

A collective model of household consumption with full expenditures and time use

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AGEW, February 14th 2019

Some background

- ▶ Demand estimation has been largely study in the economic literature.
- ▶ Households are considered as representative agents in demand analysis.
- ▶ Individuals within the households have difference tastes and preferences.
- ▶ From the 60's a literature on household economics starts to develop and we begin to understand the 'black box' of family decisions.
- ▶ Inequality within the household is the consequence of a bigger 'bargaining power' of a family member. This allows her/him to capture a bigger share of the total income and to impose her/his preferences to the other members fo the household.

Introduction and Motivation

- ▶ In demand analysis and in households economics, time allocation is not usually included, even when the time spend in one commodity can significantly vary by gender, for instance.
- ▶ Women allocate a significant amount of time to domestic activities compared to men, even when both individuals in the couple work.
- ▶ Hence, the importance of taking into account the domestic production and time allocation in a model with multiple consumption goods.

What do I aim to do?

- ▶ Include time-use distribution in the estimation of household's consumption within a collective model framework.
- ▶ Take into account domestic production in the sharing rule, by including 'full prices'. They reflect differences in productivities between households.
- ▶ Estimation of the sharing rule in a Latin American developing country with an important matriarchal society. Guatemala has 60% of Maya population, a society with matriarchal inheritance schemes (Women inherit assets instead of men).
- ▶ This can lead to higher bargaining power for women and it could be an important distributional factor in the estimation of the sharing rule.

Theoretical framework

- ▶ We use the collective model with many consumption goods presented by Browning, Chiappori and Lewel (2013) → pareto optimality of the decision process within the household.
- ▶ The specification differs from BCL in two points:
 - ▶ First, it includes full income and full expenditure in the analysis of demand patterns and in the estimation of the sharing rule.
 - ▶ It allow us to take into account the distribution of time within the household.
 - ▶ Second, we assume that the household's production transforms time and monetary inputs into final goods in the Beckerian sense.
 - ▶ The efficiency of the household's technology is therefore reflected in the shadow price of the household production function. The domestic production of singles and couples differs as concerns the efficiency of the transformation of inputs.

The model - single's maximisation program

The single's utility maximization program is given by:

$$\text{Max}_{m_i, t_i} U(Q^i) = \prod a_i Q_i^{\gamma_i}, \text{ with } Q_i = m_i^{\alpha_i} t_i^{\beta_i}$$

Utility is maximized under the full budget and production technology constraints:

$$\sum_i (m_i + \omega t_i) = w t_w + \omega(T - t_w) + V$$

$$z_i(m_i, t_i) = F(Q_i)$$

- ▶ Contrary to the BCL framework, mono-nuclear families transform monetary and time inputs through the technology function F , in order to obtain final goods Q_i .
- ▶ The shadow price corresponding to the constraint of production technology, $z_i(m_i, t_i) = F(Q_i)$, is: $\pi_i = \frac{p_i x_i + \omega t_i x_i}{p_i x_i} = 1 + \frac{\omega t_i}{p_i x_i}$

The model - couple's maximisation program

The household maximization program consist on a weighted utility sum under budget and production technology constraints:

$$\max_{q^f, q^m, z} \mu (p^{full}/y^{full}) U^f(q_i^f) + U^m(q_i^m) = \mu(\pi/y^{full}) \left(\prod_i a_i (q_i^f)^{\gamma_i} \right) + \left(\prod_i a_i (q_i^m)^{\gamma_i} \right)$$

$$\text{subject to } \sum (m_i^f + m_i^m) = w^f t_w^f + w^m t_w^m + V$$

$$\sum (t_i^f + t_i^m) = T - t_w^f - t_w^m$$

$$Q_i = q_i^f + q_i^m$$

$$z_i(m_i, t_i) = F(Q_i)$$

Combining the monetary and time constrains yields to the full constraint:

$$\sum (m_i^f + t_i^f) + \sum (m_i^m + t_i^m) = w^f t_w^f + w^m t_w^m + \omega(T - t_w)^f + \omega(T - t_w)^m + V$$

The model - domestic production and shadow prices

- ▶ We do not impose a linear Barten consumption technology as BCL but we assume that the households production transforms time and monetary inputs into final goods.
- ▶ Households purchase x_i monetary commodities and use t_i time that they transform into q via the production technology function $z_i(x_i, t_i) = F(Q_i)$.
- ▶ Difference in efficiency between singles and couples: couples are more efficient transforming inputs into final goods.
- ▶ The higher efficiency of couples in the transformation of $z_i(x_i, t_i)$ to q_i is only the consequence of sharing (ex. sharing a car, preparing a meal).
- ▶ The function F represents the household production technology in a more Beckerian interpretation of household behavior.

The model - domestic production and shadow prices

- ▶ Given the technology F , the corresponding shadow price are hence defined as the ratio of full expenditure over the monetary expenditure:

$$\pi_i = \frac{(p_i + \omega t_i)x_i}{p_i x_i} = \frac{(p_i + \omega t_i)}{p_i} = 1 + \frac{\omega t_i}{p_i}$$

- ▶ Even if we do not specify the transformation function F , we think that π is a good indicator of the shadow price of the household technology since it reflects the efficiency in the transformation of household inputs.
- ▶ For instance, couples would spend less time and money per capita when preparing food than singles. This is reflected in the shadow price, which would be higher for singles than couples.

The model - sharing rule

- ▶ The sharing rule defines the proportion of household income allocated to each member of the household.
- ▶ The sharing rule and the pareto weights depend on wages, prices, distribution factors and bargaining power.
- ▶ Two steps to estimate the sharing rule: First, couples agree on the full income sharing. Second, women and men independently decide on their level of consumption q_i given the full allocation decided before.
- ▶ Let $\eta(p^{full} / y^{full})$ be the share of full income allocated to the women consumption, that results from the sharing rule arrangements made by the household. Therefore, η represents the optimal Pareto outcome of the first step maximization program of the couple.
- ▶ η also indicates if the final full consumption of households resemble more to the women or the men preference prior marriage.

The model - model solutions

- ▶ The Hicksien demand, h^i resulting from the individual's program above, can be obtained via Roy's identity, from the indirect utility V^i of the Marshallian demand. The Hicksien solution to the single's program is therefore given by $V^i(\pi/y^{full}) = U^i[h^i(\pi/y^{full})]$.
- ▶ The solution of the household maximization program given shadow prices, π and women income share, η becomes:

$$Z = h^f\left(\frac{px + \omega tx}{px} \cdot \frac{1}{\eta}\right) + h^m\left(\frac{px + \omega tx}{px} \cdot \frac{1}{1 - \eta}\right)$$

$$\mu\left(\frac{\pi}{y^{full}}\right) = -\left[\frac{\partial V^m\left(\frac{\pi}{1-\eta}\right)}{\partial \eta}\right] / \left[\frac{\partial V^f\left(\frac{\pi}{\eta}\right)}{\partial \eta}\right]$$

Identification

- ▶ Following BLC identification would be possible if we assume that the preferences of individuals do not change with marriage and stay stable over time.
- ▶ If this assumption is true, then identification would be possible by observing single women and men demands for goods.
- ▶ Identification also requires the estimation of more than three consumption demand equations as explained by Chiappori and Ekeland (2009).
- ▶ However, if these two conditions are fulfilled, identification can be achieved when using either a non-linear demand for goods or a non-linear consumption technology.
- ▶ A simple inclusion of a non-linear parameter would suffice to identify the model; this is why non-linear demand is a perfect candidate for empirical estimation.

The estimation - single

The single's estimation (QUAIDS):

$$\omega_i(\pi/y^{full}) = \alpha_i + \Gamma_i \ln \pi + \beta_i [\ln(y_i^{full}) - c_i(\pi)] + \left[\frac{\lambda_i}{b_i(\pi) [\ln(y_i^{full}) - c_i(\pi)]} \right]^2$$

$$c_i(\pi) = \delta_i + (\ln \pi) \alpha_i + 0.5(\ln \pi) \Gamma_i \ln \pi$$

$$\ln b_i(\pi) = (\ln \pi) \beta_i$$

- ▶ QUAIDS is not linear on prices so allows identification.
- ▶ System consist of 8 commodity groups and $(n - 1)$ equations: food, housing, transportation, personal care, clothing, health, education, leisure.
- ▶ Individual heterogeneity: age, age squared, indigenous status, urban dummy, region dummy, time dummy, employee dummy, estimated price of house.

The estimation - couple

With the shadow prices π , the couple's budget share is given by:

$$\omega_k = \eta \omega^f \left(\frac{\pi}{\eta} \right) + (1 - \eta) \omega^f \left(\frac{\pi}{1 - \eta} \right)$$

The sharing rule of the couple can be calculated by:

$$\eta = \frac{\exp(s \delta)}{1 + \exp(s \delta)}$$

- ▶ The couples demand $w^f = \omega^f(\pi/y_f^{full})$ and $w^m = \omega^m(\pi/y_m^{full})$ includes all the quads parameters from the singles estimation.
- ▶ The sharing rule is represented by a logistic function as proposed by Browning et al. (1994) so that is bounded from 0 to 1.
- ▶ s are the factors influencing the sharing rule such as income and distribution factors: wife's share of total income, age difference, house ownership and household monetary expenditure with stone price index.

The datasets

- ▶ The dataset used in this paper consists of the three waves of the Guatemalan ENCOVI survey of the years 2000, 2006 and 2011.
- ▶ The ENCOVI survey is a very particular dataset as it combines both monetary and time expenditures in one single dataset.
- ▶ Our sample is composed of single households and childless couples. Due to data availability issues, households have been collapsed into one single cross section dataset after deflating the income and expenditure variables.
- ▶ For the QUAIDS estimation of the single's households, we choose only working individuals with a positive income aged 25 to 60. The estimation of the QUAIDS and the sharing rule, is only performed for childless couples where both individuals work.
- ▶ These restriction, reduce considerably our dataset, leaving us with a final sample of 496 single men, 460 single women and 1976 couples.

Single and couple's main variables and budget shares

	Descriptive Statics		
	Single Men	Single Women	Couples
<i>Monetary budget shares</i>			
Food	0.442	0.471	0.476
Housing	0.344	0.302	0.263
Transportation	0.045	0.039	0.058
Clothing	0.061	0.056	0.057
Personal Care	0.041	0.035	0.037
Health	0.028	0.025	0.038
Education	0.023	0.060	0.055
Leisure	0.014	0.012	0.016
<i>Full budget shares</i>			
Food	0.345	0.396	0.372
Housing	0.267	0.247	0.212
Transportation	0.088	0.057	0.076
Clothing	0.049	0.067	0.062
Personal Care	0.096	0.069	0.070
Health	0.018	0.016	0.024
Education	0.025	0.079	0.085
Leisure	0.111	0.071	0.099
Women share of income	0	1	0.463
Age difference	-	-	3.34
Urban households	0.435	0.528	0.531
Employee	0.264	0.233	0.475

Results - Income and Price Elasticities

Table: Monetary and full Income and Price Elasticities

	Income and Price Elasticities							
	Single Men				Single Women			
	Income		Price		Income		Price	
	<i>Monetary</i>	<i>Full</i>	<i>Monetary</i>	<i>Full</i>	<i>Monetary</i>	<i>Full</i>	<i>Monetary</i>	<i>Full</i>
Food	0.221	0.762	-1.230	-0.684	0.542	0.616	-0.963	-0.541
Housing	1.035	0.547	-0.924	-0.481	1.443	1.136	-0.970	-0.587
Transportation	1.929	0.046	-1.481	-0.362	2.146	3.120	-1.539	-0.541
Clothing	2.816	1.288	-1.425	-0.192	0.985	0.527	-1.177	-0.313
Personal Care	3.034	0.345	-1.697	-0.412	0.981	1.090	-1.471	-0.822
Health	2.159	2.603	-2.112	-0.728	1.604	1.955	-1.910	-1.144
Education	3.626	3.712	-1.564	-1.012	1.100	1.086	-1.349	-0.698
Leisure	4.457	4.039	-1.561	-0.674	1.204	0.962	-1.093	-0.743

Results- Sharing rule, Budget Shares

	Sharing rule
<i>Monetary</i>	0.71
<i>Full</i>	0.77

Table: Estimated Monetary and Full Budget Share, Men and Women

	Monetary and Full Budget Share			
	Women		Men	
	<i>Monetary</i>	<i>Full</i>	<i>Monetary</i>	<i>Full</i>
Food	0.465	0.373	0.449	0.273
Housing	0.299	0.235	0.292	0.201
Transportation	0.038	0.069	0.059	0.113
Clothing	0.057	0.058	0.063	0.046
Personal Care	0.037	0.063	0.045	0.082
Health	0.030	0.017	0.032	0.019
Education	0.061	0.101	0.044	0.064
Leisure	0.014	0.084	0.016	0.202

Results and Conclusion

- ▶ The estimation of the sharing rule show us at the preferences of the household resembles more to the women preferences than that of men.
- ▶ The results indicates that taking into account the time and the domestic production increases by 6 percentage points the share of full income allocated to women.
- ▶ Even when monetary expenditures between men and women are the same, the time spent into these activities differs. Women and men allocate the same amount of money in the consumption of food and leisure, but men spend a bigger amount of time in leisure activities while women allocates a higher proportion of time to food preparation.
- ▶ As a result, the monetary budget share might be the same for both sexes when in reality the distribution of time changes considerably the distribution of resources within the household.