

## **Atelier en microéconomie**

The impact of higher education on household alcohol consumption and its effects on price and expenditure sensitiveness

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## Abstract

This paper looks into the impacts of education and other household factors on alcohol consumption in Canada from 2004 to 2009. In terms of methodology, two-staged regression and quantile analysis are applied to an Almost Ideal Demand System (AIDS) that analyzes expenditure shares of alcoholic beverages. The *Double Hurdle* approach allows us to distinguish between the decision to consume (or not to consume) and the amount to be consumed. This is then complemented by an unconditional quantile regression analysis that permits us to differentiate between “heavy” and “moderate” consumers in a more general environment without results being conditional on specific population segments. The main findings include the importance of higher education for higher expenditure sensitiveness and lower expenditure shares, as well as higher consumption of alcohol and reduced sensitiveness to income for trade diploma graduates.

Keywords: Alcohol consumption, Almost Ideal Demand System (AIDS), Double Hurdle model, Survey of Household Spending (SHS), Unconditional quantile regression

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## 1. Introduction

It has long been established that, like the vast majority of goods, alcohol demand tends to decrease with price. However, the effects on specific groups of individuals rather than the general population using analysis “at the mean” have rarely been studied. This is of particular importance for policies which target alcoholism and excess consumption that could help mitigate high social costs to society. Therefore, there is a need to study the factors that explain changes in alcohol consumption; especially in Canada where the majority of conducted studies were limited to a macro scale analysis. This paper consequently uses cross-sectional data from the *Survey of Household Spending* (SHS) for Canada from 2004 to 2009 in an attempt to provide a microeconomic answer to the following problems and questions.

The first section of this paper uses a double staged approach which determines which factors influence the decision to consume in the first stage, followed by the factors that influence the amount to be consumed in the second stage. The Almost Ideal Demand System (AIDS) theoretical model is used to estimate alcohol demand since it offers easily interpretable results looking at expenditure share spent on alcohol as the dependent variable while maintaining all essential properties of a correctly specified demand function. Despite the use of multiple stages and models, we are still unable to differentiate between “heavy” drinkers and other types of drinkers. Thus, we call upon relatively new estimations of unconditional quantile regressions to section off different portions of the population in terms of expenditure share.

The last section analyzes the results of the unconditional quantile analysis in detail and answers the main question of this paper: what are the effects of education on alcohol consumption and how do they impact price and income sensitiveness? Using various interaction variables, we attempt to isolate the education effect on alcohol consumption and the importance of higher education in lowering alcohol consumption, especially in higher quantiles or “heavier” drinkers.

## 2. Literature review

The majority of studies on alcohol consumption revolve around time series analysis coupled with AIDS. This is especially true in Canada where Andrikopoulos, Brox and Carvalho (1997) and Alley, Ferguson and Stewart (1992)<sup>1</sup> have both done work in the area. These authors respectively study the alcohol consumption of British

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<sup>1</sup> Other recurring authors in the analysis of alcohol consumption using time series and the AIDS are Duffy and Selvanathan which have published works in similar countries including the US, UK and Australia.

Columbia and Ontario using time series data complemented by a dynamic form of the AIDS (this is done using lagged variables and prices). However, our main goal lies in the study of household consumption using pooled cross section data from the Survey of Household Spending (SHS) for all households across Canada. For this purpose, we rely on papers that use similar methodologies in comparable countries such as the US and the UK, as opposed to the previously mentioned studies that rely on time series data and models.

Using *Expenditure and Food Survey* data, Collis, Grayson and Johal (2010) estimate the elasticity of demand for alcohol for households in the UK using a Tobit model. The authors analyze quarterly data from 2001 to 2006 using a Tobit model to account for the high proportion of zero consumption as corner solutions. However, the authors do discuss that a first stage Probit model to assess the consumption decision before the consumption amount decision would be preferable<sup>2</sup>, thereby referencing Yen and Jensen's (1996) double hurdle approach. AIDS enables the authors to find price elasticities and cross-price elasticities for different types of alcoholic beverages consumed by households in the UK. The authors aggregate sub-categories of control variables in order not to limit the number of degrees of freedom and regroup redundant effects across subgroups.

Yen and Jensen (1996) emphasize the important difference between the decision to consume and the decision regarding the amount consumed. Especially in alcohol consumption, the zeroes reported are not necessarily due to corner solutions but rather due to non-economic factors such as ethnicity or religion (selection bias). Hence, the authors elaborate a Double Hurdle model with a participation equation as the first stage and an expenditure equation as the second stage if the participation equation is satisfied. The authors use 1989 and 1990 data from the *Consumer Expenditure Diary Surveys* conducted by the Bureau of Labor Statistics (BLS) in the US. Once estimated, one notices small changes in the coefficients when compared to the simple Tobit specification. Although this paper does not discuss AIDS and its applications, it serves as an important justification for the first stage participation regression using a Probit model to detect possible data selection biases. For example, a person of a certain religion may choose not to consume alcohol due to religious affiliation, and including such individuals in the model to view the impacts of changes in prices on demand would skew results.

Gao, Wailes and Cramer (1995) provide a two stage model in which the first stage consists of a Tobit model for the consumption decision and amount to be

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<sup>2</sup> Ultimately, to save time and for « expediency » issues, the authors opt not to use the double hurdle approach and do not test for a selection bias through the use of a Probit model.

consumed of alcohol, whereas the second stage focuses on the choice between beer, wine and spirits (in this case, the first stage resembles most our current research). Using AIDS, coupled with Rotterdam style modifications in the second stage, the authors are able to estimate price elasticities along with other alcohol demand parameters for their mixture of individual based and household based data from the United States Department of Agriculture (USDA) food-consumption survey for 1987-1988. Although the authors boast the advantages of mixing individual and household collected data, this does not come without important data related decisions and assumptions.

Despite not using an AIDS model, as Manning, Blumberg and Moulton (1995) work with quantities rather than expenditure shares, the authors introduce the application of quantile regression to the analysis of light, moderate and heavy drinkers. Their findings, despite little statistical significance and absence of clear confidence intervals, are of particular interest since they clearly show the concave form of price elasticities. This implies that light and heavy drinkers are more price inelastic while moderate drinkers are the most elastic and affected by price. Trends of this nature are of particular interest since they give a comparative case between this paper's use of expenditure share versus the use of quantities consumed<sup>3</sup>.

### **3. Data**

The goal of this paper is to properly model alcohol demand using expenditure share data while focusing on the roles of education, price and total real expenditure. In this study, AIDS is run to analyze alcohol consumption using data from the Statistics Canada *Survey of Household Spending* (SHS), consisting of 68,417 observations from 2004 to 2009, in addition to Consumer Price Index (CPI) data by goods category retrieved from CANSIM Table 360-0021 (breakdown for alcohol bought in store, in licensed establishments and produced domestically is also available). For more information regarding data and descriptive statistics, please refer to Appendix 1.

#### **3.1. Data selection**

Only data from 2004 to 2009 was used since prior years do not provide the highest level of attained education by the respondent; a key variable for control purposes and a crucial element to this study. In taking total alcohol expenditure, it is important to note that we deduct expenses for alcohol production within domiciles since this should be classified as production rather than consumption of alcohol, and is therefore not the object of this study. The amount of reported zero expenditures on alcohol is quite high<sup>4</sup>

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<sup>3</sup> Another important difference is that our paper uses the newer unconditional quantile regressions whereas the article by Manning, Blumberg and Moulton (1995) is much older and relies on conditional quantiles.

<sup>4</sup> See attached table for the frequency of zero declared alcohol expenditure (Appendix 2).

(around 23% per year Canada-wide) despite being somewhat lower than comparable studies such as that of Collis, Grayson and Johal (2010) for the UK (more than 30% of reported alcohol consumptions were zeroes in their data set). This issue, as will be discussed in further detail, will be addressed by using a Tobit and truncated OLS model to address the possibility of corner solutions and an initial Probit regression to address possible data selection biases.

### **3.2. Data limitations**

The availability of alcohol expenditure shares and prices is crucial to this study. Nevertheless, certain limitations to the data can be identified:

- The province of Prince Edward Islands was removed from the data set since the urban/rural control variable was omitted in the data collection of this province. Territories were similarly omitted due to lack of respondents and unavailability of price indices for each territory.
- The absence of data regarding religion and ethnicity results in the omission of important control variables that could explain a high amount of variation in alcohol consumption. The omission of these variables could lead to a certain selection bias since these variables are known to be quite important in the decision whether to consume (Yen and Jensen, 1996).
- Unfortunately, the data contains respondents below the age of 19, which is the legal drinking age of the vast majority of Canadian provinces. Hence, the lowest category for age of respondent being “24 and under”, was excluded from our sample to avoid a selection bias. Despite avoiding the selection bias of including under aged individuals as consumers, this limits the study to the analysis of alcohol consumption of higher aged individuals and therefore reduced the scope of this paper.

## **4. Demand model specification**

As elaborated in the literature review, the AIDS is a common theoretical model used in the analysis of alcohol demand due to its simplicity in analyzing expenditure share and its properties that obey the axioms pertaining to a demand function. Despite all its advantages as listed by Deaton and Muellbauer (1980), disadvantages include lack of precision when dealing with substitution between categories and goods as well as the inability to always provide a global maximum since it only estimates first order conditions. Nevertheless, seeing that we do not make use of substitute goods and the estimation by quantile allows the estimation of multiple local maxima, the AIDS model is sufficient. The Exact Affine Stone Index (EASI) method would be a good alternative

that provides higher degree polynomial estimations (Lewbel and Pendakur, 2008), however this advantage is negated by the use of quantile regressions that allow us a detailed breakdown of the function per population segment. Hence, the formal model is constructed as follows:

$$\omega_i = \alpha + \beta \ln\left(\frac{P_{alc,i}}{P_{oth,i}}\right) + \gamma \ln\left(\frac{S_i}{P_{oth,i}}\right) + X_i + \varepsilon_i$$

where  $\omega$  is the ratio of expenditure on alcoholic beverages divided by total real expenditure (expenditure excluding taxes, insurance and other investment related activities) and  $S_i$  is total real expenditure on all goods and services.  $P_{alc,i}$  corresponds to the price index of alcohol and  $P_{oth,i}$  the price index of all other goods for individual  $i$ .

This lin-log functional form is derived from Deaton and Muellbauer (1980, p.318) with “other prices” as a more precise form than using the general approximation using the Stone price index.  $X_i$  contains the following control variables: province, year, age of respondent, highest attained education of respondent, household size, urban/rural, and children (yes/no binary variable). The first ratio corresponds to the slope of the substitution between alcohol and “other goods” and the second ratio can be interpreted as the intercept in terms of “other goods”. In order to obtain  $P_{oth}$ , one must isolate its value in the following formula:

$$\ln(CPI_{p,y}) = \omega_{p,y} \ln(P_{alc}) + (1 - \omega_{p,y}) \ln(P_{oth})$$

where  $\omega_{p,y}$  corresponds to the mean  $\omega$  and CPI is the consumer price index of all goods per province, per year.

This model allows one to deduce and easily interpret price and income elasticities for alcohol consumption. They are derived as follows:

$$\frac{p \cdot q}{S} = \alpha + \beta \ln(p) + C ; \quad \text{where } C \text{ is constant in price}$$

$$\frac{p \cdot q}{S} \left[ 1 + \frac{p}{q} \frac{\partial q}{\partial p} \right] = \beta$$

$$\varepsilon_{p,q} = \frac{\beta}{w} - 1$$



since the price elasticity is defined as  $\varepsilon_{p,q} = \frac{p}{q} \frac{\partial q}{\partial p}$  and alcohol expenditure share as  $w = \frac{p \cdot q}{S}$ . Along the same logic, expenditure (income) elasticity can be defined as:  $\varepsilon_{y,q} = \frac{\beta}{w} + 1$

Having defined the theoretical model and developed its ease of interpretation, advantages and disadvantages, and its relevance in the alcohol demand literature, one can proceed to the first step of the Double Hurdle approach to analyze the decision to consume using a Probit model.

## 5. Decision to consume alcohol (Probit)

The first step in our analysis consists of determining which elements determine the decision to consume, as well as detecting possible selection biases. Variables of particular interest are the price ratio, the household spending ratio and highest attained education. To obtain this information, the proper AIDS model is used but the dependent variable is replaced by a binary variable that undertakes a value of 1 if the individual in question consumed alcohol and 0 otherwise. Once the Probit has been estimated, the marginal effect coefficients represent the probability to consume of individuals. The results of the Probit regression and the marginal effects per education level are presented in Table 1 below<sup>5</sup> and in further detail, including all control variables, in Appendix 3.

**Table 1: Probit regression - Probability to consume**

VARIABLES	Coef.	St. Error	Marg. Effect	St. Error
ln(Alcohol price/Price of other goods)	-0.452	0.527	-0.116	0.135
ln(Total expenditure/Price of other goods)	0.884***	0.013	0.227***	0.003
Education : Highschool	0.187***	0.017	0.048***	0.004
Education : Trade diploma	0.287***	0.021	0.074***	0.005
Education : College/University	0.228***	0.016	0.058***	0.004
Observations	68,487			
*** p<0.01, ** p<0.05, * p<0.1				

The above marginal effects were taken with respect to the reference individual<sup>6</sup> and therefore, it represents the average marginal effect of each coefficient if the variables for each individual in the sample were set to be equal to this benchmark. From these results, one can see that the price ratio has a negative coefficient which is in line with expectations of a downward sloping demand curve while the total expenditure ratio

<sup>5</sup> Note that many age groups and education ranges have been consolidated into larger groups. This was done solely amongst groups which weren't statistically different in order not to decrease the degrees of freedom while maintaining result accuracy and properly portraying the analysed sample.

<sup>6</sup> The reference household is from the year 2004, in Quebec, a respondent with no education and age above 65, in a household of one person, in urban area with no children.

is increasing, which is also in line with economic theory. Interestingly, total expenditure plays a statistically significant role in the probability to consume whereas price does not. This is of significant importance since parallel literature make use of Tobit models to combat the large proportion of reported zeroes for alcohol consumption; but without price being a significant factor in the decision to consume, the zeroes can simply be dropped since they bring nothing to the elasticity analysis. In addition to this, the primary focus of this study is heavy consumers of alcohol since they are the principal targets for policy purposes.

Variables such as the education level show that the probability of consuming alcohol increases with education. It can be hypothesized that more educated individuals are more likely to consume alcohol with clients and coworkers. Another interesting result is that holding a trade diploma increases the likelihood of consuming alcohol. This could possibly be explained as trade fields being socially known for greater alcohol consumption. Other control variables seem to indicate intuitive results that point towards the probability of consumption decreasing with household size<sup>7</sup>, presence of at least one child and age while increasing in rural areas. The Probit model portrays that years are not statistically significant amongst one another and therefore, do not have an impact on the probability to consume.

Having established that the price ratio is statistically insignificant in the Probit model, this paper will deviate from the use of the Tobit model and pursue an OLS estimation (excluding zero values of alcohol consumption) of the demand model. However, Appendix 4 contains the results of the Tobit model estimation applied to the current data if any reader is interested in seeing the results of this type of estimation.

## **6. Decision on amount to consume**

The second stage of the Double Hurdle approach is to determine the amount consumed using an OLS estimation once zero values for consumption are excluded from the sample (thereby eliminating the need for Tobit estimation as done in similar papers).

### **6.1. OLS estimation**

One can estimate the amount of alcohol consumed and its price and expenditure elasticities using OLS estimation. As can be noted in Appendix 5, the results for the OLS regression indicate statistically insignificant coefficients for both the price and expenditure ratios. Since the coefficients are not statistically different from zero, the elasticities can be estimated as follows:

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<sup>7</sup> This is most probably due to the presence of families, which tend to consume alcoholic beverages in greater moderation.

$$\varepsilon_{p,q} = \frac{\beta}{w} - 1 = -1$$

$$\varepsilon_{y,q} = \frac{\gamma}{w} + 1 = 1$$

These results points towards unitary elasticity for both the price and expenditure elasticity of alcoholic products. This implies that a 1% increase in price would lead to a 1% decrease in quantity of alcohol consumed whereas a 1% increase in total expenditure would increase alcohol consumption by the same percentage. Despite being surprisingly even results, these do fall within the ranges described in parallel studies<sup>8</sup>. However, adding educational interaction terms to account for the important price and expenditure sensitivity across different education levels could enhance these results and give us additional information as to the different elasticities per education level of households.

Before we develop a more enhanced model using interaction terms, one can note interesting control term effects, especially for education. The results show, as one would expect, that increases in education have a significant impact in reducing alcohol consumption as a proportion of total spending. This is however not the case for individuals whose highest education is a professional trade diploma. Individuals of this education category are the largest consumers of alcohol, probably due to the roles of certain professions (Olkinuora, 1984) that have higher social and peer pressure to drink alcoholic beverages. There are no significant differences across years as can be seen in the overlapping confidence intervals for the date controls; however, there are different consumption levels across provinces with British Columbia, Quebec and Newfoundland having the highest consumption levels. Other more intuitive results include the reduction of alcohol consumption with age, household size, presence of children and settling in an urban area.

## 6.2. OLS estimation with interaction terms

Interaction terms allow for the introduction of additional complexities and detail into the model by accounting for the important differences in price and expenditure sensitivities to alcohol consumption across education levels. After education levels are interacted with both the price and total expenditure ratios of the model, two separate methods of computing elasticities are developed in order to accurately portray the consumption of alcohol. With the presence of interaction terms, the total composite elasticity of price and expenditure can be computed using the following:

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<sup>8</sup> In their paper, Collis, Grayson and Johal (2010) include a meta-analysis of all elasticities found in different studies across multiple countries and econometric methods.

$$w_i = \alpha_i + \beta_0 P_i + \beta_1 P_i * E_{high} + \beta_2 P_i * E_{trade} + \beta_3 P_i * E_{col/uni} + \dots$$

$$\beta = \frac{1}{N} \sum_i \frac{\partial w_i}{\partial P_i} = \beta_0 + \beta_1 \overline{E_{high}} + \beta_2 \overline{E_{trade}} + \beta_3 \overline{E_{col/uni}}$$

Having obtained the marginal effect of the overall price on the dependent variable ( $\beta$ )<sup>9</sup>, one can now compute the elasticities with respect to price and expenditure. The average overall elasticity for price and expenditure are respectively as follows<sup>10</sup>:

$$\begin{aligned} \varepsilon_{p,q} &= \frac{\beta_0 + \beta_1 \overline{E_{high}} + \beta_2 \overline{E_{trade}} + \beta_3 \overline{E_{col/uni}}}{w} - 1 = -0.32^{11} \\ \varepsilon_{y,q} &= \frac{\gamma_0 + \gamma_1 \overline{E_{high}} + \gamma_2 \overline{E_{trade}} + \gamma_3 \overline{E_{col/uni}}}{w} + 1 = 0.97 \end{aligned}$$

These results portray a negligible change from the model using OLS estimation without interactions. Both total elasticities deviate from the unitary elasticity results obtained in the previous model but the price elasticity is not a significant result<sup>10</sup>. The elasticities are very close to those obtained by Gao, Wailes and Cramer (1995) in their analysis of US alcohol consumption using similar methodologies. This implies that accounting for the total effect of education we obtain results that point towards alcohol consumption being unitary elastic in price and being somewhat inelastic in terms of total household expenditure.

Another interesting approach is to analyze the subgroup elasticities. An example using college and university level graduates is as follows:

$$w_i = \alpha_i + \beta_0 P_i + \beta_1 P_i * E_{high} + \beta_2 P_i * E_{trade} + \beta_3 P_i * E_{col/uni} + \dots$$

$$\varepsilon_{p,q} = \frac{\beta_0 + \beta_3}{w} - 1$$

Hence, the subgroup elasticity of price for a certain level of education can simply be calculated through the summation of the main price ratio coefficient and its interaction with the desired level of education. It must also be noted that these subgroup elasticities are to be interpreted with caution since they are always based on the

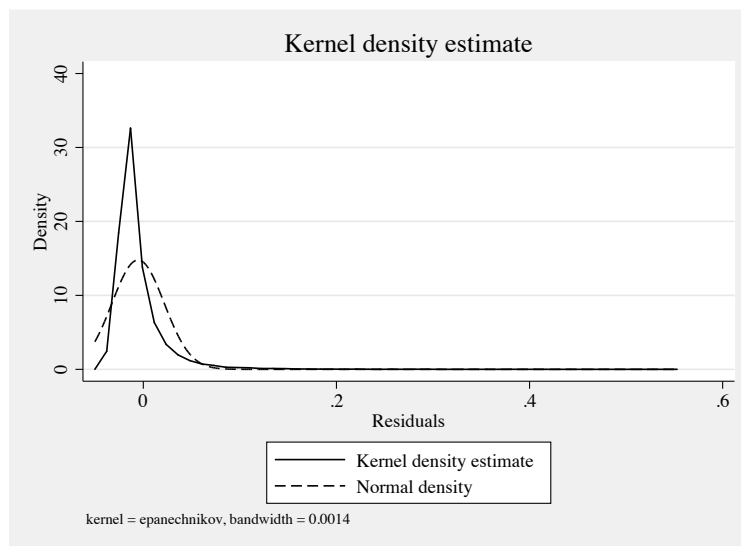
<sup>9</sup> For expenditure elasticity computation, simply replace all  $\beta$ 's by  $\gamma$ 's.

<sup>10</sup> Refer to Appendix 7 to view the method used to compute the associated confidence intervals.

<sup>11</sup> This result is not statistically significant from zero, therefore we find unitary elasticity as in the simple OLS estimation without the inclusion of interaction terms.

difference with respect to the base individual<sup>12</sup>. This paper will not attempt to go in great detail of the subgroup elasticities using OLS but will be further developed in the case of the unconditional quantile estimations. However, before moving on to quantile regressions, it is important to note the logic and reasons behind this choice.

The most important motivation of our use of quantile regressions is, as discussed in the literature review, the importance of distinguishing between heavy and light drinkers (Manning, Blumberg and Moulton, 1995). The recent development of Firpo, Fortin and Lemieux (2009), for unconditional quantiles, simply brings more precision to the results since the estimations are not conditional on the base individual. Another important justification for the use of quantile regressions is the violation of the normality of errors assumption in the OLS model as depicted in the Kernel density graph of the error term below. Therefore, quantile models are ideal, knowing that they are not sensitive to the non-normality of the error distribution (Greene, 2012) and provide further detail regarding consumer behavior for different alcohol consumption levels.



## 7. Quantile regression results

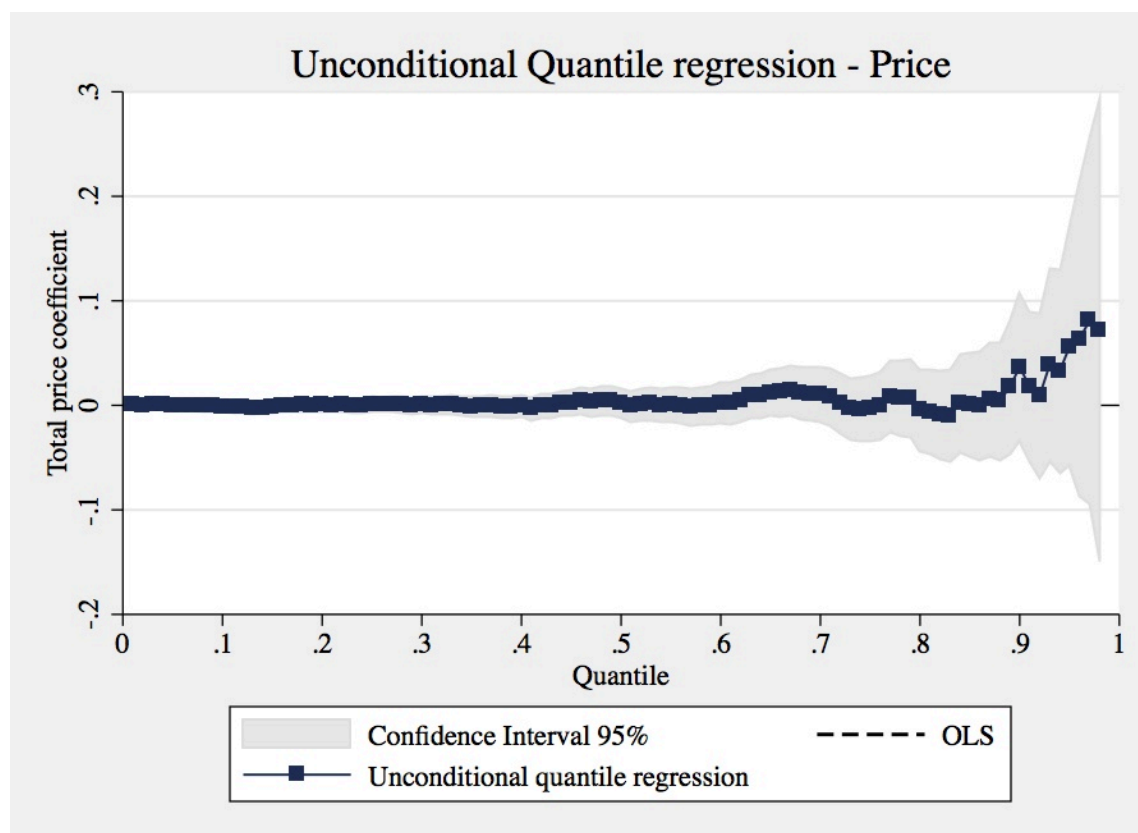
Econometric analysis has recently evolved from analysis “at the mean” to more sophisticated methods that better portray diverse population segments. Therefore, the use of quantiles in economic analysis have become increasingly popular. Nevertheless, conditional quantile regressions remain limited since they do not follow one of the oldest claims of economics of holding all other variables constant or *Ceteris Paribus*.

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<sup>12</sup> In this paper, the base individual using interaction terms is an individual without any formal education diploma (dropouts).

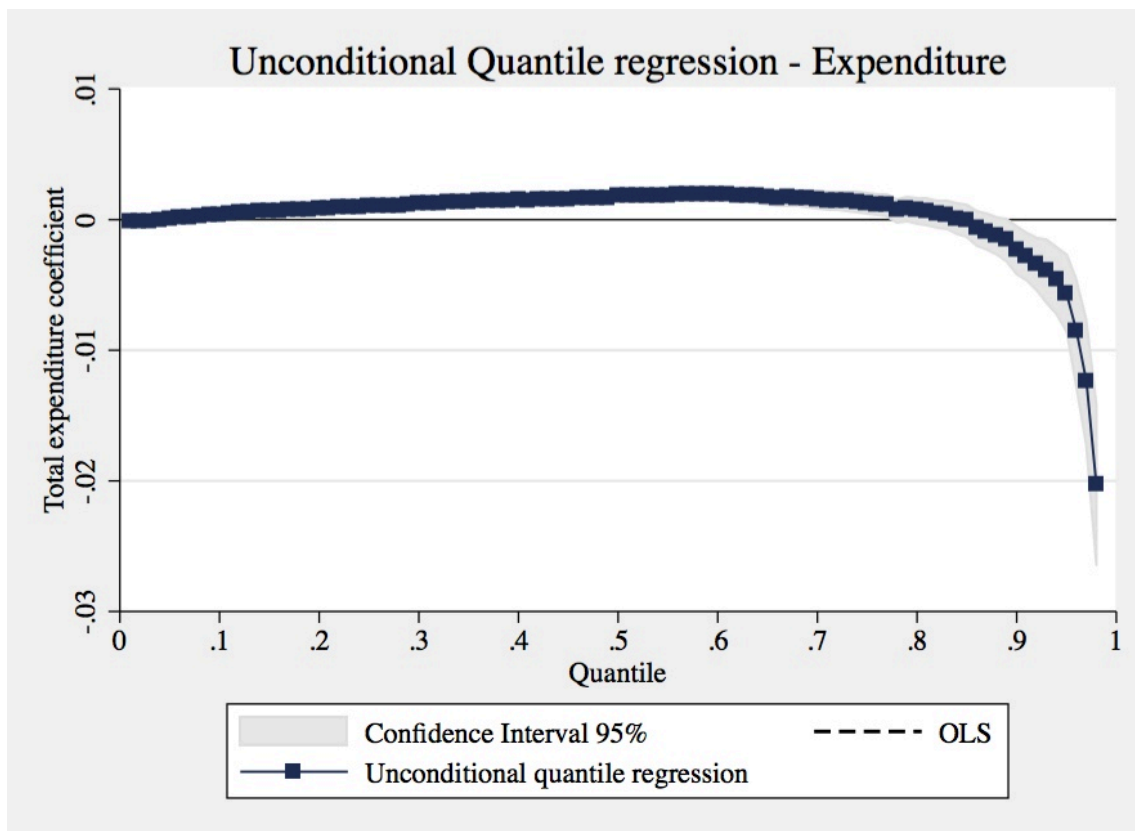
For this reason, Firpo, Fortin and Lemieux (2009) developed unconditional quantile regressions that consist of regressing the recentered influence function (RIF) of the unconditional quantile on the modeled independent variables. Using the same model, excluding zeroes for alcohol consumption and interactions with education levels, this method is of particular use since the question remains: how does alcohol consumption vary across different quantiles (light to heavy drinkers)?

The first step is to investigate the total elasticity of price and how it evolves over different expenditure shares. In the figure below, the total effect computed using the  $\beta$  developed on page 9 is shown across all quantiles and compared to the OLS coefficient (which happens to overlap with the horizontal axis).



As can be seen in the figure above, the price ratio coefficient is not significantly different from that of the OLS estimation and therefore undertakes unitary elasticity for every level of expenditure share. This implies that the drop in alcohol quantity consumed is the same (in percentage terms) as the rise in prices for alcoholic goods across all quantiles. This is of particular importance for policy purposes since a drop or hike in prices affects light and heavy drinkers indiscriminately all else held constant. This result matches UK studies better than it does US studies since UK papers seem to

report higher elasticities while US papers report very inelastic price-elasticity for alcoholic substances. One important difference from these countries is that Canada's alcohol prices are almost perfectly indexed to overall inflation and there seems to be very little variation in price<sup>13</sup>. This factor could help explain this strange result since the very low variations in price in Canadian data could be insufficient to derive the price inelastic behavior of heavier drinkers. Manning, Blumberg and Moulton (1995)<sup>14</sup>, using US data, were able to find greater variance in prices and therefore found more inelastic behaviour in price than in this paper.



The second total elasticity is that of total real household expenditure as a way to describe the quantity consumed. One can clearly see in the figure above that the coefficient for total expenditure becomes significantly smaller than zero around the 85<sup>th</sup> quantile. This implies that heavier consumers are more expenditure/income inelastic and that a decrease in income/expenditure becomes increasingly unlikely to affect consumption the greater the consumption level of the individual. This is typical of substance dependency and demonstrates the importance of using the quantile approach

<sup>13</sup> This can be seen in CPI data on CANSIM, table 360-0021.

<sup>14</sup> Another limitation is that heavy drinkers would probably have a tenancy to consume the same amount no matter the cost. This paper's results do not reflect this reality since heavy drinkers could be reducing their expenditure share while still reducing costs through lowering the quality of the alcohol consumed.

as compared to a simple OLS or Tobit estimation (the OLS coefficient is extremely close to zero and thus overlaps with the horizontal axis of the graph).

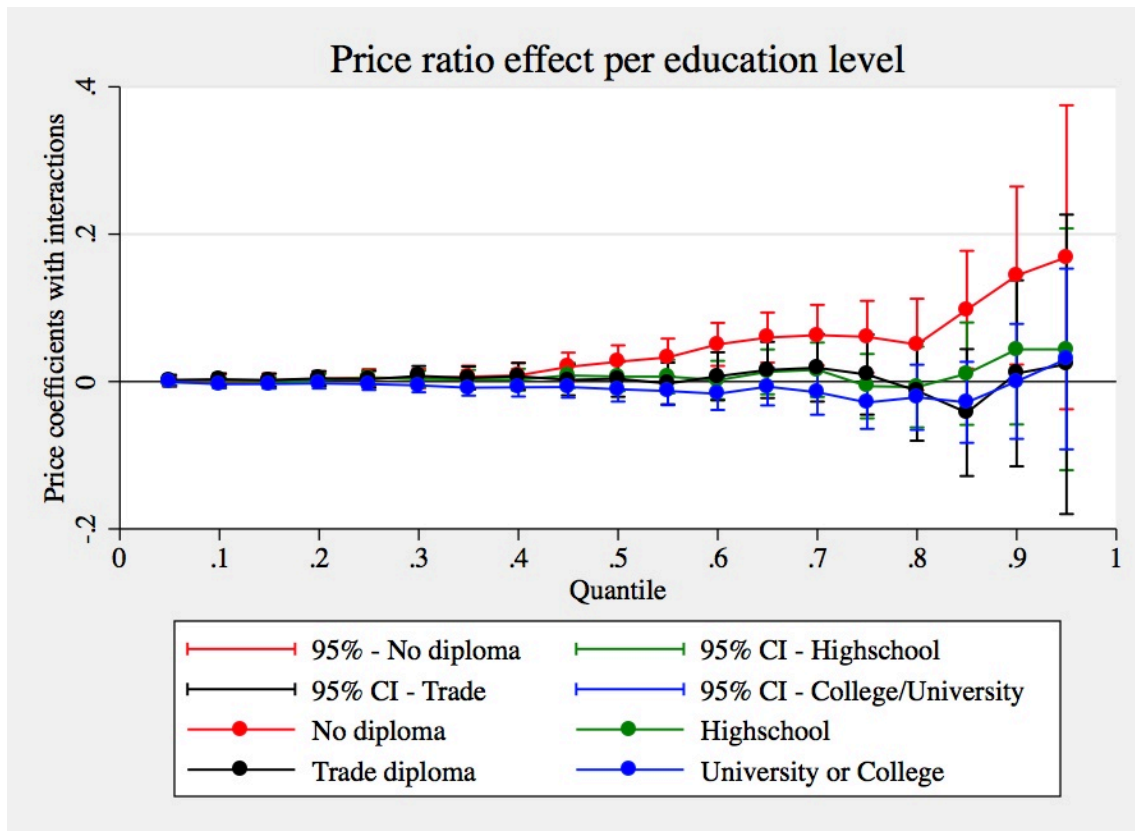
Another important tendency is the concave like function since alcohol consumption initially becomes more income elastic in lower to mid quantiles and then becomes inelastic for higher quantiles. This is particularly interesting since it suggests that both lighter and heavy drinkers are income/expenditure inelastic compared to moderate drinkers who, on average, seem to be more elastic in terms of total expenditure. This is particularly interesting for policy use since, all else equal, one can easily see that the problem does not stem from income or relative expenditure issues but rather from dependency or maybe price despite the previously seen results.

The main focus of the article now turns to the effect of education on alcohol expenditure share as well as its effect on price and expenditure sensitiveness. Appendix 9 contains the quantile analysis of the education level and its effect on the expenditure share allotted to alcohol. Beginning with high school graduates, with the reference being individuals with “no diploma”, the only quantile which significantly deviates from the zero is the 99<sup>th</sup> quantile. This implies that basic high school education only reduces the expenditure share of alcohol for extremely high consumers. In policy terms, this means that high school probably acts as a good barrier against extreme alcoholism but higher education yields even better results. Trade diplomas tend to increase the expenditure allotted to alcohol more than anything else implying there is a social construct surrounding this type of education that increases expenditure share on alcohol for individuals between the 70<sup>th</sup> and 85<sup>th</sup> quantile. Interestingly, but not surprisingly, college and university education have a very significant influence in reducing alcohol consumption which begins to be very apparent around the median up to the highest quantiles. The levels of education are very informative on the effect on expenditure share but let us go even further and look at the price and income sensitivity across education levels and try to derive the important policy implications.

As in the case of the price elasticity of alcohol, the subgroups per education level provide no significant differences among education groups. As can be seen below, the figure indicates there are very few quantiles for which price sensitivity varies among education groups. However, the difference between having minimal education and the absence of a diploma can be quite large at times suggesting education can reduce price sensitivity but there is no significant difference among high schoolers, trade, college, or university graduates. This is another important result since it shows that, compared to the base of “No diploma”, education does seem to make individuals more sensitive to price. However, the overlapping confidence intervals indicate that the difference in price sensitivity is minimal. For more interesting differences in elasticity across education subgroups, we turn to the income/expenditure elasticity per education level.



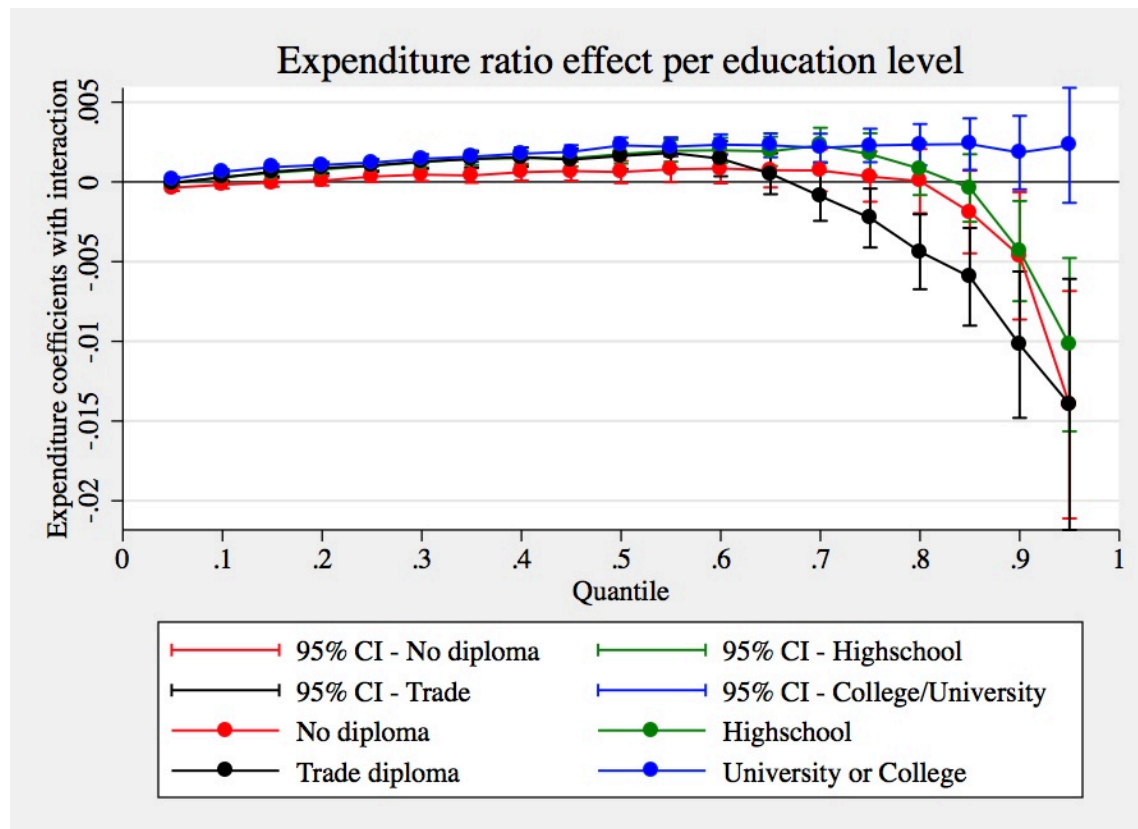
As previously mentioned, it is possible that greater variety in alcohol pricing in Canada could accentuate these results and show greater price inelastic behavior for higher quantiles.



Moving on to the expenditure elasticity of alcohol per education level, one notices a peculiar trend. All education levels other than college and university graduates tend to be inelastic in expenditure. This means that college and university level education tend to render their graduates more sensitive to fluctuations in income/expenditure. It can be hypothesized that the greater sensitivity to income among postsecondary education graduates in the higher quantiles stems from their business activities which often require meeting clients or colleagues rather than alcoholism<sup>15</sup>. This result is puzzling seeing that lower level education does not produce this effect at all. Furthermore, not only is lower education not helping increase sensitivity to total expenditure changes but, in the case of trade degree graduates, this decreases their sensitivity to these changes. As can be seen in the figure below, the results could affect policy since this indicates the advantages of postsecondary education in introducing

<sup>15</sup> An individual with higher education may drink for business purposes frequently in restaurants where the alcohol is pricier therefore more sensitive to price and income.

expenditure awareness or sensitiveness but also point out a key question: what factors explain trade degree graduates being less sensitive to expenditure fluctuations?



## 8. Policy implications

In current policy circles, the main argument being made is that higher prices dissuade alcohol consumption and therefore reduce alcoholism. Unfortunately, as the quantile approach so clearly shows, reduction in macro level consumption does not imply a significant reduction in alcoholism considering the price inelasticity of low educated individuals and the importance of income inelasticity for heavier drinkers. It is our opinion that the price inelasticity of alcohol would be more apparent if higher volatility in price were the case in Canada. The first lesson to be drawn is therefore that price and income drivers as disincentives to consume large amounts should rely on quantile rather than “at the mean” results.

Another important lesson to be drawn is the very important impact of college/university on sensitivity or even overall levels of consumption (see Appendix 9) and the negative impact of trade diplomas. For policy reasons, this paper shows the importance of finding the underlying reasons why individuals graduating with trade

diplomas as their highest education tend to consume more alcohol in terms of expenditure share and are less sensitive to variations in income, a typical sign of alcohol dependency.

## **9. Conclusion**

Having begun with a Double Hurdle approach of analysis “at the mean” for alcohol consumption in Canada, it became apparent that resorting to unconditional quantile estimations portrayed the sample in much greater detail. This enabled the analysis of alcohol demand and the derivation of important policy implications in the fight against alcoholism and the high social cost it entails. This paper could help orient future policy regarding alcohol pricing, considering, for instance, the assumed benefits of higher education and the lower expenditure sensitiveness among trade diploma graduates.

Despite these advancements and the confirmation of previous results in a Canadian context, many questions remain. Considering the results found in other countries and recent price changes on alcohol in Quebec, it could be interesting to see the differences between location of purchase; whether it be a store or a licensed establishment such as a bar or restaurant. Another informative addition would be distinguishing between different types of alcohol, especially wine, beer and liquor since Canadian data exists on these three substances and their respective prices. One last, but very important addition, could be controls for ethnicity and religion since these are omitted due to lack of data and cause a significant selection bias in our results. Finally, the suggestions for policy should be explored in more detail, but it seems clear that the quantile regression approach is a necessity when looking into alcohol consumption issues and distinguishing consumption levels among individuals.

## 10. Appendices

### Appendix 1 : Descriptive statistics

Variable	n	Mean	S.D.	Quantile				
				Min	0.25	Mdn	0.75	Max
Dummy of w	68417	0.77	0.42	0	1	1	1	1
w	68417	0.02	0.03	0	0	0.01	0.02	0.58
ln(Alcohol price/Other goods price)	68417	0	0.02	-0.06	-0.01	0	0.02	0.05
ln(Total spending/Other goods price)	68417	5.83	0.64	1.26	5.4	5.87	6.28	8.05
Year 2004	68417	0.19	0.39	0	0	0	0	1
Year 2005	68417	0.19	0.39	0	0	0	0	1
Year 2006	68417	0.19	0.39	0	0	0	0	1
Year 2007	68417	0.18	0.38	0	0	0	0	1
Year 2008	68417	0.13	0.33	0	0	0	0	1
Year 2009	68417	0.13	0.34	0	0	0	0	1
Province : Newfoundland	68417	0.1	0.3	0	0	0	0	1
Province : Nova Scotia	68417	0.1	0.3	0	0	0	0	1
Province : New Brunswick	68417	0.1	0.29	0	0	0	0	1
Province : Quebec	68417	0.14	0.34	0	0	0	0	1
Province : Ontario	68417	0.14	0.35	0	0	0	0	1
Province : Manitoba	68417	0.1	0.3	0	0	0	0	1
Province : Saskatchewan	68417	0.1	0.3	0	0	0	0	1
Province : Alberta	68417	0.1	0.3	0	0	0	0	1
Province : British Columbia	68417	0.12	0.33	0	0	0	0	1
Education : No diploma	68417	0.22	0.41	0	0	0	0	1
Education : Highschool	68417	0.25	0.43	0	0	0	0	1
Education : Trade diploma	68417	0.12	0.33	0	0	0	0	1
Education : College/University	68417	0.41	0.49	0	0	0	1	1
Rural	68417	0.18	0.39	0	0	0	0	1
Age 25 to 29	68417	0.07	0.26	0	0	0	0	1
Age 30 to 34	68417	0.08	0.27	0	0	0	0	1
Age 35 to 39	68417	0.09	0.29	0	0	0	0	1
Age 40 to 44	68417	0.11	0.31	0	0	0	0	1
Age 45 to 49	68417	0.12	0.32	0	0	0	0	1
Age 50 to 54	68417	0.11	0.32	0	0	0	0	1
Age 55 to 59	68417	0.1	0.3	0	0	0	0	1
Age 60 to 64	68417	0.08	0.28	0	0	0	0	1
Age 65 to 69	68417	0.07	0.25	0	0	0	0	1
Age 70 to 74	68417	0.06	0.23	0	0	0	0	1
Age 75 to 79	68417	0.05	0.21	0	0	0	0	1
Age 80 to 84	68417	0.04	0.19	0	0	0	0	1
Age 85 and above	68417	0.02	0.15	0	0	0	0	1
Houshold size : 1	68417	0.27	0.44	0	0	0	1	1
Houshold size : 2	68417	0.36	0.48	0	0	0	1	1
Houshold size : 3	68417	0.15	0.36	0	0	0	0	1
Houshold size : 4	68417	0.14	0.35	0	0	0	0	1
Houshold size : 5	68417	0.05	0.23	0	0	0	0	1
Houshold size : 6 or more	68417	0.02	0.15	0	0	0	0	1
Child (1 = yes)	68417	0.74	0.44	0	0	1	1	1

As can be noted, age ranges were agglomerated (in the regression models) into groups with similar effects that weren't statistically significant from one another in order not to limit degrees of freedom while maintaining the detail of the disaggregated categories of age.

## Appendix 2 : Table of reported zeroes

Reporting of zero spending on alcohol per type of purchase (2004-2009)				
	Purchases at restaurant	Purchases at store	Home made	Total alcohol spending
2004 Total number of obs.	14,154	14,154	14,154	14,154
Number of zero values	7,338	3,606	13,185	3,275
Percentage of total obs.	51.84%	25.48%	93.15%	23.14%
2005 Total number of obs.	15,222	15,222	15,222	15,222
Number of zero values	8,129	3,951	14,263	3,625
Percentage of total obs.	53.40%	25.96%	93.70%	23.81%
2006 Total number of obs.	14,635	14,635	14,635	14,635
Number of zero values	7,416	3,496	13,675	3,172
Percentage of total obs.	50.67%	23.89%	93.44%	21.67%
2007 Total number of obs.	13,939	13,939	13,939	13,939
Number of zero values	7,154	3,426	13,078	3,112
Percentage of total obs.	51.32%	24.58%	93.82%	22.33%
2008 Total number of obs.	9,787	9,787	9,787	9,787
Number of zero values	5,186	2,428	9,178	2,242
Percentage of total obs.	52.99%	24.81%	93.78%	22.91%
2009 Total number of obs.	10,811	10,811	10,811	10,811
Number of zero values	5,797	2,712	10,207	2,503
Percentage of total obs.	53.62%	25.09%	94.41%	23.15%

As seen in the table above, one can clearly see what seems to be an abnormal amount of reported zero values for consumption of alcohol, a problem identical to that of Collis, Grayson and Johal (2010) in the UK. This table also shows that the zero reporting is consistent throughout the data collection period chosen.

One can also examine data for other types of alcohol spending where restaurant regroups all licensed seated establishments and store regroups all provincially legalized alcohol distributors. This is useful for future research that may look into differences amongst different types of alcohol providers as has been done in many other countries such as the UK and US in particular.

### Appendix 3 : Probit regression table

Table 1: Probit regression - Probability to consume				
VARIABLES	(1) Probit		(2) Marginal effects	
ln(Alcohol price/Other goods price)	-0.452	(0.527)	-0.452	(0.527)
ln(Total spending/Other goods price)	0.884***	(0.0128)	0.884***	(0.0128)
Year 2005	-0.0267	(0.0185)	-0.0267	(0.0185)
Year 2006	0.0202	(0.0252)	0.0202	(0.0252)
Year 2007	0.0414	(0.0257)	0.0414	(0.0257)
Year 2008	-0.0261	(0.0276)	-0.0261	(0.0276)
Year 2009	-0.0242	(0.0273)	-0.0242	(0.0273)
Province : Newfoundland	-0.0806**	(0.0324)	-0.0806**	(0.0324)
Province : Nova Scotia	-0.216***	(0.0260)	-0.216***	(0.0260)
Province : New Brunswick	-0.361***	(0.0306)	-0.361***	(0.0306)
Province : Ontario	-0.321***	(0.0232)	-0.321***	(0.0232)
Province : Manitoba	-0.245***	(0.0288)	-0.245***	(0.0288)
Province : Saskatchewan	-0.232***	(0.0303)	-0.232***	(0.0303)
Province : Alberta	-0.404***	(0.0256)	-0.404***	(0.0256)
Province : British Columbia	-0.371***	(0.0246)	-0.371***	(0.0246)
Education : Highschool	0.187***	(0.0165)	0.187***	(0.0165)
Education : Trade diploma	0.287***	(0.0208)	0.287***	(0.0208)
Education : College/University	0.228***	(0.0165)	0.228***	(0.0165)
Rural	0.0508***	(0.0153)	0.0508***	(0.0153)
Age 25 to 34	0.523***	(0.0210)	0.523***	(0.0210)
Age 35 to 49	0.359***	(0.0176)	0.359***	(0.0176)
Age 50 to 64	0.211***	(0.0157)	0.211***	(0.0157)
Household size of 2	0.00728	(0.0155)	0.00728	(0.0155)
Household size of 3	-0.241***	(0.0217)	-0.241***	(0.0217)
Household size of 4	-0.308***	(0.0246)	-0.308***	(0.0246)
Household size of 5	-0.511***	(0.0317)	-0.511***	(0.0317)
Household size of 6 or more	-0.918***	(0.0411)	-0.918***	(0.0411)
Children (yes/no)	-0.0267	(0.0238)	-0.0267	(0.0238)
Constant	-4.350***	(0.0676)	-4.350***	(0.0676)
Observations	68,417		68,417	

Standard errors in parentheses

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

## Appendix 4 : Tobit regression table

**Table 2: Tobit regression - Amount to consume**

VARIABLES	(1) Tobit	(2) Marginal effects
ln(Alcohol price/Other goods price)	0.00370 (0.0118)	0.00370 (0.0118)
ln(Total spending/Other goods price)	0.0115*** (0.000279)	0.0115*** (0.000279)
Year 2005	-0.000745* (0.000415)	-0.000745* (0.000415)
Year 2006	0.00232*** (0.000539)	0.00232*** (0.000539)
Year 2007	0.00256*** (0.000550)	0.00256*** (0.000550)
Year 2008	0.00144** (0.000599)	0.00144** (0.000599)
Year 2009	0.00167*** (0.000591)	0.00167*** (0.000591)
Province : Newfoundland	-0.00218*** (0.000710)	-0.00218*** (0.000710)
Province : Nova Scotia	-0.00591*** (0.000567)	-0.00591*** (0.000567)
Province : New Brunswick	-0.00797*** (0.000685)	-0.00797*** (0.000685)
Province : Ontario	-0.00612*** (0.000498)	-0.00612*** (0.000498)
Province : Manitoba	-0.00593*** (0.000635)	-0.00593*** (0.000635)
Province : Saskatchewan	-0.00652*** (0.000666)	-0.00652*** (0.000666)
Province : Alberta	-0.00709*** (0.000553)	-0.00709*** (0.000553)
Province : British Columbia	-0.00412*** (0.000530)	-0.00412*** (0.000530)
Education : Highschool	0.00240*** (0.000402)	0.00240*** (0.000402)
Education : Trade diploma	0.00385*** (0.000476)	0.00385*** (0.000476)
Education : College/University	0.000128 (0.000392)	0.000128 (0.000392)
Rural	0.00122*** (0.000349)	0.00122*** (0.000349)
Age 25 to 34	0.0165*** (0.000459)	0.0165*** (0.000459)
Age 35 to 49	0.0122*** (0.000411)	0.0122*** (0.000411)
Age 50 to 64	0.00913*** (0.000379)	0.00913*** (0.000379)
Household size of 2	-0.00513*** (0.000361)	-0.00513*** (0.000361)
Household size of 3	-0.0125*** (0.000480)	-0.0125*** (0.000480)
Household size of 4	-0.0162*** (0.000526)	-0.0162*** (0.000526)
Household size of 5	-0.0192*** (0.000688)	-0.0192*** (0.000688)
Household size of 6 or more	-0.0255*** (0.000981)	-0.0255*** (0.000981)
Children (yes/no)	-0.00322*** (0.000513)	-0.00322*** (0.000513)
Constant	-0.0529*** (0.00150)	-0.0529*** (0.00150)
Observations	68,417	68,417

Standard errors in parentheses

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

Censored on left to account for high amount of zeroes for w.

## Appendix 5 : OLS regression table

Table 3: OLS regression - Amount to consume				
VARIABLES	(1) OLS		(2) OLS - excl. zeroes	
ln(Alcohol price/Other goods price)	0.00622	(0.00942)	0.00852	(0.0116)
ln(Total spending/Other goods price)	0.00507***	(0.000218)	-0.000419	(0.000285)
Year 2005	-0.000523	(0.000330)	-0.000580	(0.000408)
Year 2006	0.00224***	(0.000434)	0.00246***	(0.000520)
Year 2007	0.00231***	(0.000442)	0.00241***	(0.000531)
Year 2008	0.00166***	(0.000480)	0.00204***	(0.000581)
Year 2009	0.00182***	(0.000474)	0.00225***	(0.000572)
Province : Newfoundland	-0.00153***	(0.000568)	-0.000918	(0.000694)
Province : Nova Scotia	-0.00414***	(0.000454)	-0.00345***	(0.000553)
Province : New Brunswick	-0.00500***	(0.000545)	-0.00353***	(0.000675)
Province : Ontario	-0.00367***	(0.000400)	-0.00224***	(0.000482)
Province : Manitoba	-0.00400***	(0.000507)	-0.00315***	(0.000621)
Province : Saskatchewan	-0.00452***	(0.000532)	-0.00387***	(0.000652)
Province : Alberta	-0.00401***	(0.000443)	-0.00213***	(0.000538)
Province : British Columbia	-0.00150***	(0.000426)	0.000846	(0.000516)
Education : Highschool	0.000273	(0.000315)	-0.00233***	(0.000412)
Education : Trade diploma	0.00111***	(0.000378)	-0.00208***	(0.000476)
Education : College/University	-0.00187***	(0.000309)	-0.00512***	(0.000397)
Rural	0.000730***	(0.000277)	0.000290	(0.000345)
Age 25 to 34	0.0119***	(0.000366)	0.0107***	(0.000452)
Age 35 to 49	0.00858***	(0.000325)	0.00810***	(0.000413)
Age 50 to 64	0.00653***	(0.000298)	0.00676***	(0.000388)
Household size of 2	-0.00523***	(0.000286)	-0.00818***	(0.000363)
Household size of 3	-0.0106***	(0.000383)	-0.0127***	(0.000471)
Household size of 4	-0.0135***	(0.000422)	-0.0152***	(0.000512)
Household size of 5	-0.0153***	(0.000552)	-0.0164***	(0.000667)
Household size of 6 or more	-0.0183***	(0.000771)	-0.0184***	(0.000981)
Children (yes/no)	-0.00305***	(0.000412)	-0.00358***	(0.000497)
Constant	-0.00875***	(0.00116)	0.0321***	(0.00155)
R squared	0.0433		0.0511	
Observations	68,417		52,397	

Standard errors in parentheses

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1



## Appendix 6 : OLS regression table with interaction terms

Table 4: OLS regression with interactions - Amount to consume		
VARIABLES	OLS	
ln(Alcohol price/Other goods price)	0.0469***	(0.0180)
ln(Total spending/Other goods price)	-0.00308***	(0.000558)
Year 2005	-0.000595	(0.000407)
Year 2006	0.00244***	(0.000520)
Year 2007	0.00241***	(0.000530)
Year 2008	0.00203***	(0.000581)
Year 2009	0.00227***	(0.000572)
Province : Newfoundland	-0.00110	(0.000696)
Province : Nova Scotia	-0.00347***	(0.000553)
Province : New Brunswick	-0.00353***	(0.000675)
Province : Ontario	-0.00238***	(0.000483)
Province : Manitoba	-0.00315***	(0.000621)
Province : Saskatchewan	-0.00390***	(0.000652)
Province : Alberta	-0.00223***	(0.000539)
Province : British Columbia	0.000803	(0.000516)
Education : Highschool	-0.0144***	(0.00398)
Education : Trade diploma	-0.00791	(0.00483)
Education : College/University	-0.0317***	(0.00370)
Rural	0.000275	(0.000345)
Age 25 to 34	0.0110***	(0.000454)
Age 35 to 49	0.00828***	(0.000414)
Age 50 to 64	0.00689***	(0.000388)
Household size of 2	-0.00812***	(0.000363)
Household size of 3	-0.0126***	(0.000470)
Household size of 4	-0.0153***	(0.000511)
Household size of 5	-0.0165***	(0.000667)
Household size of 6 or more	-0.0184***	(0.000980)
Children (yes/no)	-0.00360***	(0.000496)
Interaction educ. High. with Price	-0.0321	(0.0196)
Interaction educ. Trade. with Price	-0.0514**	(0.0225)
Interaction educ. Col/Univ. with Price	-0.0527***	(0.0177)
Interaction educ. High. with Exp.	0.00222***	(0.000692)
Interaction educ. Trade. with Exp.	0.00119	(0.000831)
Interaction educ. Col/Univ. with Exp.	0.00461***	(0.000639)
Constant	0.0467***	(0.00308)
R squared	0.0524	
Observations	52,397	

Standard errors in parentheses

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

## Appendix 7 : Confidence intervals and standard errors with interaction terms

The average overall elasticity for price and expenditure are respectively as follows:

$$w_i = \alpha_i + \beta_0 P_i + \beta_1 P_i * E_{high} + \beta_2 P_i * E_{trade} + \beta_3 P_i * E_{col/uni} + \dots$$

$$\beta = \frac{1}{N} \sum_i \frac{\partial w_i}{\partial P_i} = \beta_0 + \beta_1 \overline{E_{high}} + \beta_2 \overline{E_{trade}} + \beta_3 \overline{E_{col/uni}}$$

The distribution of the total effect on price/expenditure is:

$$\beta \sim N \left( \widehat{\beta_0} + \widehat{\beta_1} \overline{E_{high}} + \widehat{\beta_2} \overline{E_{trade}} + \widehat{\beta_3} \overline{E_{col/uni}}, V \left( \beta_0 + \beta_1 \overline{E_{high}} + \beta_2 \overline{E_{trade}} + \beta_3 \overline{E_{col/uni}} \right) \right)$$

where  $\beta$  is the marginal effect of the overall price on the dependent variable.

The variance needed to compute the corresponding confidence intervals can be estimated as follows:

$$\begin{aligned} V \left( \beta_0 + \beta_1 \overline{E_{high}} + \beta_2 \overline{E_{trade}} + \beta_3 \overline{E_{col/uni}} \right) = & \\ & V(\beta_0) + (\overline{E_{high}})^2 V(\beta_1) + (\overline{E_{trade}})^2 V(\beta_2) \\ & + (\overline{E_{col/uni}})^2 V(\beta_3) + 2Cov(\beta_0, \beta_1)(\overline{E_{high}}) \\ & + 2Cov(\beta_0, \beta_2)(\overline{E_{trade}}) \\ & + 2Cov(\beta_0, \beta_3)(\overline{E_{col/uni}}) \\ & + 2Cov(\beta_1, \beta_2)(\overline{E_{high}})(\overline{E_{trade}}) \\ & + 2Cov(\beta_1, \beta_3)(\overline{E_{high}})(\overline{E_{col/uni}}) \\ & + 2Cov(\beta_2, \beta_3)(\overline{E_{trade}})(\overline{E_{col/uni}}) \end{aligned}$$

This is the method employed to compute the confidence intervals in the graphs relating to total elasticity of price and expenditure.

## Appendix 8 : RIFREG results tables

Unconditional quantile regressions using 200 bootstrap replications				
VARIABLES	Quantile 0.80	Quantile 0.85	Quantile 0.90	Quantile 0.95
ln(Alcohol price/Other goods price)	0.0503 (0.0332)	0.0975** (0.0402)	0.144** (0.0644)	0.169* (0.100)
ln(Total spending/Other goods price)	4.83e-05 (0.000973)	-0.00189 (0.00131)	-0.00464** (0.00194)	-0.0140*** (0.00380)
<b>Control variables</b>				
Year 2005	-0.00102 (0.000721)	-0.000392 (0.000832)	-6.79e-05 (0.00136)	0.000652 (0.00231)
Year 2006	0.00351*** (0.000841)	0.00564*** (0.000993)	0.00623*** (0.00139)	0.00861*** (0.00222)
Year 2007	0.00379*** (0.000883)	0.00645*** (0.00107)	0.00698*** (0.00153)	0.0113*** (0.00235)
Year 2008	0.00282*** (0.000978)	0.00411*** (0.00118)	0.00507*** (0.00160)	0.00821*** (0.00264)
Year 2009	0.00322*** (0.000997)	0.00559*** (0.00117)	0.00645*** (0.00178)	0.00748*** (0.00240)
Province : Newfoundland	-0.00175 (0.00140)	-0.00105 (0.00144)	-0.00229 (0.00234)	-0.00138 (0.00342)
Province : Nova Scotia	-0.00494*** (0.00101)	-0.00485*** (0.00118)	-0.00616*** (0.00174)	-0.00742*** (0.00270)
Province : New Brunswick	-0.00382*** (0.00110)	-0.00518*** (0.00140)	-0.00808*** (0.00222)	-0.00973*** (0.00355)
Province : Ontario	-0.00404*** (0.000785)	-0.00371*** (0.00103)	-0.00438*** (0.00152)	-0.00248 (0.00259)
Province : Manitoba	-0.00611*** (0.00113)	-0.00602*** (0.00125)	-0.00669*** (0.00199)	-0.00565* (0.00333)
Province : Saskatchewan	-0.00736*** (0.00109)	-0.00782*** (0.00131)	-0.00931*** (0.00205)	-0.00772** (0.00352)
Province : Alberta	-0.00556*** (0.000856)	-0.00461*** (0.00126)	-0.00281* (0.00162)	0.00174 (0.00284)
Province : British Columbia	0.000779 (0.000903)	0.00277** (0.00112)	0.00498*** (0.00175)	0.00810*** (0.00300)
Education : Highschool	-0.00564 (0.00713)	-0.0101 (0.00939)	-0.00638 (0.0139)	-0.0325 (0.0258)
Education : Trade diploma	0.0259*** (0.00874)	0.0237* (0.0125)	0.0285 (0.0187)	-0.00931 (0.0313)
Education : College/University	-0.0197*** (0.00663)	-0.0332*** (0.00802)	-0.0527*** (0.0126)	-0.121*** (0.0247)
Rural	0.000961 (0.000593)	0.00130* (0.000746)	0.00104 (0.00120)	0.000685 (0.00181)
Age 25 to 34	0.0161*** (0.000867)	0.0203*** (0.00121)	0.0282*** (0.00179)	0.0382*** (0.00328)
Age 35 to 49	0.0115*** (0.000743)	0.0140*** (0.000988)	0.0195*** (0.00151)	0.0266*** (0.00266)
Age 50 to 64	0.00982*** (0.000669)	0.0118*** (0.000892)	0.0159*** (0.00142)	0.0205*** (0.00233)
Household size of 2	-0.00873*** (0.000729)	-0.0130*** (0.000915)	-0.0210*** (0.00160)	-0.0386*** (0.00308)
Household size of 3	-0.0171*** (0.000883)	-0.0222*** (0.00124)	-0.0316*** (0.00211)	-0.0514*** (0.00367)
Household size of 4	-0.0228*** (0.00101)	-0.0287*** (0.00132)	-0.0402*** (0.00224)	-0.0609*** (0.00399)
Household size of 5	-0.0249*** (0.00119)	-0.0304*** (0.00148)	-0.0416*** (0.00252)	-0.0607*** (0.00417)
Household size of 6 or more	-0.0267*** (0.00145)	-0.0332*** (0.00186)	-0.0432*** (0.00270)	-0.0637*** (0.00447)
Children (yes/no)	-0.00586*** (0.000882)	-0.00858*** (0.000961)	-0.00991*** (0.00136)	-0.0115*** (0.00211)

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**Interaction variables**

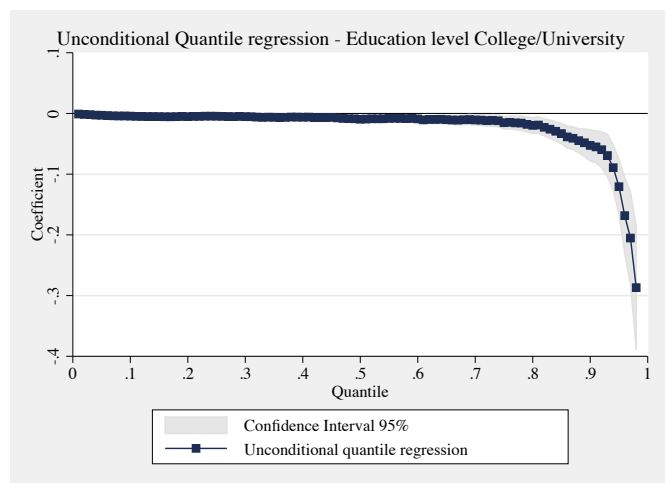
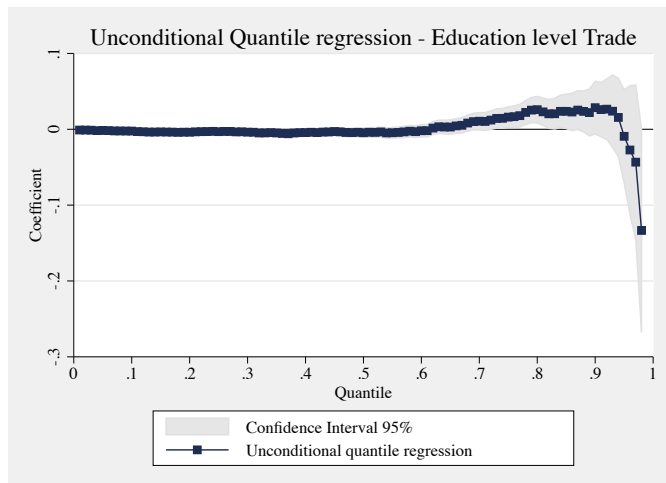
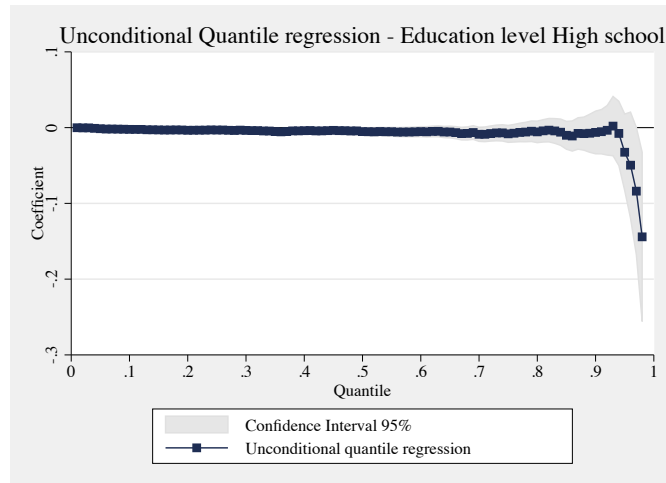
Interaction : Price ratio*Education highschool	-0.0578 (0.0357)	-0.0868* (0.0487)	-0.100 (0.0670)	-0.125 (0.116)
Interaction : Price ratio*Education trade	-0.0629 (0.0400)	-0.140*** (0.0515)	-0.133* (0.0747)	-0.145 (0.120)
Interaction : Price ratio*Education College/University	-0.0717** (0.0293)	-0.126*** (0.0414)	-0.144** (0.0628)	-0.138 (0.108)
Interaction : Expenditure ratio*Education highschool	0.000779 (0.00122)	0.00150 (0.00161)	0.000297 (0.00238)	0.00377 (0.00445)
Interaction : Expenditure ratio*Education trade	-0.00443*** (0.00150)	-0.00406* (0.00212)	-0.00557* (0.00317)	2.12e-05 (0.00529)
Interaction : Expenditure ratio*Education College/University	0.00229** (0.00114)	0.00426*** (0.00138)	0.00647*** (0.00214)	0.0163*** (0.00413)
<b>Constant</b>	0.0417*** (0.00539)	0.0631*** (0.00732)	0.0987*** (0.0110)	0.189*** (0.0216)
<b>Observations</b>	52,397	52,397	52,397	52,397
<b>R-squared</b>	0.038	0.040	0.038	0.035

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Standard errors in parentheses  
p<0.01, p<0.05, p<0.1

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## Appendix 9 : Quantile analysis of education effect on expenditure share



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