# The Passive Drinking Effect: Evidence from Italy

M. Menon F. Perali L. Piccoli

December 4, 2007

**Abstract**

This paper investigates whether consumption of alcoholic beverages can affect distribution of resources between household members. We refer to this effect as *passive drinking effect,* highlighting the negative impact that alcohol addicted individuals can have with respect to other household members. For the investigation of this issue we rely on the collective framework and estimate a structural collective demand system. Our results show that for Italian households a high level of alcohol consumption actually influences the distribution of resources. In general, the resources distribution is in favour of the husband, with a larger effect in poor households. This evidence underlines that alcohol consumption is not only an individual problem. Public costs that are transfered to the other household members should be taken into account when designing social policies.

**JEL Classification Codes:** C31,C34,C51,D12,D13.

# Draft

**Acknowledgements.** *We thank the participants of the Workshop on Health Economics, held in Oslo, for their useful comments and suggestions; the Institute of Health Management and Health Economics (University of Oslo) and Statistics Norway, and in particular Knut R. Wangen, Rolf Aaberge and Snorre Kverndokk for support and encouragement. Finally a special thank you goes to Eugenio Peluso, Luca Zarri, Sara Borelli for their comments and help, and to all people we forgot to mention.*

*This work is part of the **ReAct** project.*[1]

# 1 Introduction

This paper addresses the issue of whether a high level of individual alcohol consumption leads to negative economic consequences to other members of the household. We refer to it as the passive drinking effect. One of the most cited examples is the old times English "egoistic" husband, who on Friday evening was used to drink his wage at the pub, bringing no bread to the wife and the children. A similar example is given in Borelli and Perali (2002) for households of Djibouti, where husbands spend much of their wage on a legal drug, the qat, depriving other members of basic needs.

As suggested by these examples, intra-household distribution of resources is a relevant determinant of household's welfare. Several negative "household internalities" caused by alcohol consumption, such as episodes of violence, misunderstandings, lack of attention, health problems, increased probability of car crashes, and so on, suggest the need of a policy intervention. However, these negative consequences are difficult to measure and evaluate economically. For this reason in our analysis we focus on the intra-household distribution of resources as a way to measure the negative impact that alcohol consumption may have on household welfare.

In general, the analysis of consumption of addictive substances should be conducted through an intertemporal framework at the individual level. In fact, the process towards addiction to substances is strictly private and depends on the quantities consumed by the person itself in the past. The household in this process plays a secondary role, being just part of the environment in which the individual develops addiction. In the present work we give back to the household the central role that it deserves as a potential victim of a social injustice. The analytical tool that we adopt to study this issue is the collective framework of Chiappori (1988), which allows us to investigate whether private alcohol consumption affects or not the intra-household distribution of resources.

In particular, our approach is similar to the proposal of Browning, Bourguignon, Chiappori, and Lechene (1994), in that we undertake a structural estimation of a collective demand system and test whether a high level of alcohol consumption induces a modification of the "sharing rule" respect to households in which alcohol is not consumed. For instance, in some households, a despotic heavy drinker may take decisions regardless of other member's needs. This situation may occur when a strong habit to consume alcohol is present and a part of household resources is devoted to the daily measure of alcohol, and hence negated to other members. Here a policy intervention, aimed at restoring a more egalitarian intra-household distribution of resources by reducing consumption of the vicious good may be auspicable. To analyze in depth these questions we focus on non-elderly Italian couples without children, and match the Italian household expenditure survey with a living standard survey[2] which provides information on individual alcohol consumption.

To our knowledge, in the literature there are no previous empirical studies on the link between alcohol consumption and the intra-household distribution of resources. Though we cannot compare our results with previous works, our findings are meaningful. According to our estimates, alcohol consumption significantly affects the intra-household distribution of resources in favour of the husband, especially for low income household. The results of this work seem to suggest that on average men tend to be more inclined to overbearing

[1] **ReAct** (**Re**search Group on **Addict**ion) - http://dse.univr.it/addiction

[2] The surveys we refer to are both from the Italian National Statistics Accounts (ISTAT), and titled "Consumi delle Famiglie Italiane" and "Indagine Musliscopo su Stili di Vita e Condizioni di Salute."

behaviors when alcohol is consumed. This effect is more evident for low income households. We recommend a policy intervention to reduce the consumption of alcoholic beverages and increase the bargaining power of the wife within the household. In fact, since alcoholic beverages prove to have a particularly small own price elasticity, a policy intervention of increased taxation on alcoholics will have a poor impact on consumption, which could be compensated reducing consumption of other goods.

The paper is organized as follows. Section 2 introduces the theoretical framework of Collective Choice Models and the demand system specification. Section 3 deals with the econometric method which will be applied and describes the data used. Section 4 shows the results and Section 5 concludes.

## 2 The Model of Collective Choice

The collective framework, introduced by Apps and Rees (1988) and Chiappori (1988, 1992), extends the unitary framework to recover individual preferences using household data. This is done by introducing a function, the sharing rule, which determines the proportion of household resources devoted to each household member. A fundamental issue of collective models is the identification of the sharing rule. Since data is collected at the household level, in general it is not possible to empirically distinguish preferences of the single household member and, as a consequence, the sharing rule would not be identified. However, the identification of the sharing rule and the estimation of individual preferences are possible when the dataset endows some relevant information.

There are mainly three empirical approaches for the identification of the sharing rule. The first approach is proposed by Chiappori (1992) and several later works, and consists in assuming that leisure time is an exclusive good. Observing how each member devotes his/her time to leisure, it is possible to identify the sharing rule by means of a labour supply collective model.

The second approach proposed by Browning, Chiappori, and Lewbel (2007),[3] assumes that an individual does not change his/her preferences when changing marital status from single to married. Using available information on singles one can estimate individual preferences, and, applying these preferences to couples, it is possible to recover the sharing rule.

The third approach for the identification of the sharing rule, applied in Browning, Bourguignon, Chiappori, and Lechene (1994), consists in using available information on exclusive or assignable consumption goods. If the survey records expenditures in goods which can be assigned to just one member of the household, then it is possible to identify the sharing rule. This method shares its theoretical foundation with the first approach.

The choice of the proper approach depends on the available data. If the available dataset has no information on any exclusive or assignable good and no information on the time use of individuals, the best that one can do is to use the second approach, since information on singles will probably be available. On the other hand, if one has information on the time use, but not on exclusive or assignable goods, the first approach should be the choice. Finally, if one observes consumption of exclusive or assignable goods, but not the time use, the third approach should be used.

We are exactly in the latter situation. The expenditure dataset used in this work provides information on two exclusive goods, male clothing and female clothing, but no information is given about the time use. However, we improve the analysis by matching

[3] And in the field of labor supply by Barmby and Smith (2001) and Bargain, Beblo, Beninger, Blundell, Carrasco, Chiuri, Laisney, Lechene, Longobardi, Myck, Moreau, Ruiz-Castillo, and Vermeulen (2006).

information with the living standard dataset, which contains information on individual alcohol consumption, favouring the estimation of the sharing rule and allowing for a relevant policy analysis. Hence, our choice falls on the third approach, which allows us to both estimate the sharing rule and to investigate the hypothesis that consumption of alcoholic beverages leads to a modification of the sharing rule between husband and wife.

Let us define the theoretical framework in more details.

## 2.1 Theoretical Framework

In general, unitary models of consumption maximize an household utility function, which depends on consumed quantities of some goods subject to a budget constraint. Consumption of single individuals within the household is not taken into account and incomes pooling is assumed, that is individual incomes are put together to finance household expenditures. The household consumption decision process can be represented by the following maximization program

$$\begin{aligned} &\max U^h(\mathbf{x}^h, \boldsymbol{\theta}^h) \\ &s.t. \quad \mathbf{p}'\mathbf{x}^h \leq y^h \\ &\qquad\ \ \mathbf{x}^h \geq 0, \end{aligned}$$

where $U^h$ is the household utility function, $\mathbf{x}^h$ is a vector of consumption goods[4], $\mathbf{p}$ is the vector of prices of $\mathbf{x}^h$, $y^h$ is household income and $\theta^h$ is a set of parameters describing the preferences of the household toward goods $\mathbf{x}^h$. The household utility function $U^h$ is usually assumed to be continuous, twice differentiable, increasing and quasi-concave in $\mathbf{x}^h$.

If each element in $\mathbf{x}_h$ is a continuous variable, then Marshallian demand functions can be derived for each good $j$ in $\mathbf{x}^h$, $x_j^h = x_j^h(y^h, \mathbf{p}, \boldsymbol{\theta}^h)$, representing the optimal quantity of the good $x_i^h$demanded by the household given the household income level $y^h$, the prices set $\mathbf{p}$ and household's preferences represented by $\theta^h$.

Within the Collective theory the decision taker is not the household as a whole but its members individually. This feature allows to have a representation of the household in which each member has its own preferences. In this context, it is possible to explain the intra-household distribution of resources through a function called sharing rule.

Following the idea of Browning, Bourguignon, Chiappori, and Lechene (1994), assume that the household is composed by two members, the husband ($m$) and the wife ($f$). In principle, each of them can receive a labor income, which, together with any non-labour income, contributes to the household income $y^h$. Then the spouses, through a bargaining process, decide how to share the household income, assigning respectively $\phi^m$ and $\phi^f$,[5] which represent the sharing rule.

Each member of the household may consume part of the good purchased for the household $\mathbf{o}^h$ (with prices $\mathbf{p}^o$) or consume some exclusive goods $\mathbf{e}^k$, with $k = m, f$ (whose prices are $\mathbf{p}^k$).[6] These exclusive goods may be, for instance, male and female clothing,[7] which are consumed respectively by the husband and the wife exclusively.

[4]If not differently specified, when we talk about consumption goods or vectors we always refer to quantities. Superscripts indicate the household member, subscripts indicate a specific good.

[5]Note that, being $\phi^m$ and $\phi^f$ values, not a relative measure, they are chosen such that $\phi^m + \phi^f = y^h$.

[6]In this study, we do not take into account public household goods, as housing, travelling costs and so on. The reason is that the inclusion of such goods implies the adoption of a household production function, possibly whith economies of scale which, in absence of the proper information in the data, would cause identification issues for the sharing rule.

[7]In the literature, the most used exclusive good is leisure, which can provide the needed information for the indentification of the sharing rule within a labor supply model.

The individual maximization problem can be written as

$$\begin{aligned}
&\max U^k(\mathbf{e}^k, \mathbf{o}^k, \boldsymbol{\theta}^k) \\
&\quad s.t. \quad \mathbf{p}^{k\prime}\mathbf{e}^k + \mathbf{p}^{o\prime}\mathbf{o}^k \leq \phi^k \\
&\qquad\qquad \mathbf{e}^k, \mathbf{o}^k \geq 0 \\
&\qquad\qquad k = m, f;
\end{aligned} \tag{1}$$

which leads to the following Marshallian demand functions $x_j^k = x_j^k(\phi^k, \mathbf{p}^k, \mathbf{p}^o, \boldsymbol{\theta}^k)$, where $x_j^k$ is the demand of the $k-th$ household member for good $j$, and $j$ can be any good in $\mathbf{e}^k$ or $\mathbf{o}^k$.

In principle we could estimate these demand functions separately, but in practice this is not feasible, since microeconomic datasets are collected at the household level. Moreover, even whether individual expenditure is collected, it is impossible to assign an individual consumption to each good, since some goods are for their own nature public goods, while others, such as food, are in any case shared with all household's member.

On the other side, several datasets collect information on individual expenditure for some goods only, which is still a sufficient condition to identify the sharing rule (see Bourguignon, 1999). This suggests that it is possible to construct a household demand system which takes into account for individual income effects (thanks to the sharing rule) and to recover at least some of the individual preferences parameters.

Considering that the household consumption vector $\mathbf{x}^h$ and the price vector $\mathbf{p}$ are respectively

$$\mathbf{x}^h = \begin{bmatrix} \mathbf{e}^m \\ \mathbf{e}^f \\ \mathbf{o}^m + \mathbf{o}^f \end{bmatrix} \quad \text{and} \quad \mathbf{p} = \begin{bmatrix} \mathbf{p}^m \\ \mathbf{p}^f \\ \mathbf{p}^o \end{bmatrix},$$

the household demand system can be specified by adding up individual demands, so that

$$x_j^h(\phi^m, \phi^f, \mathbf{p}^m, \mathbf{p}^f, \mathbf{p}^o, \boldsymbol{\theta}^m, \boldsymbol{\theta}^f) = x_j^m(\phi^m, \mathbf{p}^m, \mathbf{p}^o, \boldsymbol{\theta}^m) + x_j^f(\phi^f, \mathbf{p}^f, \mathbf{p}^o, \boldsymbol{\theta}^f). \tag{2}$$

We can now define the demand system specification, which will be used in the empirical exercise.

### 2.2 The Collective Quadratic Almost Ideal Demand System

The chosen demand system is an extension to the Almost Ideal Demand System originally proposed by Deaton and Muellbauer (1980). The model is extended introducing a quadratic income term, following Banks, Blundell, and Lewbel (1997).[8] Demographic characteristics interact multiplicatively, with income in a theoretically plausible way (Barten, 1964; Gorman, 1976; Lewbel, 1985). The model is called "collective" because it incorporates individual incomes for the two members of the household.

The following equation shows the budget share equation of the demand function for good $i$ according to the specification of the collective quadratic almost ideal demand system (CQAIDS) derived in Appendix B

$$\begin{aligned}
w_i = {} & \alpha_i + t_i(\mathbf{d}) + \sum\nolimits_j \gamma_{ji} \ln p_j + \beta_i^m \left(\ln \phi^{m*} - \ln a(\mathbf{p})\right) \\
& + \frac{\lambda_i^m}{b^m(\mathbf{p})} \left(\ln \phi^{m*} - \ln a(\mathbf{p})\right)^2 + \beta_i^f \left(\ln \phi^{f*} - \ln a(\mathbf{p})\right) + \frac{\lambda_i^f}{b^f(\mathbf{p})} \left(\ln \phi^{f*} - \ln a(\mathbf{p})\right)^2,
\end{aligned} \tag{3}$$

[8] The choice is motivated in Appendix A, which provides evidence for a rank 3 demand system.

where $w_i$ is the household budget share of good $i$, $\alpha_i$, $\gamma_{ij}$, $\beta_i$ and $\lambda_i$ are parameters, $p_j$ is price of good $j$, $\phi^{m*}$ and $\phi^{f*}$ are demographically scaled sharing rules, $a(\mathbf{p})$ and $b(\mathbf{p})$ are two price indexes, $t(\mathbf{d})$ is a translating function and $\mathbf{d}$ is a vector of demographic variables or household characteristics. The individual scaled total expenditures are defined as

$$\begin{aligned} \ln \phi^{m*} &= \ln \phi^m(p^m, p^f, y^h, \mathbf{z}) - \sum\nolimits_i t_i(\mathbf{d}) \ln p_i, \\ \ln \phi^{f*} &= \ln \phi^f(p^m, p^f, y^h, \mathbf{z}) - \sum\nolimits_i t_i(\mathbf{d}) \ln p_i, \end{aligned} \tag{4}$$

where the sharing rules $\phi^m(\cdot)$ and $\phi^f(\cdot)$ are function of household expenditure $y^h$, prices of the exclusive goods $p^m$ and $p^f$, and a vector of exogenous variables called distribution factors $\mathbf{z}$.[9]

In order to comply with homogeneity properties of the demand system, the demographic specification of the budget shares demand system is subject to a number of restrictions on the parameters. In particular, to satisfy linear homogeneity in $\mathbf{p}$ and Slutsky symmetry the following restrictions must hold

$$\sum\nolimits_i \alpha_i = 1; \sum\nolimits_i \beta_i = 0; \sum\nolimits_i \lambda_i = 0; \sum\nolimits_i \gamma_{ij} = 0; \sum\nolimits_j \gamma_{ij} = 0; \gamma_{ij} = \gamma_{ji}; \sum\nolimits_i \tau_{ir} = 0.$$

This specification is consistent with the collective model stated in the previous section (equation 2). In fact, it is possible to estimate individual income parameters $\beta_i^m$, $\beta_i^f$, $\lambda_i^m$ and $\lambda_i^f$, but it is not possible to estimate individual parameters for $\alpha_i$, $\gamma_{ji}$ and the parameters of the scaling function $t_i(\mathbf{d})$.

In the following section we discuss about the identification of the sharing rules.

## 2.3 Identification of the Sharing Rule

In the specification of the CQAIDS described by equations (3) and (4), $\phi^m(\cdot)$ and $\phi^f(\cdot)$ are not observed variables. In fact, recovering the structure of the sharing rule is one of the objective of this paper. Being the sharing rules functions of observed variables, what we need is a parametric specification of these functions, such that when included in the demand system its parameters are identified. In particular, the main issue is to find a viable way to use information on individual expenditures on some goods, which are recorded in several household budget datasets.

If observed expenditure on some goods are exclusively consumed by one of the household members, or a certain percentage can be certainly assigned to one of them, than those goods can be considered as individual consumption, and hence part of $\mathbf{e}^k$, as specified in (1). The other goods, which are not either exclusive nor assignable, belong to $\mathbf{o}^h$, which is assumed to be equally divided between the spouses (i.e. $\mathbf{o}^m = \mathbf{o}^f = \frac{1}{2}\mathbf{o}^h$).

Given the observed individual expenditure as $\mathbf{p}^{m\prime}\mathbf{e}^m + \mathbf{p}^{o\prime}\frac{1}{2}\mathbf{o}^h$ and $\mathbf{p}^{f\prime}\mathbf{e}^f + \mathbf{p}^{o\prime}\frac{1}{2}\mathbf{o}^h$, it is possible to construct an index $\mu$ which determines the observed share of husband expenditure on total household expenditure

$$\mu = \frac{\mathbf{p}^{m\prime}\mathbf{e}^m + \mathbf{p}^{o\prime}\frac{1}{2}\mathbf{o}^h}{y^h}, \tag{5}$$

which implicitly defines also the wife share of household expenditure as $1-\mu$, and which can be used to to define the individual expenditures $y^k$ as a function of household expenditure $y^h$.

[9] The distribution factors are variabes which may influence the intra-household distribution of resources without affecting the household demand level. Examples of distribution factors are individual and household characteristics, relative wages, relative prices of the individual goods and environmental variables.

In the present work, to econometrically identify the sharing rule[10] we use a technique borrowed from Pollak and Wales (1981) and Lewbel (1985), commonly used to incorporate demographic variables or exogenous factors into the demand functions, and from Bollino, Perali, and Rossi (2000), used to estimate household technologies. In general, the idea is that demographic functions interact with exogenous prices or income and can be econometrically identified provided that there is sufficient information and variability in the data.

Following this strategy, we define an income scaling function $m^k(p^m, p^f, \mathbf{z})$ *a la* Barten (Barten, 1964; Perali, 2003), which relates the sharing rule $\phi^k(p^m, p^f, y, \mathbf{z})$ and the observed individual expenditure $y^i$ according to

$$\phi^k(p^m, p^f, y, \mathbf{z}) = y^k m^k(p^m, p^f, \mathbf{z}), \tag{6}$$

thus, the estimation problem is similar to that of estimating a regression containing unobservable independent variables (Goldberger, 1972).

Being the CQAIDS in the budget share form, we need to express equation (6) in natural logarithm, obtaining

$$\begin{aligned} \ln \phi^m(p^m, p^f, y, \mathbf{z}) &= \ln y^m + \ln m^m(p^m, p^f, \mathbf{z}) \\ \ln \phi^f(p^m, p^f, y, \mathbf{z}) &= \ln y^f + \ln m^f(p^m, p^f, \mathbf{z}), \end{aligned} \tag{7}$$

where $m^m(p^m, p^f, \mathbf{z})$ and $m^f(p^m, p^f, \mathbf{z})$ are the scaling functions.

The identifying assumption in the model is that the portion of income of each member, $\ln y^m$ and $\ln y^f$, can be recovered from observed expenditures on exclusive or assignable goods. Namely, we define $\ln y^m = \mu \ln y^h$ and $\ln y^f = (1-\mu)\ln y^h$, which implies that $\ln y^m + \ln y^f = \ln y^h$. Note that with respect to this definition of the individual expenditures, the sharing rule should be considered a function determining the portion of the natural logarithm of income assigned as well, such that $\ln \phi^m(\cdot) + \ln \phi^f(\cdot) = \ln y^h$.

These definitions of the sharing rules and the observed individual expenditures are a key feature for the identification of the sharing rule. In fact, they imply that the following condition must hold

$$\ln m^m(p^m, p^f, \mathbf{z}) = -\ln m^f(p^m, p^f, \mathbf{z}), \tag{8}$$

which allows us to set $\ln m^m(\cdot) = \ln m(\cdot)$ and $\ln m^f(\cdot) = -\ln m(\cdot)$. In this way we can estimate the same scaling function $m(\cdot)$ for both household members, being sufficient to change the sign of $m(\cdot)$ to identify both individual scaling functions.

Summing up equation (7) and the above consideration about the scaling function $m(\cdot)$, it is possible to rewrite equations (4) as

$$\begin{aligned} \ln \phi^{m*} &= \mu \ln y^h + \ln m(p^m, p^f, \mathbf{z}) - \sum\nolimits_i t_i(\mathbf{d}) \ln p_i \\ \ln \phi^{f*} &= (1-\mu) \ln y^h - \ln m(p^m, p^f, \mathbf{z}) - \sum\nolimits_i t_i(\mathbf{d}) \ln p_i. \end{aligned}$$

In analogy to function $t_i(\mathbf{d})$, function $m(p^m, p^f, \mathbf{z})$ is identified provided there is enough variation in the individual prices $p^m$ and $p^f$ and in the distribution factors $\mathbf{z}$ (the proof is similar to proving that function $t_i(\mathbf{d})$ is identified, as shown in Gorman (1976), Lewbel (1985) or Perali (2003)).

[10] Recall that the minimal information required for the identification of the sharing rule is the observability of at least one assignable good, or, equivalently, two exclusive goods (Bourguignon, 1999). If a good is exclusive, and there are no externalities, for a given observed demand $x(\mathbf{p}, y)$ satisfying the Collective Slutsky property (Chiappori, 1988, 1992; Chiappori and Ekeland, 2002, 2006), and such that the Jacobian $D_{\mathbf{p}}x(\mathbf{p}, y)$ is invertible, then the sharing rule is identified.

In our empirical study, we specify $m(p^m, p^f, \mathbf{z})$ as a Cobb-Douglas function, so that the logarithmic specification is linear in the parameters

$$\ln m(p^m, p^f, \mathbf{z}) = \phi_0 \ln p_r + \sum\nolimits_{n=1}^{N} \phi_n \ln z_n,$$

where $p_r$ is a price ratio, whose specification is given below, and $N$ is the dimension of vector $\mathbf{z}$. With this specification there is an additional restriction, which is that distribution factors $\mathbf{z}$ must differ from the demographic variables $\mathbf{d}$. If it were not so, the parameters $\ln m(p^m, p^f, \mathbf{z})$ and $t_i(\mathbf{d})$ would not be identified for the variables that are shared by $\mathbf{z}$ and $\mathbf{d}$.

In the following section we describe the data we used and report the econometric tools employed in the estimation of the collective demand system.

# 3 Empirical Strategy

## 3.1 Data Description

The data used in this work is drawn from the Italian household expenditure survey (ISTAT 2004). We selected households composed by married couples without dependent children with an observed positive consumption for male and female clothing.[11] To ensure a demographically homogeneous sample, we excluded households in which at least one member is retired from work. In this way we restrict our study to working couples with a similar lifestyle. The sample includes 742 observations. The dataset information has been matched with individual alcohol consumption data from ISTAT 2002 survey on the standard of living.[12]

In the latter dataset, information is collected on an individual basis. This feature allows us to assign alcohol consumption respectively to the husband or to the wife. Clothing can be exclusively assigned to the husband and the wife since male and female clothing is separately recorded in the expenditure survey.

We consider only expenditure of non durable goods, hence the aggregated expenditure categories considered are Food, Alcohol, Clothing, Education&recreation, and Other goods. Household-specific prices are assigned following the procedure described in section 3.3.

Table 1 and Table 2 report the descriptive statistics of the sample. The set of demographic variables includes macro regions (North-East, North-West and Center), a dummy variable to capture seasonality (particularly Christmas time), a dummy variable indicating if head households have a university or higher degree, a dummy variable to indicate that the household does not live in urban areas (rural), a dummy variable indicating that husband is an employee, a variable signaling if at least one in the couple smokes. The exogenous variables chosen for the sharing rule are quite limited by the information disposable in the dataset and are defined as follows. The price ratio (price-r) is the price of male clothing

[11] We restrict to positive clothing expenditures because this is the source of identification for the sharing rule. Adding observations with no clothing expenditure would not add useful information for the identification of the sharing rule.

[12] The matching of the two datasets was conducted via the Stata command "Hotdeck" (for details see the references for this command at *http://ideas.repec.org/c/boc/bocode/s366901.html*). In short, we have two datasets: the first sample, which does not have information on individual alcohol consumption, and the second sample. Both samples share a number of variables which describe household characteristics. The strategy is as follows. We divide both samples in cells determined by some household characteristics. To impute values to a household in a cell belonging to the first sample, we randomply pick up a value from the corresponding cell in the second sample. This is done for each household belonging to each cell of the first sample. Doing this way we have two particular advantages: zero observed expenditures are preserved, and the overall distribution of the variable remains almost unchanged after imputation.

divided by the sum of male and female clothing prices, the age ratio (age-r) is defined as husband's age divided by the sum of both members ages, and the education ratio (edu-r) is defined as husband's years of schooling divided by the sum of both members years of schooling.

In the next section we specify the econometric strategy used to perform our estimates.

### 3.2 Econometric Model

Econometricians working with households micro-data often are faced to the zero expenditures problem, especially when working with disaggregate goods, which is the case, for example, of alcohol consumption, tobacco or clothing. Since coefficient estimates are inconsistent when only observed positive purchase data are used, the proper correction technique has to be used.

These methods differ for different assumptions related to the source of zero expenditures. For example the Tobit model (Amemiya, 1985; Maddala, 1983) captures the corner solutions for the utility maximization problem, which implies that the observation is zero just because the household decided not to consume on the basis of disposable income, prices and preferences. This could be the case for some goods, but not for some other, such as semi-durables (for instance clothing) which may not be purchased in the reference period because they give utility for more than one period and a household may need to buy them only once in, say, 3 months. This situation is called infrequency of purchases, and cannot be captured by a Tobit model.

The Double-Hurdle model (Yen, 1993), on the other side, assumes that zero expenditures are explained by a decision process that arises from unobserved latent variables which drive consumer choices. The model allows a separate estimation of participation and expenditure parameters. This is the case of alcohol, which may not be consumed because of moral conviction or health problems, which may not be observable in the survey. Again this model is not useful when considering semi-durable goods.

An alternative to the Double-Hurdle model is the Heckman two-step estimator, which assumes that zero expenditures are due to sample selection bias (Heckman, 1979) and are treated as a mispecification error. This approach allows for separate estimates of participation and expenditure parameters.

In the original model, the first stage determines the participation probability using a probit regression, and then, in the second stage, Heckman proposes a specification for the omitted variable which can be used to correct the sample selection bias. The omitted variable is the inverse Mill's ratio, which is the ratio between density and cumulative probability function of the standard normal distribution.

In this paper we use a generalization of the Heckman two-step estimator overcoming the issues which emerge in Amemiya (1978, 1979) and Heien and Wessells (1990). In particular, we refer to the work of Shonkwiler and Yen (1999), which shows the inconsistency of the generalized Heckman estimator and proposes a consistent, though still simple, two-step estimator for a censored system of equations.

In choosing the proper estimator, we had to keep in mind that the dataset has zero expenditures for two goods: alcohol and education&recreation. The double-hurdle model is particularly well suited for alcohol consumption, which is what we are focussing on, but is not general enough to consider other sources of zero expenditures. Hence, we decided to use the Shonkwiler-Yen estimator, which is well suited for a rather large source of zero expenditures, is consistent with a two-stages decision process similar to that of the double-hurdle and keeps things simple.

Following Shonkwiler and Yen (1999), consider the following general limited dependent variables system of equations[13]

$$
\begin{aligned}
&y_{it}^* = f(x_{it}, \theta_i) + \epsilon_{it}, \quad d_{it}^* = z_{it}'\tau_i + \upsilon_{it}, \\
&d_{it} = \begin{cases} 1 & \text{if } d_{it}^* > 0 \\ 0 & \text{if } d_{it}^* \leq 0 \end{cases} \qquad y_{it} = d_{it} y_{it}^*, \\
&\quad (i = 1, 2, ..., m; t = 1, 2, ..., T),
\end{aligned} \tag{9}
$$

where $i$ represents the $i$-th equation and $t$ the $t$-th observation, $y_{it}$ and $d_{it}$ are the observed dependent variables, $y_{it}^*$ and $d_{it}^*$ are the latent variables, $x_{it}$ and $z_{it}$ are vectors of exogenous variables, $\theta_i$ and $\tau_i$ are parameters, and, $\epsilon_{it}$ and $\upsilon_{it}$ are random errors. Without entering into details, system (9) can be written as

$$y_{it} = \Psi(z_{it}'\tau_i) f(x_{it}, \theta_i) + \eta_i \psi(z_{it}'\tau_i) + \xi_{it},$$

where $\Psi(\cdot)$ and $\psi(\cdot)$ are univariate normal standard cumulative distribution and probability density functions respectively. The system can be estimated by means of a two-step procedure, where $\tau_i$ is estimated using a Maximum Likelihood probit estimator, and is used to calculate $\Psi(z_{it}'\tau_i)$ and $\psi(z_{it}'\tau_i)$. Successively, estimates of $\theta_i$ and $\eta_i$ in the system

$$y_{it} = \Psi(z_{it}'\hat{\tau}_i) f(x_{it}, \theta_i) + \eta_i \psi(z_{it}'\hat{\tau}_i) + \xi_{it} \tag{10}$$

are obtained by Full Information Maximum Likelihood.

Besides that of zero expenditures, another problem arises: we lack information on prices and/or unit values. Since the ISTAT survey records only expenditure information, the lack of information about quantities purchased precludes the possibility to derive household specific unit values. On the other hand, ISTAT's price indexes have an aggregation level similar to that of the survey, but are not sufficient to provide plausible elasticities. For this reason, we use a procedure, originally proposed by Lewbel (1989) and applied by Atella, Menon, and Perali (2003), to construct pseudo unit values.

In the next section we present the results and some comments.

# 4 Results

This section describes the results coming from estimates of model (10) where $y_{it}$ and $f(x_{it}, \theta_i)$ are replaced by $w_{it}$ and the right hand side of (3) respectively.

The estimates of the parameters are obtained by Full Information Maximum Likelihood estimation of a collective Quadratic Almost Ideal Demand System, as described in Section 3.2. Zero observed expenditures are corrected applying the generalized Heckman two-step estimator proposed by Shonkwiler and Yen (1999).

Symmetry and homogeneity properties of the demand system are ensured by construction, with the Slutsky matrix having two individual income terms which sum up to the household income effect, because of the symmetry of the individual transfers shown in equation (8).

Table 6 shows (double-sided numerical) income elasticities and compensated price elasticities. In our analysis we implement a "pointwise" elasticity strategy, meaning that we calculate all elasticities for each sample observation rather than just for the mean value. This have two implications. The first one is related to the standard error calculation. Since

[13] Note that function $f(\cdot)$ is a general function and has the only scope of illustrating the zero expenditure correction technique. In the application, the function $f(\cdot)$ needs to be substituted by the budget share demand equation.

we have elasticities for the whole sample, we can directly calculate the standard deviation of the vectors of elasticities. Hence, this standard deviation should not be interpreted as a measure of the accuracy of the elasticities estimates, but rather as the variability that the elasticities have across the sample (which is a possibly useful information as well). Secondly, this methodology allows us to analyze the variability of elasticities with respect to some household characteristics of interest. For example, figures in table 7 show how income and own prices elasticities vary across household income.

In general, negative own price elasticities are consistent with consumption theory. According to their size, education and recreation is the most elastic good to price and income changes, while alcohol is one of the less elastic. Alcohol own price elasticity is the smallest of the group of goods, suggesting that a policy of an increased taxation on alcoholic beverages may not have much success in reducing consumption.[14] It seems plausible that this small elasticity may induce the individual to substitute other goods for alcohol, in case of price increase.

On the variability side, Education and Recreation has by far the most variable elasticities, suggesting that within this group of goods it may be used as a buffer for income or price shocks. This consideration is reinforced if we consider that both income and price elasticities considerably reduces when household income increases. Focussing on alcohol, income elasticity shows the second higher variability across the sample, with its value considerably decreasing with respect to household income, but this does not have particular behavioral implications, considering that in any case the budget share on alcohol is relatively small. On the other side, own price elasticity has the smallest variability in the group of goods, suggesting that price is really not an important determinant of the alcohol consumption level for all the sample. Moreover, the own price elasticity is substantially constant with respect to income variations.

Focussing on the main objective of the work, in Table 4 we present the estimates of the CQAIDS demand system. In general, income and price parameters are significant with some exceptions, as alcohol income parameters, which are all non significant. Also the $\eta_i$ parameters are significant, indicating that the observed zero expenditures do not come from Kuhn-Tucker corner solutions, but rather from other sources of error, as sample selection bias, infrequent purchases or moral decisions. Among the demographic variables, the general trend is towards small parameters values, even if many of them are significantly different from 0.

An exception stands on the alcohol demand equation, which is insensible to most demographic variables. A positive effect is observed if the household lives in the north of Italy, with the north-east having even a stronger effect. It is as expected and is cited in some ISTAT reports on alcohol. The tendency is to relate different behavior to climate differences. In the south, a warmer temperature discourages consumption of alcoholic beverages in summer, while during winter rigid northern temperatures tend to favour consumption of spirits. A positive effect is also observed for the seasonality control variable. This is also as expected, since during winter holidays there is a strong increase in champagne wine demand.

More interestingly, the education parameter is found to be non significant. This implies that in Italy education does not have effects on alcohol consumption. However, in Italy it is common practice to drink a glass of wine at meals and a moderate consumption of good quality wine is an encouraged behavior.

Contrary to what we expect, we find a non significant parameter from the smoke dummy

[14] It could be argued, however, that the increased taxation may serve to compensate for the negative social effects produced by alcohol abuse, but this has nothing to do with alcohol consumption choice.

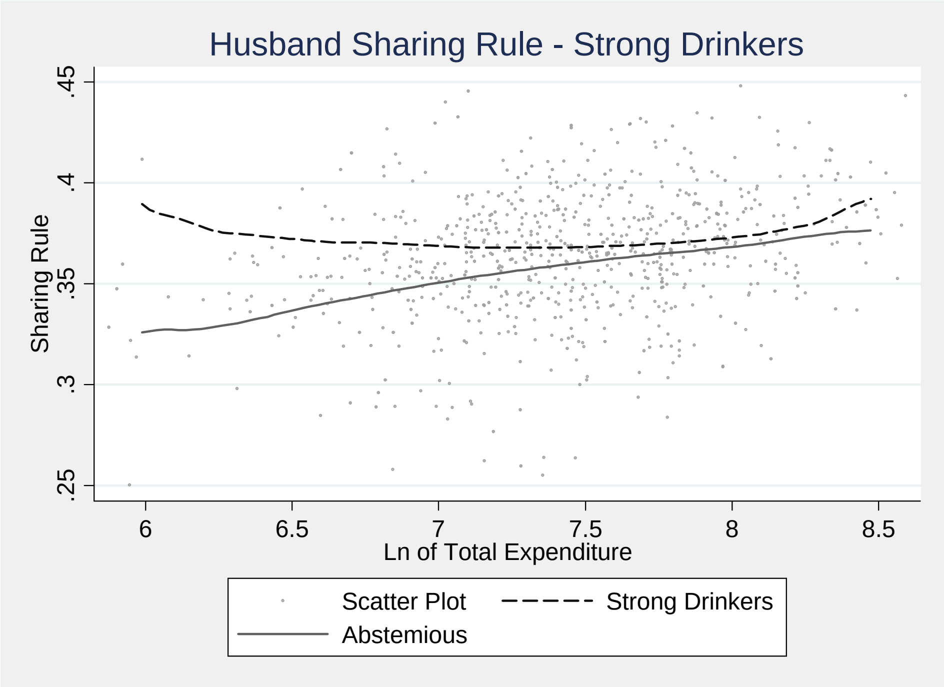


Figure 1: Heavy drinkers

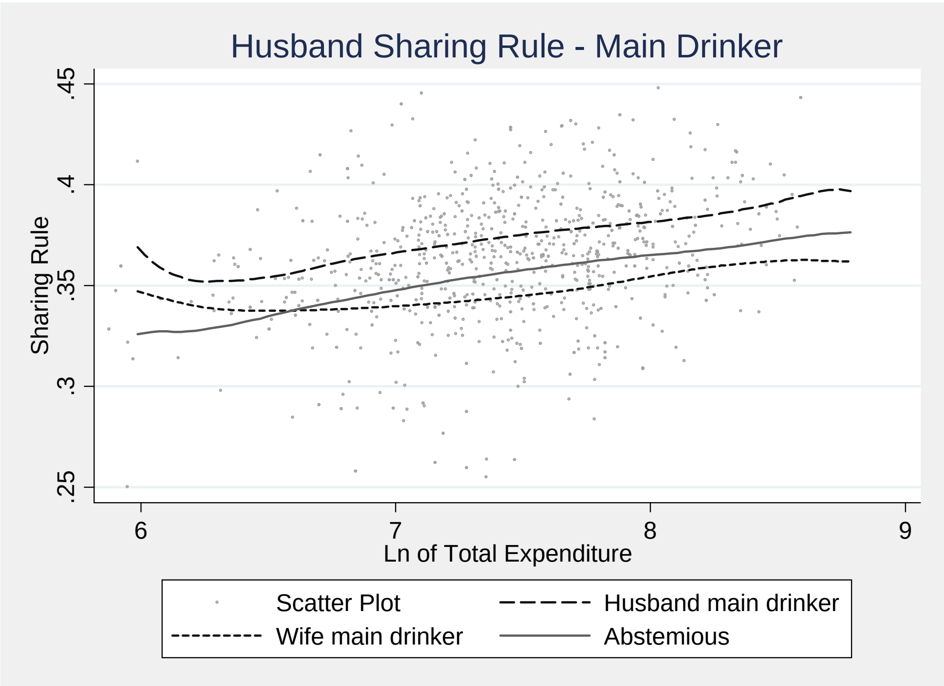


Figure 2: Main drinker

variable. However, we should take into account that we treat participation and consumption are treated separately. In the participation equation (see Table 5) the parameter is positive and significant, indicating that there is a gateway effect between alcohol and tobacco. The non significant parameter in the demand equation states that there is not a positive relation between expenditure on alcohol and the fact of being a smoker. In other words, a smoker has a higher probability of being a drinker, but smoking does not influence how much one drinks.

The parameters of the sharing rule tell us that the husband's share of total expenditure is negatively influenced by the price of male clothing. If the husband is more educated than his wife, the effect will be of an increase in its share of household resources, while if the husband is older there will be a decrease.

To detail further the intra-household income distribution analysis, we have depicted figures 1 through 4, which represent the relative husband sharing rule, expressed as the ratio between husband expenditure and total household expenditure ($\ln \phi^m(\cdot)/\ln y^h$). These pictures are drawn by means of nonparametric regressions of the sharing rule by total expenditure, selecting groups of households with some characteristics of interest.

In Figure 1, we select a group of abstemious households and a group of heavy[15] alcohol consumers. The sharing rule is different in these groups, with the husband being favoured in the distribution of resources when alcohol consumption is large, especially for low income households. This larger shift cannot be explained with budget related consideration. The Engel curve of alcohol consumption (Figure 5) shows that alcohol budget shares have a reversed U shape relationship with the log of total expenditure, meaning that, on average, poor households do not spend more of their budget on alcohol, respect to rich households. Moreover, if we look at the magnitudes, the curvature of the Engel curve is rather flat and the non-significant income parameters for the alcohol equation confirm this. According to this analysis, alcohol consumption seems to cause a household income distribution modification with respect to abstemious households which could motivate a policy intervention.

Further, in Figure 2 we investigate the relation between alcohol consumption and the sharing rule. Selecting households by its main drinker,[16] the sharing rule shifts towards the main drinker himself/herself, except for poorer households where even when the main drinker is the wife, the sharing rule is still shifted towards the husband.[17] When the main drinker is the man the effect is evident and could be explained by a combination of several factors. Among other causes, there could be the fact that men tend to have a overbearing behavior more frequently than women, and this tendency may be strengthened by alcohol, which makes them more self confident and violent. This could also explain why when the main drinker is the wife the distribution of resources still favours the husband when the household is poor.[18] In these households there could be a despotic husband which tends to keep control on household resources and to impose his decisions. In such a situation, it may happen that the wife falls into depression and/or uses alcohol as a mean to "escape from that reality". If this was true, wife alcohol consumption would be more a consequence of a degraded environment rather than the cause of household income distribution inequalities.

The situation depicted by Figure 1 and 2 justifies a policy intervention, however, as stated above, a strategy based on direct taxation is likely to have a small impact. Moreover,

[15] We consider heavy consumers households which have an alcohol budget share above 0.035.

[16] The household member is the main consumer if he/she consumes at least 75% of household alcohol consumption.

[17] Remember that represented is always the usband sharing rule, hence, a higher line means that the husband is favoured, while a lower line means that the wife is favoured.

[18] In poor households there is a higher probability that the wife does not work and in psychology there is evidence that housewives may feel subjugated and tend to drink more.

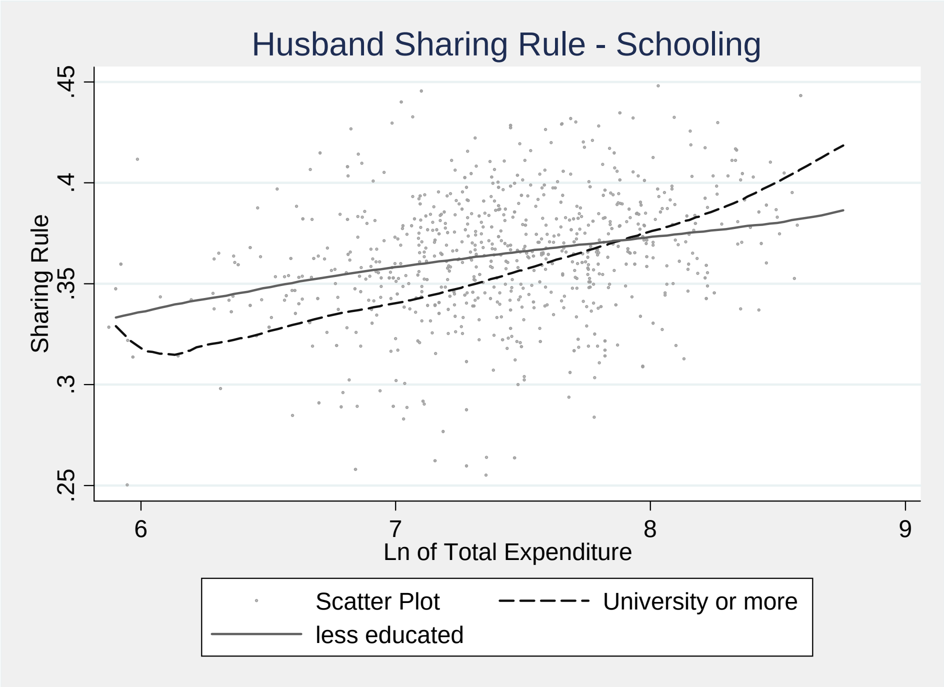


Figure 3: Schooling

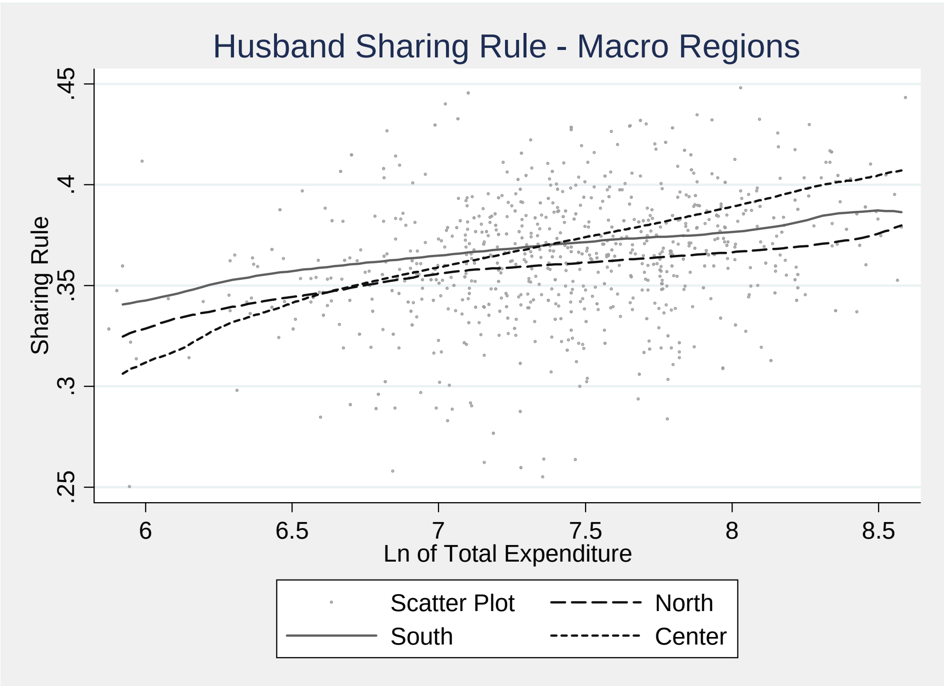


Figure 4: Macro-regions

the problem is more serious for low income households and a price increase may even worsen their situation. Instead, we are in favour of gender specific policies with the aim of balancing the decisional power within the household. Just as an example, subsidies for poor household or children subsidies should be given to woman. In this way the wife gains bargaining power and there is less probability that the money is spent on alcohol both because she feels more self confident or because the husband has less money to spend on alcohol. This policy, which has been implemented with much success for micro-credit policies in developing countries, has no additional costs and could bring a noticeable welfare improvement to those households.

It is interesting to note that the change in the sharing rule depicted in Figure 1 can be explained in terms of Figure 2. In fact, the most part of the effect observed for poor households in Figure 1 can be explained in terms of the sum of the individual effects of figure 2. For high income households the shift of the sharing rule towards the husband is lowered by the wife's shift, while for low income households the shift towards the husband is strengthened. The result is a sharing rule which is strongly modified for poor households in the case of high alcohol consumption, while being substantially unchanged for rich households.

Figure 3 plots the sharing rule by the household head's education. The picture shows that when the head of the households has less education, the household tends to distribute more resources to the husband for middle and low income households, while for households with higher level of income the situation is reverted. This can be explained in terms of agreement, in the sense that in rich households, if the husband is educated, the wife may agree that her husband should manage the household resources. This is confirmed by the positive sign of the edu-r parameter in the sharing rule (which indicates the relative education difference between the husband and the wife). If the husband is more educated than the wife, he will obtain a greater share of household resources.

Figure 4 shows that the sharing rule is scarcely influenced by macro-regional divisions. There is a slight difference from North to South, where the distribution of resources favours the husband. In the Center, for low income households, there is the tendency to allocate more resources to the wife, while in high income households the husband is favoured. Looking at parameters in Table 4 we see that macro regions have generally significant parameters, which means that consumption levels are different across macro regions, and that this difference does not always reflect to the sharing rule.

The following section concludes and proposes future developments to this work.

# 5 Conclusions

In this paper we present some evidence that for Italian households an excessive alcohol consumption can affect the distribution of resources within the household. The results are relatively strong, even for a country which is supposed to have a relatively advanced social background.

When a significative amount of alcohol is consumed we find a systematic shift of the sharing rule towards the husband. This shift is greater for low income households, implying that the effects of alcohol consumption on the intra-household income distribution are heavier for low income households. This provides the rational for a policy intervention aimed to contrast this phenomenon. However, since the price elasticity of alcohol is the lowest across goods, we suggest that the proper policy should not be that of increasing direct taxation on alcoholic beverages,[19] since the price increase would probably be shifted to other goods.

[19] This is true only if we consider an aggregate alcohol good. If we are willing to differentiate taxation by

Taking into account individual alcohol consumption, we find that the sharing rule shifts toward the main drinker in the household, but with a substantial difference between the husband and the wife. In fact, when the main drinker is the husband, the shift is evident and constant in the whole range of household income distributions.[20] When the main drinker is the wife the effect is less evident, but in poor households, even when the main drinker is the wife the distribution of resources changes in favour of the husband. In this case it is likely that alcohol consumption is not the cause of a different resource distribution, but rather a reaction against a despotic behavior of the husband.

The generalized shift of resources toward the husband in the case of large alcohol consumption is the sum of these two effects. This means that the proper policy for the reduction of the modification of the distribution of resources observed in the case of alcohol consumption should be gender specific.

However, these issues need further investigations and we are planning future developments to extend the analysis in several ways. The first extension regards the quality of data available. We are building a new dataset to incorporate much more information on single household components lifestyle, health, income and labour supply. This will be done by matching three sources of data available in Italy in separate datasets provided by ISTAT and the Bank of Italy.[21]

Regarding the estimation technique, we are investigating whether it could be more convenient to estimate the system as a whole, with restrictions on parameters which come from the theory, or if it would be easier to estimate it equation by equation, and successively recover parameters restrictions by means of a Minimum Distance Estimator. This technique would be useful when estimation is much cpu intensive (for a large dataset it can take hours to get results on a modern pc) or whenever numeric techniques run into difficulty because of the complexities of calculations and limited precision of algorithms.

Such a single equation specification would also be useful in treating the observed zero expenditures. To this extent, we could apply the proper zero correction technique to each good, allowing the use of specific correction techniques like Double-Hurdle, Infrequent Purchases, and so on.

An interesting development would regard the Pareto efficiency of household consumption choice. In our analysis, we do not explicitly take into account the possibility of inefficient resources allocation. However, the collective model would be a suitable instrument to answer this question since it allows an estimation of individual income effects. These income effects could be employed to test Pareto efficiency following the intuition of Browning, Bourguignon, Chiappori, and Lechene (1994) and Udry (1996).

In the present work, we focus our attention to the distribution of resources between husband and wife alone. We are working to prove that a "three-sided" sharing rule would be identified, provided that three exclusive goods or one assignable good (or some combination of exclusive and assignable goods) are observed, so the sharing rule between three members of the household (husband, wife and children) could be estimated simultaneously. The usefulness of such a specification is evident when evaluating the effects of alcohol abuse, in which the looser may be the children, the wife or both.

the alcohol content of each beverage, as spirits, wine and beer, the response would probably be different, and an increase taxation of spirits would probably shift consumption towards wine and beer. However, due to our data, we cannot make this interesting analysis.

[20] There is a slight increase of the shift for very poor households.

[21] In this regard, the good results obtained by matching data on individual alcohol consumption incentives us to proceed in this direction.

## References

AMEMIYA, T. (1978): "On a Two-Step Estimationof a Multivariate Logit Model," *Journal of Econometrics*, 8, 13–21.

——— (1979): "The Estimation of a Simultaneous Equation Tobit Model," *International Economic Review*, 20(1), 169–81.

——— (1985): *Advanced Econometrics*. Harvard University Press, Cambridge, Massachusetts.

APPS, P. F., AND R. REES (1988): "Taxation and the Household," *Journal of Public Economics*, 35(3), 355–69.

ATELLA, V., M. MENON, AND F. PERALI (2003): "Estimation of Unit Values in Cross Sections Without Quantity Information," in *Household Welfare and Poverty*, ed. by G. Ferrari, and C. Dagum. Physica Verlag.

ATKINSON, A. B., G. GOMULKA, AND N. H. STERN (1990): "Spending on Alcohol: Evidence from the Family Expenditure Survey 1970-1983," *Economic Journal*, 100, 808–27.

BANKS, J., R. BLUNDELL, AND A. LEWBEL (1997): "Quadratic Engel Curves and Consumer Demand," *The Review of Economics and Statistics*, 79(4), 527–39.

BARGAIN, O., M. BEBLO, D. BENINGER, R. BLUNDELL, R. CARRASCO, M. C. CHIURI, F. LAISNEY, V. LECHENE, E. LONGOBARDI, M. MYCK, N. MOREAU, J. RUIZ-CASTILLO, AND F. VERMEULEN (2006): "Collective Models Od Household Labor Supply with Non-Convex Budget Sets and Non-Participation: A Calibration Approach," *Review of the Economics of the Household*, 4(2), 113–127.

BARMBY, T., AND N. SMITH (2001): "Household Labor Supply in Britain and Denmark: Some Interpretation Using a Model of Pareto Optimal Behavior," *Applied Economics*, 33, 1109–16.

BARTEN, A. P. (1964): "Family Composition, Prices and Expenditure Patterns," in *Econometric Analysis for National Economic Planning: 16th Symposium of the Colston Society*, ed. by P. Hart, G. Mills, and J. K. Whitaker. Butterworth.

BIERENS, H. J., AND H. A. POTT-BUTER (1987): "Specification of Household Engel Curves by Nonparametric Regression," *Econometric Reviews*, 9, 123–84.

BLUNDELL, R., P. PASHARDES, AND G. WEBER (1993): "What Do We Learn About Consumer Demand Patterns from Micro-Data?," *American Economic Review*, 83, 570–97.

BOLLINO, C. A., F. PERALI, AND N. ROSSI (2000): "Linear Household Technologies," *Journal of Applied Econometrics*, 15(3), 275–87.

BORELLI, S., AND F. PERALI (2002): "Drug Consumption and Intra-Household Distribution of the Resources: The Case of Qat in an African Society," in *Household Behaviour, Equivalence Scales and Well-Being*, ed. by Dagum, and Ferrari, Collana Physica Verlag. Springer.

BOURGUIGNON, F. (1999): "The Cost of Children: May the Collective Approach to Household Behavior Help?," *Journal of Population Economics*, 12, 503–21.

Browning, M., F. Bourguignon, P. A. Chiappori, and V. Lechene (1994): “Incomes and Outcomes: A Structural Model of Intrahousehold Allocation,” *Journal of Political Economy*, 102(6), 1067–96.

Browning, M., P. A. Chiappori, and A. Lewbel (2007): “Estimating Consumption Economies of Scale, Adult Equivalence Scales, and Household Bargaining Power,” forthcoming.

Chiappori, P. A. (1988): “Rational Household Labor Supply,” *Econometrica*, 56(1), 63–90.

——— (1992): “Collective Labor Supply and Welfare,” *Journal of Political Economy*, 100(3), 437–67.

Chiappori, P. A., and I. Ekeland (2002): “The Micro Economics of Group Behavior: Identification,” working paper, Department of Economics, University of Chicago.

——— (2006): “The Micro Economics of Group Behavior: General Characterization,” *Journal of Economic Theory*, 127(1), 1–26.

Deaton, A. S., and J. Muellbauer (1980): “An Almost Ideal Demand System,” *American Economic Review*, 70, 321–26.

Gill, L., and A. Lewbel (1992): “Testing the Rank of Estimated Matrices with Applications to Factors, State Space, and ARMA Models,” *Journal of the American Statistical Association*, 87, 766–76.

Goldberger, A. S. (1972): “Maximum-Likelihood Estimation of Regressions Containing Unobservable Independent Variables,” *International Economic Review*, 13(1), 1–15.

Golub, G. H., and C. F. VanLoan (1983): *Matrix Computations*. John Hopkins University Press, Baltimore.

Gorman, W. M. (1976): “Tricks with Utility Functions,” in *Proceedings of the 1975 AUTE Conference, Essays in Economic Analysis*, ed. by M. J. Artis, and A. R. Nobay. Cambridge University Press, Cambridge.

Härdle, W., and M. Jerison (1988): “The Evolution of Engel Curves over Time,” Discussion Paper A-178, SFB 303, University of Bonn.

Hausman, J. A., W. K. Newey, and J. L. Powell (1995): “Nonlinear Errors in Variables: Estimation of some Engel Curves,” *Journal of Econometrics*, 65, 205–33.

Heckman, J. (1979): “Sample Selection Bias as a Specification Error,” *Econometrica*, 47(1), 153–61.

Heien, D., and C. R. Wessells (1990): “Demand Systems Estimation with Microdata: A Censored Regression Approach,” *Journal of Business and Economic Statistics*, 8, 365–71.

Hildebrand, W. (1994): *Market Demand: Theory and Empirical Evidence*. Princeton Univeristy Press, Princeton.

Leser, C. E. V. (1963): “Forms of Engel Functions,” *Econometrica*, 31, 694–703.

Lewbel, A. (1985): “A Unified Approach to Incorporating Demograpic or Other Effects Into Demand Systems,” *Review of Economic Studies*, 70, 1–18.

——— (1989): "Identification and Estimation of Equivalence Scales under Weak Separability," *Review of Economic Studies*, 56, 311–16.

——— (1991): "The Rank of Demand Systems: Theory and Nonparametric Estimation," *Econometrica*, 59, 711–30.

——— (2002): "Rank, Separability, and Conditional Demand," *Canadian Journal of Economics*, 35(2), 410–413.

Maddala, G. S. (1983): *Limited-Dependent and Qualitative Variables in Econometrics.* Cambridge University Press, Cambridge.

Pagan, A., and A. Ullah (1999): *Nonparametric Econometrics.* Cambridge University Press, London.

Perali, F. (2003): *The Behavioral and Welfare Analysis of Consumption. The Cost of Children, Equity and Poverty in Colombia.* Springer-Verlag.

Pollak, R., and T. J. Wales (1981): "Demographic Variables in Demand Analysis," *Econometrica*, 49(6), 1533–51.

Shonkwiler, J. S., and S. T. Yen (1999): "Two-Step Estimation of a Censored System of Equations," *American Journal of Agricultural Economics*, 81, 972–982.

Silverman, S., and B. W. Silverman (1986): *Density Estimation for Statistics and Data Analysis.* CRC Press.

Udry, C. (1996): "Gender, Agricultural Production and the Theory of the Household," *Journal of Political Economy*, 104(5), 1010–46.

Working, H. (1943): "Statistical Law of Family Expenditure," *Journal of the American Statistical Association*, 38, 43–56.

Yen, S. T. (1993): "Working Wives and Food Away from Home: The Box-Cox Double-Hurdle Model," *American Journal of Agricultural Economics*, 75, 884–95.

# A Appendix A: Non-parametric Engel curves and Rank Test

Engel curves are a widely used tool to assess the relationship between consumption and income. They have been studied for a long time, but still there is no agreement on which functional form is best suited to describe this relationship. According to the early work of Working (1943) and Leser (1963) Engel curves could be considered linear in the log of income, but later studies, among which Atkinson, Gomulka, and Stern (1990), Bierens and Pott-Buter (1987), Blundell, Pashardes, and Weber (1993), Hausman, Newey, and Powell (1995), Härdle and Jerison (1988), Hildebrand (1994), and Lewbel (1991), have shown that this specification is rather poor in describing Engel curves for some goods. The general evidence on micro-data is in favour of a quadratic relationship between budget shares and the log of total expenditure,[22] i.e. a rank 3 demand system.[23]

Even if there is some general agreement on the use of quadratic Engel curves, we provide nonparametric evidence to verify the rank of the demand system. We use single equation non-parametric Engel curve estimation,[24] and model the budget share of each good to be a non-linear function of the natural logarithm of total expenditure. Following Banks, Blundell, and Lewbel (1997) and Perali (2003), we plot in Figure 5 non-parametric estimates of alcohol individual Engel curves (orange line) and its 95% confidence interval (blue dashed lines). Similarly in Figure 6 we plot clothing individual Engel curves. Figure 7 represents household level Engel curves for food, education and recreation and other goods. In each graph also a quadratic polynomial regression (purple line) is plotted. The purpose is to verify whether a quadratic relationship can fit within the Engel's curves confidence intervals. Finally, along with Engel curves, we present nonparametric kernel bivariate density estimates and contour density plots.

A graphical analysis shows that the relation between food and total log expenditure can be represented by a linear functional form, while all other goods except clothing exhibit a shape rather close to a quadratic function. However, considering the confidence interval, a quadratic form cannot be excluded for clothing either.

To deepen the analysis we perform a non-parametric rank test for the demand system (Gill and Lewbel, 1992). This test does not need the specification of a functional form for the demand system, and hence avoids specification errors. The test is based on the estimated pivots of a matrix associating shares to functions of the total expenditure. The data matrix is decomposed using the Lower-Diagonal-Upper (LDU) Gaussian elimination with complete pivoting (Golub and VanLoan, 1983). The rank of each matrix equals the number of non-zero elements of the diagonal matrix of pivots. The null hypothesis is tested against the alternative that the rank is greater than $r$, and that the rank test is conducted sequentially, starting with $r = 1$. The test evaluates the hypothesis that only pivot $d_1$ is significantly different from 0, and consequentially all remaining $p - r$ pivots are zero. The results of the rank test, summarized in Table 3, show that the system can be considered a rank 3 with a p-value of 0.989, which indicates that the choice of a quadratic demand system is likely to be correct.

[22] Total expenditure is often used in cross section analysis when no reliable information on income is available. This is also our case, since ISTAT does not record income information.

[23] Following Lewbel (2002), we define the rank of a demand system as the maximum dimension of the function space spanned by the Engel curves.

[24] We perform a local polynomial regression of first degree. The bandwidth value is the same for all the goods and is rather larger than the Silverman and Silverman (1986) Rule-of-thumb. Since we do not need much punctual information and we have a small sample, the choice of a large bandwidth allows to reduce noise without compromising the information we are looking for. The analysis is conducted using the *Nonparametrix* package for Mathematica provided by Bernard Gress, which refer to the technique described in Pagan and Ullah (1999).

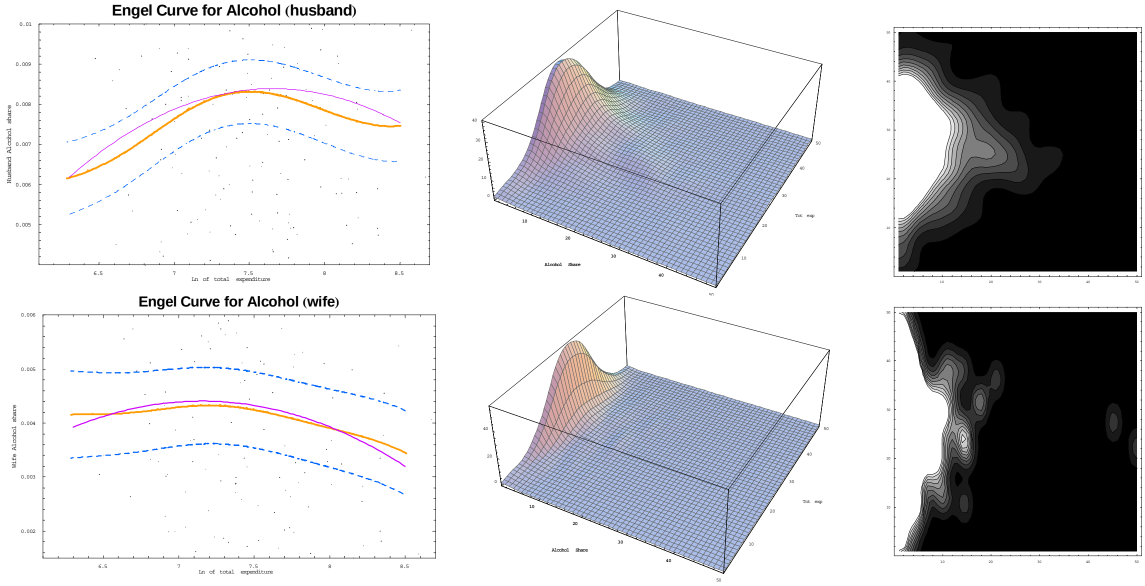


Figure 5: Alcohol Engel curves for the husband and the wife

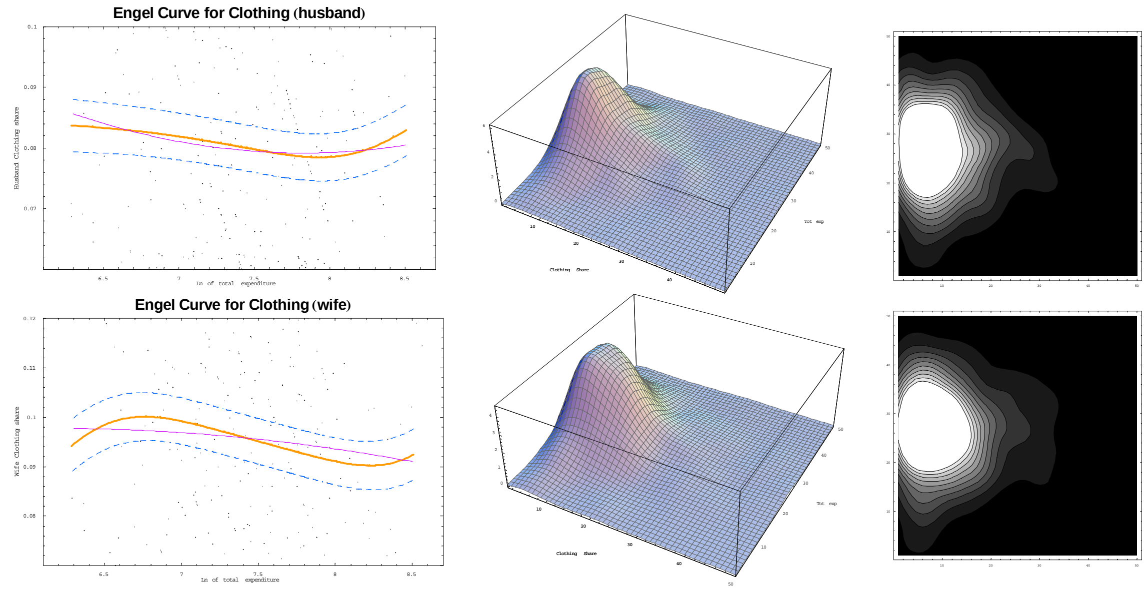


Figure 6: Clothing Engel curves for the husband and the wife

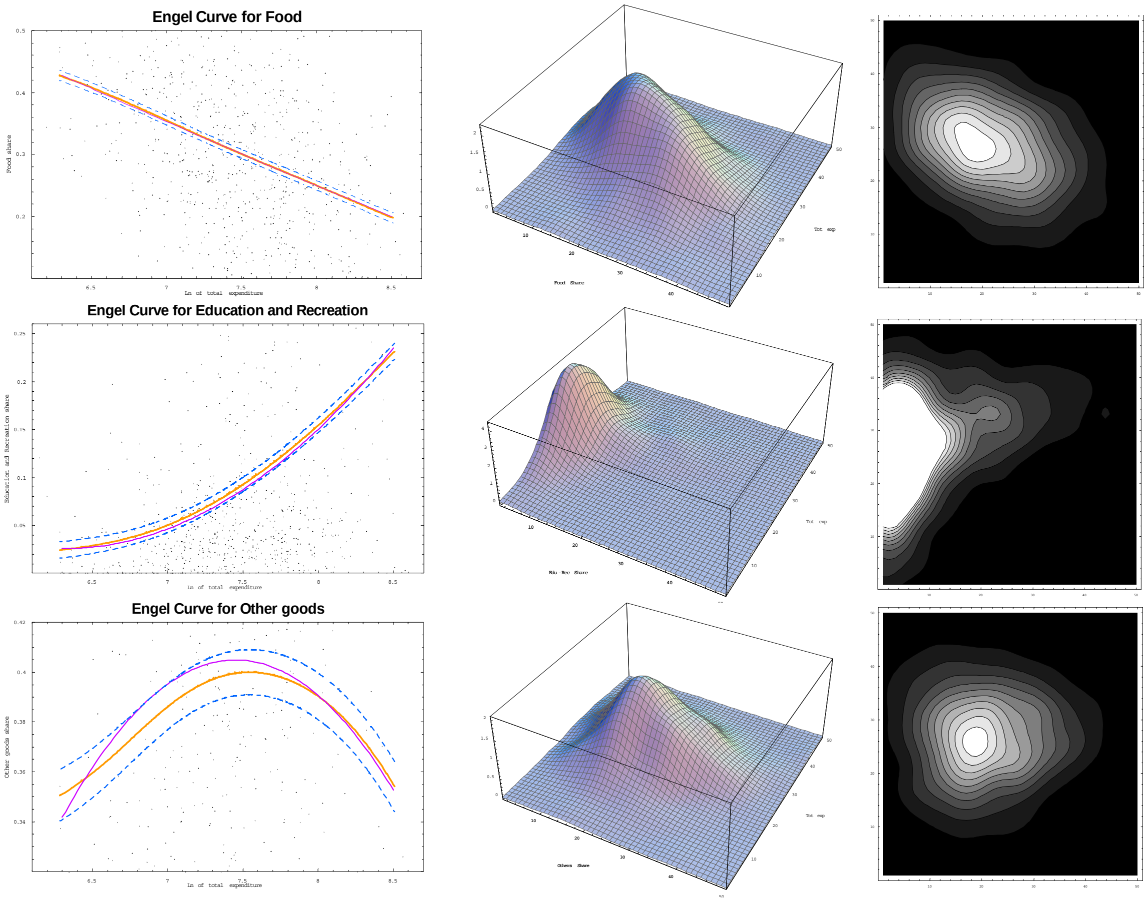


Figure 7: Household Engel curves

# B Appendix B: Derivation of the Collective Quadratic Demographically modified AIDS

The budget shares specification of a Quadratic Almost Ideal Demand System (QAIDS) is

$$w_i(y^h, \mathbf{p}) = \alpha_i + \sum\nolimits_j \gamma_{ji} \ln p_j + \beta_i (\ln y - \ln a(\mathbf{p})) + \frac{\lambda_i}{b(\mathbf{p})} \left(\ln y^h - \ln a(\mathbf{p})\right)^2, \qquad (11)$$

where $w_i(y, \mathbf{p})$ is the good $i$ budget share, $\alpha_i$, $\gamma_{ij}$, $\beta_i$ and $\lambda_i$ are parameters, $p_j$ is price of good $j$ and $y^h$ is total household expenditure. $a(\mathbf{p})$ and $b(\mathbf{p})$ are two price indexes, defined as

$$\ln a(\mathbf{p}) = \alpha_0 + \sum\nolimits_i \alpha_i \ln p_i + \frac{1}{2} \sum\nolimits_i \sum\nolimits_j \gamma_{ij} \ln p_i \ln p_j$$
$$\ln b(\mathbf{p}) = \sum\nolimits_i \beta_i \ln p_i, \qquad \text{or, in antilog} \qquad b(\mathbf{p}) = \prod\nolimits_i p_i^{\beta_i}.$$

When demographic translation is introduced, budget shares are modified as follows

$$w_i(y^h, \mathbf{p}) = w_i(y^h, \mathbf{p}, t_i(\mathbf{d})),$$

where $t(\mathbf{d})$ is a translating function and $\mathbf{d}$ is a vector of demographic variables or household characteristics.

Similarly to the Slutsky decomposition of income and substitution effects, the demographic specification translates the budget line via demographic characteristics (income scaling).

Applying this transformation to equation (11), we obtain the following demographically modified budget share equation

$$w_i(y^h, \mathbf{p}, \mathbf{d}) = \alpha_i + t_i(\mathbf{d}) + \sum\nolimits_j \gamma_{ji} \ln p_j + \beta_i \left(\ln y^{h*} - \ln a(\mathbf{p})\right) + \frac{\lambda_i}{b(\mathbf{p})} \left(\ln y^{h*} - \ln a(\mathbf{p})\right)^2,$$

where

$$t_i(\mathbf{d}) = \sum\nolimits_r \tau_{ir} \ln d_r,$$
$$\ln y^{h*} = \ln y^h - \sum\nolimits_i t_i(\mathbf{d}) \ln p_i,$$
$$\ln a(\mathbf{p}) = \alpha_0 + \sum\nolimits_i \alpha_i \ln p_i + \frac{1}{2} \sum\nolimits_i \sum\nolimits_j \gamma_{ij} \ln p_i \ln p_j,$$
$$\ln b(\mathbf{p}) = \sum\nolimits_i \beta_i \ln p_i, \quad \text{or, in antilog} \quad b(\mathbf{p}) = \prod\nolimits_i (p_i)^{\beta_i}.$$

In order to comply with homogeneity properties of the demand system, the demographic specification of the budget shares demand system is subject to a number of restrictions on the parameters. In particular, to satisfy linear homogeneity in $\mathbf{p}$ and Slutsky symmetry the following restrictions must hold

$$\sum\nolimits_i \alpha_i = 1; \sum\nolimits_i \beta_i = 0; \sum\nolimits_i \lambda_i = 0; \sum\nolimits_i \gamma_{ij} = 0; \sum\nolimits_j \gamma_{ij} = 0; \gamma_{ij} = \gamma_{ji}; \sum\nolimits_i \tau_{ir} = 0.$$

To obtain the collective demographically modified QAIDS, the next step is to introduce the sharing rule. The maximization problem in (1) states that the sharing rule determines the amount of resources that each household member receives. Each member decides how to allocate his share of total expenditure, and the observed household budget share will be equal to

$$
\begin{aligned}
w_i = {} & \alpha_i + t_i(\mathbf{d}) + \sum\nolimits_j \gamma_{ji} \ln p_j + \beta_i^m \left(\ln \phi^{m*} - \ln a(\mathbf{p})\right) \\
& + \frac{\lambda_i^m}{b^m(\mathbf{p})} \left(\ln \phi^{m*} - \ln a(\mathbf{p})\right)^2 + \beta_i^f \left(\ln \phi^{f*} - \ln a(\mathbf{p})\right) + \frac{\lambda_i^f}{b^f(\mathbf{p})} \left(\ln \phi^{f*} - \ln a(\mathbf{p})\right)^2,
\end{aligned}
$$

where $\ln \phi^{m*}$ and $\ln \phi^{f*}$ are demographically scaled sharing rules.

# C Appendix C: Tables

Table 1: Descriptive statistics - Goods - 742 obs.

| | Trunc. % | Mean | Std. Dev | Min | Max |
|---|---|---|---|---|---|
| *Shares* | | | | | |
| Food | 0 | 0.307 | 0.128 | 0.026 | 0.711 |
| Alcohol | 39.08 | 0.012 | 0.019 | 0 | 0.162 |
| Clothing | 0 | 0.195 | 0.120 | 0.008 | 0.742 |
| Education and Recreation | 10.24 | 0.094 | 0.131 | 0 | 0.777 |
| Other consumption | 0 | 0.392 | 0.147 | 0.055 | 0.895 |
| *Other relevant shares* | | | | | |
| Clothing for men | 0 | 0.080 | 0.061 | 0.003 | 0.436 |
| Clothing for women | 0 | 0.095 | 0.075 | 0.004 | 0.472 |
| *Total expenditure and Prices*[1] | | | | | |
| Total expenditure | | 7.447 | 0.518 | 5.728 | 9.027 |
| Food | | 1.539 | 0.229 | 0.466 | 2.170 |
| Alcohol | | -1.214 | 0.162 | -1.683 | -0.848 |
| Clothing | | 0.714 | 0.132 | 0.028 | 0.902 |
| Clothing for men | | -0.353 | 0.173 | -0.629 | -0.018 |
| Clothing for women | | 0.410 | 0.186 | 0.048 | 0.753 |
| Education and Recreation | | 0.459 | 0.182 | 0.067 | 0.747 |
| Other consumption | | 2.501 | 0.252 | 1.341 | 3.046 |

Note: 1. Values are expressed as natural logarithms.

Table 2: Demographic variables - 742 obs.

| | Mean | Std. Dev | Min | Max |
|---|---|---|---|---|
| North-east | 0.302 | 0.459 | 0 | 1 |
| North-west | 0.252 | 0.435 | 0 | 1 |
| Center | 0.173 | 0.378 | 0 | 1 |
| December | 0.098 | 0.298 | 0 | 1 |
| Rural | 0.170 | 0.376 | 0 | 1 |
| Employee | 0.690 | 0.494 | 0 | 1 |
| Smoke | 0.373 | 0.484 | 0 | 1 |
| University | 0.155 | 0.362 | 0 | 1 |
| Price ratio | 0.320 | 0.048 | 0.207 | 0.462 |
| Edu. ratio | 0.493 | 0.087 | 0 | 1 |
| Age ratio | 0.517 | 0.032 | 0.277 | 0.667 |

Table 3: Rank test

| Rank | r=1 | r=2 | r=3 | r=4 |
|---|---|---|---|---|
| test | 18.00 | 1.55 | 0.021 | 0.000 |
| p-value | 0.001 | 0.670 | 0.989 | 1.000 |

Table 4: Parameters of the demand system - 742 obs.

| param. | food | alcohol | clothing | edu.-rec. | others |
|---|---|---|---|---|---|
| $\alpha_i$ | 0.639 (0.077) | -0.002*(0.039) | 0.185 (0.101) | -0.486 (0.106) | 0.664 (0.134) |
| | | | | | |
| $\gamma_{ij}$ | -0.192 (0.021) | 0.004*(0.006) | 0.035 (0.019) | 0.108 (0.021) | 0.045 (0.019) |
| | | -0.003*(0.007) | -0.015 (0.008) | 0.002*(0.006) | 0.012 (0.006) |
| | | | -0.131 (0.034) | 0.032*(0.031) | 0.079 (0.028) |
| | | | | -0.252 (0.034) | 0.111 (0.026) |
| | | | | | -0.248 (0.030) |
| | | | | | |
| $\beta_i^m$ | -0.055 (0.021) | 0.011*(0.012) | -0.115 (0.072) | 0.137 (0.024) | 0.022*(0.053) |
| | | | | | |
| $\beta_i^f$ | -0.022*(0.055) | -0.006*(0.022) | -0.154 (0.057) | 0.074*(0.092) | 0.107 (0.079) |
| | | | | | |
| $\lambda_i^m$ | -0.011*(0.013) | -0.007*(0.004) | 0.072 (0.016) | -0.008*(0.014) | -0.046 (0.019) |
| | | | | | |
| $\lambda_i^f$ | -0.015 (0.012) | 0.001*(0.004) | 0.045 (0.013) | 0.004*(0.013) | -0.035 (0.019) |
| | | | | | |
| $\eta_i$ | - | -0.013 (0.012) | - | -0.184 (0.118) | - |
| | | | | | |
| demo. vars. | | | | | |
| north-east | -0.033 (0.013) | 0.012 (0.004) | -0.019 (0.011) | -0.027 (0.020) | 0.067 (0.028) |
| north-west | 0.012 (0.004) | 0.009 (0.004) | -0.012*(0.011) | -0.031 (0.020) | 0.072 (0.025) |
| center | -0.032 (0.014) | 0.002*(0.003) | -0.028 (0.013) | -0.002*(0.019) | 0.061 (0.023) |
| december | 0.005*(0.014) | 0.006 (0.003) | 0.016* (0.013) | -0.031 (0.013) | 0.004*(0.015) |
| university | -0.022*(0.012) | 0.001*(0.003) | 0.012* (0.011) | 0.016 (0.011) | -0.008*(0.013) |
| dep. worker | 0.007*(0.010) | -0.001*(0.003) | -0.007*(0.009) | -0.03*(0.008) | 0.003*(0.012) |
| rural | 0.004*(0.011) | 0.002*(0.003) | -0.018*(0.010) | 0.007*(0.011) | 0.005*(0.014) |
| smoke | -0.001*(0.009) | -0.002*(0.003) | -0.018 (0.008) | -0.018*(0.009) | 0.038 (0.011) |
| | price-r | edu-r | age-r | | |
| sharing rule | -2.349 (0.835) | 0.883 (0.415) | -1.261 (0.943) | | |

∗ Denotes non significant parameters at the 5% significance level.

Standard errors in parentheses

Table 5: Parameters of the participation equatuions - 742 obs.

| | alcohol | education&recreation |
|---|---|---|
| constant | 0.156*(0.224) | 0.904 (0.247) |
| December | 0.085*(0.163) | 0.095*(0.220) |
| north-east | -0.392 (0.179) | 0.995 (0.214) |
| north-west | -0.455 (0.183) | 0.784 (0.216) |
| center | -0.119*(0.197) | 0.662 (0.222) |
| south (no isles) | -0.151*(0.195) | 0.169*(0.204) |
| rural | -0.039*(0.130) | -0.212*(0.157) |
| age | 0.066 (0.021) | -0.039*(0.027) |
| smoke | 0.309 (0.099) | 0.233 (0.136) |
| husband dep. worker | -0.003*(0.112) | 0.011*(0.116) |
| wife dep. worker | -0.069*(0.107) | -0.081*(0.138) |

* Denotes non significant parameters at the 5% significance level.

Standard errors in parentheses

Table 6: Income and price elasticities

| income elasticities | | | | | |
|---|---|---|---|---|---|
| | food | alcohol | clothing | edu.-rec. | other |
| | 0.747 (0.224) | 1.051 (0.303) | 1.064 (0.203) | 2.068 (3.306) | 0.882 (0.175) |

| compensated price elasticities | | | | | |
|---|---|---|---|---|---|
| | food | alcohol | clothing | edu.-rec. | other |
| food | -1.126 (0.166) | 0.039 (0.074) | 0.373 (0.168) | 0.351 (0.196) | 0.571 (0.317) |
| alcohol | 0.472 (0.352) | -1.099 (0.075) | -0.521 (0.502) | 0.177 (0.099) | 0.855 (0.433) |
| clothing | 0.521 (0.220) | -0.073 (0.058) | -1.377 (0.195) | 0.168 (0.079) | 0.635 (0.210) |
| edu.-rec. | 0.642 (0.962) | -0.028 (0.545) | -0.067 (1.955) | -2.946 (7.279) | 1.202 (2.290) |
| other | 0.511 (0.232) | 0.051 (0.086) | 0.368 (0.177) | 0.412 (0.309) | -1.278 (0.414) |

Standard deviations in parentheses

Table 7: Elasticities