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D. Aristei, F. Perali and L. Pieroni

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e-mail: de-child@unito.it
Web site: http://www.child-centre.it

Cohort analysis of alcohol consumption: a double hurdle approach

David Aristei[*], Federico Perali[*] and Luca Pieroni[**]

Abstract

This paper describes the life-cycle alcohol consumption patterns of Italian households by decomposing gender, cohort, age and time effects and estimates the importance of demographic characteristics using a double hurdle model. The application is based on ISTAT households expenditure survey for the period 1997-2002 organized in cohorts. As expected, cohort and age effects are significant in both participation and consumption. The significance of gender and geographic differences suggests interesting policy implications.

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Keywords: Alcohol consumption, double-hurdle models, birth cohorts, ageing, gender.

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[*] Department of Economics, University of Verona.
[**] Department of Economics, Finance and Statistics, University of Perugia.

1. Introduction

The analysis of household expenditures on alcoholic beverages is interesting both from a public health and a socio-economic perspective. The analysis of alcohol consumption is receiving renewed attention aiming at preventing the negative effects of alcohol-related behaviours, such as drunk driving, teenage alcohol consumption, alcoholism and other health problems, which are significantly contributing to current levels of mortality. Many studies have shown that most of the changes in alcohol consumption, in different time periods and birth cohorts, are due to a set of factors such as society's mobility across economic state, tax, prices, and the demographic structure of the household (Atkinson et al. 1984; Blaylock and Blisard, 1993; Ruhm, 1995; Dee, 2001; Chaloupka et al., 2002; Pierani and Tiezzi, 2004). The identification of non-price determinants of alcohol consumption is crucial for preventing alcohol abuse and the related health problems (Yen and Jensen, 1996).

Descriptive analyses of alcohol consumption show that ageing significantly affects expenditure decisions and that consumption level are higher amongst successive birth cohorts at the same age (Evandrou and Falkingham, 2004). Therefore, differences in household alcohol consumption among generations represent a main focus for public health analysts, investigating the presence of health inequalities along the life-cycle.

This paper first describes the dynamics of alcohol consumption in Italy present in the series of repeated cross-sections of the ISTAT household expenditure survey for the period 1997-2002. The trends in alcohol consumption are examined by cohorts in order to investigate the behaviour over the life-cycle. By decomposing alcohol expenditure in cohort and age effects we gain a clearer picture of the different patterns of consumption and of possible changes in preferences between older and younger cohorts.

Differently from other studies, we use individual rather than cohort means in order to account for cohort, age and time effects. Consequently, since many households have zero expenditures on alcoholic beverages, the choice of appropriate econometric techniques is crucial for the consistency of the empirical results. Further, we carry out a cohort-age-time decomposition of alcohol consumption in an extended double hurdle model, emphasizing the importance of a bivariate generalization of the Tobit model (Jones, 1989; Jones, 1992; Labeaga, 1999). The use of a double hurdle specification allows us to analyse the determinants of participation and consumption decisions separately and to evaluate the effect of the household's demographic heterogeneity on alcohol consumption patterns.

The paper is organized as follows. Section 2 describes the dynamics of alcohol consumption by cohort. Section 3 presents the econometric specification and estimation technique with a special emphasis on the decomposition in cohort, age and time effects of alcohol expenditure used to assess the existence of a life-cycle pattern. Section 4 discusses the empirical results. Section 5 concludes the paper with the discussion of interesting policy implications.

2. Data and descriptive analysis

In this Section, we illustrate the dataset used in the empirical analysis by showing the cohort classification adopted and describing the lifetime profiles of household alcohol consumption.

2.1. Cohort definition

The data set includes six independent cross-sections of Italian households, for a total of 140023 observations (22362 in 1997, 21586 in 1998, 20930 in 1999, 23728 in 2000, 23918 in 2001, 27499 in 2002). The ISTAT survey provides a random sample of the population each year and, even if we lack a panel structure and cannot track individual households, it is possible to track groups of households.

By grouping households according to the age of the household head (Browning et al., 1985), we divide the sample into homogeneous groups and track over time the cohorts. A cohort can be defined as a group with fixed membership formed by individuals which can be identified as they show up in the surveys (Deaton, 1985). Groups can be defined in different ways, as long as the membership remains constant through time. The most natural representation is to consider an age cohort formed by individuals (household's heads) born in the same period. For this reason, we group the households on the basis of the head's year of birth, using five-years age bands cohorts. We decide to exclude from the sample all the households whose head was born after 1976 and before 1917, limiting the attention to those with head aged 21-80 in 1997 (who are aged 26-85 in 2002). The sample size, after dropping these observations, reduces to 134515 households. All the remaining households are allocated to 12 five-years cohorts (with the first cohort representing all the households with head born between 1972 and 1976, aged 21-25 in 1997, until the twelfth cohort which includes those households with head born between 1917 and 1921, aged 75-80 in 1997). The definition of five-years cohorts, together with the birth years, the ages observed and the size of each cell, are reported in Table 1. As it can be noted, the size of all cohorts, with the exception of the first one, is sufficiently large and remains stable over the survey years. The dimension of the first cohort, on the other hand, is small mainly in the first two years of the sample, thus limiting the representativeness of the youngest cohort.

Table 1 – Five-years cohorts definition and number of households in each cohort in each year

Cohorts	Year of birth	Age in 1997	Age in 2002	1997	1998	1999	2000	2001	2002	Total
1	1972/1976	21-25	26-30	173	199	300	422	532	778	2404
2	1967/1971	26-30	31-35	823	931	1,033	1,311	1,514	1,859	7471
3	1962/1966	31-35	36-40	1,862	1,923	1,846	2,158	2,297	2,725	12811
4	1957/1961	36-40	41-45	2,257	2,161	2,134	2,343	2,361	2,651	13907
5	1952/1956	41-45	46-50	2,332	2,232	2,189	2,473	2,523	2,706	14455
6	1947/1951	46-50	51-55	2,520	2,421	2,381	2,566	2,535	2,841	15264
7	1942/1946	51-55	56-60	2,165	2,217	1,965	2,284	2,258	2,602	13491
8	1937/1941	56-60	61-65	2,280	2,125	2,082	2,420	2,321	2,737	13965
9	1932/1936	61-65	66-70	2,031	1,992	1,937	2,169	2,237	2,534	12900
10	1927/1931	66-70	71-75	2,004	1,937	1,869	2,120	2,086	2,289	12305
11	1922/1926	71-75	76-80	1,787	1,562	1,543	1,691	1,579	1,909	10071
12	1917/1921	76-80	81-85	996	909	825	886	874	981	5471
Total				21230	20609	20104	22843	23117	26612	134515

2.2. Descriptive analysis

In this section we carry out a pre-estimation analysis of the data by examining the lifetime profiles of alcohol consumption. Figure 1 plots the average alcohol expenditure, obtained as the mean of alcohol consumption of each cohort from 1997 to 2002, against the age of household's head[1]. Alcohol consumption expenditures are expressed at 1995 constant prices, using the regional prices indexes published by ISTAT. In the figure, each connected line represents the consumption behaviour of a cohort over the 6 years of the sample period. For example, the first segment on the left represents the average

[1] We limit our attention to the period 1997-2002 because, given the introduction of the new European System of National Accounts (SEC95), the household surveys for the years before 1997 are not comparable.

consumption of the youngest cohort which is tracked between the ages of 21 and 30. Since the cohorts are defined within a five-years interval and the sample covers a period of six years, each cohort overlaps five years with the next one. Cohort 1 is observed between ages 21 and 30, while Cohort 2 is observed between ages 26 and 35, and so on. This representation permits some preliminary consideration about the presence of age and cohort effects (Browning, 1987; Kapteyn et al., 2005). The vertical difference between lines measures the cohort-time effect. The differences between consumption levels for those households with the same age[2] but different year of birth can be explained by the presence of significant generational (or cohort) effects. The difference along the same line measurers the age-time effect. Since we have defined five-years cohorts, it is possible to track the behaviour of households with different ages within each cohort in order to evaluate the effect of the population aging. However, it is important to underline that, at this stage, it is not possible to disentangle cohort effects from age and time effects. In order to implement this disaggregation, we need an econometric model through which we can explain household consumption behaviours and obtain a decomposition of cohort, age and time effects, as it will be done in the next section.

Figure 1 shows the life-cycle path of alcohol consumption. Inspection of the Figure reveals that the profile is characterized by a hump, with alcohol expenditures declining considerably in the last part of the lifecycle. Average expenditure on alcoholic beverages continuously rises over the first seven cohorts, up to those households born in the period 1942-1946, and peaks around age 58. The decline is not particularly sudden, with average alcohol consumption that remains quite high up to the eleventh cohort. Alcohol consumption appears to be higher among adjacent cohorts at the same age, suggesting the presence of positive cohort effects for almost all the cohorts. This positive cohort effect is evident between cohort 3 and 4, but it is much more significant for the oldest cohorts, particularly for those households born between 1937-1941, 1932-1936 and 1927-1931. The age-effect is also significant. The young and middle-age cohorts display a notable growth in alcohol consumption as their age increases; old cohorts, on the other hand, are characterized by a decline in alcohol expenditure, which is particularly evident from the eighth cohort onward.

[2] For convenience, when we refer to the age of a household we mean the age of the household's head.

Figure 1 – Average expenditure on alcoholic beverages by age and cohort

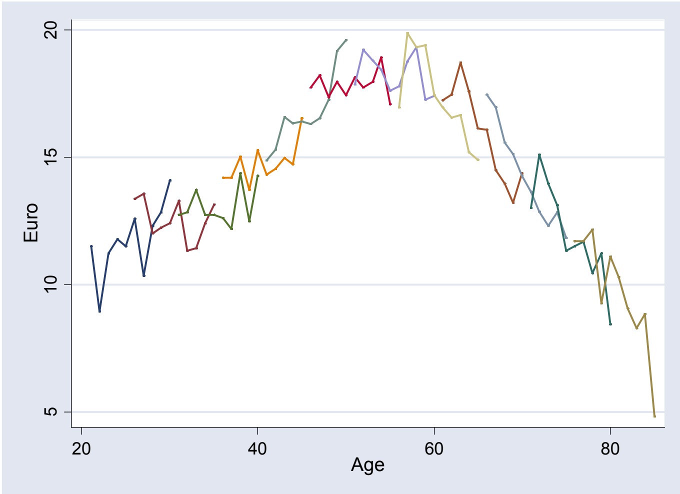
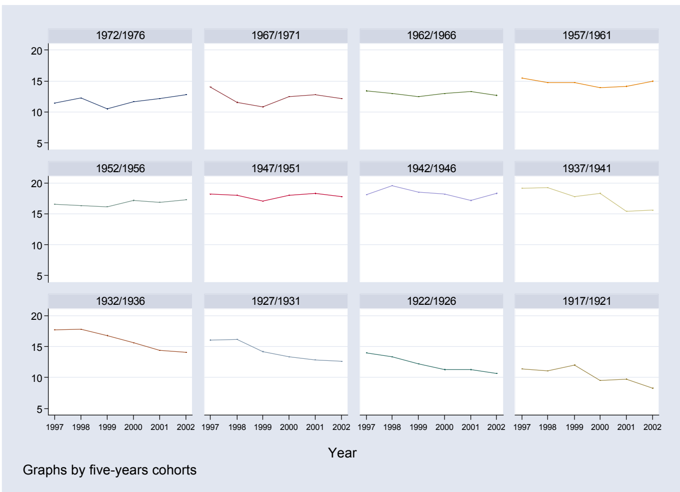


Figure 2 presents the within-cohort patterns of average alcohol consumption. Each panel represents the consumption behaviour of a single cohort from 1997 to 2002. The horizontal axis represents the years of the sample, while the vertical axis represents the yearly mean of total consumption, expressed in Euros. Comparison of different panels reveals that the level of average alcohol consumption increases with age up to the seventh cohort (households born in 1942-1946) and then starts decreasing, in line with the shape profile depicted in Figure 1. Moreover, analysing the within-cohort consumption pattern, we note that the first six cohorts are characterized by an increasing level of consumption for the period 1999-2002, revealing an upward trend of alcohol expenditure over time.

Figure 2 – Average expenditure on alcoholic beverages by year, all cohorts

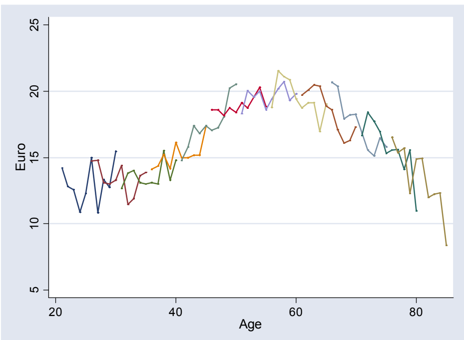


In order to further investigate the pattern of alcohol consumption, we carry out a disaggregated analysis by dividing the households according to the gender of the household head and to the area of residence.

Figure 3 shows the different life-cycle profiles of average alcohol consumption of male and female-headed households. Inspection of the graphs reveals that the level of consumption is always higher for the male-headed families. In the youngest and oldest cohorts the expenditure on alcoholic beverages of male-headed households is almost twice as that of female-headed. Moreover, the consumption profiles, even if they are both characterized by the presence of hump, are considerably different. For the male-headed households alcohol consumption reaches its peak at age 58, while the peak of alcohol consumption for female-headed families is reached much long before, around age 40. The level of alcohol consumption of the male-headed families, in particular, remains high even in the last part of the lifecycle, declining considerably only in the oldest cohort. Analysing the profiles of Figure 3, we note the presence of significant positive cohort effects for both middle-age and old cohorts of male-headed households. Concerning the age effect, young and middle-age cohorts are characterized by an increase in alcohol consumption as they age, while the expenditure on alcoholic beverages in old cohorts displays a downward trend, which is however not particularly evident. On the other hand, for the female-headed families no clear pattern for both the cohort and the age effects can be identified from the analysis of the figure.

Figure 3 – Average expenditure on alcoholic beverages by age and cohort

Male-headed households



Female-headed households

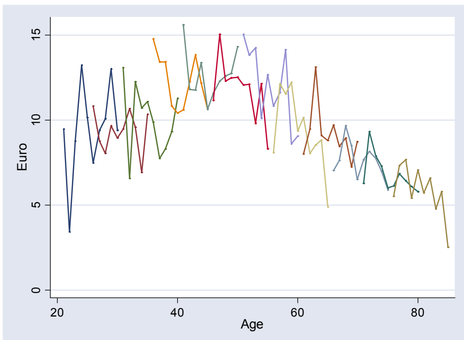


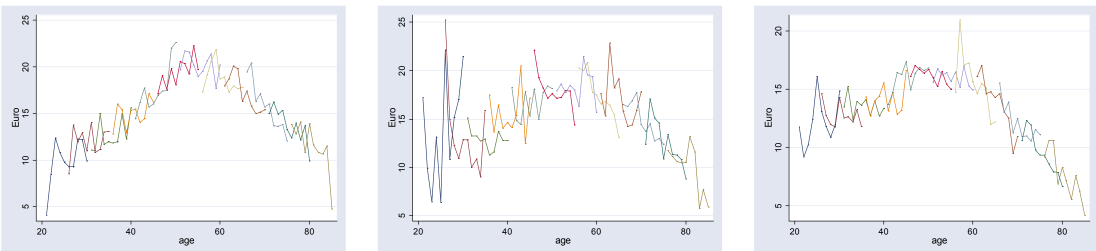
Figure 4 shows the average alcohol consumption disaggregated according to the geographical distribution of Italian households located in the North, Centre and South of

Italy. Comparison of the graphs reveals that expenditure in alcoholic beverages is considerably lower in the South than in the two other areas. This difference becomes much more evident for the oldest cohort. Although all profiles are characterized by the typical humped shape, alcohol consumption in the South shows a slight upward trend up to the seventh cohort and then sharply decreases. The pattern in the South of Italy can be interpreted partly as a habit effect, due to the fact that the South is not a traditional wine producing area, and partly as an income effect, considering that the levels of income are relatively lower.

On the other hand, both in the North and in the Centre the level of alcohol consumption remains high also in the last cohorts. It is worth noting that, in the Centre, alcohol spending reaches its peak at age 26. The expenditure on alcoholic beverages of the households aged 26 in both the first and second cohort, in fact, reaches a value close to 25 Euros per month, which is well above the level of all the other households in the sample. Concerning the analysis of cohort and age-time effects, from Figure 4 it is possible to note the presence in the North of a positive age effect, with alcohol consumption increasing with the age of the households, up to the sixth cohort. From the seventh cohort onward the level of alcohol consumption tends to decrease as households age. In the Centre and especially in the South, on the other hand, a negative age-time effect characterizes the life-cycle profile of alcohol consumption. From the graphs of Figure 4, no clear pattern for the cohort-time effect emerges. In all the three macro-areas, however, the presence of a positive generational effect can be highlighted between the eldest cohorts, particularly from the eighth onward. In the South, this positive cohort-time effect is evident also between the middle-age cohorts.

Figure 4 – Average expenditure on alcoholic beverages by age and cohort

North *Centre* *South*



3. Econometric Method

3.1. Modelling alcohol consumption: a double-hurdle approach

The aim of this section is to evaluate the determinants of household expenditures on alcoholic beverages, placing special attention on the analysis of the life-cycle pattern of alcohol consumption. Besides assessing the effects that economic, demographic and social factors may exert on alcohol demand, we are also interested in identifying and modelling the structure of generational and age effects by means of a cohort-age decomposition of alcohol consumption patterns.

Household expenditure surveys represent an important source of data to analyze private consumption behaviours. The use of microdata permits evaluating the effect of household characteristics and provides the degrees of freedom necessary to estimate a large number of parameters. However, household consumption surveys are often characterized by a significant proportion of observations with reported zero expenditures, that makes the choice of appropriate econometric techniques crucial for the consistency of the empirical results (Maddala, 1983; Amemiya, 1984).

Most demand studies have used the Tobit model (Tobin, 1958) to estimate demand relationships with limited dependent variables. Tobit model can be, however, very restrictive for both economic and statistical reasons, which makes this model unsuitable for certain empirical applications. From an economic point of view, according to the Tobit framework, zero consumption observations arise from corner solutions generated by a constrained budget. For commodities like alcohol or tobacco, it is nevertheless implausible that all zeros represent corner solutions. The Tobit model is also statistically restrictive because it assumes that the same set of variables determine both the probability of a non-zero consumption and the level of expenditure. Several empirical studies have shown the inadequacy of the standard Tobit model in cross-sectional analysis of alcohol and tobacco consumption, emphasizing the importance of a bivariate generalization of that model (Blundell and Meghir, 1987; Jones, 1989; Pudney, 1989; Blaylock and Blisard, 1993, Yen, 1994; Yen and Jensen, 1996; Labeaga, 1999). The participation and consumption decision stems from two separate individual choices. It is therefore necessary to use a double-hurdle specification, which properly models these two decisions.

In the present analysis, different double-hurdle models are used to analyze household alcohol expenditure patterns, devoting particular attention to the specification of the stochastic structure of the model by testing whether the conventional assumption of independent errors across the participation and consumption equations is acceptable.

The double-hurdle model, originally proposed by Cragg (1971), assumes that individuals (or households) make two decisions concerning the purchase of a certain good. Each decision stage is determined by a different set of factors. According to the behavioural content of this model, two separate hurdles must be passed before a positive level of consumption can be observed. In the context of alcohol consumption analysis, both hurdles can be viewed as the outcome of an individual choice. The first hurdle involves the decision about whether or not to consume alcoholic beverages (*participation decision*). It is reasonable to assume that to the choice of consuming alcohol, just like the decision to smoke, is both an economic decision, and is also influenced by social and demographic factors (Blaylock and Blisard, 1993) which are independent of the quantity consumed and are related to the perception of drinking as a form of social behaviour. The second hurdle concerns the level of alcohol consumption to choose *(consumption decision*). Separating the two decisions is particularly relevant for modelling alcohol consumption, since the decision to drink can be assumed as mainly related to social factors, like the prestige or stigma of drinking among different social groups, and the decision of how much to drink can be viewed as a more private or individual decision depending on the personal rate of impatience.

We now turn to the econometric specification of the model. Both hurdles are assumed to be linear in the parameters (a, b), with additive disturbance terms u and v, randomly distributed with a bivariate normal distribution. The matrices z and x include the variables that are assumed to influence participation and consumption decisions, respectively. Formally, following Jones (1989) and Pudney (1989), the bivariate model can be written as:

i) Observed consumption:

$$y = d \cdot y^{**} \tag{1}$$

ii) Participation equation:

$$w = a'z + u \qquad u \sim N(0,1) \tag{2}$$

$$d = \begin{cases} 1 & \text{if } \; w > 0 \\ 0 & \text{otherwise} \end{cases}$$

iii) Consumption equation:

$$y^* = b'x + v, \qquad v \sim N(0, s^2) \tag{3}$$

$$y^{**} = \begin{cases} y^* & \text{if } \; y^* > 0 \\ 0 & \text{otherwise} \end{cases}$$

A positive level of alcohol consumption y is observed only if the individual (or household) is a potential drinker ($d = 1$) and actually consumes alcoholic beverages (y^{**}). For this reason, in double-hurdle models, differently from the Heckman selection model (Heckman, 1979), in which zeros are not affected by the consumption decision, zero consumption is the result of participation or consumption decisions and potential drinkers may have zero alcohol expenditure.

Assuming that the error terms of the participation and consumption equations are correlated allows for the possibility that the two decisions are made simultaneously. In particular, we assume that *u* and *v* are distributed as a bivariate normal:

$$(u,v) \sim BVN(0,\Sigma), \qquad \Sigma = \begin{bmatrix} 1 & sr \\ sr & s^2 \end{bmatrix} \tag{4}$$

where r is the correlation coefficient.

Denoting zero consumption as 0 and positive consumption as +, the likelihood function for the full double-hurdle model with dependence between *u* and *v* can be written as:

a) Double-hurdle model with dependent error terms

$$\begin{aligned} L &= \prod_0 \left[1 - p(d=1)p(y^* > 0 \mid d=1) \right] \prod_+ p(d=1)p(y^* > 0 \mid d=1) g(y^* \mid y^* > 0, d=1) \\ &= \prod_0 [1 - p(u > -a'z)p(v > -b'x \mid u > -a'z)] \\ &\qquad \prod_+ p(u > -a'z)p(v > -b'x \mid u > -a'z) g(y^* \mid v > -b'x, u > -a'z) \end{aligned} \tag{5}$$

or:

$$L = \prod_0 [1 - \Phi(a'z, b'x, r)] \prod_+ \left\{ a'z + \frac{r}{s}\left[y^* - b'x \right] \Big/ \sqrt{1 - r^2} \right\} \frac{1}{s} f\left[(y^* - b'x)/s \right] \tag{6}$$

where p denotes probability, Φ and f are distribution and density functions, respectively, and $g(\cdot) = f(\cdot)/\Phi(\cdot)$.

In empirical applications of double-hurdle models it is common to assume that u and v are independent (i.e. $r = 0$). Under this hypothesis we obtain the original formulation proposed by Cragg (1971).

b) Double-hurdle model with independent error terms – Cragg model

$$\begin{aligned} L &= \prod_0 [1 - p(u > -a'z) p(v > -b'x)] \prod_+ p(u > -a'z) p(v > -b'x) g(y^* \mid v > -b'x) \\ &= \prod_0 [1 - \Phi(a'z)\Phi(b'x)/s] \prod_+ \Phi(a'z) \frac{1}{s} f\left[(y^* - b'x)/s\right]. \end{aligned} \tag{7}$$

This model hypothesizes that the participation and consumption decisions are made separately and that there is a feedback effect from the quantity of possible consumption to the participation decision (Atkinson et al., 1984; Deaton and Irish, 1984). In the present analysis we do not make any *a priori* assumption on the correlation structure of the error terms. For this reason, differently from other studies (Yen and Jensen, 1996; Moffat, 2003; Newman et al., 2003), the independence of error terms is not assumed as a maintained hypothesis, but its significance is tested by means of a Wald test.

It is worth noticing that the standard Tobit model is a nested version of the Cragg model, when $a_j = 0$ for $j \neq 0$ and $a_0 = \infty$, that is when $p(u > -a'z) = 0$ (i.e. $\Phi(a'z) = 1$). A likelihood ratio test can be used to distinguish between the Tobit and the independent double-hurdle model (Garcia and Labeaga, 1996). In particular, since the independent double-hurdle model allows variables to have different effects on the participation and consumption decisions, by testing the statistical equivalence of these models it is possible to verify whether participation and consumption decisions are based on the same choice structure or they should be separately modelled.

3.2. Disaggregating cohort, age and time effects

In the context of the double hurdle approach, several empirical analyses have verified the existence of a life-cycle pattern of alcohol participation and consumption decisions[3]. Our aim is to investigate the presence of generational and age effects on alcohol expenditure by including a linear cohort-age-time decomposition (Deaton and Paxson, 1994; Deaton, 1997; Attanasio, 1998; Deaton and Paxson, 2000; Blisard, 2001) in an extended double hurdle specification. We express observed alcohol consumption as a function of household's head age and birth-year cohort and two sets of socio-demographic and economic variables which are hypothesized to separately affect household participation and consumption decisions. Formally, the econometric model can be written as:

$$\ln c = F(z,x) + \alpha_c D^a + \gamma_c D^b + \varphi_c D^{a+b} + u_c, \tag{8}$$

where $\ln c$ is a vector of observed consumption (in logarithmic terms), D^a is a matrix of age dummies, D^b is a matrix of birth cohort dummies, D^{a+b} (with $a+b=1,...,T$, where 1 and T are the first and last available cross-sections, respectively) is a matrix of time dummies for each survey year, and $F(z,x)$ is a function of the z and x vectors of variables included in the participation and consumption equations, respectively.

By estimating equation (8), we are able to decompose the age, cohort and year effects. The first effect gives the typical age profile associated with lifecycle changes, the second represents the trend that is associated with generational effects, and the third accounts for the aggregate effects that may temporarily move the households off their trend and age profiles (Deaton, 1997). This decomposition is obtained under the assumption of absence of interactions between age, cohort and year effects, so that the estimated coefficients should be considered as representing the net effect of these variables on observed alcohol consumption.

Birth-cohorts are created by grouping the households on the basis of the head's year of birth. Twelve cohort dummy variables are then created for each five-year cohort. In the same way, thirteen age dummy variables are created, starting from age 21 and ending with age 85, and six year dummies are defined for all the years of the sample (1997-2002).

The specification described in (8) models the a, b and $a+b$ matrices of dummy variables linearly. The year in which each household is observed is equal to the age of the household head, a, plus his year of birth, b. For this reason, it is not possible to

[3] For example Jones (1989) included individual's age and its square as explicative variables, while Yen and Jensen (1996) used both household age composition and the age of the household head.

identify the effect of a, b and $a+b$ in equation (8) and any trends in the data can be arbitrarily attributed to either the year effect or to a combination of age and cohort effects. To overcome this problem, following Deaton and Paxson (1994), we assume that the time effect captures cyclical fluctuations that average to zero over the long run. This is equivalent to assume that any trend in the data can be interpreted as a combination of age and cohort effects and are therefore predictable. The time effect then reflects the influence of macroeconomic shocks or the residual effect of non-systematic measurement error (Jappelli, 1999). This assumption leads to the necessity to drop one column from both the age and cohort matrices of dummy variables, and the first and second year dummy variables. Moreover, the remaining year dummy variables are included in the model in a normalised form:

$$D^{a+b} = d_t - (t-1)d_2 + (t-2)d_1 \tag{9}$$

where d_t is the usual zero or one dummy variable. This transformation implies that all the year dummy variables sum to zero and makes the year effects orthogonal to a time trend:

$$\begin{gathered}\sum_{a+b=1}^{T} D^{a+b} = 0 \\ \sum_{a+b=1}^{T} (a+b)D^{a+b} = 0\end{gathered} \tag{10}$$

The coefficients of the first two years dummies, namely D^1 and D^2, can be then recovered given the fact that the year effects sum to zero.

4. Model Specification and Empirical Results

In this section, the estimation results of the decomposition of alcohol consumption into cohort, age and time effects are presented in a double-hurdle generalized specification that contains a set of exogenous variables which allows to control for socio-demographic effects. As it is known, theory provides no guidance as to which explanatory variables should be included in the double-hurdle model. Thus, hypothesizing that a given variable affects only alcohol participation and not consumption or vice versa is difficult. In this study, the cohort-age-time decomposition structure is included in both alcohol participation and consumption equations. Both decisions are postulated to be function of the number of household's components and children, region of residence, gender, education level and occupation of household's head.

In a pre-estimation phase, we have tested the effect of several variables in each equation of the double-hurdle, since certain variables may be important determinants, but may be endogenously determined. For example, the education levels are connected to the life cycle and are closely related to generational changes. This issue could make the identification of the age profile difficult, since in the augmented regressions the age effects could be captured by additional variables (Jappelli, 1999). Conversely, when the estimated parameters of socio-demographic and economic variables as well as the parameters of age effects are statistically significant, the identification problem is negligible.

Since the inclusion of the same set of regressors in each hurdle makes it difficult to identify the parameters of the model correctly, exclusion restrictions must be imposed. An underlying assumption is that the first hurdle is a function of non-economic factors determining household's decision to participate in the market, so that the income variables are excluded from the first equation (Newman et al, 2003). In our model, we include in the participation equation (2) two additional variables: a variable that indicates the presence of elderly persons (over 65 years old) in the household (O*ld*), as a proxy of health status and of age-related health problems, and a variable indicating whether or not the household consumes tobacco (*Smoke*), as a proxy for social awareness or habit formation tendencies (Blaylock and Blisard, 1993).

In the consumption equation specific variables accounting for economic conditions have been introduced. Household total expenditure (*LogExp*) is a proxy of current income and it has been included because, by separating generational or cohort effects from aging effects, the patterns of alcohol consumption could be the result of either current incomes or differences in tastes and preferences. Further, household tobacco expenditure (*LogTab*) is included as a proxy to verify the presence of complementary relationships with household expenditures on alcoholic beverages. The socio-demographic variables used in this analysis are listed and described in Table 2.

Table 2 – Variable definitions and sample means

Variable	Definition	Sample means *Full sample (n=134515)*	*Consuming (n=79254)*	*Non-consuming (n=55261)*
NCHILD014	Number of children aged 0-14 in the household	0.406	0.411	0.398
NC	Number of household's components	2.829	2.966	2.633
OLD	Equals 1 if there are persons over 65 years old in the household, otherwise zero	0.448	0.427	0.477
NORTH	Equals 1 if the household resides in the North, otherwise zero	0.437	0.413	0.473
SOUTH	Equals 1 if the household resides in the South, otherwise zero	0.372	0.387	0.351
CENTRE	Omitted base group	0.190	0.200	0.177
CITY	Equals 1 if the household resides in urban area, otherwise zero	0.780	0.772	0.792
MALEHD	Equals 1 if household's head is male	0.775	0.835	0.689
EDUCATION	Equals 1 if household's head has at least a high school education, otherwise zero	0.297	0.293	0.303
OCCUPATION	Equals 1 if household's head is in a white collar occupation, otherwise zero	0.209	0.208	0.211
SMOKE	Equals 1 if the household consumes tobacco, otherwise zero	0.378	0.435	0.297
LOGEXP	Household total expenditure, in logarithmic terms	7.522	7.623	7.377
LOGTAB	Household tobacco expenditure, in logarithmic terms	1.352	1.567	1.043

To investigate the statistical significance of the components in which the consumption behaviour has been disaggregated, we estimate all models and test the dependent Double Hurdle specification against the independent specification. Based on the value of the log-likelihood function the null hypothesis of an empirical model with independent errors is rejected at the 1% significance level. The value of the c^2 statistic is *6.6* (*p-value=0.0098*). Thus, the model that best rationalizes consumption data is a dependent double-hurdle model[4].

We than perform the Wald test to determine whether or not the cohort and age effects are jointly statistically significant. Due to the lack of identification of cohort, age, and time effects, an extensive specification testing is necessary to verify the models' stability under alternative assumptions (Kerr et al., 2004). The Wald tests, as it clearly emerges from Table 3, suggest that the age and cohort effects are statistically significant (*p-value<0.02*) in both the participation and consumption equations.

[4] Further, the independent double-hurdle model has been tested against the Tobit specification by means of a likelihood-ratio test (Garcia and Labeaga, 1996). The LR test clearly indicates the inadequacy of the univariate Tobit model. The results are available upon request from the authors

Table 3 – Wald tests of the joint significance of age and cohort effects

Equation	Cohort Effect	Age Effect
Participation	$c^{2}_{(11)} = 23.11$ *p-value* = 0.017	$c^{2}_{(12)} = 56.93$ *p-value* = 0.000
Consumption	$c^{2}_{(11)} = 71.53$ *p-value* = 0.000	$c^{2}_{(12)} = 39.57$ *p-value* = 0.000

The estimated parameters of both the dependent and independent double-hurdle models of alcohol consumption are reported in Table 4.

In the discussion of the results, we start from the analysis of the cohort-age-time decomposition. However, we do not comment on the estimated parameters of the year (time) effects because they can be considered as a measure of the residual influence of non-systematic errors rather than representing the impact of macroeconomic shocks on consumption (Jappelli, 1999), considering that our sample is built on only six repeated cross-sections covering the years from 1997 to 2002. We find significant evidences indicating the existence of a life-cycle pattern for both participation and consumption decisions. The statistical significance of the estimated cohort parameters are in line with the monotonic decrease in alcohol consumption of recent birth cohorts indicating that in Italy the older cohort tend to consume more alcohol than the younger (Figure 5)[5]. The second and third cohorts (year of birth 1967/1971 and 1962/1966) show a non-significant relationship with alcohol consumption (with a t-statistics equal to –0.38 and 0.88, respectively). On the other hand, we remark that up to the eighth cohort the parameters of the alcohol participation equation are not statistically significant.

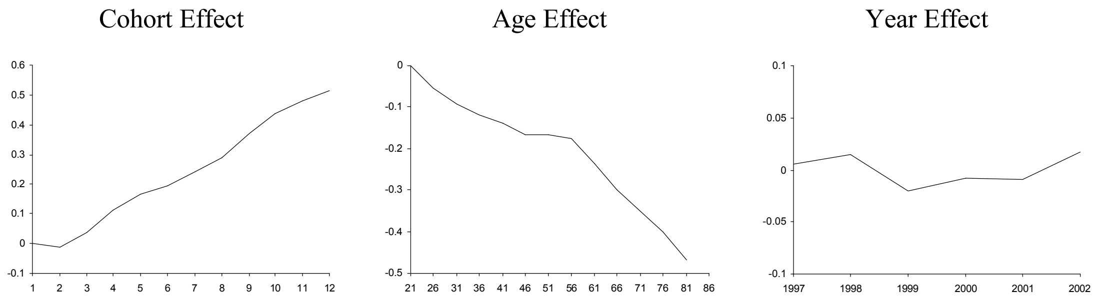
These results suggest that economic and social changes have modified the current use of alcohol consumption, questioning the traditional Italian model which has mainly explained the consumption of alcoholic beverages (mainly wine) in connection with the food habits of the household.

[5] This result, however, is not in contradiction with the recent evidences concerning the increasing number of problematic drinkers and the high levels of alcohol consumption among teenagers and young classes.

Table 4 – Dependent and independent double hurdle estimates

Variable	Dependent Double Hurdle Model		Independent Double Hurdle Model	
	Coefficient	Std. Error	Coefficient	Std. Error
a) Alcohol Participation				
Cohort 2	-0.056	0.039	-0.057	0.039
Cohort 3	-0.047	0.046	-0.048	0.046
Cohort 4	0.005	0.051	0.004	0.051
Cohort 5	0.039	0.056	0.038	0.056
Cohort 6	0.068	0.060	0.066	0.060
Cohort 7	0.079	0.063	0.078	0.063
Cohort 8	0.118	0.067	0.116	0.067
Cohort 9	0.166	0.071	0.165	0.071
Cohort 10	0.197	0.075	0.196	0.075
Cohort 11	0.218	0.079	0.216	0.079
Cohort 12	0.241	0.084	0.239	0.084
Age class 2	0.054	0.061	0.055	0.061
Age class 3	0.068	0.069	0.070	0.068
Age class 4	0.096	0.072	0.098	0.072
Age class 5	0.083	0.075	0.085	0.075
Age class 6	0.099	0.079	0.102	0.079
Age class 7	0.053	0.081	0.056	0.081
Age class 8	0.069	0.084	0.071	0.084
Age class 9	0.026	0.087	0.023	0.087
Age class 10	-0.049	0.090	-0.052	0.090
Age class 11	-0.103	0.093	-0.106	0.093
Age class 12	-0.190	0.097	-0.192	0.097
Age class 13	-0.339	0.103	-0.342	0.103
Year 3	0.005	0.008	0.005	0.008
Year 4	0.010	0.008	0.010	0.008
Year 5	0.011	0.007	0.011	0.007
Year 6	-0.019	0.006	-0.019	0.006
Nchild014	-0.078	0.007	-0.077	0.007
Old	0.035	0.014	0.042	0.014
Nc	0.068	0.004	0.068	0.004
Smoke	0.303	0.008	0.302	0.008
North	-0.133	0.010	-0.133	0.010
South	-0.043	0.010	-0.043	0.010
City	-0.037	0.009	-0.037	0.009
Education	-0.020	0.009	-0.020	0.009
Occupation	-0.022	0.010	-0.022	0.010
Malehd	0.411	0.009	0.412	0.009
Constant	-0.365	0.055	-0.369	0.055
b) Alcohol Consumption				
Cohort 2	-0.013	0.037	-0.010	0.037
Cohort 3	0.039	0.044	0.042	0.044
Cohort 4	0.113	0.049	0.112	0.049
Cohort 5	0.168	0.053	0.165	0.052
Cohort 6	0.196	0.056	0.191	0.056
Cohort 7	0.242	0.059	0.238	0.059
Cohort 8	0.290	0.062	0.283	0.062
Cohort 9	0.371	0.065	0.361	0.065
Cohort 10	0.437	0.068	0.425	0.068
Cohort 11	0.480	0.072	0.467	0.072
Cohort 12	0.516	0.078	0.502	0.078
Age class 2	-0.054	0.060	-0.057	0.060
Age class 3	-0.092	0.067	-0.096	0.067
Age class 4	-0.119	0.070	-0.124	0.070
Age class 5	-0.140	0.073	-0.144	0.073
Age class 6	-0.167	0.075	-0.172	0.075
Age class 7	-0.167	0.077	-0.170	0.077
Age class 8	-0.175	0.080	-0.179	0.080
Age class 9	-0.236	0.082	-0.239	0.082
Age class 10	-0.300	0.085	-0.298	0.085
Age class 11	-0.351	0.087	-0.347	0.087
Age class 12	-0.401	0.091	-0.391	0.091
Age class 13	-0.468	0.099	-0.448	0.098
Year 3	-0.020	0.007	-0.021	0.007
Year 4	-0.008	0.007	-0.009	0.007
Year 5	-0.009	0.006	-0.010	0.006
Year 6	0.018	0.005	0.019	0.005
Nchild014	-0.038	0.007	-0.034	0.006
Nc	-0.006	0.004	-0.009	0.003
LogTab	0.049	0.003	0.044	0.002
North	0.098	0.009	0.106	0.009
South	0.038	0.009	0.041	0.009
City	-0.069	0.008	-0.066	0.008
Education	-0.064	0.008	-0.063	0.008
Occupation	-0.048	0.009	-0.047	0.009
LogExp	0.461	0.006	0.462	0.006
Malehd	0.224	0.014	0.198	0.009
Constant	-0.998	0.080	-0.897	0.069
Log Likelihood	-189732.9		-189736.5	
Wald test of independence	c^2 (1) = 6.6 *p-value* = 0.0098			

Figure 5 –Cohort, age and year decomposition of alcohol consumption



Since the alcohol participation and consumption decisions are not based on the same decision-making structure, we illustrate the differences considering the age decomposition variables. Even if, by the Wald test in Table 3, the age effects are in general statistically significant, it is important to show that while in the consumption equation the age parameters are almost all significant and with an expected negative sign, in the participation equation the age parameters exhibit a positive sign for the first 9 classes (until age class 61-65), even if we find that none of the coefficients are statistically significant. This evidence is confirmed by the non-rejection of the joint hypothesis that alcohol participation decision between the ages 21-60 is not affected by ageing ($c^2(7) = 8.83$, *p-value*=0.2649). For the older classes the parameters of the age dummies in the participation equation are negative and statistically significant, indicating that the potential participation of alcohol consumption is significantly decreasing in the last part of the life-cycle. Thus, the effects of age structure on alcohol participation and consumption for the oldest households appear to be coherent with the expected declining pattern. This result is in line with the behaviour of older age classes found by Kerr et al. (2004) on a sample of US households, even if it is worth noticing a slight anticipation in the reduction of alcohol consumption in Italy.

In order to account for the within-cell heterogeneity, alcohol participation and consumption are allowed to vary according to the socio-demographic characteristics of the households. Our attention concentrates on the statistical significance of the variables distinguishing the participation and consumption decisions. After this discussion, the focus turns to the impacts of the socio-demographic variables in the double-hurdle model.

In the participation equation being a smoker significantly increases the likelihood that an household consumes alcoholic beverages. The presence of elderly persons in the family (O*ld*) also increases the probability to participate to alcohol consumption.

Concerning the consumption equation, the estimated parameter shows that income has a positive and significant effect on household alcohol consumption. This result is in line with previous works where income effects dominate any drinking pattern related to the opportunity cost of time or to the psychological stress of economic recessions, remarking that the income variable is an important economic factor in the second hurdle of the decision process (Ruhm, 1995; Ettner, 1996). Further, tobacco consumption has a complementary effect on alcohol consumption, confirming that smokers are more likely to consume alcoholic drinks than non-smokers.

We now consider the estimated parameters of the household socio-demographic characteristics in both participation and consumption equations. The estimated parameters indicate that living in urban areas, having children aged 0-14, being an individual with high education and white collar employment reduces the likelihood that an household participates and consumes alcohol. Conversely, being the household's head a male increases the probability to participate and consume alcoholic beverages.

It is worth noticing that the working status of the household's head significantly affects alcohol consumption behaviour. Differently from the results of Blaylock and Blisard (1993) the job condition, linked to the wage possibilities, determines a lower alcohol consumption. Similar to the effect of working status on alcohol consumption, the negative impact of education of the household's head is coherent with the results of Kerr et al. (2004), but it is in contrast with investigations based on sub-samples of men (Blaylock and Blisard, 1993) or of alcohol product (Kerr et al., 2004). For example, concerning this last case, the sign of education (and working status) could strictly depend on the different patterns of each alcohol components, such as beer, wine or spirits.

Finally, the number of household components (*Nc*) has been included in the model postulating that the household would attempt to moderate alcohol consumption when more component, in particular children, are present (Browning, 1987; Blaylock and Blisard, 1993; Kerr et al., 2004). In this study, given that we are already controlling for the number of children and for the presence of elderly persons, the inclusion of the number of household components in both the participation and consumption equations provides some insight into the effects that the dimension and composition of the family exerts on observed alcohol expenditure. In empirical literature, the family composition has been often found to be non-significant in modifying the potential household behaviours in alcohol consumption. In our sample, the estimated parameter shows a positive and significant value in the participation equation while it is negative and statistically significant at the 10 percent level in the consumption equation. As a consequence, the model indicates that larger households have a significantly higher probability to drink alcohol even if they consume less. In a preliminary estimation, following Newman et al. (2003), we have included in the model a set of dummy variables indicating the structure of the household, namely *Single*, *Single with children*, *Couple* and *Couple with children*. The results obtained were in line with those obtained with the variable *Nc*, suggesting that, ceteris paribus, single adult households tend to consume more alcohol than couples with children. The same sign differences are found for the variables related to the region of residence (*North* and *South*). These variables are both significant and negative in the participation equation, whereas they are significant and positive in the consumption equation. In this case we have not an intuitive explanation.

To deepen the investigation of the observed alcohol consumption heterogeneity, we disaggregate the analysis according to the geographical distribution of the families and to the gender of the household's head. In fact, the presence of significant regional and gender differences in alcohol consumption behaviours has been already revealed by the results of the general double-hurdle model and by the evidences highlighted in the descriptive analysis of Section 2.

In order to analyze the alcohol consumption decisions of male and female-headed households, we undertake a disaggregate estimation comparing the different patterns of the generational effects (Greenfield and Kerr, 2003; Gibson and Scobie, 2001). In the Appendix (Table A.1), we report the structure of our sample, dividing the households according to their composition and to the head's gender, in order to obtain some preliminary information on the presence of gender-differentiated alcohol consumption behaviours. It is worth remarking that female-headed households only represent the 22.5% of the sample (30270 households). This sub-sample mainly consists of singles

(52.5%). On the other hand, male-headed households are mainly married couples with children (63856 households).

The estimated parameters of dependent and independent double-hurdle models are reported in Table A.2 in the Appendix. In the discussion, the dependent double-hurdle model is used for male-headed households, while the Cragg model is the best representation for female-headed households. The Wald test implemented to verify the independence is rejected for male at the five percent level and non-rejected for female. The value of the c^2 statistic are *5.17* (*p-value=0.023*) and *0.88* (*p-value=0.348*) for male and female, respectively. We remark that the parsimonious restriction of the Cragg model to the Tobit specification for the female-headed households is largely rejected by the data.

As previously done, the Wald tests were performed to determine whether or not the cohort and age effects are jointly statistically significant for male and female-headed households. The tests, reported in Table 5, show that the age and cohort effects for male-headed households are highly significant for both participation and consumption equations, while for female-headed households only the cohort effect in alcohol consumption equation is significant. We conclude that the age effects do not influence whether or not a female will participate and consume alcoholic beverages. It is important to remark that the parameters of cohort effects for female show a slight decrease of alcohol consumption moving away from the old generations to the middle-age generations (cohort 8, year of birth 1937-1941), while there is an increase of alcohol consumption in cohort 7 (year of birth 1942-1946). Subsequently, the pattern decreases among the female youngest cohorts. A likely explanation to this pattern can be connected to the social acceptance, starting from the late 60's, of drinking and smoking by women as a form of emancipation.

Table 5 – Wald tests of the joint significance of age and cohort effects

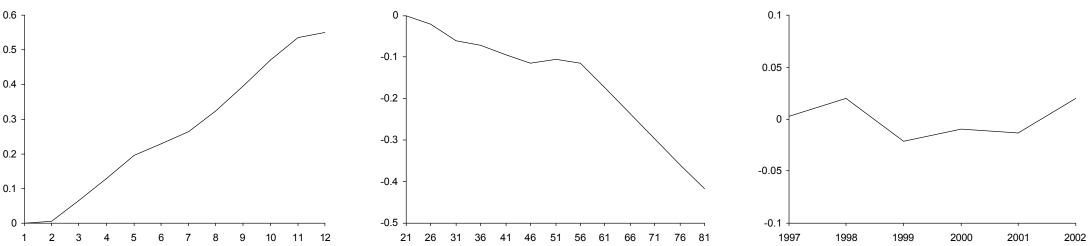
Equation	Male-headed households		Female-headed households	
	Cohort Effect	Age Effect	Cohort Effect	Age Effect
Participation	$c^2_{(11)} = 30.32$ *p-value* = 0.001	$c^2_{(12)} = 54.22$ *p-value* = 0.000	$c^2_{(11)} = 11.88$ *p-value* = 0.373	$c^2_{(12)} = 17.03$ *p-value* = 0.149
Consumption	$c^2_{(11)} = 65.05$ *p-value* = 0.000	$c^2_{(12)} = 31.96$ *p-value* = 0.002	$c^2_{(11)} = 24.83$ *p-value* = 0.010	$c^2_{(12)} = 12.37$ *p-value* = 0.416

The cohort and age profiles of the consumption equations are reported in Figure 6. Remarking that the cohort effects are less marked for the female-headed households, the statistical significance of the age effect for male suggests the existence of different behaviours. Alcohol consumption levels of the male-headed households slightly rises up to age 56 and rapidly decreases thereafter. Conversely, we note that the only statistically significant age effect for females is related to the evident break in the continuous decreasing pattern of alcohol consumption for the age class 36-40, which corresponds to the age with the highest frequency of problematic alcohol use by women (Scafato and Russo, 2004).

Figure 6 – Cohort, age and year decomposition of alcohol consumption, by sex

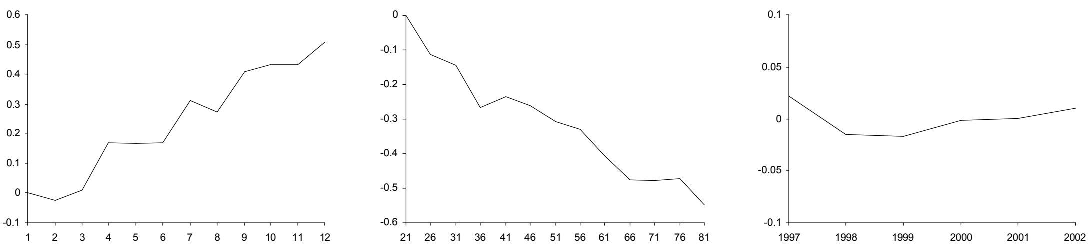
Male-headed households

Cohort Effect Age Effect Year Effect



Female-headed households

Cohort Effect Age Effect Year Effect



Turning to the analysis of the specific impacts of socio-demographic characteristics (Table A.2 in the Appendix), we concentrate our attention on the sign changes between participation and consumption equations. Firstly, the estimated parameter of the number of household components (*Nc*) shows a significant and positive value in the participation equation for male and female-headed households. On the other hand, in the consumption equation, for the male-headed households the parameter is significant and negative whereas for the female-headed households the sign is coherent with the participation equation. This result indicates that only in the male-headed households, the number of components contributes to a higher probability to consume alcoholic beverages, but the level of alcohol consumption reduces as *Nc* increases. It is important to note that the level of education has a different impact on male and female headed households. The alcohol participation equation presents a significant and positive impact of high education for the females while the coefficient is negative and significant for the male-headed households. This result is not confirmed in the consumption equation where the education is not significant for the female. The previous results related to the presence of heterogeneous consumption behaviours between male and female-headed households are further confirmed by the different effects of the regional dummies, highlighting a lower consumption level for the female-headed households in the South.

Another way to characterize the heterogeneity of alcohol consumption behaviour consists in carrying out the cohort-age-time decomposition for three regional sub-areas, namely North, Centre and South, in order to assess the presence of territorial differences in alcohol participation and consumption decisions. The estimated double hurdle models and the tests against the nested models show that only for the North the dependent double-hurdle model is the best model in interpreting the data, while for the Centre and the South of Italy, the Cragg specification is more appropriate. In the last two cases, the restriction to the Tobit specification has been strongly rejected. However, as shown in the Appendix (Table A.3), it is worth remarking that the estimated parameters of the dependent and independent double-hurdle have the same sign and size.

The cohort-age-time decomposition applied singularly to the participation and consumption equations shows highly significant values of cohort and age effects for both participation and consumption equations in the South, while the cohort effect in the North and the age effect in the Centre are not significant in the participation and consumption equations, respectively. More ambiguous is the age effect in the North. In fact, the results of the statistical tests, along with the non-significance of many age and cohorts parameters, suggest to explore the differences between the signs of the participation and consumption equations, already noticed in the general model.

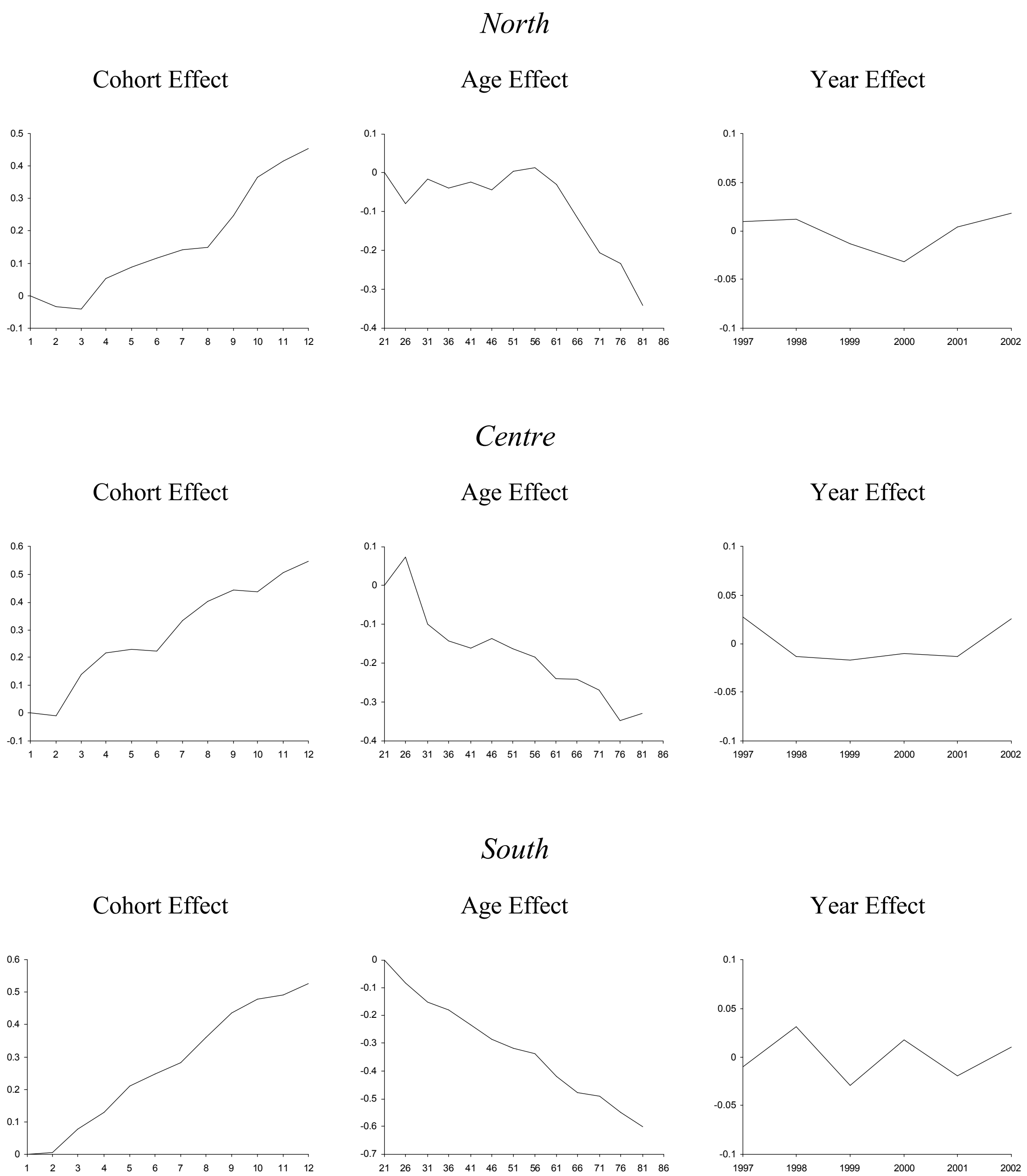
Table 6 – LR tests of joint significance of age and cohort effects

Equation	North		Centre		South	
	Cohort Effect	Age Effect	Cohort Effect	Age Effect	Cohort Effect	Age Effect
Participation	$c^{2}_{(11)}$ = 6.56 *p-value* = 0.834	$c^{2}_{(12)}$ = 19.47 *p-value* = 0.078	$c^{2}_{(11)}$ = 35.43 *p-value* = 0.000	$c^{2}_{(12)}$ = 26.96 *p-value* = 0.008	$c^{2}_{(11)}$ = 17.81 *p-value* = 0.086	$c^{2}_{(12)}$ = 45.06 *p-value* = 0.000
Consumption	$c^{2}_{(11)}$ = 35.13 *p-value* = 0.000	$c^{2}_{(12)}$ = 25.49 *p-value* = 0.013	$c^{2}_{(11)}$ = 23.36 *p-value* = 0.016	$c^{2}_{(12)}$ = 12.15 *p-value* = 0.433	$c^{2}_{(11)}$ = 34.11 *p-value* = 0.000	$c^{2}_{(12)}$ = 26.09 *p-value* = 0.010

From Figure 7 it is possible to extract the cohort-age-time decomposition. Two aspect should be remarked. First, in the North, alcohol consumption remains stable across younger cohorts. The Wald tests show that the cohort effects are jointly non-significant between cohorts 1 and 8 (*p-value*=0.157). This result confirms the stylised fact that younger generations drink less wine, which is substituted by strong drinks or beer in line with the behaviour of young generations observed both in Italy and in Europe. This hypothesis is confirmed by the negative and decreasing age effect in the oldest age classes. Secondly, it can be pointed out that the behaviour in the South of Italy is markedly different from the behaviour in the North. It is interesting to note that the South of Italy is characterized by a pattern of consumption of alcoholic beverages connected to the food habits of the household, which explains the decline of alcohol expenditure among the youngest cohorts and the negative signs of the age effects parameters. As already found for the male and female sub-samples, the heterogeneous pattern of alcohol consumption among macro-regions depends on different social models.

These evidences can be complemented by the analysis of the effects of the socio-demographic characteristics of the household. We note that the number of components (*Nc*) represents a significant factor affecting alcohol consumption in the South, where the likelihood of participating increases as the dimension of the family grows. Conversely, the consumption equation shows that the number of components is not significant in the South, while it is, as expected, negative and significant in the North. Moreover, the education level of the household's head seems to have a different effect across regions, influencing only the consumption levels of the South of Italy, where more educated people tend to consume less alcohol.

Figure 7 – Cohort, age and year decomposition of alcohol consumption, by zone



5. Concluding remarks

The recent availability of regular collection of cross-sectional surveys has increased the possibilities of understanding the factors affecting alcohol consumption while controlling for heterogeneous behaviours across households. In this paper, we have proposed an empirical strategy to account for the non-price determinants of alcohol consumption using a double hurdle model. The econometric execution has been designed to separately model alcohol participation and consumption decisions, and to decompose the cohort, age and time effects to explain the life-cycle patterns of observed expenditures on alcohol beverages.

The results, based on a sample of Italian households, show that both the cohort-age decomposition and the socio-demographic characterization are empirically relevant. The tests have shown that the best model to rationalize alcohol consumption behaviours is the dependent double-hurdle model. The presence of intergenerational differences have shown significant life-cycle patterns for both participation and consumption decisions. The heterogeneity of household characteristics also have a strong impact on observed alcohol expenditure. The results suggest that in Italy older cohorts tend to consume more alcohol than the younger ones. Even if age effects are statistically significant, only the older classes are consistent with theoretical expectations.

Concerning the effects of economic and socio-demographic variables on alcohol expenditure, the results show that living in urban areas, having children aged 0-14, being an individual with high education and a white collar employment reduces the likelihood that households participate and consume high levels of alcohol. Conversely, if the household's head is a male, consuming tobacco and having high income increases alcohol expenditures. These results imply that the efforts to encourage alcohol moderation may be most successful if focused on households with this socio-demographic profile. On the other hand, the ambiguous signs of working status and education levels are likely to be linked to the existence of different consumption behaviours concerning each component of alcohol expenditure (wine, beer and spirits). As a consequence, in order to highlight these within groups relationships, an investigation of how the socio-demographic characteristics affect the single alcohol consumption components is needed.

Some additional indications are found when we condition the data by gender and geographical areas. With respect to male behaviour, the cohort effects do not influence the alcohol participation decision of female-headed households, showing a slight increase of alcohol consumption in middle-age generations and a decrease among younger cohorts. This result does not surprise because much public health information on alcohol-related pathologies has been directed mainly towards the female world and it has been understood by younger generations. Finally, the extension of the analysis to geographical sub-samples appears to be significant in explaining the decline of alcohol participation and consumption in the youngest cohorts of the southern areas of Italy. The different patterns for the geographical areas improves the analysis of household's alcohol expenditure, suggesting the importance of using socio-anthropological models connected to alcohol consumption behaviours as an instrument to reduce policy inefficiencies, justifying a decentralization of public health policies.

Appendix

Table A.1 – Sample composition by gender and household type

Household composition	Male-headed		Female-headed		Full sample
	Consuming	*Non-consuming*	*Consuming*	*Non-consuming*	
Single	5492	3359	5476	10414	24741
Single with children	948	536	3969	3932	9385
Single with parents/relatives	831	517	677	712	2737
Single with children and parents/relatives	246	124	742	521	1633
Married couple	14929	9018	865	629	25441
Married couple with children	40752	23104	1233	910	65999
Married couple with parents/relatives	522	303	43	26	894
Married couple with children and parents/relatives	2448	1116	81	40	3685
All households	66168	38077	13086	17184	134515

Table A.2 – Dependent and independent Double Hurdle estimates, by gender

	Male-headed households				Female-headed households			
	Dependent Double Hurdle Model		Independent Double Hurdle Model		Dependent Double Hurdle Model		Independent Double Hurdle Model	
Variable	Coefficient	Std. Error	Coefficient	Std. Error	Coefficient	Std. Error	Coefficient	Std. Error
a) Alcohol Participation								
Cohort 2	-0.031	0.045	-0.031	0.045	-0.058	0.076	-0.062	0.076
Cohort 3	-0.022	0.053	-0.022	0.053	0.018	0.098	0.013	0.097
Cohort 4	0.035	0.058	0.035	0.058	0.077	0.114	0.070	0.113
Cohort 5	0.084	0.063	0.084	0.063	0.073	0.127	0.065	0.127
Cohort 6	0.103	0.067	0.103	0.067	0.219	0.140	0.212	0.140
Cohort 7	0.130	0.071	0.129	0.071	0.172	0.151	0.162	0.151
Cohort 8	0.180	0.075	0.180	0.075	0.172	0.160	0.159	0.160
Cohort 9	0.253	0.080	0.252	0.080	0.151	0.167	0.138	0.166
Cohort 10	0.313	0.084	0.313	0.084	0.118	0.172	0.106	0.171
Cohort 11	0.338	0.090	0.338	0.090	0.137	0.176	0.125	0.176
Cohort 12	0.366	0.098	0.366	0.098	0.149	0.182	0.138	0.182
Age class 2	0.105	0.076	0.106	0.076	-0.013	0.103	-0.010	0.103
Age class 3	0.122	0.084	0.123	0.084	-0.023	0.123	-0.018	0.123
Age class 4	0.170	0.087	0.171	0.087	-0.108	0.137	-0.101	0.137
Age class 5	0.171	0.090	0.173	0.090	-0.148	0.149	-0.141	0.149
Age class 6	0.197	0.093	0.199	0.093	-0.109	0.160	-0.101	0.160
Age class 7	0.155	0.096	0.157	0.096	-0.170	0.170	-0.160	0.170
Age class 8	0.160	0.099	0.162	0.099	-0.152	0.179	-0.140	0.178
Age class 9	0.082	0.103	0.078	0.103	-0.117	0.184	-0.112	0.184
Age class 10	-0.025	0.106	-0.029	0.106	-0.105	0.189	-0.100	0.189
Age class 11	-0.109	0.110	-0.113	0.110	-0.092	0.194	-0.087	0.193
Age class 12	-0.185	0.115	-0.189	0.115	-0.181	0.198	-0.176	0.198
Age class 13	-0.320	0.126	-0.324	0.126	-0.320	0.205	-0.316	0.205
Year 3	0.002	0.009	0.002	0.009	0.014	0.018	0.014	0.018
Year 4	0.003	0.009	0.002	0.009	0.034	0.016	0.034	0.016
Year 5	0.017	0.008	0.017	0.008	-0.010	0.014	-0.010	0.014
Year 6	-0.018	0.007	-0.018	0.007	-0.020	0.012	-0.019	0.012
Nchild014	-0.041	0.008	-0.041	0.008	-0.152	0.021	-0.150	0.021
Old	0.057	0.017	0.064	0.017	-0.015	0.029	-0.002	0.026
Nc	0.023	0.004	0.023	0.004	0.194	0.009	0.196	0.009
Smoke	0.269	0.008	0.267	0.008	0.388	0.018	0.385	0.018
North	-0.158	0.011	-0.158	0.011	-0.071	0.020	-0.071	0.020
South	0.013	0.011	0.014	0.011	-0.229	0.022	-0.229	0.022
City	-0.039	0.010	-0.039	0.010	-0.027	0.020	-0.027	0.020
Education	-0.046	0.010	-0.046	0.010	0.057	0.020	0.056	0.020
Occupation	-0.020	0.011	-0.020	0.011	-0.025	0.025	-0.025	0.025
Constant	0.050	0.069	0.047	0.069	-0.471	0.094	-0.479	0.093
b) Alcohol Consumption								
Cohort 2	0.006	0.042	0.008	0.042	-0.037	0.083	-0.025	0.081
Cohort 3	0.065	0.050	0.067	0.050	0.012	0.105	0.010	0.104
Cohort 4	0.129	0.054	0.128	0.054	0.182	0.122	0.169	0.120
Cohort 5	0.197	0.058	0.192	0.058	0.179	0.135	0.168	0.133
Cohort 6	0.229	0.061	0.224	0.061	0.207	0.152	0.170	0.145
Cohort 7	0.263	0.064	0.257	0.064	0.340	0.160	0.312	0.155
Cohort 8	0.323	0.068	0.314	0.067	0.299	0.168	0.273	0.164
Cohort 9	0.395	0.071	0.383	0.071	0.431	0.175	0.407	0.171
Cohort 10	0.471	0.075	0.456	0.075	0.450	0.180	0.434	0.177
Cohort 11	0.535	0.080	0.519	0.079	0.454	0.186	0.434	0.183
Cohort 12	0.551	0.087	0.533	0.087	0.530	0.193	0.508	0.190
Age class 2	-0.020	0.072	-0.025	0.072	-0.116	0.109	-0.113	0.108
Age class 3	-0.061	0.079	-0.067	0.079	-0.149	0.132	-0.145	0.130
Age class 4	-0.073	0.082	-0.081	0.082	-0.288	0.147	-0.268	0.144
Age class 5	-0.096	0.085	-0.104	0.085	-0.264	0.161	-0.236	0.156
Age class 6	-0.116	0.087	-0.125	0.087	-0.281	0.170	-0.262	0.167
Age class 7	-0.106	0.089	-0.114	0.089	-0.336	0.180	-0.307	0.175
Age class 8	-0.115	0.092	-0.123	0.092	-0.356	0.188	-0.330	0.184
Age class 9	-0.173	0.094	-0.179	0.094	-0.427	0.194	-0.406	0.191
Age class 10	-0.236	0.097	-0.237	0.097	-0.493	0.200	-0.475	0.197
Age class 11	-0.297	0.100	-0.294	0.100	-0.496	0.205	-0.479	0.202
Age class 12	-0.361	0.104	-0.355	0.104	-0.508	0.213	-0.474	0.207
Age class 13	-0.417	0.114	-0.403	0.114	-0.611	0.229	-0.549	0.217
Year 3	-0.021	0.008	-0.021	0.008	-0.014	0.019	-0.016	0.019
Year 4	-0.009	0.008	-0.010	0.008	0.005	0.019	-0.001	0.017
Year 5	-0.013	0.007	-0.014	0.007	-0.001	0.016	0.000	0.016
Year 6	0.020	0.006	0.021	0.006	0.006	0.014	0.010	0.013
Nchild014	-0.024	0.007	-0.022	0.007	-0.053	0.035	-0.027	0.021
Nc	-0.021	0.004	-0.022	0.004	0.071	0.038	0.037	0.008
LogTab	0.045	0.002	0.042	0.002	0.069	0.021	0.051	0.005
North	0.101	0.010	0.109	0.010	0.074	0.025	0.087	0.021
South	0.056	0.010	0.056	0.010	-0.081	0.051	-0.038	0.023
City	-0.073	0.008	-0.071	0.008	-0.046	0.022	-0.041	0.021
Education	-0.073	0.009	-0.071	0.009	-0.020	0.025	-0.031	0.022
Occupation	-0.054	0.010	-0.053	0.010	-0.018	0.027	-0.014	0.026
LogExp	0.448	0.007	0.448	0.007	0.516	0.015	0.518	0.015
Constant	-0.694	0.085	-0.632	0.080	-1.609	0.352	-1.306	0.143
Log Likelihood	-152586.2		-152588.7		-36585.53		-36588.32	
Wald test of indep.	$\chi^2(1) = 5.17$ *p-value* = 0.023				$\chi^2(1) = 0.88$ *p-value* = 0.348			

Table A.3 – Dependent and independent Double Hurdle estimates, by region

	North				Centre				South			
	Dependent Double Hurdle		Independent Double Hurdle		Dependent Double Hurdle		Independent Double Hurdle		Dependent Double Hurdle		Independent Double Hurdle	
Variable	Coeff.	Std. Error	Coeff.	Std. Error	Coeff.	Std. Error	Coeff.	Std. Error	Coeff.	Std. Error	Coeff.	Std. Error
a) Alcohol Participation												
Cohort 2	-0.008	0.055	-0.009	0.055	-0.248	0.098	-0.247	0.098	-0.040	0.068	-0.040	0.068
Cohort 3	-0.032	0.066	-0.034	0.066	-0.169	0.114	-0.170	0.114	-0.015	0.080	-0.015	0.080
Cohort 4	0.010	0.074	0.008	0.074	-0.032	0.126	-0.032	0.126	0.009	0.087	0.009	0.087
Cohort 5	-0.002	0.081	-0.004	0.081	-0.050	0.136	-0.050	0.136	0.110	0.094	0.110	0.094
Cohort 6	0.006	0.088	0.003	0.088	-0.036	0.145	-0.037	0.145	0.171	0.100	0.171	0.100
Cohort 7	0.002	0.093	0.000	0.093	-0.026	0.153	-0.027	0.153	0.200	0.106	0.200	0.106
Cohort 8	0.024	0.099	0.021	0.099	0.023	0.162	0.022	0.162	0.259	0.113	0.259	0.113
Cohort 9	0.031	0.105	0.027	0.105	0.209	0.170	0.208	0.170	0.281	0.119	0.280	0.119
Cohort 10	0.073	0.110	0.070	0.110	0.315	0.178	0.315	0.178	0.256	0.126	0.255	0.126
Cohort 11	0.101	0.116	0.097	0.116	0.342	0.186	0.341	0.186	0.257	0.132	0.256	0.132
Cohort 12	0.156	0.124	0.153	0.124	0.259	0.196	0.259	0.196	0.308	0.141	0.308	0.141
Age class 2	0.066	0.085	0.070	0.085	0.129	0.154	0.128	0.154	-0.005	0.108	-0.005	0.108
Age class 3	0.116	0.096	0.120	0.096	0.135	0.172	0.135	0.172	-0.029	0.120	-0.029	0.120
Age class 4	0.175	0.102	0.180	0.102	0.097	0.181	0.097	0.181	-0.009	0.126	-0.009	0.126
Age class 5	0.201	0.108	0.205	0.107	0.076	0.188	0.076	0.188	-0.069	0.130	-0.069	0.130
Age class 6	0.269	0.113	0.274	0.113	0.109	0.195	0.109	0.195	-0.122	0.135	-0.123	0.135
Age class 7	0.272	0.117	0.277	0.117	0.095	0.201	0.096	0.201	-0.251	0.139	-0.251	0.139
Age class 8	0.275	0.122	0.280	0.122	0.105	0.208	0.106	0.208	-0.220	0.144	-0.220	0.144
Age class 9	0.249	0.126	0.246	0.126	0.076	0.213	0.073	0.213	-0.289	0.149	-0.295	0.149
Age class 10	0.210	0.131	0.207	0.131	-0.139	0.219	-0.142	0.219	-0.327	0.154	-0.333	0.154
Age class 11	0.170	0.135	0.167	0.135	-0.208	0.226	-0.212	0.226	-0.389	0.159	-0.394	0.159
Age class 12	0.098	0.141	0.095	0.141	-0.310	0.233	-0.313	0.233	-0.483	0.165	-0.488	0.165
Age class 13	0.003	0.151	0.000	0.151	-0.436	0.245	-0.440	0.245	-0.707	0.176	-0.712	0.176
Year 3	-0.003	0.012	-0.003	0.012	0.001	0.019	0.001	0.019	0.019	0.014	0.019	0.014
Year 4	0.013	0.012	0.013	0.012	-0.051	0.018	-0.051	0.018	0.036	0.013	0.036	0.013
Year 5	0.033	0.011	0.033	0.011	-0.007	0.016	-0.007	0.016	-0.005	0.012	-0.005	0.012
Year 6	-0.031	0.009	-0.030	0.009	0.032	0.013	0.032	0.013	-0.031	0.009	-0.031	0.009
Nchild014	-0.084	0.011	-0.083	0.011	-0.085	0.017	-0.085	0.017	-0.097	0.011	-0.097	0.011
Old	0.055	0.020	0.066	0.020	0.003	0.030	0.009	0.029	0.023	0.026	0.030	0.026
Nc	0.058	0.006	0.059	0.006	0.057	0.009	0.057	0.009	0.082	0.006	0.083	0.006
Smoke	0.303	0.011	0.301	0.011	0.317	0.017	0.316	0.017	0.285	0.012	0.283	0.012
City	0.013	0.013	0.013	0.013	-0.077	0.019	-0.077	0.019	-0.077	0.015	-0.077	0.015
Education	0.003	0.013	0.003	0.013	-0.010	0.020	-0.010	0.020	-0.059	0.015	-0.059	0.015
Occupation	-0.049	0.015	-0.049	0.015	0.012	0.024	0.012	0.024	0.002	0.017	0.002	0.017
Malehd	0.330	0.013	0.331	0.013	0.389	0.021	0.389	0.021	0.549	0.016	0.549	0.016
Constant	-0.579	0.077	-0.586	0.077	-0.241	0.138	-0.243	0.138	-0.348	0.096	-0.351	0.096
b) Alcohol Consumption												
Cohort 2	-0.032	0.059	-0.031	0.059	-0.022	0.090	-0.010	0.089	0.003	0.058	0.005	0.058
Cohort 3	-0.041	0.071	-0.038	0.070	0.130	0.105	0.139	0.105	0.077	0.068	0.078	0.068
Cohort 4	0.053	0.078	0.051	0.078	0.215	0.115	0.216	0.115	0.129	0.074	0.128	0.074
Cohort 5	0.087	0.085	0.087	0.085	0.227	0.123	0.230	0.123	0.215	0.079	0.210	0.079
Cohort 6	0.116	0.091	0.114	0.091	0.221	0.130	0.223	0.130	0.256	0.084	0.248	0.083
Cohort 7	0.142	0.096	0.141	0.096	0.333	0.137	0.334	0.136	0.293	0.088	0.283	0.088
Cohort 8	0.150	0.101	0.147	0.100	0.402	0.143	0.401	0.143	0.373	0.093	0.361	0.093
Cohort 9	0.247	0.106	0.243	0.105	0.450	0.150	0.442	0.149	0.450	0.099	0.437	0.098
Cohort 10	0.366	0.111	0.358	0.111	0.450	0.157	0.437	0.156	0.490	0.104	0.478	0.104
Cohort 11	0.417	0.117	0.406	0.117	0.521	0.164	0.506	0.163	0.503	0.111	0.491	0.110
Cohort 12	0.454	0.126	0.438	0.125	0.557	0.175	0.547	0.174	0.542	0.121	0.528	0.120
Age class 2	-0.080	0.094	-0.086	0.094	0.079	0.142	0.073	0.142	-0.082	0.091	-0.082	0.091
Age class 3	-0.018	0.106	-0.029	0.105	-0.095	0.160	-0.101	0.160	-0.155	0.102	-0.153	0.101
Age class 4	-0.039	0.112	-0.056	0.111	-0.138	0.168	-0.143	0.167	-0.182	0.106	-0.181	0.106
Age class 5	-0.023	0.117	-0.042	0.116	-0.158	0.173	-0.162	0.173	-0.239	0.110	-0.235	0.110
Age class 6	-0.044	0.121	-0.069	0.120	-0.132	0.179	-0.137	0.179	-0.292	0.113	-0.286	0.113
Age class 7	0.004	0.125	-0.022	0.124	-0.158	0.184	-0.163	0.183	-0.330	0.117	-0.318	0.117
Age class 8	0.012	0.129	-0.014	0.128	-0.178	0.189	-0.184	0.188	-0.349	0.121	-0.339	0.120
Age class 9	-0.031	0.133	-0.059	0.132	-0.236	0.193	-0.240	0.193	-0.431	0.124	-0.418	0.124
Age class 10	-0.117	0.137	-0.141	0.136	-0.248	0.198	-0.243	0.198	-0.492	0.129	-0.478	0.128
Age class 11	-0.207	0.141	-0.227	0.140	-0.277	0.204	-0.269	0.203	-0.509	0.134	-0.491	0.133
Age class 12	-0.232	0.146	-0.245	0.146	-0.361	0.211	-0.347	0.210	-0.571	0.140	-0.548	0.139
Age class 13	-0.342	0.157	-0.345	0.157	-0.351	0.225	-0.331	0.223	-0.637	0.155	-0.601	0.152
Year 3	-0.013	0.012	-0.013	0.012	-0.017	0.016	-0.017	0.016	-0.028	0.011	-0.029	0.011
Year 4	-0.031	0.011	-0.033	0.011	-0.012	0.016	-0.010	0.016	0.019	0.011	0.018	0.010
Year 5	0.004	0.011	0.001	0.010	-0.013	0.014	-0.013	0.014	-0.019	0.010	-0.019	0.010
Year 6	0.018	0.009	0.022	0.008	0.027	0.012	0.026	0.012	0.009	0.008	0.010	0.008
Nchild014	-0.056	0.012	-0.048	0.011	-0.068	0.016	-0.064	0.015	-0.032	0.009	-0.027	0.009
Nc	-0.014	0.006	-0.019	0.006	-0.009	0.008	-0.011	0.008	0.007	0.006	0.003	0.005
LogTab	0.053	0.004	0.045	0.003	0.056	0.007	0.052	0.004	0.041	0.004	0.037	0.003
City	-0.047	0.013	-0.048	0.013	-0.051	0.017	-0.047	0.016	-0.108	0.012	-0.105	0.012
Education	-0.002	0.013	-0.002	0.013	-0.020	0.018	-0.019	0.018	-0.163	0.013	-0.160	0.013
Occupation	-0.038	0.016	-0.033	0.015	-0.005	0.021	-0.006	0.021	-0.066	0.014	-0.066	0.014
LogExp	0.438	0.010	0.438	0.010	0.484	0.014	0.484	0.014	0.484	0.009	0.485	0.009
Malehd	0.239	0.020	0.206	0.014	0.183	0.033	0.164	0.020	0.246	0.026	0.216	0.016
Constant	-0.843	0.133	-0.663	0.110	-1.240	0.193	-1.164	0.161	-1.021	0.119	-0.935	0.103
Log Likelihood	-82961.65		-82964.19		-36661.73		-36662.04		-69519.59		-69520.79	
Wald test of indep.	$c^2(1) = 5.85$ *p-value* = 0.0156				$c^2(1) = 0.53$ *p-value* = 0.4683				$c^2(1) = 2.17$ *p-value* = 0.1407			

References

Amemiya, T. (1984). Tobit Models: A Survey. *Journal of Econometrics* 84, pp.3-61.

Attanasio, O. (1998). A cohort analysis of saving behavior by U.S. households, *Journal of Human Resources,* Vol. 33, pp. 575-609.

Blaylock, J.R. and Blisard, W.N. (1993). Wine consumption by US men, *Applied Economics*, Vol. 24, pp. 645-651.

Blisard, W.N. (2001). Income and Food Expenditures Decomposed by Cohort, Age and Time Effects, Technical Bulletin n. 1896, United States Department of Agriculture.

Browning, M. (1987). Eating, Drinking, Smoking, and Testing the Lifecycle Hypothesis, *Quarterly Journal of Economics*, Vol. 102, pp. 329-45

Browning, M., Deaton, A. and Irish, M. (1985). A Profitable Approach to Labor Supply and Commodity Demands over the Life-Cycle, *Econometrica*, Vol. 53, pp. 503-543.

Chaloupka, F. J., Grossman, M. and Saffer H. (2002). The effects of price on alcohol consumption and alcohol-related problems, *Alcohol Research and Health,* Vol. 26, pp. 22-34.

Cragg, J. (1971). Some statistical models for limited dependent variables with application to the demand for durable goods, *Econometrica*, Vol. 39, pp. 829-844.

Deaton, A. (1985). Panel data from time series of cross sections, *Journal of Econometrics,* Vol. 30, pp. 109-126.

Deaton, A. (1997). *The Analysis of Household Surveys: A Microeconomic Approach to Development Policy*, Baltimore, Johns Hopkins University Press.

Deaton, A. and Irish, M. (1984). Statistical models for zero expenditures in household budgets, *Journal of Public Economics*, Vol. 23, pp. 59-80.

Deaton, A. and Paxson, C. (1994). Intertemporal Choice and Inequality, *Journal of Political Economy*, Vol. 102, pp. 437-467.

Deaton, A. and Paxson, C. (2000). Growth and saving among individuals and households, *Review of Economics and Statistics,* Vol. 82, pp. 212-225.

Dee, T. S. (2001). Alcohol abuse and economic conditions: evidence from repeated cross-sections of individual-level data, *Health Economics*, Vol. 10, pp. 257-270.

Ettner, S.L. (1996). New evidence on the relationship between income and health, *Journal of Health Economics*, Vol. 15, pp. 67-85.

Evandrou, M. and Falkingham, J. (2004). Cigarette Smoking and Drinking Behaviour in Northern Ireland 1986-2002: A Cohort Analysis, *mimeo*.

Garcia, J. and Labeaga, J.M. (1996). Alternative Approaches To Modelling Zero Expenditure: An Application To Spanish Demand For Tobacco, *Oxford Bulletin of Economics and Statistics*, Vol. 58, pp. 489-506.

Gibson, J. K. and Scobie, G. M. (2001). Household Saving Behaviour in New Zealand: A Cohort Analysis, Treasury Working Paper 01/19, The Treasury, Wellington.

Greenfield, T. K. and Kerr, W. C. (2003). Tracking Alcohol Consumption Over Time, *Alcohol Research and Health*, Vol. 27, pp. 30-38.

Heckman, J. (1979). Sample selection bias as a specification error, *Econometrica*, Vol. 47, pp. 153-161.

Jappelli, T. (1999). The age-wealth profile and the life-cycle hypothesis: a cohort analysis with a time series of cross-sections of Italian households, *Review of Income and Wealth,* Vol. 45, pp. 57-75.

Jones, A.M. (1989). A double-hurdle model of cigarette consumption, *Journal of Applied Econometrics*, Vol. 4, pp. 23-39.

Jones, A.M. (1992). A note on computation of the double-hurdle model with dependence with an application to tobacco expenditure, *Bulletin of Economic Research,* Vol. 44, pp. 67-74.

Kapteyn, A., Alessie, R. and Lusardi, A. (2005). Explaining the Wealth Holdings of Different Cohorts: Productivity Growth and Social Security, *European Economic Review*, Vol. 49, pp. 1361-1391.

Kerr, W. C., Greenfield, T. K., Bond, J., Ye, Y. and Rehm, J. (2004). Age, period and cohort influences on beer, wine and spirits consumption trends in the US National Alcohol Surveys, *Addiction,* Vol. 99, pp. 1111-1120.

Labeaga J.M. (1999). A double-hurdle rational addiction model with heterogeneity: estimating the demand for tobacco, *Journal of Econometrics*, Vol. 93, pp. 49-72.

Maddala, G.S. (1983). *Limited dependent and qualitative variables in econometrics*, Cambridge, Cambridge University Press.

Moffatt, P.G. (2003). Hurdle models of loan default, working paper, School of Economic and Social Studies University of East Anglia.

Newman, C., Henchion, M. and Matthews A. (2003). A double-hurdle model of Irish household expenditure on prepared meals, *Applied Economics*, Vol. 35, pp. 1053-1061.

Pierani, P. and Tiezzi, S. (2004). Addiction and the Demand for Alcoholic Beverages: Evidence from Italian Data, *mimeo*, University of Siena.

Pudney, S. (1989). *Modelling Individual Choice: The Econometrics of Corners, Kinks and Holes*, New York, Basil Blackwell.

Ruhm, C.J. (1995). Economic conditions and alcohol problems, *Journal of Health Economics*, Vol. 14, pp. 583-603.

Scafato, E. and Russo R. (2004). La donna e l'alcol. Tendenze nei consumi e strategie di intervento, *Annali dell'Istituto Superiore di Sanità*, Vol. 40, n. 1.

Tobin, J. (1958). Estimation of relationships for limited dependent variables, *Econometrica*, Vol. 26, pp. 24-36.

Yen, S.T. (1994). Cross-section estimation of U.S. demand for alcoholic beverages, *Applied Economics*, Vol. 26, pp. 381-392.

Yen, S.T. and Jensen, H.H. (1996). Determinants of household expenditures on alcohol, *The Journal of Consumer Affairs*, Vol. 30, pp. 48-67.