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Job Insecurity Within the Household: Are Australian Householders Caring When it Comes to Risk Sharing?*

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Abstract

We investigate perceived job security risk and the distribution of non-labour income between spouses in a household context. In the process, the restrictions implied by Beckerian-caring preferences in the Chiappori (2002) Collective model are considered, and estimates of the sharing rule are derived. The findings support the idea of household formation as a tool that caring partners use to share risk. Our results provide further insight as to how unemployment risk may affect interaction between Australian spouses.

JEL Classification: J01, J3, J6

Keywords: household, labour supply, job-insecurity, collective, bargaining.

1. Introduction

A major risk encountered by workers in the labour market is the possibility of losing their job; not least because becoming unemployed has serious consequences for an individual's consumption, savings and wealth (Berloffa and Simmons, 2003). The role played by unemployment risk on the decision making of the individual is, however,

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substantially more complex when that person is placed within a household context. For example, couples may adjust their hours of employment to offset changes in their partner's employment (Altonji, 1986; Juhn and Potter, 2007; Lundberg, 1985; and Mumford and Smith, 1999), which could be viewed as behaviour consistent with the household insuring against the risk of income shocks (Blundell *et al*., 2012; Apps *et al*., 2014).

Intra-household interaction is a focus of the Collective models which appeared in the labour supply literature with the works of Chiappori (1988, 1992). In the Collective framework, the household is an environment where the respective spouses first interact and agree upon a sharing rule (e.g., the sharing of the household total non-labour income between the couple); and then maximize their own utility functions subject to their own budget constraints (for a recent survey see Browning *et al*., 2014).

Our contribution to this literature is to shed further light on how unemployment risk may affect interaction between spouses. We investigate the relationship between perceived unemployment risks and the relative power between the members of the couple in a particular type of household. This is achieved by first introducing job insecurity elements into the sharing rule and then estimating to what extent job insecurity affects the distribution of power between spouses in a household. In order to capture this effect, a specific version of the Collective model proposed by Chiappori *et al*., (2002) is estimated.

The paper is organized as follows: section 2 discusses the theoretical model developed by Chiappori *et al*., (2002); section 3 describes the data and the sample's characteristics; section 4 explains the econometric approach and presents the results; and section 5 concludes.

2. Model

In the Collective models the household's members' decision process is given by a two-step procedure. In the first phase the members of the couple agree on a sharing rule and they split the total household non-labour income. This sharing is affected by the individual's relative power (sometimes called bargaining strength). In the second phase the two individuals separately maximize their utility functions subject to their own budget constraints.

Following Chiappori *et al*., (2002), let h^i and C^i, for i=1,2 denote member i's labour supply (where $0 \leq h^i \leq 1$) and consumption of a private Hicksian composite good whose price is set equal to 1. In addition, $\mathbf{x}$ denotes a K-vector of preference factors such as age, gender, and education of the two agents. Also, let w_1, w_2, y represent the members' wage rates and the household non-labour income. Finally, let $\mathbf{s}$ be an L-dimension vector of distribution factors. Distribution factors affect the decision process but don't impact on the preferences or the budget constraint; for example, in our case exogenous changes in individual job insecurity.

In the most general framework member i's preferences are represented by some utility function of the form $U^i\left(1 - h^1, C^1, 1 - h^2, C^2, x\right)$ and the household is assumed to maximize a General Household Welfare Function (GHWF) that can be explicitly written as $H^C = \mu U^1 + (1 - \mu)U^2$. Formally, given $\left(w_1 w_2 y, s, x\right)$ there exists

a weighting factor $0 \leq \mu(w_1, w_2, y, \mathbf{s}, \mathbf{x}) \leq 1$ assumed continuously differentiable in its arguments such that (h^i, C^i) is a solution to the program:

$$\max_{\{h^1, h^2, C^1, C^1\}} \quad \mu U^1 + (1 - \mu) U^2 \tag{1}$$

subject to

$$w_1 h^1 + w_2 h^2 + y \geq C^1 + C^2,$$
$$0 \leq h^i \leq 1, \quad i = 1,2.$$

It is important to note that a change in **s** does not affect the Pareto frontier but only the final location of the optimal solution on it.

Note the form of the individual preferences used in program (1), $U^i(1 - h^1, C^1, 1 - h^2, C^2, x)$, imply that this general version of the Collective model cannot be uniquely identified from knowledge of just the labour supplies. There is a continuum of different structural models generating the same labour supply functions. Additional identifying assumptions are accordingly imposed on the model in order to estimate the Collective model. As shown by Chiappori (1992), the main identifying assumption for a Collective model to be estimated is given by the individual preferences being either egoistic, $U^i(1 - h^i, C^i, x)$ for i=1,2; or caring in a Beckerian sense, $u^i = F^i[U^i(1 - h^i, C^i, x)\ U^j(1 - h^j, C^j, x)]$ with i=1,2 and $i \neq j$. Note that in the Beckerian case household members care about each other's preferences as well their own.

Both types of preferences are discussed in Chiappori *et al*., (2002). The Beckerian Caring Preferences impose an additional restriction on the household members' labour supply functions (see equation (9)). The egoistic assumption plays a key role in the formulation of the maximization problem. Chiappori (1992) proved that whenever individual utilities are of the form $U^i(1 - h^i, C^i, x)$, then (1) can be reformulated as in Proposition 1, as a direct consequence of the Second Fundamental Welfare Theorem.

Proposition 1 – Whenever individual preferences are egoistic, then, there exists some function $\varphi(w_1 w_2 y, s, x)$ *such that* (h^1, h^2, C^1, C^2) *is the solution to the program:*

$$\max_{\{h^i, C^i\}} \quad U^i(1 - h^i, C^i, \mathbf{x}) \tag{2}$$

subject to

$$w^i h^i + \phi^i \geq C^i,$$
$$0 \leq h^i \leq 1,$$

where $\varphi^1 = \varphi$ *and* $\varphi^2 = y - \varphi$.

The two individuals have to first agree upon $\varphi(w_1 w_2 y, s, x)$. As shown by (2), the sharing rule φ^i, represents the link between the two individuals who would otherwise behave independently. Importantly, φ^i is not observable to the analyst if the data report total household non-labour income and not the shares.

In the Collective model it is possible to identify $\varphi(w_1 w_2 y, s, x)$ by considering the response of the labour supply function of the two individual spouses in the

household to variations in w_1, w_2, y and s. The labour supply functions are assumed to be continuously differentiable and can be written as:

$$h^1 = H^1\left(w_1, \varphi\left(w_1, w_2, y, \mathbf{s}, \mathbf{x}\right), \mathbf{x}\right); \tag{3}$$

$$h^2 = H^2\left(w_2, y - \phi\left(w_1, w_2, y, \mathbf{s}, \mathbf{x}\right), \mathbf{x}\right); \tag{4}$$

where $H^i(\cdot)$ represents member i's Marshallian labour supply function. The partial derivatives of the two labour supply equations with respect to w_1, w_2, y and s, generate a system of partial differential equations. The sharing rule $\varphi(w_1 w_2 y, s, x)$ is then obtained by integrating this system. Given the nature of the solution, $\varphi(w_1 w_2 y, s, x)$ is identifiable only up to an additive constant $\boldsymbol{\kappa}(\mathbf{x})$. This implies $\sum_i \hat{\varphi}^i \approx y$, the sum of the two estimated non-labour income shares is approximately equal to total non-labour income, and will differ by the additive constant $\boldsymbol{\kappa}(\mathbf{x})$ which depends on the household heterogeneity and cannot be empirically identified. The structure of the two labour supply functions makes it possible to impose testable restrictions on labour supply behaviour and recover the partial derivatives of the sharing rule (see Chiappori *et al*., (2002) for further detail, especially Proposition 2).

We explore the distribution of power within the household by assuming that this distribution can be fully captured by how income is allocated between the spouses. Browning and Gørtz (2012) argue that the concept of power is defined not only in terms of how money is allocated between the spouses but also in terms of leisure. Using data on the use of time within households (Danish Time Use Survey), Browning and Gørtz (2012) observe that in some households the spouse that spends more time in the labour market is also the one enjoying less leisure. There are many possible explanations. For example, there might be some heterogeneity in the tastes for leisure and consumption within the household. Wages or productivity in home production may also vary across the spouses, and that may lead to differences in the leisure taken. Ultimately, there may be an uneven distribution of power within the household such that the low-power individual may be required to work more. The intra-household allocation of time has also been the focus of other studies (see Apps and Rees, 1996; 1997). Unfortunately, we do not have access to complete information on time-use within the household in the HILDA data set[1] and so we focus on the within household allocation of non-labour income.

2.1 Labour supplies: Functional form and parametric specification

Before proceeding with the estimation of the Collective model, it is necessary to specify the functional form of the spouses' labour supply functions. In this work the two distribution factors, namely, the elements of the s vector that appears in $\varphi(w_1 w_2 y, s, x)$ are: the individual's own expected job insecurity; and the individual's own worries about his/her future employment. The unrestricted semi-log system of equations is given by

[1] The HILDA data set provides some information on time use within the household but does not contain complete information on the distribution of time in the period.

$$h^1 = \alpha_0 + \alpha_1 \log w_1 + \alpha_2 \log w_2 + \alpha_3 y + \alpha_4 \log w_1 \log w_2 + \alpha_5 s_1 + \alpha_6 s_2 + \boldsymbol{\alpha}_7' \mathbf{X_1}; \quad (5)$$

$$h^2 = \beta_0 + \beta_1 \log w_1 + \beta_2 \log w_2 + \beta_3 y + \beta_4 \log w_1 \log w_2 + \beta_5 s_1 + \beta_6 s_2 + \boldsymbol{\beta}_7' \mathbf{X_2}; \quad (6)$$

Equation (5) is the parameterized version of equation (3) and represents the labour supply function of the female spouse. The α_i's, for $i = 1,\cdots,6$, are scalars; $\boldsymbol{\alpha}_7'$ is a K-vector of parameters; variables $\mathbf{s}_1$ (i.e. expected job insecurity) and $\mathbf{s}_2$ (i.e. future employment worry) represent the distribution factors; and $\mathbf{X_1}$ is a matrix consisting of a set of socio-demographic variables describing the wife. Analogously, equation (6) is the parameterized version of equation (4) and represents the labour supply function of the male spouse.

Using a semi-log functional form is standard in the estimation of labour supply.[2] Adopting this functional form allows equations (5) and (6) to be expressed in their *unrestricted* form; the restrictions of Proposition 1 and 2 are not imposed on the system and can instead be empirically tested. If the parameters (the α_i's and β_i's and) meet the collective restrictions, then the sharing rule can be derived up to the additive constant $\boldsymbol{\kappa}(\mathbf{x})$, and for a given $\boldsymbol{\kappa}(\mathbf{x})$ the individual indirect utility functions can be recovered. This specification can also be readily extended to allow for interactions between distribution factors and preferences factors. The generalized log-system constitutes a good basis if one wanted to make the whole system more flexible by, for example, introducing higher order polynomial in $\log w_1$, $\log w_2$ and y. The log form for wages allows the effect of w_i on h^i to decrease as h^i increases.

2.2 Sharing rule

Assuming the Collective restrictions are satisfied, and given the spouses' labour supply equations (3) and (4) and their empirical counterparts (5) and (6), the partial derivatives of φ are:

$$\phi_{w_1} = \frac{1}{\Delta} \frac{(\alpha_4 \beta_1 + \alpha_4 \beta_4 \log w_2)}{w_1}$$

$$\phi_{w_2} = \frac{1}{\Delta} \frac{(\beta_4 \alpha_2 + \beta_4 \alpha_4 \log w_1)}{w_2}$$

$$\phi_y = \frac{\alpha_3 \beta_4}{\Delta}$$

$$\phi_{s_1} = \frac{\beta_4}{\Delta} \alpha_5$$

$$\phi_{s_2} = \frac{\beta_4}{\Delta} \alpha_6$$

[2] Semi-log estimation of equations (5) and (6) implies the labour supply curves should be either upward sloping or backward bending everywhere. Empirical evidence, however, shows that the sign of the slope may change with the level of the wages. This is especially true in a household contest (i.e. in a two-individual economy where the two subjects strictly interact). What happens in such an environment is that the sign of $\partial h^i / \partial w_i$ changes both with the level of and with the level of $w_j (j \neq i)$.

where $\Delta(\alpha_3\beta_4 - \alpha_4\beta_3)$.

Solving this system of five differential equations system, the sharing rule equation is obtained as

$$\phi = \frac{1}{\Delta}\begin{pmatrix}\beta_1\alpha_4 \log w_1 + \alpha_2\beta_4 \log w_2 + \alpha_4\beta_4 \log w_1 \log w_2 \\ + \alpha_3\beta_4 y + \beta_4\alpha_5 s_1 + \beta_4\alpha_6 s_2\end{pmatrix} + \kappa(x). \tag{7}$$

Following the approach used by in Chiappori *et al*., (2002) the model restrictions are:

$$\frac{\beta_5}{\alpha_5} = \frac{\beta_6}{\alpha_6}, \tag{8}$$

in the case of pure Egoistic Preferences, and:

$$\frac{\beta_4}{\alpha_4} = \frac{\beta_5}{\alpha_5} = \frac{\beta_6}{\alpha_6}, \tag{9}$$

in the Beckerian Caring Preference case.

3. Data

We use data collected by the Household, Income and Labour Dynamics in Australia (HILDA) survey2. The HILDA survey started in 2001 and is an annual nation-wide longitudinal survey of Australian households occupying private dwellings. For greater detail on the response rates, structure, and changes over time in the HILDA design see Summerfield *et al*., (2013).

HILDA collects information on a range of topics including economic and subjective well-being, labour market dynamics and family dynamics. A potential weakness of annual surveys, such as HILDA, is the failure to capture intra-year dynamics. To address this problem, HILDA respondents are asked to recall information, especially with respect to labour market and social security histories, over the course of the previous year.

A particularly attractive characteristic of the HILDA survey is the presence of subjective job insecurity information. This inclusion is rare amongst economics surveys. Indeed, to the best of our knowledge, the only other relevant surveys containing similar information on employment prospects are: the Health and Retirement Survey (HRS), conducted at the University of Michigan since 1992; the Survey of Economic Expectations (SEE), conducted at the University of Wisconsin-Madison since 1994; and the Survey on Household Income and Wealth (SHIW) conducted at the Bank of Italy during the years 1995 and 1998. The problem with these latter three surveys, for the purposes of this study, is that they either collect information only at an individual level or they collect information only for a random sample of members within each household. This leaves HILDA as the preferred data source for this study.

[3] This paper uses unit record data from the Household, Income and Labour Dynamics in Australia (HILDA) Survey. The HILDA Project was initiated and is funded by the Australian Government Department of Social Services (DSS) and is managed by the Melbourne Institute of Applied Economic and Social Research Melbourne Institute). The findings and views reported in this paper, however, are those of the authors and should not be attributed to either DSS or the Melbourne Institute.

3.1 Sample selection and descriptive statistics

The Collective models are a class of generally non-nested models: each Collective model, while sharing some common features with the others, is unique in terms of the model restrictions and population of interest. The reference population analysed in this work is given by the Collective model developed by Chiappori *et al*., (2002). The selection criteria are: being an employee[4]; and being one of the two members of a couple family (with or without children) who are married (legally or de-facto). The sample is also restricted to households whose members are younger than 55.

We pool waves 2 to 9 of the HILDA survey data to estimate the Collective model. The first wave of data is excluded due to lack information on pertinent variables; and waves post 2009 have been excluded due to the impact of the recent global recession.[5] The years 2002 to 2009 (inclusive) are associated with a period of stable economic growth in Australia. These sampling restrictions and those associated with the explanatory variables leads to the identification of 6,613 couples.

Summary statistics for the sample of interest are reported in Table 1. On average the males are slightly older than the females, and the women are slightly better educated. The men are typically working almost 45 hours per week; unsurprisingly this is some four hours more than they would like to work. In contrast, the women are averaging almost 33 hours a week. The men also have considerably higher average hourly wages than the women. The difference of 17 log wage points between men's and women's wages is consistent with the empirical literature on the labour market in Australia (Chzhen *et al*., 2013). The men tend to work in the managerial and technical occupations whilst the women are more likely to work as professionals, clerical-administrators or personal service providers. Table 1 also shows that a relatively large proportion of women are employed on casual contracts, while men are more commonly employed on a permanent basis. Women tend to be employed in the education, health and retail services sectors whilst men are more typically found in manufacturing, public administration and construction.

We use two measures of job-insecurity. The first measure captures the individual household member's own expected job-insecurity. The respondent is asked the following question: "What do you think is the per cent chance that you will lose your job during the next 12 months? (That is, get retrenched or fired or not have your contract renewed)." A value of 0 indicates the individual is certain of retaining their job, whereas a value of 100 suggests the individual is certain of losing his/her job in the next 12 months. The second measure is of future employment worry: the respondent is asked to agree on a scale from 1 (totally disagree) to 7 (totally agree) with the following statement: "I have a secure future in my job". A binary variable was created and coded as 1 if the response is less than the midpoint 4 and 0 otherwise. Men perceive their employment prospects to be (slightly) but significantly more uncertain than women in our sample (see Table 1). The correlation between the spouses' job insecurity is low, however, averaging around 0.07 across the four possible combinations of the two job insecurity measures.

[4] The estimation of this particular version of the Collective model requires both members of the household to supply a positive number of hours of work. This means that any issue related to non-participation is ruled out.

[5] 2010 saw the impact of the global recession in Australia with a substantial growth in unemployment (Junankar, 2014).

Table 1 - Selected individual and household characteristics

	Men		*Women*	
Individual Variables	*Mean*	*Sd*	*Mean*	*Sd*
Age	40.34	8.86	38.37	8.69
Hours of Work	44.66	9.51	32.58	12.31
Desired Hours of Work	41.35	8.68	30.30	10.30
Ave Hourly Wage	26.87	12.02	22.48	9.84
Log Ave Hourly Wage Rate	3.20	0.41	3.03	0.39
Expected Job Insecurity	8.96	18.69	7.68	17.70
Overall Market Insecurity	10.34	3.08	9.33	2.92
Future Employment Worry	0.15	0.35	0.13	0.34
Schooling (Years of)	13.08	2.85	13.20	2.62
Household Variables		**Mean**	**Sd**	
Household Size		3.34	1.17	
Total Dependent Children		0.83	0.99	
Household Non-labour Income		7705.69	27609.76	
Regions		**Freq**	**Percent**	
New South Wales		1891	28.6	
Victoria		1701	25.7	
Queensland		1486	22.5	
South Australia		573	8.7	
Western Australia		477	7.2	
Tasmania		208	3.1	
Northern Territory		64	1.0	
Australian Capital Territory		213	3.2	
Section of State				
Major Urban		4178	63.2	
Other Urban		1598	24.2	
Rural		837	12.7	
Employment Contract	**Freq**	**Percent**	**Freq**	**Percent**
Employed on a Permanent basis	5592	84.6	4807	72.7
Employment on a Casual Basis	415	6.3	1130	17.1
Other (e.g. Fixed-term Contract)	606	9.2	676	10.2
Occupation				
Managers	1123	17.0	516	7.8
Professionals	1645	24.9	2282	34.5
Technicians and Trades	1239	18.7	231	3.5
Community-Personal Service	501	7.6	917	13.9
Clerical-Administrative	673	10.2	1654	25.0
Sales	327	4.9	535	8.1
Machinery Operators and Drivers	672	10.2	55	0.8
Labourers	430	6.5	421	6.4
Industry				
Agriculture-Fishing-Forestry	132	2.0	66	1.0
Mining	205	3.1	30	0.5
Manufacturing	996	15.1	297	4.5
Electricity-Gas Supply	150	2.3	20	0.3
Construction	533	8.1	84	1.3
Wholesale Trade	300	4.5	150	2.3
Retail Trade	382	5.8	632	9.6
Accommodation-Restaurants	166	2.5	296	4.5
Transport	465	7.0	122	1.8
Communication	201	3.0	187	2.8

Table 1 - Selected individual and household characteristics (continued)

	Men		*Women*	
	Freq	**Percent**	**Freq**	**Percent**
Finance	259	3.9	351	5.3
Rental-Hiring-Real Estate	80	1.2	82	1.2
Profess Scientific Technical	398	6.0	432	6.5
Administrative-Support	80	1.2	168	2.5
Public Administration	938	14.2	491	7.4
Education-Training	613	9.3	1387	21.0
Health Care	342	5.2	1572	23.8
Recreation Services	110	1.7	77	1.2
Other	263	4.0	169	2.6

Source: HILDA Dataset – Pooled Sample (Wave 2 to Wave 9).

The measure of overall market job insecurity makes some allowance for gender based employment differences in occupation and industries; it is constructed by taking the average of the individuals' "expected job insecurity" variable across all possible 151 combinations between occupations and industries. The individual hypothetical market is identified by a specific combination represented by his/her own occupation and his/her own industry. For example, an individual who is a technician and working in health care may operate in a different market from a technician working in the finance sector. Men are again found to have higher perceived job insecurity than women using the market based measure, although the gap between the genders is a little lower.

On average the households have slighter less than one dependent child (a resident child aged under 15), with total household size averaging 3.34 people suggesting that many households have another adult living with them. Finally household non-labour income[6] is relatively high in Australia as a wealthy OECD country, however, there is also considerable variance in this measure indicating high levels of inequality (Mariotti *et al*, 2015).

4. Estimation

As discussed above, the sharing rule plays a crucial role in Collective Labour Supply models. This rule is recovered if the Collective restrictions (either (8) or (9)) are satisfied. In the following, individual utilities are modelled as caring in a Beckerian sense and equations (5) and (6) are estimated subject to the restrictions reported in equation (9). The non-linear constraints, as specified in equation (9), can be dealt

[6] Household financial year non-labour disposable income calculated as the difference between household financial year gross incomes (including windfall and other income but excluding wages) less all household financial year taxes, measured in 2005 Australian dollars. To calculate net values, the tax rates indicated in the HILDA Usermanual (in accordance with Wilkins, 2009) are applied to relevant taxable income after deductions. The components which the Australian Tax Office (ATO) treats as taxable income are: wages and salaries, business income, investment income, private pensions and taxable Australian public transfers. Taxable public transfers are obtained by subtracting from public transfer income Family Tax Benefit Parts A and B, including Child Benefit and Child Tax Relief; Maternity Allowance, Maternity Payment, the Disability Support Pension and estimated Rent Assistance, none of which are taxable.

with in the usual manner by algebraic substitution. Thus rather than estimating the parameters β_4 and β_5 the following quantities are estimated:

$$\gamma_1 = \frac{\beta_6 \alpha_4}{\alpha_6} \; ; \quad \gamma_2 = \frac{\beta_6 \alpha_5}{\alpha_6}. \tag{10}$$

This reduces the dimensionality of the parameter vector by two (as two constraints are imposed on the problem). The two labour supply equations are reformulated:

$$h^1 = \alpha_0 + \alpha_1 \log w_1 + \alpha_2 \log w_2 + \alpha_3 y + \alpha_4 \log w_1 \log w_2 + \alpha_5 s_1 + \alpha_6 s_2 + \boldsymbol{\alpha}_7' \mathbf{X_1} + \varepsilon_1; \tag{11}$$

$$h^2 = \beta_0 + \beta_1 \log w_1 + \beta_2 \log w_2 + \beta_3 y + \gamma_1 \log w_1 \log w_2 + \gamma_2 s_1 + \beta_6 s_2 + \boldsymbol{\beta}_7' \mathbf{X_2} + \varepsilon_2; \tag{12}$$

where γ_1 and γ_2 as given by (10) are estimated in place of β_4 and β_5. Equations (11) and (12) are estimated simultaneously and the restrictions are imposed directly in the estimation process. The (asymptotic) standard errors $se(\hat{\gamma}_1)$ and $se(\hat{\gamma}_2)$ needed for constructing confidence intervals, conducting tests and making inference are computed using the Delta Method.

The two labour supply functions are estimated using the Generalized Method of Moments (GMM). This approach is preferred since it is able to consistently estimate the standard errors even in the presence of heteroskedasticity of unknown form (unlike Maximum Likelihood). The GMM estimator exploits the assumption that the instruments are exogenous, and the estimator is robust to heteroskedasticity (of unknown form) and allows for possible correlation between ε_1 and ε_2.

5. Results

Selected results for the estimation of the labour supply functions are presented in Table 2. The models are well defined and the coefficients are consistent with the priors discussed above. If the focus of this paper was on labour supply, we would go on to present relevant elasticities and discuss the results more fulsomely. However, for our purposes, the emphasis is on the parameter estimates as a means to calculate the sharing rule.

We proceed by considering whether Australian households behave in an efficient manner according to the Collective assumptions. The Collective restrictions (equation 9) are accordingly tested on the estimated unrestricted model and the results are reported in Table 2, columns 1 (for the wife) and 2 (for the husband). These results provide support for the efficiency assumptions behind the Collective model in this case.

Subsequently, the Collective restrictions are imposed directly on the GMM objective function as discussed in Section 4 above. Table 2 provides the results for the Collective model with Caring which is represented as a system of non-linear equations and estimated with non-linear GMM. Columns 3 and 4 of Table 2 report the parameter estimates of (11) and (12). The final column (column 5) reports the implicit parameter estimates of the sharing rule (7). It is worth stressing that the implicit parameters of the sharing rule are obtained as non-linear combinations of the previously estimated (constrained) parameters derived from the estimation of (11) and (12). The (asymptotic) standard errors of the sharing rule parameters estimates are computed using the Delta Method.

Table 2 - Parameter estimates

	Unrestricted model		*Constrained model*		
	Wife	*Husband*	*Wife*	*Husband*	*Sharing Rule with Caring*
	(1)	(2)	(3)	(4)	(5)
log w_f	-0.874**	-1.129***	-1.076***	-0.909***	5400.741**
	(0.444)	(0.401)	(0.388)	(0.260)	(2474.172)
log w_m	-0.961**	-1.128***	-1.145***	-0.905***	5325.301**
	(0.403)	(0.408)	(0.350)	(0.267)	(2396.712)
log w_f × log w_m	0.299**	0.350***	0.360***	0.282***	-1674.494**
	(0.133)	(0.125)	(0.116)	(0.081)	(766.352)
Nonlabour income	-0.0002**	0.00003	-0.0002**	0.00001	0.955***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.311)
Distribution Factors					
Expected Job Insecurity	-0.0002**	-0.0001*	-0.0002**	-0.0002**	0.942*
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.544)
Future Employment Worry	-0.025***	-0.019***	-0.025***	-0.020***	116.294**
	(0.006)	(0.005)	(0.005)	(0.004)	(51.694)
Over-identifying restrictions:	5.391 (p=0.980)		6.803 (p=0.977)		
Observations:	6613		6613		

HILDA Dataset – Pooled Sample (Wave 2 to Wave 9). Notes: Significance levels: 10% (*), 5%(**), 1%(***). Control variables in Xi are: age; number of dependent children; general health; industry; occupation; and urbanisation

When dealing with labour supply in a household context, possible endogeniety of wages should be considered. If unobserved individual characteristics are positively correlated with wages, spurious correlation between the regressors and the error term in the labour supply equations is an issue [7]. Our choice of instruments is influenced by Mroz (1987), the set of (excluded) instruments consists of time dummies, second order polynomials in education, and the interaction of age and education [8].

As shown in Table 2, the set of instruments passes the over-identifying restrictions test. An additional test was conducted to check for the weakness of instruments. As explained in Stock and Yogo (2001) and Stock *et al*., (2002), this test involves the construction of what they call the concentration parameter. Given the different set of instruments used for the two labour supply equations, the concentration parameter was computed for the two labour supplies. Their closeness to the critical values provided in Stock and Yogo (2001) support the validity of the chosen instruments and their strength. Moreover, given the weighting matrix used in equation

[7] The dataset provides information on gross weekly wage and weekly hours of work. Average hourly wage rates are the ratio of these two variables. Measurement error in the hours of work measure may lead to a spurious negative correlation between this average hourly wage measure and the dependent variable.

[8] As discussed in Pencavel (1986), there is a debate in the labour supply literature whether education variables should be used as instruments for the wage rates or as exogenous regressors in the labour supply equation. It is common practice to use schooling as an instrument for wage rates whenever other instruments are not available. This approach has been followed in this work, and education has been used as an instrument.

(14), the GMM estimator used for the estimation is the efficient one among the class of GMM estimators, and is also robust to heteroskedasticity (of unknown form) and to any possible correlation between the two errors in the labour supply equations and across observations (in order to exploit the panel structure of the data).

The dependent variable and non-labour income are rescaled (they were divided by 100 and 1,000, respectively). This rescaling is necessary so the scale of the sharing rule and the scale of household non-labour income match each other. As explained in Section 2 and as represented in (2) the sharing rule function $\varphi(\cdot)$ gives the household non-labour income share that goes to the individual and adds to his/her own individual labour income before the spouses maximize their utilities. While household non-labour income is information that is usually available, the share φ^i that goes to the individual (as represented in (2)) is not available and is computed according to the sharing rule $\varphi(\cdot)$. This implies the scale of the household non-labour income share φ^i must match the scale of the household non-labour income y.

As discussed above, the distribution factors (i.e. the elements of the s vector) are: the individual's own "Expected job insecurity"; and the individual's own "Future employment worry". The control variables included in the analysis are: age; number of dependent children; industry; occupation; urbanisation; and an indicator of general health.

The estimates of the structural components of the two labour supply equations can be compared with those obtained by Chiappori *et al*., (2002). The estimates for the wife's labour supply equation obtained in this work are similar to those obtained in Chiappori *et al*., (2002). In contrast, the results related to the husband's labour supply equation are quite different. In particular, the estimates related to the wage rates are negative, as opposed to Chiappori's estimates that are positive. The negativity of the wage rates also contrasts with the empirical literature on male labour supply according to which the response of labour supply to increase in wages is positive. To check the robustness of the estimates for the male equation, different specifications of the male labour supply equation have been estimated (both individually and jointly with the wife's labour supply). In all the specifications the labour supply response to increase in wages is negative (for them). This result may be explained by the specific features of the selected sample. Table 1 indicates that these Australian men would rather supply less hours of work if allowed to do so. This might suggest that their position on the labour supply curve is on the backwards sloping section.

What is of particular note is the effect of the two self-assessed job insecurity variables on the sharing rule. Here the interpretation is carried out from the wife's perspective, but the same interpretation can be conducted from the husbands' perspective. The implicit parameters of the sharing rule suggest that when the perceived employment prospects of the wife change, and she becomes concerned about the future security of her job, she gets an additional portion of non-labour income from the husband. This is compatible with the type of utility function chosen for this work, namely "caring in a Beckerian sense". Since the members of the couple operate in a "caring" context it is plausible to think that the economic risks are shared between the members of the couple.

6. Conclusion

The study exploits a Collective model of labour supply to consider the household as a risk sharing tool that individuals use to cover against potential economic risks. The focus is the household as an environment and not as an economic agent. An application is made addressing (perceived) individual job insecurity. The job insecurity measures are incorporated into the model under the form of distribution factors. The restrictions implied by Beckerian-caring preferences in the Chiappori (2002) Collective model are considered, and estimates of the sharing rule are derived.

The results support the idea of household formation as a tool that (caring) individuals have in order to share possible risks they could encounter throughout their lives. Moreover, the collective behaviour of the Australian households under analysis has been tested and confirms their efficient behaviour. A negative shock, thought of in terms of an increase in individual job insecurity, is found to be related to the (re) distribution of power between the members of the couple. The results are consistent with the idea of caring individuals and show how the spouse affected by the negative shock is supported by the relatively more job-secure partner, supporting the idea of household formation as a tool that caring partners use to share risk. Our findings provide further insight as to how unemployment risk may affect interaction between Australian spouses.

References

Altonji, J. (1986), 'Intertemporal Substitution in Labor Supply: Evidence from Micro Data', *Journal of Political Economy*, 94(3 Part 2), S176-S215.

Apps, P., Andrienko, Y. and Rees, R. (2014), 'Risk And Precautionary Saving in Two-Person Households', *American Economic Review*, 104(3), 1040-46.

Apps, P. F., and Rees, R., (1996), 'Labour Supply, Household Production and Intra-Family Welfare Distribution', *Journal of Public Economics*, 60, 199-219.

Apps, P. F., and Rees, R., (1997), 'Collective Labor Supply and Household Production', *Journal of Political Economy*, 105, 178-190.

Berloffa G. and Simmons, Peter, J., (2003), 'Unemployment Risk, Labour Force Participation and Savings', *Review of Economic Studies*, 70, 521-539.

Blundell, R., Pistaferri, L. and Saporta-Eksten, I. (2012), 'Consumption Inequality and Family Labor Supply', *NBER Working Paper* No. 18445, November.

Browning, M., Chiappori. P.A. and Weiss, Y. 2014. Economics of the Family CUP, Cambridge.

Browning, M., & Gørtz, M. (2012). 'Spending Time and Money Within The Household', *Scandinavian Journal of Economics*, 114(3), 681-704

Browning, M. and Meghir, C., (1991), 'The Effects of Male and Female Labor Supply on Commodity Demands', *Econometrica*, 59, 925-51.

Chiappori, P.A., (1988), 'Rational Household Labor Supply,' *Econometrica*, 56, 63-89.

Chiappori, P.A., (1992), 'Collective Labor Supply and Welfare', *Journal of Political Economy*, 100, 437-467.

Chiappori, P.A., Fortin, B. and Lacroix, G., (2002), 'Marriage Market, Divorce Legislation and Household Labor Supply', *Journal of Political Economy*, 110, 37-72.

Chzhen, Y., Mumford, K.A., and Nicodema, C. (2013), 'The Gender Pay Gap in The Australian Private Sector: Is Selection Relevant Across the Wage Distribution', *Economic Record*, 89(286), 367-381.

Juhn, C. and Potter, S. (2007), 'Is There Still an Added Worker Effect?" *Federal Reserve Bank of New York*. Staff Report No. 310

Junankar, P.N. (2014), 'The Impact of the Global Financial Crisis on Youth Labour Markets', *IZA DP* No. 8400.

Lundberg, S. (1985), 'The Added Worker Effect', *Journal of Labor Economics*, 3(1), 11-37.

Lundberg, S., Pollak, R., and Wales, T., (1997), 'Do Husbands and Wives Pool Their Resources? Evidence from the U.K Child Benefit', *Journal of Human Resources*, 32, 463-480.

Mariotti, F., Mumford, K.A., and Pena-Boquete, Y. (2015) 'Household Asset Holding Diversification in Australia', *Australian Economic Review*, 48(1), 43-64.

Mumford, K.A. and Smith, P.N. (1999), 'The Hiring Function Reconsidered: On Closing the Circle', *Oxford Bulletin of Economics and Statistics*, 61(3), 343-364.

Pencavel, J., (1986), 'Labor Supply of Men: A Survey', in Orley Ashenfelter and Richard Layard (ed.), *Handbook of Labour Economics Volume 1*, Amsterdam: North-Holland, 3-102.

Stock, J. H., Wright, J., and Yogo, M., (2002), 'A Survey of Weak Instruments and Weak Identification in Generalized Method of Moments', *Journal of Business & Economic Statistics*, 20, 518-529.

Stock, J. H., and Yogo, M., (2001), 'Testing for Weak Instruments in Linear Iv Regression', unpublished manuscript, Harvard University.

Summerfield, M., Freidin, S., Hahn, M., Ittak, P., Li, N., Macalalad, N., Watson, N., Wilkins, R. and Wooden, M. (2013) HILDA User Manual – Release 12. Melbourne Institute of Applied Economic and Social Research, University of Melbourne, Australia.

Wilkins, R. (2009) 'Updates and Revisions to Estimates of Income Tax and Government Benefits', *HILDA Project Technical Paper Series*, No. 1/09, February 2009.