INTRA HOUSEHOLD RESOURCE ALLOCATION, CONSUMER PREFERENCES AND COMMODITY TAX REFORMS: THE AUSTRALIAN EVIDENCE*

by

Paul Blacklow

School of Economics
University of Tasmania
GPO Box 252-85
Hobart Tasmania 7001
Australia

Tel: +61 (0)3 6226 2283
Fax: +61 (0)3 6226 7587
email: Paul.Blacklow@utas.edu.au

Ranjan Ray

School of Economics
University of Tasmania
GPO Box 252-85
Hobart Tasmania 7001
Australia

Tel: +61 (0)3 6226 2275
Fax: +61 (0)3 6226 7587
email: Ranjan.Ray@utas.edu.au

October 2002

* The research for this paper was supported by an Australian Research Council (Large) grant to the second author.

ABSTRACT

Empirical analysis of household expenditure behaviour has traditionally ignored the issue of resource allocation between household members, assuming that they have identical or unitary preferences. This paper relaxes that assumption and develops a household utility maximising resource sharing rule and demand systems, able to identify differences in the expenditure preferences of household members, from household level data. The resulting price and expenditure elasticities are used to demonstrate that collective demand models suggest different directions for commodity tax reforms than that of the traditional unitary model.

Keywords: Intra Household Resource Allocation, Intra Household Demand Systems, Marginal Commodity Tax Reforms.

JEL Classification: D11, D12, D13, H21

1. INTRODUCTION

Empirical analysis of household expenditure has traditionally been based on the unitary model that assumes identical preferences of the household members. The assumption of common preference ordering among family members can be traced to Samuelson (1956) and Becker (1981). The assumption of common preferences, also, underlines much of the literature on optimal commodity taxes and tax reforms [see, for example, Atkinson and Stiglitz (1980), Ray (1999)] via its linkage with utility theory and maximisation of household welfare. The unitary model has been increasingly challenged in recent years through attempts at incorporating the divergent and conflicting preferences of different family members. Examples include the cooperative bargaining models [Manser and Brown (1980), McElroy and Horney (1981), Moehling (1995)], the non cooperative bargaining models [Kanbur and Haddad (1994), Lundberg and Pollak (1994)], and the "sharing rule" approach based on a Pareto efficient sharing rule between household members [Chiappori (1988), Browning and Chiappori (1998)]. Crucial to the non unitary models is the relative "power" of individual members in the household [see Pollak (1994)].

Notwithstanding significant methodological advances, the empirical evidence on non unitary or collective choice models in the consumer demand literature is virtually non existent. There are two principal reasons: (a) absence of the required disaggregated information on the earnings and expenditure of the household members, and (b) lack of an intra household demand system that is explicitly based on a resource allocation mechanism and takes account of the varying preferences inside the household. As Basu (2001) has recently pointed out, a distinctive, perhaps limiting, characteristic of the literature on non unitary models is that the welfare weights assigned to the household members are fixed and exogenous to household decisions.

The principal motivation of this study is to fill these gaps in the empirical demand literature. The paper proposes a welfare maximisation based household resource sharing rule, which is used to derive collective household demand models. The resource sharing rule, which is endogenously derived and estimated on budget data, is shown to play a useful role in identifying the separate preference parameter estimates of the individuals inside the household. The paper proposes alternative methodologies for deriving intra household demand models that incorporate the preferences of the individual household members and are based on the household sharing rule introduced here. The alternative intra household demand models are estimated and the expenditure, price elasticities compared not only with one another but with those of the standard demand system based on the unitary model.

The paper, then, demonstrates the policy usefulness of the intra household demand models, proposed here, by using the demand estimates in tax reform analysis. One of the chief policy applications of empirical demand analysis in recent years has been in using the price, expenditure elasticities to calculate the direction of welfare improving marginal commodity tax reforms [see, for example, Ahmad and Stern (1984), Decoster and Schokkaert (1990), Madden (1996), Ray (1997, 1999)]. The results of these studies, which are all based on the unitary model, generally suggest that the direction of marginal commodity tax reforms are insensitive to changes in demand specification. The present study compares the direction of marginal commodity tax reforms between the unitary and intra household demand models and, also, between the alternative variants of the latter. An important finding of this study is that the picture of robustness of marginal tax reforms to demand specification in the unitary model does not extend to the non unitary case. The directions of commodity tax reforms are sensitive to whether the unitary or the collective demand model is used to calculate the required price elasticities.

The plan of this paper is as follows. The theoretical framework is presented and the estimating equations are derived in Section 2. Section 2.1 presents the resource sharing rule inside the household, Section 2.2 derives the alternative intra household demand models that are based on the resource sharing rule, and Section 2.3 presents the marginal social cost expressions that provide the basis for the tax reform calculations. The data is briefly described in Section 3. The results are presented and analysed in Section 4. The paper ends on the concluding note of Section 5.

2. THEORETICAL FRAMEWORK

The household is assumed to be involved in a 2 step welfare maximisation exercise in order to arrive at the intra household demand model. The assumption of weak separability between goods and leisure is required for this 2 step exercise. In step 1, the household decides on the intra household resource sharing rule by maximising its welfare function defined over the earnings of the individual members. In step 2, the household, using the resource sharing rule thus derived, decides on the various quantities by maximising preferences subject to the individual budget constraints implied by the resource sharing rule. The distinction between the intra household demand equation and the traditional unitary model stems from the fact that the former recognises the individual preferences and the resource sharing rule, the latter does not. This paper introduces two variants of intra household demand model which differ in the manner the individual preferences are taken into account on way to obtaining aggregate household demand that can be estimated on conventional expenditure information on the aggregate household.

To keep this exercise manageable, we consider only households which consist of a man and a woman, both of whom are working, with no children or elderly dependents. In Section 2.1, we introduce an extension of the resource sharing rule, originally proposed in

Koolwal and Ray (2001), and in Section 2.2, we derive the alternative forms of the intra household demand model.

2.1 Resource Allocation Inside the Household

Following the "collective approach" outlined in Koolwal and Ray (2001), the household welfare or utility function is given by:

$$\mathrm{U} = \theta(\mathbf{z})\mathrm{u}_1(\mathbf{q}) + (1-\theta(\mathbf{z}))\mathrm{u}_2(\mathbf{q}) \tag{1}$$

where u_1, u_2 denote, respectively, the individual utilities of the woman and the man specified as a function of goods and leisure, **q**. The balance of power in the household (θ) is dependent of the vector of earnings (z_1, z_2). As θ increases, the 'power' of the woman increases. The "collective approach" either considers θ to be fixed or specifies the earnings variables to be exogenous to the analysis so that θ is also exogenously given. The unitary model imposes the restriction of common preferences on (1), ie., $\mathrm{u}_1(\mathbf{q}) = \mathrm{u}_2(\mathbf{q}) = \bar{\mathrm{u}}(\mathbf{q})$.

To simplify the estimation, let us assume leisure goods separability and specify the individual utilities to be functions of leisure hours, ie., l_1, l_2 that are, respectively, the leisure hours of the woman and of the man. The individual utilities, namely, $u_1(l_1,l_2)$, $u_2(l_1,l_2)$ allow the individuals to care for their spouses' leisure, besides their own.

The household's welfare maximisation problem can, therefore, be written as:

$$\max_{\{\text{w.r.t } l_1, l_2\}} \theta(\mathbf{z})\mathrm{u}_1(l_1,l_2) + (1-\theta(\mathbf{z}))\mathrm{u}_2(l_1,l_2) \tag{2}$$

subject to

$$w_1 l_1 + w_2 l_2 + x \le y \tag{3}$$

where **z** denotes the vector of earnings, w_1, w_2 are the market wage of women, men, respectively, (considered exogenous in this analysis), x is aggregate household expenditure and y is unearned income. If we recognise leisure hours as, simply, the negative of labour hours (h_1, h_2), then welfare maximisation involves minimising the function:

$$\theta(\mathbf{z})u_1(h_1,h_2)+(1-\theta(\mathbf{z}))u_2(h_1,h_2) \tag{4}$$

Note that the utilities are decreasing in labour hours.

We choose a simple functional form for the female power variable:

$$\theta(z_1,z_2)=\left(\frac{z_1}{z_1+z_2}\right)^{\varphi} \tag{5}$$

where $z_i = w_i h_i$ is labour earnings (i = 1, 2). ϕ allows the female's "power" to exceed her share of exceed earnings if $\phi < 1$ and to fall short of it if $\phi > 1$. A test of $\phi = 1$ constitutes a test of Basu (2001)'s assumption that the female's share of adults earnings is a correct measure of her bargaining power.

Let us choose the following functional forms for u_1, u_2:

$$u_1(h_1,h_2)=h_1^{-\rho_{11}}h_2^{-\rho_{12}} \tag{6a}$$

$$u_2(h_1,h_2)=h_1^{-\rho_{21}}h_2^{-\rho_{22}} \tag{6b}$$

$\rho_{11} > 0$, $\rho_{12} > 0$, $\rho_{21} > 0$, $\rho_{22} > 0$

Note that while ρ_{11}, ρ_{22} denote the individuals' disutility from their own work hours, ρ_{12}, ρ_{21} denote the disutility from their spouse's work hours. For simplicity of estimation, we assume symmetric disutility ie. $\rho_{12} = \rho_{21}$. After routine manipulation, the welfare maximisation exercise yields the following earnings share equations for female and male, respectively.

$$s_1 \equiv \frac{w_1 h_1}{Z} = \frac{\theta\rho_{11}u_1+(1-\theta)\rho_{12}u_2+\theta_1 h_1(u_2-u_1)}{\theta(\rho_{11}+\rho_{12})u_1+(1-\theta)(\rho_{12}+\rho_{22})u_2} \tag{7a}$$

$$s_2 \equiv \frac{w_2 h_2}{Z} = \frac{(1-\theta)\rho_{22}u_2+\theta\rho_{12}u_1+\theta_2 h_2(u_2-u_1)}{\theta(\rho_{11}+\rho_{12})u_1+(1-\theta)(\rho_{12}+\rho_{22})u_2} \tag{7b}$$

where $Z = w_1 h_1 + w_2 h_2$ is total household earnings, u_1, u_2 are the individual utilities defined earlier and $\theta_1 = \frac{\partial\theta}{\partial h_1} > 0$, $\theta_2 = \frac{\partial\theta}{\partial h_2} < 0$ denote the responsiveness of the female's bargaining power to female and male labour hours, respectively. In conventional treatments of the collective model, $\theta_1 = \theta_2 = 0$.

2.2 The Intra Household Demand Models

The two intra household demand models that are introduced here will be referred to as IHI (intra household model with individual optimisation) and IHJ (intra household model with joint optimisation). While the former is based on the individual maximising her/his preferences, the latter is based on the joint preferences of the spouses taking into account their individual preferences. Both these models assume PIGLOG preferences for the individuals inside the household but allow the preference parameters to vary between the individuals. In more detail, the alternative models are as follows:

Intra Household Demand Model with Individual Optimisation (IHI):

Individual i's preferences are given by:

$$\mathrm{v}^{\mathrm{i}} = \frac{\log x^{\mathrm{i}} - \log \mathrm{a}^{\mathrm{i}}(\mathbf{p})}{\mathrm{b}^{\mathrm{i}}(\mathbf{p})} \tag{8}$$

i = 1, 2

where $x^{\mathrm{i}} = \theta^{\mathrm{i}} x$ is the resource available to i based on the resource allocation rule, outlined above, θ^{i} is the welfare weight of i, **p** is the vector of prices, and x is the total expenditure resources available to the household. This leads to individuals i's demand equation for item j.

$$w_{\mathrm{j}}^{\mathrm{i}} = \mathrm{a}_{\mathrm{j}}^{\mathrm{i}}(\mathbf{p}) + \frac{\mathrm{b}_{\mathrm{j}}^{\mathrm{i}}(\mathbf{p})}{\mathrm{b}(\mathbf{p})} \log\left[\frac{x^{\mathrm{i}}}{\mathrm{a}^{\mathrm{i}}(\mathbf{p})}\right] \tag{9}$$

where $\mathrm{a}_{\mathrm{j}}^{\mathrm{i}}(\mathbf{p}), \mathrm{b}_{\mathrm{j}}^{\mathrm{i}}(\mathbf{p})$ are the derivatives of log $\mathrm{a}^{\mathrm{i}}(\mathbf{p})$, $\mathrm{b}^{\mathrm{i}}(\mathbf{p})$, respectively, with respect to the log of price of j. Assuming the AIDS functional forms for $\mathrm{a}^{\mathrm{i}}(\mathbf{p})$, $\mathrm{b}^{\mathrm{i}}(\mathbf{p})$, the individual's budget share for item j are given by:

$$w_j^i = \alpha_j^i + \sum_k \gamma_{jk}^i \log p_k + \beta_j^i \log\left[\frac{x^i}{a^i(\mathbf{p})}\right] \tag{10}$$

i = 1, 2
j = 1,.., *n*

where $\log a^i(\mathbf{p}) = \alpha_0^i + \sum_{j=1}^{n} \alpha_j^i \log p_j + \frac{1}{2}\sum_j \sum_k \gamma_{jk}^i \log p_j \log p_k$ and $b^i(\mathbf{p}) = \beta_0 \prod_k p_k^{\beta_k^i}$.

Since the individual budget shares, w_j^i, are not observed on conventional survey data, only the aggregate budget shares, we aggregate the individuals' budget shares w_j^i into household level budget shares, w_j, as follows:

$$w_j = \theta w_j^1 + (1-\theta) w_j^2 \tag{11}$$

where w_j^1, w_j^2 are given by (10) above. In the empirical application, we assume that the γ_{jk}'s are invariant between individuals, ie., $\gamma_{jk}^i = \gamma_{jk}$. The IHI demand equations are given by:

$$w_{jh} = \theta_h \alpha_j^1 + (1-\theta_h)\alpha_j^2 + \sum_{k=1}^{n} \gamma_{jk} \log p_k + \theta_h \beta_j^1 \log\left(\tilde{x}_h^1\right) + (1-\theta_h)\beta_j^2 \log\left(\tilde{x}_h^2\right) \tag{12}$$

j = 1,…,n

where the subscript h denotes household, and $\tilde{x}_h^i$ denotes the price deflated real expenditure of individual i in household h, ie.,

$$\log\left(\tilde{x}_h^i\right) = \log\left(\frac{\theta_h^i x_h}{a^i(\mathbf{p})}\right) \tag{13}$$

i = 1,…2

Note that if individual preferences are identical, ie., $\alpha_j^1 = \alpha_j^2$, $\beta_j^1 = \beta_j^2$, then the intra household AIDS (IHI), given by eqn. (12), specialises to the unitary AIDS model, with the resource sharing variable, θ_h, having an impact on the budget share only through the intercept term.

The estimation of (12) follows the two step decision making outlined earlier. In step 1, we estimate ϕ, ρ_{11}, ρ_{12}, ρ_{22} from eqn. (7a) on earnings data. Note that since $s_1 + s_2 = 1$, (7b) is not independent of (7a). Consequently, the sharing rule parameters are estimated by single equation estimation of (7a) using non linear least squares. In step 2, the estimated ϕ is used to generate the θ_h variable via eqn. (5). These (θ_h) are, then, used to identify and estimate the individual specific parameters, $\left(\alpha_j^i, \beta_j^i\right)$, besides the common preference parameters, γ_{jk}, in the second step estimation of eqn. (12) using FIML.

Intra Household Demand Model with Joint Optimisation (IHJ):

The household utility function, V, is defined as a θ-weighted function of the individual utilities, v^i:

$$V = \theta v^1 + (1-\theta) v^2 \tag{14}$$

where V^i is defined in eqn. (8). Hence,

$$V = \theta\left[\frac{\log(\theta x) - \log\ a^1(\mathbf{p})}{b^1(\mathbf{p})}\right] + (1-\theta)\left[\frac{\log((1-\theta)x) - \log\ a^2(\mathbf{p})}{b^2(\mathbf{p})}\right] \tag{15}$$

where, as before, θ is the female power variable. Assuming, as before, AIDS functional forms for $a^i(\mathbf{p})$, $b^i(\mathbf{p})$, we obtain, after routine manipulation, the cost or expenditure function, x, of the household. In logarithmic form, it is given by:

$$\log\ x = B_0 - B_1 + \beta_0 B_2 V \tag{16}$$

where:

$$B_0 = \frac{1}{\theta b^2(\mathbf{p}) + (1-\theta) b^1(\mathbf{p})}\left[\theta \tilde{a}^1 b^2(\mathbf{p}) + (1-\theta)\tilde{a}^2 b^1(\mathbf{p})\right] \tag{17a}$$

$$B_1 = \frac{1}{\theta b^2(\mathbf{p}) + (1-\theta) b^1(\mathbf{p})}\left[(\theta \log\theta) b^2(\mathbf{p}) + \{(1-\theta)\log(1-\theta)\} b^1(\mathbf{p})\right] \tag{17b}$$

$$B_2 = \frac{b^1(\mathbf{p}) b^2(\mathbf{p})}{\theta b^2(\mathbf{p}) + (1-\theta) b^1(\mathbf{p})} \tag{17c}$$

and

$$\tilde{a}^i = \log a^i(\mathbf{p}) \tag{17d}$$

On application of Shephard's Lemma to (16), we obtain the IHJ demand system in budget share terms as follows:

$$w_j = B_0' - B_1' + \frac{B_2'}{B_2}\left[\log x - B_0 + B_1\right] \tag{18}$$

where $$B_0' = \frac{\partial B_0}{\partial \log p_i}, B_1' = \frac{\partial B_1}{\partial \log p_i}, B_2' = \frac{\partial B_2}{\partial \log p_i}$$

Note that, as with IHI (eqn. 12), if individuals' preferences are identical, then IHJ (eqn. 18) specialises to the conventional unitary AIDS model.

2.3 Marginal Tax Reforms

If λ_j (j = 1,…,n) denotes the marginal social cost of raising an extra unit of revenue by taxing the jth. commodity, then

$$\lambda_j = -\frac{\partial W / \partial p_j}{\partial R / \partial p_j} \tag{19}$$

where W is social welfare defined over the household utilities, p_j is the tax inclusive consumer price of j, and R is the aggregate revenue that is to be raised. (19) assumes that taxes, (t_j) are passed on fully to the consumer. Using Roy's identify, λ_j can be expressed as follows [See Ray (1999)]:

$$\lambda_j = \frac{\sum_h \omega_h x_{jh}}{X_j + \sum_{k=1}^{n} \tilde{t}_k X_k e_{kj}} \tag{20}$$

j = 1,…,n

where x_{jh} is money expenditure on item j by household h, $X_j = \sum_h x_{jh}$ is aggregate money expenditures on item j, $\tilde{t}_k = \frac{t_k}{p_k}$ is the tax rate on k, ω^h is the social marginal utility of income to household h, and e_{kj} is the aggregate uncompensated price elasticity of k wrt. j.

If $\lambda_j \neq \lambda_k$, then social welfare can be increased by reducing taxes on commodities with high λ_j and raising taxes on others. In other words, a welfare improving tax reform rule is: if $\lambda_j > \bar{\lambda}$ (mean λ), then tax on j (t_j) should be reduced, and if $\lambda_j < \bar{\lambda}$, then, t_j should be increased. The scope for welfare improving commodity tax changes exists until the λ_j s. are all equal, which characterises the state where commodity taxes are optimal. Hence, a ranking of the λ_j s. in increasing order of magnitude provides the direction of marginal tax reforms, with items with lower ranked λ_j candidates for tax increase, and those with higher ranked λ_j candidates for tax decrease. It is clear from (20) that λ_j s. depend on, among others, the uncompensated price elasticities (e_{kj}) which are calculated from the demand system parameter estimates. This establishes the potential sensitivity of tax reform direction to the demand system used to calculate the price elasticities, an issue that we examine empirically in this study.

Following Ahmad and Stern (1984), nearly all the marginal tax reform studies use the isoelastic social welfare function to calculate the welfare weights, ω^h. We continue this practice in this study. Normalising $\omega' = 1$ for the poorest household, this leads to

$$\omega_h = \left(\frac{x_1}{x_h}\right)^{\varepsilon} \tag{21}$$

where $\varepsilon \geq 0$ denotes inequality aversion, and x_h is the aggregate expenditure of household h. Note that since we are considering only two adult households consisting of a working woman and a working man, there is no need to correct for household size and composition using equivalence scales.

3. DATA

The demand estimation is based on pooled expenditure data on 19716 adult couples (both spouses working), with no dependents, from the 1975-76, 1984, 1988-89, 1993-94 and 1998-99 Household Expenditure Surveys (HES) published by the Australian Bureau of Statistics (ABS). The prices for the broad commodities were derived from the capital city based CPI series. The demand estimation, using FIML, was based on observations which were weighted by the households survey weights.

The resource sharing parameter, ϕ, was estimated, along with the labour hours disutility parameters (ρ_{11}, ρ_{12}, ρ_{22}), from the application of non linear least squares to eqn. (7a) on the 1998-99 HES. The earnings and hours information were taken directly from the person records in the 1998-99 HES. As with the demand estimation, the resource share equation was estimated on data on adult couple households with both spouses working and with no dependents.

The tax reforms calculations were performed on the data in the 1998-99 HES on two adult households with no children or dependents. The actual tax rates $\left(\tilde{t}_k\right)$ that are required to calculate the marginal social cost, λ_j, (see eqn. (20)) are the post-GST effective tax rates in Australia in 2000-01 calculated and used in our study on optimal commodity taxes (see Blacklow and Ray (2000)).

The demand estimation and the tax reform analysis were carried out on the following nine good disaggregation of consumer expenditure: food and non-alcoholic beverages; housing (rent, mortgage interest, equipment and services); fuel, electricity and gas; clothing and footwear; transport and communications; medical and personal care; alcohol and tobacco; entertainment; and miscellaneous (including education and credit card interest payments as the main items).

4. RESULTS

Table 1 presents the results of estimating the resource equation (7a). The parameter estimates, which are all well determined, suggest that the female cares more for the leisure of her partner $\left(\hat{\rho}_{12} = 3.96\right)$ than for her own $\left(\hat{\rho}_{11} = 0.013\right)$. Moreover, the male's disutility from work $\left(\hat{\rho}_{22} = 4.33\right)$ exceeds that of the female $\left(\hat{\rho}_{11} = 0.013\right)$ by a long margin. The parameter of crucial importance for the rest of this study is the resource sharing parameter, ϕ. The ϕ estimate of 0.831, which is consistent with the ϕ estimate of 0.889 for Nepal reported in Koolwal and Ray (2001), suggests that the woman's share of wage earnings in the household is an understatement of her true bargaining power. Note from Table 1 that $\phi = 1$ is easily rejected by the data.

Table 2 contains evidence on the preference heterogeneity between women and men that forms the basis of the intra household demand models that are proposed and estimated here. For reasons of space and clarity of presentation, we do not report the parameter estimates themselves but these are available on request. Table 2 reports, for the two intra household demand models, the difference (along with its standard error) in the estimates of α_i, β_i between the spouses, ie., $\hat{\alpha}_i^1 - \hat{\alpha}_i^2$, $\hat{\beta}_i^1 - \hat{\beta}_i^2$ (i = 1,…,9). Note that $\hat{\alpha}_i^1 = \hat{\alpha}_i^2$, $\hat{\beta}_i^1 = \hat{\beta}_i^2$ for the unitary AIDS and, also, that the γ_{ij}s. are identical across individuals in all the models. Table 2 provides considerable evidence of preference heterogeneity between the spouses, since several of the differences between the parameter estimates are statistically significant. However, the intra household demand systems don't agree beyond that. The magnitude of the difference and, sometimes, even the sign vary sharply between the two intra household demand models. One of their rare points of agreement is that the food parameter estimates (α_1, β_1) are invariant between the spouses since the difference is statistically insignificant in all the four cases. The overall message is that, while the assumption of identical preferences underlying the unitary demand model is decisively rejected by the data, the nature and magnitude of preference heterogeneity is sensitive to the manner in which the individual preferences are aggregated into the household demand model.

Tables 3, 4 compare the expenditure and own price elasticities between the unitary and the two variants of the intra household demand models. The own price elasticities show a good deal of variation between the demand models, though more for some items, less for others. The variation generally seems to be much less between the unitary and the IHI models than between the intra household demand models (IHI, IHJ). In contrast, the expenditure elasticities seem quite robust to demand specification.

Table 5 provides the λ_j estimates, ie. the social marginal cost of raising revenue by taxing item j (see eqn. (20)) implied by the elasticites, tax rates, etc. The table reports the λ_j estimates, corresponding to the different demand models, at three values of inequality aversion (ε). The numbers in brackets denote the λ_j ranking when they are arranged in increasing order. Let us recall that lower ranked items are candidates for tax increases, higher ranked items are candidates for tax reductions. The λ_j rankings, rather than the magnitudes, are of policy interest since they indicate directions of marginal tax reform. Consistent with our earlier observation, the λ_j rankings vary a good deal more between the non unitary models than between the unitary model and the individual optimising version of the intra household model (IHI). This reflects the fact that IHI is closer in spirit to the unitary model than IHJ. Note, however, that the result, first noticed by Ahmad and Stern (1984), that at low ε values, Food is a candidate for tax increase ($\lambda_{Food} < \bar{\lambda}$) but is a candidate for tax decrease ($\lambda_{Food} > \bar{\lambda}$) at high ε values holds true for all the demand models. This result is explained by the fact that at very low values of 'inequality aversion', efficiency considerations prevail, but at Rawlsian levels, equity dominates so that the direction of tax reform reverses for a necessity item such as Food.

Table 6 provides formal evidence on the sensitivity of the directions of marginal tax reform to demand system by reporting the Spearman rank correlation ($\hat{r}_s$) (with standard errors and z values for H_0: $r_s = 1$) between the λ rankings in the 3 demand systems. Note that, while at 5% significance level, the hypothesis of rank invariance between the unitary AIDS and IHI cannot be rejected, the reverse is true for the other comparisons. In other words, the directions of marginal tax reforms do alter significantly between unitary AIDS and IHJ and between IHI, IHJ. The results confirm that the general picture of insensitivity of marginal tax reforms to demand system, that the literature conveys, is not true once we allow for resource sharing between spouses and varying preference inside the household in an intra household demand system.

6. CONCLUSIONS

This paper examines the implications of modelling intra household behaviour and allowing preferences to vary within the household for commodity tax reforms. Notwithstanding significant methodological advances in modelling intra household behaviour via the various types of collective choice models, the empirical evidence remains limited. Moreover, there has been little attempt to work out the public policy implications of departing from the conventional unitary model of household behaviour. In the taxation literature, while there have been attempts to examine the issue of tax unit in the income tax context from the view point of intra household behaviour [see, for example, Apps and Rees (1988), Piggott and Whalley (1996)], there has not been any such attempt in the context of commodity taxes. This paper attempts to overcome these gaps in the literature by providing Australian evidence on intra household preferences and examining its implications for marginal commodity tax reforms. Methodologically, the paper proposes and uses an intra household resource sharing rule that helps to identify, up to a point, the intra household preference parameters on conventional budget data. The empirical evidence rejects the assumption of identical preferences inside the household underlying the unitary household model. The policy significance of this result is underlined by the further empirical evidence which confirms the sensitivity of the directions of marginal tax reforms to departures form the unitary model framework used in tax reform analysis.

Table 1: Non Linear Estimates of Earnings Share Equation Parameters [Eqns. (7a, 7b)]

Parameter	Estimate[a]
ϕ_0	0.832 (0.0058)
ρ_{11}	0.013 (0.0002)
ρ_{12}	3.957 (0.0176)
ρ_{22}	4.326 (0.0114)

[a] Standard errors in brackets.

Table 2: Preference Heterogeneity Between Women and Men

Difference in Preference Parameters	Estimated Difference[a]	
	IHI	IHJ
$\alpha_1^1 - \alpha_1^2$	-.010 (.017)	-.106 (.154)
$\alpha_2^1 - \alpha_2^2$	-.075[b] (.030)	.215 (.238)
$\alpha_3^1 - \alpha_3^2$	-.012[b] (.004)	.188 (.134)
$\alpha_4^1 - \alpha_4^2$	.064[b] (.015)	-1.512[b] (.315)
$\alpha_5^1 - \alpha_5^2$	.003 (.031)	-1.544[b] (.353)
$\alpha_6^1 - \alpha_6^2$	.002 (.011)	.973[b] (.138)
$\alpha_7^1 - \alpha_7^2$	.097[b] (.021)	1.485[b] (.340)
$\alpha_8^1 - \alpha_8^2$	-.116[b] (.013)	-2.167[b] (.297)
$\alpha_9^1 - \alpha_9^2$	.047[b] (.016)	2.255[b] (.285)
$\beta_1^1 - \beta_1^2$	-.002 (.003)	-.0025 (.002)
$\beta_2^1 - \beta_2^2$	.011[b] (.005)	-.0014[b] (.0007)
$\beta_3^1 - \beta_3^2$	.001 (.0007)	-.0004 (.0004)
$\beta_4^1 - \beta_4^2$	-.008[b] (.002)	.0064[b] (.001)
$\beta_5^1 - \beta_5^2$	.0003 (.005)	.0115[b] (.003)
$\beta_6^1 - \beta_6^2$	-.0009 (.002)	.0014[b] (.0003)
$\beta_7^1 - \beta_7^2$	-.013[b] (.003)	-.0036[b] (.001)
$\beta_8^1 - \beta_8^2$	.018[b] (.002)	-.003[b] (.0006)
$\beta_9^1 - \beta_9^2$	-.006[b] (.003)	-.008[b] (.002)

[a] Standard errors in brackets.
[b] Statistically significant at 5%.
[c] The items are: Food & Non Alcoholic Beverages; Housing (rent, mortgage interest, equipment and services); Fuel, Electricity and Gas; Clothing and Footwear; Transport & Equipment; Health and Personal Care; Alcohol & Tobacco; Entertainment; Miscellaneous.

Table 3: Expenditure Elasticities

Item		Unitary	IHI	IHJ
1.	Food & Non Alcoholic Beverages	0.526	0.595	0.603
2.	Housing: Rent, Mortgage Interest, Equipment & Services	1.059	1.051	1.050
3.	Fuel, Electricity and Gas	0.012	0.210	0.171
4.	Clothing and Footwear	1.437	1.343	1.335
5.	Transport & Equipment	1.298	1.265	1.260
6.	Health and Personal Care	0.772	0.796	0.800
7.	Alcohol & Tobacco	1.294	1.237	1.235
8.	Entertainment	0.746	0.857	0.868
9.	Miscellaneous	1.409	1.331	1.271

Table 4: Own Price Elasticities

Item		Unitary	IHI	IHJ
1.	Food & Non Alcoholic Beverages	-0.256	-0.405	-0.489
2.	Housing: Rent, Mortgage Interest, Equipment & Services	-0.905	-0.904	-0.839
3.	Fuel, Electricity and Gas	0.377	0.409	0.826
4.	Clothing and Footwear	0.702	0.754	0.495
5.	Transport & Equipment	-1.058	-1.025	-0.778
6.	Health and Personal Care	0.174	0.143	0.174
7.	Alcohol & Tobacco	-1.151	-1.326	-1.934
8.	Entertainment	-0.508	-0.705	-1.153
9.	Miscellaneous	-0.840	-0.877	-1.634

Table 5: Marginal Social Cost (λ_j) Estimates[a]

Item		Demand Model								
		Unitary			IHI			IHJ		
		ε = 0	ε = 2	ε = 5	ε = 0	ε = 2	ε = 5	ε = 0	ε = 2	ε = 5
1.	Food & Non Alcoholic Beverages	.126 (6)	.057 (6)	.018 (5)	.116 (5)	.043 (6)	.011 (5)	.114 (3)	.003 (5)	.0003 (7)
2.	Housing: Rent, Mortgage Interest, Equipment & Services	.110 (3)	.047 (4)	.014 (4)	.110 (4)	.038 (3)	.009 (4)	.113 (2)	.002 (2)	.0002 (4)
3.	Fuel, Electricity and Gas	.120 (5)	.056 (5)	.019 (6)	.109 (3)	.041 (5)	.011 (6)	.142 (6)	.005 (7)	.0005 (8)
4.	Clothing and Footwear	.390 (9)	.159 (9)	.044 (9)	.335 (9)	.111 (9)	.023 (9)	.294 (8)	.005 (8)	.0002 (3)
5.	Transport & Equipment	.096 (2)	.040 (1)	.011 (1)	.098 (2)	.033 (2)	.007 (1)	.096 (1)	.002 (1)	.0001 (1)
6.	Health and Personal Care	.092 (1)	.040 (2)	.013 (2)	.091 (1)	.032 (1)	.008 (2)	.120 (4)	.003 (3)	.0003 (6)
7.	Alcohol & Tobacco	.238 (7)	.099 (7)	.028 (7)	.304 (8)	.102 (8)	.022 (8)	.376 (9)	.023 (9)	.001 (9)
8.	Entertainment	.301 (8)	.132 (8)	.041 (8)	.220 (7)	.078 (7)	.018 (7)	.129 (5)	.003 (4)	.0003 (5)
9.	Miscellaneous	.110 (4)	.045 (3)	.013 (3)	.120 (6)	.040 (4)	.008 (3)	.202 (7)	.003 (6)	.0002 (2)
	$\bar{\lambda}$[b]	.147	.063	.019	.149	.051	.011	.289	.005	.0003

[a] Figures in brackets denote λ-rank in ascending order.

[b] $\bar{\lambda}$ is a weighted average of the λ_j s, where the weights are the quantity demand by all households of commodity *j*.

Table 6: Spearman Rank Correlation (with z-statistics)
Between λ-rankings of Unitary, IHI, IHJ Demand Models

	Unitary, IHI					**Unitary, IHJ**					**IHI, IHJ**				
	$\varepsilon = 0$	$\varepsilon = 1$	$\varepsilon = 2$	$\varepsilon = 5$	$\varepsilon = 25$	$\varepsilon = 0$	$\varepsilon = 1$	$\varepsilon = 2$	$\varepsilon = 5$	$\varepsilon = 25$	$\varepsilon = 0$	$\varepsilon = 1$	$\varepsilon = 2$	$\varepsilon = 5$	$\varepsilon = 25$
Rank Correlation $(\hat{r}_s)$	0.900	0.933	0.950	0.983	0.983	0.633	0.633	0.667	0.467	0.700	0.717	0.800	0.783	0.533	0.750
z-Stat. (H_0: $r_s = 1$)	-1.60	-1.07	-0.80	-0.27	-0.27	-5.87	-5.87	-5.33	-8.53	-4.80	-4.53	-3.20	-3.47	-7.47	-4.00

References:

Ahmad, E. and N.H. Stern (1984), "The Theory of Reform and Indian Indirect Taxes", *Journal of Public Economics*, 25, 259-298.

Apps, P. and R. Rees (1988), "Taxation and the Household", *Journal of Public Economics*, 35, 355-369.

Atkinson, A.B. and J.E. Stiglitz (1980), *Lectures in Public Economics*, McGraw Hill, New York, NY.

Basu, K. (2001), "Gender and Say: A Model of Household Behaviour with Endogenously-Determined Balance of Power", *CAE Working Paper*, 01-01, Cornell University, USA.

Becker, G.S. (1981), *A Treatise on the Family*, Cambridge: Harvard University Press.

Blacklow, P. and R. Ray (2002), "Optimal Commodity Taxes in Australia", *Australian Economic Review*, 35(1), 45-54.

Browning, M. and P. Chiappori (1998), "Efficient Intra-Household Allocations: A General Characterisation and Empirical Tests", *Econometrica*, 66(6), 1241-1278.

Chiappori, P.A. (1988), "Rational Household Labour Supply", *Econometrica*, 56(1), 63-89.

Decoster, A. and E. Schokkaert (1996), "Tax Reform Results with Different Demand Systems", *Journal of Public Economics*, 41, 277-296.

Kanbur, R. and L. Haddad (1994), "Are Better Off Households More Unequal or Less Unequal: A Bargaining Theoretic Approach to 'Kuznets' Effects at the Micro Level", *Oxford Economic Papers*, 46(3), 445-458.

Koolwal, G. and R. Ray (2001), *Estimating the Endogenously Determined Intra Household Balance of Power and Its Impact on Expenditure Pattern: Evidence from Nepal*, Working Paper, The World Bank, Washington, U.S.A.

Lundberg, S. and R. Pollak (1994), "Non Cooperative Bargaining Models of Marriage", *American Economic Review: Papers and Proceedings*, 84(2), 132-137.

Madden, D. (1996), "Marginal Tax Reform and the Specification of Consumer Demand Systems", *Oxford Economic Papers*, 48, 556-567.

Manser, M. and M. Brown (1980), "Marriage and Household Decision Making: A Bargaining Analysis", *International Economic Review*, 21(3), 31-44.

McElroy and M. Horney (1981), "Nash Bargained Household Decisions", *International Economic Review*, 22(3), 333-350.

Moehling, C.M. (1995), *The Intra-Household Allocation of Resources and the Participation of Children in Household Decision-Making: Evidence from Early Twentieth – Century America*, Mimeo, North Western University, U.S.A.

Piggott, J. and J. Whalley (1996), "The Tax Unit and Household Production", *Journal of Political Economy*, 104(21), 398-418.

Pollak, R.A. (1994), "For Better or Worse. The Role of Power in Models of Distribution Within Marriage", *American Economic Review*, 84(2), 148-152.

Ray, R. (1997), "Rules in Setting and Changing Commodity Tax Rates: A Review with Illustrative Australian Evidence", in *Taxation Towards 2000*, eds. J.G. Head and R. Krever, Australian Tax Research Foundation, Sydney.

Ray, R. (1999), “Marginal and Non-Marginal Commodity Tax Reforms with Rank Two and Rank Three Demographic Demand Systems, *Oxford Economic Papers*, 51, 689-712.

Samuelson, P. (1956), “Social Indifference Curves”, *Quarterly Journal of Economics*, 70, 1-22.