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THE ECONOMIC EFFECTS OF PUBLIC HOUSING

PROGRAMS IN AUSTRALIA

by

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ABSTRACT

Public housing provides subsidized shelter to approximately 300,000 low-income families in Australia. This paper presents estimates of the benefits and costs of the program and examines its allocative and distributive effects. The paper provides the first estimates of the effects of the program on the consumption pattern of participants, and of the benefits they derive from it. It also examines the distribution of benefits among participants. The effects of the public housing programs are compared with those under an alternative program of equivalent-value, unrestricted cash grants.

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I INTRODUCTION

The past fifteen years have witnessed a steady stream of studies of the effects of government housing programs in the United States due, in large part, to the availability of data on the characteristics of households and their housing for large random samples of the population (Olsen, 1972; Desalvo, 1975; Murray, 1975; Kraft and Olsen, 1977; Rosen, 1979; Olsen and Barton, 1983; Mayo, 1986; Hammond, 1987). In contrast, due to the absence of relevant data, little has been learned about the effects of rental housing subsidies to low-income families in Australia. Recently, however, the Australian Bureau of Statistics (ABS) has collected and disseminated the minimal information necessary to conduct such a study. The unit record data available from the 1981-82 Income and Housing Survey (IHS) include, among other household characteristics, information on whether a household lives in a government-owned unit.

* I wish to thank Edgar O. Olsen for generous help and guidance.

Although the Survey does not contain enough information on the characteristics of housing to make accurate estimates of the effects of government housing programs, it nevertheless seems worthwhile to make estimates based on the best available data. This is the primary purpose of this paper. A secondary purpose is to make clear how more detailed data could be used to obtain more reliable estimates.

The following questions will be answered in the study:

- (1) What are the dollar values of the public housing programs to their direct beneficiaries?
- (2) What cost is incurred by taxpayers to provide these benefits? (We are able to provide only a partial answer to this question.)
- (3) How much better or worse housing do public housing tenants occupy than they would have occupied in the absence of the programs?
- (4) How much more or less of other goods do public housing tenants consume as a result of the housing programs?
- (5) How do these changes in the consumption pattern of public housing tenants compare with the changes that would have occurred had each family been given an unrestricted cash grant which would allow it to consume any combination of goods with the same market value as the combination consumed under the public housing programs?

(6) How does tenant benefit vary with the age and sex of the household head; with the number of children in the household; and with household income?

(7) To what extent do equally situated families receive the same benefits?

Answers to these questions are produced within the framework of a simple general equilibrium model using methods developed by Desalvo (1971, 1975), Olsen (1972), and Murray (1975). The methodology involves using an estimated indifference map to calculate the value of a Government program to each direct beneficiary. It also enables us to examine the beneficiary's consumption pattern under alternatives to the program. The empirical results are based on unit record data from the 1981-82 IHS.

The rest of the paper is set out as follows. Section 2 presents a brief description of public housing programs in Australia. The theoretical framework of the study is laid out in Section 3. Section 4 contains a description of the data and the methodology used to obtain the values of certain variables necessary for the study. The empirical results are presented in Section 5. Finally, Section 6 concludes the paper with a summary of the main results.

2 RENTAL HOUSING ASSISTANCE PROGRAMS

Descriptions of different aspects of public housing programs in Australia are available in various degrees of detail from a number of studies in the relevant literature (Carter, 1980, 1983, 1987a, 1987b; Flood and Yates, 1986; Henderson, 1978; Ministry of Housing, Victoria, 1985; Neville, Vipond and Warren, 1984; Temby, 1982; Williams, 1984). Hence, in this paper, we shall limit ourselves to examining only a few salient features of the programs. Below, we review briefly: the rationale for the programs; their method of operation; and finally, funding arrangements.

2.1 Rationale for the Programs

The first question we need to ask ourselves regarding any government program is: is it necessary? The usual explanation proffered in the Australian literature for why government intervention in the housing market is desirable is that there are positive externalities in the consumption of housing. Thus, Carter (1987b, p.7) for example, explicitly justifies government involvement in housing programs on this basis:

"Housing, like education, transport and health, is a merit good -- that is, the social benefit generated by the provision of the good exceeds the private benefit. Private markets operating freely would fail to provide sufficient housing services in societal terms and the distribution of these services to various income groups would be unacceptable."

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A similar sentiment is expressed by Henderson (1978, p.34) who addresses this question directly:

"Why should we provide houses rather than food, clothes or money income for poor people? Historically, the arguments were that bad housing led to many other bad features of the family life of the poor and that adequate housing is necessary for industrial development."

Indeed, there seems to be a consensus in the literature regarding this issue. In analysing housing policies, Neville, Vipond and Warren (1984, p.55) state this externalities argument as:

"... Given Society's wish that all households should have adequate shelter ...".

If there are tangible externalities or some people care about others but think that these others undervalue housing, then housing subsidies can be justified within the framework of Paretian welfare economics (Olsen, 1981). The existence of tangible externalities is frequently asserted, as we saw above. Available evidence suggests, however, that while some such externalities exist, their magnitude is small (Weicher, 1979, pp. 489-492). The existence of paternalistic altruists can hardly be denied, but the extent and depth of this sentiment has never been seriously studied.

2.2 Method of Operation

Public housing programs are one of the main forms of housing assistance to low-income families. Despite the fact that the provision of subsidies to the cost of housing low-income families seems widely perceived by Australians to be desirable, public housing assistance is not very widespread. As Table 1 (based on data from the 1981-82 IHS) reveals, less than four per cent of all families¹ in Australia live in public housing, i.e. in dwellings rented from a Housing Commission or other state housing authority.

The major Commonwealth program of rental housing assistance flows through the state housing authorities under the periodically renegotiated terms of the Commonwealth-State Housing Agreement (CSHA). Under this Agreement, funds are made available to the states to provide housing assistance within broad guidelines agreed between the Commonwealth and the states.

The Australian government first became involved in housing assistance during the post World-War II period. Its aim, then, was to alleviate the acute shortage of housing caused by the low levels of construction during the war period and the large influx of migrants during the post-war period. The main form of assistance during these years was to provide funds to the states through the CSHA to build rental dwellings for public ownership. Thus, the initial objective of these programs was merely to increase the supply of housing in response to an extreme shortage; targeting of assistance to the lowest income groups was not a feature of the programs during this period.

ENDNOTES

1. The ABS distinguishes the terms 'household', 'family', and 'income unit' from one another. In this study we use these terms loosely and interchangeably to mean an ABS income unit (defined in Section 4.1.1).
2. Even if the long-run price elasticity of supply of housing services were perfectly inelastic, it would be unlikely that the public housing program would generate perceptible effects on market price since the program represents such a small proportion of community-wide aggregate demand for housing services.
3. While it is clear that these assumptions facilitate analysis, it will become equally apparent that some of the findings of our study could depend critically on one or more of the assumptions. Assumptions (6) and (7) are perhaps the most likely to be violated with important consequences for the present study. Work by researchers in the U.S. is underway to assess the magnitude of biases introduced into analyses of this kind when control for participation in other in-kind benefit programs is neglected. Research on the effects of in-kind transfers on earnings is in its infancy. An attempt by Murray (1980) found the reduction in work effort associated with the introduction of public housing subsidies to be about 4 per cent of presubsidy work effort. While Powell, Tulpule and Filmer (1978) provide a theoretical framework to estimate such effects in the Australian context, no empirical estimates are as yet available.
4. Olsen and Barton (1983), estimated that it cost between \$1.10 and \$1.14 to produce a dollar's worth of housing services with public housing due to the production inefficiencies associated with construction subsidies. Mayo et al. (1980, Part 2), like other researchers, have estimated the magnitude of the production inefficiency for construction programs to be much larger.
5. Dependant children are defined as all unmarried persons living with their parent(s) and either under 15 years of age, or full-time students aged 15-20 years. Any income received by dependant children is not included in the income of the income unit to which they belong.

they were given cash grants equal to the difference between the market and subsidized rents of their public housing unit.

Among the families in public housing, mean benefit is greater for poorer and larger families and varies little with the age or sex of the household head. In addition, we find that there is a large variance of benefit among families that are the same in these respects. Amongst families of different types, single parent households headed by females receive the largest benefits from the program and single persons between the ages of 15-24, the smallest.

In conclusion, though subsidized public rental housing remains a minor part of the Australian housing market, this study shows that it provides substantial benefits to public housing tenants. While there are alternative programs that provide assistance to the poor,

"... public housing offers one of the very few means that those on very low incomes have of achieving secure, adequate and affordable housing." (Carter, 1987a, p.1)

TABLE 1
DISTRIBUTION OF FAMILIES AND FAMILY INCOMES
BY NATURE OF OCCUPANCY IN 1981-82

Nature of Occupancy	Number (thousands)	Proportion (per cent)	Mean Annual Income (\$)
Owner/occupier - purchasing dwelling	1769.0	24.76	23353
Owner/occupier - owns dwelling outright	1920.9	26.88	15249
Renting - from Housing Commission	268.7	3.76	11250
Renting - from other landlord	1094.0	15.31	14448
Earning child (15+) living with parent(s)	1214.9	17.00	9246
Other*	377.9	12.29	11715
Total	7145.4	100.00	15528

Source: Based on data from the 1981-82 Income and Housing Survey.

* This category consists of persons such as those living rent-free, renting from employer, or renting from another person in the same dwelling.

The policy of providing rental assistance through public ownership remained largely unchallenged into the 1970's. Things began to change, however, during the mid 1970's. Firstly, by then the acute shortage of housing had been largely eliminated. Secondly, the 1975 Commission of Inquiry into Poverty in Australia (CIPA) found that a significant proportion of public housing tenants were not poor, and that they were being subsidized at the expense of other, more needy groups. The main problem was that although entry into public housing was means tested, continuation of tenancy, once established, was not. Once admitted, tenants could remain indefinitely at rents based on historical costs, which were well below those charged in the private market.

These two concerns led to a change in the general perception of the functions desired of public housing authorities. They were no longer required as providers of increased housing stock but were instead expected to distribute more equitably the existing stock of housing. This view is expressed quite succinctly by Henderson (1978, p.35):

"No case remains for State intervention just to add to the general stock of housing. We need improvement in the distribution of housing."

The way to achieve more effective targeting of public subsidies was seen by the CIPA and the Priorities Review Staff (1975) as a move away from the historical practice of charging 'economic' (or cost) rents towards a new practice of charging market rents coupled with means-tested housing rebates paid to those below the poverty line. The 1978 CSHA incorporated the main features of these recommendations.

The results indicate that among families in public housing, we can be quite confident that mean benefit is greater for poorer and larger families. The mean benefit does not appear to vary much with the age and sex of the head of the family.

The relatively low adjusted coefficient of determination (R^2) and the standard error of \$22 suggest that there is nothing approaching equal treatment of equals among families in public housing. In other words, there exists significant horizontal inequity among program recipients. Certainly, one explanation of this result is the large variance in the desirability of different public housing projects. There is no allocating mechanism for placing families with the same characteristics in housing of equal quality in equally desirable locations. This feature of the program might make it less desirable than otherwise.

6 CONCLUSION

This study finds that the public housing program typically results in a large improvement in the housing of its participants and a significant increase in their consumption of other goods. The mean benefit of the program to these families is substantial relative to their incomes. However, the costs to taxpayers are higher than the benefits of the program. These costs arise due to the distortion in the consumption patterns of public housing tenants. Such distortions are consistent with the justification of the program, and we find that they are in the desired direction. On average, public housing tenants occupy better housing and spend less on other goods than they would choose if

TABLE 8
ESTIMATED RELATIONSHIPS BETWEEN WEEKLY BENEFITS PER FAMILY
IN PUBLIC HOUSING AND FAMILY CHARACTERISTICS IN 1981-82

Regressor	Description of Regressor	Coefficients (t values)
X1	1 if age of head is 25-34 years 0 otherwise	4.67 (1.32)
X2	1 if age of head is 35-49 years 0 otherwise	0.70 (0.20)
X3	1 if age of head is 50-64 years 0 otherwise	-1.03 (-0.29)
X4	1 if age of head is 65 years or more 0 otherwise	0.84 (0.22)
X5	1 if sex of head is female 0 otherwise	0.95 (0.51)
X6	1 if number of children is 1 0 otherwise	7.90 (2.97)
X7	1 if number of children is 2 0 otherwise	9.27 (3.43)
X8	1 if number of children is 3 0 otherwise	9.29 (2.77)
X9	1 if number of children is 4 or more 0 otherwise	7.27 (1.81)
X10	Weekly Family Income	-0.06 (-10.69)
Constant	(applies to family with male household head under 25 years of age with no children)	40.18
Adjusted Coefficient of Determination (R Square)		0.1845
Standard Error		21.92
Number of Observations		777

The gradual replacement of rent subsidies for all public tenants by the more selective targeting of the poor removed some of the inequities of the program (Williams, 1984). This feature is reflected in Table 1, which shows that by 1981-82, public tenants were among the lowest income groups in Australia. This change in the operation of the program, however, came under considerable criticism. As middle-income families moved out to private accommodation, critics argued that this method of changing rents would restrict public housing largely to the poor and encourage a 'welfare housing' attitude to the tenure. Williams (1984) has correctly pointed out, however, that the solution to this problem is to achieve a wider geographical spread of public housing, perhaps through the purchase of existing privately-owned dwellings in several different neighbourhoods. A movement back to subsidies for all public tenants, he points out, would only serve to perpetuate the inequalities of the past.

Unfortunately, however, the 1984 CSHA has adopted just such a policy: It recommended that the practice of charging market rents be abandoned and instead rents are now to be based on "historical costs".

2.3 Funding Arrangements

Commonwealth government contributions towards the Rental Housing Assistance Program have been traditionally made by non-repayable grants and loans at concessional interest rates (4.5 per cent repaid over 53 years). These funds are supplemented by state government contributions and operating surpluses from the programs. Some of the Commonwealth funds are "earmarked" to provide rental assistance for pensioners and

Aboriginals. About 20 per cent of funds provided were tied in this way in 1981-82 (Temby, 1982). The states are free to determine what proportion of the Commonwealth funds are used for rental and homeownership assistance: in 1981-82, 77 per cent of Federal funds were spent on public housing.

The levels of resources devoted to solving low income housing problems have changed erratically over the years. As Carter (1983) points out, these levels fell in real terms in each successive year from 1974-75 to 1981-82: from 366 million dollars in 1974-75, funding fell in 1981-82 to 227 million current dollars (which were the equivalent of a mere 107 million 1974-75 dollars). There was a reversal in this trend in 1982-83, but in real terms the funds still remained well below the 1974-75 peak. By 1984-85, the funding had increased by just enough to restore the 1974-75 level in real terms. This amounted to over 900 million in 1984-85 dollars.

The introduction of market rents coupled with income-related rental rebates had the effect of accelerating the departure of higher income households who had passed through their low income phase during which they had gained access to public housing. They were replaced by people currently in their low income phase and thus, eligible for both entry and the rental rebate. Carter (1983) reveals the extent of the transition that took place in public housing during 1976-77 to 1981-82. He shows that, on average, foregone revenue caused by rental rebates increased six-fold in only five years; the total value of rental rebates in the six states increased from 19.7 million dollars in 1976-77 to 118 million dollars in 1981-82. Since then, all states have reported that a rapidly increasing proportion of new and existing tenants are eligible

TABLE 7
THE AVERAGE ANNUAL BENEFIT FROM PUBLIC HOUSING FOR DIFFERENT
TYPES OF FAMILIES RECEIVING HOUSING BENEFITS IN 1981-82

Type of Family	Average Benefit (dollars)
Married couple, husband under 65 years of age-	
(1) no dependant children	1279
(2) one dependant child	1360
(3) two dependant children	1408
(4) three dependant children	1052
(5) four or more dependant children	1247
Married couple, husband aged 65 years or more-	
(6) no dependant children	1778
One parent, female-	
(7) one dependant child	2104
(8) two dependant children	2693
(9) three or more dependant children	2828
One parent, male-	
(10) one or more dependant children	1718
One person-	
(11) aged 15-24 years	231
(12) aged 25-64 years	1253
(13) aged 65 years or more	1665
Total (for all families)	1581

in Table 6, the average income of public renters is lower than that of the corresponding group of private renters. In addition, the types of families overrepresented in public housing are amongst the types with the lowest incomes.

Table 7 reveals that the distribution of benefits from the program varies considerably depending on family type. The largest benefit recipients are single parent families headed by females. Single fathers also receive larger-than-average benefits. In addition, older persons, married or single, receive substantial benefits from the program. The group that receives the lowest benefits is that of single persons aged 15-24 years; as compared to the national average of \$1581, their average annual benefit of \$231 is quite meagre: this, despite the fact that the average income of this group of recipients is considerably lower than that of the average public housing tenant.

The distribution of benefits among the program beneficiaries may be examined to determine the extent to which the program's design fosters horizontal or vertical inequities. The regressions reported in Table 8 summarize the distributive results. Weekly real benefit was regressed on weekly income, the age of the household head, the sex of the household head and the number of children in the household. The coefficients in the column indicate how mean benefit varies with family characteristics. The t-values in parentheses exceeding 1.960 or 1.645 in absolute value indicate that the variable is significant at the 0.05 or 0.10 level, respectively.

for rebates. By 1985, over 70 per cent of all public housing tenants were receiving rental rebates.

These changes have had some important budgetary consequences for the states. State housing authorities have effectively become an extension of the welfare sector and have assumed important income maintenance responsibilities. In the absence of suitably increased funding available from the Commonwealth government, these increased rebate bills have constrained the ability of housing authorities to adequately maintain and/or expand their rental housing stock. This has been reflected in the ever-increasing number of applicants on the waiting lists for public housing in recent years, with customary waiting periods of up to three years.

3 THEORETICAL FRAMEWORK

In this study, a simple general equilibrium model is used to compare 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. To facilitate our study, we make the following assumptions:

- (1) there are two composite commodities called housing services and other goods;
- (2) the markets for these commodities are perfectly competitive and in long-run equilibrium;

- (3) the long-run supply curves in all markets are perfectly elastic 2;
and,
- (4) information and transportation are costless.

These assumptions have two implications. First, that all consumers within an area face the same set of prices; and second, that this set would be the same under the three alternatives considered in this study. The second implication can be justified on the basis that less than four per cent of all families in Australia live in public housing, and that in the absence of the program these families would account for a smaller fraction of total consumption of housing services. Hence, even a large increase in their consumption would have little effect on the total.

Each of the three alternatives evaluated (public housing, no housing assistance, an equivalent value cash grant) may involve different tax payments or quantities of other public services. We assume, however, that:

- (5) 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 in public housing.

Finally, we assume that:

- (6) public housing tenants receive no other subsidies in kind; and that

TABLE 6
A COMPARISON OF FAMILIES IN PUBLIC AND PRIVATE RENTAL HOUSING
IN 1981-82

Type of Family	Proportion of Total		Mean Annual Income (dollars)	
	Public Renters	Private Renters	Public Renters	Private Renters
Married couple, husband under 65 years of age- (1) no dependant children (2) one dependant child (3) two dependant children (4) three dependant children (5) four or more dependant children Married couple, husband aged 65 years or more- (6) no dependant children One parent, female- (7) one dependant child (8) two dependant children (9) three or more dependant children One parent, male- (10) one or more dependant children One person- (11) aged 15-24 years (12) aged 25-64 years (13) aged 65 years or more	13.0	14.2	23798	16686
	7.4	7.8	19984	16433
	14.3	8.1	20607	17479
	6.8	2.7	19086	19086
	3.9	1.3	18201	16930
	7.1	1.5	7615	7238
	8.1	3.1	8848	6538
	6.0	2.3	8791	7836
	4.2	1.3	8795	8302
	1.3	0.5	11359	10621
	1.5	24.2	11542	7497
	11.9	29.2	14284	7271
	14.5	3.8	5686	4864
100	100	15320	11531	
Total				

TABLE 5
SOME EFFECTS OF REPLACING PUBLIC HOUSING WITH
UNRESTRICTED CASH GRANTS IN 1981-82

1.	Mean annual market rents of public housing units	\$ 3968
2.	Mean annual housing expenditure of public housing families with cash grants in place of public housing	\$ 3306
3.	Percentage increase in aggregate consumption of housing services with cash grants in place of public housing	-16.7%
4.	Mean annual expenditure on other goods by public housing families under the public housing programs	\$ 9715
5.	Mean annual expenditure on other goods by public housing families with cash grants in place of public housing	\$10377
6.	Percentage increase in aggregate consumption of other goods with cash grants in place of public housing	6.8%

(7) occupants of public housing would choose the same job and work the same number of hours under all alternatives considered here and are unconcerned about the consumption of others 3.

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 a 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 and P_x . It would select some combination m of the two goods, spending $P_h Q_h^m$ on housing and $P_x Q_x^m$ 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 unit, the family must pay a certain rent E_h^g . After paying this rent, the family has enough money left to spend $P_x Q_x^g$ 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-good case, it effectively adds one point to a 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 sufficiently low to induce the family to accept the offer, the basic assumptions of the theory of consumer choice do not imply that public housing tenants occupy better housing than they would in the absence of the program. The only things that can be said a priori about the location of the point g are that it is above the indifference curve containing m , since the family has the alternative of renting in the private market, and it is below the horizontal line at height Y/P_x , since rents in public housing are positive.

services and consume less of other goods than they would choose were they given an unrestricted cash grant which would allow them to consume any combination of goods with the same market value as the combination under the program (Olsen, 1981). Table 5 shows that, in aggregate, public housing has the desired effect. An equivalent value unrestricted cash grant would reduce the consumption of housing by public housing families by 16.7 per cent and increase their consumption of other goods by 6.8 per cent.

5.2 Distribution

A change in the allocation of resources generally implies a change in the distribution of well-being among benefit recipients and taxpayers as well. Thus, many argue that policy-induced changes should not only lead to greater efficiency, but also conform to principles of equity. This section examines the distribution of program-induced benefits to assess the degree of conformity with the established principles of horizontal and vertical equity.

We begin by considering who is being served by the programs. Table 6 compares the composition of public and private renters according to family type. It reveals that, on average, larger families, single parents and older persons are overrepresented in public housing. On the other hand, married couples with fewer than two children and single persons below the age of 65 years are underrepresented. The table also reveals a desirable feature of the program; i.e., that the benefits of the program are accruing to low-income families. For each family type

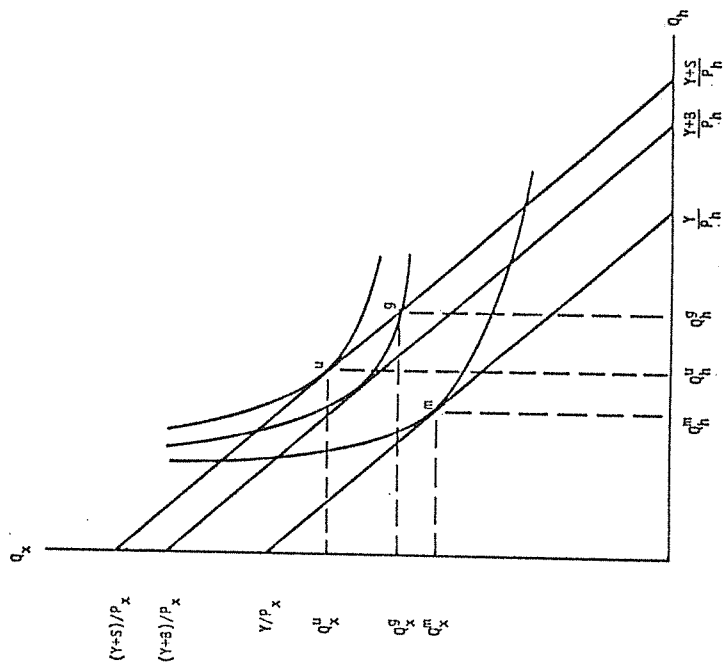


FIGURE 1
THE EFFECT OF PUBLIC HOUSING AND CASH
GRANTS ON CONSUMPTION PATTERNS

which is attributable to 'distortions' in the consumption patterns of public housing tenants. This is evidenced by the substantial difference between the mean benefit to these families -- B in Figure 1 -- and the market value of the subsidy -- S. This difference is equal to \$571 per family in public housing units. Replacing the public housing program with unrestricted cash grants equal to the difference between the market and subsidized rent of each family's public housing unit would increase the aggregate benefit to these families by 36 per cent. Previous estimates from U.S. studies range from 15-37 per cent. Therefore, no one who wants to help low-income families and considers these families to be the best judges of what is good for themselves should support the existing public housing programs unless tangible external benefits result from the better housing of its participants.

If there exists such a consumption externality, the achievement of an efficient allocation requires recipient families to consume more of the good generating the external benefits and less of the other goods than they would choose with an unrestricted cash grant (Olson, 1981). This necessarily restricts the recipients to a lower level of welfare than that experienced under the cash grant. Thus, it might be said that the additional external benefit associated with the movement to an efficient allocation is purchased in part with the foregone extra benefit to recipients associated with the consumption point chosen under an unrestricted cash grant.

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. The rationale for housing subsidies implies that recipients should consume more housing

3.1 Changes in Consumption Patterns

To evaluate the effect of the public housing program on the consumption patterns of public housing tenants, we proceed as follows. The assumptions we have made allow us to express changes in quantities in terms of changes in market values. Hence, the proportional changes in the *i*th family's consumption of housing services in the *j*th area resulting from the public housing program is given by expression (1):

$$\frac{[P_{h,j} Q_{h,i,j}^E - P_{h,j} Q_{h,i,j}^M]}{[P_{h,j} Q_{h,i,j}^M]} \quad (1)$$

where $i = 1, 2, \dots, I_j$ and $j = 1, 2, \dots, J$. Similarly, the proportional change in the *i*th family's consumption of other goods is given by substituting subscript *h* by *x* in expression (1). The proportional change in total consumption of housing services for a set of families living in different areas can be calculated using expression (2):

$$\frac{\sum_{j=1}^J \sum_{i=1}^{I_j} [(P_{h,j} Q_{h,i,j}^E - P_{h,j} Q_{h,i,j}^M) / P_{h,j}]}{\sum_{j=1}^J \sum_{i=1}^{I_j} (P_{h,j} Q_{h,i,j}^M / P_{h,j})} \quad (2)$$

Notice that price per unit is assumed to be the same for all consumers within an area but not necessarily between areas. As above, the proportional change in the total consumption of other goods for a set of families living in different areas can be calculated by substituting *x* for *h* in expression (2).

To calculate the change in the consumption of housing services due to the program, we need to know: first, the value of the market rent of each family's public housing unit, $P_{h,j} Q_{h,i,j}^g$; and second, the family's expenditure on housing in the absence of the public housing program, $P_{h,j} Q_{h,i,j}^m$. This will enable us to evaluate expression (1). Similarly, to calculate the change in the consumption of other goods due to the program, we need to know: first, the amount each family in public housing spends on other goods, $P_{x,j} Q_{x,i,j}^g$; and second, the family's expenditure on other goods in the absence of the program, $P_{x,j} Q_{x,i,j}^m$.

Since there are only two goods and no saving or dissaving is assumed, everything that the family does not spend on housing services is spent on other goods. Hence, for a family in public housing, expenditures on other goods can be depicted as:

$$P_{x,j} Q_{x,i,j}^g = Y_{i,j} - E_{i,j}^g \quad (3)$$

In the absence of the program, these expenditures would be:

$$P_{x,j} Q_{x,i,j}^m = Y_{i,j} - P_{h,j} Q_{h,i,j}^m \quad (4)$$

Therefore, the effect of these programs on the consumption of other goods by public housing tenants can be calculated from a knowledge of the family's income, $Y_{i,j}$; the rent of its public housing unit, $E_{i,j}^g$; and its expenditures on housing in the absence of the program, $P_{h,j} Q_{h,i,j}^m$. In addition to these values, we need to know

TABLE 4
SOME AGGREGATE EFFECTS OF PUBLIC HOUSING PROGRAMS
IN 1981-82

(1)	Mean annual housing expenditure of public housing families in absence of these programs	\$ 2723
(2)	Mean annual market rent of their public housing units	\$ 3968
(3)	Percentage increase in aggregate consumption of housing services by these families $\frac{[(2)-(1)]}{(1)} \times 100$	45.7%
(4)	Mean annual expenditure on other goods by public housing families in absence of these programs	\$ 8808
(5)	Mean annual expenditure on other goods by public housing families under these programs	\$ 9715
(6)	Percentage increase in aggregate consumption of other goods by these families $\frac{[(5)-(4)]}{(4)} \times 100$	10.3%
(7)	Mean annual rent paid by public housing families	\$ 1816
(8)	Weighted mean percentage reduction in market price of housing services to public housing families $\frac{[(2)-(7)]}{(2)} \times 100$	54.2%
(9)	Mean annual income of public housing families $(5) + (7)$	\$11531
(10)	Mean annual increase in market value of goods consumed by these families $[(2)+(5)] - [(1)+(4)]$	\$ 2152
(11)	Mean annual benefit to public housing families	\$ 1581
(12)	Mean annual subsidy $(2) - (7)$	\$ 2152
(13)	Benefit - cost ratio $(11) \div (12)$	0.73

5.1 Efficiency

Table 4 shows that in aggregate, public housing families occupy substantially better housing than they would in the absence of the program and also consume significantly more of other goods. Our estimate of a 45.7 per cent increase in the consumption of housing lies within the range of previous estimates of 11-71 per cent obtained from U.S. studies of similar programs. The estimate of a 10.3 per cent increase in the consumption of other goods is, however, lower than previous estimates of 14-18 per cent for U.S. housing programs. The average net price of housing for participants of the program was reduced by 66.7 per cent, yielding an average subsidy of \$2152 per year. Approximately 58 per cent of this subsidy was spent by the recipients on housing, increasing their consumption of housing services by the 45.7 per cent. The remaining 42 per cent was devoted to non-housing expenditure, leading to the 10.3 per cent increase in the consumption of other goods.

The benefits of the programs to the public housing families were substantial, especially relative to their incomes. From their viewpoint, public housing was equivalent to a 13.7 per cent increase in income. Previous estimates for this figure from U.S. studies range from 12-35 per cent.

Although the benefit to tenants was large relative to their incomes, it was small compared with the cost to taxpayers. Even if we ignore the differences in the costs of construction of a dwelling by the government and by the private sector, there is still a cost involved

the market rent of the family's public housing unit, $P_{n,j} Q_{n,i,j}^S$ to calculate the change in its consumption of housing services.

Our data include the values of the first two variables for a random sample of public housing tenants. We predict the values of the remaining two variables for these families. The methodology for making the predictions is discussed in Section 4.

3.2 Measuring Benefits

In recent years information on individual households has been increasingly used to estimate sophisticated measures of the net benefit of public housing programs. Any good measure of the net benefit of a government program will depend in part on the preferences of affected households. Since public housing programs typically confront households with one point outside their original budget space, the consumption patterns of households under these programs often provide little information about their preferences. As a result, the preferences of similar households not in public housing are estimated and imputed to these families.

The typical approach to benefit estimation used in these recent studies is to:

- (1) identify families who can be presumed to face the usual linear budget constraint;

- (2) divide these families into groups according to such characteristics as family size, age and sex of household head;
 - (3) posit a particular functional form for the indifference map of families of each type;
 - (4) estimate its parameters by estimating the parameters of the implied system of demand equations;
- and,
- (5) use the estimated indifference map for families of each type to estimate the net benefit of the program that will accrue to similar households participating in it. The indifference map parameters estimated are the means of the parameters for households of each type.

This is the methodology adopted in our study.

In Figure 1, there is some unrestricted cash grant B which, if given to the 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 the concept adopted in this study of the benefit of the program to the family, and is known technically as the Hicksian price-equivalent variation measure. Obviously, the benefit of the program to the family depends on its preferences as well as its income and consumption pattern with the program. Let $k_{(i,j)}$ to simplify the

case, it is not possible to infer the parameters of the CES or Stone-Geary indifference map of a family based on its response to a single set of prices and income.

One solution to this problem is to adopt one of these indifference maps and to make assumptions about the values of all but one parameter, and then to use data on the observed consumption pattern of similar privately renting families to estimate the remaining parameter for each type of family. A range of plausible values can be used to determine the sensitivity of the results to the assumptions made about the indifference map parameters. For example, Olsen and Agrawal (1982) calculated individualized benefits from the U.S. public housing program using values of 0.5, 0.75, 1.0 (the Cobb-Douglas case) and 1.25 for the elasticity of substitution between housing services and other goods. The value of the remaining parameter of the CES utility function was then solved for using the observed consumption patterns of privately renting families under these alternative assumptions about its elasticity of substitution between housing and other goods. No such sensitivity analysis has been attempted in this study.

5 EMPIRICAL RESULTS

In this section, the methodology and data of the previous sections are used to estimate the effects of the public housing program on the participants' consumption of housing and other goods; the costs of the program; the benefits to the participants; and the distribution of these benefits among the various participants. In addition, information is developed about factors presumed to affect external benefits to taxpayers.

TABLE 3
THE AVERAGE RENT-INCOME RATIO FOR DIFFERENT TYPES OF
FAMILIES RENTING PRIVATELY IN 1981-82

Type of Family	Rent- Income Ratio
Married couple, husband under 65 years of age-	
(1) no dependant children	.18
(2) one dependant child	.21
(3) two dependant children	.20
(4) three dependant children	.22
(5) four or more dependant children	.22
Married couple, husband aged 65 years or more-	
(6) no dependant children	.34
One parent, female-	
(7) one dependant child	.34
(8) two dependant children	.34
(9) three or more dependant children	.37
One parent, male-	
(10) one or more dependant children	.29
One person-	
(11) aged 15-24 years	.21
(12) aged 25-64 years	.23
(13) aged 65 years or more	.34
Total (for all families)	.23

notation. It is assumed that the kth family has preferences which can be represented by a Cobb-Douglas utility function:

$$U_k = (Q_{h,k})^{\alpha_k} (Q_{x,k})^{(1-\alpha_k)} \quad (5)$$

where α_k is a parameter that can be different for different families. We selected the Cobb-Douglas utility function because it is easy to estimate and yields an explicit formula for tenant benefit. Since our data is poorly suited for estimating alternative indifference maps, we have not done so. By maximizing U_k subject to the following budget constraint:

$$Y_k = P_{h,j} Q_{h,k} + P_{x,j} Q_{x,k} \quad (6)$$

one may obtain the individual demand functions for $Q_{h,k}$ and $Q_{x,k}$:

$$Q_{h,k} = \alpha_k Y_k / P_{h,j} \quad (7)$$

$$Q_{x,k} = (1-\alpha_k) Y_k / P_{x,j} \quad (8)$$

If one substitutes these demand expressions for $Q_{h,k}$ and $Q_{x,k}$ into the utility function (5), one gets the expression for the maximum utility U^* , obtainable at the given income and prices (i.e., the indirect utility function):

$$U_k^* = \left[\frac{\alpha_k Y_k}{P_{h,j}} \right] \left[\frac{(1-\alpha_k) Y_k}{P_{x,j}} \right]^{\alpha_k} \quad (9)$$

Similarly, the utility U_k^B derived by the family from the consumption bundle $(Q_{h,k}^B, Q_{x,k}^B)$ chosen under the program, can be expressed as:

$$U_k^B = (Q_{h,k}^B)^{\alpha_k} (Q_{x,k}^B)^{(1-\alpha_k)} \quad (10)$$

Let Y_k^B denote the income level necessary to place the individual purchasing goods at market prices at the same level of utility as he/she would obtain by consuming $Q_{h,k}^B$ and $Q_{x,k}^B$ under the public housing program. To obtain the value of Y_k^B that would satisfy this requirement, we only need to substitute Y_k in expression (9) by Y_k^B , equate the resulting expression to expression (10), and solve that equation for Y_k^B :

$$Y_k^B = \left[\frac{P_{h,k} Q_{h,k}^B}{\alpha_k} \right]^{\alpha_k} \left[\frac{P_{x,j} Q_{x,k}^B}{(1-\alpha_k)} \right]^{(1-\alpha_k)} \quad (11)$$

This level of income is $(Y + B)$ in Figure 1. A family's initial income, Y_k , may be subtracted from the expression for Y_k^B to yield an expression for the family's net benefit, B_k (denoted benefit, hereafter) under the public housing program:

$$B_k = Y_k^B - Y_k \quad (12)$$

parameter according to family type. Families are divided into categories defined in terms of family size and the age, sex and marital status of the head of the household. It is assumed that all families of the same type in public housing have the same rent-income ratio α . The value of α is determined as the mean value of the rent-income ratio for a particular type of family renting from the private market. It is then imputed to all families of this type that rent from the government.

Table 3 contains the estimates of the rent-income ratio for 13 types of families. These values were obtained as the average values for each type of family renting privately. To obtain reasonable estimates, we excluded from our sample families who paid either less than five per cent or more than seventy-five percent of their income as rent.

Table 3 reveals that the rent-income ratio varies considerably among different types of families. On average, single parents and older persons spend significantly higher proportions of their income on housing. As we shall see later, these groups are also among the lowest income recipients in our data. The numbers reported in Table 3 are used to estimate the benefit accruing to each public housing family in our sample. They are also used to estimate the changes in the family's consumption patterns under alternative housing programs.

As stated earlier, the reason we adopted the Cobb-Douglas indifference maps for the families in our sample is that, given our data, it was the only one we could estimate. Except in this special

TABLE 2
 PREDICTED MARKET RENTS OF PUBLIC HOUSING UNITS
 IN 1981-82

Type of Dwelling	Average Weekly Rent (dollars)		
	Metropolitan	Ex-Metropolitan	
Separate House	(1) with 1 bedroom	44.66	-
	(2) with 2 bedrooms	81.00*	61.00*
	(3) with 3 bedrooms	86.00*	69.00*
	(4) with 4 bedrooms	72.00*	73.00*
Low-Rise Flat	(5) bedsitter flat	41.00*	-
	(6) with 1 bedroom	60.00*	40.28
	(7) with 2 bedrooms	68.00*	83.63*
	(8) with 3 bedrooms	81.00*	-
Semi-Detached House	(9) with 1 bedroom	46.00*	39.74
	(10) with 2 bedrooms	50.80	47.43
	(11) with 3 bedrooms	111.00*	74.67
High-Rise Flat	(12) with 1 bedroom	61.68	-
	(13) with 2 bedrooms	75.73	-
	(14) with 3 bedrooms	78.27	-

* For these categories, the average values for market rents obtained from the data have been adjusted upwards as described on page 27.

3.3 Measuring Costs

To provide public housing tenants with benefits, taxpayers must bear a cost. This does not imply that they are necessarily worse off since the value they place on the change in the consumption patterns of the benefit recipients may exceed the cost that they incur. The cost incurred is equal to the excess of the cost of providing public housing units over the rent collected from public housing tenants. This cost can be separated into the direct subsidy, S , covering the rent not paid by the tenants, the administrative cost, and the marginal welfare cost of raising funds with distortive taxes. In addition, since some units in the public housing program were directly constructed by the housing authority (rather than purchased from the private market) using subsidized funds available from the Commonwealth Government, there may be some additional costs due to such production inefficiency as may occur with subsidized construction programs⁴. In this paper, we are able to provide an estimate of the direct cost, S , only.

3.4 Comparing Alternative Program Effects

In addition to estimating the consumption changes and the benefits under the public housing program, the family's demand equations (7) and (8) may be used to predict consumption patterns and benefits under an alternative program such as unrestricted cash grants. If the family depicted in Figure 1 were given an unrestricted cash grant, S , which would allow it to consume any combination of goods with the same market value as the combination consumed under the public housing program, then its income y_x^S would be:

$$\begin{aligned}
 Y_k^S &= Y_k + P_{h,j} Q_{h,k}^S - E_{h,k}^S \\
 &= Y_k + S_k \quad .
 \end{aligned}
 \tag{13}$$

It would then select the bundle u and its housing expenditure could be obtained by substituting this income for Y_k in expression (7) and multiplying the predicted level of housing services, $Q_{h,k}^u$, by the price of housing, $P_{h,j}$. The proportional differences in the consumption of housing and other goods under the public housing program from what would be consumed under an equivalent value cash grant would be given by replacing the expenditures on housing and other goods at m with those at u in expressions (1) and (2). Notice that although the family depicted in Figure 1 occupies better housing and consumes fewer other goods under the public housing program than with the cash grant, the opposite is entirely possible.

4 DATA AND METHODS OF PREDICTION AND ESTIMATION

4.1 Concepts Used in the Analysis

4.1.1 Income Units

All empirical results of this paper are based on data collected during the 1981-82 IHS by the ABS. These data relate to two types of income-receiving units: individuals and 'income units'. For our study, we adopt the ABS classification of income units as the relevant one. Basically, an income unit is a way of describing a nuclear family. All income units can be classified into one of the following types:

rent a proportion of their stock at market rates, and to provide data on these market rates, the only solution is to obtain data on more characteristics.

Our predicted market rents are presented in Table 2. Note that for some categories in the table, the predicted rent was too low; i.e., it implied that some public housing tenants renting that type of dwelling were receiving negative subsidies. These rents were adjusted upwards until the figures implied that each public housing tenant was receiving at least \$1 in subsidy. It is these adjusted figures that are reported in Table 2.

4.3 Estimation of the Parameters of the Indifference Maps of Families in Public Housing

Individualized estimates of the parameters of the indifference maps had to be obtained to calculate the individualized benefits from the public housing program for the families in our sample. As stated earlier, it is impossible to obtain this information directly for these tenants unless one has data on their pre-program consumption patterns. These data, however, were not available from the IHS. Instead, we assumed that the preferences of public housing tenants were the same as those of similar persons who were private renters.

Since we have assumed that each family has a Cobb-Douglas indifference map, the only parameter value required is the rent-income ratio of the family. This information is available for the private renters in our sample. We estimate the indifference map

categories: metropolitan and ex-metropolitan. Rents in Tasmania were lower than those for comparable dwellings in metropolitan areas of the mainland, while rents in the Territories (dominated by Canberra) were approximately equal to metropolitan rents elsewhere. For this reason, Tasmania was assigned to the ex-metropolitan group, while the Territories were assigned to the metropolitan category.

While theoretically a public housing unit could belong to 48 possible categories (number of bedrooms (6) x type of dwelling (4) x area of location (2)), empirically we found that we needed to predict market rents for only 22 of these categories. The other cells were either empty or contained very small samples.

We calculated the average weekly rent paid by tenants renting from the private market for each of the 22 types of dwellings, and imputed these to dwellings rented from the government. In doing so, we have to assume that the market rent of public housing units and private rental units are the same--as long as the three characteristics of the units are the same. This is clearly the weakest part of our study. This assumption is likely to be violated since the list of characteristics included in the imputation are far from exhaustive and public housing units which are the same as private rental units with respect to these three characteristics could be quite different, and possibly inferior, in other respects. For example, it has been suggested that on average, public housing projects are located in worse neighbourhoods. If this argument is correct, then we have probably overestimated the market rents of public housing units. This is likely to lead to a bias towards an overestimation of the benefits of the programs. Of course, unless the providers of public housing were to

- (1) married couple income units, which consist of a husband, wife and dependant children (if any) as defined⁵. Stated de facto relationships are included;
- (2) one parent income units, which consist of a parent and at least one dependant child;
- (3) one person income units, which consist of persons who are not included in (1) or (2) above. Non-dependant children living with their parents are classed as one person income units.

4.1.2 Current Income

In the Survey, income was collected both on a last financial year basis (for 1981-82) and on a current basis, i.e., at the time of interview. The housing occupancy and cost data, however, were collected only on a current basis. In our study, to maintain consistency between the income data and the housing data, we adopt the current income measure. Otherwise, we find a number of cases for whom the calculated annual rent paid far exceeds the annual income.

Current income--unit income consists of total income from the following sources: wages or salary; business income; government cash benefits; superannuation; interest, dividends, rents, etc.; and 'other' income. This pre-tax, post-transfer income measure is the one adopted in our study.

4.1.3 Nature of Occupancy

The data include information on the nature of occupancy of each income unit; that is, on whether the income unit:

- (a) owns its dwelling;
- (b) is purchasing its dwelling;
- (c) is renting in the private market;
- (d) is renting from a Housing Commission
(or other housing authority);
- (e) other.

We examine the economic effects of the housing program on those belonging to category (d) only. This sample consists of 831 income units which, when weighted appropriately, represent 3.8 per cent of total income units in the population.

In addition, we use information on the consumption patterns and the rents paid by those renting in the private market, category (c). This sample consists of 3004 income units which, when weighted appropriately, represent 15.3 per cent of total income units in the population.

4.2 Predicting Market Rents for Public Housing Units

The approach is to estimate the rent for a particular type of dwelling in the private market and then impute this value to a similar dwelling rented by public housing tenants. In the studies evaluating housing programs in the U.S., this is done typically by regressing market rent on a host of housing characteristics. For example,

Gillingham (1973) estimated the relationship between market rent and the following housing characteristics: age of structure, number of rooms, number of bathrooms, condition of unit, inclusion in rent of furnishings, refrigerator, air conditioning and stove, the presence of hot running water, central heat, covered parking, and elevator. Unfortunately, no such detailed data are available as yet in Australia. In the IHS data, we have information on only three characteristics of a dwelling: the number of bedrooms, the type of dwelling and the geographical location. Hence, we decided to predict the market rent by just calculating the average rent for each type of unit, cross-classified according to each of these characteristics.

A dwelling can be classified into one of six categories on the basis of the number of bedrooms in it: these categories range from a bedsitter flat to a one, two, three, four or five or more bedroom unit, respectively. Each dwelling can also be categorized on the basis of its type of structure. This can be of one of the following six types: separate house; low-rise flat; semi-detached house; high-rise flat; mobile or improvised dwelling; and, dwelling and non-dwelling combined. In our study, we exclude from our sample those belonging to the last two categories.

Finally, the geographical area of location is known for each dwelling. A dwelling can be located in one of the following twelve areas: a metropolitan or ex-metropolitan area for each of the five states excluding Tasmania; the state of Tasmania; and the Northern Territory (N.T.) and the Australian Capital Territory (A.C.T.) combined. Since our sample size did not permit us to examine the effects of public housing for each of these areas separately, we aggregate them into two