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THE BENEFITS AND COSTS OF PUBLIC HOUSING IN NEW YORK CITY

The New York City Housing Authority (NYCHA) was created by the City government in 1934 as a public corporation with a charter to acquire and operate housing for low-income families. It was the first such corporation in the nation and is still by far the largest, accounting for 20 to 25 percent of all publicly owned housing for low-income families in the United States. In 1936, New York City provided the first municipally aided low-income housing project in the nation; in 1939, New York State began our nation's first state assisted housing program for low-income families. About 44 percent of the Authority's inventory of dwelling units are in Federal projects, 36 percent in State projects, and 20 percent in City projects. Below-market rentals are made possible by low-interest tax-exempt financing and by annual subsidies to the NYCHA from Federal, State, and City governments. The City also contributes nearly complete property tax exemption on all Federal and State projects and some exemptions on City projects.[1]

The purpose of this paper is to investigate the benefits and costs of public housing in New York City. In particular, the following questions will be answered. What are the dollar values of these public housing programs to their direct beneficiaries? What cost is incurred by taxpayers to provide these benefits? Although we are not able to estimate the value of these programs to taxpayers, we are able to investigate certain program effects upon which this value presumably depends. Specifically, how much better or worse housing do

public housing tenants occupy than they would have occupied in the absence of these programs? How much more or less of other goods do they consume as a result of the programs? How do these changes in consumption patterns compare with the changes that would have occurred had each family been given an unrestricted cash grant that would allow it to consume all combinations of goods with the same market value as the combination consumed under the public housing program? To what extent are subsidies limited to the poorest families? What proportion of public housing tenants receive such a large benefit that their effective income (that is, nominal income plus benefit from the program) is greater than the upper-income limit for eligibility? How does tenant benefit vary with the income and size of the household and with the age, race, and sex of its head? To what extent do equally situated families receive equal benefits? Finally, since it is possible to have public subsidies without public provision of housing services, it is important to investigate the efficiency with which housing services are produced under these public housing programs. Therefore, we also estimate the full resource cost incurred under the programs to provide housing with a market value of one dollar.

Answers to these questions are produced within the framework of a simple general equilibrium model using methods developed by Joseph DeSalvo [1971, 1975], Michael Murray, and Edgar Olsen [1972, 1977]. One novelty of this approach lies in using an estimated indifference map to estimate the value of a government program to each direct beneficiary and the beneficiary's consumption pattern under alternatives to the program. This study differs from previous studies of public housing in that a broader range of questions are answered, more suitable data is used

to predict the market rents of public housing units, and a different class of indifference maps is estimated. The empirical results are based primarily on microdata, on the characteristics of thousands of public and private dwelling units, and on their occupants in New York City in 1965 and 1968.

I. Theoretical Framework

This study compares the allocation of resources in the presence of public housing with the long-run equilibrium allocations under two alternatives, namely, no public housing and unrestricted cash grants in place of public housing. The empirical results are produced within the framework of a simple economic model.[2] Assume that (1) there are two composite goods called housing services and other goods; (2) the uncontrolled markets for these goods are perfectly competitive and in long-run equilibrium; (3) the long-run supply curves in all markets are perfectly elastic; and, (4) information and transportation are costless.[3] These assumptions imply that all consumers who buy all goods in uncontrolled markets face the same set of prices and that this set of prices would be the same under the three alternatives considered in this paper.[4] The three alternatives necessarily involve different tax payments or quantities of other public services. Assume that there is no difference in the quantities of other public services in the three cases and that the differences in taxes do not affect the tax payments of families eligible for public housing.[5] Assume that occupants of public housing receive no other subsidies in kind. Finally, assume that occupants of public housing would choose the

same job and work the same number of hours under the three alternatives and are unconcerned about the consumption patterns of others.

With the preceding assumptions, the situation of a public housing tenant under the three alternatives can be depicted in a two dimensional diagram. Figure 1 contains several indifference curves of one family living in public housing. In the absence of the program, this family would have some income Y and could buy as much of each good as it could pay for at prices P(h,m) and P(x,m). It would select some combination m of the two goods, spending P(h,m)Q(h,m) on housing and P(x,m)Q(x,m) on other goods. Under the public housing program, the family has been offered and has accepted a particular dwelling unit providing some quantity of housing service Q(h,g). In order to occupy this apartment, the family must pay a certain rent P(h,g)Q(h,g). After paying this rent, the family has enough money left to spend P(x,m)Q(x,g) on other goods. It is important to realize that public housing does not change an eligible family's situation by rotating its budget line. In the two goods case, it effectively adds one point to the family's budget space. Since the public housing authority could offer a family a dwelling worse than it would otherwise occupy and charge a rent so low that the family is able to increase its consumption of other goods by more than enough to compensate for its decreased housing consumption, the basic assumptions of the theory of consumer choice together with the possible changes in budget spaces under the public housing programs do not imply that public housing tenants occupy better housing than they would in the absence of these programs. The only two things that can be said a priori about the location

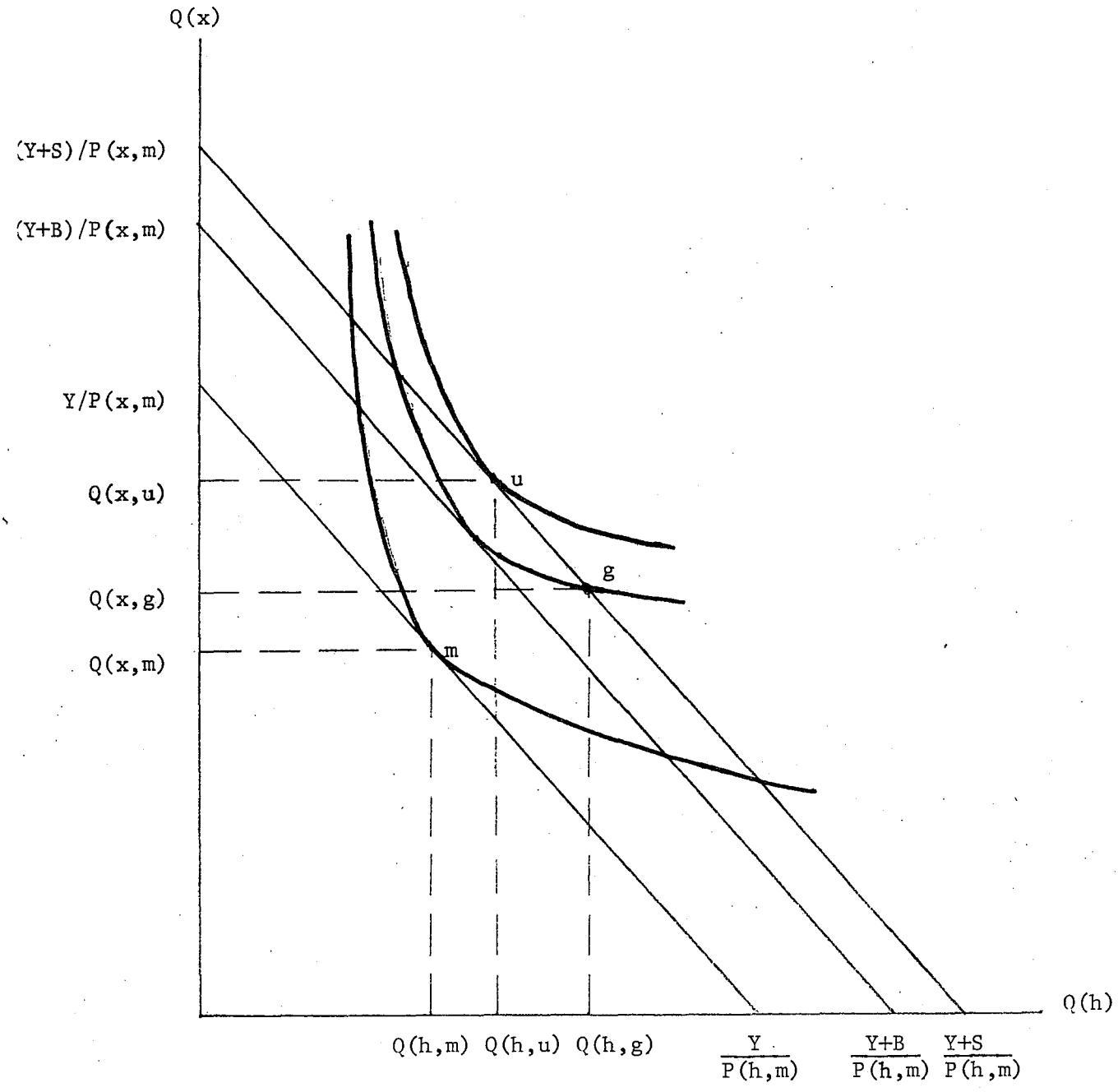
Q(x)
(Y+S)/P(x,m)
(Y+B)/P(x,m)
Y/P(x,m)
Q(x,u)
Q(x,g)
Q(x,m)
u
g
m
Q(h)
Q(h,m)
Q(h,u)
Q(h,g)
Y / P(h,m)
Y+B / P(h,m)
Y+S / P(h,m)

Figure 1

of the point, g, are that it is above the indifference curve containing m, since the family has the alternative of renting a private, uncontrolled apartment, and it is below the horizontal line at height $Y/P(x,m)$, since rents in public housing are positive.

The proportional changes in the ith family's consumption of housing services and other goods resulting from the public housing programs are given by expression (1).

$$\sum_{s=h,x} [P(s,m)Q(s,g,i) - P(s,m)Q(s,m,i)]/[P(s,m)Q(s,m,i)] \qquad (1)$$

Similarly, the proportional changes in total consumption of the two goods for a set of families are given by expression (2).

$$\sum_{s=h,x} \Sigma_i [P(s,m)Q(s,g,i) - P(s,m)Q(s,m,i)]/\Sigma_i [P(s,m)Q(s,m,i)] \qquad (2)$$

Since there are only two goods, everything that the family does not spend on housing services is spent on other goods. In symbols,

$$P(x,m)Q(x,g,i) = Y(i) - P(h,g,i)Q(h,g,i) \qquad (3)$$

and

$$P(x,m)Q(x,m,i) = Y(i) - P(h,m)Q(h,m,i). \qquad (4)$$

Therefore, the effect of these programs on the consumption patterns of public housing tenants can be calculated from a knowledge of each family's income, Y(i), the rent of its public housing unit, $P(h,g,i)Q(h,g,i)$, its expenditure on housing in the absence of the

public housing programs, $P(h,m)Q(h,m,i)$, and the market rent of its public housing unit, $P(h,m)Q(h,g,i)$. Our data include the values of the first two variables for a random sample of public housing tenants; we have predicted the values of the last two variables for these families.

There is some unrestricted cash grant, B, which, if given to this family in place of its eligibility for public housing, would leave the family as well off as it is under the public housing program. This is what we mean by the benefit (or value) of the program to the family. Obviously, the value of the program to the family depends on its preferences as well as its income and consumption pattern with the program. We assume that the ith family has preferences that can be represented by the utility function

$$U = [Q(h,i) - \beta(h,i)]^{\gamma(h,i)} [Q(x,i) - \beta(x,i)]^{1-\gamma(h,i)} \quad (5)$$

where $\beta(h,i)$, $\beta(x,i)$, and $\gamma(h,i)$ are parameters. The indifference map corresponding to this utility function provides the rationale for one of the most frequently estimated complete systems of demand equations. Notice that we allow the parameters of the indifference map to be unlike for different families. The benefit to a public housing family having such preferences is

$$\{[P(h,m)Q(h,g,i) - P(h,m)\beta(h,i)]/\gamma(h,i)\}^{\gamma(h,i)}\{[P(x,m)Q(x,g,i) - P(x,m)\beta(x,i)]/[1-\gamma(h,i)]\}^{1-\gamma(h,i)} + P(h,m)\beta(h,i) + P(x,m)\beta(x,i) - Y(i).^{6} \quad (6)$$

We have estimated the parameters of indifference map corresponding to equation (5) for each public housing family in our sample.

These estimated indifference maps are used not only to estimate benefits, but also to predict consumption patterns under the two alternatives. If a public housing family has preferences that can be represented by the utility function (5), then its housing expenditure in the absence of these programs, $P(h,m)Q(h,m,i)$, would be

$$\gamma(h,i)Y(i) + (1-\gamma(h,i))\beta(h,i)P(h,m) - \gamma(h,i)\beta(x,i)P(x,m). \qquad (7)$$

If this family were given an unrestricted cash grant, S, that would allow it to consume all combinations of goods with the same market value as the combination consumed under the public housing program, then the family's housing expenditure, $P(h,m)Q(h,u,i)$, would be

$$\gamma(h,i)[Y(i) + P(h,m)Q(h,g,i) - P(h,g,i)Q(h,g,i)] + (1-\gamma(h,i))\beta(h,i)P(h,m) - \gamma(h,i)\beta(x,i)P(x,m), \qquad (8)$$

and its expenditure on other goods would be

$$Y(i) + P(h,m)Q(h,g,i) - P(h,g,i)Q(h,g,i) - P(h,m)Q(h,u,i). \qquad (9)$$

The proportional changes in consumption of the two goods resulting from replacing public housing with these unrestricted cash grants are given by expressions similar to equations (1) and (2). Although the family depicted in Figure 1 occupies better housing under the public housing program than it does with the cash grant, the opposite is entirely possible.

To provide public housing tenants with benefits, others must bear a cost.[7] This cost is equal to the excess of the full resource cost of providing public housing units over the rent collected from public housing tenants. The latter is known, but the full resource cost must

be estimated because these programs receive two implicit subsidies. The interest on NYCHA bonds used to finance the purchase of land, site improvement, and construction of projects is exempt from federal income taxation. As a result, the NYCHA is able to borrow at below-market interest rates. Furthermore, the NYCHA does not pay full property taxes on its projects.[8]

Looking back at the formulas derived in this section, we see that in order to answer the questions posed in the introduction we must predict the market rents of public housing units, estimate the parameters of the indifference maps of public housing tenants, and estimate the full resource cost incurred to provide public housing.

II. Data and Methods of Prediction and Estimation

With the exception of the estimate of full resource cost, the empirical results of this paper are based on data for individual families and housing units from the 1965 and 1968 New York City Housing and Vacancy Surveys (NYCHVS), conducted by the U.S. Bureau of the Census. In each year many pieces of information were obtained for a stratified random sample of close to 35 thousand housing units and their occupants, including whether the housing unit was in a public housing project or subject to rent control.[9] We will now explain how these data and other information concerning resource cost were used to make the predictions and estimates underlying the empirical results.

A. Market Rents of Public Housing Units

Assume that the annual gross rent per room of uncontrolled private rental housing in New York City in 1965 and 1968 is a linear function of the stochastic regressors listed in Table 1, and an error term that is independent of these regressors.[10] Assume, further, that the conditional distributions of gross market rent per room given the housing characteristics in Table 1 are the same for public housing units and uncontrolled private rental units.[11] These assumptions imply that

$$[a(t,0) + \sum_{i=1}^{14} a(t,i)X(i)]/X(1) \qquad (10)$$

is an unbiased predictor of the annual gross market rent for a public housing unit selected at random, where the a(t,i) are the "weighted least-squares" estimators of the coefficients of the regressors in the stochastic model in year t based on a stratified random sample of uncontrolled private rental dwelling units.[12]

In each year the NYCHVS contained information on about ten thousand such dwellings. Since the NYCHA did not provide furniture for its units, we excluded from our sample of private dwellings those units for which the landlord provides furniture. We also excluded units with more than seven rooms because the number of rooms was not reported in these cases and almost no public housing projects were this large. The results in Table 1 were obtained using the remaining uncontrolled private rental dwellings for which all variables involved in the regression were reported.[13] These equations were used to predict the market rent of each public housing unit in our samples for 1965 and 1968, respectively.

Table 1

Estimated Relationships Between Annual Gross Rent per Room and Housing Characteristics

Regressors	Description of Regressors	Coefficients (Standard Errors)	
		1965	1968
X_1	Inverse of the number of rooms	1,023.88 (23.27)	1,159.72 (26.50)
X_2	1 if dwelling built in 1960-1965 (1960-1968); 0 otherwise	110.92 (11.15)	139.93 (12.09)
X_3	1 if dwelling built in 1947-1959; 0 otherwise	1.89 (10.12)	51.35 (11.01)
($X_2 = X_3 = 0$ if dwelling built prior to 1947)			
X_4	1 if condition of unit is sound; 0 otherwise	189.51 (34.62)	187.91 (34.48)
X_5	1 if condition of unit is deteriorating; 0 otherwise	110.69 (36.51)	144.85 (36.94)
($X_4 = X_5 = 0$ if condition of unit is dilapidated)			
X_6	1 if dwelling located in Queens; 0 otherwise	-168.65 (8.29)	-217.40 (9.03)
X_7	1 if dwelling located in Bronx; 0 otherwise	-195.31 (10.28)	-278.61 (13.42)
X_8	1 if dwelling located in Brooklyn; 0 otherwise	-217.70 (8.89)	-259.48 (9.68)
X_9	1 if dwelling located in Richmond; 0 otherwise	-180.55 (49.67)	-280.06 (33.52)
($X_6 = X_7 = X_8 = X_9 = 0$ if dwelling located in Manhattan)			
X_{10}	Story of unit if it is less than 7; 0 otherwise	-22.88 (4.56)	-46.15 (4.54)

Table 1 (cont.)

Regressors	Description of Regressors	Coefficients (Standard Errors) 1965	1968
X_{11}	X_{10}*ELEV where ELEV is 1 if building has an elevator and 0 otherwise	32.02 (3.79)	52.53 (3.81)
X_{12}	1 if story of unit is 7 or greater; 0 otherwise	138.54 (11.18)	135.76 (12.37)
X_{13}	1 if unit heated with central warm air furnace; 0 otherwise	-- --	350.53 (19.95)
X_{14}	Proportion of rooms that are bedrooms	74.60 (24.82)	191.14 (27.95)
	Constant	102.35	79.04
	Coefficient of determination	.61	.59
	Standard error	187.40	230.78
	Number of observations	4260.	5077.

B. Indifference Maps of Families in Public Housing

It has already been assumed that each family in New York City has a displaced Cobb-Douglas indifference map. If $\beta(h,i)$ and $\beta(x,i)$ are nonnegative, then this indifference map has been interpreted to say that there are minimum quantities, $\beta(h,i)$ and $\beta(x,i)$, of the two goods necessary for subsistence and that the family will spend on housing a constant proportion, $\gamma(h,i)$, of the income left after buying the minimum quantities of the two goods. This interpretation must be modified in our case. We measure expenditure on other goods as the excess of current income over current housing expenditure. Obviously, this difference can be negative since savings can be used to finance current expenditure on housing services and nonhousing goods. Therefore, other goods is a composite of present consumption of nonhousing goods and future consumption of both goods. The parameter, $\beta(x,i)$, can be negative and reflects the amount by which current expenditure on housing can exceed current income while still leaving the family with enough wealth to subsist in the future.

It is not assumed that the parameters are the same for all families. Instead, families are divided into types defined in terms of the age, race, marital status of the head of the household, and the number of persons in the household. It is assumed that all families of the same type have the same displacement parameters, $\beta(h)$ and $\beta(x)$, but different parameters, $\gamma(h,i)$. Let $\gamma(\bar{h})$ be the mean of the $\gamma(h,i)$ for all families of a particular type. Then, for any family of this type, $\gamma(h,i)$ can be written as the sum of $\gamma(h)$ and some new variable,

$w(i)$, which has mean zero. The parameters $\beta(h)$, $\beta(x)$, and $\gamma(h)$ may be different for families of different types.

Under these assumptions, a maximizing family that can buy as much of each good as it can pay for at prices $P(h,i)$ and $P(x,i)$, will devote a fraction of its income to housing:

$$P(h,i)Q(h,i)/Y(i) = \gamma(h) + (1-\gamma(h))\beta(h)P(h,i)/Y(i) - \gamma(h)\beta(x)P(x,i)/Y(i) + [1-(P(h,i)\beta(h) + P(x,i)\beta(x))(1/Y(i))]w(i). \quad (11)$$

Since we estimate the parameters $\beta(h)$, $\beta(x)$, and $\gamma(h)$ based on a random sample of families of each type. $P(h,i)$, $P(x,i)$, $Q(h,i)$, $Y(i)$, and $w(i)$ are jointly distributed random variables. This stochastic model cannot be estimated as it stands because there is insufficient variation in prices in the sample, and the small differences that exist are inaccurately measured. For any one year, we see no way of discerning any variation in prices. Data for the two years could be pooled and BLS indices of housing and other prices used. However, a majority of apartments in the BLS sample in New York City were subject to rent control and hence, the BLS index understated the difference between the market price of housing services in the two years. Even with an accurate housing price index, the change in relative prices between 1965 and 1968 would be too small to obtain reliable estimates of the parameters in a straightforward way.

Our solution to this problem is as follows: First, we analyze each year's data separately; second, we define units of the goods such that the price of each is one dollar. Thus, for families of a particular

type, the stochastic equation (11) can be rewritten as

$$P(h)Q(h,i)/Y(i) = \gamma(h) + \alpha(h)(1/Y(i)) + u(i), \qquad (12)$$

where $\alpha(h) = (1-\gamma(h))\beta(h) - \gamma(h)\beta(x)$ and $u(i) = [1 - (\beta(h) + \beta(x))(1/Y(i))]w(i)$; third, we assume that the random variables, $Y(i)$ and $w(i)$, are independent. This implies that $1/Y(i)$ and $u(i)$ are uncorrelated (though not independent) and hence, that the weighted least-squares estimators of $\gamma(h)$ and $\alpha(h)$ are consistent.[14] Tables 2 and 3 report estimates of these parameters based on a stratified random sample of families living in unfurnished, uncontrolled private rental housing for which the variables in the regression and those used to define family types are reported; fourth, in order to obtain separate estimates of $\beta(h)$ and $\beta(x)$, one of these estimates must be gotten by other means. Since units of housing services have been defined so that the price of this good is one, $\beta(h)$ can be interpreted as minimum expenditure as well as minimum quantity of housing service. Our estimate of this parameter for each family type is the smallest housing expenditure among sample families of that type living in uncontrolled private rental housing.[15] These estimates are reported in Tables 2 and 3. Since the sample minimum is a consistent estimator of the population minimum,

$$[(1 - c(h))b(h) - a(h)]/c(h) \qquad (13)$$

is a consistent estimator of $\beta(x)$, where $a(h)$, $b(h)$, and $c(h)$ are the estimators of $\alpha(h)$, $\beta(h)$, and $\gamma(h)$.[16] Tables 2 and 3 report estimates of $\beta(x)$.

Table 2

Estimates of Parameters of Indifference Maps, 1965

Color	Marital Status	Age of Head	Family Size	c(h)	s[c(h)]	a(h)	s[a(h)]	R^2	No. of Cases	b(h)	b(x)
W	M	-30	1-3	.058	.006	1089	41	.58	501	684	-7666
			4-	.077	.012	949	70	.49	191	708	-3835
		31-50	1-3	.037	.007	1359	48	.61	534	620	-20604
			4-	.085	.007	931	48	.36	668	504	-5529
		51-	1-3	.074	.006	1184	26	.79	557	624	-8192
			4-	.033	.012	1461	95	.68	110	780	-21421
	S	-30	1-2	.080	.017	1304	93	.56	159	852	-6504
			3-	.101	.060	1367	263	.40	42	816	-6275
		31-50	1-2	.123	.009	851	42	.57	307	720	-1786
			3-	.124	.016	911	59	.71	101	684	-2516
		51-	1-2	.150	.014	762	29	.69	307	480	-2361
			3-	.066	.024	1250	110	.73	50	864	-6706
B	M	-40	1-3	.046	.014	1154	85	.68	90	804	-8417
			4-	.046	.017	1098	85	.68	82	625	-10909
		41-	1-3	.019	.021	1227	83	.83	47	696	-28627
			4-	.009	.021	1366	94	.82	47	744	-62992
	S	-40	1-2	.105	.030	853	83	.72	42	612	-2990
			3-	.025	.027	1273	63	.85	73	768	-20981
		41-	1-2	.134	.027	870	64	.79	52	780	-1450
			3-	.109	.037	858	16	.53	27	792	-1395

Table 3

Estimates of Parameters of Indifference Maps, 1968

Color	Marital Status	Age of Head	Family Size	c(h)	s[c(h)]	a(h)	s[a(h)]	R^2	No. of Cases	b(h)	b(x)
W	M	-30	1-3	.039	.005	1327	39	.72	467	672	-17436
			4-	.097	.010	871	75	.42	191	912	-485
		31-50	1-3	.061	.007	1291	46	.63	466	744	-9654
			4-	.058	.006	1265	44	.62	519	576	-12370
		51-	1-3	.095	.006	1082	29	.70	574	468	-6927
			4-	.058	.015	1367	119	.59	95	1020	-6988
	S	-30	1-2	.120	.011	1059	54	.69	177	900	-2226
			3-	.103	.070	1478	311	.45	30	1044	-5250
		31-50	1-2	.089	.010	1004	60	.53	246	696	-4157
			3-	.107	.020	1063	100	.54	98	816	-3112
		51-	1-2	.126	.014	965	31	.72	380	480	-4329
			3-	.052	.018	1345	72	.93	28	1044	-6811
B	M	-40	1-3	.036	.012	1251	90	.70	85	912	-10364
			4-	.070	.017	1097	106	.53	95	816	-4808
		40-	1-3	.048	.015	1190	53	.87	79	744	-9980
			4-	.048	.040	1457	241	.54	33	960	-11419
	S	-40	1-2	.074	.017	1004	64	.81	62	816	-3345
			3-	.070	.017	1221	54	.85	90	960	-4672
		40-	1-2	.115	.020	806	59	.75	64	672	-1835
			3-	.013	.028	1464	118	.81	39	924	-41359

C. Full Resource Cost

The full resource cost of public housing is calculated for two reasons. First, we want to compare the value of the program to its direct beneficiaries with its cost to taxpayers in order to know the extent to which it is different from a program of unrestricted cash grants. The cost to taxpayers is the difference between full resource cost and the rent paid by public housing tenants. Second, we want to compare the full resource cost with the market rent of public housing units in order to determine the efficiency with which housing services are produced under the program. In long-run equilibrium in a competitive market, market rent is equal to full resource cost. Therefore, we view the market rent of a public housing unit as an estimate of the full resource cost incurred in the private sector to produce housing equally satisfactory to its occupant.

It is not clear even in principle how the full resource cost should be calculated. It cannot be obtained directly from the records of the NYCHA because these programs receive the two implicit subsidies mentioned earlier. The most obvious approach is to estimate what the expenses of the NYCHA would have been in 1965 and 1968 if the interest on their bonds had been subject to federal income taxation and they were required to pay full property taxes. This does not strike us as entirely satisfactory for two reasons.

First, it seems to be an arbitrary way of spreading initial development cost over the lives of projects. It could be argued that loans with equal monthly payments are typical in the private sector because the repayment of principal under such loans corresponds with the expected depreciation of housing. Even if there were some truth in this remark, the

path of depreciation in public housing might be different from that which is typical in the private sector. Nevertheless, since we have nothing better to propose, we adopt this approach.

Second, redemption of these bonds is guaranteed by the Federal government, and hence the only risk to their buyers is that future interest rates will be higher than expected. The editors of the 1972 issue of Benefit-Cost and Policy Analysis have said that "there is a surprising convergence of views on the concept of measuring the opportunity cost of public investments. . .that the rate of discount for public sector projects should include a risk premium that is specific to each project. . . ." While we are inclined to accept the reasoning which leads to this conclusion, we do not believe that this issue has been resolved to the satisfaction of all participants in the controversy. Therefore, the full resource cost will be estimated using three alternative series of interest rates. These series are presented in Table 4. The first is a series of yields on long-term federal government bonds. They are riskless rates of return. The second is a series of mortgage yields on all types of property in Manhattan between 1937 and 1952 and on one- to four-family properties throughout the country between 1953 and 1968. They are intended to be lower bounds on the rates of return to funds invested in multi-family rental housing because (1) we expect them to be about equal to yields on loans for such investments and (2) we expect borrowers to earn a greater rate of return on their equity since they bear most of the risk. Using the crude estimates of the rate of return on investments in multi-family rental housing that exist for particular times and places and data on the yields of mortgages for such investments, we estimate that the overall

Table 4

Alternative Interest Rates for Calculating Full Resource Cost
(percentages)

Year	Series (1)	Series (2)	Series (3)
1937	2.68	4.82	8.32
1938	2.56	4.66	8.16
1939	2.36	4.76	8.26
1940	2.21	4.72	8.22
1941	2.05	4.53	8.03
1942	2.46	4.77	8.27
1943	2.47	4.42	7.92
1944	2.48	4.32	7.82
1945	2.37	4.48	7.98
1946	2.19	4.42	7.92
1947	2.25	4.44	7.94
1948	2.44	4.49	7.99
1949	2.31	4.57	8.07
1950	2.32	4.52	8.02
1951	2.57	4.55	8.05
1952	2.68	4.75	8.25
1953	2.94	4.73	8.23
1954	2.55	4.78	8.28

Table 4 (cont.)

Year	Series (1)	(2)	(3)
1955	2.84	4.75	8.25
1956	3.08	4.90	8.40
1957	3.47	5.50	9.00
1958	3.43	5.53	9.03
1959	4.07	5.71	9.21
1960	4.01	6.06	9.56
1961	3.90	5.83	9.33
1962	3.95	5.71	9.21
1963	4.00	5.53	9.03
1964	4.15	5.48	8.98
1965	4.21	5.50	9.00
1966	4.66	6.11	9.61
1967	4.85	6.33	9.83
1968	5.25	6.83	10.33

SOURCES: Series (1); Board of Governors of the Federal Reserve System (1945, p. 483; 1966, p. 68; 1969, A-34). Series (2): Leo Grebler, David Blank; and Louis Winnick (Table 0-1) for 1937-52, and Jack Guttentag and Morris Beck (p. 62) for 1953-68. Series (3): The second series plus 3.5.

rate of return exceeds the mortgage yield by at least 3.5 percentage points. The third series is obtained by adding this number to the second series. We consider these yields to be conservative estimates of rates of return on investments in multi-family rental housing and to approximate the interest rate that should be used in calculating the full resource cost. It is interesting to note that in 1970 the U.S. Office of Management and Budget prescribed a rate of 10 percent for evaluating most federal investment decisions. The choice of the third series seems consistent with this directive.

Using data on the initial development cost and completion date of each public housing project published by the NYCHA, we calculated how much the Authority would be paying on its loans in 1965 and 1968 had it borrowed at the interest rates in Table 4 and made equal payments on these loans over forty years. (Almost all NYCHA permanent financing is of this duration.) George Sternlieb [1972:196] has found that in 1968 the ratio of property tax to market rent in private uncontrolled rental housing in New York City averaged 0.25. We multiplied our estimated mean market rents of public housing units by this ratio to obtain estimates of full property taxes. Operating costs excluding payments in lieu of taxes were obtained from Dreyfuss and Hendrickson [1968: 18, 22, 24, 25, 27, 28] and from the Annual Fiscal Report of the NYCHA. Adding these three components yields an estimate of the full resource cost. Alternative estimates of full resource cost, and cost to taxpayers are presented in Table 5. However, the discussion of the results is limited to the estimates resulting from what we consider to be the appropriate discount rate, namely, the third series.

Table 5

Some Aggregate Effects of Public Housing

	1965	1968
Mean annual housing expenditure of public housing families in absence of these programs	$1,367	$1,497
Mean annual market rent of their public housing units	$2,159	$2,480
Percentage increase in aggregate consumption of housing services by these families	58%	66%
Mean annual expenditure on other goods by public housing families in absence of these programs	$3,120	$3,510
Mean annual expenditure on other goods by public housing families under these programs	$3,645	$4,112
Percentage increase in aggregate consumption of other goods by these families	17%	17%
Mean annual rent paid by public housing families	$ 842	$ 895
Weighted mean percentage reduction in market price of housing services to public housing families	61%	64%
Mean annual increase in market value of goods consumed by these families	$1,317	$1,585
Percentage increase in market value of goods	29%	32%
Mean annual benefit to public housing families	$1,018	$1,160
Cost to taxpayers per family in public housing	$1,019 $1,208 $1,612	$1,232 $1,422 $1,838
Full resource cost per public housing unit	$1,861 $2,050 $2,454	$2,127 $2,317 $2,733

III. Empirical Results

Table 5 shows that, in aggregate public housing, families occupy substantially better housing than they would occupy in the absence of the program and consume significantly more of other goods. In each year we estimate that about 90 percent of public housing families consumed more of both goods as a result of the program. The benefits of the changes in consumption patterns to these families were substantial, especially relative to their incomes. From their viewpoint, public housing was equivalent to a 20 to 25 percent increase in income. However, the total benefit to tenants was significantly less than the total cost to taxpayers for several reasons. First, the NYCHA appears to be an inefficient producer of housing services. Specifically, it appears to cost at least $1.10 to produce one dollar's worth of housing service under these programs. This accounts for between one-third and one-half of the difference between tenant benefit and taxpayer cost. Second, the program does distort the consumption patterns of public housing tenants. This is evidenced by the substantial difference between the benefit to these families and the increase in the market value of the goods that they consume. Public housing should not be supported in the belief that it is essentially the same as a program of unrestricted cash grants.

Although we have not attempted to estimate the value of these programs to taxpayers, we have investigated certain effects of the programs upon which this value presumably depends. First, the rationales for housing subsidies imply that recipients should occupy better housing and consume less of other goods than they would choose were they given unrestricted cash grants, which would allow them to consume all combina-

tions of goods with the same market value as the combination consumed under the program. Table 6 shows that aggregate public housing has the desired effect. Furthermore, we estimate that more than 90 percent of public housing tenants occupy better housing than they would occupy were they given unrestricted cash grants in these amounts.

Second, the value of these programs to taxpayers depends on their effect on the distribution of well-being. We begin by considering who is served. Table 7 shows that the mean income of families in public housing is about the same as that of other eligible families, and much less than that of families who are not eligible.[17] This table contains three other noteworthy results. Families with a black head are greatly overrepresented in public housing. Table 8 indicates that this is true even if we hold constant the other family characteristics and despite the fact that such families do not receive larger benefits from the program, again holding other characteristics constant. Another interesting result from Table 7 is that more than one-half of the families in NYC are eligible for public housing.[18] Finally, less than 25 percent of all eligible families are served. This would perhaps not be so objectionable if those served were the poorest of the poor. However, this is far from the case. Tables A-1 through A-4 show that more than one-half of the families in public housing have annual incomes greater than $4000 while about 80 percent of all families with incomes less than this amount are not served.

The regressions reported in Table 8 summarize the distributive effects of public housing. The first column for each year focuses on the distribution of benefit among families who receive a benefit. The third column considers the distribution of benefit among all eligible families, assigning zero benefit to families who are eligible but not served. The

Table 6

Some Effects of Replacing Public Housing with Unrestricted Cash Grants

	1965	1968
Mean annual market rents of public housing units	$2,159	$2,480
Mean annual housing expenditure of public housing families with cash grants in place of public housing	$1,462	$1,618
Percentage increase in aggregate consumption of housing services with cash grants in place of public housing	-32%	-35%
Mean annual expenditure on other goods by public housing families under the public housing programs	$3,645	$4,112
Mean annual expenditure on other goods by these families with cash grants in place of public housing	$4,342	$4,974
Percentage increase in aggregate consumption of other goods with cash grants in place of public housing	19%	21%

Table 7

Comparison of Characteristics of Families in Public Housing, Other Eligible Families, and Ineligible Families Not Living in Controlled Housing

Characteristics	1965			1968		
	Public Housing	Other Eligible	Ineligible	Public Housing	Other Eligible	Ineligible
Mean annual income	4487	4828	12335	5007	4723	13539
Mean number of persons	3.7	3.0	3.1	3.5	2.9	3.1
Mean age of head of family	46	49	47	48	51	46
Percentage of families headed by black	39	16	6	41	19	10
Percentage of families headed by female	24	22	10	30	27	11
Number of families in thousands	142	720	525	144	617	740

Table 8

Distributive Effects of Public Housing

	1965			1968		
	Public Housing Families	All Eligible Families Not Living in Controlled Housing		Public Housing Families	All Eligible Families Not Living in Controlled Housing	
Family Characteristics	Annual Benefit	Participation (1 if family participates; 0 otherwise)	Annual Benefit	Annual Benefit	Participation (1 if family participates; 0 otherwise)	Annual Benefit
Annual income in thousands of dollars	-23.51 (5.79)	-.0262 (.0025)	-33.43 (2.80)	-13.94 (5.34)	.0028 (.0029)	-4.48 (3.76)
Number of persons	51.20 (6.66)	.0472 (.0030)	60.10 (3.28)	58.95 (8.47)	.0317 (.0038)	55.42 (4.91)
Color of head (1 if black; 0 otherwise)	-13.18 (21.92)	.1865 (.0113)	183.62 (12.50)	-49.74 (26.97)	.2087 (.0133)	222.25 (17.31)
Sex of head (1 if female; 0 otherwise)	22.92 (27.91)	.0243 (.0115)	26.19 (12.75)	18.73 (31.83)	.0543 (.0137)	63.27 (17.87)
Age of head in tens of years	- 2.76 (8.19)	-.0042 (.0031)	- 6.42 (3.38)	- 6.27 (9.66)	.0044 (.0038)	.72 (.49)
Constant	944.31	.1386	146.08	1066.86	.0560	70.24
R^2 (adj.)	.05	.09	.09	.04	.06	.06
Standard error	383	.3719	411	497	.4230	551
Sample size	1366	7333	7333	1515	5901	5901

NOTE: The numbers in parentheses are estimates of the standard deviations of the parameter estimators.

coefficients in the equations indicate how mean benefit varies with family characteristics and hence are relevant to a discussion of vertical equity, the coefficient of determination and standard error indicate the extent to which equally situated families receive equal benefits.

Among families in public housing, we can be quite confident that mean benefit is greater for poorer and larger families. Mean benefit does not appear to vary significantly with the color, sex, and age of the head of the family. The significance of income in explaining variations in benefit is less than in previous studies and declines between 1965 and 1968. This is undoubtedly attributable to a unique feature of the public housing programs in New York City. In public housing elsewhere and in projects in New York City built prior to 1959, the rent that a family must pay varies directly with its income. In NYC projects built after 1959, rents do not vary with income until incomes rise above certain permissible amounts. The coefficients of determination and standard errors show that there is nothing approaching equal treatment of equals among families in public housing. Certainly, one explanation of this result is the large variance in the desirability of different public housing projects.

In most cases, the participation rate is greatest for family types with the largest expected benefit in public housing. The only clear exception has already been mentioned. Blacks are clearly overrepresented in public housing even though they receive benefits little different from whites.

The distribution of benefit among families in public housing together with the participation rates of families of different types determine the distribution of benefit among all eligible families. Among

such families, we can be quite confident that mean benefit is greater for poorer (in 1965), larger, and black-headed families. Our conclusions concerning horizontal equity are unchanged. Equals are not treated at all equally.

Finally, we consider the extent to which public housing provides its occupants with such a large benefit that their effective incomes (that is, nominal income plus benefit from the program) are greater than the relevant upper income limit for eligibility. The results are presented in Table 9. When the effect of public housing alone is considered, leapfrogging does not appear to have been a great problem in 1965. By 1968, this can no longer be said. Furthermore, these results greatly understate the magnitude of the real problem because many of the families receive benefits from other government programs (e.g., food stamps) and, if the benefits from these programs were added to their incomes, Table 9 would show leapfrogging of a much larger magnitude.

Table 9

Deviations of Effective Income from Upper Income Limit for Eligibility

	1965	1968
Effective income less than upper income limit	89.6%	78.2%
Effective income greater than upper income limit		
1 to 10 percent	5.1	5.9
11 to 20 percent	2.8	5.3
Over 20 percent	2.4	10.6

Table A-1

Distribution of Benefits Among Families in Public Housing
by Income and Family Size, 1965

Family Size	Statistics	Income Class 0-2000	2000-4000	4000-6000	6000-8000	8000-
	(1) Mean annual benefit	897	856	617	-	-
	(2) Standard deviation of benefit	282	476	556	-	-
1	(3) Mean annual income	1,235	2,836	4,775	-	-
	(4) Ratio of benefit to income	.73	.30	.13	-	-
	(5) Number of families	10,277	3,395	1,278	-	-
	(1)	1,024	945	1,056	676	-
	(2)	343	344	382	1,055	
2	(3)	1,538	3,124	5,020	6,502	-
	(4)	.67	.30	.21	.10	-
	(5)	4,919	10,659	6,764	1,982	
	(1)	871	1,107	989	966	834
	(2)	310	303	405	399	402
3-4	(3)	1,493	3,246	5,161	6,884	9,250
	(4)	.58	.34	.19	.14	.09
	(5)	2,602	22,409	21,413	10,992	3,411
	(1)	1,209	1,184	1,123	990	1,083
	(2)	215	321	309	418	400
5-	(3)	1,655	3,516	5,074	7,108	9,256
	(4)	.73	.34	.22	.14	.12
	(5)	1,240	10,887	16,501	10,008	3,372
	(1)	946	1,070	1,037	951	965
	(2)	312	347	387	505	419
All	(3)	1,376	3,251	5,098	6,949	9,248
	(4)	.69	.33	.20	.14	.10
	(5)	19,039	47,350	45,956	22,982	6,935

Table A-2

Distribution of Benefits Among Families in Public Housing
by Income and Family Size, 1968

Family Size	Statistics	Income Class 0-2000	2000-4000	4000-6000	6000-8000	8000-
1	(1) Mean annual benefit	982	1,099	1,052	-	-
	(2) Standard deviation of benefit	331	364	446	-	-
	(3) Mean annual income	1,323	2,900	4,810	-	-
	(4) Ratio of benefit to income	.74	.38	.22	-	-
	(5) Number of families	14,201	5,442	2,035	-	-
2	(1)	1,099	1,073	1,130	1,154	-
	(2)	336	389	446	462	-
	(3)	1,609	2,874	5,052	7,042	-
	(4)	.68	.37	.22	.16	-
	(5)	5,091	9,131	7,430	3,233	-
3-4	(1)	1,147	1,225	1,232	958	1,078
	(2)	335	377	406	784	522
	(3)	1,594	3,222	5,108	7,032	10,172
	(4)	.72	.38	.24	.14	.11
	(5)	1,228	14,614	20,670	11,193	9,373
5-	(1)	1,153	1,326	1,321	1,255	1,270
	(2)	501	343	615	547	690
	(3)	1,618	3,391	5,008	7,141	10,624
	(4)	.71	.39	.26	.18	.12
	(5)	1,250	5,447	16,247	8,701	6,432
All	(1)	1,029	1,181	1,239	1,097	1,161
	(2)	351	384	502	672	593
	(3)	1,422	3,106	5,051	7,065	10,291
	(4)	.72	.38	.25	.16	.11
	(5)	21,771	34,633	46,382	23,556	17,665

Table A-3

Distribution of Benefits Among Families Eligible for Public Housing and Not Living in Controlled Housing by Income and Family Size, 1965

Family Size	Statistics	Income Class 0-2000	2000-4000	4000-6000	6000-8000	8000-
1	(1) Mean annual benefit	134	50	23	-	-
	(2) Standard deviation of benefit	337	231	157	-	-
	(3) Ratio of benefit to income	.11	.02	.00	-	-
	(4) Number of families	68,880	58,297	34,895	-	-
	(5) Proportion who participate	.15	.06	.04	-	-
2	(1)	128	151	87	102	-
	(2)	359	373	310	475	-
	(3)	.08	.05	.02	.02	-
	(4)	39,506	66,623	82,283	13,201	-
	(5)	.13	.16	.08	.15	-
3-4	(1)	176	428	182	85	300
	(2)	376	571	421	297	467
	(3)	.12	.13	.03	.01	.03
	(4)	12,894	58,012	116,525	125,520	9,493
	(5)	.20	.39	.18	.09	.36
5-	(1)	348	538	342	150	135
	(2)	559	628	544	390	385
	(3)	.24	.16	.06	.02	.02
	(4)	4,309	23,969	54,233	66,235	27,050
	(5)	.29	.45	.30	.15	.13
All	(1)	143	245	165	107	182
	(2)	360	479	410	345	420
	(3)	.10	.08	.03	.01	.02
	(4)	125,589	206,901	287,936	204,956	36,694
	(5)	.15	.23	.16	.11	.19

Table A-4

Distribution of Benefits Among Families Eligible for Public Housing and Not Living in Controlled Housing by Income and Family Size, 1968

Family Size	Statistics	Income Class 0-2000	2000-4000	4000-6000	6000-8000	8000-
1	(1) Mean annual benefit	204	108	63	-	-
	(2) Standard deviation of benefit	426	346	273	-	-
	(3) Ratio of benefit to income	.16	.03	.02	-	-
	(4) Number of families	68,264	55,589	33,909	-	-
	(5) Proportion who participate	.21	.10	.06	-	-
2	(1)	160	141	131	307	-
	(2)	408	389	392	563	-
	(3)	.11	.05	.03	.05	-
	(4)	34,967	69,643	64,154	12,143	-
	(5)	.15	.13	.12	.27	-
3-4	(1)	118	398	286	103	727
	(2)	364	613	556	393	662
	(3)	.09	.12	.05	.01	.08
	(4)	11,972	44,938	89,155	103,987	13,888
	(5)	.10	.33	.23	.11	.68
5-	(1)	364	448	417	196	284
	(2)	606	658	704	504	622
	(3)	.25	.13	.08	.03	.03
	(4)	3,962	16,126	51,489	55,835	28,749
	(5)	.32	.34	.32	.16	.22
All	(1)	188	220	241	150	461
	(2)	425	488	538	451	680
	(3)	.14	.07	.05	.02	.05
	(4)	119,166	186,296	238,708	172,393	44,497
	(5)	.18	.19	.19	.14	.40

NOTES

[1]For a more detailed description of the operation of these programs, see David Dreyfuss and Joan Hendrickson [1968: 14-32] and U.S. Congress, Joint Economic Committee [1972: 232-235].

[2]Although the results depend upon the assumptions of this model, they may not be very sensitive to reasonable changes in these assumptions. This cannot be known without answering the same questions using a random sample of data from the same population but a different set of assumptions.

[3]The third assumption is consistent with the finding of Richard Muth [1960: 42-46], but Frank DeLeeuw and Nkanta Ekanem [1971] find price elasticities of long-run supply of housing services between 0.3 and 0.7.

[4]Except for the question of technical efficiency in producing housing services, these two implications could replace the preceding assumptions as the theoretical basis of the study. We consider the second implication to be entirely plausible because we estimate that these public housing programs have changed the total quantity of housing service produced in New York City by less than 2 percent and the effect of the program of unrestricted cash grants would be even smaller.

[5]Since expenditure on public housing is such a small part of total government expenditure and the burden of major taxes borne by eligible families is only a part of the total burden, we believe that the empirical results of this paper would be little affected by assuming that changes in government expenditure on public housing are accompanied by proportional changes in the rates of any set of major taxes.

[6]A special case of this formula, namely the case where $\beta(h,i)$ and $\beta(x,i)$ are zero, has been used by DeSalvo [1975], Murray [1975], and Kraft and Olsen [forthcoming] to calculate the predicted benefits of housing programs. Formula (6) can be derived in the same way that DeSalvo [1971] derived the formula in the special case. For the convenience of our readers, we outline the derivation here. If the public housing family is given an unrestricted cash grant, $B(i)$, in place of public housing, then its budget constraint will be

$$P(h,m)Q(h,i) + P(x,m)Q(x,i) = Y(i) + B(i).$$

If the family has preferences that can be represented by the utility function (5), then it will spend

$$\gamma(h,i)(Y(i) + B(i)) + (1-\gamma(h,i))\beta(h,i)P(h,m) - \gamma(h,i)\beta(x,i)P(x,m) \qquad (A)$$

on housing services and

$$(1-\gamma(h,i))(Y(i) + B(i)) - (1-\gamma(h,i))\beta(h,i)P(h,m) + \gamma(h,i)\beta(x,i)P(x,m) \qquad (B)$$

on other goods. Let $Q(h,b,i)$ and $Q(x,b,i)$ be the quantities of housing services and other goods that the family would choose were it given an unrestricted cash grant, $B(i)$, in place of public housing. We want to find the value of $B(i)$ such that

$$[Q(h,b,i) - \beta(h,i)]^{\gamma(h,i)} [Q(x,b,i) - \beta(x,i)]^{1-\gamma(h,i)} = [Q(h,g,i) - \beta(h,i)]^{\gamma(h,i)} [Q(x,g,i) - \beta(x,i)]^{1-\gamma(h,i)}.$$

This equation can be rewritten as

$$[P(h,m)Q(h,b,i) - P(h,m)\,\beta(h,i)]^{\gamma(h,i)}\,[P(x,m)Q(x,b,i) - P(x,m)\beta(x,i)]^{1-\gamma(h,i)}$$

$$= [P(h,m)Q(h,g,i) - P(h,m)\beta(h,i)]^{\gamma(h,i)}\,[P(x,m)Q(x,g,i) - P(x,m)\beta(x,i)]^{1-\gamma(h,i)}.$$

Substituting expressions (A) and (B) into the preceding equation for $P(h,m)Q(h,b,i)$ and $P(x,m)Q(x,b,i)$, respectively, and solving for $B(i)$ yields expression (6).

[7]This is not to say that these others are worse off since the value that they place on the change in the tenants's consumption patterns may exceed the cost that they incur.

[8]It should also be mentioned that these loans are repaid using revenues raised with distortive taxes. On this matter, see Edgar Browning [1976]. Unfortunately, it is not easy to introduce this consideration since our other estimates depend on the rejection of this possibility.

[9]A description of the sample design can be obtained from the authors.

[10]Notice that our stochastic model assumes that the effect of story of the unit on rent per room depends upon whether the building has an elevator. The estimates imply that, if the building does not have an elevator, higher apartments rent for less, but if the building has an elevator, higher apartments rent for more.

[11]It has been suggested on several occasions that this assumption is violated because the characteristics included in the regression are far

from exhaustive and public housing units that are the same as uncontrolled private rental units, with respect to included characteristics, are worse with respect to other characteristics. For example, it has been suggested that, on the average, public housing projects are located in worse neighborhoods. If this argument is correct, then we have probably overestimated the market rents of public housing units. Although we are inclined to accept many of these particular examples, the overall direction of the bias is not entirely clear to us because we see at least one major factor working in the opposite direction. The NYCHA has an unusually systematic maintenance policy and rapid response to requests for repairs [Rydell 1970]. Of course, the only solution to this shortcoming is to obtain data on more characteristics.

[12]The phrase "weighted least-squares" does not have the same meaning as its use in econometrics literature. In our case, OLS estimators are biased because of the sampling procedure used to generate the data, namely, stratified random sampling. We presume that H.S. Konijn's article [1962] provides the theoretical basis for the SPSS program used to make the estimates.

[13]The weights of the remaining observations were adjusted to reflect the incidence of nonreporteds for each initial weight, and these adjusted weights were changed proportionally so that they summed to the sample size.

[14]They also happen to be unbiased.

[15]This statement is not entirely accurate. In twelve of forty cases, we deleted the observation reporting the smallest housing expenditure because housing expenditure seemed inplausibly low and was a distinct

outlier in the sample distribution for families of the particular type. The annual housing expenditures reported for the deleted observations ranged from $125 to $744 with a mean of $400. We believe that housing expenditure either was not correctly reported, or did not represent a purely private market transaction in these cases. For example, the owner might be renting it to a relative at a below-market rent or the rent might be subsidized under a government program other than public housing or rent control.

[16]Jerry Kelly has suggested that superior estimates of $\beta(h)$ and hence $\beta(x)$ could be obtained by specifying the functional form of the population distribution of housing expenditure and using all of our data to estimate it. Since we would have to redo all of our calculations to take advantage of this suggestion, we have decided to leave it to future researchers. It should be noted that only the predictions of tenant benefit depend on the estimates of $\beta(h)$.

[17]Families living in private rent-controlled housing are excluded from the analysis of distributive effects. We would have liked to exclude all families which benefit from housing programs other than public housing. However, our data only enables us to delete families living in rent-controlled housing. Fortunately, the overwhelming majority of families in New York City benefiting from housing programs other than public housing are under rent control.

[18]Our estimates of this proportion are subject to two difficulties. The different public housing programs have different upper income limits for families of each size. For example, these range from $4200 per

year for a family of four in Part I City projects to $8316 in Part IV and V City projects. We defined eligibility in terms of the largest upper income limit for families of each size. Furthermore, upper income limits are defined in terms of net income (that is, gross income minus certain deductions). The surveys provide data on gross income and do not provide enough information to calculate net income. The difference between gross and net income is not negligible. Nevertheless, our calculations presume that there is no difference and hence we have underestimated the number of families eligible to participate in at least one of the public housing programs.

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