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**CARING AND SHARING: TESTS BETWEEN ALTERNATIVE MODELS  
OF INTRA-HOUSEHOLD ALLOCATION**

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# Caring and Sharing: Tests Between Alternative Models of Intra-household Allocation.

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## Abstract

Several models of intra-household decision making have been suggested in the literature. One important dichotomy is between non-cooperative and cooperative models (including specific models of bargaining). The other important distinction is between models that allow for caring and those that do not. We present a framework that includes all suggested models and variants as special cases. We derive the theoretical predictions of these models for the relationship between expenditures on goods and the intra-household distribution of income. We estimate and test between these relationships using Canadian household expenditure data. We conclude that there is evidence that both husbands and wives care for each other in the sense that with an unequal distribution of incomes the high income partner behaves as a ‘Becker dictator’ and there is local income pooling. We further find that for about half of the households in our sample (those with more equal incomes) a re-distribution of income would lead to changes in budget allocations. We conclude that the data are consistent with a collective model with caring partners.

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**Keywords:** intra-household allocation, altruism, cooperative behaviour, non cooperative behaviour.

## 1. Introduction

There is now considerable empirical evidence that the distribution of income within the household makes a difference to many household outcomes (see, for example, Bourguignon, Browning, Chiappori and Lechene (1993), Browning (1995), Browning, Bourguignon, Chiappori and Lechene (1994), Lundberg, Pollak and Wales (1995), Phipps and Burton (1992), Schultz (1990) and Thomas (1990)). This universal rejection of 'income-pooling' contradicts one of the basic predictions of the 'unitary' model of household behaviour that posits that the household behaves as though it has a single objective function. These empirical findings, coupled with the methodological unease that arises from treating an aggregate, the household, as though it is an individual has lead to a burgeoning literature on intra-household models. There has not been, however, much work on exactly which model best describes what goes on inside the household. In this paper we present a framework that allows us to capture several of the theoretical models suggested in the literature as special cases. Different models give different empirical predictions for the relationship between demands and the distribution of income within the household. We derive these predictions and provide empirical tests between them.

Once we allow that individuals within the household may have different preferences over how to allocate the time and money available to the household we need to specify a model of within household decision making. In doing this, all investigators in economics adopt a 'Beckerian' framework in which each person in the household has a utility function defined over household outcomes (see Becker (1991) for a definitive statement). The different models vary in how they allow for the dependence of household outcomes on these preferences. Basically there are four broad options for theoretical models: assuming enough to give a single utility function (unitary) model (see, for example, Becker (1991) and Samuelson (1956)); adopting a bargaining model (see, for example, Manser and Brown (1980), McElroy and Horney (1981), Lundberg and Pollak (1993) and Rasheed (1996)); taking a model which assumes only efficiency (the 'collective' model) (see, for example, Apps and Rees (1988), Chiappori (1988) and (1992) and Browning and Chiappori (1997)) or adopting some non-cooperative model (see, for example, Leuthold

(1968), Bourguignon (1984), Ulph (1988), Woolley (1993), Browning (1994) and Konrad and Lommerud (1995)).

There has been some structural empirical work using one or other model. In this work specification testing has been confined to general specification tests or to tests of specific predictions of the model used. Sometimes, however, the prediction is not unique to that model (formally, we cannot identify which model is generating our data). The obvious example is the rejection of income pooling which is generally common to all non-unitary models. The only empirical testing between different non-unitary models is that of Kapteyn and Kooreman (1990); they test between bargaining models, with varying power for both partners, from "male dictatorship" to "female dictatorship", using a linear Engel curve specification. In this paper we present tests between the unitary model and one variant of each of the broad classes of models (bargaining, collective and non-cooperative). The testing is based on a general Engel curve analysis which voids the linearity assumption of Kapteyn and Kooreman (1990).<sup>1</sup> As well as testing between various models we also derive and implement tests for the presence of 'caring' (in the specific Becker sense given below) within the household.

## 2. Theory

### 2.1. Framework

We consider a two person ( $I = A, B$  with  $A$  being a 'she' and  $B$  being a 'he') household which faces fixed prices (which we normalise to unity) and allocates a given total expenditure among different goods. In the conventional unitary model we assume the existence of a household utility function and maximise this subject to the budget constraint. If we drop the assumption that there is a household utility function then we need to posit some other household decision process. To stay within the conventional neo-classical (Beckerian) framework, we assume in all that follows that goods are either public or private and that each person has a representable preference ordering over the within household allocation of goods. Formalising, suppose that any good can either be used privately by one or other person in the household or it is public<sup>2</sup>. Denote person  $I$ 's vector of their private

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<sup>1</sup>We do not attempt to exploit the price variation that we have in the data. For results on the collective model versus the unitary model using price variation, see Browning and Chiappori (1996).

<sup>2</sup>We could allow that goods have the possibility of having both a private and a public nature; this complicates the notation without adding much.

good by  $\mathbf{q}^I$  and let the vector of public goods be denoted  $\mathbf{Q}$ . Let  $\mathbf{q} = \mathbf{q}^A + \mathbf{q}^B$  be the vector of household consumption of the private good.

The household budget constraint is:

$$\mathbf{Q}'\mathbf{e} + \mathbf{q}'\mathbf{e} = x \quad (1)$$

where  $\mathbf{e}$  is the appropriately sized unit vector and  $x$  is household total expenditure. The most general form for the individual preferences is  $u^I = v^I(\mathbf{q}^A, \mathbf{q}^B, \mathbf{Q})$  so that each person cares not only about their own consumption but also the structure of the other person's private demands. Such preferences are usually termed 'altruistic'. Alternatively we could assume that each person has an individualistic felicity function defined over public goods and the individual's private consumption,  $v^I(\mathbf{q}^I, \mathbf{Q})$ , and that preferences are defined over the levels of these felicity functions. Thus  $u^I = \Psi^I(v^A(\mathbf{q}^A, \mathbf{Q}), v^B(\mathbf{q}^B, \mathbf{Q}))$ ; following Becker we refer to such preferences as 'caring'. In this case person  $A$  only cares about  $B$ 's private consumption insofar as it gives him pleasure. Finally we have the case of 'egotistic' preferences in which each individual cares only about their own individual felicity function:  $u^A = v^A(\mathbf{q}^A, \mathbf{Q})$  and similarly for  $B$ . Of course, we can also have hybrids. For example, Becker's presentation of the Rotten Kid Theorem implicitly has one caring person and one egotistic person; we shall return to this below.

## 2.2. Modelling the decision process.

Having defined the constraints the household faces and the preferences of the two people we have to model how they resolve differences if the two people have different ordinal preferences; that is, if  $u^A \neq F(u^B)$  for some strictly increasing  $F(\cdot)$ . There are three broad options: a bargaining model, a model which assumes only efficiency (the 'collective' model) or a non-cooperative model. If we assume that there is enough structure on the bargaining model to give Pareto efficient outcomes (or even use a Nash assumption) then the former of the three cases is a special case of the second. In the general modelling of interactions between agents, each approach has its attractions and drawbacks. In the specific context considered here two elements seem particularly relevant. First, the household may be considered one of the pre-eminent examples of a repeated game with a fairly stable environment. Second, the two agents can safely be assumed to know each other's preferences (at least after a few years)<sup>3</sup>. Together these make the use of

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<sup>3</sup>The availability of unobserved consumption - for example, taking leisure on a job - weakens this argument.

non-cooperative models that have outcomes that are not Pareto efficient relatively unattractive. After all, if agents know each other and interact very often, why should they leave potential Pareto improvements unexploited?

Conversely, the two features mentioned make the collective model a very attractive modelling option. Additionally, the collective model leads to a surprising number of restrictions on observable outcomes (see Chiappori (1988) and (1992), Bourguignon, Browning, Chiappori and Lechene (1994), Bourguignon, Browning, Chiappori (1996) and Browning and Chiappori (1998)). The final point in favour of the collective model is that we can identify a good deal of ‘who gets what’ within the household and how this changes as we change ‘distribution factors’<sup>4</sup> (see Chiappori (1992) and Browning, Bourguignon, Chiappori and Lechene (1994)). Distribution factors are variables which do not impact directly on tastes but that do affect the intra-household allocation decision (and hence household demands). Potential examples include the relative incomes of household members; divorce laws; social attitudes to the roles of men and women and the outside options of the different members. The drawback of the collective model is that it gives no hint of the process whereby members of a household might achieve a Pareto efficient outcome nor where on the utility possibility frontier the household will be located. More importantly, it gives no guidance as to what variables should appear in the set of distribution factors. For example, some authors use relative incomes or relative earnings or relative non-labour incomes. Suppose, however, that it is relative *potential* wages that matter; that is, power within the household is determined not by actual market outcomes but by what the different agents can threaten to do. Although the potential wage is correlated with earnings it obviously differs for those who choose not to participate in the observation period. To derive more specific predictions, we need more structure; typically this will take the form of assuming a specific bargaining model.

If we move to a structured bargaining model then we must specify breakdown points and outside options which considerably complicates the theoretical analysis and also makes greater data demands. A number of breakdown points have been suggested in the literature. These range from divorce (see McElroy and Horney (1981) and Manser and Brown (1980)) to each person reverting to traditional roles in the event of no agreement (see Lundberg and Pollak (1992)). For the bargaining model in this paper, we consider one specific alternative, namely that the breakdown point for the bargaining game is a non-cooperative voluntary contributions game; this is presented below. This approach can be justified by an appeal to each

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<sup>4</sup>McElroy (1990) uses the term ‘extra-household environmental parameters’.

period being one of a number in a repeated game in which the non-cooperative outcome is used as a disciplining device.

To bring out the implications of the various models, we shall only consider the effects on the household demands for one private good and one public good (but we allow that there are many other public and private goods). In doing this we hold total expenditure and all other influences on preferences constant. For expositional convenience, we assume that person  $A$  prefers the two goods we consider more than  $B$  in the following sense. If we use  $A$ 's utility function to determine household demands ( $A$  is a dictator) then the demand for these two goods is higher (and the demand for some other goods is lower) than if we use  $B$ 's utility function. In the following exposition we shall only present informal derivations; formal statements of propositions and proofs can be found in Appendix B.

### 2.3. A cooperative model.

The first case we consider is the *collective* model which assumes only that any intra-household allocation is efficient. Formally,  $(\hat{\mathbf{q}}^A, \hat{\mathbf{q}}^B, \hat{\mathbf{Q}})$  is efficient if there is no other allocation that satisfies the same budget constraint that makes one person strictly better off without making the other one worse off. This is equivalent to household demands being rationalised by the *household utility function*:

$$V(\mathbf{q}, \mathbf{Q}, \mu) = \max_{\mathbf{q}^A, \mathbf{q}^B} \{ \mu v^A(\mathbf{q}^A, \mathbf{q}^B, \mathbf{Q}) + (1 - \mu) v^B(\mathbf{q}^A, \mathbf{q}^B, \mathbf{Q}) \mid \mathbf{q}^A + \mathbf{q}^B = \mathbf{q} \} \quad (2)$$

This household utility function resembles the conventional utility function except that it allows for the influence of the weight on the individuals' utility functions. If the weighting factor  $\mu$  is a constant then this is simply the unitary model. Generally, however, the weight will depend on various (distribution) factors that reflect the 'power' of the respective partners. In all that follows, we shall concentrate on the share of earnings of person  $A$ ; that is,

$$\rho = \frac{Y_A}{Y_A + Y_B}$$

where  $Y_I$  is the earnings of person  $I$ . For the collective model we shall assume that the weighting function  $\mu$  is a strictly increasing function of  $\rho$ . There is no explicit prior non-cooperative game that justifies this assumption; rather it is implicitly

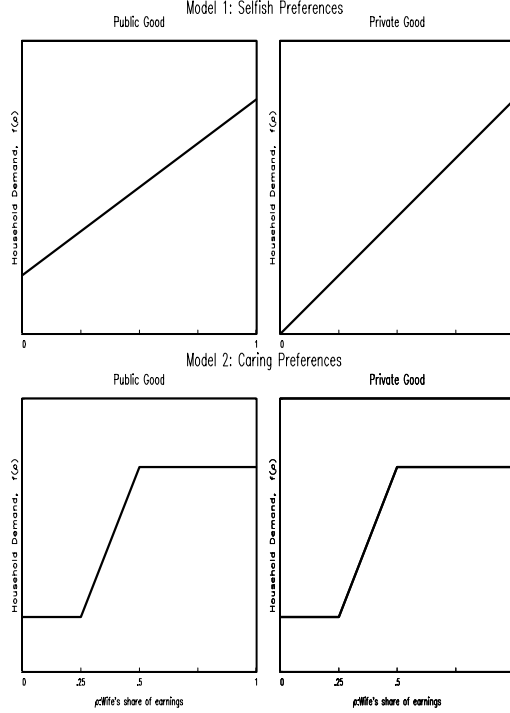


Figure 1: Cooperative Model Predictions

based on a bargaining model in which a higher share of household earnings is reflected in a more favourable breakdown point<sup>5</sup>. We shall discuss the possible endogeneity of the earnings share in the empirical section.

The first model (model 1) we consider is that in which preferences are egotistic; in this case the demand for both private and public goods is increasing in  $\rho$ , given the assumption that  $A$  prefers these two goods. For convenience, we have taken demands to be linear; see the top panels of figure 1. If we introduce caring (model

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<sup>5</sup>This lack of an explicit model is a weakness. Suppose, for example, that the weight  $\mu$  depends on relative earnings and some other factor reflecting  $A$ 's household 'power'. If the latter increases then  $A$  may decrease her earnings without  $\mu$  decreasing.

2) then we have that for extreme values of the earnings share the high income person is effectively making transfers to the low income person and demands are locally independent of the distribution of earnings. This is one version of Becker's 'Rotten Kid Theorem' so we refer to the intervals at the ends of the earnings distribution as the 'Becker' region. The bottom panels of figure 1 give an illustration of the predictions of the caring collective model. Note that the Becker regions are the same for all goods ( $[0, 0.25]$  and  $[0.5, 1]$  in the case illustrated).

#### 2.4. A non-cooperative model.

The non-cooperative model we consider is one in which each person makes voluntary contributions to the public good and their own private good from their own earnings (see Ulph (1988), Woolley (1993) and Rasheed (1996)). It is assumed that there is no other income (or that other income is distributed proportionately to earnings). We consider first the egotistic case (model 3). If  $B$  has all the earnings ( $\rho = 0$ ) then the household buys the amount of public and private goods that maximise his utility function subject to purchases equalling his earnings. Note that at this point the household allocations are efficient since we cannot re-arrange them, keeping total expenditure constant, without making  $B$  worse off. If, now, a small amount of the earnings of person  $B$  are transferred to person  $A$  then  $B$  reduces his expenditure on all private goods (assuming normality) and also reduces his contribution to the public good. However,  $A$  does not contribute anything to the public good but rather concentrates her expenditures on her own private goods. Thus the contribution to all public goods actually falls even though  $A$  prefers the public good relative to  $B$ . This is a seemingly paradoxical result and lends itself well to testing. Note that the new allocations are now inefficient since it would be possible to make both agents better off by increasing their contributions to the public good; this is the standard inefficiency result for a voluntary contributions game with public goods.

As more earnings are transferred to  $A$ , at some point she starts contributing to the public good. If  $B$  is still contributing to the public good at that point then we have the surprising and remarkable result due to Warr (1983) (see also Bergstrom, Blume and Varian (1986) and Bernheim (1986)). This result states that if a group of agents are all voluntarily contributing to a public good then small re-distributions of income will not lead to any changes in the allocation to any public or private goods. In the context here, this means that we have a central region for the distribution of earnings in which household demands are

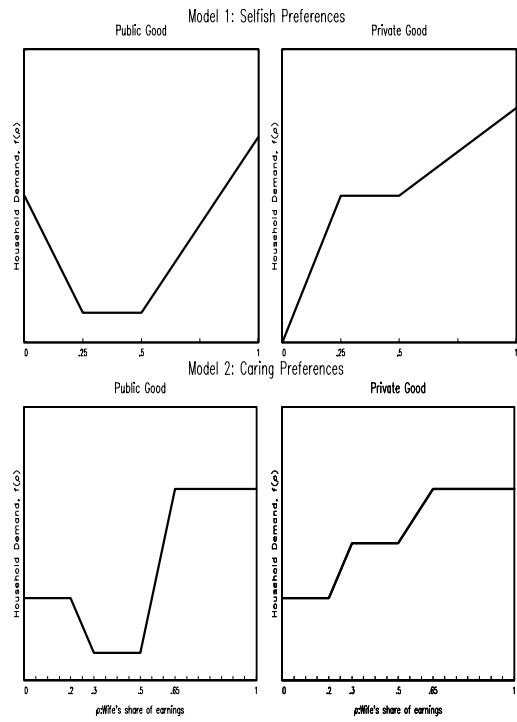


Figure 2: Non Cooperative Model Predictions

independent of the distribution of earnings; we term this the Warr region. As we continue to increase  $A$ 's share of earnings, at some point  $B$  stops contributing to any public good and at that point any further transfer to  $A$  will lead to rising contributions to all public goods and any private goods she prefers more than  $B$ . The set of predictions is given in the top panels of Figure 2<sup>6</sup>. The Warr interval in this illustration is  $(0.25, 0.5)$ .

One example of this is if there are children in the household and both parents care for the children. Suppose they agree on the utility function of the children (even though they may give that utility level different weights in their own individual welfare functions). Then goods that are bought exclusively for the child (for example, children's clothing) are a public good. If  $A$  cares more about the children than does  $B$  then more will be spent on children's clothing if  $A$  has all the earnings than would be the case if  $B$  had all the earnings. If, however, we start from  $B$  having all the earnings and then we make a small transfer to  $A$  (so that total earnings are held constant) then she will decide to spend this on private goods for herself (her own clothing, for example) rather than on any public goods, including children's clothing. Thus such a transfer may lead to an increase in expenditures on women's clothing and a decrease for children's clothing since at the same time  $B$  will cut back his spending on children. Thus children are actually worse off even though the parent who cares more for them has a higher relative income.

If we now introduce caring between  $A$  and  $B$  (model 4) then we once again have flat Becker regions at either end of the earnings distribution; see the bottom panels of Figure 2. This non-cooperative context is, actually, the one in which Becker introduced his neutrality result. Note that the motivation for the flat portions in the middle and the two at the extreme are very different. In the latter one person is acting as a benevolent dictator and outcomes are efficient whilst in the central region each person is acting selfishly and outcomes are inefficient. Note, once again, the coincidence of 'join' points across goods; that is, all demands start and stop being flat at the same values of  $\rho$  ( $\{0.2, 0.3, 0.5, 0.65\}$  in this illustration).

## 2.5. A bargaining model with a non-cooperative breakdown point.

As we emphasised in our discussion of the decision process earlier in this section, we do not find inefficient outcomes very appealing in the household context. In this

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<sup>6</sup>If  $B$  stops contributing to all public goods before  $A$  starts then the flat 'Warr' segment simply disappears.

sub-section we consider a bargaining model which has a non-cooperative outcome as its breakdown point. This follows Lundberg and Pollak (1993) but we take a different non-cooperative game than they did. Lundberg and Pollak consider a 'traditional spheres' game in which there are two public goods but each person can only contribute to one of them. Here we take the non-cooperative game of the previous sub-section as the breakdown point; this seems to us the more natural starting point.

Rasheed (1996) shows that the one shot bargaining game that results from a traditional Nash bargaining game is a sub-game perfect equilibrium of a repeated game with full information in which agents play the one shot game over and over again. Thus the bargaining model considered here is of considerable interest as being the only bargaining game in this context that formally captures the twin features that agents interact regularly and know each other well.

The question is: what properties does the bargaining outcome inherit from the non-cooperative game? For the egotistic case (model 5), Rasheed (1996) shows that the flat 'Warr' portion for public and private goods appears for the bargaining outcome. This follows since in the Warr interval the breakdown point is locally independent of the distribution of earnings and hence the final bargained outcome must also be independent. However, since the bargaining outcome is efficient, it cannot be the case that the non-monotonicity in the earnings share is also inherited. Instead, starting from  $A$  having no earnings, as her share of earnings increases so does her bargaining position and hence the household ends up buying more of the public goods she prefers. Thus the public good and private goods are both non-decreasing; see the top panels of figure 3. As can be seen, the predictions for the two types of goods are the same; for goods  $A$  prefers we have a strictly increasing segment followed by a flat portion and then another strictly increasing segment. If we now introduce caring (model 6) then this simply adds Becker regions at the ends of the distribution see the bottom panel on figure 3.

In this section we have derived predictions for demands for public and private goods under three different models for the determination of budget allocations. We have also shown that caring introduces flat regions at the extremes of the income distribution. We turn now to testing between these various predictions.

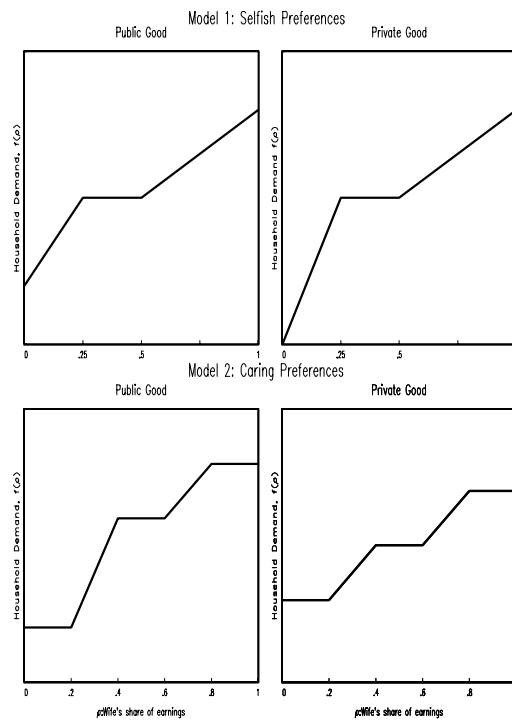


Figure 3: Bargaining Model Predictions

### **3. Empirical results.**

#### **3.1. Data.**

The data are taken from the Canadian Family Expenditure Survey (FAMEX) for sampled years between 1969 to 1992. Here we give only a brief account of sample selection and data preparation; full details and a data description can be found in Appendix *C*. We shall consider only households that are headed by a married couple and in which both the husband and wife are in full-year full-time employment. We also select on there being at least one child aged less than 17 in the household and no other members aged 17 or over. The selection on a child being present is because we want to examine expenditures on children's clothing. The exclusion of households with adult children present is because the two decision maker framework may not be appropriate if there are more than two adults. We excluded households with no expenditure on food at home, household operations and the three clothing categories but not those with zero alcohol and tobacco. We excluded households with high budget shares for any good. Finally we found that the model was unstable for very low values of the wife's share of earnings so we exclude households in which this share is less than five percent. After all these selections we are left with 2029 households in our sample. We account for relative price effects and a variety of demographic factors that are usually thought to modify preferences; these include age, the number and ages of children, region of residence and education; a full listing is given in Table A1. Finally we note that in constructing budget shares we used the ratio of individual good expenditures to total non-durable expenditure.

Since the models' predictions consist in restrictions on the relationship between the distribution of income within the household and demand, we start by the former: see figure 4. As we might expect the distribution of the wife's share of household income is concentrated below one half with quantiles of 0.33, 0.40 and 0.48. The proportion of women with earnings higher than their partner is 18.2% with less than two percent earning more than twice their husband (a share of 0.66). Consequently we must not expect too much precision in testing for effects at the high end of the distribution.

#### **3.2. Empirical methods.**

In the theory section we developed three models: a collective model; a non-cooperative model and a bargaining model with the non-cooperative outcome

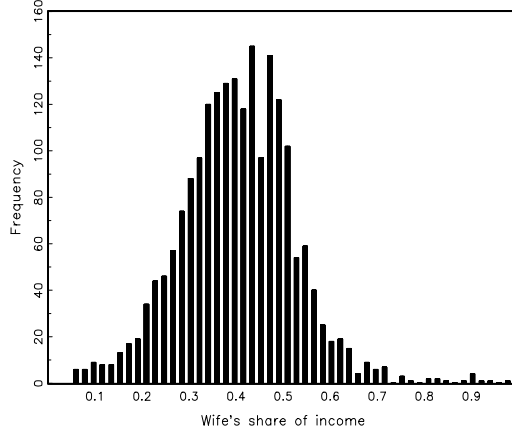


Figure 4: Distribution of wife's share of income

as a breakdown point. For each of these we have predictions for the demands for public and private goods with and without caring. Our approach to testing between these models will be to identify *ex ante* some public and some private goods and then to test for the various predictions. For public goods we take ‘children’s clothing’ and ‘household operations’ (which includes water, fuel, electricity and telephone but *not* child care expenses). For private goods we consider ‘food at home’; ‘vices’ (that is, alcohol and tobacco); ‘men’s clothing’ and ‘women’s clothing’. Although this is not exhaustive of non-durables and services we consider the classification of other goods (such as ‘food outside the home’ and ‘entertainment’) as private or public too conjectural to make it feasible to use them. The six goods we model account for about one half of total expenditures on non-durables.

We assume that all the households have the same decision process and that the population is homogenous enough in terms of level of total income so that the join points are the same for everyone.<sup>7</sup> Let  $\rho$  be the share of income of the wife. We take the unrestricted form of the models to be:

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<sup>7</sup>We modelled and estimated some specifications with heterogeneity in the join points. These never gave a significantly better fit than the corresponding models with homogeneity reported below.

$$E[\omega_i | X, \rho] = X\beta + g(\rho) \quad (3)$$

where  $\omega_i$  is the budget shares for good  $i$ ,  $X$  is the matrix of explanatory variables other than  $\rho$  and  $g$  is a function describing the relationship between the share of income of the wife and the response  $w_i$ .<sup>8</sup> In equation (3) the matrix  $X$  contains log prices, demographics and the logarithm of total expenditure ( $x$ ) and its square.

There are several ways suggested in the literature for estimating a partially linear structure such as (3) (see for example, Robinson (1988) and Härdle (1990)). These are not easily adapted to the GMM system framework we use here to take account of the endogeneity of total expenditure. Instead we adopt a flexible procedure that first involves estimating an unrestricted form of equation (3) using GMM applied to  $X$  and splines of  $\rho$ . Specifically we divide the sample sorted by  $\rho$  into 20 equally sized groups (with 19 join points) and construct 20 variables that give a piecewise linear and continuous function of the wife's share. We then include these variables on the right hand side of our equation (along with the  $X$  variables) and in the set of instruments. We instrument the total expenditure variables with log net income and its square. Thus we have a just identified, linear unrestricted system with  $\dim(X) + 20$  right hand side variables for each equation. This can be estimated using GMM in the usual way; the weighting matrix from this unrestricted model is used in all subsequent testing of restricted models. We have 120 share coefficients in the unrestricted model; with the sample size to hand this obviously leads to very imprecise estimates but that does not matter since we are only using the unrestricted model for testing heavily restricted variants.

To test for the various models developed in the theory section, we use a minimum- $\chi^2$  procedure that restricts sets of coefficients on the unrestricted  $\rho$  splines to be the same. To illustrate, consider testing for a one join model (with the same join point for all 6 goods) with a flat segment and then a slope. This corresponds to a collective model in which husbands care for their wives (so that the initial flat segment is a Becker region) but wives do not care for husbands. There are only 7 share coefficients for this model: the single join point and the 6 slope coefficients. If we fix the join point at one of the 19 join points from

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<sup>8</sup>We made attempts to allow for the possible endogeneity of the income share  $\rho$  by running specifications with this share instrumented. As instruments we tried crossed region and year dummies and also measures of relative wages for full-time employed men and women in the region-year. In no case could we reject exogeneity. On the other hand, the instruments are relatively weak and this test can hardly be considered conclusive.

the unrestricted system then we have a model that is nested in the unrestricted model. For example, if we take the fourth join point then our flat-slope structure implies that the coefficients on the first four coefficients in each equation are zero and the last sixteen coefficients equal within each equation. This gives  $24 + 90 - 1$  restrictions (the  $-1$  is to allow for the join point being estimated). The  $\chi^2$  test statistic for these restrictions is readily calculated using minimum- $\chi^2$  methods. To find the optimal join point we grid search over the 19 join points from the unrestricted model and take the value that gives the minimum of the 19 statistics as the optimal value. This approach has the disadvantage that we have not treated the income share as a continuous variable. On the other hand, this procedure is feasible and reasonably fast and is likely to give results that are close to the ‘correct’ since we have taken a relatively fine grid for the unrestricted model.<sup>9</sup>

### 3.3. Empirical results.

The first step is to estimate the unrestricted model. Then we need to test the restrictions from the theory section. Even with the minimum- $\chi^2$  grid search method outlined above, estimation of models with more than two join points is very cumbersome. Consequently we estimated a relatively small number of restricted models. We estimate all three one join models (‘flat-slope’, ‘slope-flat’ and ‘slope-slope’) and three two join models (‘flat-slope-flat’, ‘slope-flat-slope’ and ‘slope-slope-slope’) From these we choose a statistically preferred model and then test whether particular variants of this model give an improvement. The variants we use for this are two three join models with ‘slope-flat-slope-flat’ and ‘flat-slope-flat-slope’. Table 1 presents the results for these models and the unitary and collective models. The criterion values given in the Table provide tests of the given models against the unrestricted model. The differences in the  $\chi^2$  criteria between nested models give the test statistics for the restriction. For example, comparing the unitary and the collective (with no caring) model we see that the 6 restrictions to go from the latter to the former have a  $\chi^2$  statistic of 29.4 which has a probability of less than 0.01% under the null that the unitary model is correct. This is the usual rejection of income pooling. To conduct our testing, we begin with the least restricted two join model which has 20 parameters. As can be seen from the Table, neither of the two join models with one or two flat segments can be rejected against this more general model ( $\chi^2(6) = 7.1$  and  $\chi^2(12) = 11.7$  respectively). The slope-flat-slope model can be simplified to the

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<sup>9</sup>Limited experiments with finer grids gave similar qualitative results.

one join slope-slope model ( $\chi^2(1) = 0.6$ ). This latter model, however, is in turn rejected against the slope-flat model (a  $\chi^2(6)$  of 8). Thus following this branch we conclude that the slope-flat is preferred. On the other hand, all of the simpler models are rejected against the flat-slope-flat model. The restrictions of the flat-slope-flat model to the slope-flat and flat-slope models have  $\chi^2(1)$  statistics of 4 and 10.2 respectively. Importantly, the collective model with no caring is also decisively rejected ( $\chi^2(2) = 10.2$  with a probability of less than 0.5%). We conclude that the flat-slope-flat model is the statistically preferred model.

Our preferred flat-slope-flat model has a  $\chi^2(107)$  statistic of 127.8 so that the preferred model is not rejected against the very unstructured general model. It may be, however, that some model with more than two joins is preferred to the flat-slope-flat model. As stated above it is very onerous to grid search over more than two join points so we consider only two three join point alternatives. These add a slope before and after the flat-slope-flat model to give sl-fl-sl-fl and fl-sl-fl-sl respectively. Referring again to Table 1 we see that both of these are not rejected against the flat-slope-flat two join model ( $\chi^2(7)$  values of 4.6 and 8.4). Thus our preferred model is also not rejected against less restricted, parsimonious variants.

The preferred model suggests that both husbands and wives display sharing. The join points given in Table 1 (0.21 and 0.43) are at the 10th and 60th percentiles of the income share distribution. Thus about a half of the households have relative incomes such that a re-distribution of income would lead to a change in budget allocations. In Tables *D1* to *D6* in Appendix *D* we present the parameter estimates for the flat-slope-flat model. In Table 2 we present the coefficient estimates for the collective models with and without sharing and in figures 2 to 7 we present the predictions for the budget shares conditional on the sharing variable for the collective model with and without sharing. The first thing to note is that for those goods for which we had a prior on the slopes, this prior is confirmed. Thus women and children's clothing is increasing in the wife's share and men's clothing and vices are decreasing. We also find that food at home and services are decreasing in the wife's share.

A second feature of the parameter estimates of both models is that they indicate fairly substantial changes for some allocations consequent on a re-distribution of within household income. To illustrate, in columns 1 and 2 of Table 3 we present the budget share estimates for values of  $\rho$  equal to 0.25 and 0.75. In column three we give the difference proportional to the mean budget share. As can be seen, for our preferred model the budget shares for women's clothing and children's clothing rise by about 11% and 8% respectively whilst the shares for men's clothing

and vices fall by about 6% and 5% respectively.

## 4. Conclusions.

We have presented a theoretical analysis of the predictions of different models of intra-household decision processes on budget allocations. In particular, we derived the restrictions on the relationship between demands and the wife's share of income for four different models. We have shown that the different models give rise to radically different qualitative predictions which lend themselves well to testing. In the empirical section we used Canadian family expenditure survey data to test between the alternatives. Our main conclusions are:

- We do not find any evidence for a flat region surrounded by slope regions - that is, an interior region of (Warr) pooling. We interpret this as evidence against both non-cooperative behaviour and a bargaining game with non-cooperative behaviour as a breakdown point.
- We find robust evidence of caring by both husbands and wives. Specifically, we find that when the distribution of income is skewed the high income partner behaves as though he or she is a dictator who cares for the other partner. This (local) income pooling is the behaviour posited by Becker in his Rotten Kid theorem.
- Although we find evidence for caring we also find that for about half of our sample the distribution of household income is such that income pooling fails. In this central region a re-distribution of household income would lead to a change in the budget allocations.
- We find that households in which the wife has a high income share spend relatively more on women's and children's clothing (increases of 11% and 8% respectively for a change in the share from 0.25 to 0.75) and relatively less on men's clothing and alcohol and tobacco (falls of 6% and 5% respectively).

The major reservations we have about these conclusions are that we have treated the income share as exogenous and we have assumed that everyone has the same decision process and the same parameters for that process. As we have mentioned above, we tried to take account of these two shortcomings but there was no evidence that either was important. On the other hand, we have a relatively

small sample and the data are rather noisy so we suspect that the negative findings on endogeneity and heterogeneity may be more due to a lack of power in our tests. Even allowing for this, however, it is clear that the simple collective model without caring is rejected and that more structured models of intra-household behaviour are needed. In particular, it seems that we should allow that husband and wife care for each other, although not completely.

## A. Tables

Table 1: Test results.					
Model	Join 1	Join2	Join 3	Number of $\rho$ parameters	Criterion
Unitary	—	—	—	0	167.4
Collective (no caring)	—	—	—	6	138.0
Flat-slope	0.21	—	—	7	138.0
Slope-flat	0.43	—	—	7	131.8
Slope-slope	0.43	—	—	13	123.8
Flat-slope-flat	0.21	0.43	—	8	127.8
Slope-flat-slope	0.43	0.58	—	14	123.2
Slope-slope-slope	0.33	0.34	—	20	116.1
Fl-sl-fl-sl	0.21	0.43	0.58	15	119.4
Sl-fl-sl-fl	0.43	0.51	0.54	15	123.2

Table 2: Slope parameter estimates.		
	No sharing	With sharing
Food at home	−2.17 [2.2]	−3.89 [2.3]
Services	−0.43 [0.6]	−2.52 [2.0]
Women’s clothing	1.54 [3.1]	3.31 [3.7]
Men’s clothing	−0.31 [0.8]	−1.34 [2.0]
Children’s clothing	1.01 [2.8]	1.54 [2.6]
Vices	−1.45 [1.8]	−1.42 [1.0]
Values in [.] are absolute t-statistics		

Table 3: Budget share predictions				
	Model	$\rho = 0.25$	$\rho = 0.75$	Proportional difference (%)
Food	No join	21.12	20.04	−5.0
	Two join	21.51	20.80	−3.3
Services	No join	12.88	12.66	−1.7
	Two join	12.88	12.42	−3.5
Women’s clothing	No join	5.90	6.67	+14.0
	Two join	5.65	6.25	+10.9
Men’s clothing	No join	3.76	3.60	−4.1
	Two join	3.78	3.54	−6.3
Children’s clothing	No join	3.82	4.32	+14.1
	Two join	3.63	3.91	+7.9
Vices	No join	5.17	4.46	−13.1
	Two join	5.48	5.22	−4.7
All budget share values multiplied by 100.				
The terms ‘no join’ and ‘two join’ refer to the collective model without and with caring respectively.				

## B. Theory appendix

We use the same notation as before. Subscripts  $A$  and  $B$  refer to the two members of the household;  $\mathbf{q}^i$  represents the vector of private goods consumed by individual  $i$  and  $\mathbf{Q}$  the vector of public goods consumed in the household. Both private and public goods are normal. Preferences can be selfish or caring. The household budget constraint is:

$$\mathbf{e}'(\mathbf{q}^A + \mathbf{q}^B) + \mathbf{e}'\mathbf{Q} = Y_A + Y_B = Y$$

where  $Y_i$  is individual  $i$ 's income and  $\mathbf{e}$  is the appropriately sized vector of ones. For expositional convenience, we assume savings away. We also assume that the level of household income is sufficient to ensure positive expenditure on the public good.

### B.1. Non Cooperative model

Household decisions are described by a Nash equilibrium with voluntary contributions to the public goods. The properties of this game are well known. In particular, under the assumption of strict convexity of preferences, an equilibrium exists. Under the assumption that both the private and the public goods are normal, this equilibrium is unique. This doesn't seem to be too strong a requirement, especially with broad grouping of goods such as is the case here. Formal proofs can be found in Bergstrom, Blume and Varian (1986). Finally, if both partners have some income and if at least one person is contributing to the public good, the outcome of this game is inefficient. This is due to the fact that agents do not account for the externality induced by the public good, that is, it is due both to the assumption of selfish preferences and to the absence of coordination between household members in this game. Note that the outcome is efficient when all the income goes to one member.

We first consider the case where both agents' preferences are selfish; then the case where one of the agents' preferences are caring while the other's are selfish; and finally the case where both agents' preferences are caring. We assume that there is one private good and one public good.

#### B.1.1. Both members selfish

Each individual maximises utility  $U_i = v_i(q^i, Q)$ , taking the choices of individual  $j$  as given, and choices are subject to the individual's budget constraint. Each

individual contributes an amount  $g^i$  to the public good, so that  $g^i + q^i = Y_i$ ,  $i = A, B$  and  $Q = g^A + g^B$ . The results shown are also valid if  $Q = f(g^A + g^B)$ , but not necessarily for the more general case where  $Q = f(g^A, g^B)$ . In other words, we consider only pure public goods. Transfers between household members are impossible in this setting which combines selfish preferences and independent decision making (given the choices of the other member).

The first order conditions of this problem lead to:

$$v_i^q \geq v_i^Q \text{ for } i = A, B,$$

leading respectively to interior and corner solutions for each individual:

$$\begin{cases} v_i^q = v_i^Q & \hat{q}^i < Y_i & \hat{g}^i > 0 \\ v_i^q > v_i^Q & \hat{q}^i = Y_i & \hat{g}^i = 0 \end{cases}$$

We rule out the case where the marginal utility of the private good is strictly lower than that of the public good.

There are therefore 3 possibilities for the household: both members contribute to the public good, or either member ( $A$  or  $B$ ) contributes while the other one doesn't ( $B$  or  $A$ ).

***Income Pooling*** Proposition 1: For this Nash equilibrium, if both individuals are contributing to the public good, there is income pooling.

Proof: If both individuals are contributing to the public good, individual  $B$ 's problem can be written as:

$$\max_{q^B} v_B(q^B, Y_A + Y_B - q^A - q^B)$$

For an interior solution, and for small reallocations of income between  $A$  and  $B$ , the problem, and hence its solution are unchanged.

For this property to hold, the reallocations of income have to be small enough so that the household stays at an interior solution; in other words, such that both household members continue to contribute to the public good. This result (with different proofs) can be found in Warr(1983) and in Bergstrom, Blume and Varian (1986).

If there is only one contributor to the public good, then reallocations of income between household members do have an effect on outcomes, *i.e.* on the structure of expenditure. Indeed, if  $B$  is not contributing, then:

$$v_B(Y_B, Y_A - q^A) \geq v_B(Y_B - \varepsilon, Y_A - q^A + \varepsilon)$$

***Evolution of expenditure as a function of income shares*** Let the share of household income accruing to member  $A$  be denoted by:

$$\rho = \frac{Y^A}{Y^A + Y^B}$$

Let  $\rho^1$  be the value of  $\rho$  such that for smaller values of  $A$ 's share of income,  $B$  is the only contributor to the public good. Let  $\rho^2$  be the value of  $\rho$  such that for larger values of  $A$ 's share of income,  $A$  is the only contributor to the public good. For values of  $\rho$  between  $\rho^1$  and  $\rho^2$ , both individuals contribute to the public good, and we have shown that there is income pooling. The evolution of the quantities demanded of public and private goods when the share of income varies are directly deduced from the assumption that all goods are normal.

Contributors to Q:	Range of $\rho$	Evolution of expenditure	Indirect Utility
$B$	$[0, \rho^1]$	$\frac{\partial q^A}{\partial \rho} > 0, \frac{\partial q^B}{\partial \rho} < 0,$ $\frac{\partial G}{\partial \rho} = \frac{\partial q^B}{\partial \rho} < 0$	$v_A(\rho Y, (1 - \rho)Y)$ $v_B((1 - \rho)Y, (1 - \rho)Y)$
$A$ and $B$	$[\rho^1, \rho^2]$	$\frac{\partial q^A}{\partial \rho} = \frac{\partial q^B}{\partial \rho} = \frac{\partial G}{\partial \rho} = 0$	$v_A(Y, Y), v_B(Y, Y)$
$A$	$[\rho^2, 1]$	$\frac{\partial q^A}{\partial \rho} > 0, \frac{\partial q^B}{\partial \rho} < 0,$ $\frac{\partial G}{\partial \rho} = \frac{\partial q^A}{\partial \rho} > 0$	$v_A(\rho Y, \rho Y)$ $v_B((1 - \rho)Y, \rho Y)$

These results give rise to the picture presented in the text.

### B.1.2. One caring individual

Assume, for instance, that  $A$  is selfish and  $B$  is caring. Preferences can be written:

$$U_A = v_A(q^A, Q) \quad \text{and} \quad U_B = F(v_A(q^A, Q), v_B(q^B, Q))$$

The game remains the same as in the previous case, save for the fact that the structure of the preferences opens the possibility of income transfers from the caring individual to the selfish individual.  $A$ 's choices are made subject to  $q^A + g^A = Y_A + t$ , where  $t > 0$  is the transfer made to  $A$  by  $B$ .  $B$ 's choices now include the amount transferred to  $A$  and are made subject to  $q^B + g^B + t = Y_B$ .

The results in this case conform to the intuition conveyed by the form of the preferences. When the selfish individual is relatively poor, the caring individual will transfer money to him. As the share of household income held by the selfish individual increases, the transfers decrease up to a point where they become zero. Over part of the range with positive transfers, only the caring individual contributes to the public good. Then transfers cease, and then (or at the same point, depending on preferences), both individual start contributing to the public good. At the other extreme, when the selfish individual controls a large enough share of the income of the household, he becomes the only contributor to the household public good., and in this case also there is no transfer. Indeed, the transfer can only be positive, i.e. the selfish individual will never transfer to the caring individual.

For individual  $B$ , the first order conditions of this problem lead to:

$$\frac{\partial F}{\partial v_B} \frac{\partial v_B}{\partial q_B} \geq \frac{\partial F}{\partial v_A} \frac{\partial v_A}{\partial Q} + \frac{\partial F}{\partial v_B} \frac{\partial v_B}{\partial Q}$$

There are 3 cases, depending upon whether one or both individual contribute to the public good. We can substitute out for private good demands and write the utility of the caring individual in terms of incomes, transfers, and contributions as:

$$U_B = F(v_A(Y_A + \hat{t} - \widehat{g}_A, \widehat{g}_A + \widehat{g}_B), v_B(Y_B - \hat{t} - \widehat{g}_B, \widehat{g}_A + \widehat{g}_B))$$

We will be using the expression of the partial derivative of individual  $B$ 's utility with respect to the transfer to find out when the transfer is positive. In all cases:

$$\partial U_B / \partial t = F_1 v_A^q - F_2 v_B^q$$

Case 1: Both individuals contribute to the public good. Using the fact that we are at an interior solution, we can rewrite  $\partial U_B / \partial t = -F_2 v_B^G < 0$ . Therefore, if both individuals are contributing to the public good, the transfers are zero.

Case 2: The selfish individual is the only contributor. In this case,  $\partial U_B / \partial t < -F_2 v_B^G < 0$ , so that here as in the previous case the optimal level of transfers is zero.

Case 3: The caring individual is the only contributor to the household public good. Replacing in the expression of the partial derivative of  $B$ 's utility with respect to the transfer, we get  $\partial U_B / \partial t = F_1(v_A^q - v_A^G) - F_2 v_B^G$ . Both terms in this expression are positive. The expression can be either positive or negative. If  $B$  values marginally more the disequilibrium for  $A$  than his/her own marginal satisfaction from the public good, transfers will be positive; otherwise transfers will be zero. The case of positive transfers which appears here is the case described by Becker (1981) as providing foundation for the unitary model of household behavior.

To summarize, if the transfers are positive, then we know that the individual transferring is also the only contributor to the public good. Note that this is not an equivalence: there can exist a range of the distribution over which the caring individual is the only contributor but doesn't transfer. If the transfers are zero, then either both are contributing or only one is.

**Income Pooling** If the transfers are positive, then household income is pooled. Indeed in this case, small reallocations of income between household members can be compensated by changes in the level of transfer. As the share of income of the poor individual increases, the transfer decreases, leaving all else unchanged. Income pooling can also emerge, as in the egotistic case, if both individuals contribute to the public good.

**Evolution of expenditure as a function of income share** Let  $\rho^1$  and  $\rho^2$  represent the same critical values for the income share of  $A$  as in the previous case. We introduce another critical value for  $\rho$  here: it is the value of the share of income of member  $A$  below which transfers are positive. We have:

Contributors to Q:	Range of $\rho$	Transfers	Evolution of Expenditure
$B$	$[0, \rho^0]$	$\hat{t} > 0$	$\frac{\partial q^A}{\partial \rho} = \frac{\partial q^B}{\partial \rho} = \frac{\partial G}{\partial \rho} = 0$
$B$	$[\rho^0, \rho^1]$	$\hat{t} = 0$	$\frac{\partial q^A}{\partial \rho} > 0, \frac{\partial q^B}{\partial \rho} < 0, \frac{\partial G}{\partial \rho} = \frac{\partial q^B}{\partial \rho} < 0$
$A$ and $B$	$[\rho^1, \rho^2]$	$\hat{t} = 0$	$\frac{\partial q^A}{\partial \rho} = \frac{\partial q^B}{\partial \rho} = \frac{\partial G}{\partial \rho} = 0$
$A$	$[\rho^2, 1]$	$\hat{t} = 0$	$\frac{\partial q^A}{\partial \rho} > 0, \frac{\partial q^B}{\partial \rho} < 0, \frac{\partial G}{\partial \rho} = \frac{\partial q^A}{\partial \rho} > 0$

### B.1.3. Both members caring

Following the analysis in the previous paragraph, it is obvious that the assumption of mutual caring leads to a third range of values for the income share where household income is pooled.

Note that we have shown that income pooling can emerge as a local property of demand under 2 types of circumstances: 1) "à la Becker", essentially because of the caring hypothesis in a non cooperative context, 2) in the Warr region, because of the interdependency introduced by the presence of the public good in both members, when both are contributing to the public good.

### B.1.4. Multiple public goods

The income pooling result holds over the range of the intra-household distribution where both household members jointly contribute to all the public goods (Bergstrom, Blume and Varian, 1986) and, with caring preferences, over a range of the intra-household distribution where resources are unequal.

## B.2. Bargaining model with non cooperative breakdown point

We now consider the case where household decisions are obtained as solutions of a Nash bargaining game, in which the threat point is the solution of the non cooperative Nash equilibrium of the previous section. Under the standard assumptions on individual utility functions, the solution to a bargaining problem of this sort exists, is unique and efficient.

Preferences are assumed to be selfish for both individuals in the first case, and then either selfish for one individual and caring for the other or caring for both household members. The question is: what properties does the solution of this cooperative game inherit from the non cooperative threat point. The results,

presented here for the case with one private good and one public good generalise to the case of multiple public goods.

### B.2.1. Both members selfish

Each individual's preferences are defined as previously on her/his consumption of private goods and on the household public good,  $U_i = v_i(q^i, Q)$ . Choices are subject to the household budget constraint. The Nash bargaining problem can be written as:

$$\begin{aligned} \max_{q^A, q^B, Q} & [v_A(q^A, Q) - \overline{v}_A] [v_B(q^B, Q) - \overline{v}_B] \\ \text{such that} & q^A + q^B + Q = Y^A + Y^B = Y \end{aligned}$$

***Income pooling*** The Warr region of income pooling is inherited by the Nash solution. To show this, rather than working from the Nash program as it is written just above, it is easier to start from the definition of the Nash solution as Nash had formulated it. The Nash solution is entirely defined by a Pareto frontier and a pair of threat points.

*Proposition 2:* The Nash solution inherits the Warr region of income pooling from the threat point.

*Proof:* Since the Pareto frontier depends only on household income, the Nash solution will depend on household income and whatever defines the threat point. Hence in the region where the threat point depends only on household income, so will the Nash solution, since it is unique. Similarly, in the region where the threat point depend upon the repartition of income, the Nash solution will depend upon the repartition of income between household members.

***Evolution of expenditure as a function of the income share*** There remains to examine what is the behavior of the expenditure on the public good outside the  $[\rho^1, \rho^2]$  interval. For this, we need an additional assumption on individual preferences: we assume that member  $A$  relatively cares more for the public good than does member  $B$ . Outside the Warr region, the threat point depends on the distribution of income, therefore so does the bargaining solution. However, as the share of income of individual  $A$  increases, so does that individual's bargaining power, so that the expenditure on  $A$ 's private goods as well as on the public goods that  $A$  cares for relatively more than  $B$ , does increase.

Contributors to Q:	Range of $\rho$	Evolution of Expenditure
$B$ or $A$	$[0, \rho^1] \cup [\rho^2, 1]$	$\frac{\partial q^A}{\partial \rho} > 0, \frac{\partial q^B}{\partial \rho} < 0, \frac{\partial G}{\partial \rho} > 0$
$A$ and $B$	$[\rho^1, \rho^2]$	$\frac{\partial q^A}{\partial \rho} = \frac{\partial q^B}{\partial \rho} = \frac{\partial G}{\partial \rho} = 0$

### B.2.2. One caring individual or both members caring

The assumption of caring preferences by one or both members adds a region of income pooling when intra-household resources are unequally distributed, "a la Becker".

## C. Data description.

The Canadian FAMEX is a multi-staged stratified clustered survey that collects information on annual expenditures, incomes, labour supply and demographics for individual households. The survey is run in the Spring after the survey year (that is, the information for 1978 was collected in Spring 1979). The survey years are 1969, 1974, 1978, 1982, 1984, 1986, 1990 and 1992. All of the information is collected by interview so that the expenditure and income data are subject to recall bias. Although this may give rise to problems, the FAMEX surveying method has the great advantage that information on annual expenditures is collected. Thus the FAMEX has much less problem with infrequency bias than do surveys based on short diaries. It is also the case that since the survey year coincides with the tax year (January to December) the income information is thought to be unusually reliable since it is collected at about the time that Canadians are filing their (individual) tax returns. These are often explicitly referenced by the enumerators.

Prices are taken from Statistics Canada. When composite commodities are created, the new composite commodity price is the weighted geometric mean of the component prices with budget shares averaged across our sample for weights.

Table *C1* gives the sample selection path followed; the principal selection is on both husband and wife being in full-time employment and their being at least one child present.

Table <i>C1</i> : Sample selection	
	Numbers in sample
Couples with children	17,848
Both in full-time employment	2,815
Both partners have positive incomes	2,799
No adult children	2,298
Drop zero and high budget shares	2,034
Wife's share > 0.05	2,029

Tables *C2* and *C3* present sample means and other statistics for all of the variables used in the analysis (except for the prices).

Table C2: BUDGET SHARES AND INCOMES.		
BUDGET SHARES	Mean	Standard deviation
FOOD AT HOME	21.67	6.9
HOUSEHOLD OPERATIONS	12.99	4.5
WOMEN'S CLOTHING	5.1	3.3
MEN'S CLOTHING	3.83	2.4
CHILDREN'S CLOTHING	3.57	2.2
VICES	5.53	4.5
HOUSEHOLD NET INCOME*	54,867	18,600
HUSBAND'S GROSS EARNINGS*	41,423	19,553
WIFE'S GROSS EARNINGS*	27,822	13,343
WIFE'S SHARE	0.40	0.12
TOTAL NONDURABLE EXPENDITURE*	30,239	9,703
* All values in 1992 Canadian dollars.		

Table C3: MEANS OF DEMOGRAPHIC VARIABLES	
	MEAN
ATLANTIC	0.206
QUEBEC	0.183
PRAIRIES	0.231
B.C.	0.077
HOMEOWNER	0.796
CITY DWELLER	0.720
HUSBAND'S AGE	36.1
WIFE'S AGE	33.6
NUMBER OF YOUNG CHILDREN	0.36
NUMBER OF OLDER CHILDREN	1.45
MORE THAN HIGH SCHOOL*	0.542
FRANCOPHONE*	0.189
ALLOPHONE*	0.153
* Refers to husband.	

## D. Detailed results.

Table D 1: Parameter Estimates of the Caring Collective Model. Flat-slope-flat model Food at home			
	Coefficient	Standard Error	T-Value
Constant	37.944	27.261	1.392
Age	1.431	0.342	4.182
Age squared	0.079	0.228	0.347
Number of young children	1.519	0.294	5.165
Number of medium children	2.560	0.166	15.463
Spouse age	0.382	0.375	1.019
Husband Francophone	0.335	0.489	0.685
Husband allophone	1.132	0.388	2.917
House owner	-0.781	0.335	-2.329
City residence	-0.030	0.283	-0.107
Education beyond High School	0.173	0.253	0.684
Region Atlantic	-1.897	1.101	-1.723
Region Quebec	0.188	0.650	0.289
Region Prairies	-1.165	0.670	-1.740
Region British Columbia	-0.264	0.751	-0.352
ln (Price of Food)	12.371	5.208	2.375
ln (Price of Household Operations)	-0.232	7.680	-0.030
ln (Price of Tobacco)	-4.428	1.692	-2.618
ln (Price of Alcohol)	18.060	7.915	2.282
ln (Price of clothing)	-3.814	2.958	-1.289
ln (Price of Restaurant)	-4.086	5.485	-0.745
ln (Price of Gas)	0.362	2.251	0.161
ln (Price of Care)	-3.789	2.160	-1.754
ln (Price of Transportation)	-7.724	3.008	-2.567
ln (Price of Services)	3.276	3.640	0.900
ln (Price of Suppl)	-1.896	8.504	-0.223
ln (Price of Recreation)	8.101	6.825	1.187
ln (Price of Furn)	-12.529	8.518	-1.471
ln (Price of Carp)	-9.571	6.934	-1.380
ln (Total Expenditure)	17.740	13.695	1.295
ln (Total Expenditure) Squared	-4.253	1.999	-2.127
Rho	-3.886	1.709	-2.273

Table D2: Parameter Estimates of the Caring Collective Model. Flat-slope-flat model Household Operations			
	Coefficient	Standard Error	T-Value
Constant	45.181	20.443	2.210
Age	-0.191	0.268	-0.715
Age squared	-0.128	0.174	-0.732
Number of young children	0.439	0.209	2.097
Number of medium children	0.242	0.111	2.184
Spouse age	0.962	0.275	3.501
Husband Francophone	-0.980	0.356	-2.754
Husband allophone	-0.245	0.257	-0.952
House owner	2.611	0.248	10.528
City residence	-1.119	0.203	-5.516
Education beyond High School	-0.236	0.181	-1.304
Region Atlantic	0.928	0.761	1.219
Region Quebec	-0.249	0.458	-0.545
Region Prairies	-0.440	0.457	-0.963
Region British Columbia	-1.092	0.527	-2.072
ln (Price of Food)	-5.997	3.694	-1.624
ln (Price of Household Operations)	8.864	5.208	1.702
ln (Price of Tobacco)	-1.289	1.180	-1.092
ln (Price of Alcohol)	2.932	5.593	0.524
ln (Price of clothing)	1.221	2.005	0.609
ln (Price of Restaurant)	1.846	3.867	0.477
ln (Price of Gas)	-1.907	1.537	-1.241
ln (Price of Care)	-2.117	1.547	-1.368
ln (Price of Transportation)	-1.751	2.076	-0.844
ln (Price of Services)	3.179	2.461	1.292
ln (Price of Suppl)	-4.737	5.945	-0.797
ln (Price of Recreation)	-6.381	4.886	-1.306
ln (Price of Furn)	4.473	5.924	0.755
ln (Price of Carp)	4.953	5.052	0.980
ln (Total Expenditure)	-25.455	10.559	-2.411
ln (Total Expenditure) Squared	3.318	1.547	2.145
Rho	-2.524	1.273	-1.982

Table D3: Parameter Estimates of the Caring Collective Model. Flat-slope-flat model Women's clothing			
	Coefficient	Standard Error	T-Value
Constant	6.745	12.944	0.521
Age	-0.089	0.183	-0.486
Age squared	-0.180	0.103	-1.737
Number of young children	-1.255	0.150	-8.358
Number of medium children	-0.783	0.087	-8.989
Spouse age	-0.029	0.228	-0.125
Husband francophone	0.411	0.267	1.536
Husband allophone	0.565	0.221	2.560
House owner	-0.075	0.174	-0.431
City residence	-0.127	0.154	-0.825
Education beyond High School	-0.202	0.147	-1.378
Region Atlantic	-0.576	0.644	-0.895
Region Quebec	0.110	0.345	0.319
Region Prairies	-0.063	0.372	-0.170
Region British Columbia	-0.785	0.429	-1.832
ln (Price of Food)	-1.887	3.097	-0.609
ln (Price of Household Operations)	1.335	4.436	0.301
ln (Price of Tobacco)	-1.495	0.925	-1.616
ln (Price of Alcohol)	5.754	4.382	1.313
ln (Price of clothing)	-1.535	1.686	-0.910
ln (Price of Restaurant)	1.870	3.095	0.604
ln (Price of Gas)	-1.147	1.250	-0.918
ln (Price of Care)	-1.036	1.211	-0.856
ln (Price of Transportation)	-0.333	1.688	-0.197
ln (Price of Services)	-1.829	2.078	-0.880
ln (Price of Suppl)	1.073	4.671	0.230
ln (Price of Recreation)	-1.759	3.915	-0.449
ln (Price of Furn)	1.444	4.965	0.291
ln (Price of Carp)	-1.304	3.902	-0.334
ln (Total Expenditure)	-1.171	6.241	-0.188
ln (Total Expenditure) Squared	0.700	0.934	0.749
Rho	3.314	0.887	3.736

Table D4: Parameter Estimates of the Caring Collective Model. Flat-slope-flat model Men's clothing			
	Coefficient	Standard Error	T-Value
Constant	26.000	9.528	2.729
Age	0.007	0.132	0.051
Age squared	-0.088	0.072	-1.227
Number of young children	-0.509	0.112	-4.537
Number of medium children	-0.332	0.061	-5.429
Spouse age	-0.105	0.152	-0.694
Husband francophone	0.316	0.176	1.796
Husband allophone	0.314	0.151	2.074
House owner	0.013	0.133	0.095
City residence	-0.093	0.110	-0.840
Education beyond High School	-0.350	0.105	-3.337
Region Atlantic	0.126	0.474	0.265
Region Quebec	0.337	0.244	1.378
Region Prairies	0.053	0.264	0.199
Region British Columbia	-0.303	0.290	-1.042
ln (Price of Food)	1.455	2.022	0.719
ln (Price of Household Operations)	-1.332	3.070	-0.434
ln (Price of Tobacco)	0.335	0.684	0.490
ln (Price of Alcohol)	1.748	3.138	0.557
ln (Price of clothing)	-1.847	1.261	-1.465
ln (Price of Restaurant)	-0.419	2.247	-0.187
ln (Price of Gas)	-1.425	0.883	-1.613
ln (Price of Care)	-0.233	0.869	-0.268
ln (Price of Transportation)	0.200	1.236	0.162
ln (Price of Services)	-0.054	1.427	-0.038
ln (Price of Suppl)	4.935	3.443	1.433
ln (Price of Recreation)	-6.468	2.713	-2.384
ln (Price of Furn)	5.227	3.422	1.528
ln (Price of Carp)	-3.070	2.679	-1.146
ln (Total Expenditure)	-12.017	4.819	-2.494
ln (Total Expenditure) Squared	2.093	0.728	2.873
Rho	-1.335	0.689	-1.939

Table D5: Parameter Estimates of the Caring Collective Model. Flat-slope-flat model Kid's clothing			
	Coefficient	Standard Error	T-Value
Constant	-0.188	8.328	-0.023
Age	0.205	0.124	1.651
Age squared	-0.193	0.082	-2.345
Number of young children	0.183	0.111	1.655
Number of medium children	1.037	0.067	15.390
Spouse age	-0.179	0.138	-1.298
Husband francophone	0.117	0.158	0.745
Husband allophone	0.025	0.124	0.202
House owner	-0.071	0.102	-0.697
City residence	-0.252	0.098	-2.585
Education beyond High School	0.043	0.085	0.502
Region Atlantic	0.570	0.354	1.612
Region Quebec	0.016	0.197	0.082
Region Prairies	0.191	0.224	0.854
Region British Columbia	-0.343	0.237	-1.445
ln (Price of Food)	0.469	1.708	0.274
ln (Price of Household Operations)	-4.568	2.438	-1.873
ln (Price of Tobacco)	-0.860	0.570	-1.508
ln (Price of Alcohol)	-0.082	2.629	-0.031
ln (Price of clothing)	-2.782	1.015	-2.741
ln (Price of Restaurant)	2.836	1.779	1.594
ln (Price of Gas)	-0.586	0.711	-0.825
ln (Price of Care)	0.576	0.726	0.794
ln (Price of Transportation)	-0.087	0.967	-0.090
ln (Price of Services)	-0.838	1.133	-0.739
ln (Price of Suppl)	6.626	2.787	2.377
ln (Price of Recreation)	2.586	2.349	1.101
ln (Price of Furn)	-2.007	2.790	-0.719
ln (Price of Carp)	-0.690	2.394	-0.288
ln (Total Expenditure)	-0.173	4.103	-0.042
ln (Total Expenditure) Squared	-0.001	0.608	-0.001
Rho	1.542	0.585	2.637

Table D6: Parameter Estimates of the Caring Collective Model. Flat-slope-flat model Vices			
	Coefficient	Standard Error	T-Value
Constant	7.109	23.716	0.300
Age	-0.132	0.296	-0.444
Age squared	-0.013	0.178	-0.072
Number of young children	-0.764	0.229	-3.334
Number of medium children	-0.242	0.130	-1.853
Spouse age	-0.333	0.346	-0.962
Husband francophone	0.244	0.347	0.702
Husband allophone	-1.350	0.285	-4.746
House owner	-1.423	0.275	-5.178
City residence	0.433	0.220	1.972
Education beyond High School	1.223	0.207	5.900
Region Atlantic	-0.684	0.886	-0.772
Region Quebec	-0.207	0.485	-0.426
Region Prairies	-0.440	0.533	-0.826
Region British Columbia	-0.379	0.579	-0.654
ln (Price of Food)	0.834	4.152	0.201
ln (Price of Household Operations)	0.941	5.766	0.163
ln (Price of Tobacco)	-0.674	1.272	-0.530
ln (Price of Alcohol)	7.868	6.400	1.230
ln (Price of clothing)	-4.686	2.387	-1.963
ln (Price of Restaurant)	-3.230	4.381	-0.737
ln (Price of Gas)	1.150	1.608	0.715
ln (Price of Care)	-2.398	1.750	-1.370
ln (Price of Transportation)	-1.816	2.376	-0.764
ln (Price of Services)	2.749	2.679	1.026
ln (Price of Suppl)	-4.300	6.766	-0.636
ln (Price of Recreation)	-1.287	5.573	-0.231
ln (Price of Furn)	7.371	7.018	1.050
ln (Price of Carp)	-4.336	5.658	-0.766
ln (Total Expenditure)	5.156	12.245	0.421
ln (Total Expenditure) Squared	-0.838	1.791	-0.468
Rho	-1.424	1.390	-1.024

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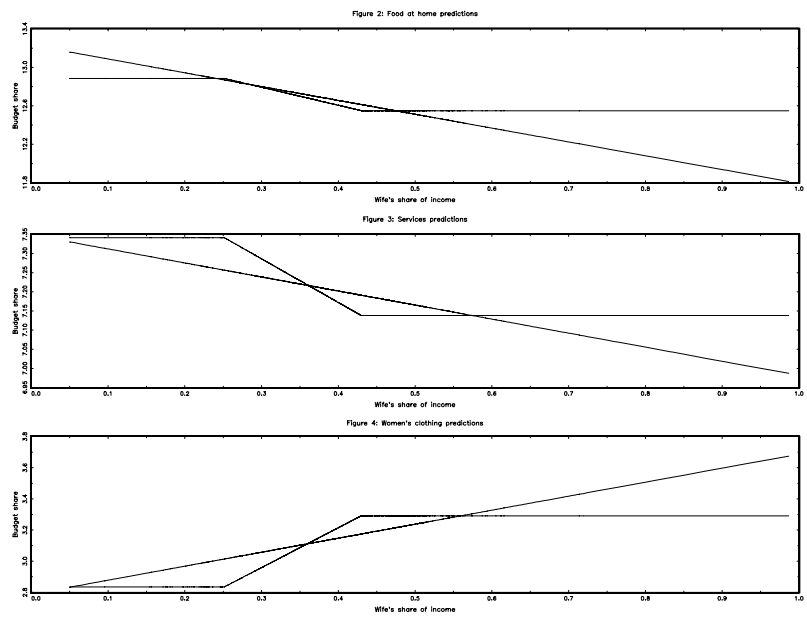


Figure 5:

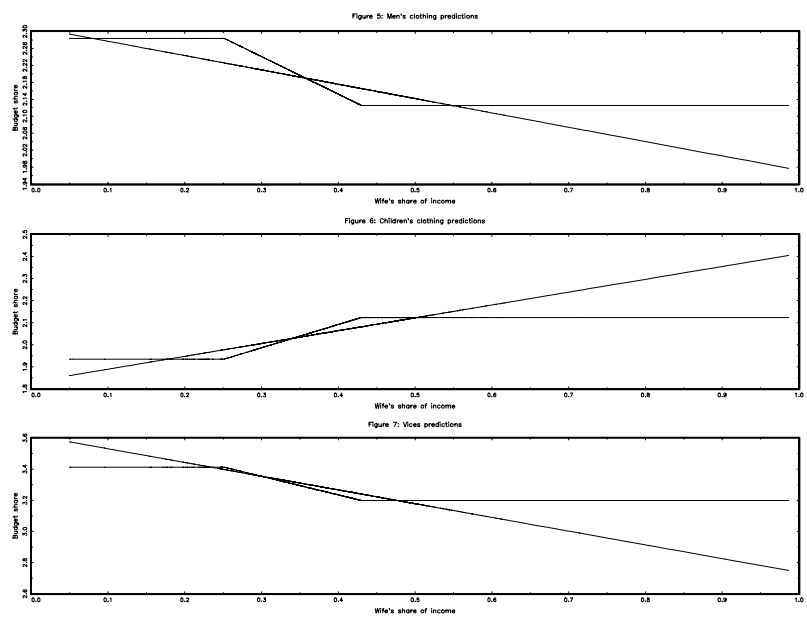


Figure 6: