AN ECONOMIC ANALYSIS OF PUBLIC HOUSING IN YELLOWKNIFE, NORTHWEST TERRITORIES

by

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ABSTRACT

For many years, social housing policy in Canada has relied upon supply-side programs. Recently, these programs have come under criticism for failing to serve the needs of poor households, precipitating a philosophical shift toward income supplement programs. While evaluations of past programs support this shift, most studies have been done at the national level and may not reflect the housing needs of specific regions or communities in Canada. This study evaluates a supply-side housing program for one community in northern Canada - Yellowknife, Northwest Territories.

Drawing upon the tools of welfare economics, the study evaluates the Public Housing Program in Yellowknife in terms of economic efficiency and equity. The study analyses the program from the viewpoints of the Canadian public and the residents of the N.W.T. In both cases, the Net Present Value, calculated from measurable costs and benefits, is negative suggesting the program is not economically efficient. Non-tenant benefits of between $446,082 and $966,955 per year are required to justify the program from the national perspective and between $123,724 and $320,304 from the territorial perspective.

The analysis suggests the program is promoting a small degree of equity. Benefits from the program are greater for households with lower incomes and decline by approximately $11 for every $100 increase in annual household income. The program supports horizontal equity with respect to age of

household head, but there is some inequality with respect to sex as female-led households receive significantly greater benefits than their male counterparts.

The results of the study are consistent with the economics literature. As expected, justification of the Public Housing Program in Yellowknife must appeal to notions other than economic efficiency. Advocates of the program may find support in the equity achievements of the program or in recent research suggesting that public housing programs have smaller work disincentive effects than programs of cash transfers.

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CHAPTER 1 INTRODUCTION

1. INTRODUCTION

1.1 BACKGROUND

Canadian housing policy has changed significantly since the first housing legislation was enacted over fifty years ago. Government activity in the housing market has expanded from its original role as banker to a more active role in income redistribution in recent decades. Today, the role of government in housing markets is being questioned by many, including the government itself.

In January, 1985, Bill McKnight, Minister Responsible for C.M.H.C., initiated a national debate on housing policy with the presentation of his Consultation Paper on Housing. Among the many issues raised for discussion in this document, is the problem of "affordability". In general, a household has an affordability problem if it cannot obtain adequate, uncrowded accommodation for less than a given percentage of its income. Over the years, this percentage has been set at 20%, 25% and, more recently, at 30%. Using the figure of 30%, the Consultation Paper reports over 700,000 households in Canada (8.5% of total households, 1981 Census) with affordability problems. The Consultation Paper summarizes this issue as follows:

> Few would disagree that governments have a responsibility to assist these groups. Whether justified through concepts of basic human rights, social justice or the redistributive role of government, there is a clear rationale for government involvement in alleviating the problems of poverty. The key questions in this area are what is the most appropriate tool for assisting groups in

> need and at what level of government does this responsibility rest? (Consultation Paper on Housing, p. 17)

Historically, the housing needs of the poor have been addressed through the supply-side programs of Public Housing, Non-Profit Housing and Co-operative Housing. These programs have all come under criticism in recent years. The Public Housing Program has been accused of "ghettoising" the poor and detracting from neighbourhood quality. The Non-Profit and Co-operative Housing Programs, designed to integrate poor households into the community by offering accommodation to a broad range of income groups, have been criticised for failing to serve the poorest of the poor.

The problem seems to be one of targetting limited dollars to households most in need without isolating those households from the community. Opponents of supply-side programs suggest the way to do this is to intervene in the demand side of the market. They argue that the inability of low income households to afford decent quality housing is an income problem rather than a housing problem and should be addressed through a program of income supplements. According to this view, a dollar in cash improves the household's welfare more than a dollar in kind.

The present federal government seems to support demand-side programs rather than the direct supply of subsidized housing. Evaluations of past housing programs support this viewpoint. However, most studies are done at the national level and may not reflect the special housing

needs in specific regions or communities in Canada. This study analyses a supply-side program in one community in a remote region of Canada - Yellowknife, Northwest Territories.

1.2 OBJECTIVES OF THE STUDY

All economic studies of supply-side housing programs conclude that they are not economically efficient. Neo-classical economists are unanimous in their support of direct cash transfers as an efficient method of housing the poor. However, economic efficiency is not the only criterion for evaluating government programs. An equally important criterion is the concept of equity. In a study of public housing projects in small cities in North Carolina, Sumka and Stegman (1978) conclude that, while the program is not economically efficient, it is justified on the grounds that it serves the needs of a minority population that is systematically discriminated against in the market. According to Sumka and Stegman:

> The important policy question is not just how efficient is the public housing program, but what is the additional cost that must be borne to maintain a publicly supported housing delivery system that partially serves the unmet needs of a minority population? In searching for a technically more efficient housing strategy, one must carefully account for the realities of the market place. In nonmetropolitan cities, public housing apparently fills a large void that the private sector cannot, or will not, fill. Until such time as we are prepared and able to improve the operation of the market per se, a program of public construction may be the only way to assure the delivery of adequate housing to the minority poor in the nonmetropolitan city. (Sumka and Stegman, pp. 409-410)

Although the race problems identified in Sumka and Stegman's study are not a factor in most Canadian cities, race is an issue in northern Canada. In Yellowknife, native people represent a minority of the population (14% in 1981, G.N.W.T. Bureau of Statistics, unpublished data). Public housing may be serving the same purpose for them as it does for black people in small American cities. It may also be serving the needs of other minority groups, such as single parents or the elderly.

This study examines the Public Housing Program in Yellowknife from the two perspectives of economic efficiency and equity. The specific objectives are:

1. to determine if the direct provision of public housing in Yellowknife is an economically efficient method of meeting the housing needs of poor households; and

2. to determine if the Public Housing Program in Yellowknife promotes horizontal and vertical equity.

1.3 OUTLINE

The thesis consists of seven chapters including this introductory chapter. Chapter 2 examines social housing policy as a tool for redistributing income and traces the evolution of social housing programs in Canada and the Northwest Territories. Chapter 3 introduces the economic framework for analysing housing policy. Chapter 4 examines the issues that arise in applying this framework to subsidized housing programs and reviews several studies appearing in the recent literature. Chapter 5 describes the

public housing projects in Yellowknife forming the sample for the study. It also sets out the four hypotheses and outlines the study methodology. Chapter 6 presents the results of the analysis and Chapter 7 concludes the thesis by suggesting possible implications of the analysis for policy-makers.

CHAPTER 2 SOCIAL HOUSING POLICY

2. SOCIAL HOUSING POLICY

This chapter focuses on social housing policy as a tool for income redistribution. It examines the three methods governments use to redistribute income: direct cash transfers, price subsidies and in-kind transfers. Finally, it reviews social housing policy in Canada and the Northwest Territories.

2.1 INTRODUCTION

Housing is a multi-faceted good. First and foremost, it is a basic necessity of life. It is also a market commodity and an investment good representing the largest single investment made by Canadian families (Fulton, 1981). Furthermore, it is an important industry, accounting for approximately 4% of the Gross National Expenditure in 1985 (National Income and Expenditure Accounts, 1985).

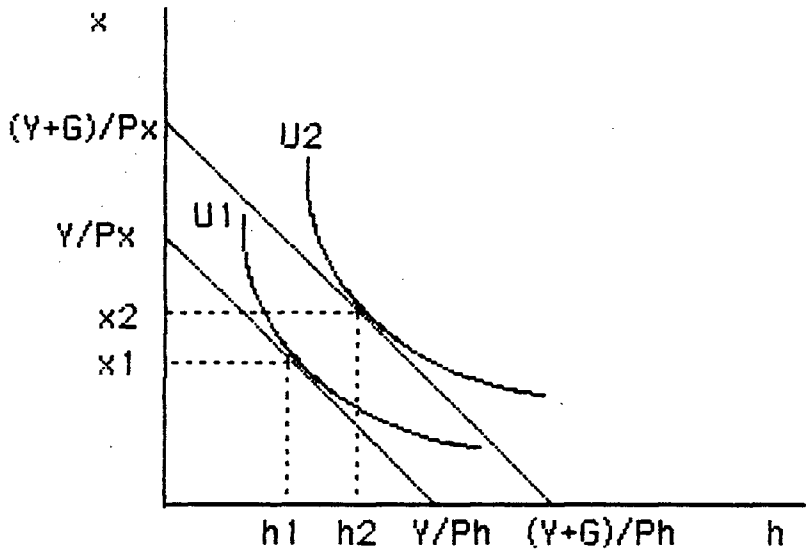
The multi-dimensional nature of housing results in greater government intervention in the market than would be expected if housing were simply a market commodity. The government achieves a variety of public policy goals through housing policy. Housing programs are designed to facilitate homeownership, to stimulate the economy and to make housing more affordable. This study focuses on housing as a basic need and the social housing policy designed to make housing more affordable.

2.2 SOCIAL HOUSING POLICY AS A TOOL FOR INCOME REDISTRIBUTION

The fact that housing is a basic need does not automatically imply that the government should intervene in the housing market. Intervention is only necessary because some households have inadequate incomes to obtain decent, uncrowded accommodation. As indicated in Chapter 1, over 700,000 households in Canada fall into this category. Public policy to assist these households takes the form of income redistribution.

Governments can redistribute income in one of three ways: direct cash transfers (e.g., income supplements), price subsidies (e.g., shelter allowances) or in-kind transfers (e.g., public housing programs). Each alternative has a different impact on the household's budget set and, consequently, a different effect on household behavior.

In a program of **direct cash transfers**, the household's budget constraint shifts out by an amount equal to the cash grant. This is illustrated in Figure 1. Housing (h) is on the horizontal axis and a composite commodity (x), representing all other goods, is on the vertical axis. In the absence of the program, the household maximizes utility by consuming that combination of h and x that coincides with the tangency point of an indifference curve and the budget constraint (i.e., (h_1, x_1) in this case). With a direct cash transfer of G dollars, the budget constraint shifts out by a vertical distance of G, increasing the household budget

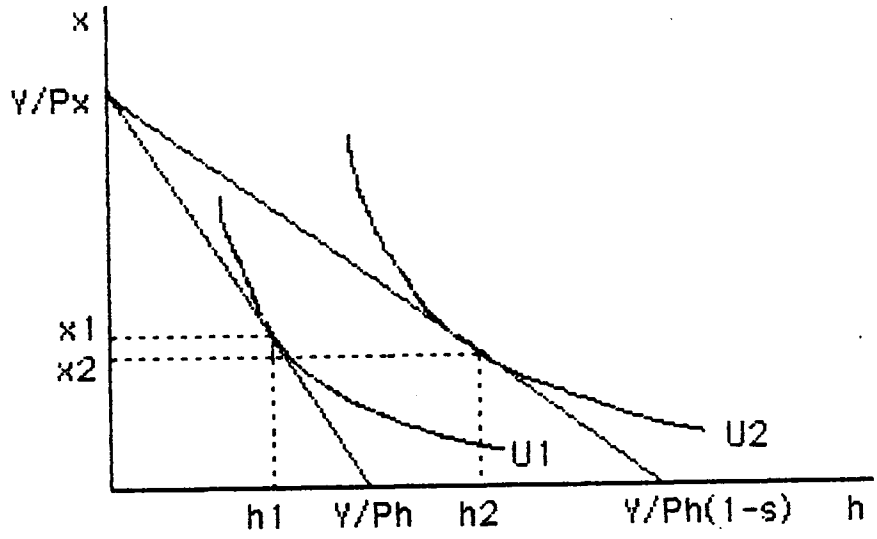


1 Direct Cash Transfer

space. The increased income allows the household to reach a higher level of utility U_2, where it consumes commodity bundle (h_2, x_2).

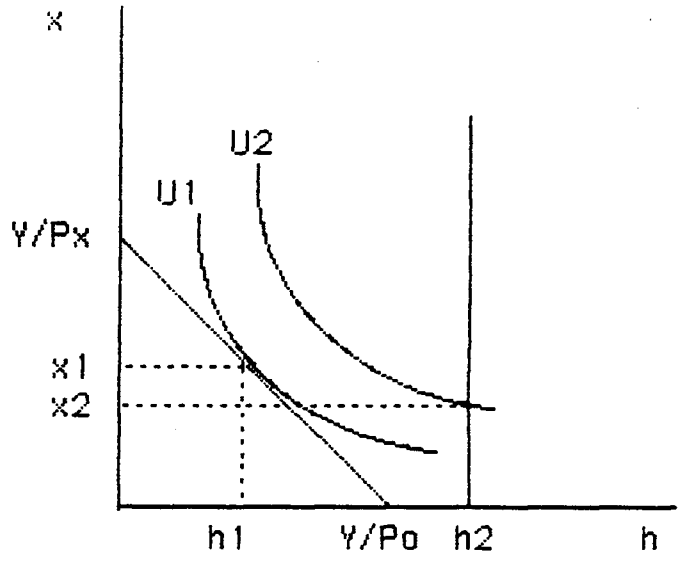
A **price-subsidy program** involves a direct payment to the household to reduce monthly rent. The subsidy alters the price ratio of housing and other goods, rotating the household budget constraint upward as indicated in Figure 2. The household increases its consumption from (h_1, x_1) to (h_2, x_2).

An **in-kind transfer program** assigns a specific housing unit to the household at a subsidized rent (e.g. rent as a percentage of income). As this rent is lower than the market price, the price ratios facing the household change, but, as Olsen and Barton (1983) point out, the budget constraint does not rotate outward. Instead, an in-kind housing program



2 Price Subsidy Program

adds one point to the budget set. This is illustrated in Figure 3 where h_2 represents the specific quantity of housing provided by the program and (h_2, x_2) is the point added to the household budget set. The household is constrained to consume this commodity bundle even though it may not coincide with the tangency point of the budget constraint and an indifference curve. In this case, the tradeoff between housing and other goods will not be optimal. The sub-optimal allocation of resources resulting from an in-kind housing program generally leads economists to support direct cash transfers.



3 In-Kind Housing Program

2.3 SOCIAL HOUSING POLICY IN CANADA

In Canada, the responsibility for housing is divided between the federal and provincial governments. The Constitution Act of 1982 confirms the division of powers originally established in the British North America Act. The federal government is responsible for economic activities at the national level, including the regulation of the money supply, banking and interest rates. Provincial governments are responsible for municipal institutions, property rights and public lands and natural resources (Goldberg and Mark, 1983). While the federal government influences the housing market through its fiscal and monetary powers, any direct involvement in the delivery of housing programs must be in partnership with the provinces.

Early housing legislation was carefully structured to fit within the federal mandate to regulate and stimulate the economy. Both the Dominion Housing Act of 1935 and the first National Housing Act (N.H.A.) of 1938 were designed to stimulate the demand for homeownership. Except for the provision of mortgage money, the government did not interfere with the allocation of housing resources provided by the private sector.

In 1949, amendments to the N.H.A. authorized the federal government, through C.M.H.C., to enter into partnership agreements with the provinces to provide low income housing. Under Section 35 (now Section 40), the capital and operating costs of the projects were shared on a 75/25 basis, with C.M.H.C. contributing 75%.

While the 1949 amendments were a major step forward in the development of an in-kind housing policy, it was not until the N.H.A was amended in 1964 that a cohesive public housing policy emerged. The 1964 amendments basically re-wrote the social housing provisions of the N.H.A. and introduced the phrase "public housing" into the Act for the first time (Rose, 1980). These amendments authorized C.M.H.C. to loan money to provincial governments for the construction of public housing projects in addition to the partnership provisions of Section 35. Under this new section (Section 35D, now Section 43), 90% loans are available at below market interest rates. Operating costs, including amortization, are shared equally by the two levels of

government.

Further amendments to the N.H.A. in 1969 allowed C.M.H.C. to enter into agreements with the provinces to provide public housing through a Rent Supplement Program. Under this program, up to 25% of the units in an existing privately-owned building are designated as public housing.

Rents for public housing units are based on income and range from a minimum of $32 per month to a maximum of 25% of adjusted family income (see Appendix 3 for further details). Some provinces and territories have revised the federal scale and charge higher or lower rents to reflect regional conditions.

Since 1980, no public housing projects have been constructed in southern Canada. Only the Northwest Territories and the Yukon continue to construct new housing under this program. The perceived failure of large scale public housing projects in the provinces has turned attention to non-profit and co-operative housing projects to serve the needs of low income households.

2.4 SOCIAL HOUSING POLICY IN THE NORTHWEST TERRITORIES

The first housing program in the N.W.T. was the Eskimo Housing Loan Program introduced in 1959 by the Department of Indian Affairs and Northern Development (Thomas and Thompson, 1972). The program was introduced to combat the spread of tuberculosis among the Inuit but was not successful as people were unfamiliar with concepts of loans

or homeownership and had little access to cash for mortgage payments or utility bills. The program was replaced in 1965 by the Eskimo Rental Housing Program which provided low cost shelter for monthly rents of between $2.00 and $67.00, depending on income and house size (Thompson, 1969).

In 1970, the Public Housing Program was officially introduced in the N.W.T. with the construction of housing projects in Hay River, Yellowknife and Inuvik and small senior citizens projects in several Mackenzie Valley communities. The projects were financed under Section 40 of the N.H.A. and were jointly funded by C.M.H.C. (75%), the Government of the N.W.T. (15%) and the municipalities (10%).

The Public Housing Program in the N.W.T. is identical to its southern counterparts with one major exception - the rental scale. In recognititon of the high cost of living in remote, northern communities, the Housing Corporation has designed a rental scale that takes into account the cost of living. Details of the scale are contained in Appendix 3.

CHAPTER 3 THE ANALYSIS OF HOUSING POLICY

3. THE ANALYSIS OF HOUSING POLICY

This chapter describes the economic framework for analysing housing policy. It introduces the key concepts of economic efficiency and equity which form the building blocks of the analysis and describes how these criteria are measured.

3.1 INTRODUCTION

The economic evaluation of public policy falls into the area of welfare economics. Boadway and Bruce (1984) define welfare economics as a means of ranking "alternative possible states of the world" where the term "state of the world" describes the allocation and distribution of resources. The tools of welfare economics measure the change in social welfare in moving from one state of the world to another. Using these tools, a policy is evaluated by the change in social welfare it produces.

In order to rank alternative states of the world, some value judgements must be made. In welfare economics, the concepts of efficiency and equity are used. A state of the world is efficient if it meets the criterion of Pareto-efficiency. A Pareto-efficient allocation is one in which "it is impossible, through any change in resource allocation, to make some person or persons better off without making someone else worse off" (Browning and Browning, 1983).

The concept of Pareto-efficiency provides a criterion for comparing efficient allocations to inefficient ones but it does not permit a comparison of efficient allocations to each other. In order to rank all possible states of the world, it is necessary to compare household utility levels under each allocation of resources. In theory, this is accomplished by introducing a social welfare function to represent society's values. However, in practice it is difficult to specify a social welfare function. As an alternative, welfare economics uses the two concepts of horizontal and vertical equity. A policy promotes horizontal equity if it "treats equals equally". That is, if it provides equivalent benefits to households with identical characteristics. A policy promotes vertical equity if it "treats unequals unequally". That is, if it provides different benefits to households with different characteristics. A policy providing greater benefits to households with lower incomes promotes vertical equity. The criteria of horizontal and vertical equity do not permit a complete ranking of states of the world, but they are useful as they are widely accepted and relatively simple to apply.

3.2 GOVERNMENT INTERVENTION IN THE HOUSING MARKET

The economic evaluation of any government program begins from the premise that government intervention in the market must be justified. Legitimate grounds for

intervention generally relate to (1) market failure, (2) redistribution of income and (3) stabilization of the economy.

Market failure arises when a market is not perfectly competitive. A perfectly competitive market has the following characteristics:

1. all economic agents have perfect information;
2. there are no monopolies or increasing returns to scale; and
3. markets are universal (i.e., no public goods or externalities and no transaction costs).

By the First Theorem of Welfare Economics, a perfectly competitive market produces a Pareto-efficient allocation of resources. Government intervention is not justified as it will not increase the welfare of one person without making someone else worse off. However, if any one of these conditions is violated, government intervention is justified if it can bring about a Pareto-improvement.

A second reason for government intervention relates to the distribution of income. The pattern of income distribution in a market economy depends upon ownership of the factors of production and does not necessarily reflect society's preferences. Government intervention may be justified to change the income distribution to correspond to society's social welfare function.

Governments may also intervene in the market to stabilize the economy. A market economy does not

automatically guarantee full employment and price stability. Government policy may be required to protect the economy from sustained periods of unemployment, stagnation and inflation.

In Canada, government intervention in the housing market has been defended on the basis of all three criteria. Mortgage insurance programs have been designed to correct market failure, social housing programs to redistribute incomes and employment programs such as the Canadian Home Ownership Stimulation Program to stabilize the economy. The ability of housing policy to achieve these varied objectives stems from the multi-faceted nature of housing.

3.3 MEASURING WELFARE GAIN

The appropriate criterion for evaluating public policy is the change in social welfare it produces. The traditional method for measuring welfare change is cost-benefit analysis. The analysis proceeds in two steps. The first step measures inputs and outputs, valuing inputs at their social opportunity cost and outputs by the benefits they produce for society. The second step calculates net present value (NPV) by aggregating expected costs and benefits over the life of the project and discounting them at the social discount rate. The sign and magnitude of the NPV indicate the net gain (or loss) produced by the policy.

3.3.1 MEASURING BENEFITS - THE DEMAND SIDE

Benefits from a housing policy may be tangible or intangible. While tangible benefits may be inferred from the market, intangible benefits are more difficult to measure. Pearce (1971) suggests three approaches: surveying households to determine "surrogate values" of the benefit - that is, the price they would be willing to pay if there were a market for the intangible good; inferring prices from consumer behavior; or using a residual approach. In the residual approach, measurable benefits are estimated and subtracted from costs and the decision-maker then determines if intangible benefits can account for the difference.

Benefits may also be classified as direct or indirect or, equivalently, as tenant benefits and non-tenant benefits.

Non-tenant benefits

Non-tenant benefits may occur in several ways. If the housing conditions of poor households enter into the utility functions of other members of society, the provision of subsidized housing not only increases the utility of program participants, it also adds to the utility of non-participants.

Non-tenant benefits from subsidized housing may also arise if low-cost housing is a "merit good". Musgrave & Musgrave (1984) define merit goods as goods which society, as distinct from individual consumers, wishes to encourage.

If housing is a merit good, then society is better off when the housing conditions of people living in sub-standard housing improve.

An alternative justification for subsidized housing is suggested by Tobin's theory of commodity egalitarianism (Tobin, 1970). While Tobin argues that, in most cases, the unequal distribution of commodities can and should be rectified through income redistribution policies, he suggests there may be grounds for ensuring a "specific egalitarian" distribution of some commodities. He points out that "[t]he social conscience is more offended by severe inequality in nutrition and basic shelter, or in access to medical care or to legal assistance, than by inequality in automobiles, books, clothes, furniture, boats." (Tobin, 1970, p. 265). Tobin identifies two situations calling for specific egalitarianism: the first is for those essentials of life that are in inelastic supply (e.g., consumption goods during wartime) and the second is for merit goods. Tobin suggests food and housing may fall into the second category. However, housing is particularly problematical for Tobin and, while he concludes that the free operation of the market, as presently organized, is not optimal, he sees little "convincing justification" in the long run for commodity egalitarianism in housing.

Non-tenant benefits from subsidized housing may also arise if there are externalities associated with the program. If public housing projects improve the health and

safety conditions of the neighbourhood, the welfare of non-participants in the neighbourhood increases. Weicher (1979) categorizes externalities from subsidized housing into two groups: (1) externalities having an effect on property values and (2) externalities due to reducing the "social" costs of slums.

(1) Property Values. It seems reasonable to suggest that improved housing leads to improved neighbourhoods. In fact, Fisher (1959) reports that one justification for introducing the Public Housing Program in the United States was the belief that the program would increase the value of the surrounding housing. This hypothesis has been tested in several recent studies. In a study of the Chicago housing market, Ferrera (1969) finds price increases for properties located within one block of one public housing project in his sample. However, properties adjacent to other housing projects in the sample showed no increases. In a similar study in New York City, DeSalvo (1974) finds average annual increases of approximately 5% in the assessed values of properties adjacent to projects built under the Mitchell-Lama program.[1] A third study by Rabiega, Lin and Robinson (1984) of small public housing projects in Portland, Oregon finds increases of between $400 and $2,400 in sales prices of surrounding properties.

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[1] The Mitchell-Lama Housing Program is designed to facilitate the construction or rehabilitation of co-operative or rental housing for middle income families.

Weicher (1979) argues against the results obtained by Ferrera and DeSalvo. He suggests that the price increases found by Ferrera were due to a zoning change and those found by DeSalvo were based on assessed values and do not necessarily reflect a "true" increase in value. He concludes that there is no stong evidence that externalities exist. The study by Rabiega, Lin and Robinson (1984) appears to be an exception to Weicher's claim. This may be due to the small scale of public housing projects constructed in Portland (i.e., small by national standards) as the six projects under study range in size from 18 units to 118 units. Alternatively, it could be due to the racial composition of the program recipients. As the authors point out, most of the clients for public housing in Portland are white, suggesting the phenomenon of "white flight" sometimes associated with public housing projects in the U.S. should not be significant.

(2) "Social" Costs of Slums. This term, coined by Rothenberg (1967), encompases a wide range of undesirable social effects of slums. These include high crime and delinquency rates, poor health and safety conditions and psychological problems resulting from a poor living environment. Economists have conducted very little research in this area due to the difficulty of empirically testing the hypothesis. Weicher (1979) summarizes the current thinking as follows:

> Thus, Rothenberg stressed the difficulty of empirical work, arguing that research so far does

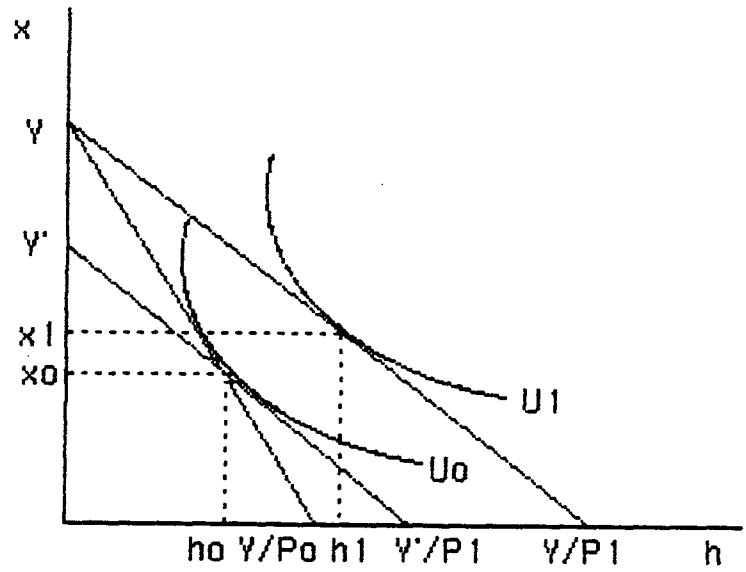
> not show that externalities do not exist, Aaron concluded that it has not been shown that they do exist, and Mills stated that, "Undoubtedly, the important causes of these problems . . . [social costs] are poverty, racial conflict, etc. none of which represent housing market failures." (Weicher, 1979, p. 492)

Tenant benefits

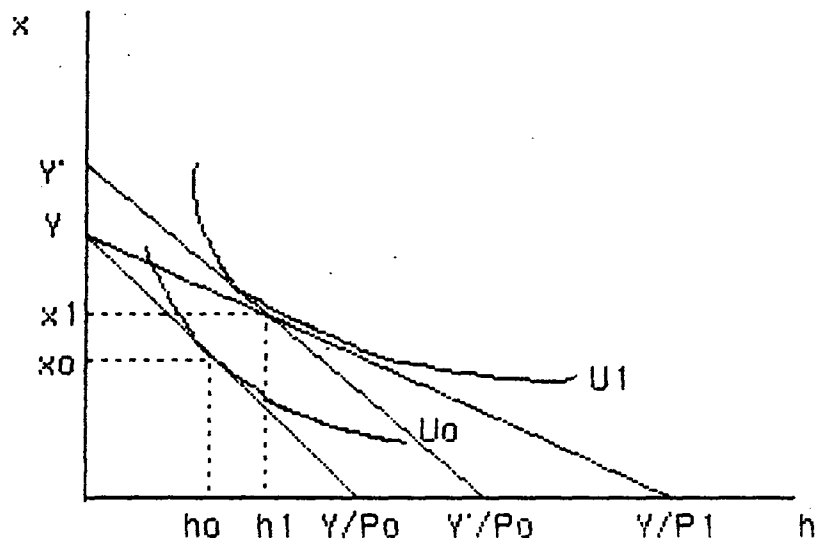
Tenant benefits accrue to program recipients and are equal to the sum of the project rent (i.e., rent paid by the tenants) and the welfare gain enjoyed by the tenants from the program. Welfare gain is measured by one of two money metrics - the Compensation Variation (CV) or the Equivalent Variation (EV). These two measures are defined as follows:

> CV - the amount of money that a household would require (forfeit) to offset the loss (gain) in utility received from the program - i.e., to return it to its original utility level given the new price ratios.
>
> EV - the amount of money that the household would require (forfeit) to make it as well off without the program as with it - i.e., to keep it at its new utility level given the old price ratios.

Figures 4 and 5 illustrate CV and EV in a utility schedule framework. Housing (h) is measured along the horizontal axis and other goods (x) along the vertical axis. The price of x is normalized to 1, allowing income (Y) to be read off the vertical axis. In the absence of a subsidized housing program, the household purchases h_o units of housing and x_o units of other goods. With a subsidized housing program (with no quantity constraint) the price of housing reduces to p_1, the budget constraint rotates outward and the household moves up to indifference curve U_1, consuming commodity bundle



4 Compensation Variation Measure



5 Equivalent Variation Measure

(h_1, x_1). CV is the amount of income that the household could give up at the new price level and still enjoy the

original level of utility (U_o). It equals Y - Y' in Figure 4. EV is the additional income required for the household to remain on U_1 at the original prices. It equals Y' - Y in Figure 5.

The difference between CV and EV can also be expressed in terms of the expenditure function [e(p,u)] as follows:

$CV = Y_1 - e(p_1,u_o)$ $\qquad\qquad$ $EV = e(p_o,u_1) - Y_o$

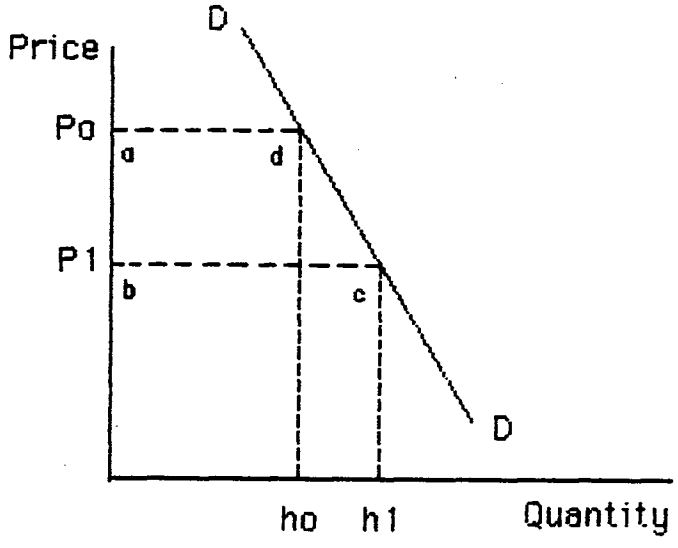
where Y_o, p_o and u_o are the original income, price and utility levels and Y_1, p_1 and u_1 are the income, price and utility levels with the program. The expenditure function describes the minimum amount of expenditure required to attain a given level of utility at a given price level.

Since EV uses original prices, it may be superior to CV. The CV measure produces ambiguous results in comparing alternate projects as it uses the price level of each project as the base. As the base differs for different projects, the measures of CV are not directly comparable.

EV can also be derived in a demand framework as illustrated in Figure 6. DD is the compensated (Hicksian) demand for housing. EV is the increase in consumer's surplus resulting from the price subsidy - in this case, area abcd. This area equals Y' - Y in Figure 5.

3.3.2 MEASURING COSTS - THE SUPPLY SIDE

Most government projects incur tangible and intangible costs. Intangible costs are difficult to measure and include any costs due to the stigma of living in a subsidized



6 Measuring EV in a Demand Framework

housing project or the perceived (or real) deterioration of a neighbourhood due to the project. Tangible costs relate to the land, labour and capital resources used to produce the project and are measured by opportunity cost. Opportunity cost is the value of the goods and services foregone by society as a result of undertaking the project. If all input markets are perfectly competitive, if the economy is at full employment and if the government produces the output as efficiently as the private sector, opportunity costs and market prices are equal. However, if any of these conditions does not hold, market prices will not reflect true opportunity costs.

3.3.3 THE SOCIAL DISCOUNT RATE

The benefits and costs of subsidized housing are spread over the life of the project. As society is not indifferent between benefits received today and benefits received in the future, the net benefit stream from the project must be discounted at the social discount rate.

Two interpretations of the social discount rate appear in the literature. Some economists, following Harberger (1972), believe the rate should represent society's time preferences (i.e., the rate at which society is willing to substitute present for future consumption). Others, following Feldstein (1972) and Marglin (1963), believe it should reflect the opportunity cost of government funds. These two interpretations result in different estimates of the social discount rate, with the former view producing a lower rate (Treasury Board, 1976). Recent literature has attempted to integrate the two approaches with most economists agreeing that the NPV of public projects depends upon both the opportunity cost of government funds and society's rate of time preference.

CHAPTER 4 LITERATURE REVIEW

4. LITERATURE REVIEW

The recent economics literature contains several studies of subsidized housing programs in North America and Europe. All studies use the welfare economics framework to evaluate the program although the estimation techniques and approach differ slightly. This chapter reviews the recent literature and examines the issues involved in applying the welfare economics framework to housing policy.

4.1 ASSUMPTIONS

All studies assume a two good economy consisting of housing and a composite commodity representing all other goods. Following Muth (1960), the consumption of housing is measured in units of housing services. This concept is useful as it reduces the household's consumption decision to the traditional utility maximization problem. The household selects its commodity bundle of housing and other goods to maximize utility subject to its budget constraint.

Housing markets are assumed to be perfectly competitive, ruling out market failure caused by monopoly power, externalities or imperfect information. This assumption ensures market prices represent equilibrium levels.

The long-run supply curve for housing is assumed to be perfectly elastic, implying a constant cost housing industry. This assumption is generally supported by empirical findings (e.g., Muth, 1960).

All studies assume the housing program has no effect on the price of non-subsidized housing or other goods. This is valid providing the amount of subsidized housing represents a small percentage of the housing stock in the study area.

Further assumptions include perfect substitutability of subsidized and non-subsidized housing; exogenous determination of household income and market equilibrium.

4.2 METHODOLOGY

All studies estimate welfare gain using the EV measure. Some studies measure EV within a utility schedule framework, while others use the demand framework.

To measure EV using utility functions, certain assumptions are made about the form of household preferences. DeSalvo (1975) assumes preferences can be represented by a Cobb-Douglas utility function. The Cobb-Douglas function implies unitary price and income elasticities for housing and other goods and a unitary elasticity of substitution. Aaron and von Furstenberg (1971), Murray (1975) and Piggott (1984) question the assumption of unitary elasticities and recommend a less rigid utility function such as the CES (Constant Elasticity of Substitution) or the generalized CES. While the CES imposes unitary income elasticity, no restrictions are imposed on price elasticity or the elasticity of substitution. The generalized CES allows flexibility for all three elasticities.

Murray (1975) finds the Cobb-Douglas utility function provides distorted results for estimating the distribution of program benefits although it provides similar results to the CES function for estimating average benefits.

> The mean benefit estimates for the sample hardly differ from one specification to the other, but examination of the family composition means shows considerably greater discrepancies. This suggests the Cobb-Douglas may be useful for computing aggregate benefits but should be used with caution if only one utility function is to be estimated. Our results should also serve to make researchers cautious in estimating the distribution of benefits with the Cobb-Douglas specification. . . Since structural characteristics such as the correlations of income or age with benefits are of substantive interest to policy makers, we encourage the use of functional forms less restrictive than the Cobb-Douglas. (Murray, p. 787)

Unfortunately, as Murray notes, the CES function presents some disadvantages for researchers as it requires observations on prices and quantities. The Cobb-Douglas function, on the other hand, has only one parameter (β, the tenant's rent-to-income ratio) and it can be estimated from data on budget shares and income. A second disadvantage of the generalized CES function is that it requires an iterative regression program to estimate EV to the desired degree of accuracy. The Cobb-Douglas function, on the other hand, yields an explicit formula for the calculation of EV.

The ease of estimation of EV permitted by the Cobb-Douglas function makes it highly desirable in cases where the assumptions of unitary elasticities are tenable. At the time of DeSalvo's study, most empirical evidence on the demand for housing supported unitary price and income

elasticities. In a survey of the literature, DeLeeuw (1971) found income elasticity of rental housing in the United States to be between 0.8 and 1.0 and price elasticity to be between -0.7 and -1.5. However, recent evidence supports much lower elasticities. Studies by Polinsky (1977), Mayo (1981) and Polinsky and Ellwood (1977) suggest that, in the aggregate, housing demand is slightly inelastic with respect to both price and income. More significantly, studies at the micro level suggest that income elasticities may be very low for an individual household.

In response to the recent evidence, economists have selected more flexibile utility functions than the Cobb-Douglas. Olsen and Barton (1983), Cronin (1983) and DeBorger (1985) experimented with the Stone-Geary or displaced Cobb-Douglas function. This function takes the form: $U = (h - h_o)^{\beta} (x - x_o)^{1-\beta} + M$ where h and x are housing and non-housing; h_o and x_o are minimum consumption levels; β is the rent-to-income ratio; and M is the utility enjoyed by a household consuming the minimum levels.

The Stone-Geary function offers the advantage of flexible income and price elasticities. Elasticities are not restricted to unity, although they monotonically approach unity as income increases. This flexibility, combined with the relative ease of estimating EV makes the Stone-Geary function highly desirable.

Other economists choose to estimate EV from demand functions. According to Clemmer (1984), this approach is

superior to the utility framework as it does not impose a priori assumptions on household preferences. However, estimates of prices and quantities are necessary, adding to the cost of research.

4.3 RESULTS

All studies conclude the cost of the housing program exceeds measurable benefits. Estimates of efficiency (EV/Subsidy) range from a low of 25% reported by Sumka and Stegman (1978) in their study of public housing in non-metropolitan cities to a high of 85% reported by Walden (1981) in his study of senior citizen projects (see Table I). Substantial non-tenant benefits are required to justify the programs in terms of economic efficiency.

Table I Efficiency Results Reported in the Literature

DeBorger (1985)	70%
DeSalvo (1975)	55%
Kraft and Kraft (1979)	67.5%
Olsen and Barton (1983)	63%
Sumka and Stegman (1978)	25%
Walden (1981)	45%/85%

NOTE:
1. Walden's study consists of two samples: (1) public housing projects for middle income groups and (2) public housing projects for older people.
2. Efficiency is estimated by the ratio of EV to the subsidy amount.

The equity results are mixed. DeSalvo (1975), Kraft and Kraft (1979) and Murray (1975) find benefits decrease with income, while DeBorger (1985) finds no significant relationship and Sumka and Stegman (1978) and Olsen and Barton (1983) both find benefits to first rise and then fall with increasing income. Most studies find little evidence of horizontal equity. DeSalvo (1975) finds benefits are lower for female-led households and Kraft and Kraft (1979) find benefits higher for white households.

CHAPTER 5 METHODOLOGY AND DATA

5. METHODOLOGY AND DATA

This chapter describes the public housing projects in Yellowknife that form the data base for the study. It sets out the four hypotheses and describes the testing process. It also explains the estimating techniques used to measure the program costs and benefits and to calculate net present value.

5.1 STUDY AREA AND DATA

The City of Yellowknife is located on the north shore of Great Slave Lake, over 600 air miles from Edmonton. Originally a remote mining town, the city grew rapidly over the past twenty years to a current population of approximately 10,500 (Bureau of Statistics, unpublished data, 1984).

The 1981 Census recorded a total of 3,185 occupied dwelling units in Yellowknife, of which 2,250 or 71% were rental and the balance were owner-occupied. Of the 2,250 rental units, 179 or 8% are public housing. Table II compares the composition of the public housing stock to the total rental stock.

Table II Yellowknife Rental Housing Stock, 1981

	Public Housing	Total Stock
Single Detached	18	565
Rowhousing	124	335
Apartment (5 or more storeys)	nil	205
Apartment (under 5 storeys)	20	890
Double House	nil	60
Duplex	nil	55
House attached to commercial	nil	5
Movable Dwelling	nil	135
Sub-total	162	
Senior Citizens Home*	17	
Total	179	2,250

* Senior Citizens Home is included as "rowhousing" in census data

SOURCE:
1. Statistics Canada, 1981 Census.
2. N.W.T. Housing Corporation, unpublished data.

The study excludes households in single detached dwellings and residents of the Senior Citizens Home. The former are excluded because market rents of single detached dwellings are not available. Without this data, it is impossible to estimate the market rent equivalents of the public housing units and impossible to calculate EV. The Senior Citizens Home is excluded because there are no comparable units in the private market. These exclusions

reduce the sample size to 144 public housing units. All projects are financed through Sections 40, 43 or 44.1(a) of the N.H.A., as indicated in Table III.

Table III Yellowknife Public Housing Projects, 1985

Project Name	Type	Units	NHA Section
"Condominium Project"	Fourplex	52	40
Forrest Drive	Apartments	6	44.1(a)
Hilltop	Rowhousing	24	40
Lanky Court	Apartments	14	44.1(a)
Sissons Court	Rowhousing	48	43
Total		144	

SOURCE: Yellowknife Housing Authority records.

5.2 HYPOTHESES

The study postulates four hypotheses about the efficiency and equity achievements of the program:

Efficiency

Hypothesis 1: Projects constructed under the Public Housing Program in Yellowknife have a negative net present value.

Equity

Hypothesis 1: Public housing tenants in Yellowknife have incomes in the lowest quartile of the total population.

Hypothesis 2: The Public Housing Program in Yellowknife is achieving vertical equity, that is, benefits decline with income.

Hypothesis 3: The Public Housing Program in Yellowknife is achieving horizontal equity, that is,

"equals are treated equally".

5.3 ASSUMPTIONS

The thesis adopts the traditional assumptions of the literature: a two good economy (housing and non-housing); rational utility-maximizing households; perfectly competitive markets; a constant cost housing industry; a subsidized housing program that has no effect on prices in other markets; perfect substitutability of subsidized and non-subsidized housing; exogenous determination of household income; and market equilibrium.

Most of these assumptions are readily justifiable. Some, however, are adopted for ease of analysis and must be relaxed at some point to produce more realistic results. Specifically, three assumptions are questionable: (1) rational utility maximizing households, (2) exogenous determination of household income and (3) market equilibrium. Each of these is discussed briefly in turn.

(1) Rational Utility Maximizing Households.

Neo-classical economists assume that households are the best judges of their own welfare and act to maximize their utility. Some groups of society - referred to as "paternalistic altruists" in the economics literature - think that poor households tend to value some goods too lightly and, in selecting their bundles of goods, they fail to maximize their welfare. Others believe that while an individual may behave in a utility-maximizing manner,

households may not. In a household with children, the adult decision-makers may not behave in a manner consistent with the best interests of the children.

These viewpoints lead some economists to oppose unrestricted cash grants. Olsen (1971) supports the provision of rent certificates on the grounds that "there are many paternalistic altruists in this country and . . . housing is one of the goods that these people think the poor value too lightly" (Olsen, 1971, p. 224).

This study accepts the premise that there are so-called paternalistic altruists in Canada who believe some poor households tend to undervalue housing. Consequently, the former derive a non-tenant benefit from the direct provision of public housing that would not be derived from a cash transfer to the poor.

(2) Exogenous Determination of Household Income. The study assumes that people living in public housing would choose the same job and work the same number of hours in the absence of the program. Unfortunately, the very nature of the rent scale in public housing in Canada may invalidate this assumption. As described in Chapter 2, rents for public housing units are calculated based on the income level and family composition of the household. This results in higher income households paying higher rents than lower income households for the identical unit. Consequently, some households may choose to work less hours or to remain unemployed rather than seek higher paying jobs and pay

higher rents. In an analysis of this hypothesis, Murray (1980) estimates that public housing induces tenants to reduce their work effort by about 4 percent in the U.S. Application of Murray's model to the Yellowknife data predicts a reduction in work effort of between 2% and 8% (see Appendix 2 for further details).

(3) Market Equilibrium. Market equilibrium is a critical assumption for any economic analysis. Unfortunately, this assumption did not hold in the Yellowknife housing market during the study period. The apartment vacancy rate in Yellowknife in 1985 approached zero percent and there were long waiting lists for accommodation. Theoretically, this situation should have corrected itself by an increase in the supply of housing. However, as economic forecasts for Yellowknife were uncertain in the early 1980's, mortgage credit for rental construction was restricted and no new apartment buildings were constructed. Consequently, market rents in 1985 may not represent equilibrium levels.

5.4 TESTING FOR EFFICIENCY

5.4.1 ESTIMATING TENANT BENEFITS

Tenant benefits are calculated by the Equivalent Variation measure of welfare gain using a Stone-Geary utility function. The first order conditions of the utility maximization problem yield Marshallian demand equations for

housing and non-housing that are linear in income and prices. These "linear expenditure" functions are given by equations [1] and [2]:

[1] housing: $p_h h_o + \beta(Y - p_h h_o - p_x x_o)$

[2] non-housing: $p_x x_o + (1-\beta)(Y - p_h h_o - p_x x_o)$

where $P_h h_o$ and $p_x x_o$ are the expenditures on the minimum consumption levels of housing and non-housing; Y is income; and β is the rent-to-income ratio for purchases of housing in excess of the minimum level. Intuitively, the equations can be interpreted as follows: the committed expenditures ($p_h h_o$ and $p_x x_o$) are purchased first leaving a residual ($Y - p_h h_o - p_x x_o$) which is allocated between housing and non-housing in fixed proportions β and $(1 - \beta)$.

The linear expenditure functions are appealing from a theoretical perspective as they satisfy the requirements of demand functions - namely, the properties of adding up, homogeneity and negativety of the direct substitution effect (Mayo, p. 105). However, the linear expenditure system is not always appropriate as it has some limitations. It cannot be used if one of the goods is inferior or if any two goods are complementary. In both cases, the linear expenditure system produces a non-concave expenditure function. Fortunately, these two restrictions do not pose a problem for this study as the two good economy represents goods which are neither inferior nor complementary.

The expenditure function corresponding to the Stone-Geary utility function is given by equation [3]:

[3] $e(p,u) = u(p_h^{\beta} p_x^{1-\beta}) + (p_h h_o + p_x x_o)$.

The last term represents expenditure on the minimum consumption levels. The first term indicates that utility can be "bought" at a constant price per unit of $(p_h^{\beta} p_x^{1-\beta})$. This term is a weighted geometric mean of prices for the two goods and represents the marginal cost of living (Deaton and Muellbauer (1980), p. 65). Setting utility at that level enjoyed by a household with the housing program (commodity bundle (h_1, x_1)), the expenditure function becomes:

[4] $$e(p,u) = \frac{[(h_1-h_o)p_h]^{\beta}}{\beta} \quad \frac{(Y_o-ap_h h_1-p_x x_o)^{(1-\beta)}}{(1-\beta)} + p_h h_o + p_x x_o$$

Letting $p_h h_1 = R_m$ (market rent of public housing unit) and $ap_h h_1 = R_p$ (project rent), the formula for EV is given by equation [5]:

[5] $$EV = [(R_m - p_h h_o)/\beta]^{\beta}[(Y_o - R_p - p_x x_o)/(1-\beta)]^{(1-\beta)} + p_h h_o + p_x x_o - Y_o$$

Observations or estimates of six variables are required to calculate EV from equation [5]:

Y_o - current household income
R_p - project rent
R_m - market rent equivalent of public housing unit
β - household's rent-to-income ratio without the program (for housing in excess of minimum level)
$p_h h_o$ - minimum expenditure on housing
$p_x x_o$ - minimum expenditure on non-housing.

Of these six variables, only the first two are observable: household income and project rent. Data for these variables are obtained from Yellowknife Housing Authority records and represent 1985 figures. The remaining variables are estimated.

The market rent equivalents of public housing units are estimated using hedonic regression. Market rents of non-public housing units are regressed on housing and neighbourhood characteristics. The resulting parameter estimates are applied to the characteristics of the public housing stock to estimate market rent equivalents. This assumes that the conditional distribution of rent given the specified housing and neighbourhood characteristics is the same for public housing and market housing. If public housing is systematically different from market housing, the resulting estimates will be biased. However, there is no reason to believe there are such systematic differences in the housing stock in Yellowknife. Public housing projects are well integrated into the community and are almost indistinguishable from market housing.

The preferred method of calculating β is to regress rent-to-income ratios on household characteristics of the non-public housing population and use these coefficients to predict β for the public housing tenants. Unfortunately, detailed data on household characteristics of the non-public housing sector is not available for Yellowknife. In the absence of this data, β is estimated from cross tabulations of rent-to-income ratios by household income from 1981 census data.

Theoreticaly, estimates of minimum expenditure levels should represent actual minimum expenditures observed from a sample of the population. Olsen and Barton (1983) and

DeBorger (1985) estimate these levels from data contained in a sample of unsubsidized households. They assume the actual minimum expenditures incurred by households of various characteristics (e.g., size, race, marital status, age of head) represent the subsistence levels for households with similar characteristics. Unfortunately, no comparable data is available for Yellowknife households living in unsubsidized housing. In the absence of hard data on minimum subsistence expenditures, this study relies on estimates prepared by government agencies.

5.4.2 ESTIMATING NON-TENANT BENEFITS

In view of the inconclusive evidence on the non-tenant benefits of public housing projects, a common approach in cost-benefit studies is to calculate the net present value based on direct benefits only, compare this figure with the direct costs of the project and judge whether non-tenant benefits can reasonably justify the difference. This study follows this approach.

5.4.3 ESTIMATING COSTS

Public housing projects incur both tangible and intangible costs. Most economic studies ignore intangible costs as does this study. Following Kraft and Kraft (1979) and Sumka and Stegman (1978), this study uses actual capital and operating cost data to estimate tangible costs.

5.4.4 CHOOSING A SOCIAL DISCOUNT RATE

Federal department submissions to the Treasury Board of Canada use a range of social discount rates. The Treasury Board Benefit-Cost Analysis Guide recommends the use of 5%, 10% and 15%. The rationale for the choice of these figures is explained as follows:

> Jenkins has estimated the weighted social rate of return on capital in Canada during the period 1965 - 1969 to be approximately 9.5 per cent. He also found that the social rate of return of 15.1 per cent for manufacturing in this period was the highest of any sector in the economy . . . One might accordingly select 10 and 15 per cent as median and upper bounds for our sensitivity analysis. The upper bound figure could be justified by the argument of Mishan that the use of a discount rate reflecting a commercial rate of return on capital will satisfy the decision-maker that "only those public projects having expected returns greater than those of the highest-yielding private investments are accepted". . . . A lower bound social discount rate of five per cent might be justified on the basis that Helliwell et al. found this to be approximately the real supply price of capital in Canada in the period 1955 - 72. (Benefit-Cost Analysis Guide, p. 26)

Correspondence from the Secretary of the Treasury Board confirms that federal departments currently use a number of discount rates in the range 5% - 15%.

Following the Treasury Board guidelines, the study uses a range of social discount rates. However, as the costs and benefits are translated to 1985 dollars, real rates rather than nominal rates are used. The range of real rates is determined from estimates of real rates over the past ten year period.

5.5 TESTING FOR EQUITY

The three equity hypotheses are stated in Section 5.2. As a reminder, they are:

1. Public housing tenants in Yellowknife have incomes in the lowest quartile of the total population.

2. The Public Housing Program in Yellowknife is achieving vertical equity, that is, benefits decline with income.

3. The Public Housing Program in Yellowknife is achieving horizontal equity, that is, "equals are treated equally".

The first hypothesis is tested simply by comparing the income distributions of the public housing tenants to that of the total population in Yellowknife. Households with lower incomes are expected to be disproportionately represented in the public housing stock. The second and third hypotheses are tested by regressing the EV measure of welfare gain for each household against household income and characteristics.

CHAPTER 6 EMPIRICAL RESULTS

6. EMPIRICAL RESULTS

This chapter presents the results of the cost-benefit analysis. Sections 6.1 and 6.2 describe the results from testing the four hypotheses of efficiency and equity. The final section compares the net annual cost of the Public Housing Program to the estimated cost of a shelter allowance program.

6.1 ECONOMIC EFFICIENCY

Earlier chapters report that all economic evaluations of subsidized housing find the programs to be inefficient. There is no reason to believe, a priori, that the program in Yellowknife will be inconsistent with these results. This expectation is formalized in Hypothesis 1.

> Hypothesis 1: Projects constructed under the Public Housing Program in Yellowknife have a negative net present value.

The results of the analysis support this hypothesis. The net present value of the five projects is estimated to be between - $13.345 million and - $17.485 million depending on the social discount rate. This section describes the estimation process leading to these results.

6.1.1 ESTIMATES OF TENANT BENEFITS

Tenant benefits are estimated by calculating the EV measure for each individual household and adding this amount to project rent as indicated in equation [6]:

[6] TENANT BENEFIT =

$$\frac{(R_m - p_h h_o)^{\beta}}{\beta} \frac{(Y_o - R_p - p_x x_o)^{1-\beta}}{(1-\beta)} + p_h h_o + p_x x_o - Y_o + R_p$$

where:

Y_o = current household income
R_p = project rent
R_m = market rent equivalent of public housing unit
β = household rent-to-income ratio without the program (for housing in excess of minimum level)
$p_h h_o$ = minimum expenditure on housing
$p_x x_o$ = minimum expenditure on non-housing.

The first two variables (current household income and project rent) are obtained from the Yellowknife Housing Authority records. The remaining four variables are estimated.

Estimates of Market Rent Equivalents

The market rents of public housing units are estimated using hedonic regression. Market rents are assumed to be a function of the variables listed in equation [7] plus an independent error term.

[7] RENT = f(STOR, YEAR, BED, COND, TYPE, FURN, UTIL, DIST2, DIST3)

The first three variables are quantitative, the remainder are dummy variables. STOR is the number of storeys in the building; YEAR is the year of construction; and BED is the number of bedrooms in the unit. COND is a dummy variable for condition rating (0 = Fair, 1 = Good) TYPE for structural type (0 = apartment, 1 = rowhousing); FURN for furniture provided (0 = no, 1 = yes) and UTIL for utilities included

in the rent (0 = none, 1 = electricity). DIST2 and DIST3 are dummy variables for location. Three locations are identified based on walking distance from the downtown core. The base location is the downtown core. DIST2 =1 if unit is located within "easy walking distance" from the downtown core and 0 otherwise. DIST3 = 1 if unit is located at more than 15 minutes walking distance from the downtown core and 0 otherwise. The base case is an unfurnished apartment in fair condition located in the downtown core of the city. Utilities are not included in rent.

The sample consists of 921 housing units. Of these, 881 are privately owned and rented. The balance are leased by the territorial government and are rented as staff housing units. Rents for staff units are based on prevailing market levels according to government policy. Observations for all independent variables are obtained from the assessment records of the territorial government. Market rents for privately owned units are obtained from the March 1985 Yellowknife Rental Survey conducted by the territorial Bureau of Statistics. Rents for staff housing are provided by the Government of the N.W.T.

On the surface, it seems reasonable to expect that housing attributes have an additive effect on rent. However, a review of the literature reveals a wide variety of forms used in hedonic regressions. In the cost-benefit analysis literature, Murray (1975) and Olsen (1972) use the linear model while Sumka and Stegman (1978) use the log linear

form. As Quigley (1979) observes "most authors have chosen the linear, semi-log, or logarithmic form for analysis, presumably on the grounds of convenience and without rigorous statistical experimentation" (Quigley, p. 400). In the absence of any agreement in the literature, Box-Cox tests are run on the Yellowknife data to determine an appropriate model. The results suggest a linear model will fit the data quite well.

The regressions are run using Ordinary Least Squares. An analysis of the residuals indicates the data comply with the critical assumptions of constant variance and uncorrelated errors (see Figure 7 in Appendix 1). However, the normal plot of residuals suggests the error term may not be normally distributed (see Figure 8 in Appendix 1). This means that the model may not provide accurate results for hypothesis testing. Fortunately, the model is only required for prediction purposes.

The estimates resulting from the regression are presented in equation [8]. T-statistics are in parentheses and significance levels in square brackets.

[8] R_m = 5860.242 − 259.968 STOR + 174.750 YEAR
(110.597) (-29.304) (37.359)
[.0001] [.0001] [.0001]

+ 1124.991 BED -618.612 COND +937.311 TYPE +261.032 FURN
(54.058) (-14.674) (12.065) (5.288)
[.0001] [.0001] [.0001] [.001]

+ 261.286 DIST2 - 441.560 DIST3 - 313.820 UTIL
(8.308) (-5.854) (-10.943)
[.0001] [.0001] [.0001]

R_m is the "market rent equivalent" of the public housing

unit, all other variables are as previously defined. All parameter estimates are significant at the .01% level. The model produces an R^2 of .93 indicating a good fit.

In general, the parameter estimates have the correct signs and confirm the expectation that rents increase with number of bedrooms, with type of structure (i.e., rowhousing is more expensive than apartment units), and with furniture provided. The parameter estimate for number of storeys has a negative sign, suggesting rents decrease with building height possibly reflecting a greater demand for ground-oriented accommodation. Rents also decrease with age of building (i.e., increase with year of construction). The parameter estimates for distance confirm expectations that units within "easy walking distance" from downtown are more desirable than those located either in the heart of the downtown core or at a more remote location.

Two parameter estimates resulting from the regression do not conform to expectations. The coefficients for COND (condition) and UTIL (utilities) both have negative signs suggesting rents are lower for units in better condition and for units with utilities included in the rent. In equilibrium, one would expect rents to increase with quality (i.e., condition) and with amenities provided (e.g., utilities).

In general, there are several possible explanations for an "incorrect" sign:

1. multicollinearity among independent variables;

2. misspecified functional form (e.g., interaction terms or higher order terms omitted);
3. omitted variable; or
4. inadequate data.

Of these four possibilities, only the last two seem plausible for this model. Multicollinearity is ruled out by an examination of the correlation matrix and the collinearity diagnostics produced by SAS (see Appendix 1). Misspecified functional form is ruled out by Box-Cox tests and by trial and error. Box-Cox tests produce a value of .94 for lambda, suggesting a linear model should fit the data quite well. Interaction terms such as AGE x COND were added to the model and found to be insignificant, suggesting cross product terms are not causing the problem. However, misspecification due to omitting an independent variable is a possibility. The model does not include a variable representing tenant characteristics. Units in poorer condition may be commanding a higher rent than comparable units in good condition because they are rented by qualitatively different groups. Tenants in the poorer units may be greater risks (lower income, more rowdy etc.) and landlords may be charging higher rents to compensate for the increased risk.

This latter behavior draws some support from economic theory. For example, Henderson (1985) suggests there is a "rental externality" associated with renting that makes it an inherently more expensive form of tenure than owning.

According to Henderson, because owners are directly responsible for all operating and maintenance costs, they utilize their housing at an optimal rate. Conversely, renters tend to overutilize their housing as they are not directly responsible for the full costs of their occupancy. Therefore, landlords set rents at a higher level to compensate for the expected cost of overutilization. Henderson attributes the difference in user cost between renting and owning to this rental externality. A natural extension of Henderson's theory suggests that landlords renting to tenants who are considered prime candidates to overutilize the property will charge higher rents than landlords renting to other groups. Similar reasoning could be used to explain a negative sign on UTIL.

A second explanation for the "incorrect" signs could be an inaccurate data base, particularly in the case of COND. The condition ratings were obtained from the assessment records of the Territorial Government. Each building is assigned a condition rating of POOR, FAIR, GOOD or EXCELLENT based on the subjective judgement of the assessor. All the buildings used in this study were assigned ratings of FAIR or GOOD. As the ratings were done at different times by different assessors, it is possible that some inconsistencies may be present. A few such inconsistencies could produce the wrong sign on COND. A similar explanation could be constructed for the "incorrect" sign on UTIL.

An alternate explanation for the perverse results could be that the rental market in Yellowknife is not in equilibrium. At the time of the study, there were long waiting lists for accommodation suggesting demand exceeds supply. Landlords may be capitalizing on this situation by charging higher rents for poorer units than the market would tolerate in equilibrium. Theoretically, this situation should correct itself by an increase in rents followed by an increase in supply. However, as economic forecasts for Yellowknife were uncertain in the early 1980's, mortgage credit for rental construction was restricted and no new apartment buildings were constructed until 1985/86.

While none of these explanations is as satisfying as obtaining the "correct" signs would be, there appears to be no alternative but to use equation [8] for estimating the market rent equivalents for the public housing units. On the positive side, there are two reasons to suggest that the model is valid for forecasting purposes. First, verification of the model by "half and half" techniques produces estimates of market rent that very closely approximate the true rent. The model is verified by splitting the data into two data sets using the random number generator in SAS. The model is fit using the first data set and the coefficients resulting from the regression are used to fit the second data set. The results of this regression are reproduced in Appendix 1. The estimated rent (YHAT) resulting from the application of the parameter estimates to the second data

set is then regressed on RENT producing the results in equation [9]. T-statistics are in parentheses and significance levels in square brackets.

[9] YHAT = 600.815 + .925 RENT
(4.978) (63.162)
[.0001] [.0001]

The t-statistics for the parameter estimates are significant at the .01% level. The R^2 is .90 suggesting the model produces a good fit. The plot of YHAT against RENT, shown in Figure 9 in Appendix 1, confirms this.

A second reason to have confidence in the model is provided by examining the market rent equivalents obtained for public housing units located in "mixed use" buildings. Included in the stock of public housing are two buildings (Forrest Drive Apartments and Lanky Court Apartments) that offer a mix of public housing units and market apartments in the same building. Presumably, the market rent equivalent of the public housing units in these buildings would equal the actual rent of the market units. Table IV compares the market rent equivalents obtained from the model in equation [8] to the actual market rents. The estimates for the units in Lanky Court are very close to the actual rent (only 2.3 - 4.7% above), while the estimates for the Forrest Drive apartments are somewhat less accurate (10.6 - 13.0% above).

Table IV Comparison of Market Rent Equivalents and Market Rents

Building	Size	Actual Rent	Market Equiv.	Error	
Lanky	2 BR	$8,400	$8,793	$393	(4.7%)
Court	3 BR	9,600	9,918	318	(3.3%)
	4 BR	10,800	11,043	243	(2.3%)
Forrest	2 BR	8,400	9,496	1,096	(13.0%)
Drive	3 BR	9,600	10,621	1,021	(10.6%)

In conclusion, the linear model presented in equation [8] seems to be a good predictor for market rents in Yellowknife and is used to estimate the market rent equivalents of public housing units.

Estimates of Minimum Expenditure Levels

The territorial Department of Social Services calculates minimum expenditure levels for non-housing by household size in order to establish welfare rates for the Northwest Territories. These levels reflect the "basic living allowance" component of welfare exclusive of housing costs. A housing component is not included as it is government policy to pay the actual cost of shelter for all welfare recipients.

Statistics Canada calculates "low income cut-off levels" by household size and place of residence. Although these levels are not designed to represent official poverty lines, they are interpreted as such by the National Council of Welfare. These levels are set at the amount of income

required by a household so that it spends 58.5 percent of its income on the basic necessities of food, shelter and clothing.[2] Thus, 58.5 percent of the "low income cut-off" levels can be interpreted as minimum expenditures for subsistence. This study uses these latter figures as minimum expenditure levels. Minimum expenditures on housing are calculated by subtracting the "basic living allowances" from the minimum expenditures for subsistence. The estimates of minimum expenditures resulting from this process are provided in Table V.

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[2] The 1978 Survey of Family Expenditures found that, on average, Canadian families spent 38.5% of their income on food, clothing and shelter. Since the portion of income spent on the basic necessities declines with income, poor families are expected to spend disproportionately more on food, clothing and shelter than the average family. In calculating the low income cut-offs, Statistics Canada set this level at 58.5%, 20 percentage points above the national level.

Table V Minimum Expenditure Levels by Household Size

Size	Poverty* Level	Minimum Exp.** For Subsistence	Basic Living Allowance	Minimum Exp. On Housing
1	$8,432	$4,933	$1,812	3,121
2	11,098	6,492	3,156	3,336
3	14,886	8,708	4,392	4,316
4	17,206	10,066	5,520	4,546
5	19,960	11,677	6,552	5,125
6	21,767	12,734	7,452	5,282
7	24,004	14,042	8,256	5,786
8***	24,004	14,042	8,940	5,786

* Statistics Canada "low income cut-off" levels
** Figures represent 58.5% of poverty level
*** While the poverty level remains constant at $24,004 for households of 7 or more people, the basic living allowance is increased for each additional household member. Therefore, to prevent the estimate of "Minimum Expenditure on Housing" from declining for a household of 8, it is set at the same level as that calculated for a household of 7 ($5,786).

SOURCE:
1. Department Of Social Services, Government of the N.W.T., unpublished data.
2. "1985 Poverty Lines" - estimates by the National Council of Welfare, March, 1985.

There are some problems with this method. The low income cut-off levels established by Statistics Canada are not prepared specifically for Yellowknife but are determined according to city size. The levels for Yellowknife are taken from the category "population of less than 30,000". Given the higher cost of living in Yellowknife than in cities of

comparable size in southern Canada, the estimates of minimum expenditures may be understated.

Estimates of β

The parameter β represents the household net rent-to-income ratio in the absence of the program. It is calculated exclusive of the minimum expenditure levels as indicated in equation [10]:

[10] $\beta = (\text{RENT} - p_h h_o)/ (\text{INCOME} - p_h h_o - p_x x_o)$.

In order to calculate β, the variable RENT must first be estimated. All other variables are either observable (INCOME) or previously estimated ($p_h h_o$, $p_x x_o$). Estimates of RENT are obtained in two steps. In the first step, gross rent-to-income ratios for tenants in Yellowknife are calculated by income group from 1981 Census data.[3] In the second step, these ratios are multiplied by household income to estimate the variable RENT for each household in public housing.

In step one, estimates of the average gross rent-to-income ratios are obtained by regressing rent-to-income ratios of all rental households in Yellowknife on household income. The regression takes the form given by equation [11]:

[11] $$\text{RENT/INCOME} = \beta_1 \text{INC1} + \beta_2 \text{INC2} + \beta_3 \text{INC3} + \beta_4 \text{INC4} + \beta_5 \text{INC5} + \beta_6 \text{INC6} + \beta_7 \text{INC7} + \beta_8 \text{INC8} + \beta_9 \text{INC9} + u$$

where INC1 to INC9 are dummy variables representing annual

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[3] I am indebted to the N.W.T. Housing Corporation for financial assistance in purchasing this data from Statistics Canada.

household income in $5,000 increments. The regression is run using Ordinary Least Squares, suppressing the intercept. The coefficients resulting from the regression represent the mean values of the gross rent-to-income ratio for each income group. They are presented in Table VI.

Table VI Gross Rent-to-Income Ratios, Yellowknife, 1980

Income Range	Ratio
under $5000	42%
$5,000 - $9,999	35%
$10,000 - $14,999	28%
$15,000 - $19,999	24%
$20,000 - $24,999	19%
$25,000 - $29,999	17%
$30,000 - $34,999	15%
$35,000 - $39,999	15%
$40,000 +	13%

In step two, estimates of RENT are obtained by applying the appropriate ratio to household income for all households in public housing. These estimates are substituted in equation [10] to produce estimates of β for each household. Before describing the results of this process, a note should be made about the sample size. The sample of public housing stock used in this study consists of 144 units. When the data were collected, 7 units were vacant, reducing the number of households to 137 and, of these, 27 households

reported zero income. Therefore, the net sample consists of 110 households.

In theory, β represents the percentage of household income, over and above the minimum expenditure level, that would be spent on obtaining housing in excess of the minimum level. By construction, all estimates of β should be non-negative since both the numerator and denominator of equation [10] should be greater than or equal to zero. The numerator should be non-negative since the variable RENT, by definition, must be greater than or equal to the subsistence shelter level and the denominator must be non-negative since household income, also by definition, cannot be less than the minimum expenditure levels. However, initial application of the data to equation [10] results in negative β's for 54 of the 110 households in the sample. This suggests one of two things:

1. the average rent-to-income ratios derived from the Yellowknife population are "too low"; or
2. the minimum expenditure levels are "too high".

In fact, both of these factors could be contributing to the problem as the estimation techniques in both cases are quite crude. However, as the estimates of average rent-to-income ratios are derived from actual market data, there is more reason for confidence in these figures than in the minimum expenditure levels for shelter. Hence, minimum housing expenditures are re-defined as the minimum estimates of RENT (i.e., rent-to-income ratio multiplied by household income)

for each category of household size. The revised minimum shelter levels are presented in Table VII.

Table VII Revised Minimum Housing Expenditure Levels

Household Size	Basic Living Allowance	Minimum Shelter*	Revised Shelter
1	1,812	3,121	2,738
2	3,156	3,336	2,738
3	4,392	4,316	3,023
4	5,520	4,546	3,023
5	6,552	5,125	3,628
6	7,452	5,282	4,445
7	8,256	5,786	4,869
8	8,940	5,786	4,895

* from Table V

SOURCE:
Department Of Social Services, Government of the N.W.T., unpublished data.

This adjustment still leaves 7 households with incomes less than the minimum subsistence levels. Incomes for 2 of the households are less than the Basic Living Allowance suggesting income is under-reported. These two observations are deleted. The remaining 5 observations have incomes in excess of the Basic Living Allowance but have inadequate income to purchase housing in the market. They are only able to subsist on their incomes because they are living in public housing and their rent is limited to 25% of their income. These 5 observations are also deleted, reducing the

sample size to 103 households.

With these revisions, estmates of β are obtained for each household in the sample. These values are substituted in equation [6] along with estimates of the other variables to produce an estimate of tenant benefits for each household. The estimates range from $2744.45 to $8064.63 with a median value of $6,519.25 and a mean of $6276.16. Total tenant benefits are estimated to be $903,767 (i.e., 144 x $6276.16).

6.1.2 ESTIMATES OF COSTS

Only tangible costs are measured at this point. Actual capital costs are obtained from C.M.H.C. and are presented in Table VIII. Actual operating costs were unavailable for 1985, but operating budgets for the 1985 calendar year have been provided by the Yellowknife Housing Authority as well as actual costs for 1984. These are also presented in Table VIII.

Table VIII Public Housing Project Costs

1. Capital Cost (actual)	$ 6,972,987
2. Capital Cost (1985 dollars)	11,094,893
3. Operating Costs (1984 actual)	927,634
4. Operating Costs (1985 budget)	882,900

SOURCE:
1. Correspondence from C.M.H.C., Yellowknife Office.
2. Yellowknife Housing Authority.

The use of actual capital costs and operating costs assumes that the input markets are perfectly competitive and that the prices paid for the land, labour and capital resources represent their value in the best alternative use. Actual operating costs may understate resource cost as they do not include the administration costs of the N.W.T. Housing Corporation or C.M.H.C. To the extent that the resources used to administer the housing projects could be used to produce other goods, they represent a true cost to society. However, in this study, it is assumed that the administration costs of the N.W.T. Housing Corporation and C.M.H.C. are not increased by the existence of the Public Housing Program in Yellowknife. This may not be all that unrealistic as the 144 public housing units in Yellowknife represent a negligible portion of the public housing stock in the N.W.T. and in Canada.

6.1.3 ESTIMATES OF NET PRESENT VALUE

Net present value (NPV) is calculated in the traditional manner by subtracting the capital cost from the discounted net income stream as in equation [12]:

$$[12]\quad NPV = -\text{Capital Cost} + \Sigma \frac{(\text{Benefits} - \text{Costs})}{(1 + r)^n}$$

where r is the social discount rate and n is the number of years.

Before calculating NPV, the capital costs of the projects are inflated to 1985 dollars using the residential construction price index. Operating costs for 1985 are not available but the 1985 budgets indicate costs are expected to be less than 1984 actual costs (see Table VIII). To retain consistency in using actual costs, the 1984 figures are used to represent 1985 operating costs.

All projects are financed over a fifty year period and are assumed to have an expected life of fifty years. The income streams are discounted at real rates of 1%, 3%, 5% and 7%. These rates reflect the range of real rates over the past 10 year period, 1975 - 1985 (see Appendix 5 for calculations). As three of the projects are financed by loans at subsidized interest rates, the estimates of NPV are adjusted upward to reflect the opportunity cost of capital. The estimates of NPV range from -$13.345 to -$17.485 million, as indicated in Table IX.

Table IX Estimates of Net Present Value

1%	3%	5%	7%
-$17,484,684	-15,289,385	-14,070,992	-13,344,704

In order to justify the program on efficiency grounds, these figures suggest that the projects must generate non-tenant benefits of between $13.345 and $17.485 million over 50 years. At interest rates of 1% to 7%, this translates to annual benefits of between $446,082 and $966,955. As indicated in Chapter 3 (sub-section 3.2.1), the jury is still out on the existence of non-tenant benefits, but, in any case, it is not likely that that they would approach the figures necessary to justify the program on efficiency grounds. As expected, the justfication of the Public Housing Program must appeal to notions of equity.

6.2 EQUITY

The first equity hypothesis is tested by comparing the income distribution of the public housing tenants to that of the total population in Yellowknife. Table X summarizes the most recent information on household incomes. Unfortunately, the data are not directly comparable as the income data for the city is taken from the 1981 Census and represents 1980 income levels while the data for the public housing tenants represents 1985 income. To make the data more comparable, the income figures for the public housing tenants are

deflated by the Consumer Price Index to translate them to 1980 dollars.

The data indicate that households in the lowest quartile of the Yellowknife population have household incomes of under $20,000 per year. Eleven public housing tenants out of 130 (8.5%) have annual incomes in excess of this amount leading to a rejection of the hypothesis. However, it should be noted that the average household income of public housing tenants is $11,632, 35.1% of that of the total population. Also, all households living in public housing have incomes below the median city income of $31,325. These statistics suggest that the program is serving low income groups. The hypothesis would not be rejected if it were re-formulated to read:

> The majority of public housing tenants in Yellowknife have incomes in the lowest quartile of the population.
>
> or
>
> All public housing tenants in Yellowknife have incomes below the median city income.

Table X Household Income, Yellowknife, 1980

	All Households		Public Housing Tenants			
			1985 Dollars		1980 Dollars*	
Income	Number	Percent	Number	Percent	Number	Percent
Total Households	3,200	100.0	130	100.0	130	100.0
Under $5000	155	4.8	13	10.0	24	18.5
5,000 - 9,999	155	4.8	22	16.9	28	21.5
10,000 - 14,999	190	5.9	23	17.7	43	33.1
15,000 - 19,999	325	10.2	23	17.7	24	18.5
20,000 - 24,999	330	10.3	26	20.0	10	7.7
25,000 - 29,999	345	10.8	18	13.8	1	0.8
30,000 - 39,999	680	21.3	5	3.8	0	0
40,000 and over	1,020	31.9	0	0	0	0
Average Income	$33,133		$16,645		$11,632	
Median income	$31,325		$16,800		$11,740	

* 1985 incomes delfated to 1980 dollars

SOURCE:
1. Statistics Canada, 1981 Census.
2. Yellowknife Housing Authority, unpublished data.

The second and third equity hypotheses (vertical and horizontal equity) are tested by regressing the estimate of tenant welfare gain (EV) against household characteristics. The regression takes the form of equation [13]:

[13] EV = f(INCOME, AGE, SIZE, SEX).

INCOME, AGE and SIZE are quantitative variables representing household income, age of household head and size of household, respectively. SEX is a dummy variable for sex of household head (0 = male, 1 = female). Observations for all independent variables are obtained from the Yellowknife Housing Authority and are coded to preserve confidentiality.

The regression is run using Ordinary Least Squares and produces the following results (t-statistics are in parentheses and significance levels in square brackets):

EV =	2782.523	- 0.108 INCOME	+ 10.362 AGE	+ 36.669 SIZE	
	(3.188)	(-5.432)	(0.782)	(0.254)	
	[.0022]	[.0001]	[.4369]	[.7999]	
+ 602.510 SEX					
(1.844)					
[.0698]					

The model produces an R^2 of .3642 and an adjusted R^2 of .3245. The residual plots suggest the error term is homoskedastic, uncorrelated and normally distributed.

The regression results suggest the Public Housing Program may be achieving some vertical and horizontal equity. Vertical equity is supported by the negative sign on the INCOME coefficient, suggesting benefits decrease with income. For every $100 increase in annual household income, benefits decline by $10.80. However, the results do not

suggest households of different sizes are treated equitably. Ideally, one would expect benefits to increase with household size. The parameter estimate for SIZE is not significantly different from zero, suggesting benefits are unaffected by size.

The regression results support horizontal equity with respect to age. The parameter estimate for AGE is not significantly different from zero, suggesting "equals" are treated equally by the program. However, there appears to be some inequality with respect to sex. The parameter estimate of 602.510 for SEX is significant at the 7% level and suggests that female-led households receive an extra $602.51 of benefits per year compared to their male counterparts.

In conclusion, the data provide some evidence that the Public Housing Program promotes equity in Yellowknife. Hypothesis 2 (vertical equity) cannot be rejected by the data and Hypothesis 3 (horizontal equity) is partly supported, at least with respect to age of household head. While Hypothesis 1 is rejected by the data, a reasonable modification to the hypothesis cannot be rejected, suggesting the program is serving low income groups.

6.3 COMPARISON OF PUBLIC HOUSING PROGRAMS TO SHELTER ALLOWANCES

The results of this study confirm expectations that public housing is not an economically efficient method of improving the welfare of poor households. Justification of

the Public Housing Program in Yellowknife must appeal to other criteria such as commodity egalitarianism, irrational behavior of households, paternalism or the existence of externalities. Critics of supply-side housing programs argue that these latter criteria are not sufficient justification for the direct provision of subsidized housing. They advocate government intervention on the demand side of the market through the provision of income supplements or shelter allowances. The purpose of this final section is to compare the costs of the public housing projects in Yellowknife with a shelter allowance program.

A shelter allowance is a special type of income supplement designed to reduce the cost of housing for specific groups in society. The Canadian Council on Social Development defines a shelter allowance as follows:

> A direct cash transfer made regularly to families or individuals to enable them to afford adequate housing of their own choice from existing stock; the amount of the allowance is based on income and housing costs. . . (C.C.S.D., 1979, p. 2)

In general, there are three basic types of shelter allowance plans:

1. an **income gap plan** where subsidies are calculated based on the difference between actual rent and a fixed percentage of recipient's income (e.g., a 75/30 income gap plan would provide a subsidy based on 75% of the gap between the actual rent and 30% of income);
2. a **percent of rent plan** where subsidies are calculated based on rent only; and

3. an **income transfer plan** where subsidies are calculated based on income criteria only.

In Canada, four provinces presently have shelter allowance programs: British Columbia, Quebec and New Brunswick for senior citizens and Manitoba for families and senior citizens. All four programs are income gap plans. The program participants receive an allowance given by the following formula:

[14] $A = \theta(R - \delta Y)$

where A is the shelter allowance, R is actual rent, Y is household income and θ and δ are program parameters and are set between 0 and 1. The expression in parentheses represents the amount by which rent exceeds a given percentage of income and is referred to as the "affordability gap". The parameter θ indicates the percentage of the affordability gap that is closed by the shelter allowance program.

Shelter allowance programs are generally targetted to specific groups, that is, those with affordability problems. To limit the availability of the program, most plans impose one or all of the following constraints: maximum income for participating in the program, maximum subsidy amount available and maximum rent threshold. With these constraints, equation [14] can be re-written as follows:

[15] $A = \theta(R - \delta Y)$ providing:

1. $Y < Y^*$;
2. $A < A^*$;

3. $R < R^*$;

where Y^*, A^* and R^* are maximums imposed by the program.

In a report for the Canadian Homebuilders' Association, Steele (1985) estimates the costs of a national shelter allowance program using equation [14]. Her calculations are based on program parameters of 75% for θ, 30% for δ and the provincial median rents for R^*. There are no maximums imposed on household income or the amount of the allowance other than those implicit in the formula. This study uses the same methodology as Steele (1985) to estimate the cost of a shelter allowance program for Yellowknife.

In the 1981 Census, 445 households in Yellowknife reported annual rent payments in excess of 25% of their incomes (Statistics Canada, 1985). Table XI indicates the breakdown of these households by rent-to-income ratio and household income.

Table XI Households With Rent-to-Income Ratios in Excess of 25%, Yellowknife, 1980

Household Income	Ratio						
	25-29	30-34	35-39	40-44	45-49	50+	Total
< $5,000	0	0	0	5	5	70	80
$5,000 - 9,999	15	15	5	5	5	50	95
$10,000 - 14,999	10	15	5	20	15	15	80
$15,000 - 19,999	25	40	25	10	5	5	110
$20,000 - 24,999	30	10	10	0	0	5	55
$25,000 - 29,999	10	0	0	0	0	5	15
$30,000 - 34,999	5	0	0	0	0	0	5
$35,000 - 39,999	5	0	0	0	0	0	5
Total	100	80	45	40	30	150	445

SOURCE:
Statistics Canada, Private Households in Tenant-Occupied Non-Farm Dwellings Showing Gross Rent As A Percentage of 1980 Household Income By Income Categories For Yellowknife, N.W.T. , unpublished data, Nov. 1985.

This study assumes that household incomes and rents increased at the same rate over the period 1980 - 1985. If the income categories in Table XI are inflated by the increase in the C.P.I. over the five-year period, the distribution of households with rent-to-income ratios in excess of 25% remains constant.

The costs of a shelter allowance program are estimated assuming the program is an income gap plan. Following Steele (1985), the threshold rent (R*) is set at the median market rent (1985) of $8,112 per year. The results of the calculations are provided in Table XII.

Table XII Estimated Annual Cost of a Shelter Allowance Program
(all figures in 1985 dollars)

θ	THRESHOLD RENT	δ	ANNUAL COST
.75	$8,112	.25	$1,191,011
.75	$8,112	.30	$985,081
.50	$8,112	.25	$794,008
.50	$8,112	.30	$656,721

NOTE: θ is the percentage of the affordability gap closed by the program and δ is the rent-to-income ratio set by the program (see equation [14]).

SOURCE: Author's calculations

Estimated annual costs range from $656,721 for a 50/30 income gap plan to $1,191,011 for a 75/25 plan. These figures compare to estimated net annual costs of between $848,213 and $1,369,086 for the public housing projects

(assuming a 1% - 7% discount rate). These figures are not directly comparable as the shelter allowance program would provide benefits to an estimated 365 households compared to the 144 households receiving benefits from public housing. Recalculating the program costs on a per household basis makes the shelter allowance program more attractive. Annual costs are estimated between $1,799 and $3,263 per household compared to $5,890 to $9,508 for each household in public housing.

Based on these estimates, a shelter allowance program would appear to be more cost effective than a continued program of subsidized housing. However, shelter allowances do present some disadvantages to policymakers: (1) they may be ineffective in a housing market with a low vacancy rate as the amount of the allowance may be swallowed up by rent increases; (2) they cannot ensure households have access to decent quality housing; (3) they do not necessarily achieve horizontal equity as the amount of the allowance depends on the amount of rent paid by the household - two households with identical characteristics living in different quality housing, paying different rents would receive different benefits from the program; and (4) they cannot assist people with special housing needs.

In addition to these disadvantages, shelter allowance programs may also have an adverse impact on the work/leisure decision of the household. In a recent paper, Murray (1980) compares the work disincentives associated with cash grants

to those of commodity subsidy programs. A review of his model with application to public housing in Yellowknife is presented in Appendix 2. The interesting result from Murray's research is that, under certain conditions, in-kind subsidies such as public housing, can actually have a stimulative effect on work effort compared to equivalent cash grants. This result sugggests that in-kind transfers may be appropriate policy initiatives in some cases, despite their economic inefficiency.

Ultimately, the relative effectiveness of shelter allowances and public housing programs depends upon supply and demand elasticities. As Weicher (1979) points out, supply-side programs are most effective in markets where supply is inelastic and demand is inelastic with respect to income and elastic with respect to price. The provision of public housing in such a market will increase the total supply of housing as landlords and builders will not react by reducing the supply. However, if the supply of housing is elastic, the provision of public housing will displace private construction. Under these circumstances, a demand-side subsidy will be more effective in improving the housing conditions of low-income households.

The supply and demand elasticities for housing in Yellowknife lead to inconclusive results about the relative effectiveness of shelter allowances and public housing. As argued previously, the supply of rental housing appears to be relatively inelastic, as evidenced by the zero vacancy

rate and long waiting lists for existing apartments. Income and price elasticities of the total population in Yellowknife are not known, but estimates obtained from the population of public housing tenants indicate the demand for housing is inelastic with respect to both current income and price. The estimates of income elasticity cover a wide range from .00007 to .64 and tend to increase with income, as expected. Estimates of price elasticity span a similar range from -.00005 to -.56 with an upward drift in absolute value as income increases. The demand elasticities do not provide decisive evidence on the relative effectiveness of demand-side versus supply-side subsidies. The inelastic supply of housing tends to favour supply-side programs but without further research, no definite conclusions can be drawn.

CHAPTER 7 IMPLICATIONS

7. IMPLICATIONS

Chapter 1 identified two objectives for this study:

1. to determine if the direct provision of public housing in Yellowknife is an economically efficient method of meeting the housing needs of poor households; and

2. to determine if the Public Housing Program in Yellowknife promotes horizontal and vertical equity.

The implicit questions posed by these objectives were answered in Chapter 6. As expected, the Public Housing Program is not economically efficient and has a negative net present value ranging from -$13.345 million to -$17.485 depending on the social discount rate. The question underlying the second objective is more difficult to answer, although the analysis suggests the program achieves a small degree of vertical equity and some horizontal equity. In any case, the message delivered by this analysis is clear: the justification of the Public Housing Program in Yellowknife must appeal to notions other than economic efficiency.

This chapter analyses the implications of this message for policy-makers. The analysis begins in Section 7.1 with a statement of objectives of the two agents involved in formulating housing policy in the N.W.T. - the N.W.T. Housing Corporation and C.M.H.C. Section 7.2 analyses the results of this study from the separate perspectives of these two agencies. Section 7.3 concludes the chapter and the thesis with a summary of the major findings of the study and some suggestions for further research.

7.1 POLICY OBJECTIVES

The objectives of the federal housing agency, C.M.H.C., are taken directly from the preamble to the National Housing Act:

> to promote the construction of new houses, the repair and modernization of existing houses, and the improvement of housing and living conditions. (N.H.A. 1953-54, p. 1)

Within this broad mandate, C.M.H.C. has defined four specific sub-objectives:

1. Social Housing - to assist those whose income is insufficient to gain access to adequate housing by supporting in conjunction with provinces, municipalities and their agencies low and moderate income public housing and the establishment of non-profit and co-operative housing corporations.
2. Rehabilitation and Conservation - to promote and support the rehabilitation of substandard housing and the improvement of existing housing.
3. Market Housing - to promote the effective operation of mortgage and housing markets.
4. Community Services - to assist in the achievement and maintenance of sound community environment by supporting the provision of basic community service. (Consultation Paper, 1985, pp. 13-15).

The overall objective of the N.W.T. Housing Corporation, as stated in the 1983/84 Annual Report, is:

> to develop, co-ordinate and direct social housing programs to ensure that an adequate standard of housing is available to residents in need, in the

Northwest Territories. (Annual Report, 1983/84, p.3)

The next section evaluates the Public Housing Program in Yellowknife in terms of its success in promoting the stated objectives of the two housing agencies.

7.2 EVALUATION OF THE PUBLIC HOUSING PROGRAM IN YELLOWKNIFE

The cost-benefit analysis in this study adopts the perspective of the Canadian public. As the federal agency responsible for housing, C.M.H.C.'s policy objectives should reflect the interests of the public and, therefore, the results of this study will directly apply. The N.W.T. Housing Corporation, on the other hand, has a mandate to serve the public interest of the N.W.T. only. The criteria for evaluating housing policy from the territorial perspective will not differ - issues of efficiency and equity are still relevant. However, the measurement of costs and benefits, particularly non-tenant benefits will differ and could lead to different assessments of the efficiency of the program.

From C.M.H.C.'s perspective, the Public Housing Program in Yellowknife is promoting one of the Corporation's stated objectives. It is "assist[ing] those whose income is insufficient to gain access to adequate housing." As reported in the last chapter, the program is serving low income households. However, as indicated by the negative net present value, it is not doing so efficiently. From the federal perspective, it is doubtful that the program is

generating non-tenant benefits to the Canadian public of the order required to justify the program on the grounds of economic efficiency. Furthermore, the N.W.T., in general, and Yellowknife, in particular, is so remote from southern Canada that it is unlikely that the median voter would support the program on the grounds of a merit good argument, commodity egalitarianism or paternalism. However, before concluding that the Public Housing Program in Yellowknife cannot be supported from a federal perspective, some consideration should be given to Murray's research on work disincentives (Murray, 1980). In analysing subsidized housing programs and income maintenance experiments in the United States and comparing the impact of the two programs on the work effort of the household, Murray finds that subsidized housing programs can actually have a stimulative effect on work effort compared to unrestricted equivalent cash grants. His analysis suggests the Public Housing Program in the U.S. reduces work effort by approximately 4% compared to estimates of approximately 13% for the income maintenance experiments. Applying Murray's model to the Yellowknife data suggests the Public Housing Program in Yellowknife reduces work effort by between 2% and 8% per week (see Appendix 2 for complete results). Unfortunately, there are no comparable figures for the decline in work effort from income maintenance or shelter allowance programs in the N.W.T., but if the figure of 13% obtained in the U.S. is applicable, there seems to be some support for providing

low-income households with subsidized housing rather than income supplements.

In order to examine the program from the territorial perspective, two adjustments are made to the analysis conducted in Chapter 6. First, the NPV is revised to include only the N.W.T. Housing Corporation's share of the capital and operating costs. Secondly, arguments are presented for supporting the program on the following grounds: positive externalities from good housing, housing as a merit good and commodity egalitarianism.

Revised Net Present Value

Recalculating the capital and operating costs to reflect the N.W.T. share of the investments yields revised net present values ranging between -$4.420 million and -$4.850 million as indicated in Table XIII.

Table XIII Estimates of Net Present Value, N.W.T. Share

1%	3%	5%	7%
-$4,849,514	-4,621,986	-4,495,708	-4,420,433

In order to justify the program on efficiency grounds, the projects must generate non-tenant benefits of between $4.420 and $4.850 million over 50 years. At discount rates of 1% to 7%, this translates to annual benefits of between $123,724 and $320,304 or approximately $12 to $31 per capita of the Yellowknife population. The remainder of this section

examines the possibility that non-tenant benefits of this magnitude may be attributable to the projects.

Positive Externalities

In Chapter 3, two possible externalities associated with subsidized housing projects were identified: (1) a net increase in the value of surrounding properties and (2) a reduction in the "social" costs of sub-standard housing. As no empirical work has been undertaken to determine the impact of public housing projects on house prices in Yellowknife, no definite conclusions can be reached at this time. Similarly, there is no empirical evidence to test the hypothesis that the public housing projects have reduced the "social" costs of sub-standard housing.

Housing as a Merit Good/Commodity Egalitarianism

In Chapter 3, Musgrave's notion of "merit goods" and Tobin's theory of commodity egalitarianism were introduced (see Section 3.2.1). To reiterate, a merit good is a good that society wishes to encourage its members to consume. The concept of merit goods is related to Tobin's theory that some goods, such as the necessities of life and health, should be distributed equally. In this sense, a basic minimum standard of housing for all members of society can be considered either as a merit good or as a good qualifying for "commodity egalitarianism".

While it may be difficult to justify the Public Housing Program in Yellowknife on the grounds of commodity egalitarianism or merit good arguments from the perspective of the Canadian public, it may be feasible to do so from the perspective of the residents of the N.W.T., or at least from the perspective of the residents of Yellowknife. Yellowknife is a small community of under 11,000 people. The welfare of its poorer citizens is not as easy to mask as it may be in large cities in southern Canada. The median voter in Yellowknife is unable to avoid the externalities of poor quality housing by living in remote, exclusive subdivisions of the city. Therefore, it seems likely that the welfare of poorer households will enter the utility schedule of other residents of the city. By improving the housing conditions of the poor, through programs such as the Public Housing Program, society in Yellowknife may move up to a higher level of utility. The underlying question that must be addressed by policy-makers in the N.W.T. is whether this increase in welfare is worth the $123,724 to $320,304 necessary to justify the program on efficiency grounds.

7.3 CONCLUSIONS

This study has evaluated the Public Housing Program in Yellowknife according to the two criteria of economic efficiency and equity. The program has been analysed from the perspective of the Canadian public, as reflected in C.M.H.C.'s policy objectives, and from the perspective of

the residents of the N.W.T., as reflected in the objectives of the N.W.T. Housing Corporation. In both cases, the NPV, calculated from measurable costs and benefits, is negative, suggesting that the program is not economically efficient. Non-tenant benefits of between $446,082 and $966,955 per year are required to justify the program from the national perspective. Arguments presented here suggest that non-tenant benefits to the Canadian public of this magnitude are not likely, leading to the conclusion that the program cannot be justified on grounds of efficiency. From the territorial perspective, required non-tenant benefits to support economic efficiency are much lower at $123,724 to $320,304 or $12 to $31 per capita of the Yellowknife population, suggesting it may be possible to appeal to notions of merit goods, positive externalities or commodity egalitarianism to justify the program.

The analysis of Chapter 6 provides some evidence that the Public Housing Program is promoting equity in Yellowknife. The regression results support the hypothesis of vertical equity with respect to income. The results from testing the hypothesis of horizontal equity are slightly ambiguous. While there is some support for horizontal equity with respect to age of household head, the analysis suggests that male- and female-led households are not treated equally. The regression results indicate that female-led households receive much larger annual benefits from the program than their male counterparts.

A comparison of the results of this study with other studies in the literature suggest the Public Housing Program in Yellowknife is performing at approximately the same level as similar programs in the United States and Europe. The estimates of efficiency reported in the literature range from a low of 25% reported by Sumka and Stegman (1978) in their study of public housing in non-metropolitan cities in the U.S. to a high of 85% reported by Walden (1981) in his study of senior citizen projects in Rochester, New York. Estimates of efficiency for the Yellowknife projects fall within this range and vary between 29% and 47% depending on the discount rate. The equity results reported in the literature vary, although most studies find the subsidized housing program under study achieves vertical but not horizontal equity.

A comparison of the Public Housing Program in Yellowknife to a shelter allowance program suggests that the latter would be much more efficient. Estimated annual costs of a shelter allowance program range from $1,799 for a 50/30 plan to $3,263 for a 75/25 plan. All figures represent annual costs per recipient. In comparison, annual costs of the Public Housing Program, after deducting rent revenues, range from $5,890 to $9,508 per household. However, as pointed out in Chapter 6, shelter allowance programs present some disadvantages to policy-makers as they cannot ensure the housing conditions of the program recipients are improved. Also, as indicated in Murray's research, public

housing programs may be preferred to cash grants as they have less of an impact on the work effort decisons of the household (Murray, 1980).

In conclusion, the results of this study are consistent with the recent literature. From an efficiency viewpoint, it is very difficult to justify in-kind housing programs such as public housing from the national perspective. Substantial non-tenant benefits are required to produce a project with a non-negative net present value. However, it may be possible to justify the program from the perspective of the residents of Yellowknife. Much lower non-tenant benefits of $12 to $31 per capita per year are required to produce a positive net present value.

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APPENDICES

APPENDIX 1

HEDONIC REGRESSION RESULTS

1. Market Rent Equivalent Model

$$RENT = \beta_0 + \beta_1 STOR + \beta_2 YEAR + \beta_3 BED + \beta_4 COND + \beta_5 TYPE + \beta_6 FURN + \beta_7 DIST2 + \beta_8 DIST3 + \beta_9 UTIL + u$$

2. Verification Model

$$YHAT = a_0 + a_1 RENT + u$$

Data Set 1 = 462 observations

Data Set 2 = 464 observations

Table XIV

Regression Results from Linear Model Using Data Set 1

Variable	Parameter Estimate	t-Statistic	Significance Level
INTERCEPT	5866.174	77.504	.0001
STOR	-227.065	-18.508	.0001
AGE	168.618	25.384	.0001
BED	1171.447	38.932	.0001
COND	-601.083	-10.167	.0001
TYPE	935.039	7.819	.0001
FURN	309.028	4.439	.0001
DIST2	296.786	6.542	.0001
DIST3	-436.318	-3.769	.0002
UTIL	-375.666	-9.242	.0001

R^2 = .9227

R^2 (adjusted) = .9212

F statistic = 599.437

Table XV

Hedonic Regression Correlation Matrix

	INT	STOR	YEAR	BED	COND	TYPE	FURN	DIST2	DIST3	UTIL
INT	1.0	.06	-.21	-.52	-.64	.21	-.53	.08	.31	-.26
STOR		1.0	-.35	.52	-.01	-.02	.10	.20	.00	-.24
YEAR			1.0	-.21	-.27	.40	.24	-.04	.02	-.14
BED				1.0	.24	-.38	.20	-.04	-.38	-.05
COND					1.0	-.31	.30	-.27	-.20	.01
TYPE						1.0	.07	.20	.26	-.23
FURN							1.0	.06	-.05	.00
DIST2								1.0	.20	-.01
DIST3									1.0	-.15
UTIL										1.0

Table XVI

Hedonic Regression Collinearity Diagnostics

Number	Eigenvalue	Condition Index
1	4.848	1.000
2	1.326	1.912
3	1.043	2.156
4	1.003	2.198
5	0.839	2.404
6	0.427	3.370
7	0.234	4.550
8	0.135	5.986
9	0.106	6.753
10	0.037	11.427

NOTE:

Eigenvalues reported here are for the matrix (X'X). The condition index is the square root of the ratio of the largest eigenvalue to each individual eigenvalue. A condition index of 30 or more indicates moderate to strong collinearity.

FIGURE 7 PLOT OF RESIDUALS AGAINST PREDICTED VALUES

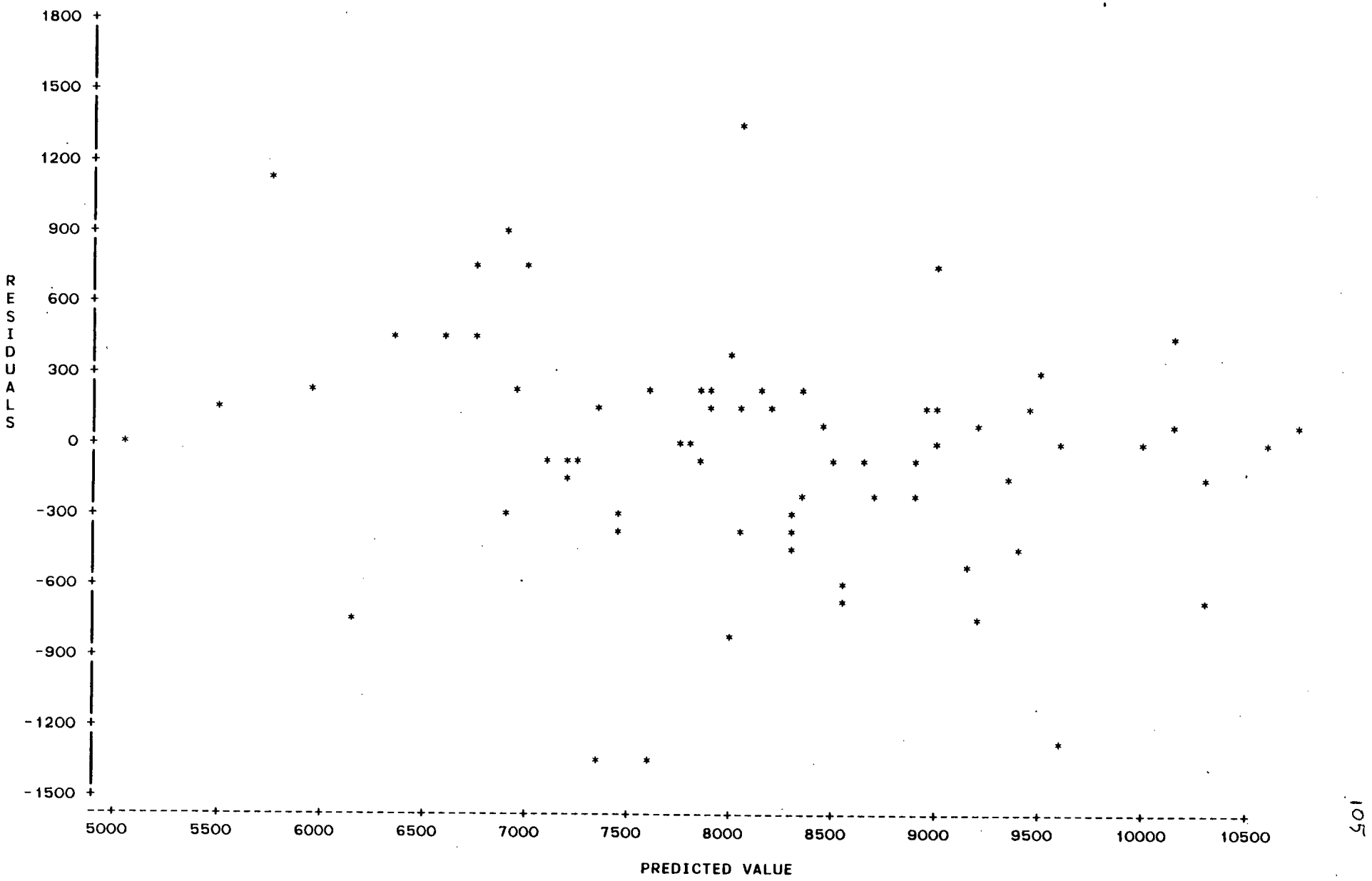


FIGURE 8 NORMAL PLOT OF RESIDUALS

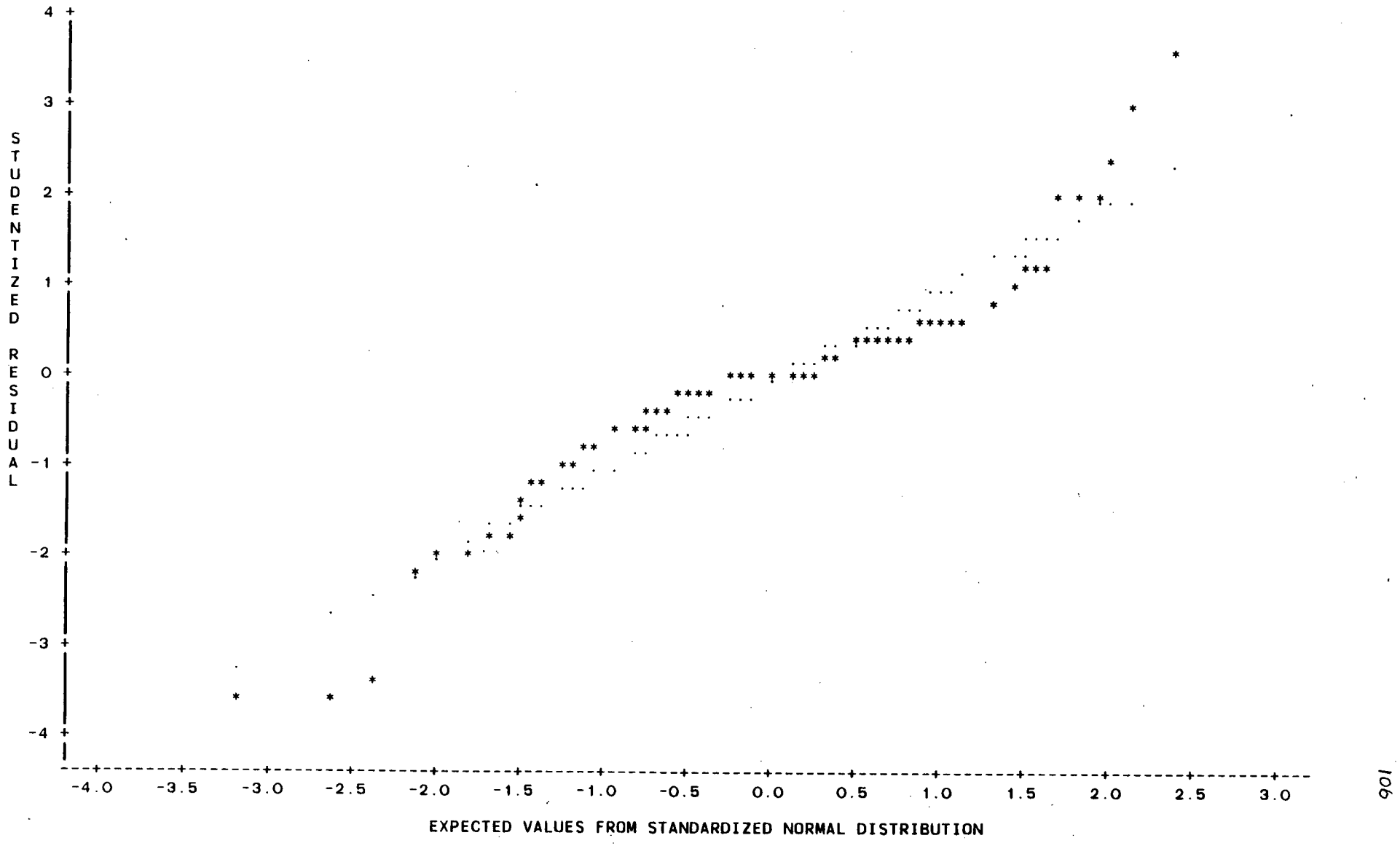
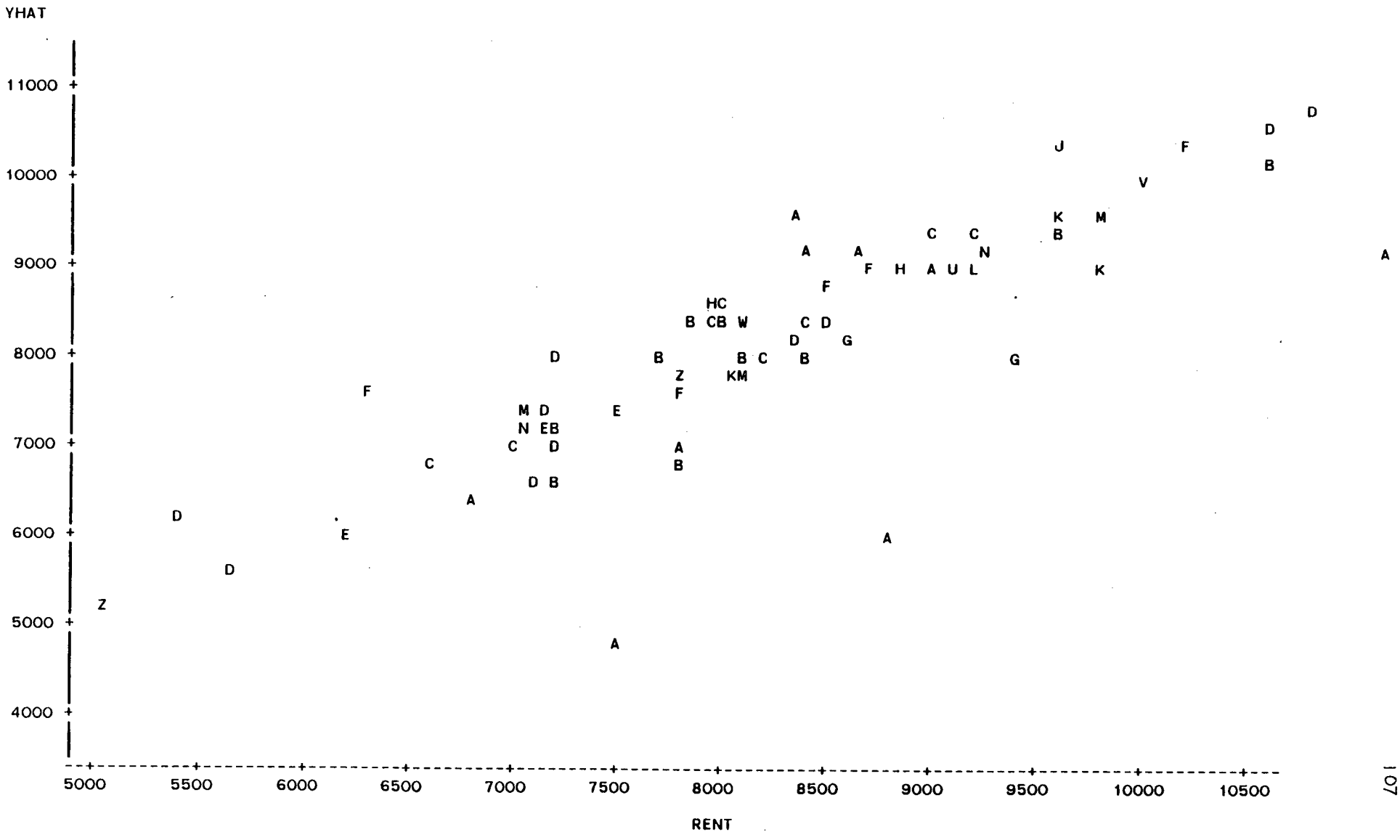


FIGURE 9 PLOT OF YHAT AGAINST RENT



LEGEND: A = 1 OBSERVATION, B = 2 OBSERVATIONS, ETC.

APPENDIX 2

A MODEL FOR ESTIMATING WORK DISINCENTIVES ASSOCIATED WITH IN-KIND SUBSIDIES WITH SPECIFIC APPLICATION TO PUBLIC HOUSING IN YELLOWKNIFE, N.W.T.

Government policy to redistribute income can take one of three forms: direct cash transfers (i.e., income supplements), price subsidies (i.e. shelter allowances) or in-kind transfers (e.g., public housing programs). Each of these alternatives has a different impact on the household's budget set and, consequently, a different effect on household behavior. From an efficiency viewpoint, an optimal policy is one that minimizes the distortion in household behavior.

Traditionally, in Canada, the housing needs of the poor have been addressed through in-kind transfers from programs such as Public Housing, Co-operative Housing and Non-Profit Housing. In all these programs, a specific quantity of housing is provided to the household at a rent based on income. As this rent level is less than the market rent, in-kind subsidies indirectly increase household income. If leisure is a normal good, then any increase in income will induce a utility-maximizing household to consume more leisure. In other words, in-kind subsidies will reduce work effort. An interesting question for public policy is whether the work disincentive associated with an in-kind transfer is greater than or less than that of other income redistribution mechanisms.

This appendix describes the traditional economic model for assessing work disincentives and also presents a new approach to the problem developed by Michael Murray (1980). The model is applied to the Public Housing Program in Yellowknife to determine the extent of the work disincentive.

1. THE TRADITIONAL INCOME-LEISURE MODEL

The traditional income-leisure model treats the work effort decision of a household as a consumer maximization problem. The household derives utility from consumption of leisure and non-leisure goods and chooses its bundle of goods to maximize utility subject to a budget constraint. The household utility function takes the form $U = u(L, x_1, \ldots x_n)$ where L represents leisure and x_i represents consumption of the i^{th} non-leisure good. The vector of non-leisure goods, $(x_1, \ldots x_n)$ is replaced with a composite commodity, Y, which represents total income (earned and unearned). It is assumed that the household has a fixed number of hours, T, to allocate between work and leisure. This implies the household faces the following budget constraint:

$$Y = w(T - L) + y$$

where w is the wage rate and y is unearned income.

Formally, the household's optimization problem can be stated as:

$$\text{Max } u(L, Y) \text{ subject to } Y = w(T - L) + y.$$

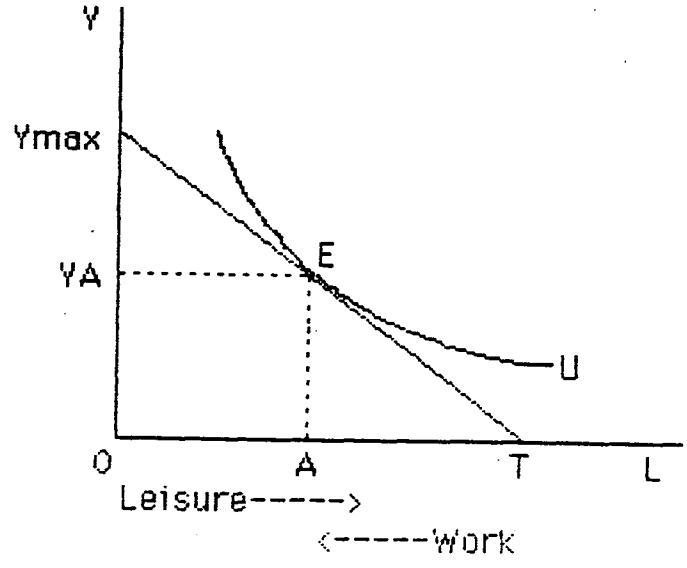
Solving this maximization problem yields the following first order conditions:

$$L: \partial U/\partial L + \lambda w = 0$$

$$Y: \partial U/\partial Y + \lambda = 0$$

Rearranging the first order conditions gives the optimization condition that the marginal rate of substitution between leisure and non-leisure goods equals the wage rate.

Diagramatically, the household optimization problem can be represented as in Figure 10. Income (Y) is on the vertical axis and work/leisure on the horizontal. The horizontal distance 0T measures the total hours available. Work effort is measured from point T and leisure is measured from the origin 0. Y_{max} represents the maximum income available if the household devotes all its time to earning



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income. If unearned income is assumed to be zero, then the budget constraint facing the household is $Y_{max}T$. If unearned income is positive, the budget constraint shifts out by a vertical distance equal to the amount of unearned income.

Given a well-behaved utility function (strictly quasi-concave, twice continuously differentiable), the household maximizes utility at the tangency point of indifference curve U and the budget constraint (point E in Figure 10). At this point, the household works TA hours and receives earned income Y_A.

The assumptions underlying this model can be summarized as follows:

1. the household may work as many hours as it desires, up to the maximum of T;
2. the wage rate per hour is the same irrespective of the number of hours worked (a change in the wage rate due to overtime bonuses etc. would not change the analysis, it would only introduce a "kink" in the budget constraint);
3. the household utility function is strictly quasi-concave and twice continuously differentiable; and
4. the relative prices of non-leisure goods are constant.

Assumptions 1, 2 and 3 are relatively weak. Assumption 4 is a stronger restriction and is necessary if non-leisure goods are to be treated as a composite commodity. By the Hicks Aggregation Theorem, goods may be represented by a composite commodity if the prices of all goods in the composite move together. The assumption of constant relative prices ensures

this condition is satisfied. While this assumption may be appropriate for modelling income supplement programs, it is not appropriate when commodity subsidies are involved because the price ratios within the composite are altered. The usual method for dealing with commodity subsidies is to add a third dimension to the model and express the utility function as follows:

$$[1] \quad U = u(L, H, Z)$$

where L is leisure, as before, H is the subsidized good and Z is a composite of unsubsidized goods. As Murray (1980) points out, this method has some practical disadvantages as it requires collection of work effort data for each subsidy program in order to estimate the parameters of the utility function. To avoid the expense of data collection, Murray designs a new model that allows the work disincentive effects of commodity subsidy programs to be inferred from data collected for income supplement programs. His motivation in developing this model stems from the availability of a rich data base on work effort effects of income maintenance programs in the U.S. His model is described in Section 2.

2. MURRAY'S MODEL

The essence of Murray's approach is to re-define the composite commodity, Y, in the utility schedule. Instead of treating Y as money income, Murray treats it as the Hicksian equivalent income. The relationship between money income and

Hicksian income can be expressed as follows. Hicksian income, for a given bundle (H, Z), is defined as the money income which would, at market prices, enable the household to achieve the same utility level as with (H, Z). In the special case of constant commodity prices, Hicksian income is equal to money income. However, if price ratios change, as they do when a housing subsidy is introduced, the two measures will differ. A housing subsidy allows the household to move up to a higher level of utility. The Hicksian income is the amount of income that the household would require to enable it to achieve this new level of utility at the original price ratios.

Murray redefines the household utility function for leisure and non-leisure goods as follows:

$$[2] \quad U = u(L, Y')$$

This representation assumes the utility function is weakly separable with respect to leisure and non-leisure goods. This implies that the marginal rates of substitution among commodities are independent of the amount of leisure consumed. As Murray points out, this assumption is not unreasonable for analysing housing subsidies as the vector of non-leisure commodities would include housing and a composite of other goods. It would be unreasonable for analysing programs such as vocational training as consumption of this commodity would not be independent of the amount of leisure consumed. For our purposes, however, the assumption of weak separability seems plausible.

For ease of presentation, it is also assumed that unearned income, y, is zero. The results of the analysis do not change if y is positive, but the assumption of zero unearned income simplifies the notation in the maximization problem that follows.

In the absence of a housing subsidy, the household maximizes utility subject to the constraint that expenditures cannot exceed money income, Y. In this case, Y' and Y are identical and the model collapses to the traditional income-leisure model. However, in the presence of a housing subsidy, the household budget is effectively constrained by the Hicksian income, Y', instead of money income. As Y' is some function of Y, the household maximization problem can be expressed as:

$$\text{Max } u(L,Y') \text{ subject to } Y' = f(Y)$$

where $f(Y) = f(w \cdot \kappa)$, w = wage rate and κ = hours of labour (equivalent to T - L). The Lagrangian becomes:

$$L(L,Y',\lambda) = U(L,Y') + \lambda[Y' - f(w \cdot \kappa)]$$

Solving the maximization problem yields the following first order conditions:

$$L: \quad \partial u(L,Y')/\partial L - \lambda \partial f(w \cdot \kappa)/\partial L = 0$$

$$= \partial u(L,Y')/\partial L + \lambda w \partial Y'/\partial Y = 0$$

$$Y': \quad \partial u(L,Y')/\partial Y' + \lambda = 0$$

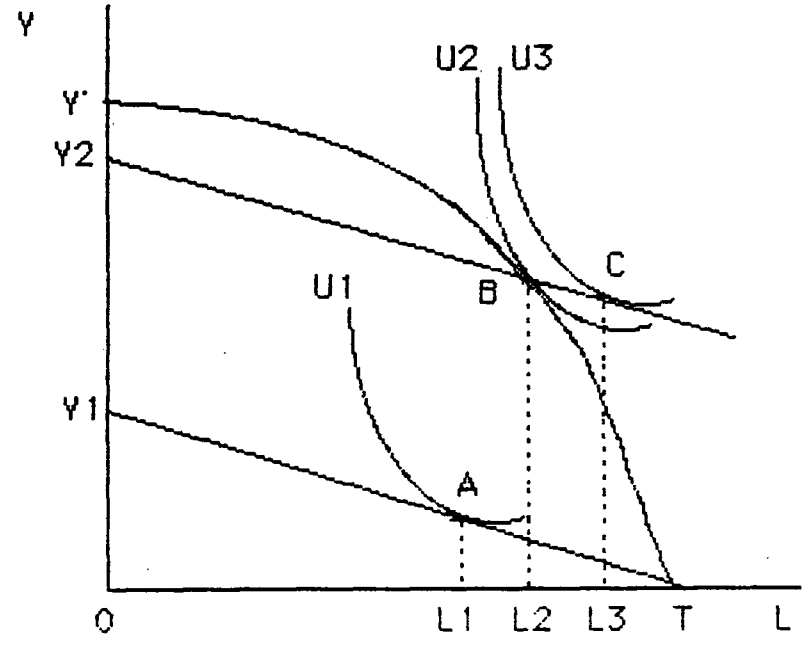
$$\lambda: \quad Y' - f(w \cdot \kappa) = 0$$

Rearranging the first order conditions gives the optimization condition:

$$[3] \qquad \frac{\partial u/\partial L}{\partial u/\partial Y'} = w \frac{\partial Y'}{\partial Y}$$

In words, equation [3] says that the marginal rate of substitution between leisure and Hicksian income must equal the effective wage rate. In the absence of a housing subsidy, $\partial Y'/\partial Y = 1$ and equation [3] reduces to the traditional first order condition that the marginal rate of substitution between leisure and income equals the wage rate.

Murray demonstrates that, under certain conditions, in-kind housing subsidies will result in $\partial Y'/\partial Y$ being greater than 1, making Y' a concave function of work effort. This is illustrated in Figure 11. In the absence of a subsidy, the household maximizes at point A in Figure 11. With an in-kind housing subsidy, requiring consumption of a fixed minimum quantity of housing, the household moves up to point B, reducing work effort from



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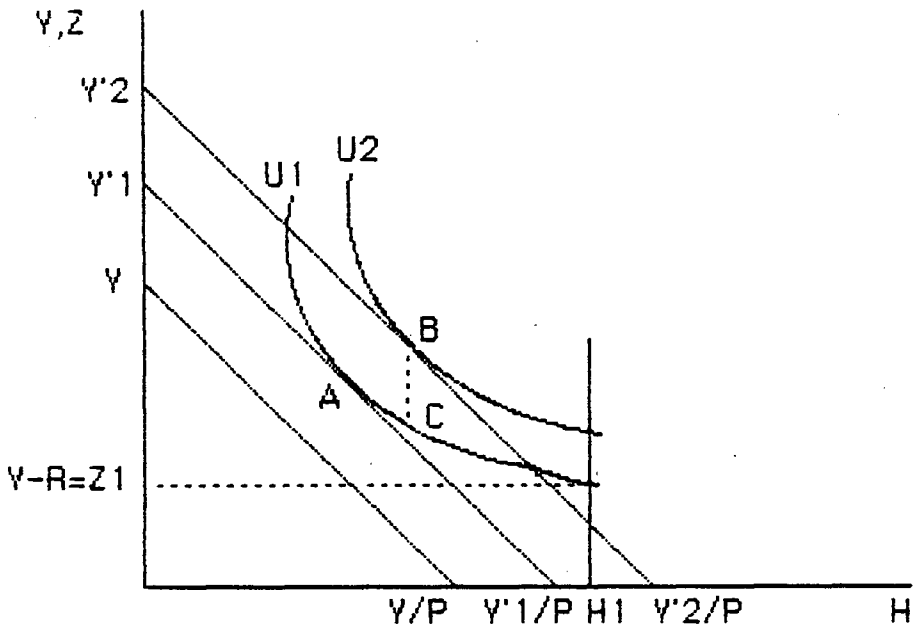
$(T-L_1)$ to $(T-L_2)$ hours. With an "equivalent" cash grant, equal to $Y_2 - Y_1$, the household moves up to point C, further reducing its work hours from $(T-L_2)$ to $(T-L_3)$. The interesting result emerging from this analysis is that in-kind transfers can actually stimulate work effort compared to equivalent cash grants.

The necessary condition to obtain this result is that Y' be a concave function of work effort, that is, $\partial Y'/\partial Y$ be greater than one. Murray summarizes the conditions for concavity of Y' in the following theorem.

> *THEOREM.* If a single subsidized good is normal and if the subsidy imposes or induces more consumption of the good than would an equivalent cash grant then $\partial Y'/\partial Y > 1$. (Murray 1980, p.74)

Two versions of the proof of this theorem are presented here: a simple geometric proof and a more elaborate mathematical proof. Geometrically, the problem can be illustrated as in Figure 12. Housing is represented on the horizontal axis and a composite good, Z, on the vertical axis. The price of Z is normalized to 1, allowing Y and Y' to be read off the vertical axis. The household is constrained to consume H_1 units of housing at a price R leaving a residual income of Y-R for the purchase of Z_1 units of the composite good. The household is on indifference curve U_1 with equivalent income Y'_1. If household income increases by ΔY, Murray argues that the full amount of the increase will be spent on increased consumption of Z as the household cannot change its consumption of housing. Therefore, the household will move



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up to indifference curve U_2 with equivalent income Y'_2. In reality, however, while the household cannot change the quantity of housing consumed under the program, it will be assessed a higher rent as a result of the increase in income. In general, public housing rents are based on 25% of income. Therefore, the increase in income will be spent as follows: .25ΔY on housing and .75ΔY on other goods. Murray seems to overlook this point.

Points A and B in Figure 12 represent the commodity bundles that would be purchased if cash grants of (Y'_1-Y) and (Y'_2-Y) were given instead of a fixed quantity of public housing. If a good is normal, then measuring it along the horizontal axis, as in Figure 12, will result in a decrease in the vertical distance between any two indifference curves as the quantity of that good increases (Murray, 1980). This

is due to the fact that, for a normal good, H, the marginal utility of the other good, Z, increases as Z decreases (see Section 6 for proof). Therefore, as H is held fixed and Z increases, the marginal utility of Z will decrease and the marginal rate of substitution between H and Z will increase, increasing the vertical distances between any two indifference curves.[4]

The vertical distance between point B and Y'_1 must be greater than the distance between B and a point C on indifference curve U_1. Since the subsidy is assumed to impose more of H than would be taken with a cash grant (a condition of the theorem), H_1 lies to the right of either A or B. Therefore, the vertical distance between U_1 and U_2 at H_1 (i.e., ΔY) must be less than the distance $Y'_2-Y'_1$ (i.e., $\Delta Y'$). In other words, $\partial Y'/\partial Y > 1$. However, if we acknowledge that only $.75\Delta Y$ is available for increased consumption of Z (since $.25\Delta Y$ is spent on increased rent), then the relationship of $\partial Y'/\partial Y$ to 1 appears ambiguous. All we can say for certain is $\partial Y'/\partial(.75\Delta Y) > 1$, in which case, $\partial Y'/\partial Y$ may be greater or less than 1. This issue seems to warrant further study.

The mathematical proof of the theorem proceeds as follows:

(1) Define B as the equivalent variation measure of welfare gain associated with the program:

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[4] This result seems to run counter to conventional economic wisdom and is presently being pursued.

$$B = e(P_m, g(H, Z)) - Y$$

where Y is money income as before and $e(\cdot)$ is the expenditure function.

(2) Define R as the project rent charged for the subsidized housing unit (R may vary with income).

(3) If a household participates in the program, expenditures on Z can be calculated as:

$$Z_S = \frac{Y - R}{P_Z}$$

where P_Z is the market price of one unit of Z and Z_S is the amount of Z consumed with the program.

(4) Differentiating B with respect to income gives

$$\partial B/\partial Y = (\partial e(\cdot)/\partial g) \cdot (\partial g/\partial Z) \cdot (\partial Z_S/\partial Y) - 1$$

where $\partial e(\cdot)/\partial g$ is the rate of change of income that would allow a non-participating household to attain the level of utility achieved with the program (at constant prices).

(5) Differentiating Zs with respect to Y gives

$$\partial Z_S/\partial Y = (1/P_Z)[1 - (\partial R/\partial Y)].$$

(6) Substituting for $\partial Z_S/\partial Y$ in (4) gives

$$\partial B/\partial Y = (\partial e(\cdot)/\partial g) \cdot [(\partial g/\partial Z)(1/P_Z)][1-(\partial R/\partial Y)] - 1$$

where the second term in parenthesis on the right hand side

is the marginal utility of income (MU_Y) evaluated at (H_s, Z_s).

(7) The partial derivative of $e(P_m, g(H, Z))$ with respect to $g(H, Z)$ is positive and, therefore, the sign of $\partial B/\partial Y$ will depend upon the sign of $\{[(\partial g/\partial Z)(1/P_z)][1 - (\partial R/\partial Y)] - 1\}$. In the absence of income conditioning (i.e., if $\partial R/\partial Y = 0$), the sign of $\partial B/\partial Y$ will depend only upon MU_Y over the range (H, Z) to (H_s, Z_s). If MU_Y rises, (i.e., if $\partial MU_Y/\partial Z > 1$) $\partial B/\partial Y$ will be positive.

(8) MU_Y will rise over the relevant range if the marginal utility of Z rises over the range. That is, $(\partial g/\partial Z \cdot 1/P_z) > 1$ if and only if $\partial g/\partial Z > 1$ as $P_z > 0$ by assumption.

(9) The marginal utility of Z will increase from (H, Z) to (H_s, Z_s) as long as H is a normal good and $Z > Z_s$ (see Section 6 for proof).

(10) From (1), $B = Y' - Y$, so

$$\partial B/\partial Y = (\partial Y'/\partial Y) - 1$$

if $\partial B/\partial Y > 0$, then $\partial Y'/\partial Y > 1$

Therefore, if housing is a normal good, $\partial Y'/\partial Y > 1$, q.e.d.

Again, while initially acknowledging the relationship between rent and income in subsidized housing, Murray seems

to ignore this relationship in his formal proof. In step (7) above, if $\partial R/\partial Y \neq 0$, then the sign of $\partial B/\partial Y$ appears to be ambiguous. That is, if $\partial R/\partial Y = .25$, then

$$\partial B/\partial Y = (\partial e(\cdot)/\partial g) \cdot [(\partial g/\partial Z) \cdot (1/P_Z)] (1 - .25) - 1.$$

Since $\partial e(\cdot)/\partial g > 0$, the sign of $\partial B/\partial Y$ depends on the magnitude of MU_Y. If $.75\ MU_Y > 1$, then $\partial B/\partial Y > 0$ and vice versa.

However, Murray's results do confirm that, in the absence of income conditioning, $\partial Y'/\partial Y > 1$. Intuitively, he explains this result as follows:

> Since the subsidy imposes "too much" of the good and the good is normal, increases in income reduce the degree to which the constraint is binding (if income rises enough, the constraint might no longer bind at all) and the discounting is reduced. Thus increases in money income are themselves worth dollars, but they also increase the value of the previously received subsidy and drive real income up by still more. (Murray, 1980, pp. 75-76)

In other words, if a subsidized program imposes too much housing, an increase in money income will increase the benefits of the program by reducing the extent of the constraint. This increase in marginal benefits implies an increase in the marginal utility of money.

Supply-side housing programs such as public housing are frequently defended on the grounds that housing is a "merit good". As such, society prefers to provide in-kind subsidies to ensure poor households consume a basic minimum level of housing. The assumption is that a household would not consume this level of housing with an equivalent cash transfer. That is, supply-side housing programs are designed

to impose a higher level of housing consumption than households would select with cash grants. This assumption, along with the assumption that housing is a normal good, suggests that public housing programs meet the conditions necessary for Murray's theorem to hold. As a consequence, public housing may not reduce work effort as much as a program of guaranteed annual incomes.

As an aside, it should be noted that Murray's theorem and subsequent proofs refer to marginal (i.e., small) changes in income. The results do not automatically extend to cases where income is increased by more than a marginal amount. As income maintenance programs are generally designed to effect discrete increases in incomes, some further study of Murray's model may be warranted.

3. EMPIRICAL RESULTS FROM MURRAY'S MODEL

Murray developed his model in order to infer work incentive effects of in-kind transfer programs from data collected for income maintenance programs. In the U.S., the Institute for Research on Poverty collected data on work incentive effects for a series of income maintenance experiments. The evidence suggests that cash transfer programs would not induce major reductions in work effort. Murray was interested in comparing these results to the work effort effects of in-kind programs.

Murray identifies five basic steps for estimating the work incentive effects of a program for which no work effort

data is available:

1. specify and estimate the parameters of the household utility function u(H,Z)
2. specify and estimate the parameters of the household utility function u(L,Y')
3. estimate L_m, the amount of leisure consumed without the program
4. estimate L_s, the amount of leisure consumed with the program
5. estimate the decrease in work effort as (L_s - L_m).

As before, Murray assumes that the utility function u(L,Y') is weakly separable with respect to leisure and non-leisure goods. He also assumes that the population receiving income maintenance is not qualitatively different from the population receiving housing subsidies. This assumption allows the parameter estimates from the income maintenance experiments to be used in calculating changes to work effort in the subsidy program. With these assumptions, Murray estimates the work incentive effects of public housing in the U.S.

Step 1 Estimation of Utility Function u(H,Z)

Murray specifies a Cobb-Douglas utility function of the form

$$[5]\quad U(H,Z) = H^{\beta}Z^{(1-\beta)}$$

where β is the rent-to-income ratio in the absence of the subsidy, H and Z are as previously defined. From previous studies, Murray estimates βs ranging between .26 and.34 for various family compositions.

Step 2 Estimation of Utility Function u(L,Y')

Murray assumes that the household's leisure/non-leisure preferences can be represented by a Stone-Geary utility

function of the form:

$$[6]\quad W = (L - \delta)^{a}\ [H^{\beta}Z^{(1-\beta)}]^{(1-a)}$$

where W is utility, L is leisure, δ is some minimum level of leisure, a is the elasticity of substitution of leisure for labour,[5] all other variables are previously defined. Substituting the Hicksian equivalent income in equation [6] yields

$$[7]\quad U = (L - \delta)^{a}\ (Y')^{(1-a)}$$

In a separate study, Abbot and Ashenfelter (1976) obtain estimates of 6,403 for δ and .12 for a. In other words, the minimum amount of leisure consumed by all families in the U.S. is 6,403 hours or 17.5 hours per day. This equates with a 45.5 hour work week. Murray uses these estimates for his analysis.

Step 3 Estimation of Lm, Leisure Without the Program

By construction, the amount of leisure without the program is defined as:

$$[8]\quad L_{m} = a(T - \delta) + \delta$$

where T is the total number of hours available or 365 x 24 = 8,760. Substituting the parameter estimates of .12 for a, 6,403 for δ and 8,760 for T, Murray obtains an estimate for L_m of 6,686 hours of leisure per year or 39.9 hours of work per week.

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[5] The elasticity of substitution of leisure for labour is the rate of change in the ratio of work (κ) and leisure (L) when the rate of substitution is increased at the rate of 1%, holding utility constant (Russell and Wilkinson, 1979). It can be expressed as the difference between the wage elasticity and total income elasticity (Cain and Watts, 1973): $\partial\kappa/\partial w - \partial\kappa/\partial Y(\kappa_{o})$ where κ_{o} is the equilibrium level of labour supply.

Step 4 Estimation of Ls, Leisure With the Program

An expression for L_s is obtained by maximizing utility with the program (U_s) with respect to leisure. U_s is calculated in three steps as follows:

1. Minimize household expenditure with respect to U_s to obtain the following expenditure function:
   $Y' = [(p_h H)/\beta]^{\beta} [(p_z Z)/(1-\beta)]^{(1-\beta)}$
2. Modify the expenditure function to reflect the fact that rents in public housing are limited to 25 percent of household income. The revised expression is:
   $Y' = [(p_h H)/\beta]^{\beta} [(.75w(T - L))/(1-\beta)]^{(1-\beta)}$
   where $w(T - L)$ represents income.
3. Substitute this expression for Y' into equation [7] to give:

$$[8]\ U_s = (L - \delta)^a \cdot [(p_h H)/\beta]^{\beta} \cdot [\{[.75w(T - L)]/(1-\beta)\}^{(1-\beta)}]^{(1-a)}$$

Maximizing equation [8] with respect to L, Murray obtains the following expression for L_s:

$$[9]\ L_s = \frac{aT + (1 - a)(1 - \beta)\delta}{a + (1 - a)(1 - \beta)}$$

Step 5 Estimation of the Decrease in Work Effort

The change in work effort as a result of the public housing program is estimated as the difference between equations [8] and [9]. For the nine family compositions in Murray's study, the decline in work effort ranges from 1.4 to 1.7 hours per week per household, representing approximately a 4 percent reduction.

4 APPLICATION OF MURRAY'S MODEL TO YELLOWKNIFE DATA

In this section, Murray's model is applied to the five public housing projects in Yellowknife to determine the impact of the program on work effort.

As described in the previous section, estimates of 4 variables are required to estimate changes in work effort:

- T - the total hours available = 8,760 by definition (24 x 365).
- δ - the minimum level of leisure.
- a - the elasticity of substitution of leisure for work.
- β - the rent-to-income ratio in the absence of the program.

In Murray's study, estimates of δ and a were obtained from a previous study in the U.S. Unfortunately, no comparable studies exist in Canada. Estimation of the parameters from Canadian data using Abbott and Ashenfelter's (1976) approach would require estimation of a system of 8 simultaneous equations, a task beyond the scope of this analysis. Therefore, for the purposes of this study, the parameter estimates from the U.S. data are used. That is, δ = 6,403 and a = .12. Estimates of the parameter β derived in Chapter 5 for nine income groups in Yellowknife range from .13 to .42.

Reduction in work effort due to the program is estimated for 110 households. Estimates range from 0.8 to 3.2 hours per week per household, or approximately 2% - 8% of the pre-subsidy work effort (39.9 hours per week). In

comparison to Murray's results, the Yellowknife data produce a much wider range of estimates. Murray's estimates fall within a range of 1.4 to 1.7 hours per week or approximately 4% of pre-subsidy work effort. The difference stems from the wider range of rent-to-income ratios used in the Yellowknife sample: .13 to .42 compared to .26 to .34. The rent-to-income ratios have a direct influence on the decline in work effort with higher ratios producing greater reductions. As high ratios are associated with low income households, the model predicts a greater reduction in work effort among poorer households.

These results should be interpreted as very rough approximations of the decline in work effort associated with the Public Housing Program in Yellowknife. Better approximations could be obtained by estimating the parameters δ (minimum level of leisure) and a (elasticity of substitution) from Canadian data or, ideally, from N.W.T. data. Also, the full policy implications of the results are not clear without comparative estimates of the decline in work effort from income maintenance or price subsidy programs.

5. SUMMARY AND IMPLICATIONS

The work disincentive effects of government redistribution programs are usually analysed within the traditional income-leisure economic framework. While this approach is useful for studying income maintenance programs,

it is not appropriate for analysing commodity subsidies as the price ratios within the non-leisure composite change. In response to this observation, and in an attempt to utilize a rich data base of work disincentive effects of income maintenance programs in the U.S., Murray (1980) designed a model for analysing work disincentives of commodity subsidy programs. The interesting result from Murray's work is that, under certain conditions, in-kind subsidies can actually have a stimulative effect compared to equivalent cash grants. The necessary conditions for this result to hold are (1) the subsidized good must be normal and (2) the program must impose "too much" consumption of the subsidized good. As both these conditions are usually met in public housing programs, the model predicts that the work disincentive associated with a public housing program will actually be less than that with a program of unrestricted, "equivalent" cash grants. This result suggests that in-kind transfers may be appropriate policy initiatives in some cases, despite their economic inefficiency.

6. PROOF OF THEOREM

Theorem: For two goods H and Z, the marginal utility of Z increases as Z decreases over the interval (H, Z) to (H_s, Z_s) if H is a normal good.

Proof:[6]

1. notation:

   let g(H, Z) be the household utility function

   let g_i be the partial derivative of g(·) with respect to i, i = H, Z

   let g_{ii} be the second partial of g(·) with respect to i

2. along an indifference curve, utility is constant:

   i.e., $g_Z dZ + g_H dH = 0$

   or $dH = -(g_Z/g_H)dZ$

3. total differential of g_Z:

   $dg_Z = g_{ZZ}dZ + g_{ZH}dH$

4. substituting for dH:

   $dg_Z = g_{ZZ}dZ - g_{ZH}(g_Z/g_H)dZ$

5. rearranging:

   $dg_Z = [g_{ZZ} - g_{ZH}(g_Z/g_H)]dZ$

6. as Z falls, $dg_Z > 0$ if and only if

   $[g_{ZZ} - g_{ZH}(g_Z/g_H)] < 0$

7. $dH/dY = [g_{ZH}(g_Z/g_H) - g_{ZZ}]\ |D|^{-1}$ where |D| is the determinant of the bordered Hessian matrix. As g is quasi-concave, |D| > 0.

8. if $dH/dY > 0$, then $[g_{ZH}(g_Z/g_H) - g_{ZZ}] > 0$ and

   $[g_{ZZ} - g_{ZH}(g_Z/g_H)] < 0$

9. $dH/dY > 0$ for a normal good

10. as Z falls, g_Z increases if H is a normal good, q.e.d.

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[6]from Murray

APPENDIX 3

PUBLIC HOUSING RENT-TO-INCOME SCALES

I C.M.H.C. RENTAL SCALE

Income	Rent (%)	Income	Rent (%)
under 200	16.7	303 - 311	22.5
201 - 209	17.4	312 - 320	22.9
210 - 219	18.1	321 - 329	23.1
220 - 228	18.6	330 - 339	23.4
229 - 237	19.2	340 - 348	23.5
238 - 246	19.7	349 - 357	23.9
247 - 255	20.2	358 - 366	24.0
256 - 265	20.7	367 - 375	24.2
266 - 274	21.2	376 - 385	24.5
275 - 283	21.6	386 - 394	24.6
284 - 292	22.0	395 - 403	24.8
293 - 302	22.3	403 +	25.0

NOTES:
1. Income figures represent monthly family income as defined on the following page.
2. The rent percentages apply to families or individuals with no children. Monthly rent is reduced by $2.00 for each child to a minimum of $32.

SOURCE: C.M.H.C., National Office.

DEFINITION OF INCOME

For the purposes of calculating monthly rent, "income" is defined as aggregate gross income of all members of the family or individual excluding the following:

1. Earnings of children in regular attendance at recognized institutions of learning;
2. Living out or travelling allowances of a family head;
3. Earnings of a working spouse of up to $900.00 per annun;
4. Income from any source other than social assistance payments of a one-parent family up to $900.00 per annum;
5. Earnings in excess of $75.00 per month of all members of the family other than the family head or spouse. (This will include persons related by blood, marriage or adoption or other persons who may reasonably be assumed to form part of the family.);
6. Capital gains, such as insurance settlements, inheritances, disability awards, sale of effects;
7. Family allowance.

SOURCE: C.M.H.C., National Office.

II N.W.T. HOUSING CORPORATION RENT SCALE

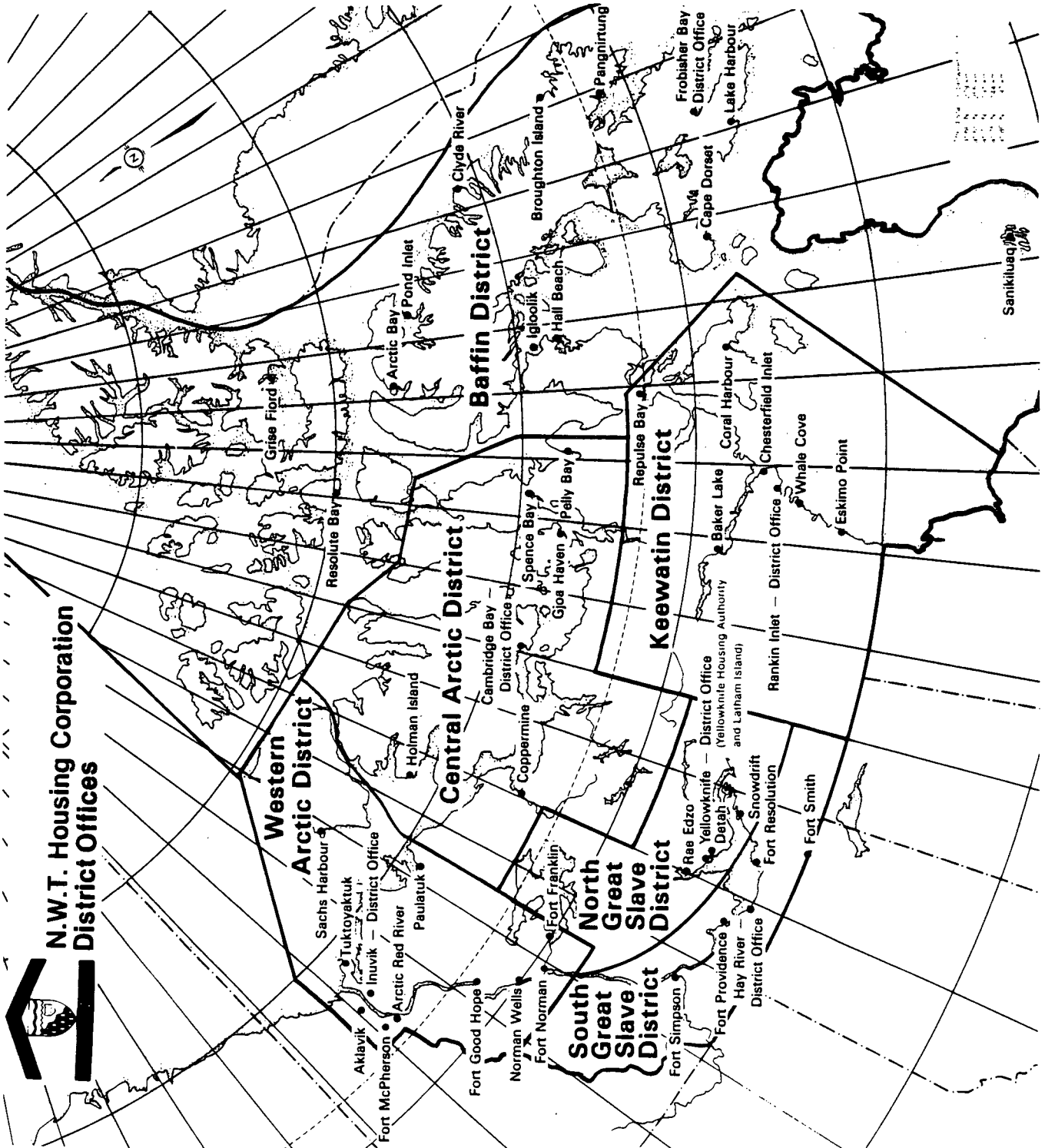
By agreement, C.M.H.C. contributes either 50% (Section 43 and 44.1(a) projects) or 75% (Section 40 projects) of the "net operating loss" of the public housing projects. In order to calculate "net operating loss", revenue is calculated based on either the federal rental scale or the territorial scale, whichever produces the greatest revenue. During the early years of the Public Housing Program in the N.W.T., the N.W.T. Housing Corporation used the federal rental scale to assess rents for all its public housing projects. However, in 1978, in response to resolutions from delegates at the Baffin Housing Conference, the Housing Corporation introduced a new rental scale to reflect northern living conditions. The scale resulted in lower rent assessments for many households but, because of the agreement with C.M.H.C., the new scale shifted the financial burden of the program from C.M.H.C. to the Housing Corporation. In 1983, the Housing Corporation revised its scale to reduce this burden, but, at the same time acknowledge the higher cost of living in remote communities. This scale is currently in use and differs from the federal scale in the following ways:

1. In the nineteen communities designated as "homeownership" communities (i.e., communities where homeownership is a realistic option), monthly rent is limited by the economic rent or market rent of the unit, whichever is greater.

2. In the remaining communities, monthly rent is limited by the rent levels of comparable G.N.W.T. staff housing units.
3. Monthly rent in remote communities is adjusted to reflect the higher cost of living.

APPENDIX 4

MAP OF THE NORTHWEST TERRITORIES*



*Copied from N.W.T. Corporation Annual Report, 1983-84.

APPENDIX 5

ESTIMATION OF REAL INTEREST RATES, 1976 - 1985

Year	Average Bond Yield (10 years & over)	Annual Average Inflation	Real Rate
1976	8.47	7.52	.95
1977	8.77	7.95	.82
1978	9.68	8.84	.84
1979	11.32	9.20	2.12
1980	12.67	10.16	2.51
1981	15.27	12.49	2.78
1982	11.69	10.80	.89
1983	12.02	5.78	6.24
1984	11.66	4.35	7.31
1985	10.06	4.00	6.06

SOURCE:
1. Bank of Canada Review, various years.
2. The Consumer Price Index, June 1985.