A Collective model of household consumption with full expenditure and time use

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Abstract

This article looks at possible inequalities in the distribution of income as well as differences in consumption between the members of a couple. We use a collective framework with many consumption goods to include not only monetary and time expenditures but also the domestic production in the estimation of the sharing rule. To do so, we assume that households transform monetary and time inputs into final goods through a technology production function. The shadow price of domestic production reflects differences in the transformation productivity. Preliminary results show that the couple's preferences resembles more to that of women and that taking into account domestic production increases by 6 percentages points their share of full income. We also observed that the inclusion of domestic production changes the budget shares of individuals, even when monetary budget shares are the same.

Introduction

Theoretical work on consumer behavior has mainly focused on individual demand of goods and services. A representative agent is the core unit of analysis in microeconomics, since his tastes and consumption patterns can be extrapolated to the rest of the population. Because microeconomics is based on the study of individuals and not of aggregates, within-household demand was of little interest until the beginning of the 1960's. Before that, household demand studies implicitly assumed that income was pooled within the household members and that the corresponding expenditures were

equally distributed among them (Samuelson (1956)). To assess this hypothesis, only a deeper study of the mechanisms and behavior of the family would provide a valid answer.

Household models, as its name indicates, represent families no longer as a unique agent but as a whole entity composed by different individuals. Each individual has different tastes of consumption, different allocation of time and different bargaining power within the family. Recent studies have shown that the structure of consumption and the allocation of goods change depending the characteristics of the households. For example, Lundberg et al. (1997), Thomas (1990) and Mincer and Polachek (1974) show that revenues in the hands of women significantly increase the expenditure share allocated to clothing, health and human capital formation respectively. Therefore, it is possible that one member of the family captures most of the income share of the household, leaving the other members with a lower proportion of income and hence, of consumption share. This produces a within household inequality in the distribution of consumption.

The inequality in the distribution of income within the household is the consequence of a bigger 'bargaining power' of one of the family members. This allows him to capture a bigger share of the total income relative to the share of the other household members. The 'bargaining power' is defined as one's ability to impose his preference to the rest of the family. It determines the distribution of income within the household, commonly known as the sharing rule. Therefore, if one wants to study within household income inequality, particular attention should be given at the study of the household sharing rule.

Theoretically speaking, the estimation of the sharing rule should not cause problems. The only thing needed, is to observe the purchases and revenues of each member of the family to reveal the sharing rule. In practice however, such a source of individual data is extremely rare, since it is difficult to disentangle which member of a family consumes what and in which proportion. Household's models offer a solution to identify the sharing rule under the actual data constraints.

The goal of this paper is to study within-household inequality by analyzing the household's sharing rule. It follows the methodology and estimation of the collective model with many goods, developed by Browning et al. (2013). Contrary to their estimation of the sharing rule, this article aims not only to include monetary expenditures but also time and domestic production in the estimation of the sharing rule. The motivation of this paper is mainly driven by the findings of the paper of Canelas and Salazar (2014) where we observed large disparities between men' and women' time allocation between paid and unpaid work activities. Indeed, women allocate a significant amount of time to domestic activities compared to men, whereas men spend larger hours to labor market activities than their counterparts. The paper concludes that, in this configuration,

the differences in the distribution of time between genders are due to significant entry barriers as well as lower wages for women in the labor market.

Nevertheless, even when both individuals of the couple work almost the same amount of hours, women still undertake the biggest share of domestic chores. In these cases, the important gap in domestic activities may also be the consequence of: First, a smaller bargaining power of women with respect to men and second, differences in tastes and preferences between the couple. In both cases, if we do not take into account the time in the estimation of the sharing rule, this might lead to a misinterpretation of the sharing rule. For instance, imagine a couple where both individuals work and for which we observe a 'monetary sharing rule' of 0.5 (which means an equal distribution of income between the couple). Imagine that, we are in the first case scenario and the man has a higher bargaining power than women and uses it to decrease the amount of hours doing domestic activities while keeping equal monetary expenditure to both partners. In this case, the women will have a smaller amount of leisure and therefore a smaller proportion of the household 'full income'. However, since domestic production is not reflected in the monetary sharing rule because there is no monetary wage when executing domestic chores, the sharing rule would remain unchanged even though there is an inequality in the distribution of full income between sexes. If the distribution of domestic activities is due to a lower bargaining power of women affecting the sharing rule and one wants to evaluate the validity of this hypothesis, the 'monetary sharing rule' would not provide valid comparisons. An estimation of a 'full sharing rule' containing monetary and time expenditures would be more adequate to assess such hypothesis.

This article aims to estimate not only the demand patterns of different households but also to focus on the distribution of full income within the households and the impact of the sharing rule in full expenditure. It is also an attempt to include household domestic production within a collective model of household consumption with many goods, through the creation of full prices and full expenditures. Full expenditures compared to monetary expenditures, may have a different impact on the sharing rule since preferences in time allocation are also taken into account. If monetary and time preferences differ, one can expect a modification of the sharing rule when accounting for full expenditures.

Another important contribution of this paper is the estimation of the sharing rule for a developing country. Unitary models have been largely tested in developing countries (Quisumbing and de La Brière (2000), Hoddinott and Haddad (1991) and Ashraf (2009) among others) but this has rarely been the case for the collective model, probably due to data availability problems. Also, Guatemala offers a particular case of study since more than 60% of its population is Maya descendant and respects a matriarchal inheritance scheme. Matriarchal inheritance allows female sons to inherit goods, granting bigger bargaining power to women. Because of this, we expect the Guatemalan bargaining

power of women to be close to those of women in developed countries, allowing us to compare with previous estimates of the sharing rule.

This article is divided as follows. Section 1 explains the theoretical framework of analysis, section 2 describes the model and section 3 develops the empirical procedure. Section 4 describes the relevant issues of the Guatemalan dataset, the next section 5 shows the main results and the last section concludes.

1 Theoretical Framework

Unitary models of household behavior assume that household's decisions are taken by a unique representative agent. In these kinds of models, the family is represented as a unique entity where all members have the same preferences and pool their resources, so that consumption decisions are independent of the level of income or the preferences of each member of the household.

The advantage of this model is the simplicity, the estimation of consumption patterns are much easier under this configuration. The main drawback is due to its inability to decorticate intra-household behavior and its consequences in the consumption decisions. Therefore, if one wants to study how the bargaining power of a household member affects its share of income, the unitary model cannot give such an answer and another household model should be specified. Intra-household models of family behavior consider individualities and differences in preferences within the members of the household, as well as in the mechanisms of the decision making process. What differentiates these models from one to another is the way of modeling the decision making process. Cooperative and non-cooperative models use game theory to determine the outcome of the bargaining process. As a consequence, the optimality of the outcome depends on the underlying assumption made to represent the decision procedure.

In order to avoid the modeling of a decision process that might or might not apply to our situation, we use the collective model instead in our specification. The collective model developed by Chiappori (1992) has the main advantage of avoiding the representation of the decision making process by assuming only the Pareto optimality of its outcome. That is, given the individual's characteristics, it does not matter how the decision-making process is carried out since the resulting outcome would be optimal.

Chiappori (1997) and Apps and Rees (1997) introduce household production in the collective model and take into account the allocation of time to domestic chores. Empirical testing of the collective model with household production such as Aronsson et al. (2001), Donni and Matteazzi (2010) and Rapoport et al. (2011) takes into account the distribution of work between paid and unpaid market activities. Since time is an

assignable good, the estimation and identification of the sharing is possible under these circumstances. Nevertheless, the estimation of the sharing rule has never been performed in a collective model with many consumption goods and household production. The estimation of a 'full sharing rule' including time and monetary expenditures gives the distribution of full income among the members of the household.

In this paper, we specifically use the collective model with many consumption goods presented by Browning et al. (2013) (from now on referred as BCL). The methodology used in the BCL methodology has been already applied to the estimations of equivalent scales, such as in Bargain and Donni (2012) and Dunbar et al. (2013) and income inequality like in Lise and Seitz (2011). The key point of the collective model with many consumption goods is that it permits to recover the household sharing rule only by the observation of consumption allocation to different commodities.

The specification used in this paper differs from the BCL model in 2 main points: First of all, it includes full income and full expenditure in the analysis of demand patterns and in the estimation of the sharing rule. The inclusion of time in the final consumption goods allow us to take into account the distribution of time within the household. Secondly, we do not impose a linear Barten's consumption technology but we assume that the household's production transforms time and monetary inputs into final goods. We assume that the efficiency of the household's technology is reflected in the shadow price of the household production function. Therefore, singles and couples production differs in terms of efficiency in the transformation of inputs.

2 The Model

Individual demand

Following a Cobb Douglas framework, the individuals maximize utility $U(Q_i)$:

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

that depends on consumption goods Q_i. In turn, Q_i is composed by a vector of monetary goods $m = (m_1, m_2, ... m_n)$, and a vector of time consumption $t = (t_1, t_2, ... t_n)$. Utility is maximized under the full budget and production technology constraints:

$$\sum_i (p_i x_i + \omega \hbar_i) = w t_w + \omega(T - t_w) + V \tag{1}$$

$$z_i(x_i, \hbar_i) = F(Q_i) \tag{2}$$

The right hand side of equation 1 represents the individual's full income, also denoted as y^{full}, and the left hand side the individual's full expenditure. Full expenditures

are compound of monetary and time expenditures. Time expenditures equal $t_i = \omega\hbar_i$, with ω, the opportunity cost of time and $\hbar_i$, the number of hours spent on activity i. The monetary expenditures correspond to $m_i = p_i x_i$, with p, the matrix of prices corresponding of the goods, x. Full income on the other hand, depends on wages w, the number of hours spent at work t_w, the non-labor income V and on $(T - t_w)$ which represents the time dedicated to domestic activities and leisure. The notation of the full budget constraint can be simplified by assuming that there exists a composite 'final input' noted $z_i(x_i, \hbar_i)$ that depends on the monetary x_i, and time $\hbar_i$, inputs as defined above. The price corresponding to this composite input is noted p^{full}. Replacing the full income constraint with these expressions yields to the simplified constraint: $\sum p_i^{full} z_i = y^{full}$.

Contrary to the BCL framework, in this model, mono-nuclear families transform monetary and time inputs through the technology function F, in order to obtain final goods Q_i. Indeed, to take into account the household domestic production, single's households transform monetary and time inputs thanks to the production function 2. The shadow price corresponding to the constraint of household production technology, $z_i(x_i, \hbar_i) = F(Q_i)$, is: $\pi_i = \frac{p_i x_i + \omega t_i x_i}{p_i x_i} = 1 + \frac{\omega t_i}{p_i}$. Finally, 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 $V^i(\pi/y^{full}) = U^i[h^i(\pi/y^{full})]$.

Household demand and technology

In this specification, the households' optimization program differs from the individual's program in two different points: First of all, households are considered as couples that maximize a weighted utility sum $\tilde{U}$ of women f and men m utility functions. The household is not considered as a unique entity but is composed of two distinct individuals. Therefore, the welfare function of the family is composed of two independent utility functions, one for each member of the couple. The collective framework avoids the modeling of the household decision process, the only assumption needed here is that, $\tilde{U}$ is the result of a bargaining process with a Pareto optimal outcome. Thus, the welfare function of the family assigns a Pareto weight to each member of the couple, which represents a measure of the person's ability to impose his/her preference upon those of the other spouse. The Pareto weight reflects the bargaining power of each member in the decision process. For simplicity, we are going to assume that μ indicates the influence of women in the household decision making, so that only one weight is needed in the household utility function. An increase in μ means that the woman preference has a bigger weight in the household utility, which results in a bigger share of women consumption q^f. As in the literature of collective models, the Pareto weight depends on wages, prices and distribution factors. The distributions factors represent all variables that affect the bargaining power but do not affect preferences; these variables only affect consumption through their influence on the bargaining power.

Second, the consumption technology of households differs from those of individuals as concerns efficiency. Households purchase x_i monetary commodities and use $\hbar_i$ time expenditures that they transform into q, via the production technology function $z_i(x_i, \hbar_i) = F(Q_i)$. In this case, z_i can be interpreted as the 'final input' compound of monetary and time inputs and Q_i as the outputs of the household production function F. The distinction between the technology function of singles and couples is given by differences in efficiency. Both types of families combine x_i and $\hbar_i$ to produce final goods but couples are more efficient at transforming inputs. This means that, even when both families use the same amount of money and time, the couple's outcome is still higher than the one of single's. The higher efficiency of couples in the transformation of $z_i(x_i, \hbar_i)$ to q_i is only the consequence of the sharing within the couple. As explained in the BCL paper, this can be seen as the gain from sharing consumption as in the case of transportation: sharing a car may reduce the total number of kilometers made by the couple compared to the situation in which both spouses were single. The function F, represents the household's production technology which is a more Beckerian interpretation of household behavior. The main difference is that, in the model of Becker, inputs are transform into a whole new commodity from which households retrieve utility, while in this model $z_i(x_i, \hbar_i)$ is transformed to produce more consumption of the same good. Therefore, joint production increases the quantity consumed by each member to a level q^i but does not transform commodities to produce new goods as in the Beckerian model.

Given the above assumption, the household maximization program consists on a weighted utility sum (one weight per member of the couple) under budget and production technology constraints:

$$\max_{q^f, q^m, z} \mu\,(p^{full}/y^{full})U^f(q_i^f) + U^m(q_i^m) = \mu(\pi/y^{full})\left(\prod_i a_i(q_i^f)^{\gamma_i}\right) + \left(\prod_i a_i(q_i^m)^{\gamma_i}\right) \quad (3)$$

$$\begin{aligned} \text{subject to} \quad & \sum(x_i^f + x_i^m) = w^f t_w^f + w^m t_w^m + V \\ & \sum(\hbar_i^f + \hbar_i^m) = T - t_w^f - t_w^m \\ & Q_i = q_i^f + q_i^m \\ & z_i(x_i, \hbar_i) = F(Q_i) \end{aligned}$$

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

$$\sum(x_i^f + \hbar_i^f) + \sum(x_i^m + \hbar_i^m) = w^f t_w^f + w^m t_w^m + \omega(T - t_w)^f + \omega(T - t_w)^m + V \quad (4)$$

Aggregating the inputs of each member of the couple and taking into account that $m_i = p_i x_i$ and $t_i = \omega\hbar_i$ compose the 'final input' $z_i(x_i, \hbar_i)$, the full income constraint

4 becomes: $\sum(p_i^{full} z_i(x_i, \hbar_i)) = y^{full}$ in which, p_i^{full} corresponds to the real price of the 'final input' z_i and y^{full} is the full income (money and time) of the household.

Total consumption of the household equals the sum of the woman and man consumption $\sum Q_i = \sum q_i^f + \sum q_i^m$ and hence the vector of final inputs $z(x, \hbar) = F(q^f + q^m)$. Therefore, the full budget constraint gives us the possible space of consumption of vectors m, t and hence z while the technology constraint gives us the feasible values of q^f and q^m given the final composite input z.

The solution of the above optimization program is given by:

$$z = h\left(\frac{p^{full}}{y^{full}}\right) \text{ and } Q = q\left(\frac{p^{full}}{y^{full}}\right) \tag{5}$$

An important point about the nature of goods q^f and q^m is on order. The commodities z consumed by the member of the household could be private or public. Public goods concern all goods that are jointly consumed by the members of the household such as heating and durable goods. Private goods on the other hand, are consumed independently by each individual as is the case for clothing, in this case, expenses serve only to the person who made the purchases.

2.1 Sharing rule and shadow prices

The Pareto weight of the household utility function μ, captures the bargaining power of the women as well as her influence in the decision process of the couple. This Pareto weight is conditional to the cardinalization of the female and male sub-utility functions, which represents its main drawback. To overcome this problem, collective model relies on the concept of the 'sharing rule'. The sharing rule as its name indicates, defines the proportion of household income allocated to each member of the household. As the Pareto weights, it depends on wages, prices, distribution factors and on the bargaining power of each individual. The Pareto weight and the sharing rule, both reflect the influence that each member of the couple has, to capture the biggest share of *full* income. The main difference between these two variables, concerns the optimization program which is split into two steps when using the sharing rule approach. In the first step, couples agree on the full income sharing, that is, as explained before, the corresponding share of total full income distributed among family members. In the second stage, women and men independently decide on their own level of consumption q^f and q^m given the full income allocation decided in the first step (through the sharing rule). The sharing rule can be seen as lump sum transfers between the members of the household. In this particular case, this transaction corresponds to transfers from women to men which can either be positive or negative.

For the sake of simplification, from now on, we drop the subscript i to start working with vectors. As explained below, the efficiency of the couples production technology, represented by $z(x, \hbar) = F(Q)$, is higher than those of single agents. Since the prices and quantities of inputs m and t of the composite final input z differ between households, the shadow price of this technology also differs from one to another. Given the technology F, the corresponding shadow price is given by:

$$\pi = \frac{px + \omega tx}{px} = 1 + \frac{\omega t}{p} \tag{6}$$

Even when we do not exactly 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, thanks to the economies of scale. This is reflected in the household full price, which as a consequence, would be higher for singles than it is for couples. In fact, the lower the units x and $\hbar$ used in the production of final goods, the lower the full price faced by the household. Low prices increase the efficiency of the household production, since it becomes cheaper to produce the same amount of final goods ceteris paribus. Therefore, as specified below, couples are more efficient than singles at producing final goods because they can produce more consumption with the same quantities of inputs.

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 preferences prior marriage. Assuming that, the shadow price expression (π) of the technology function (F) is given by the equation 6 above; the estimation of female and male consumption becomes:

$$q^f(p^{full}/y^{full}) = h^f\left(\frac{\pi(p^{full}/y^{full})}{\eta(p^{full}/y^{full})}\right)$$

$$q^m(p^{full}/y^{full}) = h^m\left(\frac{\pi(p^{full}/y^{full})}{\eta(p^{full}/y^{full})}\right)$$

$$z = h(p^{full}/y^{full}) = F[q^f(p^{full}/y^{full}) + q^m(p^{full}/y^{full})]$$

These three equations represent the solution of the household maximization program as presented in equation 5 but given shadow prices, π and women income share, η. Under this configuration, Z becomes:

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

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

2.2 Identification

The identification requires recovering the sharing rule, shadow prices and consumption technology parameters from the simple observation of households' demands. Following Browning et al. (2013) 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. The singles demands would allow us to estimate the sharing rule parameters of couples since indifference curves are not modified when individuals change their status from single to married. Even when this assumption may seem restrictive, we should consider that it is the same hypothesis that we use in the equivalence scales context. Indeed, the underlying assumption when constructing equivalence scales is that the preferences of individuals do not change according to family structure. This means that preferences of singles do not change when they set a couple and that the preferences of couples do not change when having children. The stability of preferences regardless of family structure is a very common hypothesis in economics models and hence, using this assumption here should not cause major inconveniences.

Identification also requires the estimation of more than three consumption demand equations. Indeed, if the number of goods is lower than three, identification is not possible 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. In fact, a simple form of these two functions makes difficult to separate the demand from the consumption technology causing identification problems. 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 since its properties and structure are widely known in consumer demand analysis.

3 The empirical estimation

3.1 Estimation of Singles' Demand

As explained above, identification requires stability of preferences from singles to married as well as non-linearity either in the consumption technology or in the demand function. The latter option has been chosen to achieve identification and therefore a non-linear demand system is used to estimate the singles' budget share. The Cobb-Douglas hypothesis of this model was chosen in order to facilitate the estimation of the parameters. However, the estimation of a Cobb-Douglas function does not integrate households heterogeneity and the resulting income and price elasticities are constant for the entire sample. Additionally, the linearity of the Cobb-Douglas estimation does not allow to achieve empirical identification since we require non-linearity of the demand functions. These reasons explain the choice of a Quadratic Almost Ideal Demand System (QUAIDS) for the estimations of the singles demand over more common representations of linear systems such as the Cobb-Douglas, the Linear Expenditure System (LES) or the Linear Almost Ideal Demand System (LAIDS).

The Quadratic Almost Ideal Demand System (QUAIDS) is a non-linear demand system derived from the duality program of consumer behavior. The QUAIDS model was developed by Banks et al. (1997) and follows the specification of the Almost Ideal Demand System of Deaton and Muellbauer (1980). Contrary to the AIDS model, the QUAIDS demand system includes a quadratic term in prices. Thus, the estimation is non-linear in prices and satisfies the symmetry, homogeneity and adding up constraints of demand systems. As well as the AIDS model, the QUAIDS specification stems from the cost function and takes the following form:

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

Where ω_i is the budget share of good i, α_i, Γ_i, β_i and λ_i are the coefficients of the budget share equation and y_i^{full} is the total full expenditure of households or singles. And $c_i(\pi)$ and $b_i(\pi)$ are prices indices such that:

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

Assuming that individuals' demand functions follows the QUAIDS demand, then the couples parameters could be identified by the estimation of the singles' women and

men budget shares, as demonstrated by Browning et al. (2013). The QUAIDS model will provide the estimates of the α_i, Γ_i, β_i and λ_i parameters stemmed from the singles' consumption observations. The budget share equations are jointly estimated to allow for possible correlation of errors across goods. So the system consist of $n-1$ equations, where the last equation is dropped to fulfill the Barten's adding up restriction.

To account for individual heterogeneity in preferences, the estimation of the QUAIDS model will include individuals' socio-demographic characteristics. For the QUAIDS estimation we use eight different variables of socio-demographic characteristics: the age and age squared of each individual, an indigenous dummy for people belonging to indigenous groups, a binary variable for individuals living in urban areas, three regional dummies, a dummy variable for people having complete at least secondary education, another one for employers in the private or public sector, which accounts for the stability and formality of the job, and finally one measure of wealth namely, the annual value of the household where the individual lives.

The resulting estimates are therefore conditional to the couples' observable characteristics. The main problem of the QUAIDS estimates derives from measurement error of total expenditures. Indeed, total expenditure can be mistakenly reported for many reasons: the period of study could be too short and households may not have had the time to purchase the given good, or abnormal peaks of expenditure may be observed during this period when purchasing luxury or durable goods, etc. In order to correct this measurement error, an instrumentation of total expenditure is operated and divided by the stone price index.

3.2 Estimation of the Couples Demand

Once the parameters of the single women and men budget share are estimated, the estimation of the couples' budget shares can follow. The couples demand includes all the quaids parameters from the singles estimation, so that the couples' demand of women $w^f = \omega^f(\pi/y_f^{full})$ and men $w^m = \omega^m(\pi/y_m^{full})$ depends on the parameters previously estimated in the singles' model.

As previously explained, couples have the production technology $z_k(x_i, \hbar_i) = F(Q_i)$, and shadow prices equals $\pi_k = (p_k x_k + \omega t_k x_k)/p_k x_k$ where $p_k x_k + \omega t_k x_k$ represents the household full expenditure and $p_k x_k$ its monetary component. The couples' budget share is therefore given by the weighted average sum of the budget share of each member of the couple:

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

Where η, represents the sharing rule and hence the full resources allocated to women and $1 - \eta$ is the part of full income allocated to men.

The sharing rule of the couple can be calculated by:

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

The household sharing rule is represented by a logistic function as proposed by Browning et al. (1994), so that the sharing rule will be bounded from 0 to 1. δ are the parameters to be estimated and s are the distribution factors influencing the sharing rule. The parameters of the sharing rule include the wife share of total income, the age differences between the couple's members, a dummy variable for housing ownership and the logarithm of the household monetary income deflated by the stone price index.

4 Dataset

The dataset used in this paper consists of the three waves of the Guatemalan ENCOVI survey of the years 2000, 2006 and 2011. The three waves of the survey were needed for this paper since the amount of single's households is very reduced. This is mostly explained by social norms: in Guatemala single sons stay at the family's residence until they get married, hence mono-nuclear households are rare among the population.

Our sample is composed of single households and childless couples from the three different years of the survey. Due to data availability issues, instead of working with the 3 distinct years, households have been collapsed into one single cross section dataset after deflating the income and expenditure variables. The fact that, changes in the ENCOVI questionnaire are almost negligent across years, allows us to compile the households into a compact dataset once variables are deflated. 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. This restriction in the estimation, reduces considerably our dataset, leaving us with a final sample of 496 single men, 460 single women and 1976 couples.

The table above, gives an overview of the main socio-demographic characteristics of singles and couples used in the estimation of the sharing rule. The distribution of monetary and full budget shares between the three types of families is also displayed on this table. The socio-demographic statics of the households show that the difference in age between the members of the working couple is 3 years in average. We observe that, individuals living in couple are twice more likely to work as public or private employees.

Single and couples main variables and budget shares

	Descriptive Statics		
	Single Men	Single Women	Couples
Monetary budget shares			
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
Full budget shares			
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

Being an employee in Guatemala means a more stable job, the right to benefit from social security and higher wages than in the agricultural sector. These reasons might explain why couples are more likely to be employees than singles. An important fact of the dataset concerns the share of income allocated to women. Women' income account for 46% of the total household income, which shows the equitable participation of both members of the couple to the total income share .

Concerning the monetary and full budget shares, we observe that there is not much difference between the 3 types of households. There are only few things that worth to be noted: First, the budget shares of the couples are closer to those of single women than of single men. Second, the only commodity that is significantly different for couples and for singles is health, which expenditures are much higher in the case of couples. Finally, the monetary budget share of leisure is higher for couples than singles, but when we have a look at the full expenditures we observe that budget share of leisure for single men is higher than for the rest of households. This means that, leisure represents an important time expenditure for single men while single women allocate less time and money to this commodity.

5 Preliminary results

As explained above, the estimation and identification of the sharing rule in the BCL model requires the estimation of the demand coefficients of single individuals. Since we assume that preferences do not change with marriage, identifying the consumption parameters of the single demands would allow us to calculate the couple's sharing rule. Due to the breadth of the table of the QUAIDS estimation for single women and men, the resulting estimation coefficients are not presented here, but can be recovered upon request. For the QUAIDS estimation we control for unobserved heterogeneity by accounting for the socio-demographic characteristics of the household such as: region of residence, age, age squared. We create dummy variables for the individuals: with secondary education or more, for the indigenous population, for home owners and for individuals working as private or public employees. Table 1 below shows the compensated direct price elasticities of single men and women. The first two columns of each side of the table indicate the monetary and full income elasticity while the last two display the corresponding price elasticities.

When comparing men to women, we observe that income elasticities are higher for men than for women. The income elasticity of men is rather high, specially comparing to women. This is probably due to the way in which commodities are aggregated. Since we are only observing the demand for singles, there are some goods for which demand is quite low. This is the case of education and health for example; the smallness of

Table 1: Monetary and full Income and Price Elasticities

	Income and Price Elasticities							
	Single Men				Single Women			
	Income		Price		Income		Price	
	Monetary	*Full*	*Monetary*	*Full*	*Monetary*	*Full*	*Monetary*	*Full*
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

the coefficient has a main consequence that even small changes in consumption have important aftermaths in the income elasticity. A better aggregation of goods for singles should be considered.

Monetary price elasticities are higher for men than for women, and the opposite occurs when we look at the full price elasticity which is generally higher for men. Full price elasticities are smaller than the monetary elasticity because one accounts for the monetary and time substitution in the production of final goods. Indeed, the substitution between time and money decreases the magnitude of the full price elasticity with respect to the monetary elasticity.

Table 2 below shows the sharing rule estimated with the monetary income and expenditures in the first line of the table. In the second line, the results of the sharing rule estimated with the full variables are also displayed. The variables used in the estimation of the sharing rule are: the region and area of living (urban or rural), the age differential between the members of the couple, the proportion of the women' income with respect to men and finally, the monetary or full income divided by the stone price index. The magnitude of the sharing rule with full expenditures is higher than the one composed with monetary expenditures only. η corresponds not only to the proportion of income captured by the women but it also represents the resemblance between the women' preference and the couple's preference. A higher value of η means that women capture a higher share of income and that the preference of the couple 'looks more like' the woman preference. In this particular case, the average value of the sharing rule equals 0.71 compared to 0.68 in the BCL estimation.

Women capture an even larger proportion of income when we take into account full expenditures. This means that, the distribution of time between couples also follows the

Table 2: Monetary and Full Sharing Rule

	Sharing rule
Monetary	0.71
Full	0.77

preferences of women. This might seem surprising in the case of Guatemala, where one expect social norms to play in favor of men, specially in the case of domestic chores. As explained in section 4, the dataset only concern couples where both individuals work. The particularity of the sample may induce a higher value of the sharing rule than we would obtain when including non-working individuals. Indeed, there is strong selection of women in the labor market due to important entry barriers. In fact, women who manage to enter in the labor market are even more qualified than their male counterparts.

The difference in the magnitude of the monetary and full sharing rule indicates that time should be consider when performing such an estimation. In our case, the full sharing rule increases the proportion of income allocated to women by 6% points.

Table 3: Estimated Monetary and Full Budget Share, Men and Women

	Monetary and Full Budget Share			
	Women		Men	
	Monetary	*Full*	*Monetary*	*Full*
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

The estimated monetary and full budget shares of women and men are presented in table 3. A look at the table show us that, housing expenditures seem not to be affected nor by sex or time. Health expenditures do vary with time but do not change much between gender. This means that women and men spend in average the same amount of money and time resources to health related activities. On the contrary, the allocation of time and money to transportation, personal care, education and to a lesser extend, clothing, do diverge between men and women. Men allocate more resources to transportation and personal care while women prefer to distribute a higher amount of their

resources to clothing and education.

An interesting feature worth to be highlighted in the structure of the budget shares of food and leisure. The shares of monetary expenditures of food and leisure are almost the same for men and women, they oscillate around 45% and 1.4% correspondingly of the individual's total resources. However, when we have a look at the full budget shares of the same goods, the expenditures diverge significantly between the two sexes. Women seem to spend a higher amount of time in the preparation of food and a smaller share of time to leisure activities with respect to men. The opposite occurs with the full budget shares of men, who seem to devote a lower share of hours to food preparation and a higher amount of time to leisure (more than double the amount of time devoted by women). This is a perfect example of why the household production should be included in the analysis of the sharing rule and consumption patterns.

Comparative analysis of the shadow price of the technology function is currently in progress as well as the estimation of the sharing rule by different sub-population groups. Finally, in order to avoid commodities with very little consumption, an alternative aggregation of the different commodities is ongoing, so that the income elasticities value would not be affected by them.

6 Conclusion

This paper shows the estimation of within household inequality in the distribution of full income within a collective framework. To achieve this, we estimate the 'full sharing rule' with the BCL collective approach with many consumption goods. In order to account for disparities in the time distribution of households, we include full income and full expenditures into the model. We also integrate the household domestic production by assuming that households transform monetary and time inputs into final goods through a production technology function. The shadow price of the household production function reflects the higher efficiency of couples with respect to singles, at transforming inputs into final goods. These changes, allow us to take into account the domestic production function and to assess whether the sharing rule is affected by the allocation of time within the household.

The results indicate that taking into account the time and the domestic production increases by 6 percentage points the share of full income allocated to women. This also means that, the preferences of the household resemble more to the women preferences than that of men. In particular, when we look at the sharing rule with full consumption that takes into account time preferences, we realize that the income share of women increases even more.

Nevertheless, a closer look at the distribution of time and money between different commodities (i.e the budget share) indicates that, even when monetary expenditures between men and women are the same, the time spent into these activities differ. A clear example is given by the allocation of time to food and leisure: women and men allocate the same amount of money in the consumption of these goods, but men spend a bigger amount of time in leisure activities while women allocates a higher proportion to food preparation. As a result, the monetary budget share is the same for both sexes when in reality the distribution of time changes considerably the distribution of resources within the household as concerns budget shares and in fine the sharing rule.

Finally, the estimations of price elasticities with full income are lower than those estimated with the monetary expenditures. This is explained by the fact that full elasticities incorporate the substitution between money and time, which results in a lower magnitude of the full price elasticities. On the other hand, the estimates of income elasticities are much higher compared to our previous estimates, since the consumption of certain goods by single families is much lower than for the rest of the population. Very small budget shares conduce to high income elasticities which could explain the importance of the monetary and full income elasticities.

Further research on the application of household production to technology function and publicity of goods should be undertaken.

References

Apps, P. F. and Rees, R. (1997). Collective labor supply and household production. *Journal of political Economy*, pages 178–190.

Aronsson, T., Daunfeldt, S.-O., and Wikström, M. (2001). Estimating intrahousehold allocation in a collective model with household production. *Journal of Population Economics*, 14(4):569–584.

Ashraf, N. (2009). Spousal control and intra-household decision making: An experimental study in the philippines. *The American Economic Review*, pages 1245–1277.

Banks, J., Blundell, R., and Lewbel, A. (1997). Quadratic engel curves and consumer demand. *Review of Economics and Statistics*, 79(4):527–539.

Bargain, O. and Donni, O. (2012). Expenditure on children: A rothbarth-type method consistent with scale economies and parents' bargaining. *European Economic Review*, 56(4):792–813.

Becker, G. S. (1965). A theory of the allocation of time. *The economic journal*, 75(299):493–517.

Browning, M., Bourguignon, F., Chiappori, P.-A., and Lechene, V. (1994). Income and outcomes: A structural model of intrahousehold allocation. *Journal of Political economy*, pages 1067–1096.

Browning, M., Chiappori, P.-A., and Lewbel, A. (2013). Estimating consumption economies of scale, adult equivalence scales, and household bargaining power. *The Review of Economic Studies*, page rdt019.

Canelas, C. and Salazar, S. (2014). Gender and ethnic inequalities in lac countries. *IZA Journal of Labor & Development*, 3(1):18.

Chiappori, P.-A. (1992). Collective labor supply and welfare. *Journal of political Economy*, pages 437–467.

Chiappori, P.-A. (1997). Introducing household production in collective models of labor supply. *Journal of Political Economy*, pages 191–209.

Chiappori, P.-A. and Ekeland, I. (2009). The microeconomics of efficient group behavior: Identification1. *Econometrica*, 77(3):763–799.

Deaton, A. and Muellbauer, J. (1980). An almost ideal demand system. *The American economic review*, 70(3):312–326.

Donni, O. and Chiappori, P.-A. (2011). Nonunitary models of household behavior: A survey of the literature. In *Household economic behaviors*, pages 1–40. Springer.

Donni, O. and Matteazzi, E. (2010). On the importance of household production in collective models: Evidence from us data.

Dunbar, G. R., Lewbel, A., and Pendakur, K. (2013). Children's resources in collective households: identification, estimation, and an application to child poverty in malawi. *The American Economic Review*, 103(1):438–471.

Hoddinott, J. and Haddad, L. (1991). *Household Expenditures, Child Anthropometric Status and the Intrahousehold Division of Income: Evidence from the Côtp D'Ivoire*. Research Program in Development Studies, Woodrow Wilson School, Princeton University.

Lise, J. and Seitz, S. (2011). Consumption inequality and intra-household allocations. *The Review of Economic Studies*, 78(1):328–355.

Lundberg, S. J., Pollak, R. A., and Wales, T. J. (1997). Do husbands and wives pool their resources? evidence from the united kingdom child benefit. *Journal of human resources*, pages 463–480.

Mincer, J. and Polachek, S. (1974). Family investments in human capital: Earnings of women. In *Marriage, family, human capital, and fertility*, pages 76–110. NBER.

Quisumbing, A. R. and de La Brière, B. (2000). *Women's assets and intrahousehold allocation in rural Bangladesh: Testing measures of bargaining power*. International Food Policy Research Institute Washington, DC.

Rapoport, B., Sofer, C., and Solaz, A. (2011). Household production in a collective model: some new results. *Journal of Population Economics*, 24(1):23–45.

Samuelson, P. A. (1956). Social indifference curves. *The Quarterly Journal of Economics*, pages 1–22.

Thomas, D. (1990). Intra-household resource allocation: An inferential approach. *Journal of human resources*, pages 635–664.