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Further evidence about alcohol consumption and the business cycle*

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Abstract

The main goal of this paper is to test whether macroeconomic conditions affect alcohol consumption using data from the Behavioral Risk Factor Surveillance System for the period 1987–2003. We try to control unobserved heterogeneity by relying on the construction of pseudo-panel data from the different cross-sections available. Our results indicate that when we do not take into account unobserved heterogeneity, the unemployment rate is significant and reduces the probability of becoming drinker and the number of alcoholic beverages consumed. However, once we estimate the model using cohort data, controlling for both observed and unobserved heterogeneity, the unemployment rate becomes non-significant. This implies that unobserved effects are important when explaining alcohol consumption. As a result, inferences obtained without controlling for them should be interpreted with caution.

JEL-CLASS: E23, I12

KEYWORDS: alcohol consumption, Behavioral Risk Factor Surveillance System, economic cycle, macroeconomic conditions

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1 Introduction

Concerns about the economic implications of the relationship between alcohol consumption and the labor market are well grounded. Most of the empirical literature has maintained the commonly held view that alcohol drinking is associated with lower earnings, lower employment rates, greater unemployment and productivity losses. Nevertheless, some authors (Forcier, 1988; Catalano et al., 1993) emphasize that the direction of the casuality between unemployment and alcohol consumption is not conclusive. While some studies have shown that unemployment is positively correlated with alcohol consumption (Kessler et al., 1987), with alcohol abuse (Crawford et al., 1987) and with diseases and psychological problems derived from alcohol abuse (Catalano et al., 1993), other analyses suggest that the correlation is inexistent or even negative (Ettner, 1997; Rhum and Black, 2002).

A common argument within the first set of studies is that unemployment originates a situation of financial strain, which induces the individual to canalize stress through consumption of alcohol (Peirce et al., 1994). While some authors support the existence of a positive relation between financial strain and depression, understanding chronic financial strain as a situation in which is difficult to satisfy basic needs (Kessler et al., 1987; Hamilton et al., 1990), others have found a positive relation between depression and alcohol consumption (Hartka et al., 1991). Analyses within the second set argue that unemployment usually implies lower consumption through an income effect. This reduction could not happen when unemployment is transitory and the unemployed receive benefits or family support (see Bentolila and Ichino, 2003).

Most of the previous research is based on the existence of a representative consumer. This is a non-realistic approach because there could coexist economic and sociological factors (intrinsic to individuals) that do not allow to generalize results about participation and alcohol consumption. Recent works use individual data and relax the representative consumer assumption (Dee, 2001 and Ruhm and Black, 2002 are two good examples). In this work we propose a further step to explicitly consider unobserved heterogeneity among individuals. Since panel data is not available we rely on cohorts built from independent cross-sections taken from the *Behavioral Risk Factor Surveillance System* (BRFSS from now on).

The objectives of the paper are twofold. The first and fundamental one is to show the effects of misspecification caused by missing unobserved heterogeneity, which even uncorrelated with the regressors could bias the parameter estimates or their standard errors. As a previous step we also want to replicate results obtained by previous authors, especially by Dee (2001) and Ruhm and Black (2002) in samples of different time dimension, in order to avoid the critique of obtaining different results because of using different sample periods. Finally, we also like to show that when there is a high percentage of zero observations in demand equations using individual data, it is sometimes necessary to consider the underlying reasons generating them when adjusting the model.

The structure of the paper is the following one: in section 2 we describe the methodological aspects of the models studying the relation between alcohol consumption and the cycle and we propose alternative specifications. Section 3 describes the dataset. Section 4 is devoted to comment on the results using individual and cohort data. In section 5, we propose econometric and economic interpretation of the results. Finally, section 6 summarizes the main conclusions.

2 Model and relationship to previous literature

Suppose that Y is an indicator of whether an individual is or not a drinker or the number of drinks consumed by him, whose latent variable Y^* is a linear function of some explanatory variables.

We observe Y as result of comparing the utility of consuming a number of drinks including zero consumption. So, the observability rule is $Y = 1(Y^* > 0)$ for the binary choice being a drinker or not or $Y = \max(Y^*, 0)$ for the number of drinks consumed. $1(A)$ is the indicator of event A.

Consider a general linear model for the latent variable:

$$Y^*_{ismt} = X_{ismt}\beta + UR_{smt}\gamma + \alpha_s + \delta_m + \lambda_t + \eta_i + \varepsilon_{ismt} \tag{1}$$

where the observed counterpart of Y^*_{ismt} denotes alcohol consumption (number of drinks) or the decision to drink of individual i interviewed in state s in month m of year t, X is a vector of explanatory variables, UR refers to unemployment rate, ε is an error term and α, δ, λ and η are state, month, year and individual unobserved factors.

Let suppose that X gathers all the determinants of the probability of being drinker or of the number of drinks consumed. Then, this model is equivalent to the one proposed by Ruhm and Black (2002), in which we allow the possibility that the dependent variable be limited or qualitative (binary or a count).[1]

The lack of panel data requires some assumptions to identify the parameters, or in other words, in their absence we cannot control the $\eta's$. If we assume $\eta_i = \eta$ for all i, Ordinary Least Squares (in the case Y were a continuous variable) would provide consistent estimates of the parameters. On the other hand, we only require absence of correlation among the η's and the regressors for the consistency of the parameters with individual random effects. In any case, from an economic point of view a model that does not allow correlation between individual effects and explanatory variables does not seem very interesting. For example, if individual tastes were correlated with professional occupation, then the coefficients corresponding to occupation would be biased when unobserved effects are not controlled for. If unemployment rates were different across occupations, then correlation with unobserved heterogeneity moves to the variables that proxy the economic situation. When panel data is available, this problem can be solved by treating η_i as fixed effects, using a transformation of the model or parameterizing the conditional expectation of the individual effects as a function of the explanatory variables. Obviously, it is not possible to apply these strategies if we do not have repeated observations for the same individuals. This last situation is analyzed by Dee (2001) and Ruhm and Black (2002) using information from the BRFSS for periods 1984-1995 and 1987-1999, respectively, with the aim of testing the relation between unemployment and consumption of alcoholic drinks. Our first priority will then be to reply their exercises before presenting results controlling for fixed effects.

Since the BRFSS is a combination of independent cross-sections, we cannot control for unobservable characteristics affecting consumption decisions (i.e., preferences for working, different tastes, religious beliefs, genetics, etc.). Moreover, unobserved variables could be correlated with regressors in (1) and so, the effect of unemployment on consumption would not be properly identified. We can deal with this problem by constructing pseudo-panels. Deaton (1985) suggests to divide the population in homogeneous groups (cohorts) according to one or several characteristics. At the population level, groups have to contain the same individuals along time. The basic idea of this procedure is to construct population means of the cohorts, in order to form a panel structure for the data. While it is true that cohort population means are not observable, we can use their sample analogs to proxy them, being aware that we end up with an errors in variables model. The advantage with respect to usual errors in variables models is that we can estimate the variances of

[1] From the specification above we can also generate simultaneous models if we established a double hurdle decision for consuming alcoholic drinks (Tobit type II, for example if Y were continuous for a part of the sample or Hurdle-Poisson or negative binomial for the decision and the counts). In case that variables affecting participation and consumption were the same and had identical effects over both decisions, we would be in the case of a standard Tobit (Poisson or negative binomial) model.

the measurement errors using individual data. Moreover, if the size of the cohort is large enough (Deaton, 1985, establishes 150 observations per cell), we can forget measurement errors because sample means approximate well enough their population counterparts.

From (1), we derive the cohort specification by adding up in i (for all individuals who satisfy the aggregation criterion defined) and dividing by the sample size of the group. Hereby we have:

$$\bar{Y}_{cmt} = \bar{X}_{cmt}\beta + \overline{UR}_{cmt}\gamma + \bar{\alpha}_s + \bar{\delta}_m + \bar{\lambda}_t + \bar{\eta}_c + \bar{\varepsilon}_{cmt} \quad c = 1, ..., C \tag{2}$$

We define n_{cmt} as the size of cohort c in month m of year t. Every element of $\bar{X}_{cmt}$, for example the unemployment rate, is the average of the unemployment indicators observed for individuals belonging to cohort c in month m of year t, and analogously for other variables in the model. The main estimation problem is that $\bar{\eta}_c$ is unobservable and probably still correlated with some variables in $\bar{X}_{cmt}$. Therefore, (2) does not constitute an appropriate base for obtaining consistent estimates unless the size of the cohorts is large enough. In this case, $\bar{\eta}_c$ is a good approximation to η_c, and we can replace $\bar{\eta}_c$ by a set of binary variables (fixed effects) one for each cohort.

Then a natural estimator is the covariance or within groups estimator based on the weighted means of the cohorts, introducing weights to take into account potential heteroskedasticity between cohorts. Let $\bar{X}_c = (\sum_{m=1}^{M}\sum_{t=1}^{T} n_{cmt})^{-1}\bar{X}_{cmt}n_{cmt}$ be the average of the observed means for cohort c, and define $\bar{Y}_c$ analogously. Then:

$$\hat{\beta}_{WG} = [n_{cmt}(\bar{X}_{cmt} - \bar{X}_c)'(\bar{X}_{cmt} - \bar{X}_c)]^{-1}[n_{cmt}(\bar{X}_{cmt} - \bar{X}_c)'(\bar{Y}_{cmt} - \bar{Y}_c)]$$

$\hat{\beta}_{WG}$ will be biased in small samples but it will be consistent as n_{cmt} tends to infinity if standard assumptions about second order moments are met. There exists a trade-off between accuracy and number of pseudo-panel observations. The bigger is the number of cohorts (C), the smaller is their size (n_{cmt}), which implies a trade-off between bias and variance of the estimator.

The identification of the effects of all determinants of participation and consumption becomes more complicated when we rely on time series or cross-section data. In the first case, we have to claim for the existence of a representative consumer and it is only possible to identify β and γ. For example, Brenner (1975, 1979) argues that during recessions, mortality rates increased, although there was a lag between the growth of unemployment rate and the increase in mortality rates. Nevertheless, Brenner's work has been very criticized by other authors as Gravelle et al. (1981), Stern (1983) or Wagstaff (1985) arguing absence of rationality in the election of the unemployment rate lag structure, high collinearity and variability of the results conditioned on time period, country or proxies for health status chosen.

When using a single cross-section instead of time series data, a similar problem appears. In terms of (1) we only can estimate separately β and γ (also α and δ if we have information for month and state of the observation) . If cross-section data correspond to countries, states or regions, the problems of infra-specification and existence of representative consumer are equivalent to the previous ones (Jahoda, 1991). In a photograph of individual alcohol consumption, the advantage is that X will contain a wide range of demand determinants (income and socioeconomic characteristics). The disadvantage is that we are not going to be able to establish any result relating alcohol consumption and the economic cycle. An additional problem is the possible endogeneity of the unemployment rate since poor health may be the cause rather than the consequence of unemployment (Janlert et al., 1991). Some authors (Hammarström et al., 1988, for instance), have tried to test health status of employed and unemployed workers but only have managed to capture part of the impact of changes in economic conditions, since recessions do not affect only the unemployed workers.

Another alternative is to use fixed effects panel data models for states or countries:

$$Y_{smt} = X_{smt}\beta + UR_{smt}\gamma + \alpha_s + \delta_m + \lambda_t + \varepsilon_{smt} \quad (3)$$

where Y_{smt} is the dependent variable for state (country or region) s, month m and year t, UR_{smt} refers to the unemployment rate, X_{smt} is a vector of other explanatory variables and ε_{smt} is an error term. The terms δ_m and λ_t reflect monthly and annual shocks common to all states and α_s controls those factors that are constant across time, but different among states. In this setting, DuMouchel et al. (1987) evaluated the relationship between the age at the onset of alcohol consumption and mortal accidents, and Saffer and Chaloupka (1989) studied the impact of breath alcohol detection tests with respect to mortal traffic accidentes. On the other hand, Ruhm (1995, 2000) studied the relationship between consumption of alcoholic drinks and the main death causes. It is true that a specification like (3) allows to mitigate some of the previous problems, but some authors (Freedom, 1999, for instance) have pointed out econometric problems such as unit roots or omission of relevant variables (i.e., personal attitudes towards alcohol, legislation, advertising or dynamics in consumption).

3 Data

The main dataset is the BRFSS for the 1987-2003 period in which each wave constitutes an independent cross-section. This survey is a joint project of the Center for Disease and Control Prevention (CDC) and the US states and territories. The survey is a program designed by the CDC's Behavioral Surveillance Branch (BSB) to measure the behavioral risks of the population 18+ living in family households.

The BRFSS is a phone survey designed to give state uniform and specific information of the prevalence of health habits, including alcohol consumption[2]. Uniform data collection procedures ensures the comparability of the data from one point in time to another, as well as over a given period of time, across selected populations and geographic areas. The results are used by public head officials to determine the problematic areas in their states, to develop prevention policies and intervention strategies, and to evaluate success in reducing the prevalence of behaviors that affect public health[3].

In the first survey (1984) information for only 15 states is available. However, since 1995 all the states and Columbia district have been participating continuously. The questions referring to alcohol consumption are located in the main module and are made to all individuals in the sample, except for the 1994, 1996, 1998 and 2000 that they were located in the optional module. The sample size for the period 1987-2003 is 1730792 observations[4].

3.1 Description of the variables

The survey reports several questions on alcohol consumption. First, respondents are asked whether they consumed at least one drink of any alcohol beverage (a can/bottle of beer, a glass of wine, one cocktail, a shot of liquor) in the last month[5]. Those answering affirmatively are questioned

[2] Researchers who have approached the issue about the validity of self-reports of alcohol consumption, have concentrated their efforts in the direction of under-reporting, and have tended to discount the possibility of over-reporting behaviors by attributing false positives to measurement errors (Midanik, 1989)

[3] More information about the survey can be found at http://www.cdc.gov/nccdphp/brfss.

[4] For period 1987-1999, we have 1032985 observations. We have excluded observations for Guam, Puerto Rico and Virgin Islands.

[5] The survey does not distinguish among types of drinks (except for 1987, 1988 and 2003), so it is not possible to introduce any weighting that refers to their different ethylic content.

about the number of drinks, the number of days of the week with positive consumption, the number of times they have consumed more than five drinks and whether they drove under the effects of alcohol.

We use in this study five different proxies of alcohol consumption, in addition to the indicator:

- Drinker: binary variable which takes the value one for respondents with some consumption during the last 30 days.
- Conditional consumption: number of drinks for drinkers in 30 days (in logs).
- Conditional mean consumption: number of drinks to drinkers ratio (in logs). We calculate the drinkers ratio as the proportion of drinkers in each state in each time period.
- Chronic consumption: binary indicator which takes one for male (female) having more than 60 (30) drinks during the last month[6].
- Binge drinking: binary indicator that takes one if the respondent has imbibed five or more beverages on a single occasion.
- Drive drinking: binary indicator that takes one if respondent has driven under the effects of alcohol[7].

All these measures have been frequently used in the literature. For example, Manning et al. (1995) used the first two; Dee (1999) tried to capture the implications of alcohol abuse and used two measures very similar to the fourth and fifth. Finally, Ruhm and Black (2002) and Dee (2001) used all indicators but the third. In our opinion, the third measure (conditional mean consumption) could have a lot of potential as an indicator as long as the probability of being a drinker and the consumption of drinks were affected by different determinants (or the same determinants with different effects).

We also use control of the socioeconomic characteristics of the respondent: race (white, black, hispanic), marital status (married, divorced, separated, widowed, single) and level of schooling (high school dropouts, some college, college). In addition to these variables we use the unemployment rate (*Bureau of Labor Statistics*), real per capita income (*Bureau of Economic Analysis*) and alcohol state taxes[8].

Some individuals do not provide information about age, race, level of studies or marital status. We define *missing-value* dummies in order to keep the observations. This concerns 0.75% of the sample[9]. To avoid the influence of outliers we have established a maximum of 450 drinks consumed in the last month (an average of 15 per day). This upper limit affects 0.018% of the sample and information about drinking participation is unavailable for 0.21% of the sample.

[6] The literature suggests that a moderate consumption of alcohol may have beneficial effects on health. Nevertheless, differences exist in the consumption depending on the sex (Baum-Baker, 1995). Women have lower probability of being alcoholic, it is more probable that they are abstemious and, on average, they consume less alcoholic drinks than men (Mullahy and Sindelar, 1991; Wilsnack and Wilsnack, 1992; Caetano, 1994; Wilsnack et al., 1994). There is also evidence that women answer in a different way to alcohol consumption. With the same consumption, women experience more serious hepatic damage than men. Federal recommendations advise women not to consume more than one alcoholic drink a day, and for men not to consume more than two (US Department of Health and Human Services, 2000).

[7] There is only information about this indicator until 2000. So we will include it in estimations for period 1987-1999, but not for period 1987-2003.

[8] There are three types of taxes: beer, wine and spirits. Provided that Ruhm and Black (2002) use the state taxes on the beer we have done the same. http://www.taxfoundation.org

[9] We do not present both sets of results, though they do not substantially differ.

Table B.1 contains descriptive statistics. For the period 1987–2003, 49% of the sample has consumed at least one alcoholic drink in the last month. The average number of drinks consumed by the drinkers is 34.12. Nevertheless, 51.3 % has consumed less than 10 drinks, 76.5% less than 25 and 4.9% more than 80. Besides that, 16% declares at least 5 drinks in the same occasion and 5% has consumed more than 60 (30) drinks if he is a man (woman) in the last month. Finally, weights indicate that men, hispanics or other ethnic minorities and young people are underrepresented in the survey.

3.2 Alcoholic drinks and unemployment: a first look

In Table B.2 we compare our descriptive statistics with those of Dee (2001) and Ruhm and Black (2002). We can observe that unemployment, age, sex, composition of the population by race, percentage of drinkers and consumption are very alike for the three samples. The main differences appear in high school and divorced, which are higher for Dee (2001) and us than for Ruhm and Black (2002). We also present in Figure 1 of Appendix A, the standard deviation with respect to the mean for the unemployment rate and all alcohol consumption indicators. The pattern of the relationship between unemployment and alcohol consumption indicators follow a procyclical pattern for most of the figures.

Although when considering that the only source of heterogeneity in the decisions of becoming drinker and the number of drinks consumed is sex we get a clear procyclical profile, the situation completely changes when there are another sources of heterogeneity. We have done figures for men and women grouped by age cohorts in ten year intervals from 21 to 50 years, and a last one for those aged 50 to 65. The relationship between mean consumption and the rate of unemployment is not as clear as before[10]. According to Figures 2 and 3, it seems that average consumption is procyclical only for men and women from 21 to 30. Although we cannot establish any causal relationship based on these correlations, economic conditions could have some effect on consumption at the intensive margin for some group of the population.

4 Empirical results

4.1 Estimates using individual data

As a first step to cover one of the objectives of this research, we present in Table B.3 the same set of regressions than those provided by Dee (2001) and Ruhm and Black (2002). For each of the six alcohol consumption indicators we have estimated equation (1) by weighted LS, using BRFSS final weights. We have done two kind of regressions with and without state effects and including in both controls for month, year, age and its square, gender, race/ethnicity, level of schooling, marital status and real per capita income. When state effects are not included, the unemployment rate is significant in all equations except in the binge drinking one. In fact, all alcohol consumption indicators are procyclical. Alternatively, when state fixed effects are introduced unemployment rate is non-significant for two cases: the percentage of drinkers and the percentage of binge drinkers. Real per capita income is positive and significant except for the participation decision.

Table B.4 presents a comparison of our estimates with those obtained by Dee (2001) and Ruhm and Black (2002). For the period 1987-1999 we have replicated the same results than Ruhm and Black (2002), and those obtained for period 1987-2003 are very similar. However, Dee (2001) finds

[10] It also happens for the rest of alcohol consumption indicators. We omit these graphs for reason of space, but they, as well as additional graphs for men and women at different age brackets, are available upon request.

that real per capita income is non-significant for consumption, binge drinking and chronic drinking and the unemployment rate is positive and significant for binge drinking. On the other hand, our R^2 is greater than the one reported in Dee (2001). The reasons for this disparity among results may be that Dee (2001) neither introduces final weights in his estimations nor includes any measure for alcohol prices and considers first waves of the survey, which are less reliable due to the small number of states interviewed.

Summing up the results on pooled cross-section data, all exercises find procyclical effects of unemployment at least on consumption and binge drinking. This result as well as the income coefficient and a number of coefficients corresponding to sociodemographic variables imply different determinants (or effects) on the probability of drinking and on the consumption equations. As a consequence, a problem of endogenous sample selection could arise when modelling separately both decisions. Moreover, we show that the effects on the estimates of using different sample periods are very small, at least during the time spans 1987-1999 and 1987-2003.

4.2 Results using cohort data

4.2.1 Definition of cohorts

Once we have covered our first aim of comparing the results with previous ones in the literature, we move on to estimates using cohort data. We define three types of cohorts: by date of birth, by date of birth and gender, and by date of birth, gender and educational level (some studies using these methodology are among others Attanasio and Weber, 1993 or Blundell et al., 1994). In the first case, we define 10 groups. From age 21, we take five years brackets to define a group, until age 64. The last group includes those aged 65 and more. This procedure generates a sample with 2040 observations. In the second case, we group ten year age brackets and sex. The resulting sample is formed by 4080 observations. In the case of age-gender-education cohorts, we employ ten years age brackets (23-30, 31-40, 41-50, 51-60, 61+) and two education groups (some college+ and the rest). As a result we also dispose of 4080 observations. Since the sample size in the 1987-2003 period is 1730792, we have, in the case of age cohorts, an average of 848 observations per cell, while in the two other cases, we have on average 424 observations. Given this sample size, we can neglect the errors in variables problem.

4.2.2 Homogeneous results

Before estimating the model, we test for the exogeneity of the unemployment rate and real per capita income. The unemployment rate could be endogenous because although we observe that unemployed individuals consume more alcoholic beverages, we do not know a priori the direction of the causality (Ettner, 1997). Income is potentially endogenous first because alcohol consumption is a component of total income, and second due to the good influence over efficiency at work that moderate consumption of alcohol may produce. It c

onsequently could affect earnings (Hamilton and Hamilton, 1997; French and Zarkin, 1995). As instruments for the unemployment rate and real per capita income we propose the corresponding to the same month of the previous year. Since consumption exhibits seasonality the correlation between the regressor and the instrument is high, while we do not think it exhibits correlation with the error term. We use Hausman tests for comparing LS and IV estimates. For all the cohorts and the six indicators it is not possible to reject the null of absence of systematic differences in the coefficients. Then, it seems both variables are exogenous under the identifying assumption of exogeneity of the other variables in the regression.

In Tables B.5 and B.6 we present LS estimates for age and age-sex cohorts. All regressions include month, year and state fixed effects, age and its square, gender, race/ethnicity, the level of schooling, marital status and real per capita income. We present two different sets of results with and without cohort effects. The results show some common traits for all beverage consumption indicators. When cohort effects are omitted the unemployment rate appears to be significantly negative, except in the binge drinking equation. The magnitude of the coefficient is very similar to that find in the pooled cross-section sample as it is the magnitude of the coefficient of income. When cohort effects are introduced the unemployment rate becomes non-significant. Real per capita income is always significant (even for the participation decision), regardless the inclusion of cohort effects. Cohort dummies are highly significant in all regressions. The magnitude of the coefficient of income changes significantly in models with fixed effects. Income seems to be negatively correlated with the preference for drinking, except for chronic drinkers, as expected. A seemingly unexpected result is that income is positively correlated with unobserved heterogeneity in the consumption equation. However, notice that income is a significant determinant of participation and the unobserved effects are capturing participation in this equation. Since income positively influences participation, it should not constitute a surprise that positive correlation arises.

It would be possible to argue that cohort dummies and the rate of unemployment show a high level of collinearity, but we test this is not the reason for loosing significance. We just run a regression of the unemployment rate on cohort effects in the sample of cohorts by age and we obtain an R^2 of 0.33. On the other hand, we might also think that when including month, year, state and cohort fixed effects the variation of the unemployment rate is not sufficient to properly identify its effects separately from other micro and macroeconomic determinants. In order to check it we have re-estimated all the models excluding individually each of the subsets of monthly, annual and geographical dummy variables. The result are conclusive: we get negative and significant effects of unemployment on the demand for alcoholic drinks only when cohort effects are excluded from the specifications, independently of other set of dummies being excluded or not. These results confirm our hypothesis that unobserved effects seem to be important determinants of alcohol consumption. We have re-estimated the models based on cohort data excluding income. We observe that unemployment rate is significant without cohort fixed effects, but is not when we include them[11]. Although the magnitude of the coefficient experiments small variations (ranging from 1 to 10 per cent), it seems to be sufficient to loose its significance. These changes could be related to negative correlation among unobserved effects capturing preference for working, for instance, and the unemployment rate.

Finally, Table B.7 presents estimates for the sample of cohorts formed using age, sex and education. Since we doubt about the exogeneity of education for building cohorts, we have checked that its distribution remains almost unchanged during the sample period. Thus, we rule out the possibility of taking simultaneous decisions. The results for the unemployment rate and real per capita income remain unchanged. All this evidence implies that unemployment could gather factors different from the relation with the economic activity in models estimated from individual data without controlling for unobserved heterogeneity among individuals. An example could be preferences for working which change with age or tastes for alcohol of different quality potentially correlated with income and education.

4.2.3 Heterogeneous results

In the previous section we have assumed that $\beta = \beta_c$ and $\eta = \eta_c \ \forall c$, where β is the unemployment rate coefficient, η is unobserved heterogeneity and c is and index referred to each group. Next, we

[11] All these results are available upon request.

have relaxed the equality of average consumption levels (specific constants), that is, we have estimated the model imposing $\beta_s = \beta_c \ \forall c, s$ but we have allowed $\eta_s \neq \eta_c$ and have defined cohorts by age ($c, s = 1, ..., 10$), age and sex ($c, s = 1, ..., 20$) and age, sex and education level ($c, s = 1, ..., 20$). Nevertheless, alcohol consumption may be affected on a different way by the unemployment rate for different individuals (see Figures 2 and 3). Young people in an extended family going outside may decide to drink independently of their labor status. Individuals at older ages suffering an unemployment spell could face less uncertainty concerning their expected future income flows because this spell could be used as a path to retirement. Thus, the next step consists in analyzing the impact of relaxing the assumption that the effect of the unemployment rate on alcohol consumption is equal across cohorts. So, we will assume $\beta_s \neq \beta_c$ and $\eta_s \neq \eta_c$ and analyze whether the relationship is cyclical, procyclical or inexistent at different ages.

In Table B.8 we show results using cohorts by age[12]. We observe that men have a higher probability of being drinkers and having chronic consumption for every age group. Men also present higher consumption and average consumption until they are 60 years old. This may be explained because there is a high correlation between alcohol consumption and activity. Finally, men from 21 to 45 years old are more prone to declare binge drinking than the rest. It is probably related to better health status.

Unemployment is neither significant for the participation decision nor for chronic consumption. On the other hand, for the indicators of consumption, mean consumption and binge drinking, it is significant with negative sign for men being 21 to 35 years old. When looking at cohorts based on age and sex, average consumption has a procyclical shape for young people. A plausible explanation is that in periods of economic expansion, when unemployment decreases, young men have higher probability of finding new jobs. Then, the income effects prevails. This result must not be interpreted as contradiction but as confirmation of previous evidence. When we take into account unobserved heterogeneity among consumers, we observe that although the relationship between consumption of alcoholic drinks and unemployment is not procyclical for the whole population, there are reasons for both cyclical and procyclical shapes at different ages. However, we must be aware that these reasons mainly arise from unobservables such as preferences for working or different consumption tastes.

4.2.4 Impact of other variables

In the Table B.9 we show the impact of other socioeconomic variables on the probability of being drinker and the consumption of alcoholic drinks. We have estimated a model on cohorts formed by age and sex, including as explanatory variables month, year, state and cohort fixed effects, unemployment rate, real per capita income, age and its square, race/ethnicity, marital status (married/cohabiting, divorced/separated, single), level of schooling (high school, some college, college) and beer state tax rate.

Unemployment has no effect on consumption in any of the regressions whereas income is always significant. A 5 % increase in real per capita income increases 8.92% the number of drinks consumed, 8.77% mean consumption, 4.14% binge drinking and 0.54% chronic drinking, with respect to its mean value. This implies that very few individuals start drinking as a result of an increase in their income levels, and on the other hand, that for the case of chronic consumption the addictive component exerts an important influence.

An increase in beer state tax rate has a negative and significant impact on consumption and

[12] We have 2040 observations, that is 204 observations for each cohort. We keep enough degrees of freedom even including several sets of dummy variables (16 for year, 11 for month and 50 for state) as well as other explanatory variables.

average consumption. In particular, a 5% increase in the beer state tax rate reduces 2.75% consumption and 3.50% average consumption, with respect to their mean values. The price elasticity is thus very small and it points towards habits as one of the determinants of alcohol consumption. Since we are not able to distinguish between consumption dynamics or unobserved heterogeneity, we are attributing to the later all the effects.

White men have a higher probability of being drinkers and consuming more. However, estimated coefficients for black or hispanic individuals are negative and significant. In fact, race is one of the few significant variables when explaining chronic drinking. This can be linked to certain religious beliefs or cultural behaviors. Race is also a good proxy for the level of household income, since the difference on average income between white people and people belonging to other races is more than 4000 dollars.

Education may exhibit a double influence on consumption of alcoholic drinks. On one hand, it acts as a proxy of income. On the other hand, it may reflect a higher degree of awareness of the harmful effects of alcohol consumption on health. We observe that individuals with university degree (some college, college) have a higher probability of becoming drinkers and in case they are, their consumption is higher. So it seems that the income effect dominates the substitution one due to health reasons.

Concerning marital status, being separated/divorced or single has a positive significant influence on all indicators including binge drinking and chronic consumption. On the other hand, married/cohabiting couples do not show significant differences neither in the participation nor in the consumption decision. It may be explained because having familiar responsibilities limits the possibilities of going out freely and stimulates the educating behavior (57.89% of the households have children living at home with their parents).

Finally, we can compare the coefficients of demographic variables corresponding to individual and cohort data. We do not observe great differences neither in their magnitude nor in their significance. In our opinion, these results confirm that as soon as unobservable heterogeneity is controlled for, unemployment becomes non-significant in explaining alcohol consumption while the rest of determinants maintain both their impact and significance.

5 Interpretation of the results

Our hypotheses about the relationship among alcohol consumption and the business cycle are: i) unobserved factors drive decisions about both being drinker or consuming more than the cycle do; ii) the presence of habits in the consumption of alcoholic drinks could generate spurious correlations which are not properly detected in cross-sectional studies. We are also aware that only the availability of panel or pseudo-panel data can help in distinguishing among true and spurious state dependence and also among true state dependence and unobserved heterogeneity. In this section we want to offer econometric and economic interpretations of the results obtained.

In estimations with independent cross-sections we face a problem of omission of relevant variables. The least squares estimate of β in (1) is biased and the magnitude of the bias depends on the covariance between UR and η_i and on the variance of UR. As an intuitive more than a formal check we can calculate the covariance between unemployment rate and each of the cohort fixed effects, or obtain the percentage of the difference between unemployment rate coefficients with and without cohort fixed effects. The percentages of the differences explained by each cohort, from the youngest (21-25 years) to the oldest (61-65 years) are, 13.16, 13.89, 11.90, 11.87, 11.54, 10.89, 9.56, 8.75, 8.44, respectively. We observe that all covariances are negative and cohorts corresponding to age intervals 21-25, 26-30 and 31-35 explain a higher proportion of the discrepancy in the unemployment coefficient.

If the covariance is zero, $\hat{\beta}^*$ is an unbiased estimator of β independently of considering the presence of η_i. However, even when UR and η_i are orthogonal, the omission of η_i causes biased estimates of the standard errors of $\hat{\beta}^*$. One possible explanation for some results obtaining significant correlations between the unemployment rate and the consumption of alcohol is that the results are based upon biased coefficients (if unobserved heterogeneity is correlated with unemployment rate) and/or biased standard errors.

A second problem is that, under certain circumstances, it is necessary to consider the decisions of participation and consumption together. If zero demands were due to abstention and if participation and consumption decisions were affected equally by the same determinants, the problem would not be so serious. Moreover, if we tried to perform valid inferences at population level (i.e., aggregate demand, evaluation of costs derived from the consumption of alcohol), the fact of having positive and zero observations raises a problem since both groups of consumers belong to different demand regimes and have heterogeneous preferences (Fry and Pashardes, 1994). In fact, preference heterogeneity among those with positive and zero consumption may be problematic due to changes in the income profile of drinkers. Changes in the percentage of drinkers for period 1987-2003 can introduce important estimation problems, in terms of instability of parameters (see graphs in Appendix A).

Zero consumption may be due to a problem of abstention, infrequency of purchase or corner solutions. Interview respondents are asked about alcohol consumption in the last month. Given that the observation period is wide enough, and given that individuals may choose whatever alcoholic beverage is attainable to his budget, we can ignore zeros arising from infrequency and corner solutions, possibly with the caution that corner solutions may affect individuals in the lowest centiles of the income distribution.

We are going to rewrite the equations for participation (P), per capita consumption of alcoholic drinks (C_c) and mean consumption (C_M) including as explanatory variables the unemployment rate (UR), other socioeconomic or demographic determinants including income and taxes (X) and an error term for each equation, respectively (u, v, w). We also compute elasticities with respect to the unemployment rate (ε_{UR}).

$$\begin{aligned} P &= \alpha_0 + \alpha_1 UR + \alpha_2 X + u \Rightarrow \quad \varepsilon_{UR}(P) = \alpha_1 \frac{UR}{P} \\ \log(C_c) &= \beta_0 + \beta_1 UR + \beta_2 X + v \Rightarrow \ \varepsilon_{UR}(C_C) = \beta_1 UR \\ \log(C_M) &= \gamma_0 + \gamma_1 UR + \gamma_2 X + w \Rightarrow \ \varepsilon_{UR}(C_M) = \gamma_1 UR \end{aligned}$$

Per capita consumption can be expressed as the product of participation rate and average consumption, where D is the number of drinks consumed, N is the population size and N_D is the number of drinkers (Jones, 1989).

$$C_c = \frac{D}{N} = \frac{N_D}{N} * \frac{D}{N_D} = P * C_M \tag{4}$$

Equation (4) implies a relationship among elasticities:

$$\varepsilon_{UR}(C_C) = \varepsilon_{UR}(P) + \varepsilon_{UR}(C_M) \tag{5}$$

If we measure alcohol consumption using per capita consumption we will be underestimating the real value of the consumption of drinkers. Thus pooling positive and zero observations is going to affect parameter estimates and elasticities. The estimates of the per capita consumption equation are going to be larger (in absolute value) than those of the mean consumption equation,

whenever the variables affect both decisions. This is true except in the case of changes of regime, when participation and consumption are affected by different variables, or even if they are the same ones but their influence over both decisions is different. In these three cases, we will have to consider separately $P(t)$ and $C_M(t)$.We can compare these results using the coefficients of equations previously estimated as shown in Table 1. We provide participation and consumption elasticities with respect to unemployment (standard deviations between brackets) computed for the three types of cohorts. We have used estimates from Tables B.6 to B.8 including cohort fixed effects and per capita real income[13].

Table 1. Participation and consumption elasticity with respect to unemployment rate

	$\varepsilon_{UR}(P)$	$\varepsilon_{UR}(C_M)$	$\varepsilon_{UR}(C_C)$
C. by age	-0.00020	-0.00187	-0.00216
	(0.0005)	(0.0053)	(0.0018)
C. by age and sex	-0.00022	-0.00246	-0.00275
	(0.0004)	(0.0035)	(0.0024)
C. by age, sex and education	-0.00022	-0.00267	-0.00295
	(0.0005)	(0.0031)	(0.0020)

For period 1987-2003, the three elasticities are negative but non-significant, although that corresponding to per capita consumption is in the border of significance for the three types of cohorts[14]. An important implication from these results is that we can find significant effects of the unemployment rate on alcohol consumption when pooling positive and zero observations due to, for instance, changes of regime which exaggerates the estimates.

In Table 2 we show participation and consumption elasticities with respect to real per capita income. The coefficient and t-Student of the income variable in the per capita consumption regressions are 0.05460 (2.83) for age cohorts, 0.04987 (3.27) for cohorts by age and sex, and 0.05056 (3.10) for cohorts by age, sex and education.

Table 2. Participation and consumption elasticity with respect real per capita income (thousands $)

	$\varepsilon_I(P)$	$\varepsilon_I(C_C)$	$\varepsilon_I(C_M)$
C. by age	0.1225	1.1068	1.4354
	(0.0257)	(0.2719)	(0.5072)
C. by age and sex	0.1950	1.1041	1.3110
	(0.0348)	(0.2693)	(0.4009)
C. by age, sex and education	0.1958	1.1015	1.3292
	(0.0360)	(0.2629)	(0.4288)

If income increases 1%, the percentage of drinkers increases 0.12% and mean consumption 1.4%. If we look at per capita consumption instead of mean consumption, we would say that consumption increases 1.1%. Ruhm and Black (2002) conclude that almost all procyclical variation is due to consumption of existing drinkers with very little variations in the participation rate. But in absence of changes of regime, the indicator that condenses all information about participation and consumption is mean consumption, which only requires as hypothesis that the determinants of consumption corresponding to both equations are the same. We can provide evidence about this kind of results with an example. Let us assume a situation without starters and quitters. In

[13] We have performed an OLS regression for per capita consumption. The coefficient and t-Student for the unemployment rate is -0.0433 (-1.20) for cohorts by age,-0.0455 (-0.92) for cohorts by age and sex, and -0.0459 (-1.14) for cohorts by age, sex and education.

[14] We have performed a test with the following null hypothesis: $\varepsilon_{TP}(C_C) = \varepsilon_{TP}(P) + \varepsilon_{TP}(C_M)$. The chi-squared statistic is $\chi^2_1 = 1.29$ ($p - value = 0.2561$) for age cohorts, 1.09 ($p - value = 0.2965$) for age and sex cohorts and 0.93 ($p - value = 0.3349$) for age, sex and education cohorts.

a per capita consumption equation we are attributing to the unemployment rate the same effect for drinkers and non-drinkers. A change in the unemployment rate implies some effects on the quantity consumed but even if this is true, it only affects actually drinkers but it does not affect non-participants. So, results obtained pooling observations from the two regimes are capturing inadequately the whole effect. Moreover, if we assume that a variable has only effects at the intensive margin (or that the effects at both the intensive and extensive margins are the same), and this assumption is not true, we get inadequate results in an equation like per capita consumption combining participatans and non-participants. This is the case for the income effects for two reasons: i) income is important for the decision to start or quit drinking; ii) the magnitude of the effects at both decisions is not the same.

Another source of omitted variable bias comes from the exclusion of dynamics in consumption. There are nowadays a lot of papers analysing the existence of habits (myopic or rational) in consumption of several goods as tobacco and alcohol (see Moore and Cook, 1995, Grossman, Chaloupka and Sirtalan, 1998, Bentzen, Ericksson and Smith, 1999 or Baltagi and Griffin, 2002). Even in those models which control unobserved heterogeneity, the omission of dynamics will produce biased estimates. We just conduct a simple exercise of estimating the model in a rational addiction framework, whose results are reported in Table B.10. This can only be done when repeated observations for the same individuals are available. We estimate again equations using cohort data for consumption, mean consumption, binge drinking and chronic drinking where we add the lag and lead of the respective measure of consumption. We report results for equations with cohort, month, year and state fixed effects and we also present results without cohort effects in order to avoid potential problems of multicollinearity between the effects and the unemployment rate. Although we only present results using as instruments for the lag and lead of the dependent variable some previous lags, we have done both OLS and IV regressions with alternative sets of instruments. Our results are robust to different instrument sets once we avoid potential correlation among the lag and lead of the dependent variable and the error term. The evidence reported seems to suggest both that individual heterogeneity and dynamics are important determinants of alcohol consumption. We do not find evidence about any effects of the cycle on alcohol consumption. This result is robust to any specification estimated either including or not cohort effects, using OLS or IV or using different instruments. We should also emphasize that the effects of the rest of determinants of consumption remain unaffected.

6 Conclusions

In this paper we have analyzed the influence of macroeconomic conditions captured by unemployment on the decisions of participation and consumption of alcoholic drinks. We have used cross-section data for the period 1987-2003 from the BRFSS. Opposite to previous studies (Dee, 2001; Ruhm and Black, 2002) that did not controlled for unobservable heterogeneity, we have considered it explicitly. Since genuine panel data is not available to us, we have constructed cohorts combining the cross-sections through time. We have estimated cohort models with fixed effects by LS and IV and the results confirm that unemployment is not a significant determinant of the decisions of becoming drinker and consuming alcohol. It is particularly important to confirm the robustness of most of the results to alternative specifications of cross-section, homogeneous and heterogeneous, static and dynamic cohort models.

We have also tried to offer explanations for the different results obtained with respect to previous studies. Our opinion is that there is some scope for the unemployment to affect decisions of becoming drinker and the amount of alcoholic drinks consumed. However, there is also the possibility for different effects, a positive one (income effect) and a negative one (stress or health issues)

may be compensated. In addition, we believe that unobservables such as preferences for working or drinking, environmental variables or genetic characteristics of the individuals may explain decisions about participating and consuming alcoholic drinks more than the cycle do.

There are some important for health policies from these results. If alcohol consumption is independent from the business cycle as estimated in this paper, the health expenditure associated to alcohol abuse is not going to be affected by the phase of the cycle. Whether the authorities are interested on preserving the efficiency of public expenditure, it is necessary to identify different groups of individuals to carry out specific policies, since any attempt to perform universal and homogeneous actions is going to be fruitless.

7 References

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A Figures

Figure 1. Population over 21 years

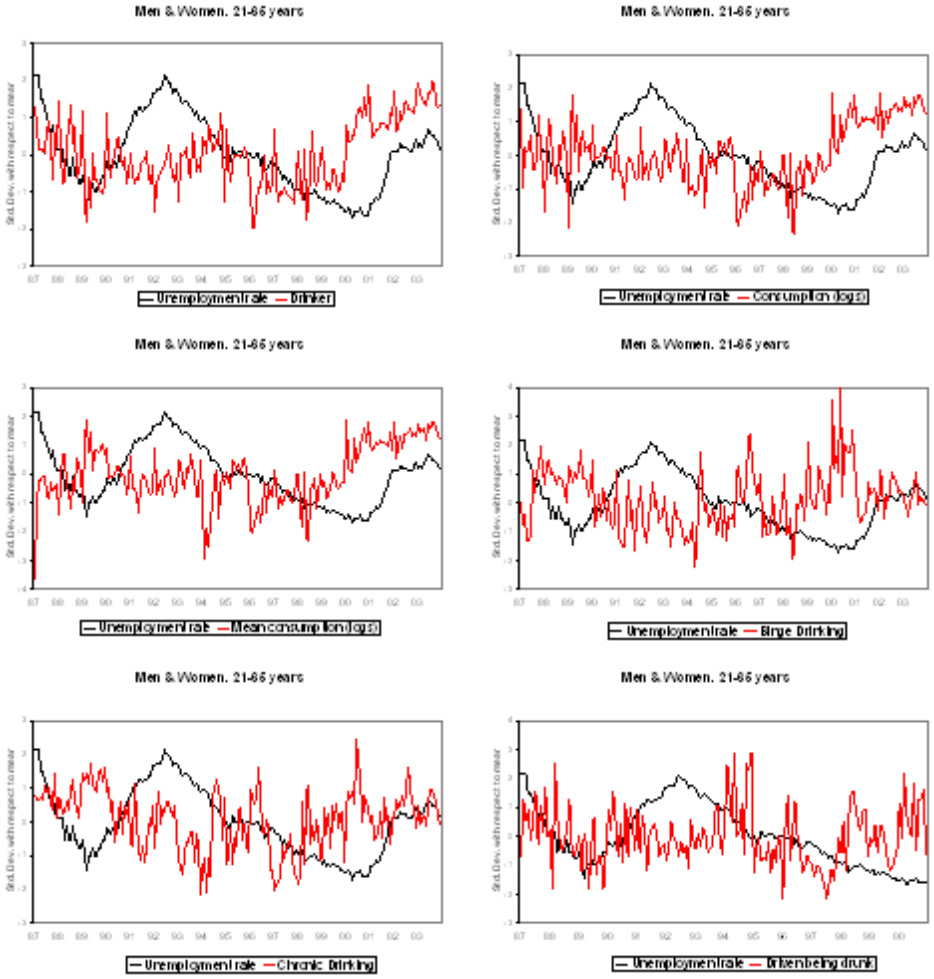


Figure 2. Age cohorts for men (mean consumption)

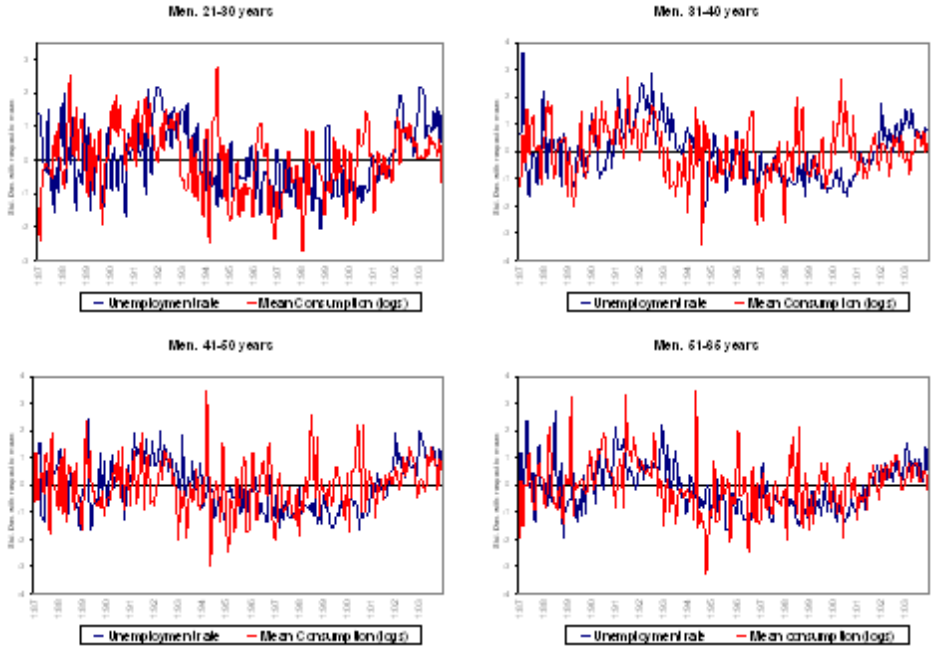
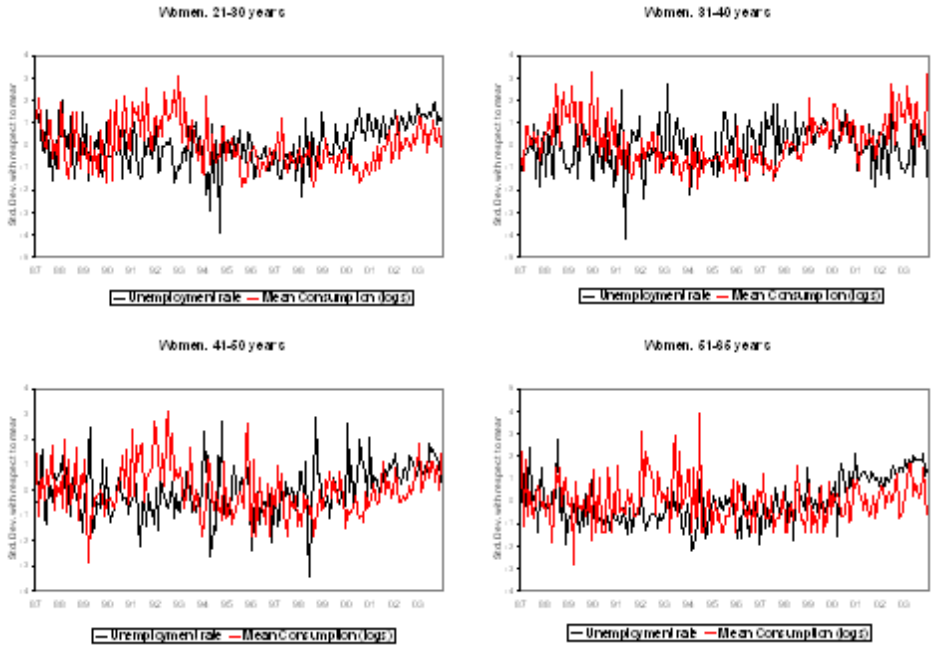


Figure 3. Age cohorts for women (mean consumption)



B Tables

Table B.1. Descriptive statistics. 1987-2003[a]

	Definition	Without weights		With weights	
		Mean	S.D.	Mean	S.D.
Drinker	1 if he/she has consumed one alcoholic beverage in the last month	0.49		0.51	
Consumption	N^o of drinks consumed by drinkers in the last month (top-coded 450)	20.3	2.87	22.5	2.46
Mean consumption	N^o of drinks/N^o of drinkers by month and state	34.12	2.91	37.43	2.63
Binge drinking	1 if he/she has consumed 5 or more drinks in the same occasion	0.16		0.17	
Chronic drinking	1 if he/she has consumed more than 60 for men (30 for women) in the last month	0.05		0.05	
Unemployment rate	Monthly state unemployment rate	0.054	0.004	0.059	0.004
Per capita real income	Per capita real income in 1999$	26.8	15.37		
Beer tax rate	State tax rate per gallon of beer ($)	0.20	0.18		
Men	1 he is a man	0.43		0.45	
White	1 he/she is white	0.78		0.76	
Black	1 if he/she is black	0.09		0.10	
Hispanic origin	1 if he/she is Hispanic	0.07		0.08	
Other race/ethnicity	1 if he/she belongs to other race/ethnicity	0.05		0.06	
Race not reported	1 if he/she doesn't report race/ethnicity	0.002		0.003	
Age	Age in years	46.5	16.25	44.8	16.44
Age not reported	1 if he/she doesn't report his/her age	0.0001		0.0001	
High School	1 he/she has High School Graduation	0.32		0.30	
Some College	1 if he/she has some college (1-3 years)	0.27		0.28	
College	1 if he/she has finished College (4 or +years)	0.29		0.31	
Education not reported	1 if he/she has not reported educational level	0.007		0.008	
Married	1 if he/she is married/cohabiting	0.58		0.59	
Separated	1 if he/she is separated/divorced	0.28		0.27	
Single	1 if he/she is single	0.06		0.05	
Widowed	1 if he/she is widowed	0.08		0.09	
Marital status not reported	1 if he/she doesn't report marital status	0.001		0.001	
N^o of observations			1730792		1730792

[a] Data are from 1987 to 2003 period of BRFSS. Information of all-items Consumer Price Index used to deflate income comes from Bureau of Economic Analysis. The first column of the table shows unweighted means; the second weights the observations using BRFSS final sampling weights.

Table B.2. Comparison of descriptive statistics[a]

	1987-2003	Ruhm & Black 1987-1999	Dee 1984-1995
Drinker	0.49	0.50	0.50
N^o of drinks	20.3	19.7	20.9
Binge drinking	0.16	-	0.19
Chronic Drinking	0.05	0.04	0.04
Unemployment rate (%)	5.4	5.4	6
Per capita real income[b]	26.8	24.9	140
Beer tax rate ($)[c]	0.20	1.92	-
Women	0.57	0.59	0.58
Age	46.5	46.1	45.5
Race/ethnicity			
Black	0.07	0.09	0.09
Hispanic origin	0.07	0.05	0.03
Other non-white	0.04	0.05	0.05
Not reported	0.002	0.003	0.001
Education			
High School	0.32	0.15	0.34
Some college	0.27	0.26	0.24
College graduate	0.29	0.26	0.26
Not reported	0.007	0.002	0.002
Marital status			
Married/cohabiting	0.58	0.57	0.56
Divorced/separated	0.28	0.15	0.14
Widowed	0.08	0.11	0.11
Not reported	0.001	0.002	0.002

[a]Dee (2001) doesn't indicate if descriptive statistics are weighted or not. To build this table we have used Ruhm and Black (2002) descriptive statistics and ours without using final weights.

[b]For Ruhm and Black and us (2002) per capita real income is measured in 1999$. Dee (2001) doesn't indicate which is the base year, but there is a great disparity among his figures, ours and Ruhm and Black (2002). El crecimiento de la renta pc (24.9 para Ruhm y Black y 26.8 para nosotros) se corresponde aproximadamente con la tasa de variación del Consumer Price Index para el periodo 99-03.

[c]Ruhm and Black (2002) use beer tax per case ($ de 1999) from Federation of Tax Administrators (www.taxadmin.org). Dee (2001) doesn't introduce any price of alcoholic drinks. We have used information from Tax Foundation web page (www.taxfoundation.org) referred to state tax rate per gallon of beer.

Table B.3. Alcohol and economic conditions.1987-1999. Individual data[a]

	WITHOUT STATE FIXED EFFECTS					
	Drinker			Consumption		
Unempl. rate	-0.0036 (-2.71)	-0.0034 (-2.34)	-0.0036 (-2.10)	-0.0250 (-5.46)	-0.0245 (-5.12)	-0.0244 (-4.28)
Real income	-	-	0.0017 (0.85)	-	-	0.0550 (6.39)
R^2	0.14	0.14	0.15	0.21	0.21	0.22
Marital st. & educ.	No	Yes	Yes	No	Yes	Yes
	Mean Consumption			Binge Drinking		
Unempl. rate	-0.0711 (-4.78)	-0.0710 (-4.59)	-0.0709 (-4.48)	0.0009 (1.58)	0.0009 (1.36)	0.0010 (1.27)
Real income	-	-	0.0425 (5.21)	-	-	0.0130 (6.27)
R^2	0.16	0.1574	0.17	0.15	0.16	0.17
Marital st. & educ.	No	Yes	Yes	No	Yes	Yes
	Chronic Drinking			Driving drunk		
Unempl. rate	-0.0071 (-5.41)	-0.0069 (-5.40)	-0.0068 (-5.33)	-0.00071 (-2.20)	-0.00069 (-2.10)	-0.00068 (-2.07)
Real income	-	-	0.0035 (2.15)	-	-	0.00020 (2.25)
R^2	0.0047	0.0096	0.0103	0.0967	0.1012	0.1145
Marital st. & educ.	No	Yes	Yes	No	Yes	Yes
	WITH STATE FIXED EFFECTS					
	Drinker			Consumption		
Unempl. rate	-0.0028(-1.81)	-0.0026(-1.64)	-0.0021(-1.62)	-0.0235(-4.22)	-0.0234(-4.18)	-0.0231(-4.42)
Real income	-	-	-0.0012(-0.52)	-	-	0.0537(6.71)
R^2	0.2902	0.2996	0.3170	0.2785	0.2836	0.2855
Marital st. & educ.	No	Yes	Yes	No	Yes	Yes
	Mean Consumption			Binge Drinking		
Unempl. rate	-0.0695 (-3.73)	-0.0694 (3.51)	-0.0693 (-3.09)	0.0011 (1.16)	0.0011 (1.14)	0.0013 (0.93)
Real income	-	-	0.0421 (5.71)	-	-	0.0134 (5.83)
R^2	0.2785	0.2788	0.2858	0.2622	0.2630	0.2630
Marital st. & educ.	No	Yes	Yes	No	Yes	Yes
	Chronic Drinking			Driving drunk		
Unempl. rate	-0.0061 (-4.95)	-0.0060 (-4.71)	-0.0057 (-4.75)	-0.00053 (-1.65)	-0.00053 (-1.48)	-0.00052 (-1.41)
Real income	-	-	0.0038 (2.11)	-	-	0.0012 (2.07)
R^2	0.21	0.21	0.21	0.19	0.20	0.21
Marital st. & educ.	No	No	Yes	No	No	Yes

[a]Heteroscedastic-consistent standard errors. t-Student statistics reported in parenthesis. Adjusted R^2. All regressions include month and year fixed effects and the individual variables representing age, age squared, race/ethnicity, sex, marital status, educational level, beer tax rates and interactions between age, sex and race/ethnicity. Total number of observations is 1032695 and for the sample of drinkers 490653. We have estimated by weighted-OLS using BRFSS final weights.

Table B.4. Comparison of estimations with individual data[a]

		1987-2003	1987-1999	Ruhm and Black 1987-1999	Dee 1984-1995
Drinker	Unempl. rate	-0.0022 (-1.48)	-0.0021 (-1.62)	-0.0021 (-1.62)	0.06 (0.33)
	Real income	0.0014 (0.66)	-0.0012 (-0.52)	-0.0012 (-0.52)	-0.69 (-0.92)
	R^2	0.32	0.32	-	0.15
Consumption	Unempl. rate	-0.0233 (-4.06)	-0.0231 (-4.42)	-0.0231 (-4.42)	-0.67 (-1.86)
	Real income	0.0541 (6.51)	0.0537 (6.71)	0.0537 (6.71)	0.04 (0.04)
	R^2	0.29	0.29	-	0.13
Binge Drinking	Unempl. rate	0.0012 (0.81)	0.0013 (0.93)	0.0013 (0.93)	0.20 (2.00)
	Real income	0.0132 (6.04)	0.0134 (5.83)	0.0134 (5.83)	-0.33 (-1.26)
	R^2	0.26	0.26	-	0.12
Chronic Drinking	Unempl. rate	-0.0058 (-4.65)	-0.0057 (-4.75)	-0.0057 (-4.75)	-0.15 (-3.00)
	Real income	0.0037 (2.32)	0.0038 (2.11)	0.0038 (2.11)	0.01 (0.07)
	R^2	0.21	0.21	-	0.04
Driving drunk	Unempl. rate	-	-0.00052 (-1.41)	-0.00052 (-1.41)	-
	Real income	-	0.0012 (2.07)	0.0012 (2.07)	-
	R^2	-	0.21	-	-

[a]Heteroscedastic-consistent standard errors. t-Student statistics reported in parenthesis. Adjusted R^2.We have included state dummy variables and state specific linear time trends and explanatory variables representing age, age squared, race, sex, educational level, marital status, per capita real income and beer tax rate. Ruhm and Black (2002) include month, year and state fixed effects, individual characteristics and beer tax rate (R^2 is not reported). Dee (2001) include month, year and state fixed effects and the same explanatory variables. Total sample size is 1032965 for Ruhm and Black (2002), 742821 for Dee (2001) and 1730792 for 1987-2003. The size of the drinkers subsample is 490653 for Ruhm and Black (2002), 359069 for Dee (2001) and 837075 for 1987-2003. Our estimations and Ruhm and Black (2002) use BRFSS final weights, but Dee (2001) doesn't.

Table B.5. Cohorts by age. 1987-2003 (N=2040)[a]

	Without cohort fixed effects				
	Drinker	Consump.	Mean Cons.	Binge D.	Chronic D.
**Without income					
Unempl. rate	-0.0022	-0.0241	-0.0701	0.0017	-0.0059
	(-2.76)	(-2.68)	(-2.52)	(0.90)	(-3.50)
R^2	0.60	0.59	0.55	0.49	0.42
**With income					
Unempl. rate	-0.0022	-0.0241	-0.0701	0.0017	-0.0059
	(-2.60)	(-2.51)	(-2.46)	(0.75)	(-2.67)
Real income	0.0015	0.0560	0.0423	0.0139	0.0043
	(3.06)	(2.77)	(3.22)	(3.85)	(2.57)
R^2	0.60	0.59	0.55	0.50	0.42
	With cohort fixed effects				
	Drinker	Consump.	Mean Cons.	Binge D.	Chronic D.
**Without income					
Unempl. rate	-0.0020	-0.0235	-0.0695	0.0015	-0.0055
	(-0.46)	(-0.48)	(-0.77)	(0.39)	(-0.53)
R^2	0.96	0.85	0.95	0.84	0.87
**With income					
Unempl. rate	-0.0020	-0.0235	-0.0695	0.0015	-0.0055
	(-0.40)	(-0.41)	(-0.65)	(0.35)	(-0.50)
Real income	0.0018	0.0486	0.0481	0.022*	0.0032
	(4.36)	(4.05)	(4.07)	(4.28)	(2.70)
R^2	0.96	0.85	0.95	0.85	0.87

[a]Heteroscedastic-consistent standard errors. t-Student statistics reported in parenthesis. Adjusted R^2. All regressions include month, year and state fixed effects and the individual variables representing age, age squared, race/ethnicity, sex, marital status, educational level and beer tax rates. (N=12 months x 17 years x 10 age groups = 2040)

Table B.6. Cohorts by age and sex. 1987-2003 (N=4080)[a]

	Without cohort fixed effects				
	Drinker	Consump.	Mean Cons.	Binge D.	Chronic D.
**Without income					
Unempl. rate	-0.0024	-0.0239	-0.0699	0.0015	-0.0059
	(-2.66)	(-2.77)	(-2.41)	(0.96)	(-3.31)
R^2	0.59	0.58	0.55	0.50	0.42
**With income					
Unempl. rate	-0.0024	-0.0239	-0.0699	0.0015	-0.0059
	(-2.40)	(-2.64)	(-2.41)	(0.79)	(-2.69)
Real income	0.0013	0.0556	0.0425	0.0138	0.0041
	(2.92)	(4.05)	(3.48)	(3.83)	(2.15)
R^2	0.59	0.59	0.55	0.50	0.43
	With cohort fixed effects				
	Drinker	Consump.	Mean Cons.	Binge D.	Chronic D.
**Without income					
Unempl. rate	-0.0022	-0.0234	-0.0693	0.0012	-0.0056
	(-0.61)	(-0.38)	(-0.68)	(0.45)	(-0.62)
R^2	0.97	0.85	0.95	0.85	0.89
**With income					
Unempl. rate	-0.0022	-0.0234	-0.0693	0.0012	-0.0056
	(-0.53)	(-0.36)	(-0.67)	(0.44)	(-0.56)
Real income	0.0019	0.0478	0.0470	0.0222	0.0029
	(4.73)	(4.22)	(4.10)	(4.22)	(2.20)
R^2	0.97	0.85	0.95	0.86	0.89

[a]Heteroscedastic-consistent standard errors. t-Student statistics reported in parenthesis. Adjusted R^2. All regressions include month, year and state fixed effects and the individual variables representing age, age squared, race/ethnicity, sex, marital status, educational level and beer tax rates. (N=12 months x 17 years x 10 age groups x 2 sex =4080)

Table B.7. Cohorts by age, sex and educational level. 1987-2003 (N=4080)[a]

	Without cohort fixed effects				
	Drinker	Consump.	Mean Cons.	Binge D.	Chronic D.
**Without income					
Unempl. rate	-0.0023	-0.0238	-0.0700	0.0016	-0.0060
	(-2.65)	(-2.90)	(-2.49)	(0.99)	(-3.74)
R^2	0.59	0.58	0.55	0.49	0.42
**With income					
Unempl. rate	-0.0023	-0.0238	-0.0700	0.0016	-0.0060
	(-2.59)	(-2.74)	(-2.43)	(0.82)	(-3.58)
Real income	0.0016	0.0558	0.0422	0.0136	0.0042
	(2.97)	(3.14)	(3.13)	(3.93)	(2.62)
R^2	0.59	0.58	0.55	0.50	0.42
	With cohort fixed effects				
	Drinker	Consump.	Mean Cons.	Binge D.	Chronic D.
**Without income					
Unempl. rate	-0.0022	-0.0233	-0.0694	0.0013	-0.0058
	(-0.49)	(-0.45)	(-0.75)	(0.47)	(-0.54)
R^2	0.95	0.86	0.95	0.86	0.89
**With income					
Unempl. rate	-0.0022	-0.0233	-0.0694	0.0013	-0.0058
	(-0.45)	(-0.42)	(-0.69)	(0.46)	(-0.53)
Real income	0.0023	0.0483	0.0474	0.0213	0.0031
	(4.51)	(4.13)	(4.19)	(4.52)	(2.92)
R^2	0.95	0.86	0.95	0.86	0.89

[a]Heteroscedastic-consistent standard errors. t-Student statistics reported in parenthesis. Adjusted R^2. All regressions include month, year and state fixed effects and the individual variables representing age, age squared, race/ethnicity, sex, marital status, educational level and beer tax rates. (N=12 months x 17 years x 5 age groups x 2 sex x 2 educational levels =4080)

Table B.8. Heterogenous estimations with cohort data. 1987-2003 (N=2040)[a]

		Drinker	Consump.	Mean Cons.	Binge D.	Chronic D.
	Unempl. rate	-0.0080	-0.1295	-0.1027	-0.0080	-0.0511
1^o cohort		(-0.11)	(-2.05)	(-3.18)	(-2.69)	(-1.27)
21-25	Man	0.0367	0.5541	0.0059	0.0030	0.0638
		(3.01)	(10.759)	(7.39)	(3.41)	(2.72)
	Unempl. rate	-0.0008	-0.0039	-0.0771	-0.0128	-0.0044
2^o cohort		(-0.07)	(-2.12)	(-2.41)	(-2.39)	(-0.25)
26-30	Man	0.1062	0.5385	0.0177	0.0012	0.0849
		(3.32)	(10.11)	(5.94)	(3.27)	(4.59)
	Unempl. rate	-0.0211	-0.0199	-0.0546	-0.0110	-0.0312
3^ocohort		(-1.27)	(-1.84)	(-3.12)	(-1.98)	(-0.99)
31-35	Man	0.0600	0.4081	0.0437	0.0079	0.0650
		(2.55)	(7.63)	(4.81)	(2.99)	(3.08)
	Unempl. rate	-0.0041	-0.2289	-0.0831	-0.0011	-0.0421
4^o cohort		(-0.20)	(-1.89)	(-2.65)	(-2.15)	(-1.53)
36-40	Man	0.0240	0.5729	0.0025	0.0110	0.0305
		(2.80)	(11.55)	(5.11)	(2.84)	(2.62)
	Unempl. rate	-0.0107	-0.0555	-0.0550	-0.0078	-0.0106
5^o cohort		(-1.12)	(-0.80)	(-1.06)	(-0.77)	(-0.30)
41-45	Man	0.0662	0.4755	0.0110	0.0066	0.0401
		(2.70)	(10.45)	(4.64)	(2.08)	(2.22)
	Unempl. rate	-0.0200	-0.0308	-0.0510	-0.0068	-0.0023
6^o cohort		(-1.35)	(-0.49)	(-2.10)	(-1.07)	(-0.09)
46-50	Man	0.0718	0.4636	0.0100	0.0074	0.0493
		(2.87)	(11.50)	(3.16)	(1.70)	(3.12)
	Unempl. rate	-0.0186	-0.0143	-0.0579	-0.0191	-0.0037
7^o cohort		(-1.47)	(-0.14)	(-1.06)	(-1.35)	(-0.12)
51-55	Man	0.0389	0.3970	0.0123	0.0052	0.0856
		(2.72)	(7.69)	(2.78)	(1.04)	(4.50)
	Unempl. rate	-0.0139	-0.1385	-0.1095	-0.0180	-0.0436
8^o cohort		(-0.82)	(-1.36)	(-1.33)	(-1.02)	(-1.10)
56-60	Man	0.0618	0.4460	0.0048	0.067	0.0668
		(2.75)	(9.06)	(3.30)	(1.18)	(3.53)
	Unempl. rate	-0.0273	-0.1385	-0.0911	-0.0126	-0.0005
9^o cohort		(-1.67)	(-1.12)	(-0.80)	(-0.86)	(-0.08)
61-65	Man	0.0985	0.4883	0.0084	0.0053	0.0735
		(2.68)	(1.07)	(0.38)	(0.56)	(2.69)
	Unempl. rate	-0.0022	-0.0870	-0.0282	-0.0094	-0.0029
10^o cohort		(-0.15)	(-1.06)	(-0.84)	(-0.90)	(-0.11)
+65	Man	0.0783	0.2504	0.0080	0.0022	0.1107
		(2.78)	(0.75)	(0.21)	(0.19)	(3.48)

[a]Heteroscedastic-consistent standard errors. t-Student statistics reported in parenthesis. Regressions are performed over cohorts by age and sex with month, year and state fixed effects and the same variables used in Table B.7.

Table B.9. Impact of social and economic conditions over alcohol consumption. 1987-2003[a]

	Drinker		Consump.		Mean Cons.		Binge D.		Chronic D.	
	I. D.	C.	I. D.	C.	I. D.	C.	I. D.	C.	I. D.	C.
Unemp. rate	-0.0022	-0.0022	-0.0233	-0.0234	-0.0695	-0.0693	0.0012	0.0012	-0.0058	-0.0056
	(-1.48)	(-0.53)	(-4.06)	(-0.36)	(-3.11)	(-0.67)	(0.81)	(0.44)	(-4.65)	(-0.56)
Income	0.0021	0.0024	0.0474	0.0477	0.0463	0.0461	0.0242	0.0224	0.0024	0.0027
	(4.62)	(4.81)	(4.42)	(5.09)	(4.66)	(4.18)	(6.78)	(6.12)	(5.75)	(6.55)
Beer tax rate	-3.18	-3.15	-0.09	-0.11	-0.16	-0.14	-0.30	-0.28	-0.66	-0.67
	(-1.20)	(-1.22)	(-2.95)	(-3.04)	(-1.95)	(-2.00)	(-0.78)	(-0.72)	(-0.54)	(-0.57)
Man	0.09	0.10	0.60	0.62	0.05	0.04	0.01	0.01	0.04	0.03
	(6.04)	(5.93)	(7.85)	(7.84)	(8.11)	(7.92)	(7.12)	(6.87)	(10.44)	(10.33)
White	0.04	0.03	0.22	0.25	0.05	0.04	0.03	0.03	0.11	0.09
	(4.39)	(4.78)	(4.10)	(4.20)	(7.38)	(7.06)	(7.99)	(8.14)	(7.65)	(7.67)
Black	-0.06	-0.06	-0.09	-0.10	-0.24	-0.23	-0.003	-0.004	-0.04	-0.03
	(-2.80)	(-2.67)	(-2.43)	(-2.34)	(-2.19)	(-2.12)	(-1.54)	(-1.87)	(-3.47)	(-3.36)
Hispanic	-0.02	-0.01	-0.40	-0.41	-0.11	-0.11	-0.001	-0.001	-0.17	-0.15
	(-2.28)	(-2.16)	(-2.19)	(-2.25)	(-2.17)	(-2.20)	(-1.91)	(-1.89)	(-3.00)	(-2.87)
Married	-0.04	-0.06	-0.88	-0.82	-0.14	-0.13	0.009	0.008	-0.009	-0.01
	(-0.91)	(-0.84)	(-3.76)	(-3.83)	(-2.75)	(-2.68)	(0.48)	(0.54)	(-0.29)	(-0.30)
Separated	0.12	0.10	0.47	0.49	0.16	0.15	0.001	0.001	0.25	0.26
	(4.85)	(4.44)	(3.03)	(2.82)	(5.36)	(5.25)	(2.08)	(2.11)	(1.04)	(1.02)
Single	0.07	0.06	0.16	0.19	0.10	0.12	0.02	0.02	0.02	0.02
	(2.74)	(2.89)	(3.12)	(3.09)	(2.32)	(2.40)	(2.71)	(2.82)	(3.19)	(2.88)
High School	-0.23	-0.21	-0.45	-0.44	-1.07	-1.08	-0.005	-0.004	-0.09	-0.09
	(-3.45)	(-3.63)	(-3.04)	(-2.96)	(-1.20)	(-1.19)	(-0.39)	(-0.30)	(-1.22)	(-1.31)
Some college	0.22	0.21	0.32	0.31	0.13	0.11	0.04	0.03	-0.12	-0.11
	(5.03)	(4.90)	(2.74)	(2.79)	(2.75)	(2.56)	(1.40)	(1.33)	(-1.00)	(-1.05)
College	0.12	0.11	0.30	0.29	0.07	0.10	0.05	0.03	-0.012	-0.11
	(2.55)	(2.78)	(3.73)	(3.21)	(3.33)	(3.12)	(1.27)	(1.32)	(-1.61)	(-1.54)
N^o observ.	1730792	4080	837075	4080	837075	4080	837075	4080	837075	4080
R^2	0.2142	0.9738	0.2245	0.8953	0.3056	0.9801	0.2692	0.8578	0.2274	0.8990

[a](I.D.= Individual data; C.= Cohort data). Heteroscedastic-consistent standard errors. t-Student statistics reported in parenthesis. Adjusted R^2. Regressions with cohort data are performed over cohorts by age and sex with the same variables included in Table B.7. Regressions with individual data include month, year and state fixed effects and the same explanatory variables than with cohort data. Data are weighted using BRFSS final weights.

Table B.10. Rational addiction models estimated on cohort data by IV[a]

	Without cohort fixed effects			
	Drinker	Mean Cons.	Binge D.	Chronic D.
** Cohorts by age				
Lag of dep. variable	0.0390**	0.4020**	0.0176**	0.0163**
Lead of dep. variable	0.0018**	0.3782**	0.0217**	0.0311**
Unempl. rate	-0.0394	-0.0811	-0.0008	-0.0030
R^2	0.83	0.85	0.86	0.80
** Cohorts by age & sex				
Lag of dep. variable	0.0389**	0.4028**	0.0182**	0.0160**
Lead of dep. variable	0.0019**	0.3792**	0.0220**	0.0316**
Unempl. rate	-0.0392	-0.0817	-0.0008	-0.0032
R^2	0.83	0.85	0.86	0.80
** Cohorts by age, sex & educ.				
Lag of dep. variable	0.0387**	0.4023**	0.0181**	0.014**
Lead of dep. variable	0.0018**	0.3784**	0.0222**	0.038**
Uneml. rate	-0.0392	-0.0809	-0.0009	-0.0033
R^2	0.83	0.85	0.86	0.80
	With cohort fixed effects			
	Drinker	Mean Cons.	Binge D.	Chronic D.
** Cohorts by age				
Lag of dep. variable	0.0345**	0.3670**	0.0151**	0.0140**
Lead of dep. variable	0.0014**	0.3595**	0.0197**	0.0281**
Unempl. rate	-0.0377	-0.0714	-0.0008	-0.0027
R^2	0.87	0.98	0.95	0.88
** Cohorts by age & sex				
Lag of dep. variable	0.0350**	0.3670**	0.0150**	0.0147**
Lead of dep. variable	0.0017**	0.3593**	0.0199**	0.0283**
Unempl. rate	-0.0374	-0.0718	-0.0009	-0.0028
R^2	0.87	0.98	0.95	0.88
** Cohorts by age, sex & educ.				
Lag of dep. variable	0.0346**	0.3670**	0.0155**	0.0143**
Lead of dep. variable	0.0015**	0.3600**	0.0199**	0.0285**
Unempl. rate	-0.0368	-0.0715	-0.0008	-0.0031
R^2	0.87	0.98	0.95	0.88

[a]Heteroscedastic-consistent standard errors. t-Student statistics reported in parenthesis. Adjusted R^2 of the OLS model. Unemployment rate, lag and lead of dependent variable are instrumented using: lag 2 and12 of unemployment rate, and lags 3, 4, 12 and 13 of dependent variable. All regressions include month, year and state fixed effects and the individual variables representing age, age squared, race/ethnicity, sex, marital status, educational level and beer tax rates. N^o of observations: cohorts by age (2040), cohorts by age and sex (4080), cohorts by age, sex and level of education (4080).

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