAM RENTS ON FMRs AND PAYMENT STANDARDS
(FOR HOUSEHOLDS THAT PAID THEIR FULL PRE-PROGRAM RENT)[a]

	Housing Voucher Program			Certificate Program		
	R^2	Root Mean Squared Error	C.V.[b]	R^2	Root Mean Squared Error	CV[b]
Regression of Pre-Program Rent for All Enrollees[c]						
a. Dummy Variable	0.20	$113	34%	0.23	$108	33%
b. Payment Standard/FMR[d]	0.12	$117	35%	0.15	$113	34%
		R = 155 + 0.38 PS (7.7) (0.016)			R = 142 + 0.41 FMR (7.5) (0.015)	
c. FMR/FMR[d]	0.12	$117	35%	0.15	$113	34%
		R = 155 + 0.38 FMR (7.8) (0.016)			R = 142 + 0.41 FMR (7.5) (0.15)	
Regression of Pre-Program Rents for Recipients Who Moved to Non-Subsidized Units						
a. Dummy Variable	0.36	$110	34%	0.34	$110	34%
b. Payment Standard/FMR[d]	0.21	$118	37%	0.22	$116	36%
		R = 82 + 0.48 PS (13.6) (0.027)			R = 70 + 0.50 FMR (14.4) (0.028)	
c. FMR/FMR[d]	0.21	$119	37%	0.22	$116	36%
		R = 81 + 0.48 FMR (13.8) (0.027)			R = 70 + 0.50 FMR (14.4) (0.28)	
Regression of Program Rents for Recipients Who Moved to Non-Subsidized Units						
a. Dummy Variable	0.79	$72	14%	0.87	- $46	9%
b. Payment Standard/FMR[d]	0.78	$72	14%	0.88	-$43	9%
		R = -1 + 1.06 PS (8.3) (0.016)			R = 8 + 0.95 FMR (5.3) (0.010)	
c. FMR/FMR[d]	0.76	$76	14%	0.88	$43	9%
		R = -1 + 1.05 FMR (8.8) (0.017)			R = 8 + 0.95 FMR (5.3) (0.010)	

[a] Excluding households that either shared their pre-enrollment unit with another household or received help in paying the rent.

[b] The estimated standard deviation of the regression residual expressed as a percent of the dependent variable mean.

[c] Includes households that did not become recipients.

[d] Numbers for regression equations in parentheses show the standard errors of estimate for the coefficient.

the regression of program rents on FMRs has an R^2 of 0.88 (as compared with 0.22 for pre-program rents) and provides as good a fit as the 75 PHA/bedroom size dummies. Since the actual maximum allowable rent in the Certificate program may be above or below the FMRs due to either PHA exceptions or rent reasonableness tests, this prediction, at least, seems amply confirmed.

Interestingly, Housing Voucher recipients show the same pattern with respect to Payment Standards. The R^2 for program rents is lower than in the Certificate program, but still 0.78, and the coefficient for the Payment Standard is slightly greater than one (as compared with slightly less than one for the FMRs in the Certificate program, which acts as a ceiling on allowable rents).

This still strong association in the Housing Voucher Program suggests two possible interpretations. First, if Payment Standards do represent a sort of minimum rent needed to meet housing requirements (in the sense that the probability that a unit meets requirements rises sharply as rents approach the FMR levels, and then rises very slowly for further increases in rent), then Housing Voucher rents would also be expected to be strongly correlated with Payment Standards. We already know (see Table D.6 above) that Housing Voucher recipients spent much more for housing than they would normally. We have surmised that this occurs because looking at higher-rent units improves an enrollee's chances of finding a unit that meets program quality and occupancy requirements. If the probability of meeting requirements rises sharply with increasing rents for rents below the Payment Standard and then levels off, there would be ample reason within the model to look for units with rents near the Payment Standard.

To test this, we tabulated the percent of Housing Voucher enrollees (excluding subunits) who qualified in place as a function of the ratio of their estimated pre-enrollment gross rent to Payment Standard (Table D.8 and Figure D. 11). The results do indeed show a sharp rise in the percentage of units meeting requirements as the ratio of unit rent to Payment Standard rises--until rents reach levels of 90 percent or more of the Payment Standard. Above this level, the relationship between rent and requirements flattens dramatically. It appears that the strong association between Housing Voucher recipient rents and Payment Standards is consistent with the model developed so far.

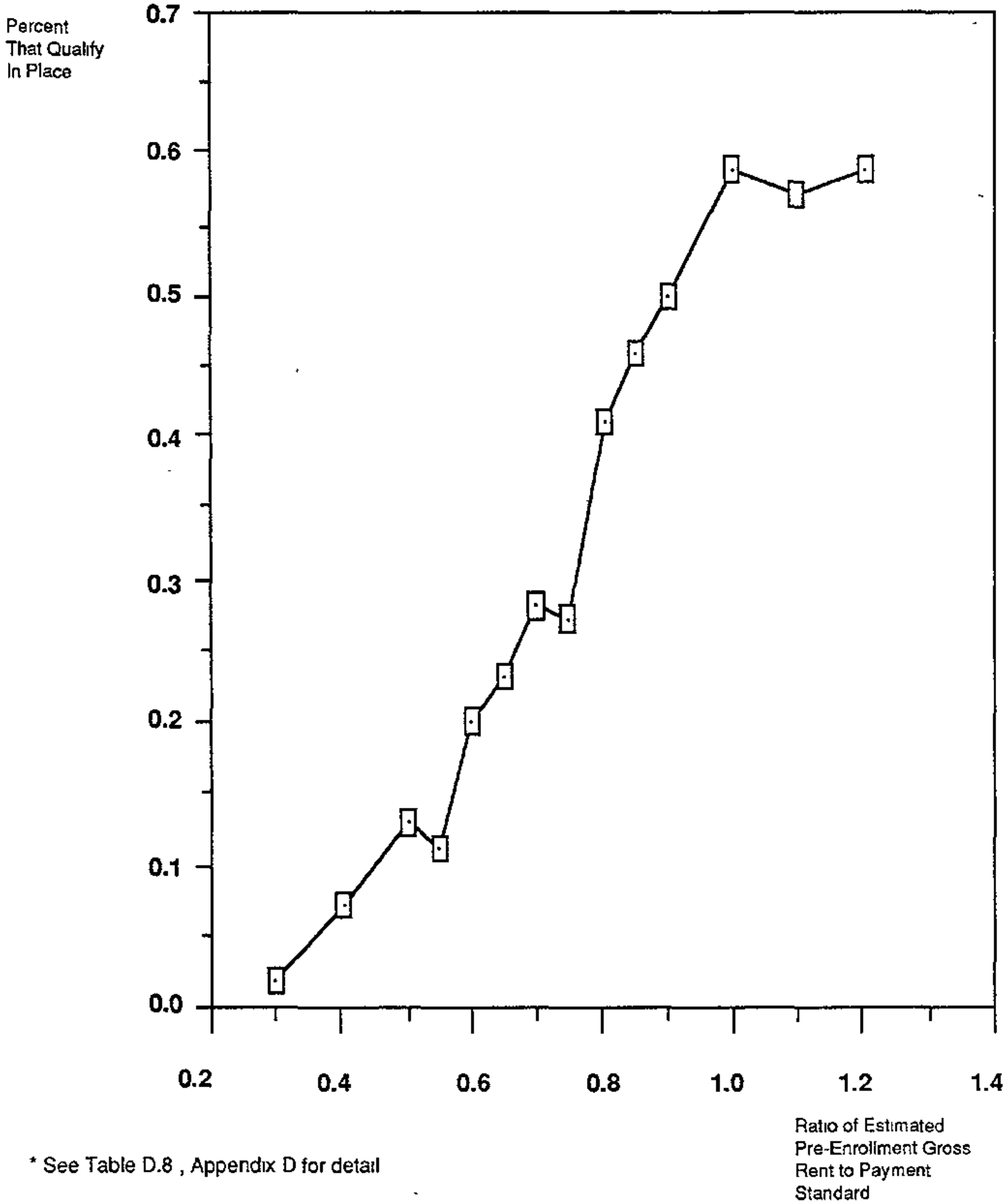
TABLE D.8

RELATIONSHIP BETWEEN THE PROPORTION OF HOUSING VOUCHER ENROLLES QUALIFYING IN PLACE AND THEIR ESTIMATED PRE-ENROLLMENT GROSS RENT TO PAYMENT STANDARDS
(EXCLUDING SUBUNITS)

Ratio of Estimated Pre-Enrollment Gross Rent to Payment Standard	Number of Enrollees	Percent That Qualify In Place
Less than or equal to 0.30	384	2
Greater than 0.30 but less than or equal to 0.40	197	7
Greater than 0.40 but less than or equal to 0.50	364	13
Greater than 0.50 but less than or equal to 0.55	252	11
Greater than 0.55 but less than or equal to 0.60	320	20
Greater than 0.60 but less than or equal to 0.65	314	23
Greater than 0.65 but less than or equal to 0.70	381	28
Greater than 0.70 but less than or equal to 0.75	333	27
Greater than 0.75 but less than or equal to 0.80	315	41
Greater than 0.80 but less than or equal to 0.85	299	46
Greater than 0.85 but less than or equal to 0.90	294	50
Greater than 0.90 but less than or equal to 1.00	432	59
Greater than 1.00 but less than or equal to 1.10	324	57
Greater than 1.10	304	59

Figure D 11

Relationship Between the Proportion of Housing Voucher Enrollees Qualifying in Place and the Ratio of Their Estimated Pre-Enrollment Gross Rent to Payment Standards (Excluding Subunits) *



* See Table D.8 , Appendix D for detail

Alternatively, if Housing Voucher recipients or landlords do not fully understand the differences between the two programs, then the close association between recipient rents and Payment Standards in the Housing Voucher Program may simply reflect the inertia of behaviors formed under the pre-existing Certificate program. We do have evidence that Housing Voucher recipients generally rented from landlords who knew about the Certificate program. As discussed in Appendix B, samples of recipients in 10 of the 18 urban PHAs were interviewed during evaluations of their units. These interviews included questions as to how the recipients found their units and whether landlords or other sources knew about the Section 8 program. As shown in Table D.9, PHA referrals, newspaper ads, and friends and relatives each accounted for about a quarter of the units found by recipients who moved. Realtors were the source for only 5 percent of recipients who moved.

It seems unlikely that PHAs markedly changed their referral lists for the Housing Voucher program. Thus, recipients finding their units through PHA referrals were probably dealing with landlords who were already part of the Certificate program. Furthermore, 39 percent of recipients who found their units through newspaper ads reported that the ad had specifically mentioned the Section 8 program (Table D.10). Among the small group of recipients who found their units through realtors almost all said that the realtor already knew about the program. If we combine the recipients who found their units from PHA referrals, from newspaper ads that explicitly mentioned Section 8, and from realtors knowledgeable about the program, 38 percent of recipients who moved found their units from sources that were directly aware of the Section 8 program and its requirements.[1]

We also asked recipients who moved whether their landlord was already well acquainted with the programs. As shown in Table D.11, over three-fourths of the recipients in both programs reported that their landlords were already well acquainted with the Section 8 Certificate program. In addition, two-thirds of the Housing Voucher recipients reported that their landlords were already well acquainted with the Housing Voucher program as well. This at least suggests that recipients were usually dealing with landlords who were

[1] We did not ask those who found units through friends or relatives about these sources' knowledge of the program.

TABLE D.9

HOW RECIPIENTS WHO MOVED FOUND THEIR UNIT
(Unweighted Sample in 10 PHAs)

Method	Housing Voucher Program	Certificate Program	Both Programs
PHA referral	22.7	24.7	23.7
Newspaper ads	21.5	21.8	21.6
Friends or relatives	24.0	24.2	24.1
Real estate agency	5.6	4.4	5.0
Other	26.2	24.8	25.6
(Sample size)	(591)	(570)	(1161)

TABLE D.10

SOURCES' KNOWLEDGE OF SECTION 8
(Unweighted Sample in 10 PHAs)

	Housing Voucher Program	Certificate Program	Both Programs
Percent of newspaper ads that mentioned Section 8	34.9%	42.4%	38.7%
(Sample)	(126)	(125)	(251)
Percent of realtors who knew about Section 8	90.6%	91.3%	90.9%
(Sample)	(32)	(23)	(55)
Percent of recipients who found units through PHA referrals, newspaper ads that mentioned Section 8, or realtors who knew about Section 8	35.2%	38.0%	36.6%

TABLE D.11

LANDLORDS' PREVIOUS KNOWLEDGE OF THE PROGRAMS
(Unweighted Sample in 10 PHAs)

	Housing Voucher Program	Certificate Program	Both Programs
Percent of landlords who were reported by tenants to:			
Be well acquainted with the Certificate Program	75.0%	82.5%	78.7%
Be well acquainted with both the Housing Voucher and Certificate Programs	66.0	a	a
Know something about the Section 8 Program	17.5	11.8	14.7
Never had heard of the Section 8 Program	7.6	5.8	6.7
(Sample size)			

[a]Not asked of Certificate Program recipients.

already active in the Section 8 program. There is some indication that a higher proportion of Housing Voucher landlords were relatively unfamiliar with Section 8, which may indicate that Housing Vouchers were reaching some additional units, but this is still only a quarter of the Housing Voucher landlords (for recipients who moved).

The Housing Voucher Demonstration was implemented in PHAs with large, ongoing Certificate programs. If, as the results cited indicate, most Housing Voucher recipients were dealing with landlords who were well acquainted with the Certificate program, it may be that most Housing Voucher rents reflected the prices set by landlords in response to the Certificate program. If this is the case, of course, we would expect that the strong role played by the Payment Standard in determining the Housing Voucher recipients rents in Table D.7 actually reflects the close association between Payment Standards and FMRs rather than any direct effect of Payment Standards on recipient behavior.

We can test this hypothesis by comparing the results of regression of Housing Voucher recipient rents on the recipients' Payment Standard and on the FMRs in effect at the same time. Twelve of the nineteen sites had periods when Payment Standards were not increased to match changes in FMRs. Among recipients who moved to otherwise non-subsidized units, about 256 or 20 percent of Housing Voucher recipients and 170 or 14 percent of Certificate recipients became recipients at a time when the FMR and Payment Standard schedules differed. The difference was not large--on average the Payment Standard was about $20 per month below the FMR in effect at the same time (or about 4 percent below the overall average FMR of $504). Even so, this does provide a test for which schedule was determining Housing Voucher recipient behavior. We tested as follows. First, we specified for each site an equation

$$(19) \qquad R = \alpha_j + \beta_j FMR + \delta_j d + (\Delta\alpha_j)V + (\Delta\beta_j)(V{*}FMR) + (\Delta\delta_j)(V{*}d)$$

where

R = Recipient gross rent

FMR = The relevant FMR in effect at the time the enrollee became a recipient

d = A dummy variable equal to one of the Payment Standard was less than the FMR and zero if the Payment Standard equaled the FMR[1]

v = A dummy variable equal to one if the recipient was in the Housing Voucher program and zero otherwise

$\alpha_j, \beta_j, \delta_j$ = The Certificate program coefficients in the j^{th} site

$\Delta\alpha_j, \Delta\beta_j, \Delta\delta_j$ = The difference between the coefficients for Housing Voucher recipients and the coefficients for Certificate recipients

We then tested to see whether the coefficients were the same in the 19 sites. The results are shown in Table D.12. As shown there, we found that we did not in fact reject the hypothesis that the δ_j and $\Delta\delta_j$ were the same in all sites, but that the relationship between recipient rents and FMRs varied across sites. Accordingly, our final specification was to estimate equations and FMR coefficients by site, but imposing a common (pooled site) term for the effect associated with becoming a recipient when the Payment Standard was less than the FMR.

The results are summarized in Table D.13. As before (Table D.7), Certificate program recipient rents are more tightly associated with FMRs; the root mean square error for the Certification regressions is $40.60--or about half that of the Housing Voucher regressions. Housing Voucher recipient rents are somewhat lower when Payment Standards are less than FMRs. The difference of $8.44 is not statistically significant and is much less than the average $20 difference in schedules, but still might suggest that Housing Voucher recipients were at least in part responding to Payment Standards rather than FMRs and thus that the concentration of Housing Voucher rents around FMRs did not reflect the inertia of the Certificate program. However, an almost equal reduction is observed for the Certificate program. This suggests that PHAs may tend to allow Payment Standards to fall below FMRs in cases where the

[1]Payment Standards were not allowed to exceed FMRs.

TABLE D.12

TESTS FOR POOLING ACROSS SITES

Equation: $R = \alpha_j + \beta_j FMR + \delta_j d + (\Delta\alpha_j)V + (\Delta\beta_j)(V \cdot FMR) + (\Delta\delta_j)(V \cdot d) \quad j=1...20$

(See text for definition of terms.)

	$\sqrt{MSE}$	R^2	Adj. R^2
Fully crossed equation	58.59	0.84	0.83

Tests of Variables	F-statistic	Percentage Change in $\sqrt{MSE}$	R^2 of Variable On Residual[a]
1. Pool difference in PS/FMR differential for Housing Voucher recipients ($\Delta\delta_j = \Delta\delta$ for all j)	F(9,2345) = 0.85	-0.1%	0.003
2. Pool effect of PS/FMR differential for Certificate program recipients ($\delta_j = \delta$ for all j)	F(9,2345) = 0.49	-0.2%	0.002
3. Pool effect and difference for both Certificate an Housing Voucher recipients ($\delta_j = \delta$, $\Delta\delta_j = \Delta\delta$, for all j)	F(20,2345) = 1.73*	0.7%	0.015
4. In addition to (1), pool difference in effect of FMR for Housing Voucher recipients ($\Delta\delta_j = \Delta\delta m$ $\Delta\beta_j = \Delta\beta$ for all j	(F(27,2345) = 2.53**	1.7%	0.028
5. In addition to (2), pool effect of FMR for Certificate program recipients ($\delta_j = \delta$, $\beta_j = \beta$ for all j)	(F(27,2345) = 1.65*	0.7%	0.019

[a]Defined as the R^2 of the regression of the residual from the equation without the variable on the variable.

** = Significant at 0.01 level

* = Significant at 0.05 level

‡ = Significant at 0.10 level

Table D.13

EFFECT OF DEVIATION OF PAYMENT STANDARD AND FMR ON RECIPIENT RENTS IN THE TWO PROGRAMS

Model

$$R = \sum a_i^k S_i + \sum \beta_i^k (FMR_i) + \gamma^k d + \varepsilon$$

where:

R = Recipient gross rent

S_i = Dummy variable for the i^{th} PHA

α_i^k = The intercept for the k^{th} program in the i^{th} PHA

FMR_i = FMR_i schedule in the i^{th} PHA

β_i^k = The coefficient in the i^{th} PHA and k^{th} program for the FMR schedule in effect in the Certificate program when the enrollee became a recipient

γ = The effect on recipient rent in the k^{th} program when the Payment Standard was less than the FMR

	Housing Voucher Program	Certificate Program	Difference
Number of observations	1,263	1,180	83
Root mean squared error	\$71.67	\$40.60	\$31.07
R-square	0.79	0.90	-0.11
Adjusted R-square	0.78	0.89	-0.11
Number of variables	38	38	0
Estimated coefficient for recipient gross rents when Payment Standard was less than FMR (standard error)	-\$8.44 (7.57)	-\$9.28‡ (4.86)	+\$0.84 (9.00)

[a] Sample is recipients who moved to otherwise non-subsidized housing

** = Significant at 0.01 level

* = Significant at 0.05 level

‡ = Significant at 0.10 level

PHA's rent reasonableness determinations hold rents below FMRs. In this case, the reduction in Housing Voucher recipient rents associated with cases where Payment Standard is below FMR is still consistent with the hypothesis that many Housing Voucher households are renting in markets where prices have been set in response to the Certificate program.

In sum, we are left with two explanations of the pattern of Housing Voucher recipient rents. One is based on the idea that Fair Market Rents are really rather good indicators for the cost of program-acceptable housing. In this case, we have discovered in effect that the restriction on rents imposed by the Certificate program may not be that important in the sense that without the restriction many recipients will still choose rents near the FMR. A second explanation is based on the idea that Housing Voucher recipients are frequently dealing with a group of "Section 8" landlords, whose prices have been set to meet Certificate program rules. In this case, replacement of the Certificate program with a Housing Voucher program could lead to very different results than those observed during the Demonstration.

We may also note that the results of Table D.13 depend on the specification. If we (erroneously) simply estimate a specification pooled across sites, we get a significant difference between the coefficients for the two programs for the Payment Standard-less-than-FMR dummy variable.[1] This simply emphasizes the desirability of testing pooled specifications. In particular, while the pooled results of Table D.7 were useful in emphasizing the close association between recipient rents and FMRs, given the results shown in Table D.12, they should not be regarded as good estimates of the coefficients.

Tables D.14A and D.14B present information on the coefficients from regressions with separate estimates by site. The table shows the average

---

[1]Under the regression

$$R = \alpha + \beta FMR + \gamma d + \varepsilon$$

where

R = recipient gross rent
FMR = the value of the FMR schedule in effect when the family became a recipient
d = a dummy variable equal to one if the family became a recipient at a time when the Payment Standard was less than the FMR

If we pool all the variables across sites we obtain the following estimates (for recipients who moved to otherwise unsubsidized housing:

	Housing Voucher Program	Certificate Program	Difference
Constant (s.e.)	4.09 (8.72)	10.61* (5.34)	6.52 (10.23)
FMR	1.05** (0.02)	0.95** (0.01)	0.10** (0.02)
Dummy	-19.84** (5.23)	-6.34‡ (3.57)	-13.50* (6.33)
Root Mean Square Error	$74.71	$42.80	$31.91
e^2	0.76	0.88	-0.12

Alternatively, if we use the specification used for Table D.13, but estimate the effect of the Payment Standard dummy separately for each site, we obtain estimates that are similar to the pooled estimates, but have variances too large to allow any conclusions:

	Housing Voucher Program	Certificate Program	Difference
Average Coefficient for Payment Standard Dummy	-25.34	-1.80	-23.53
Within PHA			
Standard error	14.57	11.44	18.62
t-statistic	1.74	0.16	1.26
Total			
Standard error	22.74	11.44	18.62
t-statistic	1.11	0.16	1.26

TABLE D.14A

WEIGHTED DISTRIBUTION OF COEFFICIENTS FOR REGRESSIONS OF RECIPIENT GROSS RENT ON FMRs ESTIMATED SEPARATELY FOR 17 URBAN PHAs BY PROGRAM[a]

	Housing Voucher Program (Payment Standard)	Housing Voucher Program (FMR)	Certificate Program (FMR)	Difference Between Programs: Both FMR	Difference Between Programs: Housing Voucher Payment Standard Certified Program FMR
Intercept					
Mean	-14.09	14.79	40.49	-25.70	-54.59
Standard deviation across PHAs	100.60	115.4	87.01	127.9	108.5
Within-PHA standard error of mean (t-statistic)[b]	15.10 (0.93)	15.06 (0.98)	8.95 (4.52)**	12.12 (2.12)*	12.16 (4.49)**
Total standard error of mean (t-statistic)[c]	27.57 (0.51)	26.76 (0.55)	21.88 (1.85)‡	31.75 (0.81)	27.71 (1.97)*
FMR or Payment Standard					
Mean	1.10	1.01	0.88	0.12	0.21
Standard deviation across PHAs	0.21	0.26	0.17	0.30	0.25
Within-PHA standard error of mean (t-statistic)[b]	0.03 (35.15)**	0.03 (33.44)**	0.02 (49.10)**	0.02 (5.10)**	0.03 (8.29)**
Total standard error of mean (t-statistic)[c]	0.06 (19.36)**	0.07 (15.01)**	0.04 (20.31)**	0.07 (1.71)‡	0.06 (3.39)**

TABLE D.14B

UNWEIGHTED DISTRIBUTION OF COEFFICIENTS FOR REGRESSIONS OF RECIPIENT GROSS RENT ON FMRs ESTIMATED SEPARATELY FOR 19 PHAs BY PROGRAM[a]

	Housing Voucher Program (Payment Standard)	Housing Voucher Program (FMR)	Certificate Program (FMR)	Difference Between Programs: Both FMR	Difference Between Programs: Housing Voucher Payment Standard Certified Program FMR
Intercept					
Mean	-34.95	0.07	15.14	-15.08	50.09
Standard deviation across PHAs	80.75	119.3	68.56	131.6	96.41
Within-PHA standard error of mean (t-statistic)[b]	15.55 (2.25)	15.44 (0.00)	10.62 (1.43)	11.21 (1.35)	11.36 (4.41)**
Total standard error of mean (t-statistic)[c]	24.19 (1.45)	31.42 (0.00)	18.98 (0.80)	32.98 (0.46)	24.86 (2.02)*
FMR or Payment Standard					
Mean	1.13	1.04	0.94	0.10	0.19
Standard deviation across PHAs	0.17	0.28	0.15	0.31	0.23
Within-PHA standard error of mean (t-statistic)[b]	0.03 (35.76)**	0.03 (33.47)**	0.02 (44.05)**	0.02 (4.39)**	0.02 (8.31)**
Total standard error of mean (t-statistic)[c]	0.05 (22.25)**	0.07 (14.39)**	0.04 (22.64)**	0.08 (1.26)	0.06 (3.37)**

[a]Sample is recipients who moved to otherwise non-subsidized units

[b]Within-PHA standard errors are based on the variances for each PHA's estimated coefficient, given the sampled PHAs.

[c]Total standard errors reflect both the within-PHA variance of estimate and the estimated sampling variation across PHAs.

** = Significant at 0.01 level   * = Significant at 0.05 level   ‡ = Significant at 0.10 level coefficient, its within-PHA standard error, the estimation variation in coefficients across PHAs, and the total error of estimates for the average coefficients. Estimates are constructed in two ways--as simple averages of results for all 19 Demonstration PHAs (excluding Houston) in Table 14A, and as weighted averages of the 17 urban PHAs in Table 14B.

The equations presented are of the form

(20 $$R = \alpha_j^k + \beta_j^k FMR/PS + \varepsilon_j^k$$

where

R = Recipient gross rent

FMR/PS = The applicable FMR for Certificate program recipients and either the FMR or the Payment Standard for Housing Voucher recipients

$\alpha_j^k, \beta_j^k, \varepsilon_j^k$ = Terms estimated separately for each program in each PHA

Mean estimates of coefficients are summarized below.

1. Housing Voucher Program Regression with Payment Standard

   (a) Pooled (Table D.7)

$$R = \underset{(8.3)}{-1} + \underset{(0.016)}{1.06^{**}}PS \qquad R^2 = 0.17$$

   (b) Average (Table D.14)

$$A: R = \underset{(27.6)}{-14} + \underset{(0.06)}{1.10^{**}}PS \qquad R^2 = 0.67$$

$$B: R = \underset{(24.2)}{-35} + \underset{(0.05)}{1.13^{**}}PS \qquad R^2 = NA$$

2. Housing Voucher Program Regression with FMR

(a) Pooled (Table D.7)

$$R = -1 + 1.05\ FMR \qquad R^2 = 0.76$$
$$\quad (8.8)\ (0.017)$$

(b) Average (Table D.14)

$$A: R = \$15 + 1.01^{**}FMR \qquad R^2 = 0.66$$
$$\quad (26.8)\ (0.07)$$

$$B: R = 0 + 1.04^{**}FMR \qquad R^2 = NA$$
$$\quad (31.4)\ (0.07)$$

3. Certificate Program Program Regression with FMR

(a) Pooled (Table D.7)

$$R = 8 + 0.95^{**}FMR \qquad R^2 = 0.88$$
$$\quad (5.3)\ (0.010)$$

(b) Average (Table D.14)

$$A: R = \$40^{\ddagger} + 0.88^{**}FMR \qquad R^2 = 0.83$$
$$\quad (21.9)\ (0.04)$$

$$B: R = 15 + 0.94^{**}FMR \qquad R^2 = NA$$
$$\quad (19.0)\ (0.04)$$

While there is some difference in coefficients under the various estimates, the basic patterns are retained: in both programs recipient rents are strongly related to FMRs; the coefficient on FMRs is slightly larger in the Housing Voucher program; recipient rents (for recipients moving to otherwise unsubsidized housing) are more exactly determined by FMRs in the Certificate program.

We have found that Housing Voucher recipient rents are strongly influenced by FMRs (or Payment Standard). At the same time, it is clear that there was some difference in the relationship between recipient rents and FMRs in the two programs. In particular, Housing Voucher rents tended to be higher and to be more dispersed. Accordingly, we can still ask whether this differential follows the predictions of the model of Eq. (15). It is in fact difficult to test this wutg the data at hand. In principle, we might estimate the normal expenditure function from pre-program rents or some other data sources such as the American Housing Survey.[1] If we coupled this demand function to a specific utility function and specified the form of $\pi(R)$, we would then be able to estimate the model. However, this sort of specification imposes far more than we know and would end up being a test of our specification of functional form as much as a test of the theory. In general, estimation and testing of such models requires the sort of background data that would be supplied by extensive data as to the behavior and housing of a control group.

Absent this, we can try to test the model in the usual way, by seeing whether observations conform to the models' testable first-order effects. The first order conditions of Eq. (15) are

$$(21) \qquad \frac{d(\pi\cdot\Delta U)}{DR} = \frac{d\pi}{dR}\Delta U + \pi\frac{d\Delta U}{dR} = 0$$

The second order condition is that:

$$(22) \qquad \left.\frac{d\ (\pi\cdot\Delta U)}{dR^2}\right|_{R*} = \frac{d^2\pi}{dR^2}\Delta U + 2\frac{d\pi}{dR}\frac{d\Delta U}{dR} + \pi\left.\frac{d^2\Delta U}{dR}\right|_{R*} < 0$$

or, substituting Eq. (21),

$$(23) \qquad \left.\frac{d\ (\pi\cdot\Delta U)}{dR^2}\right|_{R*} = \left\{ \frac{d}{dR}\left[\frac{d\pi}{dR}\frac{1}{\pi}\right] + \frac{d}{dR}\left[\frac{d\Delta U}{dR}\frac{1}{\Delta U}\right] \right\} \Delta U\cdot\pi < 0$$

The second bracketed term in Eq. (23) is clearly negative since $d^2\Delta U/dR^2$ and $d\Delta U/dR$ are both negative for R greater than $R_N(Y+S)$. The first bracketed term is clearly negative for the normal and logistic distributions pictured in Figure D.9. We see, however, no obvious reason to believe that this applies to all distributions, so the second order conditions do impose some restrictions on the model.

In terms of patterns, we have the usual comparative statistics result that:

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programs, estimates based on pre-program data may be biased.

$$(24) \qquad \frac{dR_v^*}{d\alpha} = -\left(\frac{d^2(\hat{\pi}\Delta U)}{dR}\right)^{-1} \frac{d^2(\hat{\pi}\Delta U)}{dRd\alpha}$$

$$(25) \qquad \frac{d\pi_v^*}{d\alpha} = \frac{d\pi}{dR}\frac{dR^*}{d\alpha} + \frac{d\pi}{d\alpha}$$

where

α = Some parameter of interest

$*$ = Optimal values

Given the second order conditions:

$$(26) \qquad \text{sign } \left(\frac{dR_v^*}{d\alpha}\right) = \text{sign } \left(\frac{d^2(\pi\cdot\Delta U)}{dRd\alpha}\right)$$

$$= \text{sign } \left(\frac{\partial^2\pi}{\partial R d\alpha}\Delta U + \frac{d\Delta U}{dR}\frac{d\pi}{d\alpha} + \frac{\partial\pi}{dR}\frac{d\Delta U}{d\alpha} + \pi\frac{d^2\Delta U}{dRd\alpha}\right)$$

Accordingly, if α shifts π, we have

$$(27) \qquad \text{sign } \left(\frac{\partial R_v^*}{\partial\alpha_\pi}\right)\Bigg|_{R^*} = \text{sign } \left[\frac{d^2\pi}{dRd\alpha}\Delta U + \frac{d\Delta U}{dR}\cdot\frac{d\pi}{d\alpha}\right]\Bigg|_{R^*}$$

$$= \text{sign } (\Delta U\cdot\pi)\,\frac{d\left(\frac{d\pi}{dR}\frac{1}{\pi}\right)}{d\alpha}$$

which is negative for simple shifts of the probability function in the cases shown in Figure D.9.

Substituting from Eq. (21) for $d\Delta U/dR$,

$$(28) \qquad \text{sign } \left(\frac{\partial R_v^*}{\partial\alpha_\pi}\right)\Bigg|_{R^*} = \text{sign } \left[\frac{d^2\pi}{dRd\alpha}\Delta U * \frac{d\pi}{dR}\frac{\Delta U}{\pi}\frac{d\pi}{d\alpha}\right]$$

$$= \text{sign } \left[(\Delta U\cdot\pi)\left(\frac{d^2\pi}{dRd\alpha}\frac{1}{\pi} - \frac{d\pi}{dR}\frac{d\pi}{d\alpha}\frac{1}{\pi^2}\right)\right]$$

In words, the deviation in search rents from $R_N(Y+S)$ should be smaller in sites with a higher probability of success schedule. However, this prediction applies only to simple shifts in the probability function. It will not hold if the relationship between π and R is attenuated in a way that allows

$d(\frac{d\pi}{dR}\frac{1}{\pi})/d\alpha$ to be positive (i.e., if $d^2\pi/dRd\alpha$ is positive enough).

If α is the amount of the maximum subsidy (S^v_{max}) then

$$(29) \qquad \text{sign } (\frac{\partial R_v}{\partial \alpha_s}) = \text{sign } [(\Delta U \cdot \pi)\frac{d(\frac{d\Delta U}{dR}\frac{1}{\Delta U})}{d\alpha}] > 0$$

since for $R > R_N(Y+S^v_{max})$, an increase in S^v_{max} increases $d\Delta U/dR$ (makes it less negative) and increases ΔU (further reducing the absolute value of the negative $(\frac{d\Delta U}{dR}\frac{1}{\Delta U})$).

Similarly, if α represents a shift in R_N then

$$(30) \qquad \text{Sign } (\frac{\partial R_v}{\partial d_R}) = \text{sign } [(\Delta U \cdot \pi)\frac{d(\frac{d\Delta U}{dR}\frac{1}{\Delta U})}{d\alpha}] > 0$$

Again, this prediction may be violated if the shift in R_N is associated with changes in the curvature of the indifference surface. Further, if the shift in R_N simply represents a displacement of the indifference curves, then for $(d\pi/dR)(1/\pi)$ negative, the value of $(dR_v/d\alpha_R)$ must be less than one,[1] so that we should still expect some connection between R^*_v and $R_N(Y+S^v_{max})$, but an attenuated one.

Putting these results together, we can also predict that if $\partial R_N/\partial Y < 0.3$ (the reduction rate in S^v_{max} associated with income), then there should be some positive association between income and success rate in the Housing Voucher program.

These predictions are not terribly strong. Only the prediction for S^v_{max} is definite; the predictions for shifts in π and R_N depend on the nature

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[1] If the ΔU schedule is simply shifted to the right, then for $\Delta R^*_v \Delta R_N$, we would need

$$\frac{d\pi}{dR}\bigg|_{R^*_1}\Delta U + \pi(R^*_1)\frac{d\Delta U}{dR} = \frac{d\pi}{dR}\bigg|_{R^*_0}\Delta U + \pi(R^*_0)\frac{d\Delta U}{dR}$$

Since by assumption the values of ΔU and $d\Delta U/dR$ are the same, this is not possible if $R^*_1 > R^*_0$ and $d(d\pi/dR)(1/\pi)/dR < 0$.

of the shift; the prediction for the effects of differences in income depends on the response of R_N to income. Even so, we can consider testing them in two ways. First, consider search rents. Say we express search rents (R^s) as a first order expression:

$$(31) \qquad R^s_{ijr} = R^s_{ijr}[R^N, \pi, s]$$

Under the model posed above, Certificate search rents will cluster around the FMRs, while Housing Voucher search rents would equal the FMR or Payment Standard if these corresponded to normal expenditures with a certainty of meeting requirements. Thus we can write:

$$(32) \qquad R^s_{ijr} = \alpha_0 + \alpha_1 F_{jr} + \alpha_2(R_{ijr} - F_{jr}) + \alpha_3(\pi_{jr}) + \alpha_4(S_{ijr})$$

Housing Voucher	Certificate
α_1 ?	$\alpha_1 \sim 1$
$\alpha_2 > 0$	$\alpha_2 = 0$
$\alpha_3 < 0$	$\alpha_3 = 0$
$\alpha_4 > 0$	$\alpha_4 = 0$

where

R^s_{ijr} = The search rent of the i^{th} applicant in the j^{th} PHA and r^{th} bedroom-size category

R^N_{ijr} = The normal rental expenditures under an income increased by the maximum subsidy for the i^{th} applicant in the j^{th} PHA and r^{th} bedroom-size category

π_{jr} = A measure of the shift in the $\pi(R)$ schedule in the j^{th} PHA and r^{th} bedroom-size category

S_{ijr} = The maximum payment available to the i^{th} applicant in the j^{th} PHA and r^{th} bedroom-size category

F_{jr} = The payment standard or FMR for the i^{th} applicant in the j^{th} PHA and r^{th} bedroom-size category

If we ignore the problems posed by the fact that we only observe rents for those who succeed (and thus pick up the effects of variables on $\pi(R^S)$ as well as on R^S), we could imagine testing this equation by regressing recipient rents on FMRs, estimated normal rents, and the estimated π_{jr} schedule corresponding to the FMRs.

We estimate R_N by estimating

(33) $$R^{PP}_{ijr} = \sum_{rj} \gamma_{rj} d_{rj} + \theta Y + \eta$$

(35) $$\hat{R}_N = \sum \hat{\gamma}_{rj} d_{rj} + \hat{\theta}(Y+S^{max}) + \lambda\hat{\eta}$$

where

R^{PP} = Pre-program rent

Y = Income

η = The residual from the estimate of Eq. (33)

Specifically, we used net income as defined by the program and estimated Eq. (33) for all enrollees in both programs where the enrollee paid the full pre-program rent. We used these estimates to form predicted rents for all recipients as indicated in Eq. (34), except that the estimated residual, $\hat{\eta}$, was set to zero for enrollees who were not paying their full pre-program rent (for whom, in effect, we have no estimate of the residual).

We estimate π_{jr} corresponding to Certificate Program search rents based on the observed success rate in each site/bedroom size category for Certificate holders who were very likely to move. The key issue here was to identify Certificate holders who were very likely to have to move. As discussed in Chapter 2, selecting enrollees who were subunits or expressed a definite intention of moving in the interview conducted prior to enrollment identifies a group in which over 90 percent of enrollees either move or fail to become recipients. Accordingly, this was the group we used to develop estimates of π_{jr}.

The relevant subsidy amount is the maximum subsidy, which if we exclude the relatively few cases in the Certificate Program where the tenant contribution is determined by gross income or welfare rent, is

(35) $$S_{ijr} = F_{jr} - 0.3Y_N$$

where

S_{ijr} = Maximum assistance payment

F_{jr} = FMR or Payment Standard for the j^{th} PHA and r^{th} bedroom-size category

Y_Ns = Monthly net income

Substituting these expressions into the specification of Eq. (32) yields:

$$R^S_{ijr} = \alpha_0 + \alpha_1 F_{jr} + \alpha_2(\hat{R}^N_{ijr} - F_{jr}) + \alpha_3 \pi_{jr} - \alpha_4 S_{ijr}$$

$$= \alpha_0 + \alpha_1 F_{jr} + \alpha_2[\sum \hat{\gamma}_{rj} d_{rj} + \theta Y^N_{ijr} + \theta(F_{jr} - .3Y^N_{ijr}) + \theta Y \hat{n}_{ijr} - F_{jr}]$$

$$+ \alpha_3 \bar{\pi}^c_{jr} + \alpha_4[F_{jr} - .3Y^N_{ijr}]$$

(36) $$R^s_{ijr} = \alpha_0 + [\alpha_1 - (1-\theta)\alpha_2 + \alpha_4]F_{jr} + \alpha_2(\sum \hat{\gamma}_{rj} d_{rj}) + \alpha_2 \theta \lambda \hat{n}_{ijr}$$

$$+ (0.7d_2\theta - 0.3\alpha_4)Y^N_{ijr} + \alpha_3 \bar{\pi}^c_{jr}$$

or, for recipients

(37) $$R_{ijr} = \beta_0 + \beta_1 F_{jr} + \beta_2(\sum \hat{\gamma}_{rj} d_{rj}) + \beta_3 \hat{n}_{ijr} + \beta_4 Y^N_{ijr} + \beta_5 \bar{\pi}^c_{jr}$$

where we expect that:

β^c_1 = close to (but less than) one

$\beta^c_2 = 0$	$\beta^v_2 > 0$
$\beta^c_3 = 0$	$\beta^v_3 > 0$
$\beta^c_4 = 0$	$.7\theta\beta_2 - \beta_4 > 0$
$\beta^c_5 = 0$	$\beta_5 < 0$

where

R_{ijr} = Rent of the i^{th} recipient in the j^{th} PHA and r^{th} bedroom-size category

F_{ijr} = The Payment Standard or FMR in the j^{th} PHA and r^{th} bedroom-size category

d_{rj} = 1 for recipients in the j^{th} PHA and r^{th} bedroom-size category, zero otherwise

$\hat{\gamma}_{rj}$ = Estimated coefficients from Eq. (32)

$\hat{\eta}_{ijr}$ = Estimated residual from Eq. (32)

Y^N_{ijr} = Monthly net income for the i^{th} recipient in the j^{th} PHA and r^{th} bedroom size category

$\bar{\pi}^c_{jr}$ = The mean success rate in the j^{th} PHA and r^{th} bedroom size category for Certificate program enrollees who were likely to move

The estimate of θ in Eq. (34) may not provide a good predictor for the effects on normal expenditures of the more or less permanent change in income provided by the assistance payment. The pre-enrollment incomes used in estimating Eq. (34) are current incomes and may include transitory components and, if the individual has recently become eligible, be quite different from the incomes on which the household's current rent was determined. Accordingly a failure of the test involving β_4 and β_2 could reflect mis-estimation of θ.

We first tested to see whether Eq. (37) could be pooled across sites (up to a shift term for each site) or programs (up to a shift term for each program). As shown in Table D.15, pooling was rejected. Table D.16 presents information on the individual coefficients. As in Table D.14, we present information on the distribution of the coefficients across all 19 PHAs and also on the distribution across the 17 large urban PHAs, weighted to provide a national estimate. The specific measures presented are

- The mean coefficient
- The estimated standard deviation of coefficients over sites
- The within-PHA error of estimate
- The total error of estimate

TABLE D.15

TEST STATISTICS FOR POOLING THE GROSS RENT EQUATION

Equation: $R^{*}_{yr} = \beta_0 + \beta_1 F_{jr} + \beta_2 (\sum \hat{\gamma}_{rj} d_{rj}) + \beta_3 \hat{\eta}_{ijr} + \beta_4 Y^{N}_{ijr} + \beta_5 \bar{\pi}^{c}_{jr} + \epsilon_{ij}$

(See Text Eq. 37 for definition of terms.)

Pool Sites Up to Shift Term for Each Site

Housing voucher program	$F(90,2038) = 3.52^{**}$
Certificate program	$F(86,1987) = 2.72^{**}$
Both programs	$F(176,4025) = 3.33^{**}$

Pool Programs Up to Shift Term

$F(91,4025) = 6.44^{**}$

TABLE D.16A

UNWEIGHTED ESTIMATES OF RECIPIENT GROSS RENTS FOR 19 PHAs
(Recipients Who Move to Otherwise Unsubsidized Housing)

	Housing Voucher Program	Certificate Program	Difference
Intercept			
Mean	-2133	-39	-2094
Standard deviation across PHAs	9783	8305	9748
Within-PHA standard error	1189	48	1188
Total error of estimate	2654	88	2587
(t-statistic)	(0.80)	(0.44)	(0.81)
F-statistic	NA	NA	NA
FMR			
Mean	0.63	0.80	-0.18
Standard deviation across PHAs	0.47	0.24	0.53
Within-PHA standard error	0.07	0.04	0.06
Total error of estimate	0.13	0.07	0.14
(t-statistic)	(4.66)**	(11.80)**	(1.29)
F-statistic	14.36**	60.82**	NA
Mean Rent			
Mean	6.34	0.09	6.25
Standard deviation across PHAs	26.59	1.59	26.58
Within-PHA standard error	3.24	0.17	3.24
Total error of estimate	7.22	0.43	7.05
(t-statistic)	(0.88)	(0.22)	(0.89)
F-statistic	4.17**	2.79**	NA
Residual Rent			
Mean	0.17	0.02	0.15
Standard deviation across PHAs	0.25	0.08	0.23
Within-PHA standard error	0.03	0.02	0.02
Total error of estimate	0.07	0.03	0.06
(t-statistic)	(2.52)**	(0.85)	(2.54)**
F-statistic	6.46**	1.17	NA
Income			
Mean	18.16	17.29	0.87
Standard deviation across PHAs	59.51	32.46	67.65
Within-PHA standard error	10.86	5.54	9.34
Total error of estimate	18.42	9.83	18.48
(t-statistic)	(0.99)	(1.76)‡	(0.05)
F-statistic	0.73	1.32	NA
Mean Success Rate			
Mean	1347	182	1165
Standard deviation across PHAs	5396	364	5365
Within-PHA standard error	659	53	657
Total error of estimate	1502	105	1425
(t-statistic)	(0.90)	(1.73)‡	(0.82)
F-statistic	7.63**	2.48**	NA
Root Mean Square Error	$64.88	$38.72	NA

TABLE D.16B

WEIGHTED ESTIMATES OF RECIPIENT GROSS RENTS FOR 17 LARGE URBAN PHAs
(Recipients Who Move to Otherwise Unsubsidized Housing)

	Housing Voucher Program	Certificate Program	Difference
Intercept			
Mean	-233	-110	-123
tandard deviation across PHAs	574	222	522
Within-PHA standard error	94	50	79
Total error of estimate	161.67	71	146
(t-statistic)	(1.44)	(1.55)	(0.84)
F-statistic	NA	NA	NA
FMR			
Mean	0.63	0.88	-0.25
Standard deviation across PHAs	0.56	0.20	0.62
Within-PHA standard error	0.12	0.08	0.18
Total error of estimate	0.17	0.08	0.18
(t-statistic)	(3.56)**	(11.26)**	(1.41)
F-statistic	NA	NA	NA
Mean Rent			
Mean	0.95	0.33	0.62
Standard deviation across PHAs	1.90	0.81	1.72
Within-PHA standard error	0.41	0.19	0.36
Total error of estimate	0.60	0.27	0.54
(t-statistic)	(1.59)	(1.24)	(1.15)
F-statistic	NA	NA	NA
Residual Rent			
Mean	0.14	0.02	0.12
Standard deviation across PHAs	0.22	0.07	0.22
Within-PHA standard error	0.02	0.02	0.02
Total error of estimate	0.06	0.03	0.05
(t-statistic)	(2.40)*	(0.76)	(2.21)*
F-statistic	NA	NA	NA
Income			
Mean	4.72	20.63	-15.91
Standard deviation across PHAs	37.17	24.27	39.95
Within-PHA standard error	12.01	6.87	9.85
Total error of estimate	14.73	8.85	13.63
(t-statistic)	(0.32)	(2.33)*	(1.17)
F-statistic	NA	NA	NA
Mean Success Rate			
Mean	533	210	323
Standard deviation across PHAs	970	423	731
Within-PHA standard error	154	90	126
Total error of estimate	271	132	213
(t-statistic)	(1.97)*	(1.58)	(1.52)
F-statistic	NA	NA	NA

TABLE D.16C

SUMMARY OF TESTS OF HYPOTHESES FOR GROSS RENT REGRESSIONS

Certificate Program

(1) β(FMR) - The mean coefficient is significant and less than one.

(2) β(Mean Predicted Rent) - The mean coefficient is not significantly different from zero, but the F-statistic indicates that contrary to expectation, the hypothesis that the coefficient is zero in all PHAs is rejected; the variable does influence recipient rents.

(3) β(Residual) - The mean coefficient is small and not significantly different from zero. The hypothesis that the coefficient is zero in all PHAs is not rejected.

(4) β(Income) - The mean coefficient is significantly different from zero. However, the hypothesis that the coefficient is zero in all PHAs is not rejected.

(5) β(Success Rate) - Contrary to hypothesis, the mean coefficient is significantly greater than zero and the hypothesis that the coefficient is zero in all PHAs is rejected.

Housing Voucher Program

(1) β(FMR) - The mean coefficient is significant and the hypothesis that the coefficient is zero in all PHAs is rejected. This does not contradict the model, but is not predicted by the model.

(2) β(Mean Predicted Rent) - The mean estimated coefficient is positive and larger than that estimated for the Certificate program, but neither the mean nor the difference is significantly different from zero. The hypothesis that the coefficient is zero in all PHAs is rejected.

(3) β(Residual) - The mean coefficient is significantly greater than zero and significantly greater than the coefficient of the Certificate program. The hypothesis that the coefficient is zero in all PHAs is rejected.

(4) β(Income) - Hypothesis not tested.

(5) β(Success Rate) - Contrary to hypothesis, the mean estimated is greater than zero.

and also for the tables for all 19 PHAs,

- The F-statistics for the hypothesis that the coefficient is zero in all sites

Table 16.C summarizes the findings and hypotheses. The results are mixed. Apart from the role of FMRs, discussed earlier, the major support for the model is the finding that the residual of the program rent from predicted values does significantly affect recipient rents in the Housing Voucher program, but not the Certificate program. Contrary to expectation, mean pre-program rents are significant in the Certificate program as well as the Housing Voucher program. Given the findings for the residual, this would appear to reflect a market phenomenon rather than an individual adjustment. In fact, a regression of the incidence of Certificate Program exception rents on average pre-program rents does show that higher average pre-program rents are associated with more frequent exceptions.[1] This information merely corroborates what we have already surmised--that PHAs make use of the flexibility granted them in terms of rent reasonableness tests and exception rents.

The problem for the hypothesized model is in the estimated coefficients for income and the Certificate (mean) success rate. Although the mean income coefficient is significantly greater than zero in the Certificate program we might be able to dismiss this on the basis of the large standard deviation between PHAs coupled with the fact that the hypothesis that the coefficient is zero in all PHAs is not rejected. The estimated coefficient for the Certificate success rate, however, is significantly positive in both

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[1]The regression results for Certificate Program recipients were as follows:

$$\underset{(0.0345)}{\text{DCAT} = -0.0052} + \underset{(0.000124)}{0.000717^{**}}\ \text{PROGRAM}$$

$$R^2 = 0.9$$
$$F = 33.35^{**}$$

where

DCAT = 1 if the Certificate Program recipient had a gross rent greater than the FMR, and zero otherwise

PROGRAM = Average pre-program gross rent (by site and bedroom size, net of the estimated effect of income).

programs, rejecting the prediction that Housing Voucher recipients would trade lower search rents against reduced success rates.

In sum, some gross features of the model are confirmed--especially the strong role of FMRs in the Certificate program and the evidence that Housing Voucher recipients do use the flexibility afforded by the Housing Voucher program to adjust their rents to their needs (as indexed by the deviation of their pre-program rent from the mean). Likewise, it seems likely that PHA administrative flexibility makes the actual rent restrictions of the Certificate program more complex than the simple FMR limit. However, the strong role of FMRs in the Housing Voucher program is surprising and the estimated effects of success rates puzzling.

We can apply the same sort of reasoning to the success rates of applicants, based on the idea that factors affecting search rents should affect success rates. Thus if we specify

$$(38)\qquad \ln\left(\frac{\pi_{ijr}}{1-\pi_{ijr}}\right) = b_0 + b_1 \ln\left(\frac{\bar{\pi}^c_{jr}}{1-\bar{\pi}^c_{jr}}\right) + b_2\left(\sum \hat{\gamma}_{rj} d_{rj}\right) + b_3 \hat{\eta}_{ijr} + n_4 Y^N_{ijr}$$

We expect:

$$b^c_1 = 1 \qquad\qquad b_1^v - b^c_1 < 1$$

$$b^c_2 = 0 \qquad\qquad b^v_2 > 0$$

$$b^c_3 = 0 \qquad\qquad b^v_3 > 0$$

$$b^c_4 = 0 \qquad\qquad .78 b^v_2 - b^v_4 > 0$$

The logit results are not encouraging. The coefficients have the anticipated signs, but no program difference is significant. (See Table D.17.)

D.4 Extending the Model to Take Account of Stochastic Prices

We can extend the model further to take account of the fact that housing prices are not fixed. In this context, the price of housing is not the rent paid but the ratio of rent paid to the "quantity" of housing (H) contained in the unit. Saying that prices vary simply means that different

TABLE D.17

ESTIMATION OF LOGIT SPECIFICATION FOR SUCCESS RATES OF ENROLLEES WHO WERE LIKELY TO HAVE TO MOVE[a,b]

	Coefficient	Asymptotic Standard Error	t-Statistic
Certificate Program			
Intercept	56.88	1.055	0.05
Logit (Certificate mover success rate)	1.023×10^{-1}	2.134×10^{-1}	4.79**
Estimated pre-program rent	1.683×10^{-3}	4.020×10^{-3}	0.42
Estimated pre-program residual	2.884×10^{-3}	2.233×10^{-3}	1.29
Monthly income	-9.502×10^{-4}	8.354×10^{-4}	1.14
Housing Voucher Program			
Intercept	4.972×10^{-1}	1.035	0.48
Logit (Certificate mover success rate)	8.835×10^{-1}	1.832×10^{-1}	4.82**
Estimated pre-program rent	8.355×10^{-4}	4.016×10^{-3}	0.21
Estimated pre-program residual	3.096×10^{-3}	2.106×10^{-3}	1.47
Monthly income	-1.031×10^{-3}	8.201×10^{-4}	1.26
Difference Between Housing Voucher and Certificate Coefficients			
Intercept	4.413×10^{-1}	1.478	0.30
Logit (Certificate mover success rate	-1.396×10^{-1}	2.813×10^{-1}	0.50
Estimated pre-program rent	-8.472×10^{-4}	5.682×10^{-3}	0.15
Estimated pre-program residual	2.116×10^{-4}	3.069×10^{-3}	0.07
Monthly income	-8.113×10^{-5}	1.171×10^{-3}	0.07

[a]Estimated by sequence of weighted least square regressions minimizing

$$(y - \hat{\pi})'(\pi_i^{-1}(1-\pi_i)^{-1}\delta_{ij})(y - \hat{\pi})$$

y = Vector of zeros and ones

$\hat{\pi}$ = Vector of estimated individual success rates

The weighted R^2 was 0.64.

[b]Enrollees were deemed likely to move if they shared their pre-enrollment unit with another family or expressed an intention to move during the pre-program interview.

units with the same rent may carry different levels of housing (or, conversely, that similar units may have different rents).

Imagine that people determine a maximum price that they will pay and then reject units that exceed this price. We now need to redefine the terms of Equation (15a,b) in terms of expectations. Let us further assume that each person gets to look at only one unit. Thus,

$$(39) \qquad \pi(R,\alpha) = \int_0^{\alpha} \rho(R/P_H) f(P_H) dP_U$$

$$(40) \qquad U_p(R,\alpha) = \frac{\int_0^{\alpha} U[R/P_H, \frac{Y-R+S}{P_z}] \rho(\frac{R}{P_H}) f(P_H) dP_H}{\pi(R,\alpha)}$$

where

$\pi(R,\alpha)$ = The probability of successfully finding a unit that meets program requirements as a function of search rent (R) and maximum acceptable price (α).

α = The maximum acceptable price

R = The search rent

$\rho(R/P_H)$ = The probability that a unit with real housing (R/P_H) meets program requirements

$f(P_H)$ = The density function for housing prices

$U_p(R,\alpha)$ = The expected level of utility if the household succeeds in participating

Other terms = As in Equation (15)

Given this redefinition of π and U_p, the choice problem is still written as in Equation (15). Further, it is obvious that the introduction of stochastic prices does not change the fundamental conclusion of the previous model with respect to the optimal search rent (R*). Certificate program enrollees will search at the maximum rents allowed by the program; Housing Voucher enrollees may select higher or lower search rents depending on their normal income expansion path and the strength of the relationship between rent and success rates.

The interesting aspect of the new model is the condition determining the optimal maximum acceptable rent. This is given by the condition:

$$(41) \qquad U\left(\frac{R}{\alpha^*}, \frac{Y-R+S}{P_z}\right) = U_0$$

That is, the α^* is determined to be the value that just makes the recipient indifferent between participating and not participating.

The realism of the model of Equations (39) and (40) may be increased by allowing individuals to choose an intensity of search as well. This should have no material effect on results, except of course through the Le Chatelier principle that introducing an added degree of freedom tends to reduce the absolute magnitude of the effects of exogeneous shocks.[1] (Intuitively, households may use search effort to arrive at lower α^* values, which will in turn weaken the connection between α^* and other variables.)

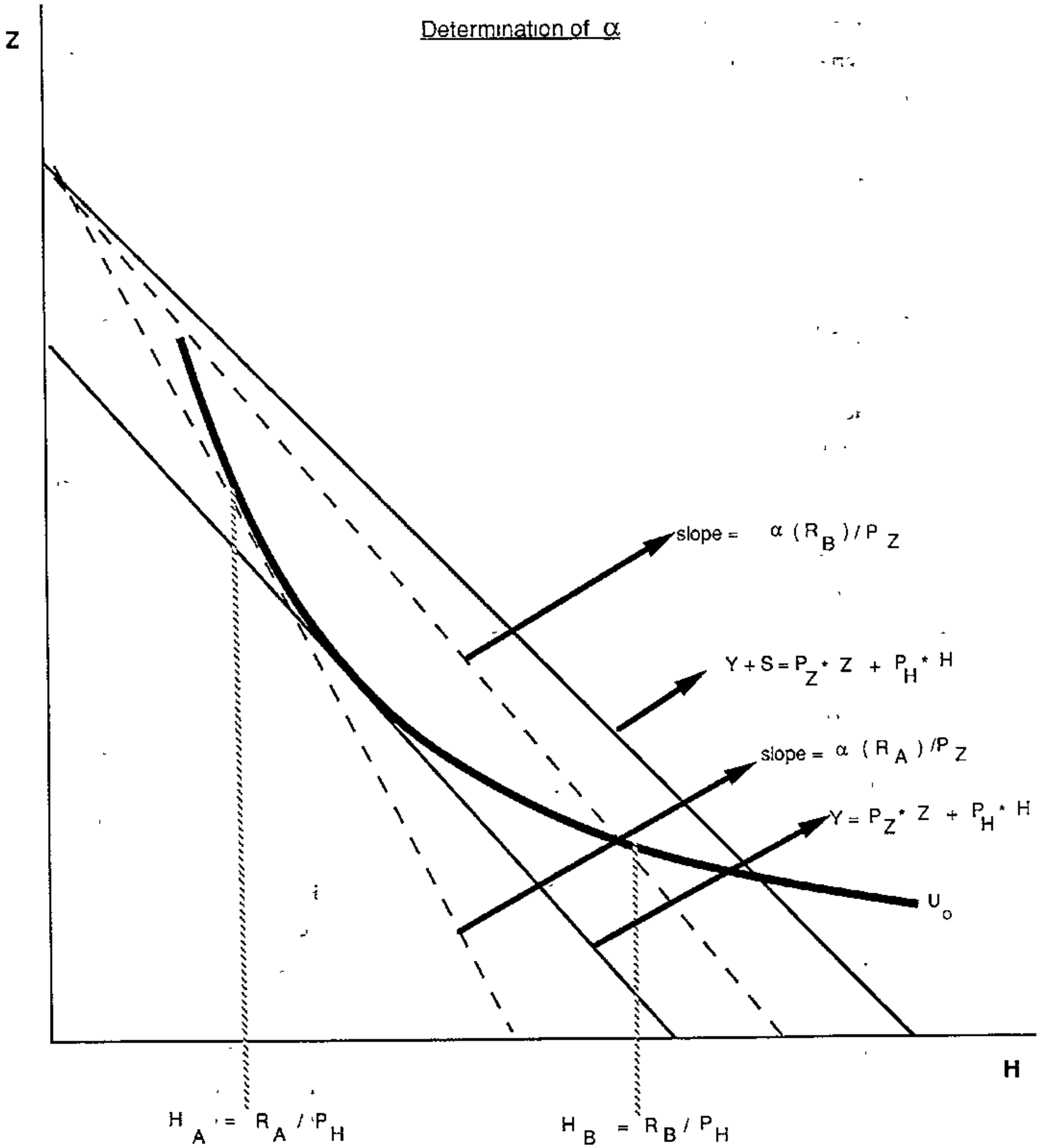
The determination of α^* is illustrated in Figure D.12. A recipient has a pre-program budget line ($Y = P_Z Z + P_H H$) and a program budget line ($Y + S = P_Z Z + P_H H$). If we fix program rental expenditures at R_B, then a recipient can consume Z_B ($= (Y + S - R_A)/P_Z$). The value of α^* is the price of housing that creates a budget line that intersects the original indifference curve at Z_B. Examination of the figure shows that this price increases as R increases from zero to R_A in Figure D.12 and then decreases as R increases above R_A, where R_A is the price of housing that would leave the recipient indifferent between his original budget constraint and a budget constraint with income $(Y + S)$.

If an individual would spend R_C under the Certificate program, then he will require a higher or lower maximum price under the Housing Voucher program depending on whether his rental expenditures under the Housing Voucher program, R_V, are higher or lower than under the Certificate program and also on whether R_C is above or below R_A in Figure D.12. However, we know that R_A

[1]See Samuelson, 1947.

Figure D.12

Determination of α



H = Housing

Z = Other Goods

S = Subsidy

Y = Income

U_o = Pre-Program Indifference Curve

P_H = Price of Housing

P_Z = Price of Other Goods

α = maximum acceptable effective price of housing given the level of rental expenditures is always below pre-program (equilibrium) consumption. Thus R_C can only be below R_A in cases where the Certificate program reduces recipient rents below pre-program levels. This is very rare. Accordingly, we expect Housing Voucher maximum acceptable prices to be lower or higher to the extent that the Housing Voucher program increases or decreases recipient target rents. As noted earlier, the Housing Voucher program could in principle lead to either increases or decreases in individual target rents, but in fact on average increases recipient rents.

This is not the end of the story, however. The expected price depends also on the distribution of rents among units that meet program quality and occupancy requirements. Thus, the expected price actually paid is given by:

$$(42) \qquad E\,(P_H|R) = \frac{\int_0^{\alpha} P_H\,\rho\,(R/P_H)\,f\,(P_H)\,dP_H}{\pi}$$

Accordingly,

$$(43) \qquad \frac{dE\,(P_H|R)}{dR} = \frac{\rho\,(R|\alpha^*)\,f\,(\alpha^*)}{\pi}\left[\alpha^* - E\,(P_H|R)\right]\frac{\partial\alpha^*}{\partial R} + \frac{\partial E\,(P_H|R)}{\partial R}$$

The first term of Eq. (43) is negative, since $\frac{\partial\alpha^*}{\partial R}$ is negative. The second term is given by:

$$(44) \qquad \frac{\partial E\,(P_H/R)}{\partial R} = \frac{1}{\pi}\int_{\sigma}^{\alpha}\left(1 - \frac{E\,(P_H/R)}{P_H}\right)\rho'(\frac{R}{P_H})\,f(P_H)\,dP_H.$$

$$= \frac{1}{\pi}\int_{\sigma}^{\alpha}(P_H - E\,[P_H/R])\,\frac{\rho'(R/P_H)}{P_H\rho(R/P_H)}\,\rho(R/P_H)\,f(P_H)\,dP_H$$

This last expression (in Eq. 44) will be positive if $(\rho'/P_H\rho)$, which equals $(\frac{\partial\rho}{\partial R}/\rho)$, is positively correlated with P_H. This is in fact what we usually expect. If we think of ρ (the probability of meeting requirements) as a function of the real housing index H, then we require that:

$$(45) \qquad \frac{\rho'(\lambda H)}{\rho(\lambda H)} < \frac{\rho'(H)}{\rho(H)} \text{ for } \lambda > 1 \quad .$$

If, for example, ρ is logistic in H, then:

$$(46) \qquad \frac{\rho'(H)}{\rho(H)} = 1 - \rho(H) \ ,$$

which satisfies Eq. (46). Equation (45) will also be met by a probit in H. Alternatively, if ρ is one or zero depending on whether H is above or below some threshold level, derivatives are not defined, but the term in Eq. (44) will be positive.

The remaining question is, of course, which of the two terms dominates. A particularly interesting version of this question is whether it is possible for the expected success rate, π, to increase while the expected price paid decreases. The answer to this is not clear. Further, even if we could sort out the relationship between target rent and prices, we only arrive at a statement of program differences by weighting the price-rent schedule by the difference between the two programs in the distribution of target rents. This seems unlikely to be very conclusive.

The critical feature of the model presented above is that the shopping incentives in the two programs are the same for any target rent. The program differences only arise from differences in the selection of target rents. If we imagine that the Housing Voucher program generates a joint distribution of rent and quality among its recipients, then under this model, the conditional distribution of quality given rent is the same in the two programs, while the distribution of rent given quality differs due to differences in the rents selected.

For concreteness, say that the search process in the Housing Voucher program generates a joint normal distribution of housing quality and rent:

$$(47) \qquad R_V = PH_V + \epsilon_V$$

where

R_V = recipient rents in the Housing Voucher program

H_V = recipient housing in the Housing Voucher program $\sim N\ (\mu_H,\ \sigma_H)$

P = the price of housing paid in the Housing Voucher program

ϵ_V = a stochastic term $\sim N\ (0,\ \sigma_\varepsilon)$

Under joint normality, this induces a regression of housing quality on rent, given by:

$$(48) \qquad PH_V = \alpha + \beta R + \theta$$

$$\alpha = (1 - \beta)\ \mu_R\ ,\ \beta = \frac{P^2\sigma_H^2}{P^2\sigma_H^2 + \sigma_\varepsilon^2}\ ,\ \mu_R = P\mu_H$$

$$\theta \sim N\ (0,\ \sigma_\theta^2),\ \sigma_\theta^2 = P^2\sigma_H^2\ (1 - \beta) = \beta\ (1 - \beta)\ \left[P^2\sigma_H^2 + \sigma_\varepsilon^2\right]$$

Now, imagine that, as we have suggested, the Certificate program does not alter the shopping incentives conditional on target rent, but selects a different set of target rents, inducing a new distribution of R. Then Eq. (48) will also apply to the Certificate program. However, this will induce a new regression of rent on housing quality in the Certificate program.

Example 1. Normally Distributed Certificate Program Rents. Assume that the Certificate program Certificate rents are still distributed normally with mean $\bar{R}_C$ and variance V_C. Since Eq. (48) still holds, we know that:

$$(49) \qquad P\bar{H}_C = \alpha + \beta\bar{R}_C$$

$$= (1 - \beta)\ \mu_R + \beta\bar{R}_C$$

Since $P\overline{H}_C$ is the Housing Voucher cost of $\overline{H}_C$, and $\overline{R}_C$ is the Certificate program cost, we have:

$$(50) \quad (\overline{R}_C - P\overline{H}_C) = (1 - \beta)\,(\overline{R}_C - \mu_R)$$

That is, the average Certificate cost will be above or below the average Housing Voucher cost for the same bundle as the average rents selected in the Certificate Program are above or below the average Housing Voucher rents. In addition, the new distribution of Certificate program rents induces the regression:

$$(51) \quad R_C = \overline{R}_C + \frac{\beta V_C}{\beta^2 V_C + \sigma_\Theta^2}\,(PH_C - P\overline{H}_C) + \omega$$

Substituting for $P\overline{H}_C$ and for α, β, σ_θ^2, and defining the variance of rents in the Housing Voucher program by:

$$V_V = P^2\sigma_H^2 + \sigma_\varepsilon^2 ,$$

so that

$$\sigma_\theta^2 = \beta\,(1 - \beta)\,V_V ,$$

Eq. (51) can be reduced to:

$$(52) \quad R_C = \left(\frac{(1 - \beta)\,V_V V_C}{\beta V_C + (1 - \beta)\,V_V} \right) \left(\frac{\overline{R}_C}{V_C} - \frac{\mu_R}{V_V} \right) + \frac{V_C}{\beta V_V + (1 - \beta)\,V_V}\,PH_C + \omega$$

The Certificate program regression of rent on housing quality will have a flatter slope than the Housing Voucher regression if the selected Certificate program rents have a lower variance; the regression line will be shifted up or down depending on whether the standardized mean rent is increased or decreased.

The content of this may be clearer if we consider another example.

Example 2. Upper and Lower Trunction of the Rent Distribution. Assume that the mechanism by which Certificate enrollees select target rents truncates the distribution of rents so that:

$$(53) \qquad a < R_C < b$$

In this case,

$$(54) \qquad R_C = PH_C + E\ (\varepsilon/\text{trunction})$$

$$(55) \qquad R_C = PH_C - \sigma_\varepsilon^2 \left[\frac{f(b - PH) - f(a - PH)}{F(b - PH) - F(a - PH)} \right]$$

where

F = the distribution function for ε.

Since ε has a zero mean in the population, it is easy to see that:

$$(56) \qquad R_C \gtrless PH_C \text{ as } b \gtrless 2PH_C - a$$

If there is any upper trunction (b finite), then for large enough PH_C, the Certificate regression line will be below the Housing Voucher regression line. If there is any lower trunction (a finite), then for small enough PH_C, the Certificate program regression line will lie above the Housing Voucher regression line.

We can generalize these insights with a final example.

Example 3. General Selection of Certificate Program Rents. Say that Certificate program enrollees select from among the target rents considered by Housing Voucher enrollees with:

$g\ (R)$ = the probability of selection for rent R, assumed to be independent of H.

Then

$$E\ (R_C - PH_C) = E\ (\varepsilon \mid \text{selection}) \tag{57}$$

$$E\ (R_C - PH_C) = \frac{\int \varepsilon g\ (PH + \varepsilon)\ f(\varepsilon)\ d\varepsilon}{\int g\ (PH + \varepsilon)\ f(\varepsilon)\ d\varepsilon} \tag{58}$$

Consider first the slope of the regression. We can rewrite the integration in Eq. (58) in terms of R:

$$E\ (R_C - PH_C) = \frac{\int (R - PH)\ g\ (R)\ f\ (R - PH)\ dR}{\int g\ (R)\ f\ (R - PH)} \tag{59}$$

$$\frac{\partial\ (R_C - PH_C)}{\partial H_C} = -\ P - P\ \left[\frac{\int (R - PH)\ g\ (R)\ f'\ (Q - PH)}{\int gf} - E\ (R_C - PH_C)\ \frac{\int gf'}{\int gf} \right] \tag{60}$$

Recall that if f is a normal density function:

$$f'\ (R - PH) = -\ \frac{R - PH}{\sigma_\varepsilon^2}\ f\ (R - PH) \tag{61}$$

thus Eq. (60) can be rewritten:

$$(62)\qquad \frac{\partial\,(R_C - PH_C)}{\partial H_C} = -\,P\left[\,1 - \frac{\int (R - PH)^2\, g\,(R)\, f\,(Q - PH)}{\sigma^2 \int gf} + \frac{(E\,[R - PH])^2}{\sigma^2}\,\right]$$

$$(63)\qquad \frac{\partial\,(R_C - PH_C)}{\partial H_C} = -\,P\left[\,1 - \frac{\mathrm{Var}\,(R - PH|\mathrm{selection})}{\sigma_\varepsilon^2}\,\right]$$

Accordingly, since

$$(64)\qquad \frac{\partial R_C}{\partial H_C} = P + \frac{\partial\,(R_C - PH_C)}{\partial H_C}$$

then substituting from Eq. (63) yields

$$(65)\qquad \frac{\partial R_C}{\partial H_C} = P\left[\,\frac{\mathrm{Var}\,(R - PH|\mathrm{selection})}{\mathrm{Var}\,(R - PH|\mathrm{without\ selection})}\,\right]$$

The slope of the Certificate program regression of rent on housing quality is greater or less than the slope of the Housing Voucher regression as the rent selection process increases or decreases the variance of rents at any given H.

Now consider the level of the Certificate regression line. Returning to Eq. (58), the Certificate line lies above or below the Housing Voucher line as:

$$(66)\qquad \frac{\int \varepsilon g\,(PH + \varepsilon)\, f\,(\varepsilon)\, d\varepsilon}{\int g\,(PH + \varepsilon)\, f\,(\varepsilon)\, d\varepsilon} \gtrless 0$$

Say that there is a rent such that Certificate recipients are less likely to select rents below this rent than above it. Then since the mean of $f(\varepsilon)$ is zero, it is clear that for low enough PH, the expression in Eq. (66) will be positive. Similarly, if there is a rent such that Certificate recipients are less likely to select rents above this rent than below it, it is clear that for high enough PH, the expression in Eq. (66) will be negative.

Accordingly, under the model of this section in which Certificate program rents tend to be more tightly clustered around FMRs than Housing Voucher rents, we expect that the Certificate regression line will have a flatter slope and be shifted up.

It is important in considering this class of models not to think of selection as a passive process. We expect that it will be more difficult to find units that meet program quality and occupany requirements at lower rents. As the model at the beginning of this section indicated, different rents will be associated with different prices and (implicitly) different incentives to expend effort in shopping. The point of the model in this section is not that the programs will not differ in average shopping intensity, but that under the model posed here these differences arise through differences in target rents and affect the joint distribution of rents and housing quality in very restricted ways.

Alternative Search Models. In the model of the previous section, individuals searching for housing select a target rent (or range of rents) and then shop for housing within this target range. It is clear, however, that individuals in looking for housing can also to some extent identify a range of housing quality in terms of unit size, amenities, and location, and search across units that meet their quality criteria based on realtor descriptions or advertisements. Further, we can imagine that on finding a unit, tenants may bargain with landlords rather than accepting the landlord's first offer. Interestingly, such processes suggest a different outcome in terms of the pattern of program prices than that found under the model of the previous section.

Imagine now that individuals select a target level of housing and then search across units with this target level until they find (or negotiate) an acceptable rent. We need not consider the process that determines the target level of housing. What concerns us here is the shopping incentives associated with any level of housing services. For the Certificate program recipients searching at a given level of services, the only thing that matters about the price is that the unit's rent be less than the FMR ceiling. Thus the Certificate program creates the same sort of rent selection process found in the previous section. Compared with the market equations, the Certificate program regression of rent on quality should be rotated down and the regression of quality on rent unaffected.

Now consider a Housing Voucher enrollee. Again we are concerned with behavior given the level of housing quality selected. We still imagine that recipients set a maximum price, but this is given by:

$$(67) \qquad \underset{\{\alpha\}}{\text{Max}} \int_0^{\alpha} U \left(H, \frac{Y + S - P_H H}{Pz} \right) \rho\ (H)\ f\ (P_H) + \left[1 - \int_0^{\alpha} \rho\ (H)\ f\ (P_H) \right] U_o$$

The first order condition for the maximum price, α ,

$$(68) \qquad U \left(H, \frac{Y + S = \alpha H}{Pz} \right) - U_0 = 0$$

But this is simply a restatement of the condition for α^* in Eq. (21). Accordingly, we know that α (H) is an inverted U-shaped curve. Accordingly, the selection on rent $(R < \alpha\ (H) \cdot H)$ is a function of H, and the regression of H or R will be shifted.

Since under this model the regression of H on R is shifted from the market regression for the Housing Voucher program and the same as the market equation in the Certificate program, the regressions will differ in the two programs -- in contrast to the results of the previous section for the target new model.

Another approach to modelling price determination in the two programs is to consider landlord behavior. It is not unreasonable to suppose that landlords may adjust rents up or down to the FMR ceiling -- either as a discriminatory response to tenants who are Certificate program recipients or because the Certificate program is important enough to induce some landlords to set prices for this market. The exact mechanisms involved are not important. Again, however, we would expect such behavior to involve shifts in rent that vary with housing level and so shift the regression of quality or rent between the two programs.

Similar considerations would apply to models in which PHAs successfully bargain with landlords (as opposed to simply setting a ceiling like the FMR).

Empirical Evidence

We started by regressing recipient gross rents on a number of unit and neighborhood characteristics. The characteristics included in the regression were chosen based on previous studies of existing housing programs. We then tested to see whether the regressions could be pooled, up to shift terms, across sites, programs, or recipients who had moved from or stayed in their pre-program units. The results for one specification are presented in Table D.18. We could not pool across sites or programs (for movers) or mover/stayer strata (for Housing Voucher recipients).[1] We were able to estimate separate equations for movers by program and site. Specifically we estimated an equation of the form:

$$R_{ijk} = X'\beta_{jk} + \varepsilon_{jk} \tag{69}$$

where

R_{ijk} = Gross rent of the i^{th} (mover) recipient in the k^{th} program in the j^{th} site

X_{ijk} = A vector describing the characteristics of the unit occupied by the i^{th} recipient in the k^{th} program in the j^{th} site

β_{jk} = A vector of hedonic "prices" for the k^{th} program in the j^{th} site

The overall fit obtained with these regressions is indicated in Table D.19. As shown there, the adjusted R^2 averaged about 0.6, with a coefficient of variation of about 12 percent. Tests of variable sets are presented in Table D.20. Unit and building descriptors are significant and important in

[1]Other specifications rejected pooling programs for stayers and strata for the Certificate program as well.

TABLE D.18

TEST STATISTICS FOR POOLED ESTIMATES

	Degrees of Freedom	F-Statistic	Percentage Increase in Standard Deviation of Residual
Pooling Sites (stratified by program and mover/stayer)			
Housing Voucher Program	F (385,342)	1.89**	21.4%
Certificate Program	F (384,341)	1.73**	17.8%
Mover stratum	F (432,564)	1.82**	16.4%
Stayer stratum	F (337,119)	1.73**	24.0%
All	F (769,683)	1.83**	19.9%
Pooling Programs (stratified by site and mover/stayer)			
Mover stratum	F (231.564)	1.41**	5.8%
Stayer stratum	F (163,119)	1.23	6.5%
All	F (394,683)	1.37**	6.5%
Pooling Mover/Stayer Strata (stratified by site and program)			
Housing Voucher Program	F (186,342)	1.37**	6.2%
Certificate Program	F (183,341)	0.98	-0.4%
All	F (369,683)	1.21*	3.6%

** = Significant at 0.01 level

* = Significant at 0.05 level

‡ = Significant at 0.10 level

Source: Leger and Kennedy (1989) Table E.8

TABLE D.19

OVERALL STATISTICS FOR THE RENTAL COST REGRESSIONS[a]

	Ten Housing Voucher Program Regressions	Ten Certificate Program Regressions
Mover Regressions		
Adjusted R-Square		
Range	0.49 to 0.81	0.30 to 0.77
Mean	0.62	0.59
Coefficient of Variation[b]		
Range	7% to 16%	6% to 14%
Mean	12.2%	10.5%
Pooled Mover/Stayer Regressions		
Adjusted R-Square		
Range	0.42 to 0.77	0.35 to 0.76
Mean	0.62	0.59
Coefficient of Variation[b]		
Range	11% to 21%	11% to 14%
Mean	13.6%	11.5%

[a]Separate regressions were estimated for each site-program combination (20 regressions).

[b]The root mean squared error of the regression as a percent of mean contract rent.

TABLE D.20

TESTS OF VARIABLE SETS FOR LINEAR HEDONIC EQUATIONS STRATIFIED BY PROGRAM AND SITE: MOVERS ONLY

	Housing Voucher Program		Certificate Program	
	F-Statistic	Percentage Increase in Std. Error	F-Statistic	Percentage Increase in Std. Error
Unit quality and building descriptors	F (132,288) = 1.67**	10.1%	F (129,282) = 1.43**	6.5%
Neighborhood variables	F (56,288) = 1.38*	3.1	F (59,282) = 1.11	1.0
Combined unit, building, and neighborhood	F (188,288) = 1.69**	12.9	F (188,282) = 1.38*	7.3

** = Significant at 0.01 level

* = Significant at 0.05 level

‡ = Significant at 0.10 level

Source: Leger and Kennedy (1989), Table E.18

each program. Neighborhood descriptors have smaller effects and are significant only for the Housing Voucher Program.

The difference in average rents between the two programs in any site may then be written:

$$(70) \qquad \bar{R}_{jv} - \bar{R}_{jc} = \bar{X}_{jv}\beta_{jv} - \bar{X}_{jc}\beta_{jc}$$

We can decompose the difference in rents from Eq. (70) into a difference in value and a difference in price:[1]

$$(71) \qquad \bar{R}_{jv} - \bar{R}_{jc} = X_{jc}(\beta_{jv} - \beta_{jc}) + (\bar{X}_{jv} - \bar{X}_{jc})\beta_{jv}$$

Specifically, we decompose the difference in average contract rent between the two programs in each PHA as follows:

---

[1]As usual, we have a choice of price/value decompositions. In Eq. (71) we evaluate the difference in prices between the two programs by comparing the cost of the average Certificate program housing bundle under the prices paid by recipients in each program--$(\bar{X}_{jc}(\beta_{jv}-\beta_{jc}))$. Conversely, the real difference in housing is evaluated as the differences in attributes values at Housing Voucher program prices--$((\bar{X}_{jv}-\bar{X}_{jc})\beta_{jv})$. We could reverse this and write

$$\bar{R}_{jv} - \bar{R}_{jc} = X_{jv}(\beta_{jv} - \beta_{jc}) + (\bar{X}_{jv} - \bar{X}_{jc})\beta_{jc}$$

In this equation, price changes are evaluated in terms of the Housing Voucher bundle--$(\bar{X}_{jv}(\beta_{jv}-\beta_{jc})$--and real change in terms of Certificate program prices--$((\bar{X}_{jv}-\bar{X}_{jc})\beta_{jc}$. The decomposition in the text seems preferable in this case since the restricted range of rents in the Certificate Program would be expected to distort the rent/quality relationship (see D.4.1 above).

Mean Housing Voucher Contract Rent	$\bar{R}_{jv}$ $(= \bar{X}_{jv}\hat{\beta}_{jv})$
Mean Certificate Program Contract Rent	$\bar{R}_{jc}$ $(= \bar{X}_{jc}\hat{\beta}_{jc})$
Difference in Contract Rent	$\bar{R}_{jr} - \bar{R}_{jc}$
<u>Decomposition at Housing Voucher Prices</u>	
Cost of Certificate Bundle	$\bar{X}_{jc}\hat{\beta}_{jv}$
Difference Due to Cost	$\bar{X}_{jc}(\hat{\beta}_{jv} - \hat{\beta}_{jc})$
Percentage Difference in Cost	$\bar{X}_{jc}(\hat{\beta}_{jv} - \hat{\beta}_{jc})/\bar{X}_{jc}\beta_{jc}$
Difference in Real Housing	$(\bar{X}_{jv} - \bar{X}_{jc})\hat{\beta}_{jv}$
Percentage Difference in Real Housing	$(\bar{X}_{jv} - \bar{X}_{jc})\hat{\beta}_{jv}/\bar{X}_{jc}\hat{\beta}_{jv}$

where

$\bar{R}_{jk}$ = Mean contract rent of recipient units in the k^{th} program in the j^{th} PHA (k = c or v)

$\bar{X}_{jk}$ = Mean vector of housing attributes of recipient units in the k^{th} program in the j^{th} PHA

$\hat{\beta}_{jk}$ = The estimated hedonic coefficient for the linear hedonic specification

We combined the individual site estimates for each element of the decomposition into an overall estimate by taking weighted averages across sites. The results are presented in Tables D.21A and D.21B. For movers we estimate that price differences account for $19 of the $29 per-month difference in average contract rent between the two programs, with a significant real change in housing valued at $10 per month. For stayers, the entire difference in rent is estimated to be due to differences in price, with no difference in real housing. However, the price difference is not significant for stayers.

In summary, the results presented thus far indicate that the average contract rent paid by Housing Voucher recipients who move is 6.7 percent higher than the average contract rent paid by Certificate Program recipients who move. This higher average rent reflects the combination of a 2.3 percent higher average level of real housing and a 4.3 percent higher price per unit

TABLE D.21A

DECOMPOSITION OF DIFFERENCES IN AVERAGE CONTRACT RENT FOR MOVERS
(Based on Separate Mover Equations--Linear Specification with Heat Dummy)

	Value	Within Std. Error	t-Statistic	Total Std.Error	t-Statistic
Mean Housing Voucher contract rent	$468.20	4.87	96.14**	32.06	14.60**
Mean Certificate Program contract rent	$438.98	4.01	109.47	32.03	13.45**
Difference in contract rent					
Dollars	$29.22	6.31	4.63*	6.91	4.23
Percent	6.7%				
Decomposition of Housing Voucher Prices					
Cost of Certificate bundle	$458.01	$5.57	82.24**	$94.96	4.82**
Difference in price[a]	$19.03	6.14	3.10**	6.14	3.10**
Percentage difference in price	4.3%				
Difference in real housing[a]	$10.18	4.71	2.16*	5.37	1.90‡
Percentage difference in real housing	2.3%				

[a]Estimated Differences in Cost and Differences in Real Housing are each estimated directly from the hedonic coefficients and may not sum to the total difference in contract rent due to rounding errors.

** = Significant at 0.01 level
* = Significant at 0.05 level
‡ = Significant at 0.10 level

Source: Leger and Kennedy (1989), Table E.19

TABLE D.21B

DECOMPOSITION OF DIFFERENCES IN AVERAGE CONTRACT RENT FOR STAYERS (POOLED ESTIMATION OF LINEAR SPECIFICATION)

	Value	Within Std. Error	(t)	Total Std.Error	t-Statistic
Mean Housing Voucher contract rent	$405.50	NA	NA	NA	NA
Mean Certificate Program contract rent	$390.34	NA	NA	NA	NA
Difference in contract rent					
Dollars	$15.16	NA	NA	NA	NA
Percent	3.7%				
Decomposition of Housing Voucher Prices					
Cost of Certificate bundle	$407.47	7.86	51.82**	53.14	7.67**
Difference in price[a]	$17.13	8.62	1.99*	10.52	1.63
Percentage difference in price	4.4%				
Difference in real housing[a]	$-1.97	5.99	0.33	8.40	0.23
Percentage difference in real housing	-0.5%				

[a]Estimated Differences in Cost and Differences in Real Housing are each estimated directly from the hedonic coefficients and may not sum to the total difference in contract rent due to rounding errors.

** = Significant at 0.01 level

* = Significant at 0.05 level

‡ = Significant at 0.10 level

of real housing. The results for recipients who stay in place are less clear. The average contract rent for Housing Voucher recipients who stay in place is 3.7 percent higher than the average for Certificate Program recipients who stay in place. However, it is not clear whether this reflects higher prices, better housing, or both.

More detailed examination of the differences between the two programs in the relationship between rents paid and housing obtained indicates that the finding of higher average prices and better average housing for movers in the Housing Voucher Program is not inherent to the two programs, but reflects the relationship between the Housing Voucher Payment Standard and the Certificate Program FMR ceiling. Specifically, it appears that the pattern of price differences for movers could be altered and even reversed by changes in the Payment Standard or FMR schedules. Again, the results for stayers are less clear.

Table D.22 presents average rents, predicted rents, differences, and percent of cases with actual rent less than predicted rent at various levels of housing quality for (a) stayers, (b) movers, and (c) combined recipients. The entries in the differences column, if appropriately weighted, would average to the $19 overall differences shown in Table D.21. The quality level is measured in terms of the ratio of the predicted rent from the Housing Voucher Program to the FMR.[1] The difference column in the right-hand panel indicates the extent to which actual average rent paid by Certificate Program recipients is above the average paid by Housing Voucher Program recipients for similar units in each quality range. At lower quality levels, Certificate Program recipients pay higher average prices than Housing Voucher recipients (i.e, actual Certificate Program average rents exceed predicted rents, producing positive entries in the differences column). At higher quality levels Certificate Program recipients pay lower prices than Housing Voucher recipients (i.e., actual Certificate Program average rents are below predicted rents, producing increasingly negative differences at higher quality levels).

The relationships in the tables are summarized by Table D.23 and Figure D.13, which graphs the regression of actual on predicted rent in the

[1]Tables organized in terms of the dollar predicted rent are presented in Appendix E.

TABLE D.22A

ACTUAL AND PREDICTED RENT BY LEVEL OF RATIO OF PREDICTED RENT TO FMR OR PAYMENT STANDARD FOR STAYERS

Ratio of Predicted Rent to FMR	Housing Voucher Program					Certificate Program				
	Sample Size	Actual Rent (s.e.)	Predicted Rent (s.e.)	Difference[a] (s.e.)[b]	Percent of Cases With Rent Less Than Predicted (s.e.)	Sample Size	Actual Rent (s.e.)	Predicted Rent (s.e.)	Difference[a] (s.e.)[b]	Percent of Cases With Rent Less Than Predicted (s.e.)
P≤0.7	26	294 (18)	295 (16)	-1 (10)	42 (10)	35	319 (14)	257 (15)	62** (16)	23 (7)
0.7<P≤0.8	50	361 (18)	345 (15)	16* (7)	36 (7)	50	357 (14)	330 (12)	26** (8)	30 (7)
0.8<P≤0.9	55	412 (18)	401 (16)	10 (8)	45 (7)	62	418 (18)	403 (16)	15* (6)	42 (6)
0.9<P≤1.0	54	413 (14)	415 (12)	-2 (6)	46 (7)	46	400 (15)	440 (15)	-40** (9)	67 (7)
1.0<P≤1.1	51	446 (18)	459 (17)	-13* (6)	55 (7)	29	426 (26)	493 (29)	-67** (12)	83 (7)
1.1<P	17	473 (23)	529 (23)	-56** (13)	94 (6)	37	430 (18)	573 (22)	-143** (12)	100 (NA)

[a]Difference Amount may differ from difference of actual and predicted rent entries due to rounding.

[b]Significance only indicated for Difference.

** = Significant at 0.01 level
* = Significant at 0.05 level
‡ = Significant at 0.10 level

TABLE D.22B

ACTUAL AND PREDICTED RENT BY LEVEL OF RATIO OF PREDICTED RENT TO FMR OR PAYMENT STANDARD FOR MOVERS[a]

	Housing Voucher Program					Certificate Program				
Ratio of Predicted Rent to FMR	Sample Size	Actual Rent (s.e.)	Predicted Rent (s.e.)	Difference[b] (s.e.)[c]	Percent of Cases With Rent Less Than Predicted (s.e.)	Sample Size	Actual Rent (s.e.)	Predicted Rent (s.e.)	Difference[b] (s.e.)[c]	Percent of Cases With Rent Less Than Predicted (s.e.)
P≤0.55	36	326 (10)	325 (9)	0 (5)	47 (8)	51	342 (11)	311 (11)	31** (10)	29 (6)
0.55<P≤0.60	13	363 (12)	351 (15)	12 (12)	23 (12)	33	380 (13)	349 (13)	31** (12)	33 (8)
0.60<P≤0.65	23	370 (19)	374 (19)	-4 (5)	57 (11)	22	374 (17)	372 (13)	3 (13)	55 (11)
0.65<P≤0.70	24	380 (17)	379 (15)	0 (7)	46 (11)	24	380 (18)	386 (21)	-5 (13)	50 (10)
0.70<P≤0.75	22	356 (16)	351 (15)	5 (7)	50 (11)	30	372 (16)	379 (16)	-6 (13)	53 (9)
0.75<P≤0.80	36	419 (17)	416 (18)	3 (6)	47 (8)	38	387 (13)	401 (18)	-14 (12)	50 (8)
0.80<P≤0.85	30	389 (14)	390 (12)	-1 (6)	53 (9)	27	379 (22)	397 (18)	-18 (12)	63 (9)
0.85<P≤0.90	46	418 (16)	413 (13)	5 (6)	48 (7)	38	395 (14)	427 (15)	-32** (11)	68 (8)
0.90<P≤0.95	39	418 (13)	420 (12)	-2 (5)	46 (5)	30	409 (19)	446 (18)	-37* (18)	57 (9)
0.95<P≤1.00	32	451 (19)	452 (18)	-1 (7)	50 (9)	29	443 (21)	457 (23)	-14 (15)	52 (9)

[a]Because of the small number of observations, 10-point intervals are used for ratios above 1.1.

[b]Difference Amount may differ from difference of actual and predicted rent entries due to rounding.

[c]Significance only indicated for Difference.

** = Significant at 0.01 level
* = Significant at 0.05 level
‡ = Significant at 0.10 level

TABLE D.22B (cont.)

ACTUAL AND PREDICTED RENT BY LEVEL OF RATIO OF PREDICTED RENT TO FMR OR PAYMENT STANDARD FOR MOVERS[a]

	Housing Voucher Program					Certificate Program				
Ratio of Predicted Rent to FMR	Sample Size	Actual Rent (s.e.)	Predicted Rent (s.e.)	Difference[b] (s.e.)[c]	Percent of Cases With Rent Less Than Predicted (s.e.)	Sample Size	Actual Rent (s.e.)	Predicted Rent (s.e.)	Difference[b] (s.e.)[c]	Percent of Cases With Rent Less Than Predicted (s.e.)
$1.00<P\le 1.05$	29	464 (17)	470 (18)	-6 (7)	62 (9)	25	460 (20)	499 (20)	-39** (13)	68 (10)
$1.05<P\le 1.10$	31	491 (21)	492 (19)	-1 (8)	52 (9)	20	502 (30)	509 (29)	-7 (14)	55 (11)
$1.10<P\le 1.20$	43	503 (20)	501 (17)	1 (8)	58 (8)	32	465 (23)	484 (19)	-19 (13)	66 (9)
$1.20<P\le 1.30$	35	557 (18)	554 (16)	3 (8)	51 (9)	29	479 (25)	532 (26)	-53* (23)	76 (8)
$1.30<P\le 1.40$	26	554 (27)	557 (25)	-3 (8)	54 (10)	20	508 (27)	555 (28)	-46* (20)	75 (10)
$1.40<P$	53	664 (19)	664 (16)	-0 (8)	45 (7)	55	569 (18)	668 (22)	-98** (18)	85 (5)

TABLE D.22C

ACTUAL AND PREDICTED RENT BY LEVEL OF RATIO OF PREDICTED RENT TO FMR OR PAYMENT STANDARD FOR ALL RECIPIENTS[a]

Ratio of Predicted Rent to FMR	Housing Voucher Program: Sample Size	Housing Voucher Program: Actual Rent (s.e.)	Housing Voucher Program: Predicted Rent (s.e.)	Housing Voucher Program: Difference[b] (s.e.)[c]	Housing Voucher Program: Percent of Cases With Rent Less Than Predicted (s.e.)	Certificate Program: Sample Size	Certificate Program: Actual Rent (s.e.)	Certificate Program: Predicted Rent (s.e.)	Certificate Program: Difference[b] (s.e.)[c]	Certificate Program: Percent of Cases With Rent Less Than Predicted (s.e.)
P≤0.55	40	315 (10)	313 (10)	3 (5)	43 (8)	59	336 (11)	291 (12)	45** (12)	27 (6)
0.55<P≤0.60	16	349 (13)	336 (14)	12 (10)	25 (11)	37	373 (12)	341 (12)	32** (10)	32 (8)
0.60<P≤0.65	29	348 (18)	357 (17)	-10 (6)	59 (9)	29	364 (16)	343 (14)	20 (13)	45 (9)
0.65<P≤0.70	37	363 (14)	362 (131)	1 (7)	46 (8)	40	358 (14)	351 (16)	7 (10)	43 (8)
0.70<P≤0.75	45	355 (16)	344 (14)	11‡ (6)	42 (7)	51	366 (12)	355 (13)	11 (10)	41 (7)
0.75<P≤0.80	63	369 (15)	388 (14)	8 (6)	43 (6)	67	374 (12)	373 (13)	1 (8)	43 (6)
0.80<P≤0.85	59	414 (16)	402 (13)	11 (7)	46 (6)	61	393 (17)	392 (14)	0 (8)	51 (6)
0.85<P≤0.90	72	404 (13)	403 (11)	1 (5)	50 (6)	66	412 (14)	424 (14)	-12‡ (7)	58 (6)
0.90<P≤0.95	64	416 (12)	416 (11)	-1 (5)	44 (6)	53	403 (15)	439 (13)	-36** (11)	62 (7)
0.95<P≤1.00	61	433 (13)	436 (11)	-3 (5)	51 (6)	52	426 (14)	455 (15)	-29** (11)	58 (7)
1.00<P≤1.05	64	442 (14)	453 (13)	-11* (5)	63 (6)	46	450 (18)	500 (20)	-50** (10)	72 (7)

[a]Because of the small number of observations, 10-point intervals are used for ratios above 1.1.

[b]Difference Amount may differ from difference of actual and predicted rent entries due to rounding.

[c]Significance only indicated for Difference.

** = Significant at 0.01 level
 * = Significant at 0.05 level
 ‡ = Significant at 0.10 level

TABLE D.22C (cont.)

ACTUAL AND PREDICTED RENT BY LEVEL OF RATIO OF PREDICTED RENT TO FMR OR PAYMENT STANDARD FOR ALL RECIPIENTS[a]

	Housing Voucher Program					Certificate Program				
Ratio of Predicted Rent to FMR	Sample Size	Actual Rent (s.e.)	Predicted Rent (s.e.)	Difference[b] (s.e.)[c]	Percent of Cases With Rent Less Than Predicted (s.e.)	Sample Size	Actual Rent (s.e.)	Predicted Rent (s.e.)	Difference[b] (s.e.)[c]	Percent of Cases With Rent Less Than Predicted (s.e.)
1.05<P≤1.10	47	492 (18)	495 (16)	-4 (6)	47 (7)	28	470 (25)	497 (22)	-27* (12)	68 (9)
1.10<P≤1.20	54	501 (17)	508 (15)	-7 (8)	65 (2)	51	457 (18)	509 (19)	-52** (11)	78 (6)
1.20<P≤1.30	40	541 (17)	549 (15)	-8 (9)	58 (7)	36	466 (22)	533 (23)	-67** (19)	81 (7)
1.30<P≤1.40	27	549 (27)	556 (24)	-8 (9)	56 (8)	25	504 (22)	580 (25)	-77** (20)	80 (8)
1.40<P	53	664 (19)	664 (16)	-0 (8)	45 (7)	61	549 (18)	661 (20)	-112** (17)	87 (4)

TABLE D.23

REGRESSION OF ACTUAL RENT ON PREDICTED RENT

STAYERS

Housing Voucher Program

$$R = \underset{(11.7)}{1.6} + \underset{(0.03)}{0.99^{**}V}$$

N=253 RMSE=53.4 CV=13%

Certificate Program

$$R = \underset{(13.2)}{128.5^{**}} + \underset{(0.03)}{0.64^{**}V}$$

N=259 RMSE=73.0 CV=19%

Combined Program

$$R = \underset{(14.0)}{1.6} + \underset{(0.03)}{0.99^{**}V} + \underset{(7.0)}{126.9^{**}C} - \underset{(0.04)}{0.35^{**}CV}$$

N=512 RMSE=64.0 CV=16%

MOVERS

Housing Voucher Program

$$R = \underset{(6.3)}{0.0} + \underset{(0.01)}{1.00^{**}V}$$

N=550 RMSE=41.1 CV=9%

Certificate Program

$$R = \underset{(10.6)}{130.0^{**}} + \underset{(0.02)}{0.66^{**}V}$$

N=541 RMSE=77.0 CV=18%

Combined Program

$$R = \underset{(9.4)}{0.0} + \underset{(0.02)}{1.00^{**}V} + \underset{(12.7)}{130.0^{**}C} - \underset{(0.03)}{0.44^{**}CV}$$

N=1091 RMSE=61.6 CV=14%

Notes:

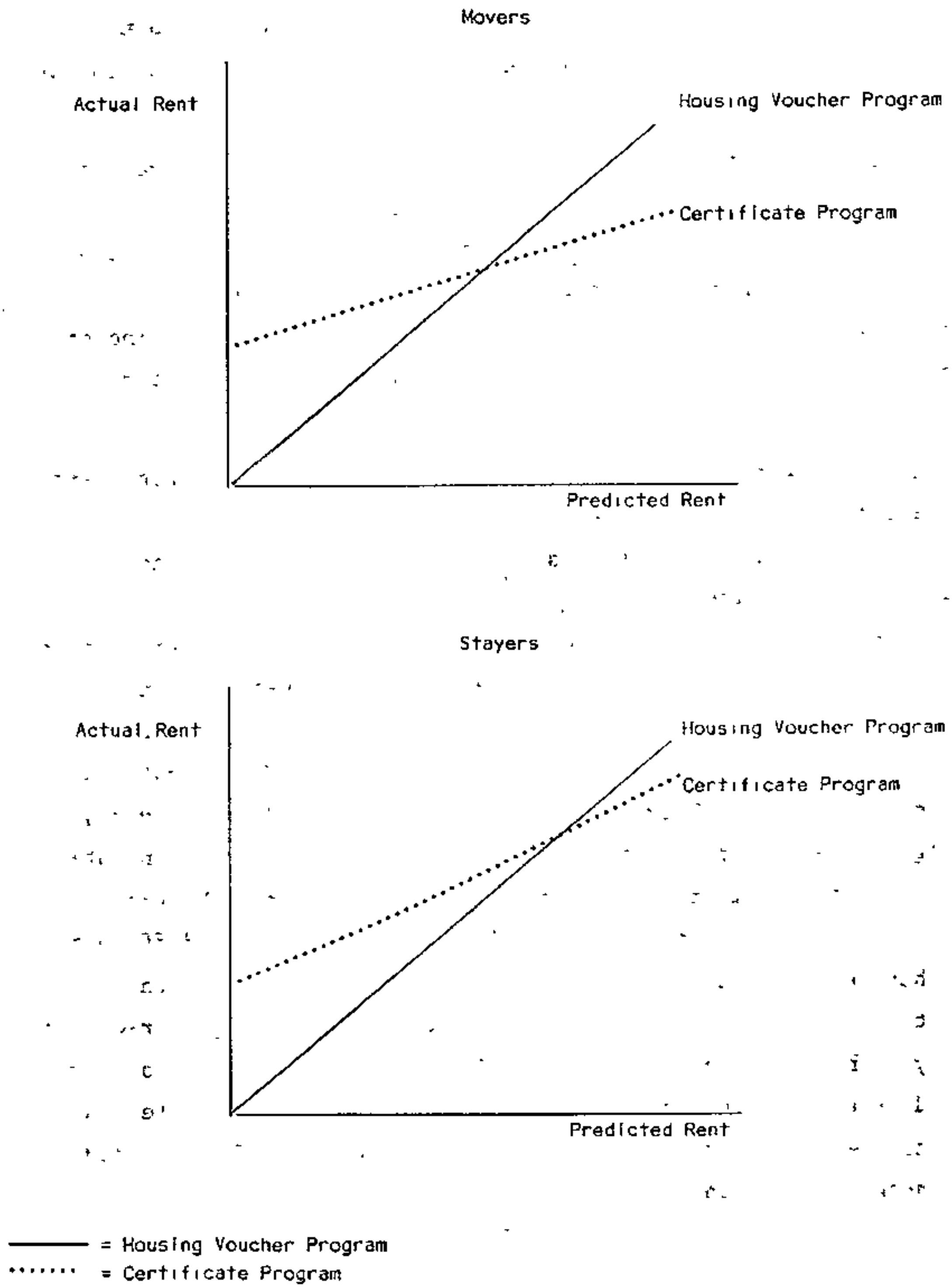
R = Actual contract rent

V = Predicted contract rent based on the estimated Housing Voucher hedonic equation

C = A dummy (0,1) variable for the Certificate Program

FIGURE D.13

SCHEMATIC REPRESENTATION OF THE REGRESSION OF ACTUAL RENT ON PREDICTED RENTS[a]



[a]See Table E.27 for details.

two programs. Since predicted rents are based on the Housing Voucher Program, actual and predicted rents for this program are the same, as indicated by the 45 degree line. The regression for the Certificate Program crosses the 45 degree line, indicating that actual Certificate Program rents are above predicted rents at lower levels of predicted rent and below predicted rent at higher levels.

The tables and regressions suggest that the average differences in prices paid in the two programs depends on the average level of housing obtained. Specifically, it appears that if program payment schedules were adjusted to change the average level of housing, then average price differences would also change. This in fact appears to be the case, though the actual range of possibilities depends on the reasons for the patterns of Table D.22 and Figure D.13.

A pattern of higher Certificate Program prices at lower quality levels and lower Certificate Program prices at higher quality levels is not unreasonable. Housing Voucher recipients face the marginal cost of housing set by the market; if they decide to rent one unit that is more expensive than another, their out-of-pocket costs increase accordingly. Certificate holders, however, face a different cost structure, depending on the rent of the unit being considered. At lower quality levels where units are likely to rent well below the FMR, Certificate Program recipients pay no additional out-of-pocket costs for higher rent units. They have no incentive to economize on rent, whereas Housing Voucher recipients face dollar-for-dollar increases in out-of-pocket costs for each additional dollar increase in rent charged by the landlord. However, when rents are near the FMR, the situation is different. A Housing Voucher recipient can occupy a higher rent unit by paying the additional cost out of his or her own pocket. A Certificate Program recipient can only occupy a unit with rents above the FMR if they are willing to leave the program and lose their entire subsidy. Thus, at higher quality levels, where unit rents are more likely to be above the FMR, the Certificate holder has a larger incentive to economize on rent.[1]

[1] Similarly, landlords faced with the Certificate Program ceilings may be tempted to agree to modest reductions in rent if they would bring the unit within the ceiling or to propose increases up to the ceiling.

This pattern of incentives would be expected to create the pattern of price differences shown above--with Certificate recipients paying higher prices for lower quality units, where they have a relatively smaller incentive to shop, and lower prices for higher quality units, where they must shop more intensively in order to meet the Certificate Program rent ceilings. Further, under this sort of model, the rental cost lines for the two programs always cross somewhere below the Certificate Program rent ceiling. Thus under this interpretation, Housing Voucher prices would be lower if the Payment Standard were low enough to lead to Housing Voucher recipient rents far enough below the Certificate Program FMRs to undo the effects of the FMR ceiling.

The pattern of program price differences can also arise in another, quite different manner. In particular, imagine that both Housing Voucher and Certificate recipients get the same average housing for the rent they pay. They may still, however, pay different average rents for a given level of housing quality. Certificate holders cannot pay rent in excess of the FMR. Accordingly, when we look at the average rent associated with a given level of housing quality, the rents paid by Certificate holders are truncated. In this case, the observed pattern of price differences in Table D.22 and Figure D.13 could be produced by differences in the rents that the Housing Voucher and Certificate holders consider in looking for housing.

Under this model, the observed schedule of rents against housing quality only shows the relationship of housing quality and rent for a given set of recipients, and does not accurately forecast the way in which average prices and housing quality are related. Indeed, if the pattern is totally created by differences in rents selected for consideration, then price differences will be directly associated with differences in housing obtained. If Payment Standards and FMRs are set so that Housing Voucher recipients have higher average housing quality, they will also have higher average prices. If Payment Standards and FMRs are set so that Housing Voucher recipients have the same average housing quality, they will pay the same average price per unit. If Payment Standards and FMRs are set so that Housing Voucher recipients have lower average housing quality, then they will have lower average prices.

We tested this interpretation by seeing whether or not the average level of housing quality obtained at a given rent was the same in the two programs. Table D.24 follows the format of Table D.22 for stayers and movers, except that now we consider the average housing quality obtained at a given rent. For recipients who move, the average level of housing quality obtained is the same in the two programs. This is confirmed by the regression of housing quality on rent for movers shown in Figure D.14 and Table D.25. This suggests that the pattern of price differences for recipients who move is in fact generated by selection effects.

For recipients who stay in place, there is still a pattern of differences in housing quality given rent. In this case, the program differences seem at least in part to reflect the differences in incentives to bargain with landlords discussed earlier.

Unfortunately, the comparison of the two programs' regressions of housing quality on rent is subject to biases that may obscure real differences. Thus, we cannot, from the available evidence, determine which model of shopping incentives is correct. This is discussed further in the Note to this Appendix.

D.5 Some Caveats

The central assumption of the simple model of Sections D.1 and D.2 is, of course, that the potential decisions of the collection of individuals in a household can be characterized by a consistent preference ordering with concave indifference curves. In addition to this, however, the model clearly abstracts from reality in several ways. Three of these are discussed in this section.

D.5.1 Landlord Behavior

Perhaps the most important omission is the fact that the models focus exclusively on applicant and recipient behavior. This is appropriate for competitive markets with perfect information and no transaction costs. Each of these assumptions is subject to question in this case.

First, as already noted, the general private market does not provide much information on whether units quality for Section 8. Accordingly, some PHAs offer applicants lists of units that are likely to qualify (and whose owners are willing to participate in the program) and some owners directly

TABLE D.24A

ACTUAL AND PREDICTED RENT BY LEVEL OF RATIO OF ACTUAL CONTRACT RENT TO FMR OR PAYMENT STANDARD FOR STAYERS

	Housing Voucher Program					Certificate Program				
Ratio of Actual Rent to FMR	Sample Size	Actual Rent (s.e.)	Predicted Rent (s.e.)	Difference[a] (s.e.)[b]	Percent of Cases With Rent Less Than Predicted (s.e.)	Sample Size	Actual Rent (s.e.)	Predicted Rent (s.e.)	Difference[a] (s.e.)[b]	Percent of Cases With Rent Less Than Predicted (s.e.)
A≤0.70	38	272 (12)	306 (13)	-34** (6)	76 (7)	36	277 (10)	325 (14)	-48** (11)	81 (7)
0.70<AP≤0.75	13	311 (31)	325 (38)	-14 (11)	62 (14)	22	309 (14)	359 (30)	-50* (25)	73 (10)
0.85<AP≤0.80	21	348 (23)	370 (24)	-21* (11)	67 (11)	23	381 (24)	402 (32)	-20 (13)	57 (11)
0.80<AP≤0.85	31	393 (21)	391 (20)	3 (7)	39 (9)	27	405 (19)	425 (24)	-21* (10)	70 (9)
0.85<AP≤0.90	26	390 (28)	394 (19)	-4 (9)	54 (10)	40	410 (19)	427 (23)	-17 (12)	50 (8)
0.90<AP≤0.95	38	448 (17)	447 (17)	1 (9)	47 (8)	4	435 (21)	464 (30)	-29 (20)	53 (8)
0.95<AP≤1.00	26	431 (20)	418 (17)	14‡ (8)	42 (10)	30	453 (21)	443 (26)	10 (14)	37 (9)
1.00<AP	56	493 (18)	472 (17)	21* (9)	29 (6)	35	423 (16)	396 (21)	27‡ (15)	26 (7)

[a]Difference Amount may differ from difference of actual and predicted rent entries due to rounding.

[b]Significance only indicated for Difference.

** = Significant at 0.01 level
* = Significant at 0.05 level
‡ = Significant at 0.10 level

TABLE D.24B

ACTUAL AND PREDICTED RENT BY LEVEL OF RATIO OF ACTUAL CONTRACT RENT TO FMR OR PAYMENT STANDARD FOR MOVERS

	Housing Voucher Program					Certificate Program				
Ratio of Actual Rent to FMR	Sample Size	Actual Rent (s.e.)	Predicted Rent (s.e.)	Difference[a] (s.e.)[b]	Percent of Cases With Rent Less Than Predicted (s.e.)	Sample Size	Actual Rent (s.e.)	Predicted Rent (s.e.)	Difference[a] (s.e.)[b]	Percent of Cases With Rent Less Than Predicted (s.e.)
A≤0.5	24	308 (9)	329 (10)	-21** (6)	71 (9)	34	308 (9)	350 (15)	-42** (14)	68 (8)
0.5<AP≤0.6	28	358 (13)	354 (14)	5 (5)	39 (9)	52	352 (9)	386 (16)	-34** (13)	62 (7)
0.6<AP≤0.7	44	362 (12)	376 (13)	-13** (5)	59 (7)	75	379 (9)	421 (15)	-42** (11)	65 (6)
0.7<AP≤0.8	56	383 (11)	389 (11)	-6 (5)	64 (6)	61	369 (9)	403 (13)	-34** (10)	66 (6)
0.8<AP≤0.9	76	407 (11)	410 (11)	-3 (4)	53 (6)	58	405 (12)	401 (15)	4 (11)	47 (7)
0.9<AP≤1.0	69	427 (11)	432 (12)	-5 (5)	49 (6)	56	447 (15)	449 (17)	-1 (9)	52 (7)
1.0<AP≤1.1	67	490 (12)	491 (13)	-1 (5)	54 (6)	46	484 (17)	503 (21)	-19 (14)	52 (7)
1.1<AP≤1.2	44	468 (11)	463 (12)	5 (5)	43 (8)	32	428 (16)	449 (25)	-21 (16)	56 (9)
1.2<AP≤1.3	34	569 (19)	566 (19)	2 (8)	47 (9)	37	547 (21)	581 (25)	-35* (15)	68 (8)
1.3<AP	76	657 (16)	633 (15)	25** (6)	32 (5)	52	594 (17)	595 (24)	-1 (17)	50 (7)

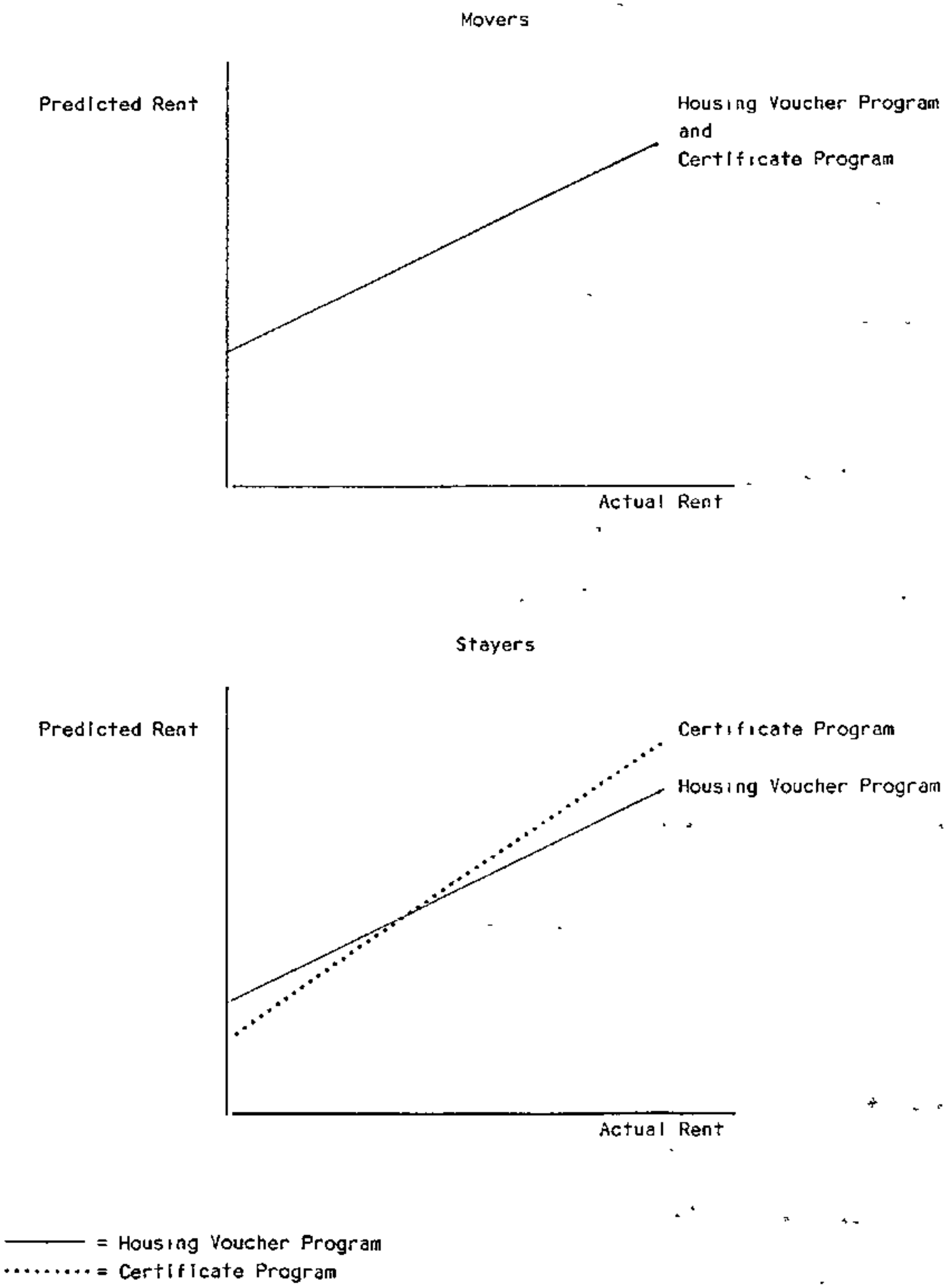
[a]Difference Amount may differ from difference of actual and predicted rent entries due to rounding.

[b]Significance only indicated for Difference.

** = Significant at 0.01 level
* = Significant at 0.05 level
‡ = Significant at 0.10 level

FIGURE D.14

SCHEMATIC REPRESENTATION OF THE REGRESSION OF PREDICTED RENTS ON ACTUAL RENT[a]



[a]See Table E.27 for details.

TABLE D.25

REGRESSION OF ESTIMATED VALUE ON RENT

STAYERS

Unweighted

$$V = \sum s_i \hat{\alpha}_i + \sum s_i R\hat{\beta}_i - 34.0\ddagger C + 0.12{*}CR$$
$$\qquad\qquad\qquad (19.9) \quad (0.05)$$

N=512 RMSE=66.9 CV=16% R^2=0.77

Weighted

$$V = \sum s_i \hat{\alpha}_1 + \sum s_i R\hat{\beta}_i - 31.16\ddagger + 0.10{*}CR$$
$$\qquad\qquad\qquad (16.6) \quad (0.04)$$

N=512 RMSE=54.4 CV=15% R^2=0.80

MOVERS

Unweighted

$$V = \sum s_i \hat{\alpha}_i + \sum s_i R\hat{\beta}_i + 13.3C + 0.00CR$$
$$\qquad\qquad\qquad (14.6) \quad (0.03)$$

N=1091 RMSE=67.0 CV=15% R^2=0.77

Weighted

$$V = \sum s_i \hat{\alpha}_i + \sum s_i R\hat{\beta}_i + 12.39 - 0.01CR$$
$$\qquad\qquad\qquad (5.6) \quad (0.04)$$

N=1091 RMSE=86.9 CV=21% R^2=0.89

Notes for Tables D.25

R = Actual contract rent

V = Predicted contract rent based on the estimated Housing Voucher hedonic equation

C = A dummy (0,1) variable for the Certificate Program

$V_i = x_i'\hat{\beta}_v$

where:

$$\text{Weight} = \begin{cases} s_v^2(1 - x'(Z'Z)^{-1}x) & \text{for Housing Voucher} \\ s_v^2(1 = x'(Z'Z)^{-1}x) & \text{for Certificate} \end{cases}$$

s_v^2 = The mean squared error for the Housing Voucher hedonic regression

Z = The matrix of housing characteristics in the Housing Voucher hedonic regressions

weight = $R^2 S^2 x'(Z'Z)^{-1}x$

where

(R^2) = R^2 from Housing Voucher hedonic equation

S^2 = Mean squared error from Housing Voucher hedonic equation

Z = The matrix of characteristics in the Housing Voucher hedonic equation

X = The vector of characteristics for the unit advertise units as meeting Section 8 requirements. This immediately suggests that success rates might be determined as much by landlords' willingness to participate in a Housing Voucher or Certificate program as by recipient behavior. Furthermore, if recipients are effectively restricted to the subset of the housing market provided by known Section 8 landlords, landlord price-setting behavior and PHA monopsony power may be quite important in determining rents. The Certificate program sets rents through a combination of published ceilings and PHA rent-reasonableness determinations. Published ceilings may restrict rents but may also serve as price-setting signals. Likewise, PHAs may be more or less effective in negotiating rents. The Housing Voucher program substitutes individual negotiation and search for the published ceilings and PHA negotiation, though PHAs may still advise applicants on reasonable rent levels. But as noted, individuals may or may not be able to exert adequate competitive pressure depending on the availability of alternatives and the ease of moving.

Differences in landlord behavior under the two programs seem unlikely to arise rapidly. PHAs have been more or less active in explaining the Housing Voucher Program to landlords who currently participate in the Certificate program, but it seems unlikely that this would generate rapid changes in behavior, especially since most such landlords would still draw the bulk of their Section 8 tenants from the Certificate program. In any case, however, to the extent that the Housing Voucher Program would ultimately attract a different set of active landlords, the effects of this are unlikely to be registered in the Demonstration.

Section D.3 (Tables D.9 through D.11) presented some evidence that many Housing Voucher landlords were already well acquainted with the Certificate Program. We also found that Housing Voucher rents were remarkably strongly influenced by FMRs. This seems to suggest that the scenario of considerable landlord inertia could be correct. If this is in fact the case, outcomes in the two programs could diverge much more over time.

D.5.2 Other Caveats

The models of this section are firmly rooted in a static world. Thus, for example, they take no account of the potential income dynamics that would affect a household's assistance payment over time (and thus, given transaction costs, its assessment of the program's present value). Recipients may make the "wrong" choices, for example choosing rents that they cannot support. This may come about for a variety of reasons, but could in principle be more severe for low income households, which may lack the resources to accommodate the errors in judgment and in guessing future income and prices that characterize anyone's consumption decisions. This problem, if it arises, would be expected to result in higher moving or dropout rates among Housing Voucher recipients. As indicated in the main text, this was not observed during the first year of participation.

A final obvious simplification in the models of this section is the assumption that we can characterize choices in terms of two overall classes of expenditures. This actually turns out to be less of a problem than it might seem. We can, in fact, assume that the household has a more complicated preference structure over various goods including a variety of housing-related services. In this case, the selection of housing and non-housing expenditures pictured in Figure D.1 essentially reflects a background optimization of expenditures on specific items, given the overall levels of housing and non-housing expenditures. In general, the important issue raised by this sort of aggregation of commodities is that household allocation of expenditures across the aggregate groups may vary if the underlying relative prices of items within an aggregate vary. Thus, estimated relationships may vary across sites if the underlying price vectors for the aggregates are not scalar multiples across sites.

This sensitivity to price structure does, however, affect the expression for the value of program participation. In both the Certificate and Housing Voucher programs, recipient housing must meet program-set standards for quality and rooms. This in effect introduces an implicit set of shadow prices reflecting the extent to which the standards force a household to obtain different housing than it would normally want to (if it were spending R_{max} on gross rent). To the extent that this happens, of course, the utility gain to the household is less.

NOTE TO APPENDIX D
ON REGRESSION OF RENT AND PREDICTED RENT

In Section D.4.2 we compared actual rents in both programs with predicted rents based on the estimated hedonic coefficients in the Housing Voucher program. In particular, we noted that:

1. The estimated regression of actual rents on predicted rents is flatter in the Certificate Program than in the Housing Voucher program.

2. The estimated regression of predicted rents on actual rents is the same in both programs for movers, but not for stayers.

From this we concluded that the actual regression of rent on housing quality is flatter in the Certificate Program and that the actual regression of housing quality on rent may be the same for movers in the two programs.

These conclusions cannot be immediately drawn from the estimated regressions. Since we base predicted rents on the estimated hedonic equation for Housing Voucher rents, the regression of <u>actual rents</u> on <u>predicted rents</u> will tend to be flatter in the Certificate Program even if the actual regression of rent on housing quality is the same in the two programs. We demonstrate below that the expected size of this effect is too small to account for the observed regressions, so that the conclusion that the true regression of rent on housing quality is flatter in the Certificate Program seems reasonable.

In a similar way, even if the true regression of housing quality on rent is the same in the two programs, the regression of <u>predicted rent</u> on <u>actual rent</u> would tend to be different. We show that this difference may be large enough so that, within our error of estimate, we would reject the hypothesis that the regressions of housing quality on rent are the same for movers in the two programs.

Consider first the regression of actual rents on predicted rents. Say that the regression of rent on housing characteristics is the same in both programs so that:

(N.1) $R = X\beta + \varepsilon$

Where

R = the vector of unit rents

X = the matrix of housing characteristics

β = unknown coefficients

ε = a stochastic term, assumed i.i.n. $(0,\sigma^2)$

We use the estimates of β from the Housing Voucher observations to create predicted rents.

(N.2) $\hat{\beta}_v = (X_v'X_v)^{-1}X_v'R_v$

$= \beta + (X_v'X_v)^{-1}X_v'\varepsilon_v$

(N.3) $V_c = X_c\hat{\beta}_v$

$= X_c\beta + X_c(X_v'X_v)^{-1}X_v'\varepsilon_v$

(N.4) $V_v = X_v\hat{\beta}_v$

$= X_v\beta + X_v(X_v'X_v)^{-1}X_v'\varepsilon_v$

Where

$\hat{\beta}_v$ = the estimate of β based on Housing Voucher observations

V_c = the predicted rents for the Certificate Program recipients based on their housing characteristics (X_c) and the estimated Housing Voucher coefficients (β_v)

V_v = the predicted rents for the Housing Voucher Program recipients based on their housing characteristics (X_v) and their estimated coefficients (β_v)

We note that in terms of asymptotic expectations, given X_c and X_v:

(N.5) $$E^A \left(\frac{R_c' R_c}{n_c}\right) = \frac{\beta' X_c' X_c \beta}{n_c} + \sigma^2$$

(N.6) $$E^A \left(\frac{R_v' R_v}{n_v}\right) = \frac{\beta' X_v' X_v \beta}{n_v} + \sigma^2$$

(N.7) $$E^A \left(\frac{V_v' R_v}{n_v}\right) = \frac{\beta' X_v' X_v \beta}{n_v} + \frac{k}{n_v} \sigma^2$$

(N.8) $$E^A \left(\frac{V_v' V_v}{n_v}\right) = \frac{\beta' X_v' X_v \beta}{n_v} + \frac{k}{n_v} \sigma^2$$

(N.9) $$E^A \left(\frac{V_c' R_c}{n_c}\right) = \frac{\beta' X_c' X_c \beta}{n_c}$$

(N.10) $$E^A \left(\frac{V_c' V_c}{n_c}\right) = \frac{\beta' X_c' X_c \beta}{n_c} + \frac{a}{n_c} \sigma^2$$

where "a" in Eq. (N.10) is defined by

(N.11) $$a = tr[(X_c' X_c)(X_v' X_v)^{-1}]$$

and

n_c = the number of observations in the Certificate Program

n_v = the number of observations in the Housing Voucher Program

k = the number of parameters in the Housing Voucher hedonic regressions

Now consider the regression of R on V -- that is:

$$\text{(N.12)} \qquad R = \alpha_0 + \alpha_1 V$$

Armed with the asymptotic expectations of Eq. (N.5) to (N.11) we see that:

$$\text{(N.13)} \qquad \text{Plim} \begin{pmatrix} \hat{\alpha}_0 \\ \hat{\alpha}_1 \end{pmatrix}_{\text{VOUCHER}} = \begin{pmatrix} 1 & \\ \bar{X}_v \beta & \dfrac{\beta' X_v' X_v \beta}{n_v} + \dfrac{k}{n_v}\sigma^2 \end{pmatrix}^{-1} \begin{pmatrix} \bar{X}_v \beta \\ \dfrac{\beta X_v' X_v \beta}{n_v} + \dfrac{k}{n_v}\sigma^2 \end{pmatrix}$$

$$= \begin{pmatrix} 0 \\ 1 \end{pmatrix}$$

$$\text{(N.14)} \qquad \text{Plim} \begin{pmatrix} \hat{\alpha}_0 \\ \hat{\alpha}_1 \end{pmatrix}_{\text{CERT}} = \begin{pmatrix} 1 & \\ \bar{X}_c \beta & \dfrac{\beta' X_c' X_c \beta}{n_c} + \dfrac{a}{n_c}\sigma^2 \end{pmatrix}^{-1} \begin{pmatrix} \bar{X}_c \beta \\ \dfrac{\beta X_c' X_c \beta}{n_c} \end{pmatrix}$$

$$= \begin{pmatrix} 0 \\ 1 \end{pmatrix} - \begin{pmatrix} -\bar{X}_c \beta \\ 1 \end{pmatrix} \left(\frac{(a/n_c)\sigma^2}{\dfrac{\beta' X_c' X_c \beta}{n_c} - (\bar{X}_c \beta)^2 + (\dfrac{a}{n_c})\sigma^2} \right)$$

This is the usual errors-in-variable result: the estimated coefficient on predicted rent in the Certificate Program is biased downward in proportion to the ratio of the error variance of predicted rent to the total variance. This does not happen in the Housing Voucher program because the error in the estimate of predicted rent is correlated with actual rents.[1]

We are concerned with the size of the last term in parentheses in Eq. (N.14). We note first that given the relatively larger dispersion of rents in the Housing Voucher Program, it seems reasonable to assume that:

$$\text{(N.15)} \quad a = \mathrm{tr}[(X_c'X_c)(X_v'X_v)^{-1}]$$

$$< (n_c/n_v)\ \mathrm{tr}[(X_c'X_c)(X_v'X_v)^{-1}]$$

$$= \frac{n_c k}{n_v}$$

thus

$$\text{(N.16)} \quad \text{(Last term of Eq. 14)} < \frac{(k/n_v)\sigma^2}{\dfrac{\beta'X_c'X_c\beta}{n_c} - (\bar{X}_c\beta)^2 + (k/n_v)\sigma^2}$$

$$= \frac{(k/n_v)\sigma^2}{\mathrm{Var}\ (R_c) - ((k - n_v)/n_v)\sigma^2}$$

Table D.N.1 tabulates this number by site using the observed variance of Certificate Program rents to estimate ($\mathrm{Var}R_c$) and the estimated mean squared error from the Housing Voucher hedonic regression to estimate σ^2. The estimated asymptotic bias would account for some, but not all, of the observed rotation of the Certificate regression line.

[1]A better test would be to compare $X_c\hat{\beta}_c$ and $X_c\hat{\beta}_v$.

TABLE D.N.1

ESTIMATE OF ASYMPTOTIC BIAS IN REGRESSION OF CERTIFICATE PROGRAM RENTS IN PREDICTED VALUES

	Movers		Stayers	
	n[a]	Bias	n[a]	Bias
Atlanta	71	-0.22	6	-0.16
Los Angeles	42	-0.27	40	-0.03
Minneapolis	42	-0.09	32	-0.10
Montgomery City	62	-0.14	19	-0.12
New York City	38	-0.03	39	-0.08
Oakland	52	-0.12	26	-0.05
Omaha	46	-0.67	35	-0.17
Pittsburgh	66	-0.44	23	-0.13
San Antonio	74	-0.13	5	-0.09
Seattle	44	-0.02	34	-0.12
Wtd. Avg.	531	-0.22	259	-0.10
Estimated Coefficient from Table E.27 Minus One		-0.36		-0.34
(std. err.)		(0.03)		(0.04)

[a] n = number of Certificate observations

Now consider the regression of predicted rents on actual rents. Our hypothesis is that the regression of $X\beta$ on actual rent is the same in the two programs. Since our estimate of β is based on the Housing Voucher Program, the regression of Certificate rents on V_c is an asymptotically unbiased estimate of the regression of Certificate rents on $X\beta$. The problem arises in the regression of Housing Voucher rents on V_v. Since the Housing Voucher rents were used to form V_v, the estimated regression tends to overstate the relationship between rents and $X\beta$. Thus, for

$$\text{(N.17)} \quad V_v = \alpha_0' + \alpha_1' R$$

we have

$$\text{(N.18)} \quad \text{Plim}\begin{pmatrix} \hat{\alpha}_0 \\ \hat{\alpha}_1 \end{pmatrix}_{\text{VOUCHER}} = \begin{pmatrix} 1 & \bar{R} \\ \bar{R} & \text{Var } R + (\bar{R})^2 \end{pmatrix}^{-1} \begin{pmatrix} \bar{R} \\ \text{Plim } \dfrac{V_v' R_v}{n_v} \end{pmatrix}$$

From Eq (N.7),

$$\text{(N.19)} \quad \text{Plim}\left(\frac{V_v' R_v}{n_v}\right) = \frac{\beta' X_v' X_v \beta}{n_v} + \frac{k}{n_v}\sigma^2$$

$$= \text{Plim}\left(\frac{\beta' X_v' R_v}{n_v}\right) + \frac{k}{n_v}\sigma^2$$

Accordingly,

$$(\text{N.20}) \quad \text{Plim} \begin{pmatrix} \hat{\alpha}_0 \\ \\ \hat{\alpha}_1 \end{pmatrix}_{\text{VOUCHER}} = \begin{pmatrix} \text{Coefficients of} \\ \text{Regression of} \\ X_v\beta \text{ on } \underline{R_v} \end{pmatrix} + \begin{pmatrix} -\bar{R}_v \\ \\ 1 \end{pmatrix} \left(\frac{(R/n_v)\sigma^2}{\text{Var } R_v} \right)$$

Again, we estimate σ^2 from the Housing Voucher MSE and VarR_v from the observed variation in Housing Voucher rents. The results, shown in Table D.N.2, indicate that the asymptotic bias is large enough to conceal a significant difference in the regressions for the two programs.[1]

[1]A better procedure would be to estimate β based on the pooled Housing Voucher and Certificate observations and then test whether the regression of predicted rents on rent is the same in both programs.

TABLE D.N.2

ESTIMATE OF ASYMPTOTIC
BIAS IN REGRESSION OF VALUE ON RENT

	Movers		Stayers	
	n[a]	Bias	n[a]	Bias
Atlanta	66	-0.08	9	-0.09
Los Angeles	47	-0.23	37	-0.25
Minneapolis	46	-0.10	27	-0.12
Montgomery City	54	-0.16	14	-0.13
New York City	39	-0.32	41	-0.19
Oakland	59	-0.09	26	-0.07
Omaha	47	-0.26	33	-0.13
Pittsburgh	57	-0.20	24	-0.14
San Antonio	75	-0.14	9	-0.13
Seattle	50	-0.28	33	-0.16
Wtd. Avg.[b]	540	-0.18	253	-0.15
Est. Differences from Table E.30 (std. err)		0.00 (0.03)		0.12 (0.05)
Wtd. Avg. of differences in each site[b]		-0.15		-0.08

[a] n = number of Housing Voucher observations.

[b] Weighted by the number of Housing Voucher observations.

APPENDIX E

PATTERNS OF OUTCOMES

As discussed in Appendix C, we can use the Demonstration data to develop national estimates of outcomes for the two programs in all large, urban PHAs. These estimates may be developed for all applicants or recipients or for subgroups. While the interpretation of these estimates including their test statistics rests on more or less explicit assumptions concerning the distribution of outcomes and the nature of the process that generates them, their validity and reliability rest on the Demonstration design and implementation. Indeed the point of this sort of experimental design is the relatively modest assumptions required to develop estimates of program differences.

In Appendix D, we went to the opposite extreme. We developed a reasonably detailed theory of the behaviors involved and then attempted to test that theory by asking whether the patterns of outcomes conformed to the theory's predictions. The results were mixed. As predicted, enrollees in the Certificate program who moved chose units with rents close to the FMR. As predicted, Housing Voucher recipient rents were less tightly distributed around FMRs (or Payment Standards). Even so, Housing Voucher recipient rents were still more closely associated with FMRs (or Payment Standards) than would have been expected. Two possible explanations were suggested and some evidence found for each--that there was a strong relationship between rents near the FMR and a unit's likelihood of meeting program occupancy and quality requirements, or that Housing Voucher enrollees often searched for units from among those owned by landlords who were already participating in, and setting rents based on, the Certificate program. We also found some evidence that, as expected, Housing Voucher recipients used the greater flexibility afforded by the program to select units with rents more closely matching their needs (or desires).

On the other hand, we found no evidence of expected effects in success rates. Further, previous analyses of housing obtained clearly showed that the proposed model of enrollee search was inadequate. Two alternatives were suggested--one, that the FMR ceiling simply screens out more expensive units and two, that the PHAs effectively applied rent reasonableness tests to obtain good deals. Some evidence for the importance of rent reasonableness tests was provided by the reduction in Certificate program recipient rents when PHAs held Payment Standard below FMRs and by the association between Certificate program recipient rents and a variable reflecting average pre-program rent levels (adjusted for income).

The focus of Appendix D was on testing a model within the context of the available data. Accordingly, its attention was narrow; we were looking for behaviors that did or did not conform to the model's predictions. The focus of this Appendix is more broadly empirical; here we are looking for gross patterns that will account for much of the variation in outcomes and thus provide a good general description of how the programs work for different groups of enrollees.

We followed the usual procedure in searching for patterns. First we considered the questions we wanted to ask and the sorts of techniques appropriate for our variables (Section E.1). Then we examined patterns in terms of intermediate behaviors that might help to structure our understanding (Section E.2). Then we considered specific demographic variables of interest (Section E.3), but did not analyze patterns across these.

E.1 Approach

The analytical approach involved two decisions--the outcomes we were going to analyze and the questions we would address.

Outcomes to Be Analyzed. We elected to concentrate in this Appendix on the success of enrollees in becoming recipients, rents paid by recipients, and the level of tenant contributions and assistance payments. This meant that we put aside (in this Appendix) direct interest in changes in rents or tenant contribution from pre-program levels or changes in outcomes after recipients had been in the program for a year. Furthermore, it turns out that recipient rents, tenant contributions, and assistance payments can all be analyzed in terms of the difference between recipient rents and FMRs.

To see this, consider how the program rules determine rents, tenant contributions and assistance payments. We have already observed in Appendix D that recipient rents are strongly related to FMRs. Thus it seems reasonable to start by considering rents in terms of their deviations from FMRs. Now consider the tenant contribution. In the Certificate program this is given by

(1) $$TC_c = 0.3Y_n + \varepsilon_c$$

where

TC_c = Tenant contribution in the Certificate program

Y_n = Recipient net monthly income

ε_c = The effect of special cases involving gross income more than three times net income on welfare rents.

In the Housing Voucher program in contrast

(2) $$TC_v = 0.3Y_n + (R_v - PS) + \varepsilon_v$$

$$= 0.3Y_n + (R_v - FMR) + (FMR - PS) + \varepsilon_v$$

where

TC_v = Tenant contribution in the Housing Voucher program

Y_n = Recipient net monthly income

R_v = Housing Voucher recipient rent

PS = The Payment Standard for the family

FMR = The FMR for the family

ε_v = The effect of the special rule that tenant contribution be at least 10 percent of gross income

Accordingly, TC_c and TC_v are determined by recipient income, program schedules, and (for the Housing Voucher program) the difference between recipient rents and FMRs

(3) $$TC_v - TC_c = (R_v - FMR) + (FMR - PS) + \varepsilon_v - \varepsilon_c$$

where

Terms = As defined for Eqs. (1) and (2)

Now consider assistance payments. These are equal to the difference between recipient rents and the tenant contribution. Thus

$$AP_c = R_c - TC_c$$

$$= R_c - 0.3Y_n - \varepsilon_c$$

(4) $$= FMR - 0.3Y_n - \varepsilon_c - (FMR - R_c)$$

$$AP_v = R_v - TC_v$$

(5) $$= PS - 0.3Y_n - \varepsilon_v$$

(6) $$AP_v - AP_i = (FMR - R_c) + \varepsilon_c - \varepsilon_v - (FMR - PS)$$

where

AP_c = Assistance payments in the Certificate program

AP_v = Assistance payments in the Housing Voucher program

R_c = Recipient rent in the Certificate program

PS = The Payment Standard for the family

FMR = The FMR for the family

$\varepsilon_c, \varepsilon_v$ = The effect of special rules

Again, assistance payments are determined by recipient incomes, program schedules, and (for the Certificate program) the difference between recipient rents and the FMR schedule.

Accordingly, in analyzing behavior under the two programs we were able to focus on success rates and the difference between recipient rents and FMRs.

The difference between recipient rents and FMRs is a continuous variable, readily analyzed in standard ways. The only obvious problem with the variable is the sharply skewed distribution in the Certificate program discussed in the main text--a problem that we decided to ignore. Success rates are more difficult, though a number of techniques for analyzing dichotomous variables have been developed over the past 20 years. The main problem is that many of the techniques are analytically cumbersome and sometimes relatively opaque, since they involve approximate solutions to maximum likelihood conditions. This makes them relatively inconvenient (compared to OLS regression, for example) for testing and assessing a number of alternative models.

As it turned out, the independent variables we wanted to analyze were also categorical. Thus we could potentially conduct the analysis in terms of a relatively continuous variable--observed success rates for various groups of individuals. However, the distribution of observed success rates may be quite "lumpy" if the number of persons in the group is small and the variance depends on the true success rate for the group. This may be overcome by the arc sine transformation.

$$(7) \qquad 2 \arcsin \sqrt{p} \overset{A}{\sim} N(2 \arcsin \sqrt{\pi},\ 1/m)$$

where

p = Observed proportions for a group

π = The true probability for the group

m = The number of observations in the group

The key fact is that the asymptotic variance of arcsin $\sqrt{p}$ does not depend on π. These are asymptotic results, but the transformation turns out to be remarkably effective for small samples. Freeman and Tukey (1950) suggest using an arc since transformation with continuity correction of

$$(8) \qquad \mathrm{arc}(p) = \left[\arcsin \left(p\frac{m}{m+1}\right)^{\frac{1}{2}} + \arcsin \left(p\left(\frac{m}{m+1}\right) + \frac{1}{m+1}\right)^{\frac{1}{2}}\right]$$

Cox (p. 111), citing Freeman and Tukey, asserts that this transform has a variance within plus or minus 6 percent of $(m+\frac{1}{2})^{-1}$ if $m\pi$ is greater than or equal to one. If we assume success rates of at least one-third, this requires only three observations per cell.

The variable arc(p) can be analyzed in the usual weighted regression context (to take account of the fact that the variance of arc(p) varies with m). There is one special feature: since we know the variance, the appropriate tests involve statistics with Chi-Square distributions instead of the usual t or F distributions. Furthermore, each observation (group of three or more individuals) must be homogeneous with respect to the independent variables.

Specifically, if we have a collection of groups characterized by some vector x, we can form the weighted regression

$$(9)\qquad (1/m_i)^{\frac{1}{2}}\mathrm{arc}(p_i) = \left((1/m_i)^{\frac{1}{2}}\delta_{ij}\right)x_i'\beta + e_i$$

where

m_i = The number of individuals in the i^{th} group

p_i = The observed success rate in the i^{th} group

x_i = The value of the vector of characteristics for the i^{th} group (which are required to be the same for each member of the group)

e_i = A residual

We can, of course, achieve a perfect fit by including a dummy for each group. We can accordingly test simpler structures by

$$(10)\qquad \sum \hat{e}_i^2 \sim \chi^2(n-k)$$

where

$\hat{e}_i$ = The observed (weighted) residual for the i^{th} group

n = The number of groups

k = The number of independent variables

Similarly, we can compare two models by

$$(11)\qquad \varepsilon_1'\varepsilon_1 - \varepsilon_0'\varepsilon_0 \sim \chi^2(k_0 - k_1)$$

where

ε_0 = The vector of (weighted) residuals from the unrestricted model

ε_1 = The vector of (weighted) residuals from the restricted model

k_0 = The number of parameters in the restricted model

k_1 = The number of parameters in the unrestricted model

Finally,

(12) $\quad \mathrm{Var}\ (\hat{\beta}_j) = (X'X)^{-1}_{jj}$

The main drawbacks of this approach are two. First, as already noted, each group must consist of individuals with the same values of the independent variables. This limits the number of variables that we can consider. For example, if we start with two programs in 19 sites and add three variables with four categories each we obtain 2,432 cells. If observations are independently distributed across the various categories we are likely to lose a large number when we eliminate cells with fewer than three observations.

Second, when we are investigating the structure of the regression, in terms of interactions, non-linear terms, and so forth, we are investigating the structure of arcsin $\sqrt{\pi}$. We lack the flexibility to, for example, investigate multiplicative structures through analysis of logs that is available with other continuous variables. However, this is a problem with all methods of analyzing discrete choices and we saw no reason to assume that arcsin $\sqrt{\pi}$ was any worse a specification than, for example, logit (π) or probit (π).

Questions to Be Addressed. We are trying to characterize outcomes in terms of relevant characteristics. These include both descriptors of pre-program housing situations and the usual demographic descriptors. For the purposes of this appendix, we can think of descriptors as categorical variables that place enrollees or recipients in different groups (elderly/non-elderly, high pre-program rent/low pre-program rent, and so forth). Given any such descriptor we can develop national estimates of outcomes for each group. However, in comparing the outcomes for different groups, we are aware that they are conditioned by all the other factors associated with the groups under consideration. We wish to sort out these different factors. Specifically we ask

1. Whether differences between groups simply reflect differences in the PHAs in which the groups are present
2. Whether differences reflect differences in intermediate behaviors
3. Whether differences seem to reflect the effects of other demographic characteristics

The first question is simply answered by estimating effects within each PHA. We can readily test whether effects in each PHA are zero through the usual

F-statistics (or for the arcsin regressions, χ^2-statistics). The problem comes when we try to determine the size of the estimated effect after controlling for PHA. Some groups are not present in some PHAs or have very few observations. If we try to calculate a weighted average of within-PHA effects using, for example, the sampling weights used to develop national estimates, the error of estimate may become very large or even be inestimable. A reasonable response is to characterize the overall effect, controlling for PHA, as

(13) $$\hat{\mu} = \sum w_i \hat{\mu}_i$$

(14) $$w_i = \text{Var}(\hat{\mu}_i)/\Sigma\,\text{Var}(\mu_i)$$

where

$\hat{\mu}$ = The estimated overall effect

w_i = Weights

$\hat{\mu}_i$ = The estimated effect in the i^{th} PHA

Var $(\hat{\mu}_i)$ = The variance of estimate of $\hat{\mu}_i$

In effect this combines the within-PHA estimates to compute the weighted average with the smallest error of estimate. It is computationally identical to the estimate provided by a regression including PHA dummies--that is, in the regression

(15) $$y = \sum s_i \delta_i + \beta X + \varepsilon$$

where

y = The outcome

s_i = A dummy for the i^{th} PHA

X = The characteristic under consideration

Then computationally

(16) $$\hat{\beta} = \hat{\mu}$$

Accordingly, we refer to them as OLS estimates.

We know that the OLS estimate may be quite misleading if there is in fact a substantial interaction between the PHAs and the demographic effect. (See, e.g., Light (1980) for a rather startling example.) However, there seems to be no other way to characterize the overall effect on a consistent basis. The best we can do is note whether pooling sites up to shift terms is rejected.

The second question involves trying to characterize the nature of demographic effects in terms of intermediate behaviors. The obvious candidates are willingness to move, which is necessary for a substantial change in housing, and measures of enrollee tastes and circumstances based on pre-program housing characteristics. These are discussed further in the next section.

In terms of other demographic factors, the usual question involves the extent to which we can sort out effects among correlated descriptors. This is discussed in Section E.3.

E.2 Intermediate Behaviors

One of our interests in examining differences in outcomes between demographic groups is to determine whether they seem to reflect the effect of preexisting differences among the groups or seem to involve some direct interaction between the program and the demographic characteristics. Accordingly, our next step was to extend the discussion of Appendix D to identify pre-program housing conditions or other intermediate behaviors that materially condition outcomes. We discuss these separately for success rates and analysis of recipient rents.

E.2.1 Success Rates

Enrollees in either the Housing Voucher or Certificate program may become recipients in one of two ways. First, if their pre-enrollment unit meets program requirements or can be made to meet requirements, they can qualify in place. Second, if they cannot quality in place or wish to move, they can qualify by finding a new unit that meets program requirements. It is evident that enrollees who can qualify in place may have a considerable advantage. Even if they want to move, if they do not find an acceptable unit within the allowed time, they can still become recipients in their current unit and continue looking for a better one.

Unfortunately, we often do not know whether an enrollee could have qualified in place. Units are only inspected at the enrollees request, and in fact most enrollees did not request an inspection. For these, we do not know whether they thought that their unit would not meet requirements or simply wanted to move. If they failed to become recipients, we can reasonably surmise that they did not think their pre-enrollment unit would qualify, but for these recipients who moved, we have no way even to guess.

Furthermore, we might expect that the differences between the two programs would vary depending on whether enrollees were able to meet physical and occupancy requirements in place. Certificate enrollees whose pre-program units meet physical and occupancy requirements requirements but have rents above the FMR cannot qualify in place unless the PHA grants an exception to the FMR requirement. On the other hand, for enrollees trying to quality by moving, the absence of rent restrictions in the Housing Voucher program opens up a larger set of units for consideration and changes enrollee incentives.

We did, in fact, ask applicant before they were enrolled whether they wanted to move from or stay in their pre-enrollment unit. This turns out to be a remarkably good predictor. Table E.1 shows the relationship between the percent of enrollees who tried to qualify their pre-enrollment unit by either asking for an inspection or submitting a request for lease approval and enrollees' intention to move. We have separated figures for subunit and non-subunit enrollees, since enrollees who were sharing quarters with another family almost always had to move in order to qualify (and indeed almost always said that they intended to move). As shown in Table E.1, there is a strong association between the enrollee's intention and whether or not they attempted to qualify in their pre-enrollment unit. Among non-subunit enrollees, only 11 percent of those intending to move attempted to qualify their pre-enrollment

TABLE E.1

PERCENT OF ENROLLEES ATTEMPTING TO QUALIFY IN THEIR PRE-ENROLLMENT UNIT[a]
(Combined Programs, Unweighted)

	Percent Attempting to Qualify In-Place	
	Not Subunits (n)	Subunits (n)
Intend to stay	69.6% (3419	21.6% (102)
Intend to move	10.8% (5438)	2.6% (2972)
Not sure	41.6% (351)	7.7% (26)

[a]Enrollees are classified as attempting to qualify in place if they are recorded as either requesting an inspection of or submitting a request for lease approval for, their pre-enrollment unit.

unit. In contrast, 70 percent of those intending to stay attempted to qualify in their pre-enrollment unit.[1]

Intentions were also strongly associated with actual outcomes, as shown in Table E.2. Among non-subunits, 66 percent of those intending to stay qualified in place, as compared with 9 percent of those intending to move. Further, among those intending to move who did not qualify by moving, only 16 percent qualified in place (as compared with 75 percent of enrollees who intended to stay and did not qualify by moving)--suggesting that these enrollees were probably usually unable to qualify in place. On the other hand, among those intending to stay who did not qualify in place, 35 percent qualified by moving. This is less than the 48 percent rate for enrollees who intended to move, but still substantial--suggesting that some enrollees who did not qualify in place may have been uninterested in qualifying by moving.

Finally, as shown in Table E.3, intentions were strongly associated with conditions that would have been likely to require moving in order to qualify--being a subunit, reporting potentially important deficiencies in a pre-program unit, or being likely to have fewer rooms than needed to meet occupancy requirements. This association may indicate that applicants had a fairly good idea of program requirements before they enrolled. On the other hand, they also represent situations that would seem likely to make enrollees more interested in moving regardless of program requirements.

Interestingly, there is no evidence that enrollee intentions were influenced by the rent limitations of the Certificate program. There is, of course, no material difference between the two programs in enrollees' intentions, since these were expressed before enrollees knew to which program they would be assigned. However, if enrollees knew about program rules before they

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[1]Comparison of Table E.1 and the success rates shown in Table E.2, below, indicates that an extraordinarily high percentage of those attempting to qualify in place succeeded in doing so. Among non-subunits, the success rate for those attempting to qualify in place (implied by the ratio of the percentages in Table E.2 to those in Table E.1) is 94 percent for those intending to stay and 84 percent for those intending to move. This may indicate substantial knowledge of program requirements before enrollment and/or effective training in self-inspection by PHAs. It also raises the possibility that inspections of pre-program units may often not have been recorded by PHAs except when the family in fact qualified in place.

TABLE E.2

OUTCOMES BY INTENT TO MOVE
(Combined Programs, Unweighted)

	Percent of Enrollees Who: Fail	Qualify In Place	Qualify By Moving	Of Those Not Moving, Percent That Qualify In Place	Of Those Not Qualifying In Place, Percent That Qualify By Moving	Sample Size
Non-Subunits						
Intend to stay	22.4%	65.8%	11.8%	74.6%	34.5%	3419
Intend to move	47.6	9.1	43.4	16.0	47.7	5438
Not sure	34.5	41.2	24.3	54.5	41.4	325
All	37.7	31.3	31.0	45.3	45.1	9182
Subunits						
Intend to stay	35.3	20.6	44.1	36.8	54.9	102
Intend to move	42.9	1.9	55.3	4.2	56.3	2972
Not sure	50.0	3.9	46.2	7.1	48.0	26
All	42.7	2.6	54.8	5.6	56.2	3101

TABLE E.3

INTENTION TO MOVE AND PRE-PROGRAM UNIT CHARACTERISTICS
(Combined Programs, Unweighted)

	Percent of Enrollees Who:			
	Intend To Stay	Intend To Move	Not Sure	Sample Size
Shared Units				
Non-subunits	37.3%	59.2%	3.5%	9261
Subunits	3.4	95.8	0.8	3129
Index of Enrollee Rating of Pre-Program Unit Adequacy (Non-Subunits)				
Not adequate	55.1	40.7	4.1	4403
Mostly inadequate	22.0	75.3	2.8	691
Inadequate	14.5	83.6	1.9	683
Pre-Program Crowding (Non-Subunits)				
Number of rooms in pre-program unit	3.3	95.9	0.8	615
Less than number of bedrooms required	17.2	79.9	3.0	1932
Equal to number of bedrooms required	41.7	54.6	3.7	3852
One more than number of bedrooms required	52.2	43.5	4.3	2861
At least two more than number of bedrooms required	37.3	59.2	3.5	9260

applied, they would have known about the Certificate program, since that was the established program prior to the Demonstration. Thus if enrollees' intentions were strongly conditioned by their expectation about whether they would be able to qualify in place under program rent limits, we would expect that enrollees with pre-program rents above the FMR would be less likely to say that they intended to stay. In fact, as shown in Table E.4, the percentage of enrollees intending to stay rises steadily with the ratio of estimated pre-enrollment gross rent to FMRs and is highest among those with rents above the FMRs.

We analyzed success rates separately for those intending to stay and those intending to move. For each group we considered the influence of the enrollee rating of their pre-program unit adequacy, the relationship between the number of rooms in the pre-program unit and the number of bedrooms required by the occupancy standard, and the ratio of pre-program gross rent to FMRs. Specifically, our starting equation was

$$(17) \qquad \text{arc } p = \alpha_j^k + \sum_{i=2}^{5} \beta_{ji}^k R_i + \sum_{i=2}^{3} \gamma_{ji}^k Z_i + \sum_{2}^{3} \theta_{ji}^k N_i, \text{ weighted}$$

where

arc p = As defined by Eq. (9)

R_i = A set of dummies of pre-program gross rent categories corresponding to Table E.4 (with greater than FMR as the omitted category

Z_2 = A dummy for moderately inadequate pre-program units

Z_3 = A dummy for severely inadequate pre-program units

Z_2 = A dummy indicating that the number of pre-program rooms equals the required number of bedrooms plus one

Z_3 = A dummy indicating that the number of pre-program rooms is at least two more than the required number of bedrooms

TABLE E.4

INTENTION TO MOVE AND
PRE-PROGRAM GROSS RENT
(Combined Programs, Unweighted)[a]

Estimated Pre-Program Gross Rent	Percent of Enrollees Who: Intend To Stay	Intend To Move	Not Sure	Sample Size
Greater than FMR	73.9%	22.7%	3.4%	1165
Between 80 and 100 percent of FMR	59.0	36.1	4.9	2107
Between 60 and 80 percent of FMR	33.1	63.1	3.8	2735
Between 40 and 60 percent of FMR	16.6	80.2	3.2	1833
Less than or equal to 40 percent of FMR	6.2	92.3	1.5	1196
All	37.5	58.9	3.8	9036

[a]Excluding subunits

$\alpha_j^k, \beta_{ji}^k, \gamma_{ji}^k, \theta_{ji}^k$ = coefficients allowed to vary across program and PHA

weighted = The regression is weighted by the number of observations in each cell

As discussed in Section E.2, our analytical approach required that we form groups based on the cross of all the dummy variables (including omitted categories) and eliminate cells with fewer than three members. This resulted in the loss of about 14 percent of the sample, as shown in Table E.5. Furthermore, due to the strong associations between adequacy and crowding and intention to stay, we had relatively few observations of inadequate, overcrowded units or low-rent units in the sample of those intending to stay and relatively few very high-rent units in the sample of those intending to move.

We then developed test statistics for

1. The omitted interactions among rent, adequacy, and occupancy dummies
2. Pooling sites up to a shift term for each site
3. Pooling programs up to a shift term for each program
4. Each set of dummies

Consider first the results for those intending to stay shown in Table E.6. The omitted interactions are not significant; we can pool sites and programs up to shift terms; we can drop rent, adequacy, and occupancy dummies in the Housing Voucher program, but only the adequacy dummies in the Certificate program. We explored the implications of this specification in two ways. First, we estimated the specification implied by Table E.6 in which occupancy and rent dummies only enter for the Certificate program. This involved an initial specification of the form

$$(18) \qquad \mathrm{Arc}(p) = E\ \gamma k^{S_j} + \sum \beta_j v S_j + \sum (1-v) R_i \gamma_i + \sum (1-v) N_i \theta_i + \varepsilon$$

where

arc(p) = Defined by Eq. (9)

S_j = A dummy for the j^{th} PHA

v = A dummy for the Housing Voucher program

TABLE E.5

SAMPLE SIZES FOR INITIAL ARC SINE REGRESSIONS

	Intend To Stay	Intend To Move	Total
Total number of enrollees without missing values	3387	5326	8713
Total number in cells with three or more members	2969	4518	7487
Percent sample reduction	12%	15%	14%
Number of cases in sample with three or more cells that have:[a]			
Z1=1	2805	2594	5394
Z2=1	81	641	722
Z3=1	83	1283	1366
N1=1	220	1851	2071
N2=1	1434	1780	3214
N3=1	1315	887	2202
R1=1	801	171	972
R2=1	1151	607	1758
R3=1	803	1546	2349
R4=1	205	1288	1493
R5=1	9	906	915

[a]Dummy sets may not add to the same total due to missing values.

TABLE E.6

INITIAL TESTS FOR THOSE INTENDING TO STAY

Test	Chi-Square: Housing Voucher Program	Chi-Square: Certificate Program	Chi-Square: Combined Programs
1. Omitted interactions among rent, adequacy, and occupancy dummies	$\chi^2(42)$ =24.97	$\chi^2(49)$ =32.17	$\chi^2(91)$ =64.14
2. Pooling sites up to shift terms for each site	$\chi^2(72)$ =60.64	$\chi^2(69)$ =80.05	$\chi^2(141)$ =140.70
3. Pool programs up to a shift term	NA	NA	$\chi^2(67)$ =62.94
4. Drop rent dummies	$\chi^2(49)$ =42.77	$\chi^2(44)$ =76.56**	$\chi^2(93)$ =119.30**
5. Drop occupancy dummies	$\chi^2(23)$ =23.28	$\chi^2(23)$ =37.44*	$\chi^2(46)$ =60.72‡
6. Drop adequacy dummies	$\chi^2(7)$ =7.62	$\chi^2(7)$ =8.51	$\chi^2(14)$ =16.12
7. Drop all dummies	$\chi^2(80)$ =77.28	$\chi^2(77)$ =122.7**	$\chi^2(157)$ =200.00*

** = Significant at 0.01 level

* = Significant at 0.05 level

‡ = Significant at 0.10 level

R_i = A dummy for the i^{th} rent category

N_i = A dummy for the i^{th} occupancy category

We then tested this against a specification without site interactions for the Housing Voucher program

$$(19) \qquad \sum \alpha_j S_j + \beta v + \sum (1-v) R_i \gamma_i + \sum (1-v) N_i \sigma_i + \varepsilon$$

The test statistic for the two equations was

$$\chi^2(18) = 20.63$$

Accordingly we adapted the specification of Eq. (19), for which estimates are presented in Appendix F. The key results are summarized in Table E.7.

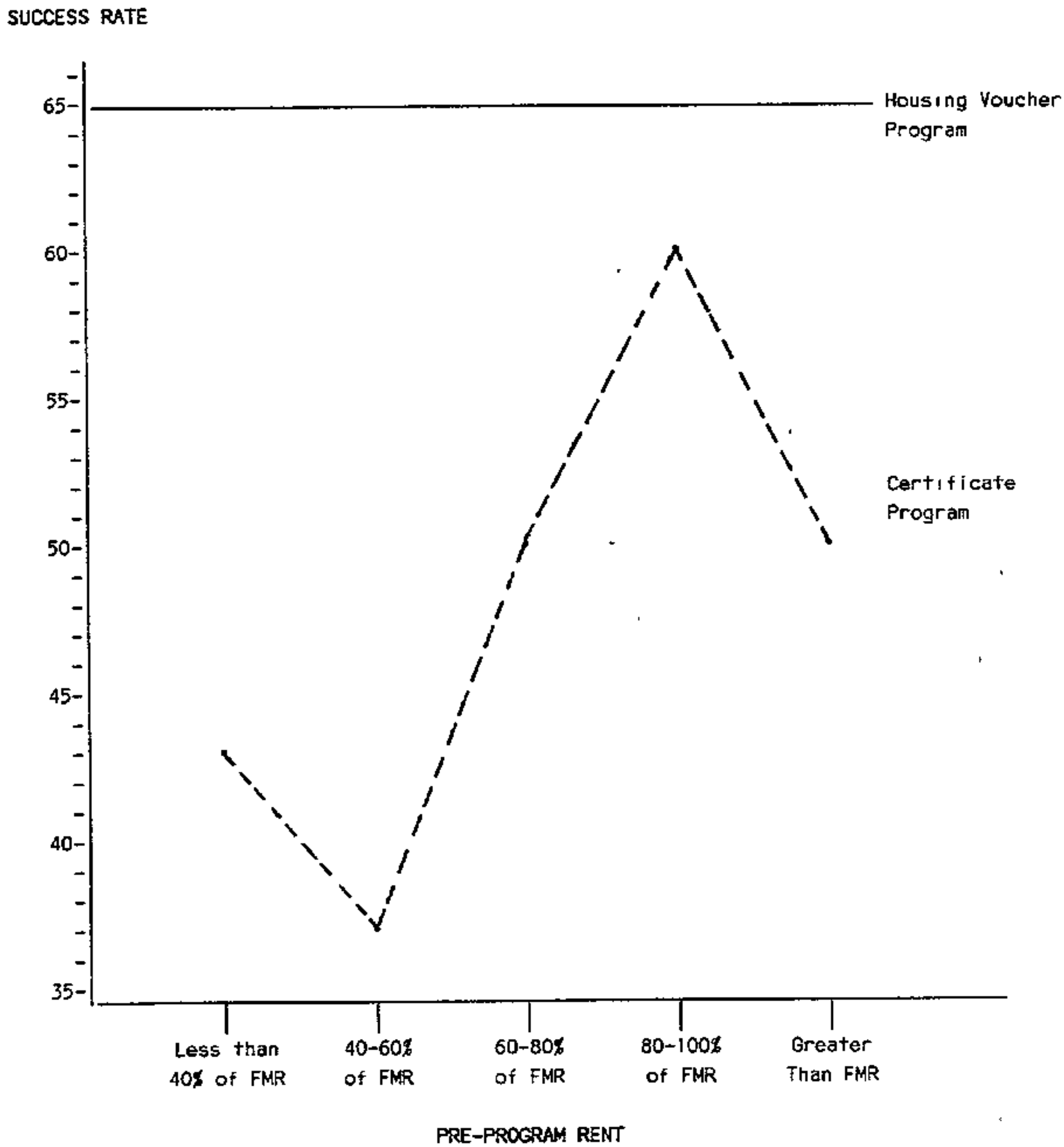
Two results seem odd. First, while having one more room than the required number of bedrooms helps to increase a Certificate enrollee's chances of qualifying, having even more rooms is as bad as having too few. We surmise that this strange pattern reflects some tendency to buy space at the cost of other deficiencies not captured by the adequacy variable. This is mildly supported by the fact that the occupancy variables are not significant without the rent variables.

The second oddity is the pattern of program differences by rent level shown in Figure E.1. Under the specification of Table E.7, the Housing Voucher success rate (for those intending to stay in place) is constant in each PHA. The Certificate enrollees with rents only somewhat below the FMR have almost the same success rate. As expected, Certificate enrollees intending to stay in their pre-enrollment units who have rents above the FMR have lower success rates. What is odd is the finding that the program differential also increases at lower rent levels. It is, of course, quite reasonable that recipients in lower-rent units would be less likely to qualify in place (the main avenue of success for those intending to stay in their pre-program unit). What seems odd is that the Housing Voucher program should undo this.

Accordingly, we tested an alternate specification in which rent and occupancy effects are introduced for both programs, and Housing Voucher program effects are specified as differences for each rent level, viz.,

FIGURE E.1

IMPLIED DIFFERENCES IN SUCCESS RATES FOR THOSE INTENDING TO STAY EVALUATED AT THE MEAN SUCCESS RATE FOR THE HOUSING VOUCHER PROGRAM[a]



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[a]Success rate computed as:

$$P = \sin^2 [\arcsin \sqrt{PV} + \frac{\text{coefficient}]}{2}$$

where

PV = Mean Housing Voucher Program success rate (64.6%)

Coefficient = Coefficient from Table E.7

TABLE E.7

PARTIAL RESULTS OF ARC SINE REGRESSION FOR THOSE INTENDING TO STAY

	Coefficient	Standard Error	t-Statistic
Intercept and dummies for each PHA		(see Appendix C)	
Certificate Program pre-program rent			
80 to 100% of FMR	0.198	0.064	3.07**
60 to 80% of FMR	0.004	0.072	0.05
40 to 60% of FMR	-0.262	0.110	2.38*
Less than or equal to 40% of FMR	-0.143	0.405	0.35
Certificate Program			
Rooms equal required bedrooms plus 1	0.235	0.099	2.37*
Rooms greater than required bedrooms plus 1	0.063	0.101	0.062
Housing Voucher Program	0.298	0.108	2.76**
Implied difference between Housing Voucher Program and Certificate Program by pre-program rent category			
Greater than FMR	0.298	0.108	2.76**
80 to 100% of FMR	0.100	0.103	0.97
60 to 80% of FMR	0.294	0.100	2.95**
40 to 60% of FMR	0.560	0.128	4.36**
Less than 40% of FMR	0.441	0.413	1.07
Implied difference between Housing Voucher and Certificate Programs by Occupancy Category			
Rooms less than or equal required bedrooms	0.298	0.108	2.76**
Rooms equal required bedrooms plus 1	0.064	0.064	1.00
Rooms greater than required bedrooms plus 1	0.236	0.061	3.84**
Root mean squared error	0.98		
R^2	0.49		

** = Significant at 0.01 level   * = Significant at 0.05 level   ‡Significant at 0.10 level

(20) $\quad arc(p) = \sum \alpha_j s_j + \sum R_i \gamma_i + \sum N_i \theta_i + \sum vR_i \delta_i + \varepsilon$

where

arc(p)	=	Defined by Eq. (9)
S_j	=	A dummy for the j^{th} PHA
v	=	A dummy for the Housing Voucher program
R_i	=	A dummy for the i^{th} rent category
N_i	=	A dummy for the i^{th} occupancy category

The key results are shown in Table E.8. The pattern is maintained: among enrollees intending to stay in their pre-program unit, Housing Voucher success rates are higher than those in the Certificate program both for those with pre-program rents above the FMR and for those with pre-program rents substantially below the FMR.

In Table E.9 we examine the rent terms in arcsin regressions for attempting to qualify in place (asking for an inspection or submitting a request for lease approval), for actually qualifying in place, and for qualifying by moving--all for enrollees who intended to stay in their pre-enrollment unit. As with the overall success rate equation, both attempting to and actually qualifying in place show a substantial increase in probability for the Certificate Program for rents just below FMR, then declining for lower rents. Similarly, both show a significantly higher probility for Housing Voucher households with rents above FMRs. The pattern of similar Housing Voucher effects at lower rents is also maintained for actually qualifying in place, but the coefficients are not significant.

To investigate this further, we examined the increases in recipient gross rent by pre-program rent levels, with special attention to the proportion of Housing Voucher recipients in each category who ended up with pre-program rents greater than FMRs. The results, shown in Table E.10, support the estimated pattern of Housing Voucher effects.

As expected, among recipients who originally intended to remain in place, 79 percent ended up with rents above the FMR in the Housing Voucher Program as compared with 46 percent in the Certificate Program. There is, as expected, a direct association between the higher Housing Voucher success rate

TABLE E.8

ALTERNATIVE SPECIFICATION OF PROGRAM DIFFERENCES IN SUCCESS RATES FOR THOSE THAT INTEND TO STAY

	Coefficient	Standard Error	t-Statistic
Intercept and dummies for each PHA		See Appendix G	
Rooms equal to required bedrooms plus 1	0.244	0.072	3.37**
Rooms greater than required bedrooms plus 1	0.134	0.074	1.80‡
Pre-program rent			
80 to 100% of FMR	0.202	0.064	3.17**
60 to 80% of FMR	0.011	0.071	0.16
40 to 60% of FMR	-0.251	0.109	-2.31*
Less than or equal to 40% of FMR	-0.127	0.402	-0.32
Differences for Housing Voucher Program by pre-program unit			
Greater than FMR	0.167	0.069	2.43*
80 to 100% of FMR	0.011	0.057	0.18
60 to 80% of FMR	0.102	0.069	1.49
40 to 60% of FMR	0.275	0.136	2.02*
Less than or equal to 40% of FMR	0.359	0.689	0.52
Root mean squared error	0.97		
R^2	0.51		

** = Significant at 0.01 level

* = Significant at 0.05 level

‡ = Significant at 0.10 level

TABLE E.9

RENT EFFECTS IN ARCSIN REGRESSIONS FOR TRYING TO QUALIFY IN PLACE, ACTUALLY QUALIFYING IN PLACE, AND QUALIFYING BY MOVING, FOR THOSE INTENDING TO STAY

	Attempt to Qualify In Place			Actually Qualify In Place			Qualify by Moving		
	Coefficient	Standard Error	t-Statistic	Coefficient	Standard Error	t-Statistic	Coefficient	Standard Error	t-Statistic
Intercept and dummies for each PHA		Not Shown			Not Shown			Not Shown	
Occupancy dummies		Not Shown			Not Shown			Not Shown	
Pre-program rent									
80 to 100% of FMR	0.221	0.066	3.36**	0.197	0.065	3.02**	-0.057	0.055	1.04
69 to 80% of FMR	0.087	0.073	1.19	0.046	0.072	0.63	-0.062	0.061	1.01
40 to 60% of FMR	0.048	0.112	0.43	-0.081	0.112	0.72	-0.152	0.094	1.62
Less than or equal to 40% of FMR	-0.433	0.415	1.04	-0.430	0.412	1.05	0.385	0.347	1.11
Difference for Housing Voucher Program by pre-program rent level									
Greater than FMR	0.181	0.071	2.55*	0.184	0.071	2.61**	-0.031	0.059	0.52
80 to 100% of FMR	0.039	0.059	0.65	0.025	0.059	0.43	-0.002	0.049	0.03
60 to 80% of FMR	0.082	0.071	1.15	0.112	0.071	1.59	-0.045	0.060	0.76
40 to 60% of FMR	0.045	0.141	0.32	0.172	0.140	1.23	0.095	0.117	0.81
Less than or equal to 40% of FMR	1.073	0.713	1.51	1.110	0.707	1.57	-0.778	0.595	1.31
Dependent mean	2.03			1.95			0.65		
Root mean	1.00			0.99			0.84		
R^2	0.46			0.41			0.53		

** = Significant at 0.01 level

* = Significant at 0.05 level

‡ = Significant at 0.10 level

TABLE E.10

RENTS OF RECIPIENTS WHO INTENDED TO REMAIN IN THEIR PRE-PROGRAM UNIT, BY LEVEL OF PRE-PROGRAM RENT
(All sites, excluding houston, unweighted)

	Sample Size		Percent of Recipients with Gross Rents Greater Than the FMR				Change In Rent From Pre-Program Level			
Pre-Program Gross Rent	Housing Voucher Program	Certificate Program	Housing Voucher Program	Certificate Program	Difference	t-Statistic for Difference	Housing Voucher Program	Certificate Program	Difference	t-Statistic for Difference
Greater than FMR										
Mean	318	252	79.2%	45.6%	33.6 pts	8.32**	$-5.80	$-22.44	$16.64	3.91**
(Standard deviation)			(2.3)	(3.1)	(4.0)		(3.35)	(2.62)	(4.25)	
80 to 100% of FMR										
Mean	439	439	21.2	9.1	12.1	4.10**	21.20	15.50	5.70	2.51**
(Standard deviation)			(2.0)	(1.4)	(3.0)		(1.71)	(1.50)	(2.27)	
60 to 80% of FMR										
Mean	304	277	11.8	5.1	6.7	2.88**	64.33	54.08	10.25	1.86‡
(Standard deviation)			(1.9)	(1.3)	(2.3)		(4.13)	(3.05)	(5.51)	
40 to 60% of FMR										
Mean	93	80	21.5	6.2	15.3	2.86**	144.98	131.86	13.12	0.89
(Standard deviation)			(4.3)	(2.7)	(5.4)		(10.24)	(10.51)	(14.67)	
Less than or equal to 40% of FMR										
Mean	14	16	28.6	12.5	1.61	1.10	288.40	261.57	26.83	0.46
(Standard deviation)			(12.5)	(8.5)	(14.6)		(49.47)	(30.89)	(58.32)	

** = Significant at 0.01 level

* = Significant at 0.05 level

‡ = Significant at 0.10 level

for this group and the relaxation of the rent limits. As would be expected, the difference between the programs in both the percentages of recipients with rents above FMR and the change in rent is smaller for recipients with pre-program rents in the 60 to 100 percent of FMR categories. However, the differences then increase for even lower pre-program rents. It is clear that at rents well below FMRs, the Housing Voucher Program allowed some additional enrollees to qualify in place by permitting modestly larger rent increases, which brought these units to levels above the FMR.

Now consider the results for enrollees who intended to move from their pre-enrollment unit. Initial tests, comparable to those of Table E.6 for those intending to stay in their pre-enrollment unit are presented in Table E.11. Again, the hypothesis that omitted interactions among rent, occupancy, and quality variables are zero is not rejected. Pooling sites (up to shift terms) is rejected for the Certificate program, but not the Housing Voucher program. Pooling programs is not rejected. Among the rent, quality, and occupancy dummies, only the rent dummies need to be retained.

Table E.11 suggests that the appropriate specification involves rent dummies and a Housing Voucher dummy variable for each site. This actually poses a problem because the rent categories are not present in all sites. Indeed in one place there are so few movers that a Housing Voucher dummy cannot reasonably be estimated. We can report the mean value and standard error of the Housing Voucher dummy in this specification across 18 sites

$$\hat{\beta} = 0.03452 \tag{21}$$

$$\text{S.E.}(\hat{\beta}) = 0.04666 \qquad \text{(within PHA)} \tag{22}$$

However, this is not very satisfactory. Accordingly, recognizing that it is a misspecification, we also estimated

$$\text{arc}(p) = \sum \alpha_j S_j + \sum \gamma_i R_i + \beta v + \varepsilon \tag{23}$$

where

$\text{arc}(p)$ = Defined by Eq. (9)

S_j = A dummy for the j^{th} PHA

TABLE E.11

INITIAL TESTS FOR THOSE INTENDING TO MOVE

Test	Chi-Square		
	Housing Voucher Program	Certificate Program	Combined Programs
1. Omitted interactions among rent, adequacy, and occupancy dummies	$\chi^2(124)$ =117.40	$\chi^2(112)$ =111.80	$\chi^2(236)$ =229.10
2. Pooling sites up to shift terms for each site	$\chi^2(113)$ =117.50	$\chi^2(105)$ =143.90**	$\chi^2(218)$ =261.50*
3. Pool programs up to a shift term	NA	NA	$\chi^2(106)$ =94.73**
4. Drop rent dummies	$\chi^2(60)$ =132.10**	$\chi^2(53)$ =147.00**	$\chi^2(113)$ =279.10**
5. Drop occupancy dummies	$\chi^2(33)$ =38.77	$\chi^2(35)$ =25.93	$\chi^2(68)$ =64.69
6. Drop adequacy dummies	$\chi^2(28)$ =21.63	$\chi^2(25)$ =38.58	$\chi^2(53)$ =60.21
7. Drop both occupancy and	$\chi^2(61)$ =65.17	$\chi^2(60)$ =65.15	$\chi^2(121)$ =130.30

** = Significant at 0.01 level

* = Significant at 0.05 level

‡ = Significant at 0.10 level

v = A dummy for the Housing Voucher program

R_i = A dummy for the i^{th} rent category

N_i = A dummy for the i^{th} occupancy category

The estimates are presented in Appendix F.[1] Key parameters are shown in Table E.12. The estimated Housing Voucher effect is small and not statistically significant.[2] For both programs, enrollees in less expensive (and presumably lower quality) pre-program units were less likely to qualify even though they intended to move.

E.2.2 Recipient Rents

Appendix D included an investigation of recipient rents for recipients who moved from their pre-program unit. In general we found that

1. Among recipients who moved, rents were strongly associated with FMRs in both programs, though more so in the Certificate program;
2. Among recipients who moved, rents were also influenced by the general level of pre-program rents in both programs;
3. Among recipients who moved, rents in the Housing Voucher program were also conditioned by individual deviations in pre-program rents from average rents;
4. Relationships, including program differences, varied across PHAs.

For the purposes of this appendix, this suggests that useful covariates for regressions of recipient rents among movers will include the recipient's FMR and pre-program rent.

Now consider recipient rents among recipients who stay in their pre-enrollment unit. We expect that these will be strongly associated with pre-program rents, but also that FMRs may play an important role. To the extent that FMRs accurately reflect local average market rents for units meeting program quality and occupancy requirements, simple regression towards the mean would suggest that recipient rents would tend to reduce any difference (posi-

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[1]The hypothesis that the Housing Voucher effect, β, did not vary across PHAs was not rejected at the 0.10 level.

[2]Examination of interactions of the Housing Voucher effect with rent category showed no significant or substantial estimated effect for any rent category. Nor was there any material change in the estimated program effect if rent category dummies were dropped altogether.

TABLE E.12

KEY ESTIMATES FROM ARC SINE REGRESSION FOR ENROLLEES INTENDING TO MOVE
(Excluding Subunits)

	Coefficient	Standard Error	t-Statistic
Intercept and site dummies	(See Appendix G)		
Pre-program rent			
80 to 100% of FMR	0.0224	0.0927	0.24
60 to 80% of FMR	-0.1321	0.0863	1.53
40 to 60% of FMR	-0.3200	0.0874	3.66**
Less than 40% of FMR	-0.5020	0.0921	5.45**
Housing Voucher	0.0303	0.0318	0.95

** = Significant at 0.01 level
 * = Significant at 0.05 level
 ‡ = Significant at 0.10 level

tive or negative) between pre-program rents and FMRs. This is reinforced in the Certificate program by the fact that increases in rents up to the FMR do not affect a Certificate program recipient's out-of-pocket costs, while rents above the FMR are prohibited without special exceptions. Certificate program recipients have no personal incentive to resist increases in rents up to the FMR level (unless the PHA imposes a lower rent reasonableness level). On the other hand, it seems likely that they would have had to resist any increase and perhaps even obtain a reduction to obtain PHA approval of rents above the FMR.

Accordingly, we began by specifying an equation for stayers of the form

$$(24) \qquad R_P = \alpha_j^k + \beta_j^k R_0 + \gamma_j^k PFMR + \eta_j^k MFMR + \theta_j^k DFPSDUM + \varepsilon_j^k$$

where

R_P = Recipient gross rent

R_0 = Pre-program gross rent

PFMR = The value of the FMR when the FMR was greater than the pre-program gross rent

MFMR = The value of the FMR when the FMR was smaller than the pre-program gross rent

DFPSDUM = A dummy variable indicating that the Payment Standard was less than the FMR when the family became a recipient

$a_j^k, \beta_j^k, \gamma_j^k$ = Unknown parameters allowed to vary across programs (h) and sites (j)

$\eta_j^k, \theta_j^k, \varepsilon_j^k$

We then examined the test statistics, shown in Table E.13 for

1. Pooling sites up to shift terms
2. Pooling programs up to a shift term

TABLE E.13

TEST STATISTICS FOR BASIC REGRESSIONS INVOLVING THE GROSS RENTS OF RECIPIENTS WHO REMAINED IN THEIR PRE-PROGRAM UNITS

	Housing Voucher Program	Certificate Program	Combined Programs
1. Pool sites	F(63,1263)=2.60**	F(60,1183)=4.87**	F(123,2446)=3.41**
2. Pool programs	NA	NA	F(63,2446)=6.66**
3. Drop pre-program rent	F(19,1263)=14.70**	F(19,1183)=26.11**	F(38,2446)=18.77**
4. Drop FMR (above pre-program rent)	F(19,1263)=34.44**	F(19,1183)=38.71**	F(38,2446)=35.72**
5. Drop FMR (below pre-program rent)	F(19,1263)=24.05**	F(17,1183)=25.90**	F(36,2446)=24.83**
6. Drop Payment Standard dummy	F(10,1263)=1.23	F(9,1183)=1.10	F(19,2446)=1.19

** = Significant at 0.01 level

* = Significant at 0.05 level

‡ = Significant at 0.10 level

3. Dropping each of the four variables

As can be seen from the table, pooling sites or programs was rejected, and only the dummy variable for differences between the Payment Standard and FMR could be dropped from the equation.

We next re-wrote the equation in terms of changes in rent:

$$(25) \qquad \Delta R = \alpha_j^k + \beta_j^k R_0 + \gamma_j^k DPFMR + \eta_j^k DMFMR + \epsilon_j^k$$

where:

ΔR = The difference between recipient gross rent and pre-program gross rent

R_0 = Pre-program gross rent

DPFMR = The difference between the FMR and pre-program gross rent if the FMR was the greater of the two

DMFMR = The difference between the FMR and pre-program gross rent if the FMR was the smaller of the two

We tested the hypothesis that the β_j^k could be dropped from the equation, which was rejected.[1] We also tested to see whether the coefficients for positive and negative deviation from FMR were equal. This was rejected for

[1]The test statistics for dropping R_0 from Eq. (25) are shown below. Although the test statistics are significant, the percentage change in the root mean square error is trivial.

	Housing Voucher Program	Certificate Program	Combined Program
Test	$F(19,1273)=276$**	$F(19,1192)=3.01$*	$F(38,2465)=2.83$**
Percentage change in root MSE	1.3%	1.6%	1.4%

the Housing Voucher Program, but not the Certificate Program.[1] Accordingly, we estimated as a final equation:

For the Housing Voucher Program:

(26) $$\Delta R = \alpha_j + \beta^v_j R_0 = \gamma^v_j DPFMR + \eta^v_j DMFMF + \varepsilon^v_j$$

For the Certificate Program:

(27) $$\Delta R = \alpha^c_j + \beta^c_j R_0 + \gamma^c_j (DPFMR + DMFMR) + \varepsilon^c_j$$

where:

Terms = As in Eq. (25).

The estimated coefficients are presented in Table E.14. They clearly show that program rents for Housing Voucher recipients who stayed in place were much less sensitive to housing pre-enrollment rents that exceeded FMRs than those of Certificate recipients who stayed in place. Essentially, as we have already noted, the Certificate Program was less likely than the Housing Voucher Program to allow enrollees with pre-program rents above FMRs to qualify in place--unless, it appears, their rents were going to be reduced or could be negotiated down. Interestingly, there is no material difference between the programs (at least for the weighted average coefficients) in the change in rent associated with having rents below the FMR. This does not, however, mean that the combination of PHA rent reasonableness tests and/or exclusion of units with increases that bring their rents above FMRs was as effective as the recipient shopping incentive provided by the Housing Voucher Program in restraining rent increases for recipients who qualify in place with pre-enrollment rents below the FMR. The earlier discussion of success rates indicated that, even among enrollees who intended to stay in their pre-program

[1]The test statistics for combining DPFMR and DMFMR are:

	Housing Voucher Program	Certificate Program
Test	F(19,1273)=6.94**	F(17,1192)=1.21
Percentage change in root MSE	4.3%	0.1%

TABLE E.14

AVERAGE COEFFICIENTS FOR FINAL REGRESSION OF THE CHANGE IN GROSS RENT FOR RECIPIENTS WHO STAYED IN THEIR PRE-ENROLLMENT UNIT

Weighted Average of 17 Urban PHAs	Housing Voucher Program	Certificate Program	Difference	t-Statistic
Intercept	15.49	21.47	-5.98	0.26
	(14.78)	(17.87)	(23.19)	
Pre-program rent	-0.042	-0.082	0.040	0.77
	(0.033)	(0.040)	(0.052)	
Extent to which FMR exceeds pre-program rent	0.607		0.015	0.25
	(0.037)	0.592	(0.059)	
Extent to which FMR is below pre-program rent	0.112	(0.046)	-0.480	2.18*
	(0.215)		(0.220)	
Simple Average of 19 PHAs				
Intercept	-6.72	43.14	-49.86	1.86‡
	(19.00)	(18.92)	(26.81)	
Pre-program rent	0.017	0.067	-0.050	0.65
	(0.041)	(0.065)	(0.077)	
Extent to which FMR exceeds pre-program rent	0.548		-0.207	1.90‡
	(0.050)	0.755	(0.109)	
Extent to which FMR is below pre-program rent	0.212	(0.097)	-0.543	2.96**
	(0.156)		(0.184)	

units and had pre-program rents below FMRs, the Certificate Program restricted rent increases by eliminating some enrollees whose rent would have increased to bring them above the FMRs. This resulted in Housing Voucher recipients having larger average increases in rent. From Table E.14 it appears that for this group, the shopping incentive provided by the Housing Voucher program meant that rent increases as a proportion of the difference between pre-program rents and FMRs were not increased.

E.3 Demographic Descriptors

We started with a list of demographic groups likely to be of interest to policy makers. These were

- Elderly/non-elderly (or other age groups)
- Racial and/or ethnic groups
- Single parents
- Female-headed households
- Handicapped/non-handicapped
- Groups based on source of income
- Presence/absence or number of children
- Larger/smaller households
- Higher/lower eligible income groups

The data by which these groups are identified are discussed in Appendix B. They reflect classifications made by PHA staff during enrollment. Thus, for example, racial and ethnic categorizations are based on staff observation, handicapped status reflects a PHA determination, and the presence of a spouse may mean a married couple, a couple living together, or whatever definition is used by the PHA.

As discussed in Appendix C, we can estimate outcomes for any of these groups. This yields a direct estimate of how outcomes vary across different groups. The moment we have done this, however, we usually want to understand more about the reasons for the observed differences. If we find, for example, that there are different average outcomes for two racial or ethnic groups, we immediately want to know whether this reflects effects associated with differences in the regions of the country in which the two groups tend to live, or effects associated with differences in income or age or other characteristics of the two groups, or effects directly associated with race or ethnicity (and presumed to reflect discrimination). Such analysis does not change the original finding that for the nation as a whole, outcomes differ between the two groups, but it may strongly influence both the intensity of policy concern and the type of policy action considered.

This sorting out of effects is, of course, only possible to the extent that different descriptors identify different groups of people. We started, therefore, by examining the incidence of the various groups in the Demonstration sample. Both the Housing Voucher and Certificate program set payments and occupancy requirements based on household size and composition. We took an initial breakdown based on the program-determined household bedroom size as our starting point. We grouped zero and one bedroom units, since these are in fact a single category of enrollee, with the exact number of bedrooms determined by the number in the unit that a recipient rents. Given the relatively small number of households in the four or more bedrooms categories, we also grouped enrollees in the larger bedroom sizes into a single three or more bedroom category.

We chose as our next variable the number of adults in the household. Program rules require that the single-person households are not eligible unless they are either elderly or handicapped. Accordingly we divided up the zero to one bedroom group into elderly, non-elderly, handicapped, and other. We also divided the larger bedroom size categories by whether there was one or more than one adults in the household. This gave the categories shown in Table E.15.

We regarded the categories of Table E.15 as fundamental since, except for the division by number of adults, they reflect program rules regarding eligibility, requirements, and payments. The next question is the extent to which we are likely to be able to identify the effects of other demographic variables apart from their association with household composition. Tables G.3 to G.14 in Appendix G present details of the association of the other demographic variables listed at the beginning of this section and household composition, showing the frequency of the demographic variable by household composition type. There were, as would be expected, some strong associations. Only 269 out of 1,464 elderly recipients in the two programs were not single-person elderly households. About half of the handicapped households are single-person households. Larger households are more frequently minority

TABLE E.15

INCIDENCE OF HOUSEHOLD SIZE/COMPOSITION CATEGORIES
(All Enrollees)

	All Enrollees		All Recipients	
	Number	Percent	Number	Percent
Single person elderly	1734	14%	1195	16%
Single person non-elderly handicapped	1411	11	893	11
Other zero or one bedroom	1496	12	735	10
Two bedrooms, one adult	3747	30	2442	32
Two bedroom, more than one adult	876	7	539	7
Three or more bedroom, one adult	2031	16	1185	16
Three or more bedroom, more than one adult	1149	9	645	8
Total	1244	100%	7604	100%

households. Of the 2,585 recipients without children, only 165 are in two or more bedroom households. Nevertheless, these do not necessarily prohibit a reasonably powerful analysis of many demographic effects apart from household composition.

We cannot in any case approach the analysis of demographic effects solely in terms of contrasts within each PHA. We can test the hypothesis that demographic contrasts are zero in each program or PHA. We cannot readily summarize the contrasts, since not all demographic groups are represented in all PHAs. Summary estimates will necessarily be based on regressions with PHA and program dummies but without full interactions between demographic effects and PHA and program. Within this context, there is frequently adequate sample size to detect moderate demographic effects.

In general, if we regress one variable on another and estimate an effect, $\hat{\beta}$, then

$$(28) \qquad \mathrm{Var}(\hat{\beta}) = (\sigma_\varepsilon^2/\sigma_x^2)(1/(n-k))$$

where

σ_ε^2 = The residual variance of the dependent variable

σ_x^2 = The residual variance of the independent variable after regression on all other regressors

n = The number of observations

k = The number of other regressors

We can characterize the implications of $\mathrm{Var}(\hat{\beta})$ in terms of statistical power. Say that the true effect, β, is positive. Asymptotically, the probability that we will estimate a significant positive effect (at the 0.05 level) is

$$(29) \qquad P_s = \mathrm{Prob}\left[\ \hat{\beta}/(\mathrm{Var}\ \hat{\beta})^{\frac{1}{2}}\ \right] > 1.96$$

$$= \mathrm{Prob}\left[\ (\hat{\beta}-\beta)/(\mathrm{Var}\ \hat{\beta})^{\frac{1}{2}}\right] > 1.96 - \left[\ \beta/(\mathrm{Var}\ \hat{\beta})^{\frac{1}{2}}\ \right]$$

Thus $P_s = 0.9$ if

$$1.96 - \beta/(\mathrm{Var}\ \hat{\beta})^{\frac{1}{2}} < -1.64$$

or

(30) $$\beta > 3.6\ (\mathrm{Var}\ \hat{B})^{\frac{1}{2}}$$

Accordingly, substituting Eq. (28) into Eq. (30), we can characterize the smallest true effect that we have a 90 percent chance of "noticing" by

(31) $$\beta_{min} = (\sigma_{\varepsilon}/\sigma_{x})(1/\sqrt{n-k})$$

Roughly speaking, we can expect that the β_{min} for differences between demographic effects in the two programs will be about twice that for the programs combined (if sample sizes are equal in the two programs). Tables E.16A and E.16 summarize the β_{min} for differences in demographic effects between the two programs

(a) For the demographic category by itself; and

(b) For a regression in which the demographic variable appears accompanied by dummies for each program and PHA and for each household composition type.

Correlations do increase the noticeable effect level, but it still runs at about 0.26 for most contrasts involving all applicants and at about 0.36 for most contrasts involving recipients. Of course, these numbers have to be evaluated in the light of the sigma attached to a specific problem. Nevertheless, they are not unreasonably large in most cases.

TABLE E.16A

SIZE OF DIFFERENCE BETWEEN PROGRAMS IN DEMOGRAPHIC EFFECT LIKELY TO BE NOTICED (ASYMPTOTIC POWER = 0.9) WITH A TWO-TAILED TEST AT THE 0.05 LEVEL (APPLICANTS)

	Noticeable Effect As a Proportion of Sigma		
	Unweighted Comparison of Means	Regression with PHA Dummies and Household Type Dummies	R^2 of Demographic Variable on PHA and Household Type Dummies
Elderly	0.17	0.37	0.79
Handicapped	0.16	0.23	0.53
Spouse present	0.19	0.26	0.43
Sex of head	0.16	0.18	0.26
Children present	0.14	0.30	0.80
More than two thirds of family income from:			
Wages and salaries	0.17	0.18	0.17
Social Security	0.16	0.21	0.45
Welfare	0.12	0.15	0.26
Other single source	1.36	0.37	0.01
No single source	0.21	0.21	0.03
Black Non-Hispanic	0.14	0.16	0.34
Hispanic	0.16	0.18	0.24

TABLE E.16B

SIZE OF DIFFERENCE BETWEEN PROGRAMS IN DEMOGRAPHIC EFFECT LIKELY TO BE NOTICED (ASYMPTOTIC POWER = 0.9) WITH A TWO-TAILED TEST AT THE 0.05 LEVEL (RECIPIENTS)

	Noticeable Effect As a Proportion of Sigma		
	Unweighted Comparison of Means	Regression with PHA Dummies and Household Type Dummies	R^2 of Demographic Variable on PHA and Household Type Dummies
Elderly	0.21	0.48	0.81
Handicapped	0.20	0.29	0.53
Spouse present	0.25	0.34	0.49
Sex of head	0.20	0.24	0.27
Children present	0.18	0.42	0.83
More than two thirds of family income from:			
Wages and salaries	0.21	0.24	0.17
Social Security	0.19	0.26	0.46
Welfare	0.17	0.19	0.24
Other single source	1.65	1.67	0.01
No single source	0.27	0.27	0.03
Black Non-Hispanic	0.17	0.23	0.44
Hispanic	0.23	0.26	0.26

APPENDIX F

BACKUP FOR SELECTED TABLES IN THE MAIN TEXT

This appendix presents more extensive detail for the national estimates in the main text. For each outcome, we present

- The mean
- The within-PHA standard error
- A total standard error including the sampling error associated with a sampling of PHAs
- The F-statistic for the hypothesis that there is no variation across PHAs

The details of these statistics are discussed in Appendix C. Briefly, the rationale behind them is as follows. We can estimate outcomes and differences in outcomes for the two programs for all large urban PHAs. However, estimates are just that--estimates--and it is important to assess their accuracy. Error can arise in three ways. First, as described in Appendix A, estimates in each PHA were based on results for a sample of recipients in that PHA. The samples are random samples of recipients and would be expected to represent, on average, the normal mean outcome for that PHA. The particular samples in the Demonstration may not, however, accurately reflect all recipients in the Demonstration PHAs. The potential size of this sort of error can be quantified, and is presented as the "within-PHA standard error of estimate." This reflects on the potential error in estimated (weighted) average estimates for the PHAs actually included in the Demonstration. In general, we expect that the true average outcome in these PHAs are quite likely to be one-fourth of the standard error greater or less than the estimated average and very unlikely to be more than twice the standard error (or more exactly 1.96 times the standard error) greater or less than the estimated average.[1]

[1]Specifically, if recipient outcomes were normally distributed, and if we drew many different samples of recipients of the same size as those in the Demonstration, the estimated (weighted) average costs would exceed the true mean by at least one quarter of the standard error or be below the true mean by at least one quarter of the standard error in about 80 percent of the samples. Similarly, they would be within plus or minus 1.96 standard errors of actual average costs in 95 percent of the samples.

Error can also arise in extrapolating these estimates to all large urban PHAs. The 18 urban Demonstration PHAs are a probability sample, and their outcomes would be expected to reflect the outcomes for all large urban PHAs. As with the recipient sample within PHAs, error arises if the actual sample of PHAs is by chance not representative of all large urban PHAs. Again this error can be quantified, though in this case using an upper bound (see Appendix C). The "total error of estimate" reflects the combined errors of estimate associated with the sample of PHAs and with the samples of recipients within PHAs. It can be interpreted in the same way as the within-PHA standard error.

Finally, error can arise from mistakes in data recording and transcription, errors of interpretation, or misspecified models. These errors cannot be readily quantified. We guard against data errors through a variety of data cleaning procedures and consistency checks, as described in Appendix B. We attempt to check our interpretation through tests of the extensive theoretical models developed in Appendix D. We rely on randomized assignment across programs to provide direct estimates of differences in outcome, independent of behavioral models. The major caveat here is the possibility that the Demonstration might not provide good estimates of long-term effects associated with changes in the composition of participating landlords and/or ecological effects as discussed in Appendix D..

Finally, we are often concerned to see whether results vary across PHAs. First, if there are significant differences among PHAs we definitely want to look at the "total standard error," since this includes the errors arising from sampling PHAs. On the other hand, if there are no significant differences across PHAs, then we can simply consider the within-PHA standard error, since the results would not depend on which PHAs were chosen for the sample. This may be especially important in this analysis, since we have a very large sample of individuals but only a small sample of PHAs.

More generally, a finding of variation in outcomes across PHAs suggests further investigation. In the case of Table F.1, for example, the lack of significant variation in the difference between the programs across PHAs suggests that the program effect is independent of site-level factors such as, for example, rental market tightness. On the other hand, the significant variation across PHAs in the number of issuances per recipient in each program suggests that success rates themselves are influenced by site-level factors of some sort, (though these may include differences in the proportion of the site population falling into various demographic groups).

TABLE F.1
(TABLE 3.1)

COMPARISON OF SUCCESS RATES IN THE TWO PROGRAMS

	Housing Voucher Program	Certificate Program	Difference	t-Statistic
Mean issuances per recipient	1.55	1.64	-0.09	
Within-PHA standard error	0.02	0.02	0.03	3.18**
Total standard error	0.14	0.16	0.03	2.79**
F-statistic for variation across PHAs	57.44** (17,3497)	51.45** (17,3328)	0.81 (17,6825)	NA
Implied success rate[a]	64.6%	61.0%	3.6 pts	2.79**

** = Significant at 0.01 level
* = Significant at 0.05 level
‡ = Significant at 0.10 level

[a]Calculated as the inverse of the mean issuance per recipient. This is an upward-biased estimate, but the bias must be less than the squared standard error of estimated mean issuances (see Section C.1.3 of Appendix C).

TABLE F.2
(TABLE 3.4)

SUCCESS RATES BY SUBUNIT

Non-Subunits	Housing Voucher Program	Certificate Program	Difference	t-Statistic
Mean issuance per recipient	1.52	1.60	-0.09	
Within-PHA standard error	0.02	0.03	0.03	2.66**
Total standard error	0.12	0.14	0.04	2.24*
F-statistic for variation across PHAs	34.19** (16,2615)	31.46** (16,2502)	0.82 (16,5117)	
Implied success rate[a]	65.9%	62.3%	3.6 pts	
Subunits				
Mean issuance per recipient	1.58	1.65	-0.07	
Within-PHA standard error	0.04	0.05	0.07	1.10
Total standard error	0.24	0.26	0.07	1.10
F-statistic for variation across PHAs	25.30** (16,807)	29.15** (16,759)	0.25 (16,1566)	
Implied success rate[a]	63.2%	60.4%	2.8 pts	
Comparison of Groups				
F-statistic for difference across groups	1.52 (1,3422)	0.70 (1,3261)	0.03 (1,6683)	

** = Significant at 0.01 level

* = Significant at 0.05 level

‡ = Significant at 0.10 level

[a]Calculated as the inverse of the mean issuance per recipient. This is an upward-biased estimate, but the bias must be less than the squared standard error of estimated mean issuances (see Section C.1.3 of Appendix C).

TABLE F.3
(TABLE 3.4 CONT.)

SUCCESS RATES BY PRE-PROGRAM UNIT ADEQUACY
(Exluding subunits)

Adequate	Housing Voucher Program	Certificate Program	Difference	t-Statistic
Mean issuance per recipient	1.35	1.43	-0.08	
Within-PHA standard error	0.02	0.02	0.03	3.11**
Total standard error	0.05	0.07	0.04	1.98*
F-statistic for variation across PHAs	11.84** (16,1955)	13.77** (16,1895)	2.02** (16,3850)	
Implied success rate[a]	74.2%	69.9%	4.2 pts	
Moderately Inadequate				
Mean issuance per recipient	1.59	1.59	-0.00	
Within-PHA standard error	0.05	0.09	0.10	0.04
Total standard error	0.19	0.27	0.17	0.02
F-statistic for variation across PHAs	12.24** (16,282)	8.15** (16,245)	2.24** (16,527)	
Implied success rate[a]	62.9%	62.7%	-0.2 pts	
Severely Inadequate				
Mean issuance per recipient	2.38	2.62	-0.23	
Within-PHA standard error	0.13	0.13	0.19*	1.25
Total standard error	0.41	0.41	0.19	1.25
F-statistic for variation across PHAs	6.60** (16,265)	6.47** (16,251)	0.08 (16,516)	
Implied success rate[a]	42.0%	38.2%	3.8 pts	
Comparison of Groups				
F-statistic for difference across groups	395.34** (2,2502)	409.22** (2,2391)	5.38* (2,4893)	

** = Significant at 0.01 level

* = Significant at 0.05 level

‡ = Significant at 0.10 level

[a]Calculated as the inverse of the mean issuance per recipient. This is an upward-biased estimate, but the bias must be less than the squared standard error of estimated mean issuances (see Section C.1.3 of Appendix C).

TABLE F.4
(TABLE 3.4 CONT.)

SUCCESS RATES BY PRE-PROGRAM OCCUPANCY

Pre-Program Occupancy Index	Housing Voucher Program	Certificate Program	Difference	t-Statistic
At Least Two More Rooms				
Mean issuance per recipient	1.47	1.49	-0.02	
Within-PHA standard error	0.03	0.03	0.05	0.37
Total standard error	0.09	0.08	0.05	0.32
F-statistic for variation across PHAs	7.94** (16,780)	5.51** (16,759)	0.70 (16,1539)	
Implied success rate[a]	68.1%	67.3%	0.8 pts	
One More Room				
Mean issuance per recipient	1.41	1.52	-0.11	
Within-PHA standard error	0.03	0.03	0.04	2.72**
Total standard error	0.10	0.12	0.04	2.72**
F-statistic for variation across PHAs	15.02** (16,1146)	14.57** (16,1089)	0.70 (16,2215)	
Implied success rate[a]	71.0%	65.9%	5.1 pts	
No More Rooms				
Mean issuance per recipient	1.71	1.83	-0.12	
Within-PHA standard error	0.06	0.07	0.09	1.37
Total standard error	0.22	0.30	0.11	1.18
F-statistic for variation across PHAs	14.46** (16,569)	15.05** (16,555)	0.76 (16,1124)	
Implied success rate[a]	58.6%	54.6%	4.0 pts	
Comparison of Groups				
F-statistic for difference across groups	53.60** (2,2495)	50.23** (2,2383)	3.12‡ (2,4878)	

** = Significant at 0.01 level

* = Significant at 0.05 level

‡ = Significant at 0.10 level

[a]Calculated as the inverse of the mean issuance per recipient. This is an upward-biased estimate, but the bias must be less than the squared standard error of estimated mean issuances (see Section C.1.3 of Appendix C).

TABLE F.5
(TABLE 3.4 CONT.)

SUCCESS RATES BY PRE-ENROLLMENT RENT

Pre-Enrollment Gross Rent	Housing Voucher Program	Certificate Program	Difference	t-Statistic
Greater than FMR				
Mean issuance per recipient	1.28	1.43	-0.15	
Within-PHA standard error	0.03	0.05	0.06	2.58*
Total standard error	0.05	0.08	0.06	2.52*
F-statistic for variation across PHAs	2.34** (16,362)	2.36** (16,287)	0.54 (16,644)	
Implied success rate[a]	78.3%	70.1%	8.2 pts	
80 to 100% of FMR				
Mean issuance per recipient	1.32	1.35	-0.03	
Within-PHA standard error	0.03	0.03	0.04	0.85
Total standard error	0.07	0.10	0.05	0.68
F-statistic for variation across PHAs	6.47** (16,625)	7.90** (16,646)	1.02 (16,1271)	
Implied success rate[a]	75.9%	74.1%	1.8 pts	
60 to 80% of FMR				
Mean issuance per recipient	1.47	1.58	-0.11	
Within-PHA standard error	0.04	0.04	0.06	1.95‡
Total standard error	0.15	0.20	0.07	1.53
F-statistic for variation across PHAs	17.04** (16,736)	16.63** (16,686)	0.90 (16,1411)	
Implied success rate[a]	68.0%	63.3%	4.8 pts	

** = Significant at 0.01 level

* = Significant at 0.05 level

‡ = Significant at 0.10 level

[a]Calculated as the inverse of the mean issuance per recipient. This is an upward-biased estimate, but the bias must be less than the squared standard error of estimated mean issuances (see Section C.1.3 of Appendix C).

TABLE F.5 (CONT.)
(TABLE 3.4 CONT.)

SUCCESS RATES BY PRE-ENROLLMENT RENT

Pre-Enrolment Gross Rent	Housing Voucher Program	Certificate Program	Difference	t-Statistic
40 to 60% of FMR				
Mean issuance per recipient	1.67	1.82	-0.15	
Within-PHA standard error	0.07	0.11	0.13	1.10
Total standard error	0.29	0.42	0.24	0.60
F-statistic for variation across PHAs	12.63** (16,396)	10.38** (16,358)	2.03** (16,754)	
Implied success rate[a]	59.7%	54.9%	4.8 pts	
Less than 40% of FMR				
Mean issuance per recipient	1.63	1.57	0.06	
Within-PHA standard error	0.06	0.06	0.08	0.73
Total standard error	0.21	0.13	0.26	0.23
F-statistic for variation across PHAs	18.94**	7.02**	9.07**	
Implied success rate[a]	61.5	63.8	-2.3 pts	
Comparison of Groups				
F-statistic for difference across groups	157.50** (4,2359)	90.17** (4,2242)	11.21** (4,4601)	

** = Significant at 0.01 level

* = Significant at 0.05 level

‡ = Significant at 0.10 level

[a]Calculated as the inverse of the mean issuance per recipient. This is an upward-biased estimate, but the bias must be less than the squared standard error of estimated mean issuances (see Section C.1.3 of Appendix C).

TABLE F.6
(TABLE 3.8)

SUCCESS RATES BY INTENTION TO MOVE OR STAY

	Housing Voucher Program	Certificate Program	Difference	t-Statistic
Intend to Stay				
Mean issuance per recipient	1.23%	1.31%	-0.08 pts	
Within-PHA standard error	0.02	0.02	0.03	3.27**
Total standard error	0.04	0.05	0.03	2.50*
F-statistic for variation across PHAs	7.81** (16,1204)	6.09** (16,1115)	1.46 (16,2319)	
Implied success rate[a]	81.4%	76.1%	5.3 pts	
Intend to Move				
Mean issuance per recipient	1.70%	1.81%	-0.10 pts	
Within-PHA standard error	0.03	0.04	0.05	2.16*
Total standard error	0.24	0.28	0.06	1.64‡
F-statistic for variation across PHAs	62.50** (16,2139)	53.49** (16,2035)	1.20 (16,4174)	
Implied success rate[a]	58.7%	55.3%	3.4 pts	
Not Sure				
Mean issuance per recipient	1.48%	1.31%	0.17 pts	
Within-PHA standard error	0.10	0.06	0.12	1.50
Total standard error	0.13	0.08	0.14	1.24
F-statistic for variation across PHAs	0.84 (16,53)	0.96 (16,79)	1.71‡ (16,132)	
Implied success rate[a]	67.5%	76.6%	-9.0 pts	
Comparison of Groups				
F-statistic for difference across groups	189.16** (2,3396)	129.37** (2,3229)	2.98* (2,6625)	

** = Significant at 0.01 level

* = Significant at 0.05 level

‡ = Significant at 0.10 level

[a]Calculated as the inverse of the mean issuance per recipient. This is an upward-biased estimate, but the bias must be less than the squared standard error of estimated mean issuances (see Section C.1.3 of Appendix C).

TABLE F.7
(TABLE 3.8 CONT.)

PERCENT OF RECIPIENTS QUALIFYING BY MOVING

	Housing Voucher Program	Certificate Program	Difference	t-Statistic
Intend to Stay				
Mean	16.7%	18.4%	-1.7 pts	
Within-PHA standard error	1.1	1.1	1.6	1.09
Total standard error	2.7	3.2	1.6	1.09
χ-statistic for variation across PHAs	103.14**	118.52**	9.99	
Intend to Move				
Mean	89.8%	88.3%	1.5 pts	
Within-PHA standard error	0.6	0.7	0.9	1.56
Total standard error	2.3	2.4	1.2	1.25
χ-statistic for variation across PHAs	200.57**	185.48**	22.06	
Not Sure				
Mean	39.6%	47.6%	-8.1 pts	
Within-PHA standard error	5.0	4.4	6.6	1.21
Total standard error	7.6	6.4	10.3	0.78
χ-statistic for variation across PHAs	20.79‡	24.05*	18.53	

** = Significant at 0.01 level

* = Significant at 0.05 level

‡ = Significant at 0.10 level

TABLE F.8
(TABLE 3.9)

SUCCESS RATES FOR ENROLLEES INTENDING TO STAY BY PRE-ENROLLMENT HOUSING ADEQUACY
(Excluding subunits)

Pre-Program Unit Rated:	Housing Voucher Program	Certificate Program	Difference	t-Statistic
Adequate				
Mean issuance per recipient	1.19	1.28	-0.09	
Within-PHA standard error	0.02	0.02	0.03	3.50**
Total standard error	0.04	0.05	0.03	3.25**
F-statistic for variation across PHAs	6.00** (16,1058)	5.08** (16,964)	0.88 (16,2022)	
Implied success rate[a]	83.7%	77.9%	5.8 pts	
Moderately Inadequate				
Mean issuance per recipient	1.20	1.30	-0.11	
Within-PHA standard error	0.05	0.08	0.09	1.14
Total standard error	0.07	0.12	0.16	0.66
F-statistic for variation across PHAs	0.76 (16,41)	1.61 (16,37)	4.10** (16,78)	
Implied success rate[a]	83.4%	76.7%	6.8 pts	
Severely Inadequate				
Mean issuance per recipient	1.54	1.48	0.05	
Within-PHA standard error	0.18	0.14	0.23	0.23
Total standard error	0.23	0.17	0.26	0.20
F-statistic for variation across PHAs	0.48 (16,20)	0.38 (16,37)	0.63 (16,57)	
Implied success rate[a]	65.1%	67.4%	-2.3 pts	
Comparison of Groups				
F-statistic for difference across groups	26.10** (2,1119)	8.97** (2,1038)	2.10 (2,2157)	

** = Significant at 0.01 level
* = Significant at 0.05 level
‡ = Significant at 0.10 level

[a]Calculated as the inverse of the mean issuance per recipient. This is an upward-biased estimate, but the bias must be less than the squared standard error of estimated mean issuances (see Section C.1.3 of Appendix C).

TABLE F.9
(TABLE 3.9 CONT.)

SUCCESS RATES FOR ENROLLEES INTENDING TO STAY BY PRE-ENROLLMENT OCCUPANCY
(Excluding subunits)

	Housing Voucher Program	Certificate Program	Difference	t-Statistic
Intend to Stay				
Mean issuance per recipient	1.21	1.29	-0.08	
Within-PHA standard error	0.02	0.03	0.04	2.02*
Total standard error	0.05	0.05	0.04	2.02*
F-statistic for variation across PHAs	2.96** (16,468)	2.29** (16,429)	0.66 (168,97)	
Implied success rate[a]	82.3%	77.4%	4.9 pts	
Moderately Inadequate				
Mean issuance per recipient	1.17	1.25	-0.08	
Within-PHA standard error	0.02	0.02	0.03	2.65**
Total standard error	0.03	0.05	0.04	2.16*
F-statistic for variation across PHAs	2.95** (16,543)	4.31** (16,506)	1.32 (16,1049)	
Implied success rate[a]	85.3%	79.9%	5.4 pts	
Severely Inadequate				
Mean issuance per recipient	1.22	1.32	-0.10	
Within-PHA standard error	0.05	0.06	0.08	1.35
Total standard error	0.08	0.13	0.12	0.88
F-statistic for variation across PHAs	1.58 (16,72)	2.95** (16,69)	1.36‡ (16,141)	
Implied success rate[a]	81.9%	75.6%	6.3 pts	
Comparison of Groups				
F-statistic for difference across groups	3.85* (2,1083)	3.20* (2,1004)	0.15 (2,2087)	

** = Significant at 0.01 level
* = Significant at 0.05 level
‡ = Significant at 0.10 level

[a]Calculated as the inverse of the mean issuance per recipient. This is an upward-biased estimate, but the bias must be less than the squared standard error of estimated mean issuances (see Section C.1.3 of Appendix C).

TABLE F.10
(TABLE 3.9 CONT.)

SUCCESS RATES FOR ENROLLEES INTENDING TO STAY BY
PRE-PROGRAM GROSS RENT
(Excluding subunits)

	Housing Voucher Program	Certificate Program	Difference	t-Statistic
Greater than 80% of FMR				
Mean issuance per recipient	1.19	1.28	0.08	
Within-PHA standard error	0.02	0.03	0.03	2.67*
Total standard error	0.04	0.05	0.04	1.89‡
F-statistic for variation across PHAs	4.68** (16,721)	3.34** (16,667)	1.11 (16,1388)	
Implied success rate[a]	83.8%	78.2%	5.5 pts	
60 to 80% of FMR				
Mean issuance per recipient	1.20	1.26	-0.06	
Within-PHA standard error	0.03	0.04	0.05	1.19
Total standard error	0.05	0.08	0.06	0.98
F-statistic for variation across PHAs	2.51** (16,272)	3.33** (16,243)	0.77 (16,515)	
Implied success rate[a]	83.2%	79.5%	3.8 pts	
Less than or equal to 60% of FMR				
Mean issuance per recipient	1.26	1.31	-0.06	
Within-PHA standard error	0.06	0.06	0.08	0.70
Total standard error	0.07	0.08	0.11	0.50
F-statistic for variation across PHAs	0.89 (16,72)	1.49 (16,73)	2.95** (16,145)	
Implied success rate[a]	79.6%	76.1%	3.5 pts	
Comparison of Groups				
F-statistic for difference across groups	2.42‡ (2,1065)	0.91 (2,983)	0.48 (2,2048)	

** = Significant at 0.01 level
* = Significant at 0.05 level
‡ = Significant at 0.10 level

[a]Calculated as the inverse of the mean issuance per recipient. This is an upward-biased estimate, but the bias must be less than the squared standard error of estimated mean issuances (see Section C.1.3 of Appendix C).

TABLE F.11
(TABLE 3.10)

SUCCESS RATES FOR ENROLLEES INTENDING TO MOVE BY PRE-PROGRAM ADEQUACY
(Excluding subunits)

	Housing Voucher Program	Certificate Program	Difference	t-Statistic
Intend to Stay				
Mean issuance per recipient	1.51	1.57	-0.05	
Within-PHA standard error	0.04	0.04	0.05	1.04
Total standard error	0.11	0.14	0.07	0.75
F-statistic for variation across PHAs	11.82** (16,789)	15.68** (16,778)	1.56‡ (16,1547)	
Implied success rate[a]	66.1%	63.8%	2.3 pts	
Moderately Inadequate				
Mean issuance per recipient	1.61	1.61	0.00	
Within-PHA standard error	0.07	0.10	0.13	0.02
Total standard error	0.22	0.33	0.24	0.01
F-statistic for variation across PHAs	7.92** (16,209)	8.92** (16,176)	2.67 (16,385)**	
Implied success rate[a]	61.9%	62.0%	-0.1 pts	
Severely Inadequate				
Mean issuance per recipient	2.44	2.85	-0.41	
Within-PHA standard error	0.19	0.17	0.25	1.61
Total standard error	0.49	0.51	0.25	1.61
F-statistic for variation across PHAs	4.45** (16,223)	6.09** (16,193)	0.03 (16,416)	
Implied success rate[a]	41.1%	35.1%	5.9 pts	
Comparison of Groups				
F-statistic for difference	88.20**	190.16**	7.78**	
across groups	(2,1201)	(2,1147)	(2,2348)	

** = Significant at 0.01 level

* = Significant at 0.05 level

‡ = Significant at 0.10 level

[a]Calculated as the inverse of the mean issuance per recipient. This is an upward-biased estimate, but the bias must be less than the squared standard error of estimated mean issuances (see Section C.1.3 of Appendix C).

TABLE F.12
(TABLE 3.10 CONT.)

SUCCESS RATES FOR ENROLLEES INTENDING TO MOVE BY PRE-PROGRAM OCCUPANCY
(Excluding subunits)

Rooms Compared with Required Number of Bedrooms	Housing Voucher Program	Certificate Program	Difference	t-Statistic
At Least 2 Extra Rooms				
Mean issuance per recipient	1.79	1.68	0.11	
Within-PHA standard error	0.09	0.07	0.11	0.94
Total standard error	0.24	0.23	0.12	0.91
F-statistic for variation across PHAs	5.81** (16,232)	9.29** (16,241)	0.48 (16,473)	
Implied success rate[a]	55.9%	59.5%	-3.6 pts	
One Extra Room				
Mean issuance per recipient	1.57	1.72	-0.15	
Within-PHA standard error	0.06	0.06	0.08	1.88‡
Total standard error	0.21	0.22	0.08	1.88‡
F-statistic for variation across PHAs	11.08** (16,516)	14.54** (16,466)	0.29 (16,982)	
Implied success rate[a]	63.8%	58.1%	5.7 pts	
No Extra Rooms				
Mean issuance per recipient	1.77	1.92	-0.15	
Within-PHA standard error	0.08	0.09	0.12	1.24
Total standard error	0.27	0.36	0.13	1.19
F-statistic for variation across PHAs	10.69** (16,447)	12.78** (16,439)	0.50 (16,886)	
Implied success rate[a]	56.5%	52.0%	4.4 pts	
Comparison of Groups				
F-statistic for difference across groups	7.58** (2,1195)	7.19** (2,1146)	3.74* (2,2341)	

** = Significant at 0.01 level

* = Significant at 0.05 level

‡ = Significant at 0.10 level

[a]Calculated as the inverse of the mean issuance per recipient. This is an upward-biased estimate, but the bias must be less than the squared standard error of estimated mean issuances (see Section C.1.3 of Appendix C).

TABLE F.13
(TABLE 3.10 CONT.)

SUCCESS RATES FOR ENROLLEES INTENDING TO MOVE BY PRE-PROGRAM GROSS RENT
(Excluding subunits)

Pre-Program Gross Rent	Housing Voucher Program	Certificate Program	Difference	t-Statistic
Greater than FMR				
Mean issuance per recipient	1.49	1.60	-0.12	
Within-PHA standard error	0.12	0.13	0.18	0.66
Total standard error	0.17	0.21	0.20	0.59
F-statistic for variation across PHAs	1.42 (16,50)	1.50 (16,36)	0.98 (16,86)	
Implied success rate[a]	67.2%	62.3%	4.9 pts	
80 to 100% of FMR				
Mean issuance per recipient	1.55	1.62	-0.06	
Within-PHA standard error	0.07	0.08	0.11	0.60
Total standard error	0.16	0.19	0.11	0.57
F-statistic for variation across PHAs	3.24** (16,148)	4.01** (16,164)	0.39 (16,312)	
Implied success rate[a]	64.5%	61.9%	2.6 pts	
60 to 80% of FMR				
Mean issuance per recipient	1.64	1.78	-0.14	
Within-PHA standard error	0.06	0.08	0.10	1.45
Total standard error	0.25	0.30	0.10	1.45
F-statistic for variation across PHAs	14.05** (16,391)	11.55** (16,361)	0.33 (16,752)	
Implied success rate[a]	61.1%	56.2%	5.0 pts	
40 to 60% of FMR				
Mean issuance per recipient	1.73	1.79	-0.06	
Within-PHA standard error	0.10	0.12	0.15	0.41
Total standard error	0.34	0.47	0.30	0.20
F-statistic for variation across PHAs	9.74** (16,286)	13.25** (16,254)	2.62** (16,540)	
Implied success rate[a]	57.9%	55.9%	2.0 pts	
Less than or equal to 40% of FMR				
Mean issuance per recipient	1.60	1.60	-0.01	
Within-PHA standard error	0.06	0.06	0.08	0.11
Total standard error	0.18	0.15	0.26	0.04
F-statistic for variation across PHAs	13.79** (16,224)	8.17** (16,234)	7.02** (16,458)	
Implied success rate[a]	62.7%	62.3%	0.4 pts	
Comparison of Groups				
F-statistic for difference across groups	9.16** (4,1099)	9.48** (4,1049)	1.96‡ (4,2148)	

** = Significant at 0.01 level   * = Significant at 0.05 level   ‡ = Significant at 0.10 level

[a]Calculated as the inverse of the mean issuance per recipient. This is an upward-biased estimate, but the bias must be less than the squared standard error of estimated mean issuances (see Section C.1.3 of Appendix C).

TABLE F.14
(TABLE 3.14)

SUCCESS RATES FOR ENROLLEES ISSUED HOUSING VOUCHERS OR CERTIFICATES DURING PERIODS WHEN PAYMENT STANDARDS AND FMRs WERE THE SAME

	Housing Voucher Program	Certificate Program	Difference	t-Statistic
Mean issuances per recipient	1.55	1.68	-0.13	
Within-PHA standard error	0.02	0.03	0.03	3.81**
Total standard error	0.14	0.16	0.06	2.25*
F-statistic for variation across PHAs	48.46** (16,2821)	53.26** (16,2580)	1.30 (16,5401)	
Implied success rate[a]	64.4%	59.5%	4.9 pts	

** = Significant at 0.01 level
 * = Significant at 0.05 level
 ‡ = Significant at 0.10 level

[a]Calculated as the inverse of the mean issuance per recipient. This is an upward-biased estimate, but the bias must be less than the squared standard error of estimated mean issuances (see Section C.1.3 of Appendix C).

TABLE F.15
(TABLE 3.15)

COMPARISON OF RECIPIENT TERMINATION RATES IN THE TWO PROGRAMS

	Housing Voucher Program	Certificate Program	Difference	t-Statistic[a]
Mean	11.0%	11.1%	-0.1 pts	
Within-PHA standard error	0.9 pts	0.9 pts	1.3 pts	0.08
Total standard error	1.4 pts	1.5 pts	1.4 pts	0.08
Chi-squared statistic for variation across PHAs	69.34** (17)	54.95** (17)	15.29 (17)	

** = Significant at 0.01 level
* = Significant at 0.05 level
‡ = Significant at 0.10 level

TABLE F.16
(TABLE 4.1)

COMPARISON OF GROSS RENTS IN THE TWO PROGRAMS

Pre-Program Gross Rents	Housing Voucher Program	Certificate Program	Difference	t-Statistic
Mean	283.59	274.48	9.11	
Within-PHA standard error	2.48	2.45	3.49	2.61**
Total standard error	15.05	15.67	3.57	2.55**
F-statistic for variation across PHAs	37.37** (17,3430)	41.45** (17,3260)	1.04 (17,6690)	
Initial Recient Gross Rents				
Mean	463.03	436.60	26.43	
Within-PHA standard error	1.25	0.90	1.54	17.13**
Total standard error	18.49	17.21	3.78	7.00**
F-statistic for variation across PHAs	218.65** (17,3497)	378.92** (17,3327)	6.05** (17,6824)	
Change in Gross Rent[a]				
Mean	179.22	162.14	17.08	
Within-PHA standard error	2.67	2.60	3.73	4.58**
Total standard error	17.99	17.87	4.00	4.27**
F-statistic for variation across PHAs	50.73** (17,3430)	51.13** (17,3259)	1.30 (17,6689)	

** = Significant at 0.01 level
* = Significant at 0.05 level
‡ = Significant at 0.10 level

[a]Change figures may differ slightly from the difference in pre and post means due to missing values.

TABLE F.17
(TABLE 4.2)

COMPARISON OF GROSS RENTS IN THE TWO PROGRAMS
FOR RECIPIENTS PAYING FULL RENT BOTH BEFORE AND AFTER BECOMING RECIPIENTS

Pre-Program Gross Rents	Housing Voucher Program	Certificate Program	Difference	t-Statistic
Mean	341.84	333.29	8.56	
Within-PHA standard error	2.43	2.41	3.42	2.50*
Total standard error	13.52	13.27	4.53	1.89‡
F-statistic for variation across PHAs	31.25** (17,2230)	32.08** (17,2084)	1.63‡ (17,4314)	
Recipient Gross Rents				
Mean	463.59	434.36	29.23	
Within-PHA standard error	1.60	1.16	1.98	14.76**
Total standard error	18.61	17.32	3.96	7.38**
F-statistic for variation across PHAs	135.62** (17,2262)	235.60** (17,2110)	4.72** (17,4372)	
Change in Gross Rent[a]				
Mean	121.34	100.71	20.63	
Within-PHA standard error	2.66	2.54	3.68	5.61
Total standard error	15.24	12.65	5.24	3.93
F-statistic for variation across PHAs	38.24** (17,2230)	29.79** (17,2084)	3.01** (17,4314)	

** = Significant at 0.01 level
* = Significant at 0.05 level
‡ = Significant at 0.10 level

[a]Change figures may not equal the difference between pre and post figures due to missing values.

TABLE F.18
(TABLE 4.2 CONT.)

COMPARISON OF GROSS RENTS IN THE TWO PROGRAMS
FOR RECIPIENTS PAYING LESS THAN FULL RENT

Pre-Program Gross Rents	Housing Voucher Program	Certificate Program	Difference	t-Statistic
Mean	176.98	173.41	3.57	
Within-PHA standard error	3.79	3.89	5.43	0.66
Total standard error	15.31	13.85	6.68	0.53
F-statistic for variation across PHAs	16.92** (17,1136)	12.75** (17,1112)	1.51‡ (17,2248)	
Recipient Gross Rents				
Mean	462.03	440.39	21.64	
Within-PHA standard error	1.95	1.35	2.37	9.12**
Total standard error	19.02	17.56	5.68	3.81**
F-statistic for variation across PHAs	93.15** (17,1171)	164.19** (17,1152)	4.71** (17,2323)	
Change in Gross Rent[a]				
Mean	285.16	267.81	17.35	
Within-PHA standard error	4.29	4.13	5.95	2.92**
Total standard error	19.47	18.96	7.64	2.27*
F-statistic for variation across PHAs	22.70 (17,1136)	21.59** (17,1111)	1.41 (17,2247)	

** = Significant at 0.01 level
* = Significant at 0.05 level
‡ = Significant at 0.10 level

[a]Change figures may not equal the difference between pre and post figures due to missing values.

TABLE F.19
(TABLE 4.2 CONT.)

F-STATISTICS FOR SIGNIFICANCE OF DIFFERENCE BETWEEN OUTCOMES FOR RECIPIENTS WHO DID AND DID NOT PAY FULL RENTS

	Housing Voucher Program	Certificate Program	Difference
Pre-program gross rent	1441.45**	1358.24**	0.66
	(1,3366)	(1,3196)	(1,6562)
Recipient gross rent	0.31	10.03**	4.98*
	(1,3433)	(1,3262)	(1,6695)
Change in gross rent	1153.97**	1329.79**	0.24
	(1,3366)	(1,3195)	1,6561)

TABLE F.20
(TABLE 4.3)

PERCENT OF RECIPIENTS WHO MOVE FROM THEIR PRE-PROGRAM UNITS

	Housing Voucher Program	Certificate Program	Difference	t-Statistic
Mean	63.2%	63.1%	0.01 pts	
Within-PHA standard error	0.8 pts	0.8 pts	1.1 pts	0.10
Total standard error	4.7 pts	5.1 pts	1.4 pts	0.08
F-statistic for variation across PHAs	488.91** (17)	529.52** (17)	23.64‡ (17)	

** = Significant at 0.01 level
 * = Significant at 0.05 level
 ‡ = Significant at 0.10 level

TABLE F.21
(TABLE 4.3 CONT.)

COMPARISON OF RECIPIENT RENTS IN THE TWO PROGRAMS
FOR RECIPIENTS WHO MOVE FROM THEIR PRE-PROGRAM UNITS

Pre-Program Gross Rents	Housing Voucher Program	Certificate Program	Difference	t-Statistic
Mean	237.14	229.04	8.09	
Within-PHA standard error	3.14	3.19	4.48	1.81‡
Total standard error	14.29	14.50	4.48	1.81‡
F-statistic for variation across PHAs	22.35** (17,2084)	21.83** (17,1991)	0.64 (17,4075)	
Recipient Gross Rents				
Mean	493.02	459.94	33.07	
Within-PHA standard error	1.49	0.96	1.77	18.69**
Total standard error	20.17	17.53	5.53	5.98**
F-statistic for variation across PHAs	187.42** (17,2139)	349.49** (17,2047)	7.58** (17,4186)	
Change in Gross Rent[a]				
Mean	255.77	231.13	24.64	
Within-PHA standard error	3.32	3.32	4.70	5.25**
Total standard error	13.52	12.54	5.17	4.77**
F-statistic for variation across PHAs	18.06** (17,2084	15.07** (17,1991)	1.25 (17,4075)	

** = Significant at 0.01 level
* = Significant at 0.05 level
‡ = Significant at 0.10 level

[a]Change figures may not equal the difference between pre and post figures due to missing values.

TABLE F.22
(TABLE 4.3 CONT.)

COMPARISON OF RECIPIENT RENTS IN THE TWO PROGRAMS
FOR RECIPIENTS WHO STAY IN THEIR PRE-PROGRAM UNITS

Pre-Program Gross Rents	Housing Voucher Program	Certificate Program	Difference	t-Statistic
Mean	362.21	350.84	11.36	
Within-PHA standard error	2.80	2.74	3.92	2.90**
Total standard error	9.71	10.20	6.85	1.66‡
F-statistic for variation across PHAs	11.33** (17,1281)	15.49** (17,1206)	3.40** (17,2487)	
Initial Recient Gross Rents				
Mean	411.59	396.72	14.87	
Within-PHA standard error	2.05	1.61	2.60	5.71**
Total standard error	14.10	14.97	4.29	3.46**
F-statistic for variation across PHAs	46.84** (17,1293)	86.50** (17,1217)	3.06** (17,2510)	
Change in Gross Rent[a]				
Mean	49.69	46.15	3.54	
Within-PHA standard error	2.57	2.61	3.66	0.97
Total standard error	8.98	8.38	5.52	0.64
F-statistic for variation across PHAs	13.29** (17,1281)	13.08** (17,1205)	2.80** (17,2486)	

** = Significant at 0.01 level
* = Significant at 0.05 level
‡ = Significant at 0.10 level

[a]Change figures may not equal the difference between pre and post figures due to missing values.

TABLE F.23
(TABLE 4.3 CONT.)

F-STATISTICS FOR DIFFERENCES BETWEEN MOVERS AND STAYERS

	Housing Voucher Program	Certificate Program	Difference
Pre-program gross rent	752.58** (1,3365)	698.23** (1,3197)	0.25 (1,6562)
Recipient gross rent	10006.29** (1,3432)	1245.05** (1,3264)	33.07** (1,6696)
Change in gross rent	1948.53** (1,3365)	1554.54** (1,3196)	10.15** (1,6561)

** = Significant at 0.01 level
* = Significant at 0.05 level
‡ = Significant at 0.10 level

TABLE F.24
(TABLE 4.4)

MOBILITY AND FULL RENT

	Housing Voucher Program	Certificate Program	Difference	t-Statistic
Percent of recipients who moved and paid full rent				
Mean	33.9%	32.2%	1.7 pts	
Within-PHA standard error	0.8	0.8	1.2	1.41
Total standard error	2.6	2.5	1.5	1.13
χ^2-statistic for variation across PHAs	163.50**	154.09**	27.59*	
Percent of recipients who moved and did not pay full rent				
Mean	29.3%	30.8%	-1.6 pts	
Within-PHA standard error	0.8	0.8	1.1	1.38
Total standard error	2.8	3.7	1.3	1.19
χ^2-statistic for variation across PHAs	202.03**	274.28**	21.17	
Percent of recipients who stayed and paid full rent				
Mean	30.5%	30.5%	-0.0 pts	
Within-PHA standard error	0.8	0.8	1.1	0.06
Total standard error	3.8	4.2	1.1	0.06
χ^2-statistic for variation across PHAs	340.06**	402.08**	16.00	
Percent of recipients who stayed and did not pay full rent				
Mean	6.3%	6.4%	-0.0 pts	
Within-PHA standard error	0.4	0.4	0.6	0.08
Total standard error	1.2	0.9	0.9	0.05
χ^2-statistic for variation across PHAs	115.89**	77.92**	35.63**	

** = Significant at 0.01 level
* = Significant at 0.05 level
‡ = Significant at 0.10 level

TABLE F.25
(TABLE 4.4 CONT.)

RECIPIENT RENTS FOR RECIPIENTS WHO MOVED AND PAID FULL RENT

Pre-Program Gross Rents	Housing Voucher Program	Certificate Program	Difference	t-Statistic
Mean	310.06	305.19	4.87	
Within-PHA standard error	3.52	3.62	5.05	0.96
Total standard error	15.26	15.02	5.30	0.92
F-statistic for variation across PHAs	20.90** (16,1108)	17.66** (16,1025)	1.01 (16,2133)	
Initial Recient Gross Rents				
Mean	506.60	468.40	38.20	
Within-PHA standard error	2.07	1.34	2.46	15.51**
Total standard error	21.67	18.12	6.95	5.50**
F-statistic for variation across PHAs	110.28** (16,1134)	193.29** (16,1046)	5.36** (16,2180)	
Change in Gross Rent[a]				
Mean	196.12	163.42	32.70	
Within-PHA standard error	3.80	3.79	5.36	6.10**
Total standard error	13.90	10.84	7.83	4.18**
F-statistic for variation across PHAs	15.54** (16,1108)	8.93** (1,1205)	2.57** (1,2133)	

** = Significant at 0.01 level
 * = Significant at 0.05 level
 ‡ = Significant at 0.10 level

[a]Change figures may not equal the difference between pre and post figures due to missing values.

TABLE F.26
(TABLE 4.4 CONT.)

RECIPIENT RENTS FOR RECIPIENTS WHO MOVED AND DID NOT PAY FULL RENT

Pre-Program Gross Rents	Housing Voucher Program	Certificate Program	Difference	t-Statistic
Mean	152.88	149.35	3.53	
Within-PHA standard error	4.04	4.11	5.76	0.61
Total standard error	13.39	11.43	5.76	0.61
F-statistic for variation across PHAs	13.13** (16,914)	8.68** (16,905)	0.96 (16,1819)	
Initial Recient Gross Rents				
Mean	477.27	451.05	26.22	
Within-PHA standard error	2.05	1.35	2.46	10.67**
Total standard error	18.67	17.07	5.80	4.52**
F-statistic for variation across PHAs	84.23** (16,943)	162.53** (16,940)	5.16** (16,1883)	
Change in Gross Rent[a]				
Mean	324.25	302.66	21.60	
Within-PHA standard error	4.49	4.28	6.20	3.48**
Total standard error	14.44	13.47	6.41	3.37**
F-statistic for variation across PHAs	11.58** (16,914)	10.43** (16,905)	1.01 (16,1819)	

** = Significant at 0.01 level
* = Significant at 0.05 level
‡ = Significant at 0.10 level

[a]Change figures may not equal the difference between pre and post figures due to missing values.

TABLE F.27
(TABLE 4.4 CONT.)

F-STATISTICS FOR DIFFERENCES IN RENTS FOR RECIPIENTS WHO MOVE BETWEEN THOSE WHO DID AND DID NOT PAY FULL RENT

[QQQQ] format?

	Housing Voucher Program	Certificate Program	Difference
Pre-program gross rent	871.44** (1,2022)	803.59** (1,1930)	0.03 (1,3952)
Recipient gross rent	88.94** (1,2077)	78.87** (1,1986)	10.41** (1,4063)
Change in gross rent	480.10** (1,20220	582.70** (1,1930)	1.82 (1,3952)

** = Significant at 0.01 level
* = Significant at 0.05 level
‡ = Significant at 0.10 level

TABLE F.28
(TABLE 4.5)

RECIPIENT RENTS FOR RECIPIENTS WHO STAYED IN THEIR PRE-ENROLLMENT UNIT AND PAID FULL RENT

Pre-Program Gross Rents	Housing Voucher Program	Certificate Program	Difference	t-Statistic
Mean	376.47	362.91	13.55	
Within-PHA standard error	2.69	2.55	3.71	3.65**
Total standard error	10.35	11.06	5.90	2.30*
F-statistic for variation across PHAs	14.02** (16,1058)	20.02** (16,998)	2.73* (16,2056)	
Initial Recient Gross Rents				
Mean	415.72	398.38	17.34	
Within-PHA standard error	2.21	1.68	2.77	6.26**
Total standard error	13.79	15.09	4.76	3.64**
F-statistic for variation across PHAs	39.64** (16,1064)	78.58** (16,1003)	3.13** (16,2067)	
Change in Gross Rent[a]				
Mean	38.96	35.13	3.83	
Within-PHA standard error	2.32	2.24	3.22	1.19
Total standard error	7.41	7.09	4.02	0.95
F-statistic for variation across PHAs	11.59** (16,1058)	12.68** (16,998)	2.33** (16,2056)	

** = Significant at 0.01 level
* = Significant at 0.05 level
‡ = Significant at 0.10 level

[a]Change figures may not equal the difference between pre and post figures due to missing values.

TABLE F.29
(TABLE 4.5 CONT.)

RECIPIENT RENTS FOR THOSE WHO STAYED IN THEIR PRE-ENROLLMENT UNITS AND DID NOT PAY FULL RENT

Pre-Program Gross Rents	Housing Voucher Program	Certificate Program	Difference	t-Statistic
Mean	291.20	292.73	-1.53	
Within-PHA standard error	8.09	7.74	11.20	0.14
Total standard error	13.34	14.27	12.44	0.12
F-statistic for variation across PHAs	2.81** (16,183)	3.53** (16,164)	1.79** (16,347)	
Initial Recient Gross Rents				
Mean	391.74	388.61	3.13	
Within-PHA standard error	5.16	4.19	6.64	0.47
Total standard error	20.50	17.85	19.46	0.16
F-statistic for variation across PHAs	13.67** (16,188)	17.83** (16,169)	17.70** (16,357)	
Change in Gross Rent[a]				
Mean	101.30	98.95	2.35	
Within-PHA standard error	7.86	7.97	11.19	0.21
Total standard error	20.44	20.36	19.37	0.12
F-statistic for variation across PHAs	6.66** (16,183)	6.31** (16,163)	4.85** (16,346)	

** = Significant at 0.01 level
* = Significant at 0.05 level
‡ = Significant at 0.10 level

[a]Change figures may not equal the difference between pre and post figures due to missing values.

TABLE F.30
(TABLE 4.5 CONT.)

F-STATISTICS FOR DIFFERENCES IN RENTS FOR RECIPIENTS WHO STAYED IN THIER PRE-ENROLLMENT UNIT AND PAID FULL RENT

	Housing Voucher Program	Certificate Program	Difference
Pre-program gross rent	151.10** (1,1241)	113.29** (1,1162)	2.47 (1,2403)
Recipient gross rent	19.37** (1,1252)	5.13* (1,1172)	4.08* (1,2424)
Change in gross rent	104.27** (1,1241)	118.35** (1,1161)	0.03 (1,2402)

** = Significant at 0.01 level
* = Significant at 0.05 level
‡ = Significant at 0.10 level

TABLE F.31
(TABLE 4.7)

RENTS FOR RECIPIENTS WHO QUALIFIED IN PLACE WITHOUT REPAIRS

Pre-Program Gross Rents	Housing Voucher Program	Certificate Program	Difference	t-Statistic
Mean	365.92	354.37	11.56	
Within-PHA standard error	3.04	3.28	4.47	2.59*
Total standard error	8.86	10.37	6.73	1.72‡
F-statistic for variation across PHAs	7.15** (16,838)	10.93** (16,811)	2.45** (16,1649)	
Initial Recient Gross Rents				
Mean	404.17	392.47	11.70	
Within-PHA standard error	2.45	1.90	3.10	3.78**
Total standard error	13.32	13.89	3.13	3.73**
F-statistic for variation across PHAs	25.53** (16,846)	49.85** (16,817)	1.10 (16,1663)	
Change in Gross Rent[a]				
Mean	38.55	38.86	-0.31	
Within-PHA standard error	2.49	3.09	3.97	0.08
Total standard error	6.80	8.17	6.44	0.05
F-statistic for variation across PHAs	7.13** (16,838)	8.98** (16,811)	3.00** (16,1649)	

** = Significant at 0.01 level
 * = Significant at 0.05 level
 ‡ = Significant at 0.10 level

[a]Change figures may not equal the difference between pre and post figures due to missing values.

TABLE F.32
(TABLE 4.7 CONT.)

RENTS FOR RECIPIENTS WHO QUALIFIED IN PLACE WITH REPAIRS

Pre-Program Gross Rents	Housing Voucher Program	Certificate Program	Difference	t-Statistic
Mean	355.37	344.84	10.53	
Within-PHA standard error	5.48	4.82	7.29	1.44
Total standard error	12.21	12.83	9.18	1.15
F-statistic for variation across PHAs	5.35** (16,395)	8.54** (16,346)	2.67** (16,741)	
Initial Recient Gross Rents				
Mean	424.49	404.63	19.85	
Within-PHA standard error	3.64	2.84	4.62	4.30**
Total standard error	16.33	18.36	7.24	2.74*
F-statistic for variation across PHAs	23.45** (16,399)	46.21** (16,350)	5.53** (16,749)	
Change in Gross Rent[a]				
Mean	68.46	59.12	9.34	
Within-PHA standard error	5.38	4.76	7.18	1.30
Total standard error	12.04	10.13	7.18	1.30
F-statistic for variation across PHAs	6.05** (16,395)	6.21** (16,345)	0.89** (16,740)	

** = Significant at 0.01 level
* = Significant at 0.05 level
‡ = Significant at 0.10 level

[a]Change figures may not equal the difference between pre and post figures due to missing values.

TABLE F.33
(TABLE 4.7 CONT.)

F-STATISTICS FOR DIFFERENCES BETWEEN RECIPIENTS QUALIFYING IN PLACE WITH AND WITHOUT REPAIRS

	Housing Voucher Program	Certificate Program	Difference
Pre-program gross rent	3.22‡ (1,1233)	2.74‡ (1,1157)	0.02 (1,2390)
Recipient gross rent	20.79** 1,1245)	11.83** (1,1167)	2.00 1,2412)
Change in gross rent	32.78** (1,1233)	14.97** (1,1156)	1.70 (1,2389)

** = Significant at 0.01 level
* = Significant at 0.05 level
‡ = Significant at 0.10 level

TABLE F.34
(TABLE 4.8)

COMPARISON OF RECIPIENT RENTS AT ANNUAL RECERTIFICATION

Initial Recipient Gross Rents	Housing Voucher Program	Certificate Program	Difference	t-Statistic
Mean	$454.86	$429.59	$25.27	
Within-PHA standard error	2.12	1.58	2.65	9.54**
Total standard error	18.53	17.49	5.43	4.65**
F-statistic for variation across PHAs	143.32** (17,1754)	219.01** (17,1598)	5.78** (17,3352)	
Recertification Gross Rents				
Mean	$473.37	$450.20	$23.17	
Within-PHA standard error	2.22	1.85	2.89	8.02**
Total standard error	18.73	18.51	5.18	4.47**
F-statistic for variation across PHAs	128.14** (17,1716)	196.69** (17,1554)	4.12** (17,3270)	
First Year Change in Gross Rent[a]				
Mean	$18.27	$20.84	$-2.58	
Within-PHA standard error	1.25	1.13	1.69	1.53
Total standard error	3.01	2.91	2.41	1.07
F-statistic for variation across PHAs	5.05** (17,1716)	9.30** (17,1554)	2.37** (17,3270)	

** = Significant at 0.01 level
 * = Significant at 0.05 level
 ‡ = Significant at 0.10 level

[a]Change figures may not equal the difference between pre and post figures due to missing values.

TABLE F.35
(TABLE 4.9)

PERCENT OF RECIPIENTS WHO MOVE FROM THEIR INITIAL UNIT BY RECERTIFICATION

	Housing Voucher Program	Certificate Program	Difference	t-Statistic
Mean	16.6%	14.6%	2.0 pts	
Within-PHA standard error	1.2 pts	1.2 pts	1.7 pts	1.15
Total standard error	1.7 pts	2.2 pts	1.7 pts	1.15
Chi-square statistic for variation across PHAs	49.06** (17)	73.61** (17)	12.90 (17)	

** = Significant at 0.01 level
 * = Significant at 0.05 level
 ‡ = Significant at 0.10 level

TABLE F.36
(TABLE 4.9 CONT.)

COMPARISON OF RECIPIENT RENTS AT ANNUAL RECERTIFICATION FOR RECIPIENTS WHO MOVE

Initial Recipient Rents	Housing Voucher Program	Certificate Program	Difference	t-Statistic
Mean	466.82	430.98	35.85	
Within-PHA standard error	4.41	3.96	5.93	6.05**
Total standard error	20.55	17.25	8.75	4.10**
F-statistic for variation across PHAs	49.93** (17,239)	37.98** (17,200)	3.79** (17,439)	
Recertification Rent				
Mean	492.53	470.41	22.12	
Within-PHA standard error	5.17	3.43	6.20	3.57**
Total standard error	20.83	22.39	13.47	1.64‡
F-statistic for variation across PHAs	29.59** (17,236)	41.06** (17,197)	3.15** (17,433)	
First Year Change in Gross Rent[a]				
Mean	26.52	44.26	-17.74	
Within-PHA standard error	4.99	4.32	6.60	2.69**
Total standard error	8.93	8.64	11.82	1.50
F-statistic for variation across PHAs	2.66** (17,236)	4.39** (17,197)	2.20** (17,433)	

** = Significant at 0.01 level
* = Significant at 0.05 level
‡ = Significant at 0.10 level

[a]Change figures may not equal the difference between pre and post figures due to missing values.

TABLE F.37
(TABLE 4.9 CONT.)

COMPARISON OF RECIPIENT RENTS AT ANNUAL RECERTIFICATION FOR RECIPIENTS WHO STAY IN THEIR INITIAL UNIT

Initial Recipient Rent	Housing Voucher Program	Certificate Program	Difference	t-Statistic
Mean	450.28	427.97	22.30	
Within-PHA standard error	2.34	1.63	2.85	7.82**
Total standard error	18.10	17.57	5.54	4.02**
F-statistic for variation across PHAs	108.24** (17,1449)	192.68** (17,1336)	4.75** (17,2785)	
Recertification Rent				
Mean	467.86	445.06	22.80	
Within-PHA standard error	2.36	1.77	2.95	7.73**
Total standard error	18.41	18.20	5.21	4.38**
F-statistic for variation across PHAs	104.93** (17,1415)	182.88** (17,1297)	4.14** (17,2712)	
First-Year Change in Gross Rent[a]				
Mean	17.18	16.50	0.68	
Within-PHA standard error	0.83	0.77	1.14	0.60
Total standard error	2.71	2.78	2.09	0.33
F-statistic for variation across PHAs	7.48** (17,1415)	17.80** (17,1297)	3.71** (17,2712)	

** = Significant at 0.01 level
* = Significant at 0.05 level
‡ = Significant at 0.10 level

[a]Change figures may not equal the difference between pre and post figures due to missing values.

TABLE F.38
(TABLE 4.9 CONT.)

F-STATISTICS FOR DIFFERENCES IN GROSS RENTS BETWEEN MOVERS AND STAYERS AT ANNUAL RECERTIFICATION

F-Statistic For:	Housing Voucher Program	Housing Certificate Program	Difference
Initial recipient rents	7.47** (1,1688)	0.44 (1,1536)	3.01 (1,3224)
Recertification rent	14.73** (1,1651)	26.03** (1,1494)	0.01 (1,3145)
Change in rents	7.14** (1,1651)	91.97** (1,1494)	15.76** (1,3145)

TABLE F.39
(TABLE 6.1)

COMPARISON OF TENANT CONTRIBUTIONS IN THE TWO PROGRAMS

Pre-Program	Housing Voucher Program	Certificate Program	Difference	t-Statistic
Mean	$283.59	$274.48	9.11	
Within-PHA standard error	2.48	2.45	3.49	2.61**
Total standard error	15.05	15.67	3.60	2.55**
F-statistic for variation across PHAs	37.37** (17,3430)	41.45** (17,3260)	1.04 (17,6690)	
Recipient				
Mean	$153.36	$143.52	9.85	
Within-PHA standard error	1.47	1.09	1.83	5.38**
Total standard error	7.11	6.63	4.82	2.04*
F-statistic for variation across PHAs	24.22** (17,3497)	40.10** (17,3227)	6.63** (17,6824)	
Change[a]				
Mean	$-129.71	$-130.77	1.06	
Within-PHA standard error	2.55	2.46	3.55	0.30
Total standard error	11.42	10.55	4.55	0.23
F-statistic for variation across PHAs	20.19** (17,3430)	19.40** (17,3259)	1.67* (17,6689)	

** = Significant at 0.01 level
* = Significant at 0.05 level
‡ = Significant at 0.10 level

[a]Change figures may not equal the difference between pre and post figures due to missing values.

TABLE F.40
(TABLE 6.1 CONT.)

COMPARISON OF TENANT CONTRIBUTION IN THE TWO PROGRAMS FOR RECIPIENTS WHO PAID FULL RENT IN THEIR PRE-PROGRAM AND PROGRAM UNITS

Pre-Program	Housing Voucher Program	Certificate Program	Difference	t-Statistic
Mean	\$341.84	\$333.29	\$8.56	
Within-PHA standard error	2.43	2.41	3.42	2.50*
Total standard error	13.52	13.27	4.53	1.89‡
F-statistic for variation across PHAs	31.25** (17,2230)	32.08 (17,2084)	1.63‡ (17,4314)	
Recipient				
Mean	\$158.37	\$152.68	\$5.69	
Within-PHA standard error	1.90	1.36	2.34	2.44*
Total standard error	6.97	6.13	4.14	1.37
F-statistic for variation across PHAs	14.11** (17,2262)	22.04** (17,2110)	3.20** (17,4372)	
Change[a]				
Mean	\$-183.25	\$-180.53	\$-2.72	
Within-PHA standard error	2.65	2.55	3.68	0.74
Total standard error	9.35	8.64	4.59	0.59
F-statistic for variation across PHAs	13.21** (17,2230)	12.55** (17,2084)	1.59‡ (17,4314)	

** = Significant at 0.01 level
* = Significant at 0.05 level
‡ = Significant at 0.10 level

[a]Change figures may not equal the difference between pre and post figures due to missing values.

TABLE F.41
(TABLE 6.1 (CONT.)

COMPARISON OF TENANT CONTRIBUTION IN THE TWO PROGRAMS FOR RECIPIENTS WHO DID NOT PAY FULL RENT IN THEIR PRE-PROGRAM OR PROGRAM UNITS

Pre-Program	Housing Voucher Program	Certificate Program	Difference	t-Statistic
Mean	$176.98	$173.41	$3.57	
Within-PHA standard error	3.79	3.87	5.43	0.66
Total standard error	15.31	13.85	6.68	0.53
F-statistic for variation across PHAs	16.92** (17,1136)	12.75** (17,1112)	1.51‡ (17,2248)	
Recipient				
Mean	$144.31	$128.06	$16.25	
Within-PHA standard error	2.21	1.75	2.82	5.77**
Total standard error	8.53	7.06	6.85	2.37*
F-statistic for variation across PHAs	14.55** (17,1171)	18.84** (17,1152)	5.84** (17,2323)	
Change[a]				
Mean	$-31.73	$-45.18	$13.46	
Within-PHA standard error	4.13	3.99	5.74	2.34*
Total standard error	11.34	9.39	9.10	1.48
F-statistic for variation across PHAs	7.89** (17,1136)	5.60** (17,1111)	2.43** (17,2247)	

** = Significant at 0.01 level
* = Significant at 0.05 level
‡ = Significant at 0.10 level

[a]Change figures may not equal the difference between pre and post figures due to missing values.

TABLE F.42
(TABLE 6.1 CONT.)

F-STATISTICS FOR DIFFERENCES BY GROUP

	Housing Voucher Program	Certificate Program	Difference
Pre-program tenant contribution	1441.45** (1,3366)	1358.24** (1,3196)	0.66 (1,6562)
Recipient tenant contribution	19.20** (1,3433)	129.10** (1,3262)	7.30** (1,6695)
Change in tenant contribution	991.22** (1,3366)	904.41** (1,3195)	6.00* (1,6561)

TABLE F.43
(TABLE 6.2)

COMPARISON OF TENANT CONTRIBUTIONS IN THE TWO PROGRAMS FOR FULL RENT MOVERS

Pre-Enrollment	Housing Voucher Program	Certificate Program	Difference	t-Statistic
Mean	\$310.06	\$305.19	\$4.87	
Within-PHA standard error	3.52	3.62	5.05	0.96
Total standard error	15.26	15.02	5.30	0.92
F-statistic for variation across PHAs	20.90** (16,1108)	17.66** (16,1025)	1.01 (16,2133)	
Recipient				
Mean	\$173.11	\$148.00	\$25.11	
Within-PHA standard error	2.63	2.03	3.32	7.56**
Total standard error	8.88	6.81	4.45	5.65**
F-statistic for variation across PHAs	11.35** (16,1134)	12.54** (16,1046)	1.14 (17,2180)	
Change[a]				
Mean	\$-136.48	\$-156.49	\$-20.01	
Within-PHA standard error	3.85	8.86	5.45	3.67**
Total standard error	8.09	9.65	5.74	3.49**
F-statistic for variation across PHAs	5.13** (16,1108)	6.56** (16,1025)	1.40 (16,2133)	

** = Significant at 0.01 level
 * = Significant at 0.05 level
 ‡ = Significant at 0.10 level

[a]Change figures may not equal the difference between pre and post figures due to missing values.

TABLE F.44
(TABLE 6.2 CONT.)

COMPARISON OF TENANT CONTRIBUTIONS IN THE TWO PROGRAMS FOR NON-FULL RENT MOVERS

Pre-Enrollment	Housing Voucher Program	Certificate Program	Difference	t-Statistic
Mean	$152.88	$149.35	$3.53	
Within-PHA standard error	4.04	4.11	5.76	0.61
Total standard error	13.39	11.45	5.75	0.61
F-statistic for variation across PHAs	13.13** (16,914)	8.68** (16,905)	0.96 (16,1819)	
Recipient				
Mean	$145.30	$125.09	$20.21	
Within-PHA standard error	2.44	1.97	3.13	6.46**
Total standard error	9.23	7.30	6.95	2.91**
F-statistic for variation across PHAs	14.36** (16,943)	16.69** (16,940)	5.03** (16,1883)	
Change[a]				
Mean	$-5.79	$-23.78	$17.98	
Within-PHA standard error	4.43	4.20	0.10	2.95**
Total standard error	8.83	7.27	8.99	2.00*
F-statistic for variation across PHAs	4.31** (16,914)	3.01** (16,905)	2.08** (16,1819)	

** = Significant at 0.01 level
 * = Significant at 0.05 level
 ‡ = Significant at 0.10 level

[a]Change figures may not equal the difference between pre and post figures due to missing values.

TABLE F.45
(TABLE 6.2 CONT.)

COMPARISON OF TENANT CONTRIBUTIONS IN THE TWO PROGRAMS FOR STAYERS

Pre-Enrollment	Housing Voucher Program	Certificate Program	Difference	t-Statistic
Mean	\$362.21	\$350.84	\$11.36	
Within-PHA standard error	2.80	2.74	3.92	2.90**
Total standard error	9.71	10.20	6.85	1.66‡
F-statistic for variation across PHAs	11.33** (17,1281)	15.49** (17,1206)	3.40** (17,2487)	
Recipient				
Mean	\$141.59	\$155.00	\$-13.42	
Within-PHA standard error	2.41	1.62	2.91	4.62**
Total standard error	4.93	5.25	4.54	2.96**
F-statistic for variation across PHAs	4.95** (16,1293)	11.65** (16,1217)	2.21** (16,2510)	
Change[a]				
Mean	\$-220.36	\$-195.96	\$-24.40	
Within-PHA standard error	2.84	2.96	4.11	5.94**
Total standard error	6.18	6.66	4.51	5.41**
F-statistic for variation across PHAs	4.73** (16,1281)	6.05** (16,1205)	1.58 (16,2486)	

** = Significant at 0.01 level
* = Significant at 0.05 level
‡ = Significant at 0.10 level

[a]Significance of t-statistic for total standard error based on degrees of freedom as indicated in Section C.1.2 of Appendix C.

TABLE F.46
(TABLE 6.2 CONT.)

F-STATISTICS FOR DIFFERENCES AMONG THE THREE GROUPS

	Housing Voucher Program	Certificate Program	Difference
Pre-program tenant contribution	NA	NA	NA
Recipient tenant contribution	178.96** (2,3370)	292.99** (2,3203)	185.98** (2,6573)
Change in tenant contribution	3311.09** (2,3303)	2425.79** (2,3135)	102.74** (2,6438)

** = Significant at 0.01 level
 * = Significant at 0.05 level
 ‡ = Significant at 0.10 level

TABLE F.47
(TABLE 6.3)

COMPARISON OF RENT BURDENS IN THE TWO PROGRAMS

Pre-Program	Housing Voucher Program	Certificate Program	Difference	t-Statistic
Mean	67.3%	65.4%	1.9 pts	
Within-PHA standard error	1.1 pts	0.9 pts	1.4 pgs	1.31
Total standard error	1.9 pts	2.8 pts	1.8 pts	1.05
F-statistic for variation across PHAs	76.73** (17)	125.23** (17)	31.11* (17)	
Program				
Mean	34.9%	30.8%	4.1 pts	
Within-PHA standard error	1.2 pts	0.0 pts	1.2 pts	3.30**
Total standard error	2.4 pts	0.7 pts	2.6 pts	1.58
Chi-square statistic for variation across PHAs	111.32** (17)	7.78 (17)	54.26** (17)	
Change[a]				
Mean	-32.7 pts	-34.5 pts	1.9 pts	
Within-PHA standard error	1.3 pts	0.9 pts	1.6 pts	1.19
Total standard error	2.3 pts	2.6 pts	2.0 pts	0.92
F-statistic for variation across PHAs	4.43** (17,3427)	9.03** (17,3255)	1.87** (17,6682)	

** = Significant at 0.01 level
* = Significant at 0.05 level
‡ = Significant at 0.10 level

[a]Change figures may not equal the difference between pre and post figures due to missing values.

TABLE F.48
(TABLE 6.3 CONT.)

COMPARISON OF RECIPIENT RENT BURDENS IN THE TWO PROGRAMS FOR RECIPIENTS WHO PAID THEIR FULL PROGRAM AND PRE-PROGRAM RENTS

Pre-Program	Housing Voucher Program	Certificate Program	Difference	t-Statistic
Mean	79.4%	75.4%	4.0 pts	
Within-PHA standard error	1.5 pts	1.0 pts	1.8 pts	2.22*
Total standard error	3.2 pts	2.2 pts	2.1 pts	1.93‡
F-statistic for variation across PHAs	7.09** (17,2229)	5.36** (17,2081)	1.76* (17,4310)	
Recipient				
Mean	33.7%	30.9%	2.9 pts	
Within-PHA standard error	1.8 pts	0.0 pts	1.8 pts	1.63
Total standard error	2.2 pts	0.7 pts	2.3 pts	1.25
F-statistic for variation across PHAs	2.35** (17,2260)	69.46** (17,2107)	1.95* (17,4367)	
Change[a]				
Mean	-46.1 pts	-44.5 pts	-1.6 pts	
Within-PHA standard error	1.6 pts	1.0 pts	1.9 pts	0.82
Total standard error	2.1 pts	2.2 pts	1.9 pts	0.82
F-statistic for variation across PHAs	3.07** (17,2229)	5.56** (17,2081)	1.12 (17,4310)	

** = Significant at 0.01 level
* = Significant at 0.05 level
‡ = Significant at 0.10 level

[a]Change figures may not equal the difference between pre and post figures due to missing values.

TABLE F.49
(TABLE 6.3 CONT.)

COMPARISON OF RECIPIENT RENT BURDENS IN THE TWO PROGRAMS FOR RECIPIENTS WHO DID NOT PAY FULL RENT IN THEIR PRE-PROGRAM OR PROGRAM UNIT

Pre-Program	Housing Voucher Program	Certificate Program	Difference	t-Statistic
Mean	45.0%	48.1%	-3.1 pts	
Within-PHA standard error	1.2 pts	1.7 pts	2.1 pts	1.51
Total standard error	2.4 pts	4.3 pts	3.3 pts	0.94
F-statistic for variation across PHAs	3.97** (17,1134)	8.21** (17,1111)	2.78* (17,2245)	
Recipient				
Mean	37.0%	30.7%	6.3 pts	
Within-PHA standard error	1.4 pts	0.3 pts	1.4 pts	4.31**
Total standard error	2.6 pts	0.7 pts	3.0 pts	2.13*
F-statistic for variation across PHAs	3.68** (17,1169)	10.05** (17,1151)	4.20** (17,2320)	
Change				
Mean	-8.0 pts	-17.4 pts	9.4 pts	
Within-PHA standard error	1.8 pts	1.6 pts	2.4 pts	3.96**
Total standard error	3.6 pts	4.0 pts	4.5 pts	2.08*
F-statistic for variation across PHAs	4.89** (17,1134)	7.68** (17,1110)	3.77** (17,2244)	

** = Significant at 0.01 level
* = Significant at 0.05 level
‡ = Significant at 0.10 level

[a]Change figures may not equal the difference between pre and post figures due to missing values.

TABLE F.50
(TABLE 6.3 CONT.)

F-STATISTICS FOR DIFFERENCES ACROSS GROUPS

	Housing Voucher Program	Certificate Program	Difference
Pre-program rent burden	328.14** (1,3363)	288.21** 1,3192)	8.20** (1,6555)
Recipient rent burden	2.17 (1,3429)	0.56 (1,3258)	2.24 (1,6687)
Change in rent burden	300.82** (1,3363)	297.47** (1,3191)	16.27** (1,6554)

TABLE F.51
(TABLE 6.4)

COMPARISON OF RECIPIENT RENT BURDENS IN THE TWO PROGRAMS FOR FULL RENT MOVERS

Pre-Enrollment	Housing Voucher Program	Certificate Program	Difference	t-Statistic
Mean	75.9%	71.7%	4.2 pts	
Within-PHA standard error	2.2 pts	1.4 pts	2.6 pts	1.62
Total standard error	3.3 pts	2.3 pts	2.6 pts	1.62
F-statistic for variation across PHAs	2.69** (17,1108)	3.21** (17,1023)	0.96 (17,2131)	
Recipient				
Mean	39.3%	30.6%	8.7 pts	
Within-PHA standard error	3.3 pts	0.0 pts	3.3 pts	2.65**
Total standard error	3.3 pts	0.8 pts	3.4 pts	2.55**
F-statistic for variation across PHAs	0.92 (17,1133)	93.13** (17,1044)	0.73 (17,2177)	
Change[a]				
Mean	-37.2 pts	-41.1 pts	3.9 pts	
Within-PHA standard error	2.5 pts	1.4 pts	2.9 pts	1.34
Total standard error	2.5 pts	2.4 pts	3.0 pts	1.28
F-statistic for variation across PHAs	1.10 (17,1108)	3.31** (17,1023)	1.10 (17,2131)	

** = Significant at 0.01 level
 * = Significant at 0.05 level
 ‡ = Significant at 0.10 level

[a]Change figures may not equal the difference between pre and post figures due to missing values.

TABLE F.52
(TABLE 6.4 CONT.)

COMPARISON OF RECIPIENT RENT BURDENS IN THE TWO PROGRAMS
FOR NON-FULL RENT MOVERS

Pre-Enrollment	Housing Voucher Program	Certificate Program	Difference	t-Statistic
Mean	40.7%	42.7%	-2.0 pts	
Within-PHA standard error	1.3 pts	1.7 pts	2.1 pts	0.94
Total standard error	2.1 pts	4.0 pts	3.5 pts	0.58
F-statistic for variation across PHAs	2.29** (17,913)	7.29** (17,904)	3.23** (17,1817)	
Recipient				
Mean	39.0%	30.7%	8.3 pts	
Within-PHA standard error	1.7 pts	0.4 pts	1.8 pts	4.72**
Total standard error	2.8 pts	0.6 pts	3.0 pts	2.75**
F-statistic for variation across PHAs	2.69** (17,942)	12.95** (17,939)	3.20** (17,1881)	
Change[a]				
Mean	-1.6 pts	-12.0 pts	10.4 pts	
Within-PHA standard error	2.0 pts	1.5 pts	2.6 pts	4.09**
Total standard error	3.3 pts	3.9 pts	4.8 pts	2.18*
F-statistic for variation across PHAs	2.82** (17,913)	6.85** (17,904)	3.35** (17,1817)	

** = Significant at 0.01 level
* = Significant at 0.05 level
‡ = Significant at 0.10 level

[a]Change figures may not equal the difference between pre and post figures due to missing values.

TABLE F.53
(TABLE 6.4-CONT.)

COMPARISON OF RECIPIENT RENT BURDENS IN THE TWO PROGRAMS FOR STAYERS

Pre-Enrollment	Housing Voucher Program	Certificate Program	Difference	t-Statistic
Mean	80.2%	78.4%	1.8 pts	
Within-PHA standard error	1.6 pts	1.5 pts	2.2 pts	0.32
Total standard error	3.1 pts	2.6 pts	2.8 pts	1.65
F-statistic for variation across PHAs	7.28** (16,1279)	3.75** (16,1205)	3.14** (16,2054)	
Recipient				
Mean	27.6%	31.1%	-3.6 pts	
Within-PHA standard error	0.4 pts	0.0 pts	0.4 pts	7.84**
Total standard error	1.0 pts	0.7 pts	1.1 pts	3.16**
F-statistic for variation across PHAs	7.40** (16,1291)	24.64** (16,1216)	8.03** (16,2507)	
Change[a]				
Mean	-52.7 pts	-47.3 pts	-5.5 pts	
Within-PHA standard error	1.5 pts	1.5 pts	2.1 pts	2.54*
Total standard error	2.3 pts	2.7 pts	2.6 pts	2.12*
F-statistic for variation across PHAs	5.15** 16,1279)	4.02** (16,1204)	2.64* (16,2483)	

** = Significant at 0.01 level
 * = Significant at 0.05 level
 ‡ = Significant at 0.10 level

[a]Change figures may not equal the difference between pre and post figures due to missing values.

TABLE F.54
(TABLE 6.4 CONT.)

TEST STATISTICS FOR DIFFERENCES IN RENT BURDENS AMONG GROUPS

	Housing Voucher Program	Certificate Program	Difference
Pre-enrollment rent burden	747.31** (2,3300)	817.55** (2,3132)	8.84** (2,6432)
Recipient rent burden	57.32** (2,3366)	13.50** (2,3199)	58.11** (2,6565)
Change in rent burden	861.77** (2,3300)	837.19** (2,3131)	55.27** (2,6431)

TABLE F.55
(TABLE 6.5)

COMPARISON OF RECIPIENT RENT BURDENS IN THE TWO PROGRAMS FOR RECIPIENTS WITH ANNUAL INCOMES OF AT LEAST $3,600

Pre-Program	Housing Voucher Program	Certificate Program	Difference	t-Statistic
Mean	58.9%	56.9%	2.0 pts	
Within-PHA standard error	0.7 pts	0.7 pts	0.9 pts	2.06*
Total standard error	2.1 pts	2.5 pts	1.4 pts	1.43
F-statistic for variation across PHAs	11.90** (17,2844)	14.98** (17,2713)	1.11 (17,5557)	
Recipient				
Mean	32.1%	30.5%	1.6 pts	
Within-PHA standard error	0.3 pts	0.0 pts	0.3 pts	5.69**
Total standard error	0.8 pts	0.4 pts	1.1 pts	1.44
F-statistic for variation across PHAs	10.11** (17,2885)	65.87** (17,2765)	12.05** (17,5650)	
Change[a]				
Mean	-26.8 pts	-26.4 pts	-0.4 pts	
Within-PHA standard error	0.7 pts	0.7 pts	1.0 pts	0.47
Total standard error	2.5 pts	2.4 pts	1.3 pts	0.36
F-statistic for variation across PHAs	15.58** (17,2844)	13.76** (17,2712)	1.35 (17,5556)	

** = Significant at 0.01 level
* = Significant at 0.05 level
‡ = Significant at 0.10 level

[a]Change figures may not equal the difference between pre and post figures due to missing values.

TABLE F.56
(TABLE 6.5 CONT.)

COMPARISON OF RECIPIENT RENT BURDENS IN THE TWO PROGRAMS FOR RECIPIENTS WITH ANNUAL INCOMES OF AT LEAST $3,600 WHO WERE PAYING FULL RENT IN THEIR PRE-ENROLLMENT AND RECIPIENT UNITS

Pre-Program	Housing Voucher Program	Certificate Program	Difference	t-Statistic
Mean	68.8%	67.9%	0.8 pts	
Within-PHA standard error	0.6 pts	0.6 pts	0.9 pts	0.90
Total standard error	1.8 pts	1.8 pts	1.1 pts	0.71
F-statistic for variation across PHAs	8.22** (16,1932)	9.21** (16,1822)	1.86* (16,3754)	
Recipients				
Mean	31.2%	30.7%	0.5 pts	
Within-PHA standard error	0.3 pts	0.0 pts	0.3 pts	1.52**
Total standard error	0.8 pts	0.4 pts	1.0 pts	0.49
F-statistic for variation across PHAs	7.92** (16,1951)	53.88** (16,1842)	9.03** (16,3793)	
Change[a]				
Mean	-37.6 pts	-37.3 pts	-0.4 pts	
Within-PHA standard error	0.6 pts	0.6 pts	0.9 pts	0.40
Total standard error	2.0 pts	1.8 pts	1.1 pts	0.33
F-statistic for variation across PHAs	10.33** (16,1932)	8.89** (16,1822)	1.65‡ (16,3754)	

** = Significant at 0.01 level
* = Significant at 0.05 level
‡ = Significant at 0.10 level

[a]Change figures may not equal the difference between pre and post figures due to missing values.

TABLE F.57
(TABLE 6.5 CONT.)

COMPARISON OF RECIPIENT RENT BURDENS IN THE TWO PROGRAMS FOR RECIPIENTS WITH ANNUAL INCOMES OF AT LEAST $3,600 WHO WERE NOT PAYING FULL RENT IN THEIR PRE-ENROLLMENT OR RECIPIENT UNIT

Pre-Program	Housing Voucher Program	Certificate Program	Difference	t-Statistic
Mean	41.5%	41.3%	0.2 pts	
Within-PHA standard error	1.0 pts	1.0 pts	0.4 pts	0.14
Total standard error	2.3 pts	2.4 pts	1.6 pts	0.12
F-statistic for variation across PHAs	5.96** (16,835)	5.50** (16,819)	1.48‡ (16,1654)	
Recipients				
Mean	32.5%	30.3%	2.3 pts	
Within-PHA standard error	0.4 pts	0.0 pts	0.4 pts	5.38**
Total standard error	0.9 pts	0.0 pts	1.0 pts	2.29*
F-statistic for variation across PHAs	3.94** (16,856)	8.66** (16,850)	4.22** (16,1760)	
Change[a]				
Mean	-8.9 pts	-10.9 pts	2.0 pts	
Within-PHA standard error	1.0 pts	1.0 pts	1.4 pts	1.41
Total standard error	2.6 pts	2.3 pts	2.0 pts	1.00
F-statistic for variation across PHAs	7.01** (16,835)	5.02** (16,818)	2.10** (16,1653)	

** = Significant at 0.01 level
* = Significant at 0.05 level
‡ = Significant at 0.10 level

[a]Change figures may not equal the difference between pre and post figures due to missing values.

TABLE F.58
(TABLE 6.5 CONT.)

F-STATISTICS FOR DIFFERENCES ACROSS GROUPS

	Housing Voucher Program	Certificate Program	Difference
Pre-program rent burden	624.35** (1,2767)	554.98** (1,2641)	0.15 (1,5408)
Recipient rent burden	6.15* (1,2807)	20.11** (1,2692)	9.55** (1,5499)
Change in rent burden	597.47** (1,2767)	544.68** (1,2640)	2.17 (1,5407)

TABLE F.59
(TABLE 6.6)

COMPARISON OF RECIPIENT RENT BURDENS IN THE TWO PROGRAMS FOR RECIPIENTS WITH ANNUAL INCOMES OF AT LEAST $3,600 WHO WERE FULL RENT MOVERS

Pre-Program	Housing Voucher Program	Certificate Program	Difference	t-Statistic
Mean	61.4%	63.0%	0.5 pts	
Within-PHA standard error	0.9 pts	1.0 pts	1.4 pts	0.32
Total standard error	2.3 pts	1.9 pts	1.4 pts	0.32
F-statistic for variation across PHAs	6.56** (16,901)	4.27** (16,841)	1.14 (16,1742)	
Recipient				
Mean	35.6%	30.5%	5.1 pts	
Within-PHA standard error	0.4 pts	0.0 pts	0.4 pts	11.16**
Total standard error	0.8 pts	0.6 pts	1.1 pts	4.58**
F-statistic for variation across PHAs	3.20** (16,917)	99.18** (16,856)	4.79** (16,1773)	
Change[a]				
Mean	-27.8 pts	-32.4 pts	4.7 pts	
Within-PHA standard error	0.9 pts	1.0 pts	1.4 pts	3.30**
Total standard error	2.0 pts	1.8 pts	1.4 pts	3.30**
F-statistic for variation across PHAs	4.48** (16,901)	4.13** (16,841)	1.01 (16,1742)	

** = Significant at 0.01 level
* = Significant at 0.05 level
‡ = Significant at 0.10 level

[a]Change figures may not equal the difference between pre and post figures due to missing values.

TABLE F.60
(TABLE 6.6 CONT.)

COMPARISON OF RECIPIENT RENT BURDENS IN THE TWO PROGRAMS FOR RECIPIENTS WITH ANNUAL INCOMES OF AT LEAST $3,600 WHO WERE NON-FULL RENT MOVERS

Pre-Program	Housing Voucher Program	Certificate Program	Difference	t-Statistic
Mean	36.0%	35.4%	0.6 pts	0.41
Within-PHA standard error	1.1 pts	1.0 pts	1.5 pts	0.41
Total standard error	1.9 pts	1.8 pts	1.5 pts	0.40
F-statistic for variation across PHAs	3.66** (16,636)	2.93** (16,636)	1.13 (16,1272)	
Recipient				
Mean	34.1%	30.2%	3.9 pts	
Within-PHA standard error	0.4 pts	0.0 pts	0.5 pts	8.11**
Total standard error	1.0 pts	0.0 pts	1.0 pts	3.96**
F-statistic for variation across PHAs	3.74** (16,651)	9.43** (16,662)	3.68** (16,1313)	
Change[a]				
Mean	-1.8 pts	-5.1 pts	3.3 pts	
Within-PHA standard error	1.1 pts	1.0 pts	1.5 pts	2.18*
Total standard error	2.0 pts	1.8 pts	2.0 pts	1.69‡
F-statistic for variation across PHAs	4.11** (16,636)	2.97** (16,636)	1.74* (16,1272)	

** = Significant at 0.01 level
* = Significant at 0.05 level
‡ = Significant at 0.10 level

[a]Change figures may not equal the difference between pre and post figures due to missing values.

TABLE F.61
(TABLE 6.6 CONT.)

COMPARISON OF RECIPIENT RENT BURDENS IN THE TWO PROGRAMS FOR RECIPIENTS WITH ANNUAL INCOMES OF AT LEAST $3,600 WHO WERE STAYERS

Pre-Program	Housing Voucher Program	Certificate Program	Difference	t-Statistic
Mean	71.7%	71.1%	0.6 pts	
Within-PHA standard error	0.8 pts	0.8 pts	1.0 pts	0.56
Total standard error	0.8 pts	1.6 pts	1.0 pts	0.56
F-statistic for variation across PHAs	1.55‡ (16,1169)	4.92** (16,1109)	1.28 (16,2278)	
Recipient				
Mean	26.8%	30.7%	-3.9 pts	
Within-PHA standard error	0.3 pts	0.0 pts	0.4 pts	10.81**
Total standard error	0.8 pts	0.4 pts	0.8 pts	5.20**
F-statistic for variation across PHAs	4.72** (16,1178)	17.08** (16,1120)	4.58** (16,2298)	
Change[a]				
Mean	-44.9 pts	-40.4 pts	-4.6 pts	
Within-PHA standard error	0.8 pts	0.8 pts	1.0 pts	4.30**
Total standard error	1.1 pts	1.5 pts	1.0 pts	4.30**
F-statistic for variation across PHAs	2.43** (16,1169)	4.89** (16,1108)	0.79 (16,2277)	

** = Significant at 0.01 level
* = Significant at 0.05 level
‡ = Significant at 0.10 level

[a]Change figures may not equal the difference between pre and post figures due to missing values.

TABLE F.62
(TABLE 6.6 CONT.)

TEST STATISTICS FOR COMPARISONS ACROSS GROUPS

	Housing Voucher Program	Certificate Program	Difference
Pre-program rent burdens	1651.06**	1591.86**	0.02
	(2,2708)	(2,2586)	(2,5292)
Recipient rent burdens	555.12**	48.48**	556.04**
	(2,2740)	(2,2638)	(2,5384)
Change in rent burden	2153.00**	1562.61**	70.94**
	(2,2708)	(2,2585)	(2,5291)

TABLE F.63
(TABLE 6.7)

COMPARISON OF RECIPIENT RENT BURDENS IN THE TWO PROGRAMS USING THE BUDDING INDEX OF INCOME NET OF HOUSING COSTS

Pre-Program	Housing Voucher Program	Certificate Program	Difference	t-Statistic
Mean	50.6%	51.4%	-0.7 pts	
Within-PHA standard error	0.7 pts	0.7 pts	1.0 pts	0.72
Total standard error	2.5 pts	2.4 pts	1.0 pts	0.72
F-statistic for variation across PHAs	13.18** (17,3426)	13.13** (17,3259)	0.44 (17,6685)	
Recipient				
Mean	76.8%	77.4%	-0.6 pts	
Within-PHA standard error	5.5 pts	0.5 pts	0.7 pts	0.82
Total standard error	4.1 pts	3.6 pts	0.9 pts	0.69
F-statistic for variation across PHAs	58.89 (17,3492)	56.52 (17,3326)	1.59‡ (17,6818)	
Change				
Mean	26.5 pts	26.1 pts	0.4 pts	
Within-PHA standard error	0.4 pts	0.4 pts	0.6 pts	0.59
Total standard error	2.6 pts	2.3 pts	0.9 pts	0.44
F-statistic for variation across PHAs	28.22** (17,3426)	25.08** (17,3258)	1.64‡ (17,6684)	

** = Significant at 0.01 level
* = Significant at 0.05 level
‡ = Significant at 0.10 level

[a]Change figures may not equal the difference between pre and post figures due to missing values.

TABLE F.64
(TABLE 6.7 CONT.)

COMPARISON OF RECIPIENT RENT BURDENS IN THE TWO PROGRAMS USING THE BUDDING INDEX OF INCOME NET OF HOUSING COSTS FOR RECIPIENTS WHO WERE PAYING FULL RENT IN THEIR PRE-ENROLLMENT OR RECIPIENT UNITS

Pre-Enrollment	Housing Voucher Program	Certificate Program	Difference	t-Statistic
Mean	42.1%	43.7%	-1.6 pts	
Within-PHA standard error	0.8 pts	0.8 pts	1.1	1.41
Total standard error	2.3 pts	2.0 pts	1.1	1.41
F-statistic for variation across PHAs	9.37** (16,2230)	7.73** (16,2083)	1.07 (16,4313)	
Recipient				
Mean	76.6%	77.5%	-0.9 pts	
Within-PHA standard error	0.6 pts	0.5 pts	0.8 pts	1.01
Total standard error	3.7 pts	3.1 pts	1.3 pts	0.69
F-statistic for variation across PHAs	39.98** (16,2262)	32.02** (16,2109)	2.54** (16,4371)	
Change[a]				
Mean	34.8 pts	33.9 pts	0.9 pts	
Within-PHA standard error	0.4 pts	0.4 pts	0.6 pts	1.37
Total standard error	2.2 pts	1.8 pts	0.9 pts	0.98
F-statistic for variation across PHAs	20.66** (16,2230)	15.91** (16,2083)	1.63* (16,4313)	

** = Significant at 0.01 level
* = Significant at 0.05 level
‡ = Significant at 0.10 level

[a]Change figures may not equal the difference between pre and post figures due to missing values.

TABLE F.65
(TABLE 6.7 CONT.)

COMPARISON OF RECIPIENT RENT BURDENS IN THE TWO PROGRAMS USING THE BUDDING INDEX OF INCOME NET OF HOUSING COSTS FOR RECIPIENTS WHO WERE NOT PAYING FULL RENT IN THEIR PRE-ENROLLMENT AND RECIPIENT UNITS

Pre-Enrollment	Housing Voucher Program	Certificate Program	Difference	t-Statistic
Mean	59.3%	58.0%	1.2 pts	
Within-PHA standard error	1.1 pts	1.2 pts	1.7 pts	0.74
Total standard error	3.1 pts	3.3 pts	1.9 pts	0.65
F-statistic for variation across PHAs	6.87** (16,1131)	8.29** (16,1111)	1.43 (16,2222)	
Recipient				
Mean	66.4%	67.3%	-0.9 pts	
Within-PHA standard error	0.8 pts	0.8 pts	1.2 pts	0.77
Total standard error	4.0 pts	3.7 pts	1.4 pts	0.66
F-statistic for variation across PHAs	21.52** (16,1165)	22.80** (16,1151)	1.21 (16,2316)	
Change[a]				
Mean	7.5 pts	9.2 pts	-1.7 pts	
Within-PHA standard error	0.8 pts	0.7 pts	1.0 pts	1.60
Total standard error	2.2 pts	1.9 pts	1.6 pts	1.03
F-statistic for variation across PHAs	8.87** (16,1131)	6.73** (16,1110)	2.30** (16,2241)	

** = Significant at 0.01 level
 * = Significant at 0.05 level
 ‡ = Significant at 0.10 level

[a]Change figures may not equal the difference between pre and post figures due to missing values.

TABLE F.66
(TABLE 6.7 CONT.)

TEST STATISTICS FOR DIFFERENCES BETWEEN GROUPS IN BUDDING INDEX

	Housing Voucher Program	Certificate Program	Difference
Pre-program	150.37** (1,3361)	102.42** (1,3194)	2.06 (1,6555)
Recipient	92.32** (1,3427)	109.51** (1,3260)	0.00 (1,6687)
Change	912.72** (1,3361)	867.08** (1,3193)	4.42* (1,6554)

TABLE F.67
(TABLE 6.8)

COMPARISON OF RECIPIENT RENT BURDEN IN THE TWO PROGRAMS USING THE BUDDING INDEX OF INCOME NET OF HOUSING COSTS FOR FULL RENT MOVERS

Pre-Enrollment	Housing Voucher Program	Certificate Program	Difference	t-Statistic
Mean	42.7%	44.1%	-1.4 pts	
Within-PHA standard error	1.0 pts	1.2 pts	1.6 pts	0.88
Total standard error	2.4 pts	2.2 pts	1.6 pts	0.88
F-statistic for variation across PHAs	4.75** (16,1108)	3.85** (16,1024)	0.79 (16,2132)	
Recipient				
Mean	66.1%	71.1%	-5.0 pts	
Within-PHA standard error	0.8 pts	0.8 pts	1.1 pts	4.46**
Total standard error	3.3 pts	3.3 pts	1.4 pts	3.66**
F-statistic for variation across PHAs	17.03** (16,1134)	19.23** (16,1045)	2.00** (16,2179)	
Change[a]				
Mean	23.6 pts	27.2 pts	-3.5 pts	
Within-PHA standard error	0.6 pts	0.6 pts	0.9 pts	3.82**
Total standard error	1.6 pts	1.7 pts	0.9 pts	3.82**
F-statistic for variation across PHAs	6.93** (16,1108)	7.02** (16,1024)	1.17 (16,2132)	

** = Significant at 0.01 level
 * = Significant at 0.05 level
 ‡ = Significant at 0.10 level

[a]Change figures may not equal the difference between pre and post figures due to missing values.

TABLE F.68

(TABLE 6.8 (CONT.)

COMPARISON OF RECIPIENT RENT BURDEN IN THE TWO PROGRAMS USING THE BUDDING INDEX OF INCOME NET OF HOUSING COSTS FOR NON-FULL RENT MOVERS

Pre-Enrollment	Housing Voucher Program	Certificate Program	Difference	t-Statistic
Mean	59.5%	59.8%	-0.3 pts	
Within-PHA standard error	1.2 pts	1.3 pts	1.8 pts	0.17
Total standard error	3.3 pts	3.5 pts	2.2 pts	0.14
F-statistic for variation across PHAs	6.77** (16,910)	7.62** (16,904)	1.50‡ (16,1814)	
Recipient				
Mean	61.1%	64.6%	-3.5 pts	
Within-PHA standard error	0.9 pts	0.9 pts	1.3 pts	2.76**
Total standard error	3.8 pts	3.8 pts	1.3 pts	2.76**
F-statistic for variation across PHAs	19.02** (16,939)	20.80** (16,939)	0.78 (16,1878)	
Change[a]				
Mean	1.9 pts	4.7 pts	-2.8 pts	
Within-PHA standard error	0.8 pts	0.8 pts	1.1 pts	2.58**
Total standard error	1.6 pts	1.4 pts	1.5 pts	1.87‡
F-statistic for variation across PHAs	4.64** (16,910)	3.29** (16,904)	1.72* (16,1814)	

** = Significant at 0.01 level
 * = Significant at 0.05 level
 ‡ = Significant at 0.10 level

[a]Change figures may not equal the difference between pre and post figures due to missing values.

TABLE F.69
(TABLE 6.8 CONT.)

COMPARISON OF RECIPIENT RENT BURDENS IN THE TWO PROGRAMS USING THE BUDDING INDEX OF INCOME NET OF HOUSING COSTS FOR STAYERS

Pre-Enrollment	Housing Voucher Program	Certificate Program	Difference	t-Statistic
Mean	44.2%	44.3%	-0.1 pts	
Within-PHA standard error	1.1 pts	1.1 pts	1.5 pts	0.06
Total standard error	2.2 pts	2.2 pts	1.5 pts	0.06
F-statistic for variation across PHAs	5.20** (16,1280)	5.49** (16,1206)	1.09 (16,2486)	
Recipient				
Mean	88.8%	83.5%	5.2 pts	
Within-PHA standard error	0.8 pts	0.8 pts	1.1 pts	4.61**
Total standard error	3.7 pts	3.0 pts	1.5 pts	3.54**
F-statistic for variation across PHAs	22.48** (16,1291)	17.90** (16,1217)	2.68** (16,2508)	
Change[a]				
Mean	44.7 pts	39.1 pts	5.6 pts	
Within-PHA standard error	0.5 pts	0.5 pts	0.8 pts	6.80**
Total standard error	1.6 pts	1.5 pts	0.9 pts	6.05**
F-statistic for variation across PHAs	8.04** (16,1280)	6.94** (16,1205)	1.73* (16,2485)	

** = Significant at 0.01 level
* = Significant at 0.05 level
‡ = Significant at 0.10 level

[a]Change figures may not equal the difference between pre and post figures due to missing values.

TABLE F.70
(TABLE 6.8 CONT.)

TEST STATISTICS FOR DIFFERENCES BETWEEN GROUPS IN BUDDING INDEX

	Housing Voucher Program	Certificate Program	Difference
Pre-program	230.30** (2,3298)	219.75** (2,3134)	0.74 (2,6432)
Recipient	1277.84** (2,3364)	604.81** (2,3201)	97.75** (2,6565)
Change	3768.64** (2,3298)	2669.49** (2,3133)	119.82** (2,6431)

TABLE F.71
(TABLE 6.9)

TENANT CONTRIBUTION AT RECERTIFICATION

	Housing Voucher Program	Certificate Program	Difference	t-Statistic
Initial Recipient Tenant Contribution				
Mean	148.15	142.13	6.02	
Within-PHA standard error	2.46	1.93	3.13	1.92‡
Total standard error	7.83	7.34	5.71	1.05
F-statistic for variation across PHAs	19.60** (16,1754)	23.77** (16,1598)	3.96** (16,3352)	
Recipient Tenant Contribution at Recertification				
Mean	169.40	151.87	17.53	
Within-PHA standard error	2.89	2.14	3.59	4.88**
Total standard error	8.40	8.21	6.87	2.55*
F-statistic for variation across PHAs	32.53** (16,1714)	32.68** (16,1553)	24.16** (16,3267)	
Changein Recipient Tenant Contribution[a]				
Mean	20.76	9.44	11.32	
Within-PHA standard error	2.02	1.73	2.66	4.26**
Total standard error	3.75	1.99	4.54	2.42*
F-statistic for variation across PHAs	3.42** (16,1714)	1.67* (16,1553)	3.36** (16,3267)	

** = Significant at 0.01 level
 * = Significant at 0.05 level
 ‡ = Significant at 0.10 level

[a]Change figures may not equal the difference between pre and post figures due to missing values.

TABLE F.72
(TABLE 6.10)

RECIPIENT RENT BURDEN AT RECERTIFICATION

	Housing Voucher Program	Certificate Program	Difference	t-Statistic
Initial Recipient Rent Burden				
Mean	33.6%	31.4%	2.2 pts	
Within-PHA standard error	1.2	0.5	1.3	1.65‡
Total standard error	1.5	1.3	2.3	0.96
F-statistic for variation across PHAs	4.01** (16,1753)	26.83** (16,1597)	5.67** (16,3350)	
Recipient Rent Burden at Recertification				
Mean	34.9%	30.8%	4.1 pts	
Within-PHA standard error	0.5	0.0	0.5	7.41**
Total standard error	1.4	0.7	1.7	2.47*
F-statistic for variation across PHAs	6.90** (16,1680)	40.03** (16,1530)	7.31** (16,3210)	
Changein Recipient Rent Burden[a]				
Mean	1.2 pts	-0.6 pts	1.8 pts	
Within-PHA standard error	1.1	0.5	1.3	1.42
Total standard error	1.2	0.6	1.4	1.29
F-statistic for variation across PHAs	2.68** (16,1679)	5.45** (16,1529)	3.46** (16,3208)	

** = Significant at 0.01 level
 * = Significant at 0.05 level
 ‡ = Significant at 0.10 level

[a]Change figures may not equal the difference between pre and post figures due to missing values.

TABLE F.73
(TABLE 7.1)

COMPARISON OF RECIPIENT HOUSING ASSISTANCE PAYMENTS IN THE TWO PROGRAMS

Housing Assistance Payment	Housing Voucher Program	Certificate Program	Difference	t-Statistic
Mean	$309.67	$293.09	16.58	
Within-PHA standard error	1.09	1.38	1.76	9.41**
Total standard error	13.75	14.09	4.49	3.69**
F-statistic for variation across PHAs	175.33** (17,3497)	113.13** (17,3327)	6.69** (17,6824)	
Annual Net Income				
Mean	5692.86	5649.79	43.06	
Within-PHA standard error	41.90	44.06	60.80	0.71
Total standard error	280.90	261.52	60.80	0.71
F-statistic for variation across PHAs	47.06** (17,3496)	39.53** (17,3327)	0.58 (17,6823)	
Payment Standard or FMR				
Mean	455.93	460.41	-4.49	
Within-PHA standard error	0.34	0.40	0.52	8.55**
Total standard error	18.78	17.70	2.91	1.54
F-statistic for variation across PHAs	2591.23** (17,3497)	1954.84** (17,3328)	24.75** (17,6825)	
Difference in payment if average net income is the same				$17.66
Difference in payment if the Payment Standard had equaled the FMR				$22.15

** = Significant at 0.01 level
* = Significant at 0.05 level
‡ = Significant at 0.10 level

TABLE F.74
(TABLE 7.2)

COMPARISON OF RECIPIENT HOUSING ASSISTANCE PAYMENTS
IN THE TWO PROGRAMS FOR RECIPIENTS WHO MOVE

Housing Assistance Payments	Housing Voucher Program	Certificate Program	Difference	t-Statistic
Mean	332.79	323.15	9.64	
Within-PHA standard error	1.37	1.65	2.15	4.49**
Total standard error	14.06	12.87	4.82	2.00**
F-statistic for variation across PHAs	117.46** (17,2139)	66.84** (17,2047)	5.33** (17,4186)	
Annual Net Income				
Mean	5398.58	5409.52	-10.94	
Within-PHA standard error	52.44	57.22	77.62	0.14
Total standard error	298.77	280.95	77.62	0.14
F-statistic for variation across PHAs	35.75** (17,2139)	28.28** (17,2046)	0.45 (17,4185)	
Payment Standard or FMR				
Mean	469.16	475.92	-5.76	
Within-PHA standard error	0.41	0.48	0.63	9.13**
Total standard error	19.96	17.80	3.61	1.60
F-statistic for variation across PHAs	2172.60** (17,2139)	1549.77** (17,2047)	34.22** (17,4186)	
Difference in payment if average net incomes equal				$9.37
Difference in payment if Payment Standard equaled FMR				$15.13

** = Significant at 0.01 level
* = Significant at 0.05 level
‡ = Significant at 0.10 level

TABLE F.75
(TABLE 7.2 CONT.)

COMPARISON OF RECIPIENT HOUSING ASSISTANCE PAYMENTS IN THE TWO PROGRAMS FOR RECIPIENTS WHO STAY IN THEIR PRE-PROGRAM UNITS

Housing Assistance Payments	Housing Voucher Program	Certificate Program	Difference	t-Statistic
Mean	270.00	241.71	28.29	
Within-PHA standard error	1.63	2.17	2.71	10.42**
Total standard error	11.20	11.86	4.44	6.37**
F-statistic for variation across PHAs	47.19** (17,1293)	31.73** (17,1217)	3.11** (17,2510)	
Annual Net Income				
Mean	6197.90	6059.93	137.96	
Within-PHA standard error	64.77	66.86	93.09	1.48
Total standard error	230.16	215.63	98.19	1.41
F-statistic for variation across PHAs	13.21 (17,1292)	11.93 (17,1218)	1.66 (17,2510)	
Payment Standard or FMR				
Mean	433.22	435.64	-2.42	
Within-PHA standard error	0.60	0.69	0.92	2.64
Total standard error	16.36	16.88	3.84	0.63
F-statistic for variation across PHAs	583.52** (17,1293)	508.47 (17,1218)	12.76** (17,2511)	
Difference in payments if average net income the same in both programs				$31.74
Difference in payments if the Payment Standard equal to the FMR				$34.16

** = Significant at 0.01 level
* = Significant at 0.05 level
‡ = Significant at 0.10 level

TABLE F.76
(TABLE 7.2 CONT.)

TEST STATISTICS FOR DIFFERENCES IN ASSISTANCE PAYMENT OUTCOMES BETWEEN THOSE WHO MOVED FROM OR STAYED IN THEIR PRE-ENROLLMENT UNITS

	Housing Voucher Program	Certificate Program	Difference
Housing assistance payments	855.21** (1,3432)	935.93** (1,3264)	30.05 (1,6696)
Annual net income	92.32** (1,3431)	56.94** (1,3264)	1.55 (1,6695)
Payment Standard or FMR	2166.03** (1,3432)	2069.30** (1,3265)	8.38** (1,6647)

TABLE F.77
(TABLE 7.5)

CHANGE IN GROSS RENTS AS A PERCENT OF HOUSING ASSISTANCE PAYMENTS

	Housing Voucher Program	Certificate Program	Difference	t-Statistic
Mean	54.9%	51.5%	3.4 pts	
Within-PHA standard error	0.9 pts	0.9 pts	1.3 pts	2.66**
Total standard error	4.5 pts	4.8 pts	1.6 pts	2.14**
Chi-square statistic for variation across PHAs	410.82** (16)	436.36** (16)	29.20* (16)	

** = Significant at 0.01 level
* = Significant at 0.05 level
‡ = Significant at 0.10 level

TABLE F.78
(TABLE 7.5 CONT.)

COMPARISON OF THE AVERAGE RATIO OF THE CHANGE IN RENTS TO HOUSING ASSISTANCE PAYMENTS FOR MOVERS AND STAYERS

Recipients Who Move From Their Pre-Program Unit	Housing Voucher Program	Certificate Program	Difference	t-Statistic
Mean	77.4%	72.3%	8.0 pts	
Within-PHA standard error	1.1 pts	1.1 pts	1.6 pts	3.13**
Total standard error	2.5 pts	2.8 pts	2.1 pts	2.41**
F-statistic for variation across PHAs	100.47** (16)	115.27** (16)	43.80** (16)	

** = Significant at 0.01 level
* = Significant at 0.05 level
‡ = Significant at 0.10 level

TABLE F.79
(TABLE 7.5 CONT.)

COMPARISON OF THE AVERAGE RATIO OF THE CHANGE IN RENTS TO HOUSING ASSISTANCE PAYMENTS BY MOBILITY AND PRE-ENROLLMENT RENT

Pre-Enrollment Paid Full Rent, Moved	Housing Voucher Program	Certificate Program	Difference	t-Statistic
Mean	58.5%	51.0%	7.5 pts	
Within-PHA standard error	1.2 pts	1.3 pts	1.8 pts	4.31**
Total standard error	2.8 pts	2.6 pts	2.3 pts	3.32**
F-statistic for variation across PHAs	6.18** (16,1108)	4.56** (16,1025)	2.04** (16,2133)	
Did Not Pay Full Pre-Enrollment Rent, Moved				
Mean	99.8%	95.0%	4.8 pts	
Within-PHA standard error	1.8 pts	1.8 pts	2.5 pts	1.90‡
Total standard error	3.1 pts	2.6 pts	3.7 pts	1.30
F-statistic for variation across PHAs	4.04** (16,9,14)	2.04** (16,9,05)	2.12** (16,18,19)	
Stayed				
Mean	16.7%	16.4%	0.3 pts	
Within-PHA standard error	0.9 pts	1.1 pts	1.4 pts	0.18
Total standard error	2.3 pts	2.3 pts	1.6 pts	0.16
F-statistic for variation across PHAs	6.34** (16,1281)	5.64** (16,1205)	1.69* (16,2486)	

** = Significant at 0.01 level
* = Significant at 0.05 level
‡ = Significant at 0.10 level

TABLE F.80
(TABLE 7.6)

COMPARISON OF RECIPIENT PAYMENT AT ANNUAL RECERTIFICATION

Initial Monthly Payment	Housing Voucher Program	Certificate Program	Difference	t-Statistic
Mean	$306.71	$287.46	$19.25	
Within-PHA standard error	1.70	2.36	2.91	6.61**
Total standard error	12.93	14.25	4.84	3.98**
F-statistic for variation across PHAs	92.39** (16,1754)	57.20** (16,1598	3.57** (16,3352)	
Monthly Payment After Recertification				
Mean	$303.53	$297.91	$5.62	
Within-PHA standard error	2.15	2.75	3.49	1.61
Total standard error	13.85	14.61	5.24	1.07
F-statistic for variation across PHAs	61.86** (16,1748)	45.37** (16,1590)	2.74** (16,3338)	
Change in Monthly Payment				
Mean	$-3.04	$10.59	$-13.62	
Within-PHA standard error	1.74	1.99	2.64	5.16**
Total standard error	2.97	4.25	3.94	3.46**
F-statistic for variation across PHAs	2.70** (16,1748)	4.74** (16,1590)	2.97** (17,3338)	
Determinants of Change in Payment				
Change in annual net income	$468.93	$456.85	$12.08	0.12
Change in FMRs	7.84	22.42	-14.58	3.72**
Level of FMRs at recertification	457.99	475.38	-17.39	3.90**

** = Significant at 0.01 level
* = Significant at 0.05 level
‡ = Significant at 0.10 level

APPENDIX G

MISCELLANEOUS SUPPORTING TABLES

TABLE G.1

ARC SINE REGRESSIONS FOR THOSE INTENDING TO MOVE

	Coefficient	t-Statistic
Intercept	1.83	14.68
Site dummies		
1	0.02	0.17
2	-0.18	1.24
3	0.68	3.91**
4	0.46	2.52*
5	0.29	1.72‡
7	0.35	3.16**
8	0.15	1.33
9	0.10	0.74
10	-0.25	0.71
11	-0.73	7.74**
12	0.59	5.62**
13	0.63	5.19**
14	0.35	2.49*
15	0.28	2.01*
16	0.54	4.41**
17	0.53	4.80**
18	0.50	4.63**
19	-0.18	1.17
Pre-program rent		
80 to 100% of FMR	0.02	0.24
60 to 80% of FMR	-0.13	1.53
40 to 60% of FMR	-0.32	3.66**
Less than 40% of FMR	-0.50	5.45**
Housing Voucher Program	0.03	0.95

Error degrees of freedom	484
Error sum of squares	547.89
Dependent mean	1.56
Root mean squared error	1.06
R^2	0.71

** = Significant at 0.01 level
* = Significant at 0.05 level
‡ = Significant at 0.10 level

TABLE G.2

ARC SINE REGRESSION FOR THOSE INTENDING TO STAY
(Weighted observations)

	Parameter	t-Statistic
Constant	2.10	24.25
Site:		
1	-0.11	0.59
2	-0.17	1.01
3	0.71	2.38*
4	0.06	0.27
5	0.18	1.63
7	0.31	2.32*
8	0.36	3.21**
9	0.34	2.07*
10	0.18	1.21
11	-0.14	1.59
12	0.32	2.71**
13	0.38	3.17**
14	0.56	4.17**
15	-0.21	1.58
16	0.56	2.68**
17	0.38	3.92**
18	0.39	3.37**
19	0.21	1.83‡
Certificate Program		
Rent 80 to 100% of FMR	0.20	3.07**
Rent 60 to 80% of FMR	0.00	0.05
Rent 40 to 60% of FMR	-0.26	2.38*
Rent less than 40% of FMR	-0.14	0.35
Housing Voucher Program	0.30	2.76**

Error degrees of freedom	260
Error sum of squares	247.77
Dependent mean	2.19
Root mean square error	0.98

R^2 0.49

** = Significant at 0.01 level
* = Significant at 0.05 level
‡ = Significant at 0.10 level

TABLE G.3

ENROLLEE SAMPLE SIZE: HOUSEHOLD COMPOSITION BY ELDERLY/NON-ELDERLY

Household Type	Number and Percent of Enrollees In Given Household Type Who Are: Elderly		Non-Elderly	
	Percent	Number	Percent	Number
Single person elderly	100.0%	1734	0.0%	0
Single person handicapped	0.0	0	100.0	1411
Other zero or one bedroom	17.5	262	82.5	1233
Two bedrooms, one adult	0.9	32	99.1	3715
Two bedrooms, more than one adult	12.0	105	88.0	771
Three or more bedrooms, one adult	0.4	9	99.6	2022
Three or more bedrooms, more than one adult	2.8	32	97.1	1116
All	17.5	2,174	82.5	10,268

TABLE G.4

ENROLLEE SAMPLE SIZE: HOUSEHOLD COMPOSITION BY HANDICAPPED STATUS

	Number and Percent of Enrollees In Given Household Type Who Are:			
	Handicapped		Non-Handicapped	
Household Type	Percent	Number	Percent	Number
Single person elderly	30.6%	530	69.4%	1204
Single person handicapped	100.0	1411	0.0	0
Other zero or one bedroom	17.5	261	82.5	1234
Two bedrooms, one adult	3.6	136	96.4	3611
Two bedrooms, more than one adult	22.8	200	77.2	676
Three or more bedrooms, one adult	3.2	65	96.8	1966
Three or more bedrooms, more than one adult	9.2	105	90.8	1043
All	21.8	2708	78.2	9734

TABLE G.5

ENROLLEE SAMPLE SIZE: HOUSEHOLD COMPOSITION BY WHETHER SPOUSE IS PRESENT

	Number and Percent of Enrollees In Given Household Type Who Are:			
	Spouse Present		No Spouse Present	
Household Type	Percent	Number	Percent	Number
Single person elderly	0.0%[a]	0	100.0%	1734
Single person handicapped	0.0[a]	0	100.0	1411
Other zero or one bedroom	30.1	450	69.9	1045
Two bedrooms, one adult	0.0[a]	0	100.0	3747
Two bedrooms, more than one adult	56.9	498	43.1	378
Three or more bedrooms, one adult	0.0[a]	0	100.0	2031
Three or more bedrooms, more than one adult	57.8	664	42.1	484
All	13.1	1,612	86.9	10,830

[a]Reported incidences of less than 0.3 percent are suppressed as data errors.

TABLE G.6

ENROLLEE SAMPLE SIZE: HOUSEHOLD COMPOSITION BY SEX OF HEAD

Household Type	Number and Percent of Enrollees In Given Household Type Who Are: Male		Female	
	Percent	Number	Percent	Number
Single person elderly	18.5%	321	81.5%	1413
Single person handicapped	47.3	668	52.7	743
Other zero or one bedroom	30.5	456	69.5	1038
Two bedrooms, one adult	1.8	66	98.2	3681
Two bedrooms, more than one adult	49.5	434	50.5	442
Three or more bedrooms, one adult	1.7	34	98.3	1997
Three or more bedrooms, more than one adult	50.5	580	49.5	568
All	20.6	2559	79.4	9882

TABLE G.7

ENROLLEE SAMPLE SIZE: HOUSEHOLD COMPOSITION BY RACE/ETHNICITY STATUS

	Number and Percent of Enrollees in Given Household Type Who Are:							
	Non-Minority		Black, Non-Hispanic		Hispanic		Other Minority	
Household Type	Percent	Number	Percent	Number	Percent	Number	Percent	Number
Single person elderly	62.3%	1079	22.9%	397	13.6%	236	1.2	21
Single person handicapped	48.6	686	37.8	533	12.3	174	1.3	18
Other zero or one bedroom	23.5	351	44.1	659	30.2	451	2.3	34
Two bedrooms, one adult	26.1	977	54.5	2043	18.2	680	1.2	46
Two bedrooms, more than one adult	40.0	350	32.4	284	24.2	212	3.4	30
Three or more bedrooms, one adult	18.1	367	60.1	1219	20.5	416	1.4	28
Three or more bedrooms, more than one adult	24.0	276	37.5	431	27.0	310	11.4	131
All	32.9	4086	44.8	5566	19.9	2479	2.5	308

TABLE G.8

ENROLLEE SAMPLE SIZE: HOUSEHOLD COMPOSITION BY PRESENCE OF CHILDREN

	Number and Percent of Enrollees In Given Household Type Who Are:			
	No Children Present		Children Present	
Household Type	Percent	Number	Percent	Number
Single person elderly	100.0%	1734	0.0%	0
Single person handicapped	100.0	1411	0.0	0
Other zero or one bedroom	39.6	593	60.4	903
Two bedrooms, one adult	0.0[a]	0	100.0	3747
Two bedrooms, more than one adult	30.1	264	69.9	612
Three or more bedrooms, one adult	0.0	0	100.0	2031
Three or more bedrooms, more than one adult	2.1	24	97.9	1125
All		4026		8418

[a]Recorded incidence of 0.1 percent suppressed as data error.

TABLE G.9

RECIPIENT SAMPLE SIZE: HOUSEHOLD COMPOSITION BY ELDERY/NON-ELDERLY

	Number and Percent of Enrollees In Given Household Type Who Are:			
	Elderly		Non-Elderly	
Household Type	Percent	Number	Percent	Number
Single person elderly	100.0%	1195	0.0%	0
Single person handicapped	0.0	0	100.0	863
Other zero or one bedroom	21.9	161	78.1	573
Two bedrooms, one adult	0.9	22	99.1	2420
Two bedrooms, more than one adult	11.1	60	88.9	479
Three or more bedrooms, one adult	0.6	7	99.4	1178
Three or more bedrooms, more than one adult	3.0	19	97.0	628
All	19.3	1464	80.7	6139

TABLE G.10

RECIPIENT SAMPLE SIZE: HOUSEHOLD COMPOSITION BY HANDICAPPED STATUS

Household Type	Number and Percent of Enrollees In Given Household Type Who Are: Handicapped		Non-Handicapped	
	Percent	Number	Percent	Number
Single person elderly	26.9%	321	73.1%	874
Single person handicapped	100.0	863	0.0	0
Other zero or one bedroom	19.9	146	80.1	588
Two bedrooms, one adult	3.6	87	96.4	2355
Two bedrooms, more than one adult	21.9	118	78.1	421
Three or more bedrooms, one adult	3.3	39	96.7	1146
Three or more bedrooms, more than one adult	9.3	60	90.7	585
All	21.5	1634	78.5	5969

TABLE G.11

RECIPIENT SAMPLE SIZE: HOUSEHOLD COMPOSITION BY PRESENCE OF SPOUSE

Household Type	Number and Percent of Enrollees In Given Household Type Who Are: Spouse Present		No Spouse Present	
	Percent	Number	Percent	Number
Single person elderly	0.0%[a]	0	100.0	1195
Single person handicapped	0.0[a]	0	100.0	863
Other zero or one bedroom	38.4	282	61.6	452
Two bedrooms, one adult	0.0[a]	0	100.0	2442
Two bedrooms, more than one adult	61.6	332	38.4	207
Three or more bedrooms, one adult	0.0[a]	0	100.0	1185
Three or more bedrooms, more than one adult	60.6	391	39.4	254
All	13.4	1005	86.6	6598

[a]Recorded incidences of less than 0.5 percent suppressed as data errors.

TABLE G.12

RECIPIENT SAMPLE SIZE: HOUSEHOLD COMPOSITION BY SEX OF HEAD OF HOUSEHOLD

	Number and Percent of Enrollees In Given Household Type Who Are:			
	Male		Female	
Household Type	Percent	Number	Percent	Number
Single person elderly	17.1%	204	82.9%	991
Single person handicapped	42.9	370	57.1	493
Other zero or one bedroom	37.7	277	62.3	457
Two bedrooms, one adult	1.9	46	98.1	2396
Two bedrooms, more than one adult	51.0	275	49.0	264
Three or more bedrooms, one adult	1.6	19	98.4	1166
Three or more bedrooms, more than one adult	53.2	343	46.8	302
All	20.2	1534	79.8	6069

TABLE G.13

RECIPIENT SAMPLE SIZE HOUSEHOLD COMPOSITION BY RACE/ETHNICITY STATUS

Minority Household Type	Number and Percent of Enrollees in Given Household Type Who Are: Non-Minority Percent	Non-Minority Number	Black, Non-Hispanic Percent	Black, Non-Hispanic Number	Hispanic Percent	Hispanic Percent	Number	Other Number
Single person elderly	69.9%	834	18.8%	225	10.4%	124	0.9%	11
Single person handicapped	54.1	487	36.3	313	8.0	69	1.6	14
Other zero or one bedroom	34.7	255	40.9	300	22.5	165	1.9	14
Two bedrooms, one adult	31.6	772	52.6	1285	14.1	345	1.6	39
Two bedrooms, more than one adult	43.8	236	30.4	164	21.9	118	3.9	21
Three or more bedrooms, one adult	21.5	255	60.7	719	16.4	194	1.3	16
Three or more bedrooms, more than one adult	28.4	183	35.4	228	23.7	153	12.6	81
All	39.5	3002	42.6	3234	15.4	1168	2.6	196

TABLE G.14

RECIPIENT SAMPLE SIZE: HOUSEHOLD COMPOSITION BY PRESENCE OF CHILDREN

	Number and Percent of Enrollees In Given Household Type Who Are:			
	Do Not Have Children		Have Children	
Household Type	Percent	Number	Percent	Number
Single person elderly	100.0%	1195	0.0%	0
Single person handicapped	100.0	863	0.0	0
Other zero or one bedroom	49.3	362	50.8	373
Two bedrooms, one adult	0.0[a]	0	100.0	2442
Two bedrooms, more than one adult	28.2	152	71.8	387
Three or more bedrooms, one adult	0.0	0	100.0	1185
Three or more bedrooms, more than one adult	2.0	13	98.0	632
All	34.0	2585	66.0	5019

[a]Recorded incidence of less than 0.1 percent suppressed as data error.

TABLE G.15

BACK-UP FOR FIGURES 4.1 AND 4.2

Distribution of the Ratio of Pre-Program and Recipient Gross Rents to FMR
for All Recipients (National Projection)

		Pre-Program Gross Rent		Recipient Gross Rent	
Ratio to FMR		Housing Voucher Program	Certificate Program	Housing Voucher Program	Certificate Program
1	≤ 0.05	5.0%	5.2%	*	*
2	>0.05, ≤0.10	1.4	1.4	*	*
3	>0.10, ≤0.15	2.4	2.8	*	*
4	>0.15, ≤0.20	3.0	3.8	*	*
5	>0.20, ≤0.25	3.3	3.6	*	*
6	>0.25, ≤0.30	3.8	3.9	*	*
7	>0.30, ≤0.35	2.8	3.5	*	*
8	>0.35, ≤0.40	3.9	3.6	*	*
9	>0.40, ≤0.45	4.6	4.1	*	*
10	>0.45, ≤0.50	4.7	4.6	*	*
11	>0.50, ≤0.55	4.5	3.9	*	*
12	>0.55, ≤0.60	5.1	5.4	0.7	*
13	>0.60, ≤0.65	6.3	4.8	0.7	0.7
14	>0.65, ≤0.70	5.8	5.8	1.1	1.1
15	>0.70, ≤0.75	5.6	7.5	2.0	2.8
16	>0.75, ≤0.80	7.0	6.2	3.4	3.8
17	>0.80, ≤0.85	5.1	5.8	5.1	6.7
18	>0.85, ≤0.90	5.4	5.5	8.9	8.9
19	>0.90, ≤0.95	4.7	4.8	12.6	14.3
20	>0.95, ≤1.00	4.4	4.5	19.0	43.1
21	>1.00, ≤1.05	3.5	4.3	13.2	8.3
22	>1.05, ≤1.10	2.7	2.2	11.4	8.3
23	>1.10, ≤1.15	1.5	1.1	7.8	1.3
24	>1.15, ≤1.20	1.3	0.6	5.3	**
25	>1.20, ≤1.25	0.8	0.4	3.0	**
26	>1.25, ≤1.30	0.5	**	2.1	**
27	>1.30, ≤1.35	0.5	**	1.2	**
28	>1.35, ≤1.40	**	**	0.8	**
29	>1.40, ≤1.45	**	**	0.6	**
30	>1.45	**	**	**	**
Sample Size		3787	3611	3885	3719

*Less than 1 percent of the (weighted) sample at or below this interval.

**Less than 1 percent of the (weighted) sample at or above this interval.

TABLE G.16

BACK-UP FOR FIGURES 4.3 AND 4.4

Distribution of the Ratio of Pre-Program and Recipient Gross Rents to FMR for Recipients Who Moved to Otherwise Unsubsidized Housing and Paid Their Full Pre-Program Rent (National Projection)

Ratio to FMR	Pre-Program Gross Rent: Housing Voucher Program	Pre-Program Gross Rent: Certificate Program	Recipient Gross Rent: Housing Voucher Program	Recipient Gross Rent: Certificate Program
1 ≤ 0.05	*	*	*	*
2 >0.05, ≤0.10	0.7%	0.9%	*	*
3 >0.10, ≤0.15	1.4	1.3	*	*
4 >0.15, ≤0.20	1.6	1.7	*	*
5 >0.20, ≤0.25	2.1	2.1	*	*
6 >0.25, ≤0.30	3.7	3.1	*	*
7 >0.30, ≤0.35	2.6	3.1	*	*
8 >0.35, ≤0.40	3.8	3.1	*	*
9 >0.40, ≤0.45	4.7	4.8	*	*
10 >0.45, ≤0.50	6.9	6.9	*	*
11 >0.50, ≤0.55	7.2	6.2	*	*
12 >0.55, ≤0.60	6.5	8.5	*	*
13 >0.60, ≤0.65	10.4	7.2	*	*
14 >0.65, ≤0.70	8.7	9.1	*	*
15 >0.70, ≤0.75	7.1	10.5	0.9	0.8
16 >0.75, ≤0.80	8.2	7.9	0.9	2.6
17 >0.80, ≤0.85	4.7	5.7	3.5	4.1
18 >0.85, ≤0.90	4.5	5.0	6.6	9.0
19 >0.90, ≤0.95	4.2	3.7	11.8	15.3
20 >0.95, ≤1.00	3.4	2.9	19.2	47.7
21 >1.00, ≤1.05	2.3	1.8	15.3	9.5
22 >1.05, ≤1.10	1.6	1.7	14.8	8.7
23 >1.10, ≤1.15	1.1	0.8	9.8	1.3
24 >1.15, ≤1.20	0.9	**	7.0	**
25 >1.20, ≤1.25	0.5	**	3.6	**
26 >1.25, ≤1.30	**	**	2.1	**
27 >1.30, ≤1.35	**	**	1.7	**
28 >1.35, ≤1.40	**	**	1.1	**
29 >1.40, ≤1.45	**	**	1.0	**
30 >1.45	**	**	**	**
Sample Size	1237	1159	1277	1189

*Less than 1 percent of the (weighted) sample at or below this interval.

**Less than 1 percent of the (weighted) sample at or above this interval.

TABLE G.17

BACK-UP FOR FIGURES 4.6 AND 4.7

Distribution of the Ratio of Pre-Program and Recipient Gross Rents to FMR
for Recipients Who Stayed In their Pre-Enrollment Unit and
Paid Their Full Pre-Enrollment Rent (National Projection)

Ratio to FMR	Pre-Program Gross Rent: Housing Voucher Program	Pre-Program Gross Rent: Certificate Program	Recipient Gross Rent: Housing Voucher Program	Recipient Gross Rent: Certificate Program
1 ≤ 0.05	*	*	*	*
2 >0.05, ≤0.10	*	*	*	*
3 >0.10, ≤0.15	*	*	*	*
4 >0.15, ≤0.20	*	*	*	*
5 >0.20, ≤0.25	*	0.7%	*	*
6 >0.25, ≤0.30	*	0.0	*	*
7 >0.30, ≤0.35	*	0.2	*	*
8 >0.35, ≤0.40	0.5%	0.8	*	*
9 >0.40, ≤0.45	1.0	1.0	*	*
10 >0.45, ≤0.50	1.5	0.5	*	*
11 >0.50, ≤0.55	1.7	2.2	*	*
12 >0.55, ≤0.60	3.8	3.4	1.0	0.4
13 0.60, ≤0.65	5.0	4.5	1.8	1.5
14 >0.65, ≤0.70	6.5	5.8	2.9	2.6
15 >0.70, ≤0.75	7.5	9.5	4.2	4.9
16 >0.75, ≤0.80	9.6	9.6	7.2	6.4
17 >0.80, ≤0.85	9.7	10.6	7.9	10.5
18 >0.85, ≤0.90	9.9	10.1	11.1	10.2
19 >0.90, ≤0.95	9.1	10.1	14.2	14.4
20 >0.95, ≤1.00	8.6	10.1	15.5	34.2
21 >1.00, ≤1.05	8.3	11.2	10.6	5.5
22 >1.05, ≤1.10	6.2	4.3	7.9	6.9
23 >1.10, ≤1.15	3.1	2.3	5.7	1.4
24 >1.15, ≤1.20	2.3	0.6	3.4	**
25 >1.20, ≤1.25	1.5	0.3	2.6	**
26 >1.25, ≤1.30	1.6	**	1.4	**
27 >1.30, ≤1.35	1.1	**	0.8	**
28 >1.35, ≤1.40	0.3	**	0.5	**
29 >1.40, ≤1.45	**	**	0.5	**
30 >1.45	**	**	**	**
Sample Size	1258	1174	1270	1187

*Less than 1 percent of the (weighted) sample at or below this interval.

**Less than 1 percent of the (weighted) sample at or above this interval.

TABLE G.18

BACKUP FOR FIGURES 6.1 AND 6.2
Distribution of Recipient Rent Burdens (National Estimates)

		All Recipients		Recipients Who Move		Recipients Who Qualify in Place	
		Housing Voucher Program	Certificate Program	Housing Voucher Program	Certificate Program	Housing Voucher Program	Certificate Program
1	≤ 0.10	*	*	*	*	*	*
2	>0.10, ≤0.15	11.4%	*	5.3%	*	21.9%	*
3	>0.15, ≤0.20	7.3	*	6.1	*	9.2	*
4	>0.20, ≤0.25	10.6	*	9.0	*	13.5	*
5	>0.25, ≤0.30	16.8	54.3%	16.8	56.3%	16.7	50.9%
6	>0.30, ≤0.35	16.7	42.8	17.1	41.9	16.1	44.3
7	>0.35, ≤0.40	11.7	0.9	13.5	0.6	8.7	11.4
8	>0.40, ≤0.45	8.2	0.2	9.9	0.1	5.1	0.4
9	>0.45, ≤0.50	5.1	0.2	6.2	0.1	3.1	0.3
10	>0.50, ≤0.55	3.2	0.5	4.1	0.4	1.7	0.6
11	>0.55, ≤0.60	2.3	0.4	3.0	**	1.3	0.9
12	>0.60, ≤0.65	1.8	**	2.2	**	1.1	0.5
13	>0.65, ≤0.70	1.1	**	1.4	**	0.7	**
14	>0.70, ≤0.75	1.1	**	1.6	**	**	**
15	>0.75, ≤0.80	0.5	**	0.7	**	**	**
16	>0.80, ≤0.85	0.2	**	0.3	**	**	**
17	>0.85, ≤0.90	0.2	**	0.3	**	**	**
18	>0.90, ≤0.95	0.4	**	0.5	**	**	**
19	>0.95, ≤0.100	0.2	**	0.3	**	**	**
20	><1.00	1.1	**	1.7	**	**	**
Sample Size		3878	3713	2350	2267	1528	1446

*Less than 1 percent of the (weighted) sample at or below this interval.

**Less than 1 percent of the (weighted) sample at or above this interval.

TABLE G.19

RECIPIENT SAMPLE SIZE: HOUSEHOLD COMPOSITION BY SOURCE OF INCOME

	Number and Percent of Recipients In Given Household Type Who Are.									
	Salaries and Wages		Social Security		Welfare		Other Single Source		No Single Source	
Household Type	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number
Single person elderly	1.3%	16	73.8%	882	11.0%	131	0.1%	1	13.8%	165
Single person handicapped	2.6	22	59.4	513	29.3	253	0.1	1	8.6	79
Other zero or one bedroom	19.1	140	26.1	192	44.6	328	0.1	1	10.1	74
Two bedrooms, one adult	24.5	597	3.4	84	63.8	1558	0.4	10	7.9	193
Two bedrooms, more than one adult	35.8	193	15.0	81	33.2	179	0.2	1	15.8	85
Three or more bedrooms, one adult	18.9	224	2.4	28	67.5	800	0.3	3	11.0	130
Three or more bedrooms, more than one adult	37.1	239	5.1	33	40.6	262	0.3	2	16.9	109
All	18.8	1431	23.8	1813	46.2	3511	0.3	19	10.9	830

TABLE G.20

ENROLLEE SAMPLE SIZE. HOUSEHOLD COMPOSITION BY SOURCE OF INCOME

	Number and Percent of Enrollees In Given Household Type Who Are:									
	Salaries and Wages		Social Security		Welfare		Other Single Source		No Single Source	
Household Type	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number
Single person elderly	1.2%	21	72.6%	1259	12.6%	218	0.2%	3	13.4%	233
Single person handicapped	2.6	36	57.2	807	32.8	463	0.1	2	7.3	103
Other zero or one bedroom	17.1	255	19.1	285	55.3	827	0.3	4	8.4	125
Two bedrooms, one adult	23.0	862	3.2	120	66.2	2482	0.3	12	7.2	271
Two bedrooms, more than one adult	35.2	308	15.0	131	35.1	307	0.1	1	14.7	129
Three or more bedrooms, one adult	18.0	365	2.4	49	69.6	1414	0.2	4	9.8	199
Three or more bedrooms, more than one adult	35.6	409	4.3	49	44.0	506	0.2	2	15.9	183
All	18.1	2256	21.7	2700	50.0	6217	0.2	28	10.0	1243

TABLE G.21

ISSURANCE PER RECIPIENT BY PHA

(weighted)[a]

PHA	Issuances per Recipient: Housing Voucher Program Mean	Housing Voucher Program Standard Error	Certificate Program Mean	Certificate Program Standard Error	Difference Mean	Difference Standard Error	t-Statistic
Atlanta	1.50	0.08	1.80	0.11	-0.29	0.13	2.18*
Boston	2.13	0.20	2.07	0.03	0.06	0.27	0.23
Cleveland	1.24	0.06	1.29	0.09	-0.05	0.11	0.54
Dayton	1.40	0.07	1.62	0.12	-0.22	0.14	1.54
Erie County (Buffalo)	1.22	0.04	1.40	0.09	-0.18	0.10	1.77‡
Los Angeles	1.34	0.06	1.45	0.06	-0.11	0.09	1.23
Montgomery County	1.34	0.06	1.48	0.07	-0.14	0.09	1.51
Minneapolis	1.52	0.08	1.61	0.10	-0.09	0.13	0.69
New Haven	1.38	0.09	1.56	0.12	-0.18	0.15	1.24
New York	2.92	0.10	3.17	0.12	-0.25	0.16	1.55
Oakland	1.23	0.03	1.32	0.04	-0.09	0.05	1.79‡
Omaha	1.18	0.03	1.20	0.04	-0.02	0.05	0.44
Pinellas County	1.27	0.05	1.23	0.04	0.04	0.06	0.67
Pittsburgh	1.56	0.08	1.45	0.07	0.11	0.11	1.00
San Antonio	1.20	0.05	1.28	0.05	-0.08	0.07	1.20
San Diego	1.20	0.02	1.24	0.02	-0.04	0.03	1.34
Seattle	1.38	0.04	1.28	0.04	0.10	0.06	1.63
F-statistic for variation across PHAs	57.44**		51.48**		0.81		
(Degrees of freedom)	(17,3497)		(17,3328)		(17,6825)		

** = Significant at 0.01 level
 * = Significant at 0.05 level
 ‡ = Significant at 0.10 level

[a]Estimates are weighted to reflect a common projected bedroom size distribution for both programs in each PHA.

TABLE G.22

SUCCESS RATES BY PHA[a]

(weighted)[b]

PHA	Housing Voucher Program Mean	Housing Voucher Program Standard Error	Certificate Program Mean	Certificate Program Standard Error	Difference Mean	Difference Standard Error	t-Statistic
Atlanta	66.5%	3.4 pts	55.7%	3.4 pts	10.8 pts	5.0 pts	2.18**
Boston	47.0	4.5	48.4	4.2	-1.4	6.0	0.23
Cleveland	80.8	3.2	77.3	5.2	3.5	6.5	0.54
Dayton	71.6	3.7	61.8	4.8	9.8	6.4	1.54
Erie County (Buffalo)	81.7	3.0	71.2	4.6	10.5	5.9	1.77‡
Los Angeles	74.4	3.4	69.0	2.9	5.4	4.4	1.23
Montgomery County	74.6	3.1	67.7	3.2	6.9	4.6	1.51
Minneapolis	65.8	3.4	62.3	3.8	3.5	5.1	0.69
New Haven	72.6	4.7	64.0	4.8	8.6	6.9	1.24
New York	34.3	1.2	31.6	1.2	2.7	1.7	1.55
Oakland	81.3	2.0	76.0	2.2	5.3	3.0	1.79‡
Omaha	84.7	2.5	83.1	2.5	1.6	3.7	0.44
Pinellas County	78.6	2.8	81.4	3.0	-2.8	4.2	0.67
Pittsburgh	64.2	3.3	68.8	3.2	-4.6	4.6	1.00
San Antonio	83.4	4.7	77.9	3.2	5.5	4.6	1.20
San Diego	83.6	1.1	80.6	1.6	3.0	2.2	1.34
Seattle	72.4	2.3	77.9	2.4	-5.5	3.4	1.63

** = Significant at 0.01 level
 * = Significant at 0.05 level
 ‡ = Significant at 0.10 level

[a]Success rates are derived as the inverse of the mean issuances per recipient in Table G.21.

[b]Estimates are weighted to reflect a common projected bedroom size distribution for both programs in each PHA.

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