RISK FACTORS ASSOCIATED WITH ALCOHOL ABUSE IN CANADA: LONGITUDINAL NATIONAL POPULATION HEALTH SURVEY

by

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ABSTRACT

Alcohol beverages are popular across Canada and approximately 3.2% of the Canadian population who are older than 15 abused alcohol or were dependent on this substance in 2012 (Canadian Centre on Substance Abuse, 2014, p. 1). Furthermore the estimated total cost of alcohol-related harm to Canadians was $14.6 billion per year (Canadian Centre on Substance Abuse, 2014, p. 1). Discrete duration analysis and a few different econometric functional forms are used to examine transition from moderate to heavy drinking based on the longitudinal National Population Health Survey which consists of nine cycles collected between 1994 and 2011. The findings suggest that after statistically controlling for variation in other factors men are more likely to become heavy drinkers than women and individuals who are between 15 and 34 years old are more likely to become heavy drinkers than people in older age groups. With regard to gender differences, smoking is a significant risk factor for alcohol abuse, especially among women. Furthermore under some particular circumstances the likelihood of becoming a heavy drinker is similar among men and women.

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1. INTRODUCTION

According to Health Canada, 78.4% of Canadians reported drinking alcohol in 2011 (Statistic Canada, 2012), which indicates that alcohol beverages are popular across Canada. Furthermore in 2012 approximately 3.2% of the Canadian population who are older than 15 abused alcohol or were dependent on this substance (Canadian Centre on Substance Abuse, 2014, p. 1). According to a comprehensive cost study, conducted in 2002, the estimated total cost of alcohol-related harm to Canadians was $14.6 billion per year (Canadian Centre on Substance Abuse, 2014, p. 1) which includes the lost productivity due to disability and premature death ($7.1billion), direct health care costs ($3.3billion), and direct enforcement costs ($3.1 billion). Thus, alcohol consumption, especially alcohol abuse, is associated with social costs related to health, productivity, and violence. Under these circumstances policy makers may be interested in lowering these costs. Given such interests conveying a set of alcohol abuse risk factors may be informative. The main purpose is examining risk factors related to alcohol abuse.

From a policy standpoint, examining risk factors associated with alcohol abuse may be informative for those interested in reducing alcohol-related social costs. Although it is useful from a policy standpoint, there are few empirical studies that focus on the risk factors related to alcohol abuse in Canada. Furthermore very few published papers examine the hazard of transition to heavy drinking. The Canadian National Population Health Survey (NPHS) is longitudinal and is used to examine this transition. A few published papers have used this survey to examine the relationship between alcohol abuse and depression (Wang & Patten, 2001; Bulloch, Lavorato,

Williams & Patten, 2012) and they do not examine the hazard of transition. In addition to depression other risk factors potentially associated with the transition to heavy drinking are examined. In order to contribute to this literature, survival analysis is used to examine the NPHS.

Survival analysis is used to examine the transition from strictly positive non-heavy drinking to heavy drinking. The NPHS data are longitudinal and report information over nine years. This essay is an extension of a master essay by Stephen Murphy (2008) in which the NPHS is examined over a five year panel. Murphy (2008) applied discrete duration analysis and used a logit model in order to examine the transition to alcohol abuse. Murphy (2008) is extended by examining data collected over a wider time range and by employing an alternative econometric functional form. Furthermore other explanatory variables are examined. This paper consists of 5 sections. The first section is an introduction and the following section reviews a set of the articles on alcohol abuse and survival analysis. Section 3 generally discusses the data and methods employed and Section 4 includes descriptive statistics as well as regression results. The last section involves conclusions and discussion.

2. LITERATURE REVIEW

All the studies reviewed are related to alcohol abuse and alcohol-related social costs. In this review a number of papers related to this topic are summarized. These papers examine a number of factors potentially related to alcohol abuse and few of them focus on the alcohol abuse in Canada. These studies found that the main factors are depression, gender, parental alcohol abuse, employment status, and age. A comprehensive review of alcohol-related social cost in high-income countries indicates that the health care cost related to heavy drinking in Canada is higher than average health care costs associated with other factors across high-income countries (Mohapatra et al., 2010).

As mentioned above Murphy (2008) applies discrete duration analysis and a logit model in order to examine alcohol abuse. The youngest age group in Murphy (2008) is 15 to 19 and after controlling for other factors this age group has the highest likelihood of transition to heavy drinking. Murphy (2008) also found that males have more than 5 times the odds of transitioning to heavy drinking than females do. Another finding in Murphy (2008) is that people who are married or live with a partner are less likely to become heavy drinkers than people who are divorced or single.

Mohapatra et al. (2010) is a comprehensive review of alcohol-related social cost in high-income countries. They suggest that the indirect costs of alcohol consumption, such as loss of productivity, are more than alcohol-related direct costs, such as health care costs and law enforcement costs. In an overview table of alcohol-related

social costs in 2006, total alcohol cost as percent gross domestic product in Canada was 1.18 which is lower than the average value across high-income countries (1.57); in contrast, the health care alcohol cost as percent gross domestic product was 0.27 which is higher than average value across high-income countries (0.23). Another table in Mohapatra et al. (2010) provides an overview of the social costs related to the heavy drinking or alcohol dependence; in 2006, total alcohol cost as percent gross domestic product in Canada was 0.72 which is lower than the average value across high-income countries (0.96); again in contrast, health care alcohol cost as percent gross domestic product was 0.16 which is higher than average value across high-income countries (0.14). The authors also suggest that measures aimed at reducing alcohol-related costs be implemented.

JianLi Wang and Scott B Patten (2001) suggest that alcohol consumption levels are not a risk factor for major depression; alcohol consumption levels included any drinking, drinking daily, having more than 5 or more drinks on one occasion, and having more than 1 drink daily on average. They also found that women who drink large amounts per occasion may have a strong relationship with major depression. Stephen Murphy (2008, p. 7) also summarizes JianLi Wang and Scott B Patten (2002) and points out that major depression in the first cycle of a sample has no statistically significant effect on the likelihood of starting to drink in the future when other cycles are collected. In contrast when they analyzed men and women separately, they found that major depression is a significant risk factor for future alcohol abuse among women.

Andrew Bulloch, Dina Lavorato, Jeanne Williams and Scott Patten (2012) examine

the association between alcohol consumption and major depression by analyzing NPHS longitudinal data. They found no association between alcohol consumption and MDE (major depressive episodes). In contrast, when alcohol dependence contained in the model, a strong association between alcohol dependence and MDE can be observed among men: men with alcohol dependence could increase the risk of MDE, and men who suffered in major depression could also increase the risk of alcohol dependence.

Jiafang et al. (2004) estimate risk factors of alcohol abuse in urban China during 2003. The subjects are 15 to 65-year-old urban Chinese adults. They estimate a logistic model and find that gender, age, personal income, smoking status, and mother's drinking behavior is related to alcohol abuse. The results suggest that men are more likely to start abusing alcohol and the likelihood of alcohol abuse increased by 0.37% as age increased by 1 year. Jiafang et al. (2004, p. 1106) also find that individuals who have higher personal income are more likely to become alcohol abusers. Furthermore they mention that drinkers who currently smoke are more likely to become alcohol abusers (Jiafang et al. (2004, p. 1106)). With regard the drinking behavior of a person's mother, Jiafang et al. (2004, p. 1109) find that drinkers have a higher likelihood of becoming alcohol abusers when his or her mother drinks very frequently. In addition, they find that the effect of a fathers' drinking behavior is non-significant.

French et al. (2014) examine gender differences in alcohol consumption among middle-aged and older adults in Australia, the United States (US) and South Korea. They find that men are more likely to be heavy drinkers than women in these three

countries, especially Korean men. In the US, they found that men who had higher levels of education are less likely to become heavy drinkers, but for women, heavy drinking is associated with higher education. In Korea, they found that female individuals without a partner are more likely to become heavy drinkers. They also suggest that heavy drinking is associated with higher income in Australia. Agic et al. (2015) also examine the gender differences with regard to alcohol abuse and risk drinking among Ontario adults. The sample was collected by the Centre for Addiction and Mental Health (CAMH) between January 2005 and December 2010. They examine gender differences among ethnic groups. Logistic regression analysis was used and they find gender differences across all ethnic groups, and men have higher likelihood to be risk drinkers than women. The results also indicate that the degree of gender differences varies across ethnic groups. North Europeans had the smallest gender difference and the widest gender difference was observed among South Asians.

Bosque-Prous et al. (2015) estimated whether individual job loss and contextual changes in unemployment influence hazardous drinking during economic recession. They analyze a longitudinal sample and estimate a multilevel Poisson model. The results suggest that an increase in the national unemployment rate during an economic recession is associated with a higher risk of hazardous drinking. They also find that increases in alcohol consumption due to job losses during an economic recession are stronger among people age 50 to 64. In addition, job loss during a recession had a positive effect on hazardous drinking among middle-aged adults.

The studies reviewed above focus on alcohol-related problems and a number of

factors related to alcohol abuse. They suggest that men, people who are unemployed, and individuals who are between 15 and 19 years old are more likely to become heavy drinkers; people with major depression and parental alcohol abuse history also have a higher likelihood of heavy drinking. Most of these studies estimate a logistic regression model and few of them examine Canadian data. Even fewer studies apply duration analysis in order to examine when people make the transition to heavy drinking. This may be important if the likelihood of becoming a heavy drinker, the likelihood of remaining a heavy drinker, and/or the likelihood of quitting each involve very different factors, effects, and/or circumstances. In the following sections 18 years of longitudinal data are analyzed and other regression models are used to examine risk factors associated with alcohol abuse. The factors discussed above are explanatory variables examined below.

3. DATA AND ECONOMETRIC FUNCTIONAL FORM

3.1 Data

This study is based on information in the Canadian National Population Health Survey (NPHS). The NPHS is longitudinal, and has been collected every two years between 1994 and 2011. It reports the health status of Canadians and contributes to understanding the determinants of health. Below cycles 1-9 are used to examine when people make the transition from moderate to heavy alcohol consumption. The sample examined consists of 17,276 respondents; cycle 1 was collected in 1994-1995 and cycle 9 was collected in 2010-2011.

Below individuals between and including 15 to 74 years old are examined. Very few individuals under age 15 may drink heavily and the factors that motivate them to do so may be very different than for older people. For this reason, individuals 15 or older are examined. Like young individuals older people may be less likely to make the transition to heavy drinking and the factors that motivate them to may be very different. For example older people who have retired, have a low income, and a certain level of social activity may be less healthy and have a very different likelihood of becoming heavy drinkers than younger people under similar circumstances. Furthermore individuals who are very likely to become heavy drinkers may have a lower life expectancy and hence are less likely to be in the sample at older age levels. In summary individuals age levels 15 to 74 are examined.

The NPHS is collected every two years subsequent to the beginning of the panel. The dependent variable is specific to the previous year, between adjacent cycles there is a one year gap that is not observed and this could affect the results somewhat. For example, individuals who report casual drinking in 1994 (cycle 1) and 1996 (cycle 2), could have been heavy drinkers between these two cycles and this will not be reported in the sample. This will be a minor issue if most people who make the transition remain heavy drinkers for at least a year. The variables used in this paper are introduced below.

3.11 Dependent Variable

Sample responses to the question “how often in the past 12 months have you had 5 or more drinks on one occasion?” is used to construct the dependent variable. The

main topic is the determinants of transition from casual to heavy drinking and there are different ways to define this transition. Francesca JA Perlman (2010) suggests that the type of the alcohol, such as wine or Vodka, may affect the definition of heavy drinking. He also mentioned that the quantity consumed per occasion in grams is normally used in Russia. With regard to this subject the Canadian Drug Summary (Canadian Centre on Substance Abuse, 2014, p. 2) defines risky drinking differently for men and women. Men who consume four or more drinks per occasion monthly or more often in the past year are defined as risky drinkers and for women, the definition is more than three drinks per occasion.

The *Diagnostic and Statistical Manual of Mental Disorders* (DSM-5) defines heavy drinkers as those who have had 5 or more drinks at least 1 time a week over the past year, this implies that heavy drinkers have had 5 or more drinks at least 52 times over the past year. As mentioned above one NPHS question on heavy drinking is, "how often in the past 12 months have you had 5 or more drinks on one occasion?" Thus, an individual who reports consuming 5 or more drinks at least 52 times in the past 12 months is considered to be a heavy drinker.

Below the time between entering the sample and the first transition reported is examined. This transition is the movement from casual to heavy drinking. When individuals report heavy drinking in cycle 1, the time at which transition to heavy drinking took place is uncertain and hence these individuals are excluded from the sample. For each cycle individuals who have not yet reported transition are included up until and including the year that the transition occurs or right censoring takes place.

Below the dependent variable is the hazard of reporting transition to heavy drinking over the previous year in the following cycle. Transition examples are in Table 1. Everyone examined enters the sample when in cycle 1 and no one enters after this. An important factor to note is that only the first reported transition is examined and respondents are excluded after they report heavy drinking for the first time. Individuals who report heavy drinking or never drinking in cycle 1 are left out. All cycle 9 observations are right censored since this is the final cycle examined. Table 1 illustrates how the dependent variable is constructed.

Table 1: Examples for the "Transition" variable

ID	Cycle	Heavy Drinker	Transition
A	1	1	.
A	2	0	.
A	3	0	.
A	4	0	.
A	5	1	.
A	6	0	.
A	7	0	.
A	8	0	.
A	9	0	.
B	1	0	1
B	2	1	.
B	3	0	.
B	4	0	.
B	5	0	.
B	6	1	.
B	7	0	.
B	8	0	.
B	9	1	.
C	1	0	0
C	2	0	0
C	3	0	0

C	4	0	1
C	5	1	.
C	6	0	.
C	7	0	.
C	8	1	.
C	9	0	.
D	1	0	0
D	2	0	0
D	3	0	0
D	4	0	0
D	5	0	0
D	6	0	0
D	7	0	0
D	8	0	0
D	9	0	.

For example, individual A reports heavy drinking in cycle 1. As mentioned above it is not clear when this first took place and hence this individual is omitted. Individual B is a casual drinker in cycle 1 and reports heavy drinking in cycle 2. This means that for individual B the dependent variable is equal to 1 in cycle 1. Because just the first transition is examined all of the observations collected after this are omitted. Individual C reports transition to heavy drinking over the previous year in cycle 5, which means that the dependent variable is equal to one in cycle 4 and zero in the previous cycles. All the 'transition' observations for individual D in Table 1 are equal to zero, which means that he or she is right censored and in other words never reports heavy drinking.

3.12 Explanatory Variables

There are two types of explanatory variables: those that are by definition constant over time at risk and those that may vary over this time span. Gender, parental

alcohol history, and immigration status are time constant covariates; others, such as age, marital statues, geographical location, income, education, depression, the price of alcohol, smoking, and employment status can vary over time at risk.

Time Constant Variables

For men a sex indicator variable is equal to 1, and otherwise equal to 0. As we mentioned in the literature review, men have a higher risk of becoming heavy drinkers than women (Zhang Jiafang, Wang Jiachun, Lu Yunxia, Qiu Xiaoxia and Fang Ya, 2004). It is also possible that other risk factors have different effects on the hazard of transition for men and women. Thus, in this paper, separate analysis is done for men and women.

Immigration status is also a time constant indicator variable. In Canada, there are approximately 6,775,800 foreign-born immigrants and this makes up 20.6% of the total population (Statistic Canada, 2011). Magdalena Szaflarski, Lisa A. Cubbins and Jun Ying (2010) find evidence that a person born outside of the US has a lower risk of becoming a heavy drinker as compared to US-born people. Ali JS, McDermott S, Gravel RG (2004) also find that an immigrant has better health behaviors and conditions than people born in the country they reside in.

Parental alcohol abuse history is an explanatory variable examined. Parental alcohol behaviors might affect future generations. Joseph W. LaBrie, Savannah Migliuri, Shannon R. Kenney and Andrew Lac (2010) find that family history of alcohol abuse is a risk factor for heavy alcohol use and they also find higher alcohol-related

problems among college students; what is more, Joseph W. LaBrie, Shannon R. Kenney, Andrew Lac and Savannah F. Migliuri (2009) find that the parental alcohol history has a stronger negative effect among females than among males. Thus, a binary variable indicating parental alcohol abuse history is included.

Time Varying Variables

A set of binary variables are used to examine age differences and the likelihood of alcohol transition is assumed to be different among various age groups. Young people may have a higher risk of becoming heavy drinkers; one possible reason is that young people may tend to disregard potential negative consequences of heavy drinking. The age group of 15 to 34 serves as a reference category and the following three other age categories are included: 35-44, 45-59, 60-74.

Within these age groups the risk of transition may vary across birth year cohorts. For example, the likelihood of transition among people who are between 15 and 34 years old may vary across birth cohorts. In order to examine such differences the age indicators mentioned above are crossed with a set of birth year indicators. In particular the following four birth year categories are examined: 1920-1939, 1940-1959, 1960-1979 and 1980-1999. These age and birth year indicator variables are crossed, giving 16 categories. In order to examine the robustness of findings to the functional form, one set of parameters are arrived at with the age crossed with birth year covariates, and a second set of findings are arrived at with separate age and birth year covariates. An important factor to note is that birth year plus age is equal to calendar year, which means these three variables are perfectly correlated.

For identification purposes, calendar years are left out, and after estimation, the decade born and age parameters can be combined in order to examine the hazard of transition associated with particular calendar years.

Marital status may affect alcohol consumption. Wenbin Liang and Tanya Chikritzhs (2012) find that a married person has a lower likelihood of hazardous drinking, especially a young and middle age person. On the contrary, an individual who never married, divorced or separated has a strong risk of alcohol consumption. People who have never married or are single and have divorced in the past serve as a reference category, and individuals who are married or living with partners are in the another category.

Each person's province of residence is also included. There are ten provinces in Canada and across these provinces public policies related to the alcohol such as drunk driving laws and minimum age requirements are different (Giesbrecht et al, 2013). For example, the legal drinking age is 18 in Alberta, Manitoba and Quebec (Giesbrecht et al, 2013, p. 34). Given these policy differences and unobserved factors across provinces that may have motivated them a person's province of residence may be related to alcohol consumption. Thus, ten provincial binary variables are examined and Ontario serves as a reference category.

Living in urban or rural areas may also affect alcohol consumption. Individuals living in urban areas might have easier to access alcohol. One possible reason is that people living in urban areas might be closer to the liquor stores, bars or pubs, making it more convenient for them to consume alcohol than people living in rural

areas. For this reason an urban binary variable is included and rural residence serves as a reference category.

By definition for normal goods demand increases when income increases and falls when income decreases. Income may influence alcohol consumption. Income might also be correlated with other potentially important variables which may affect the alcohol consumption, such as social status and dwelling environment. For example, people who live in a non-heavy drinking environment may be less likely to become heavy drinkers. Therefore a set of income indicators are included. In the NPHS household income per person is divided into five levels and they are listed in Table 2. These income per person indicators are each included and the lowest income group serves as a reference category.

Table 2: Income level description

Lowest income	Less than $10,000 and 1 to 4 people Less than $15,000 and 5 or more people
Lower middle income	$10,000 to $14,999 and 1 to 2 people $10,000 to $19,999 and 3 to 4 people $15,000 to $29,999 and 5 or more people
Middle income	$15,000 to $29,999 and 1 or 2 people $20,000 to $39,999 and 3 or 4 people $30,000 to $59,999 and 5 or more people
Upper middle income	$30,000 to $59,000 and 1 or 2 people $40,000 to $79,000 and 3 or 4 people $60,000 to $79,000 and 5 or more people
Highest income	$60,000 or more and 1 to 2 people $80,000 or more and 3 or more people

Health behaviors may be inter-related with education levels in a number of different

ways. For example, highly educated individuals may have stronger self-control and hence avoid negative health behaviors. Furthermore, people with higher education may know more about the health effects of alcohol abuse and may devote more attention to their health. Another possible reason is that people with higher education spend more time investing in education, and hence have less leisure time which may be associated with alcohol consumption. It is also possible that the stress of education encourages more drinking. Thus, the following four education categories are examined: less than high school, high school graduate, some post secondary education, and post secondary graduate. The base category is less than high school.

An individual's state of mind may also have an effect on alcohol consumption. As mentioned in the literature review, depression may increase the risk of alcohol dependence. Therefore, a binary variable identifies whether or not a person suffers from major depression. In the NPHS, individuals with a depression score of 0.9 or higher indicates a major depressive episode during the previous year.

As previous research reveals, smoking - another addictive variable - has a close relationship with the alcohol abuse (Jurgen Rehm et al, 2005). Changes in smoking may encourage people to alter how much they drink, and changes in drinking may alter how much they smoke. Furthermore other missing covariates may be associated with smoking and drinking, for example, risky people may be more likely to participate in risky behaviors, such as smoking and drinking. Therefore, compared to non-smokers, daily smokers might be at a higher risk to become heavy drinkers; it is easy for them to transfer the risk behavior from smoking to drinking. For this reason smoking indicator variables are examined. The following three binary

variables are included: non-smokers, occasional smokers and daily smokers. Non-smokers serve as a reference category. In the future it may be informative to examine both smoking and drinking dependent variables.

For any goods, price is a potentially important factor with regard to both supply and demand. The following information was acquired from Statistic Canada's CANSIM and used to calculate the price of alcohol: interprovincial alcohol price (monthly), intercity alcohol price, interprovincial all goods price (monthly) and intercity all goods price. A twelve month average real price of alcohol is merged with the NPHS based on the province of residence and the month during which the NPHS interview took place.

Employment status is another explanatory variable. The change of employment status may affect individuals' alcohol behavior. Favorable employment change may decrease the possibility of the alcohol abuse. In contrast high work stress may encourage alcohol consumption and then lower the productivity. Individuals who are not in labor force, such as women taking care of the baby at home, may be less likely to become heavy drinkers. The following three employment status variables are examined: unemployed, employed and not in labor force. Non-employment serves as a base category.

3.2 Econometric Functional Form and Interpretation

The main topic of this essay is transition from casual to heavy drinking. Each parameter estimate is assumed to have an asymptotically normal distribution across

samples. This transition takes place when a person's net utility associated with heavy drinking rather than casual casual drinking is strictly positive. This net utility is unobservable and the dependent variable examined is equal to one when net utility is strictly positive and equal to zero otherwise. Discrete duration analysis is applied since the sample reports relatively wide two year time spans within which the transition takes place.

The logit and complementary log-log models are well known and commonly applied in the field of discrete duration analysis. The complementary log-log model is:

$$hazard = 1 - \exp(-\exp(\beta_0 + \beta_1 x_1 + \beta_2 x_2 + ... + \beta_k x_k))$$

Each x is an explanatory variable and each $\hat{\beta}$ is a parameter estimate.

Under a complementary log-log model with all of the covariates are set equal to zero, the baseline hazard of transition is equal to 1-exp (-exp ($\hat{\beta}_0$)) for each individual. This model is extended by allowing the baseline hazard to be gamma distributed with a mean of one across individuals. This is called a Prentice, Gloeckler, Meyer (PGM) hazard model (Meyer, 1990). As the gamma variance parameter approaches zero, this PGM hazard model approaches a complementary log-log model. Under this PGM hazard model discrete time intervals within which the event takes place are examined and it is valuable to link this to a continuous time model.

Over continuous time the hazard of failure is assumed to be a function of continuous time at risk (t), a row vector of parameters (B), and a matrix of explanatory variables X:

$$\text{hazard} = F(t, X\beta)$$

The hazard of an event under a Cox model is proportional to a base line over continuous time (F(t_0)) and a set of covariates, along with the associated parameters, can enter the function exponentially (Cox 1972):

$$\text{hazard} = F(t_0) \exp(X\beta)$$

Under this model, the hazard ratio associated with a one unit increase in the kth covariate is exp(β_k). This proportional hazard ratio model is well known and has the advantage of simple interpretation. With a sample that reports discrete time intervals within which the event takes place these same parameters can be estimated under a complementary log-log model and under a PGM hazard model when the baseline hazard is gamma distributed across individuals. Since discrete time PGM and complementary log-log models are consistent with a continuous time Cox proportional hazard model exponentiated parameter estimates are calculated and these hazard ratios are discussed below. This interpretation is common in the duration literature.

4. RESULTS AND ANALYSIS

4.1 Descriptive statistics

All the descriptive statistics are calculated by using the NPHS sampling weights. Table 3 reports summary statistics for all respondents over the 9 cycles. In this sample: the number of male respondents (44.92%) is less than the number of female respondents (55.08%), nearly 36% of respondents reside in Ontario, over 85% of the respondents were born in Canada, and approximately 45% are either married or living with a significant other.

Table3: Summary statistics for the target population (All 9 cycles)

Variable	Percent
Sex	
female	55.08
male	44.92
Province of residence	
ONT	36.18
NFLD&LABRADOR	2
PEI	0.5
NS	3.29
NB	2.73
QUE	25.73
MAN	3.66
SASK	3.51
ALTA	10.15
BC	12.25
Age & year of birth	
1920s-30s, 45-59	2.13
1920s-30s, 60-74	14.85
1940s-50s, 15-34	0.13
1940s-50s, 35-44	12.07
1940s-50s, 45-59	27.18
1940s-50s, 60-74	5
1960s-70s, 15-34	24.5
1960s-70s, 35-44	11.87
1960s-70s, 45-59	2.28
Immigrant	
NO	85.33
YES	14.67
Married	
NO	41.61
YES	44.66
Other, Widowed or Separated	13.74

Table 4 presents information on transition from one cycle to the next. For example, there are 14,644 individuals who were casual drinkers and are eligible to become

heavy drinkers in the following cycle. Among these individuals, 3.37 percent become heavy drinkers in the next cycle.

Table 4: Statistics for those eligible for transition from one cycle to the next

cycle	number of individuals eligible for transition	weighted percentage with transition
1	14,644	3.37
2	12,928	2.75
3	11,418	2.48
4	10,047	2.71
5	8,793	2.53
6	7,681	2.7
7	6,580	2.53
8	5,712	1.68

The summary statistics in Table 5 suggest that people who have parental alcohol abuse history are more likely to become heavy drinkers in the following cycle than individuals who do not have parental alcohol abuse history. With regard to gender differences 4.12 percent of eligible males made the transition into the heavy drinkers while only 1.21 percent of females made the transition. With regard to age, the youngest group has the highest proportion of people making the transition into heavy drinking. Furthermore Table 5 indicates that individuals who are depressed are more likely to make the transition than those who are not depressed. Finally individuals born in the 1980s or 1990s are more likely to become heavy drinkers than individuals born during other time periods.

Table 5: Statistics for those eligible for transition from one cycle to the next

	Individuals eligible for transition	weighted percentage with transition
Sex		
female	45,946	1.21
male	37,468	4.12
Immigrant		
NO	71,150	2.71
YES	12,232	1.37
Parental alcohol abuse history		
NO	54,216	1.79
YES	9,167	2.52
Age		
15-34	22,347	5.47
35-44	14,008	2.48
45-59	18,486	1.6
60-74	11,640	0.69
Year of birth		
1920s-30s	12,720	0.7
1940s-50s	25,034	1.9
1960s-70s	21,846	3.26
1980s-90s	20,297	3.84
Province of residence		
ONT	30,121	2.51
NFLD&LABRADOR	1,663	3.43
PEI	419	3.06
NS	2,740	2.96
NB	2,272	2.52
QUE	21,420	2.46
MAN	3,049	2.77
SASK	2,923	2.64
ALTA	8,454	2.27
BC	10,202	2.45

Marital status		
NO	34,703	3.86
YES	37,246	1.56
Other, widowed or separated	11,456	1.56
Urban/Rural		
Rural	14,948	2.53
Urban	79,449	2.51
Smoking status		
Non-smoker	61,358	2.03
Daily smoker	12,827	5.33
Occasional smoker	3,015	6.71
Major depression		
No	70,454	2.75
Yes	3,356	3.74
Education		
Less than high school	21,643	4.14
High school	9,869	2.65
Some post secondary	18,622	3.02
Post graduate	26,520	1.53
Income		
Lowest	2,280	2.82
Low_Mid	6,076	2.42
Mid	17,949	2.25
Up_Mid	27,376	2.48
Highest	22,917	2.27
Employment status		
NO	2,902	4.7
YES	45,465	3.08
Not in labor force	24,498	1.8

In Table 6, the proportion who report transition among males and among females is reported for each cycle. For example, in cycle 1 nearly 5.24 percent of eligible males report transition to heavy drinking in the following cycle; among females, only 1.64

percent of them make the transition. Furthermore for each cycle a higher proportion of the males make the transition than females.

Table 6: gender difference in transition from one cycle to the next

Cycle	females eligible for transition	weighted percentage with transition	males eligible for transition	weighted percentage with transition
1	8,142	1.64	6,433	5.24
2	7,324	1.01	5,563	4.7
3	6,638	1.28	4,768	3.92
4	5,934	1.21	4,116	4.57
5	5,274	1.3	4,033	4.11
6	4,653	1.46	3,046	4.33
7	4,036	1.44	2,567	3.99
8	3,571	0.91	2,171	2.77

Table 7 reports that in cycle 1 there are 6,200 respondents who are non-drinkers, 474 respondents are heavy drinkers, and 9,831 respondents who are casual drinkers.

Table 7: Summary statistics for all individuals in cycle 1

	non-drinker	casual drinker	heavy drinker
cycle1	6,200	9,831	474

Table 8 reports the percentage who make the transition within each age level examined. For example, there are 1,438 individuals who were casual drinkers when 17 years old. Among these individuals, 10.93 percent become heavy drinkers and this is the highest transition rate among all of the age levels. In general individuals who are 20 or younger have a particularly high likelihood of transition.

Table 8: Summary statistics for each particular age level

Age	individuals eligible for transition	transition, weighted percentage	Age	individuals eligible for transition	transition, weighted percentage
15	1,474	6.75	**43**	1,480	2.33
16	1,572	9.30	**44**	1,455	1.54
17	1,438	10.93	**45**	1,420	2.33
18	1,339	9.95	**46**	1,425	1.23
19	1,225	9.47	**47**	1,416	2.23
20	1,108	7.25	**48**	1,415	1.85
21	1,008	4.89	**49**	1,345	1.62
22	1,002	4.92	**50**	1,328	0.89
23	934	4.32	**51**	1,321	2.12
24	931	2.92	**52**	1,267	1.47
25	892	4.91	**53**	1,179	1.31
26	948	2.70	**54**	1,170	0.94
27	917	3.23	**55**	1,084	1.35
28	970	1.62	**56**	1,057	0.71
29	983	1.93	**57**	1,053	1.23
30	1,040	2.51	**58**	1,021	1.30
31	1,082	2.25	**59**	983	1.48
32	1,128	2.05	**60**	950	1.36
33	1,142	2.40	**61**	911	0.71
34	1,215	1.55	**62**	853	0.35
35	1,300	2.89	**63**	903	0.69
36	1,325	2.56	**64**	813	0.53
37	1,358	2.44	**65**	840	0.87
38	1,343	2.86	**66**	794	0.45
39	1,415	2.37	**67**	791	1.32
40	1,409	2.71	**68**	733	0.61
41	1,485	1.94	**69-71**	2,138	0.18
42	1,438	1.87	**72-74**	1,913	0.67

4.2 Regression Results

Below one set of results arrived at with both male and female subjects are discussed. Furthermore the sample of males and the sample of females are separately examined.

With the unobserved heterogeneity term equal to one and all dummy variables set to equal zero the hazard of becoming a heavy drinker among males who face the average price cross the months and provinces examined ($\bar{p}$) is: $hazard_{male} = \exp(\beta_{0,male} + \beta_{p,male} * \bar{p})$ which is equal to 0.049. Among females who face this same price the hazard of becoming a heavy drinker is: $hazard_{female} = \exp(\beta_{0,female} + \beta_{p,female} * \bar{p})$ and this is equal to 0.034. These findings imply a male to female hazard ratio of $hazard_{male} / hazard_{female}$=1.42. This suggests that under these circumstances men have a 1.42 times higher hazard than women. When male and female samples are separately examined this same formula is used to calculate the male to female hazard ratio that is associated with other covariates.

Table 9 presents hazard ratios arrived at under a PGM model. The first row shows reports the male to female hazard ratio arrived at when a male indicator is included and the sample of both males and females is examined. This male/female hazard ratio is 7.10 and the associated parameter is statistically significant at 1%. This suggests that among a group of people who report the same covariates and have the same gamma distributed characteristics the hazard of heavy drinking is 7 times higher among males compared to females.

The second row reports the immigrant/native-born hazard ratio arrived at with the sample of males and females. The third and fourth rows report the immigrant/native-born hazard ratios arrived at when the males and female samples are separately examined. Finally the fifth row reports the male to female hazard ratio among immigrants and with the parameter estimates arrived at when males and females are separately examined.

Table 9: Three sets of PGM regression results: transition as the dependent variable

Time constant variables		
	Hazard Ratio	**z**
Men	7.10 *	14.65
Immigration	0.65 *	-2.57
men	0.70 **	-1.84
women	0.46 **	-2.05
male/female hazard ratio	2.13	
Parental alcohol abuse	1.30 **	1.88
men	1.14	0.74
women	1.56 **	2.29
male/female hazard ratio	1.04	
Time varying variables		
	Hazard Ratio	**z**
Age & year of birth		
1920-1939; 45-59	reference group	
1920-1939; 60-74	0.46 *	-2.55
men	0.58	-1.53
women	0.12 *	-3.62
male/female hazard ratio	6.79	
1940-1959; 15-34	1.83	0.99
men	3.11	1.61
women	0.38	-0.84
male/female hazard ratio	11.50	
1940-1959; 35-44	1.63 **	1.80
men	2.24 *	2.51
women	0.62	-1.03
male/female hazard ratio	5.15	

1940-1959; 45-59	1.16	0.55
men	1.35	0.91
women	0.70	-0.76
male/female hazard ratio	2.72	
1940-1959; 60-74	0.51	-1.40
men	0.61	-0.89
women	0.21	-1.46
male/female hazard ratio	4.06	
1960-1979; 15-34	1.96 *	2.48
men	2.37 *	2.64
women	1.05	0.10
male/female hazard ratio	3.22	
1960-1979; 35-44	1.62	1.54
men	2.07 **	1.89
women	0.70	-0.70
male/female hazard ratio	4.20	
1960-1979; 45-59	1.35	0.39
men	2.09	0.88
women	0.10 **	-2.09
male/female hazard ratio	31.33	
Province		
ONT	reference group	
NFL&LABRADOR	1.13	0.34
men	1.54	0.96
women	0.56	-0.80
male/female hazard ratio	3.89	
PEI	0.83	-0.43
men	0.92	-0.16
women	0.74	-0.37
male/female hazard ratio	1.77	

NS	1.08	0.19
men	1.22	0.41
women	0.87	-0.20
male/female hazard ratio	1.98	
NB	0.89	-0.31
men	1.09	0.19
women	0.64	-0.62
male/female hazard ratio	2.43	
QUE	0.73	-1.33
men	0.71	-1.29
women	0.91	-0.21
male/female hazard ratio	1.11	
MAN	1.06	0.26
men	0.95	-0.19
women	1.58	1.22
male/female hazard ratio	0.86	
SASK	0.90	-0.36
men	0.56	-1.63
women	2.08	1.47
male/female hazard ratio	0.39	
ALTA	0.74	-1.42
men	0.72	-1.33
women	0.94	-0.14
male/female hazard ratio	1.08	
BC	0.99	-0.05
men	0.88	-0.52
women	1.42	1.02
male/female hazard ratio	0.88	
Marital status		

Never married, single or divorced	reference group	
Married	0.63 *	-3.48
men	0.69 **	-2.30
women	0.53 *	-2.46
male/female hazard ratio	1.87	
Other, widowed or separated	0.93	-0.43
men	0.94	-0.31
women	0.90	-0.42
male/female hazard ratio	1.49	
Urban vs. Rural		
Urban	1.22	1.68
men	1.17	1.13
women	1.37	1.32
male/female hazard ratio	1.21	
Smoking		
Non-smoker	reference group	
Daily smoker	2.60 *	8.50
men	2.24*	6.07
women	3.70*	6.26
male/female hazard ratio	0.86	
Occasional smoker	1.61 **	2.09
men	1.41	1.27
women	2.20**	2.15
male/female hazard ratio	0.91	
Depression Status		
Major depression	1.29	1.09
men	1.23	0.57
women	1.27	0.87
male/female hazard ratio	1.37	

Education		
Less than high school	reference group	
High school	0.70 **	-2.08
men	0.65 **	-2.20
women	0.90	-0.36
male/female hazard ratio	1.02	
Some post secondary	0.73 **	-2.12
men	0.70 **	-2.06
women	0.81	-0.85
male/female hazard ratio	1.23	
Post secondary graduate	0.51 *	-4.47
men	0.46 *	-4.45
women	0.64	-1.70
male/female hazard ratio	1.02	
Income		
Lowest	reference group	
Low-Mid	0.80	-0.96
men	0.99	-0.04
women	0.63	-1.39
male/female hazard ratio	2.23	
Mid	0.67 **	-1.86
men	1.04	0.13
women	0.32 *	-3.52
male/female hazard ratio	4.56	
Up-Mid	0.73	-1.51
men	1.05	0.20
women	0.47 *	-2.59
male/female hazard ratio	4.99	
Highest	0.79	-1.07
men	1.20	0.68

women	0.41 *	-2.67
male/female hazard ratio	4.13	
Employment status		
Unemployment	reference group	
Employed	1.01	0.04
men	1.05	0.20
women	0.79	-0.71
male/female hazard ratio	1.89	
Not in the labor force	0.91	-0.42
men	1.15	0.53
women	0.50 **	-1.87
male/female hazard ratio	3.29	
Price of alcohol		
Real price of alcohol	1.01	0.58
men	1.00	-0.05
women	1.04	0.99
Gamma variance	2.715782	
men	2.511612	
women	2.605525	

Note:

**signifies statistical significance at the 1% level. ** signifies statistical significance at the 5% level.*

For immigrants the hazard of transition to heavy drinking is 65% of the hazard among non-immigrants and the associated parameter estimate is significant at 1%. This finding may change over the time that an immigrant spends in Canada. For example, immigrants may have relatively few social activities at first and as time

goes on, alcohol consumption might subsequently increase. Therefore in the future it may be informative to examine whether immigrant effects change over the amount of time spent living in Canada. With regard to gender differences among immigrants, the male/female hazard ratio is 2.13, which means that male immigrants face a 2.13 times higher hazard than female immigrants under similar circumstances.

The parameter estimates arrived at with the sample of males and females suggests that parental alcohol abuse is a risk factor. The parental alcohol abuse hazard ratio is 1.30 and statistically significant at 5% which means that transition among individuals who have parental alcohol abuse history is nearly 32% higher than among individuals who have no parental alcohol abuse history. Furthermore when examining men and women separately, the parental alcohol abuse hazard ratio among females is 1.56 and statistically significant at 5%, and for men this hazard ratio is 1.14. When comparing men and women whose parents have alcohol abuse problems, the hazard ratio is 1.04 which is close to 1. This suggests that the hazard among men and women is about same when they have parents who abuse alcohol.

Table 10 reports the hazard ratio associated with each birth year-age group examine and the sample of males and females. For each birth year cohort, the hazard of becoming a heavy drinker decreases as people become older. Among people born in the 1940s or 50s, the youngest age group has the highest hazard and it is statistically insignificant. For individuals born in the 1960s or 70s, the youngest group also has the highest hazard. The associated parameter estimate is statistically significant and the reference category is born between 1920 and 1939 and age levels 45-59. The hazard ratio among people between 45 and 59 and born between 1960 and 1979 is

1.35 and is statistically insignificant. Also, the hazard is lowest among those age 60 to 74 and born between 1920 and 1939. Perhaps this is because older people have stronger health concerns.

For each age group the hazard of becoming a heavy drinker is higher among those more recently born except for those between 35 and 44 years old. For example, among people in the youngest age group, people born between 1960 and 1979 have the highest hazard and it is statistically significant. For the 45-59 and 60-74 age groups, the hazard is higher among people born more recently. Among those who are 35-44, the hazard is just slightly lower among those born more recently. As mentioned earlier a person's birth year plus age is equal to a calendar year and hence these finding may in part reflect factors that are changing over calendar time.

Table 10: The cross hazard ratio for age and year of birth

	Age15-34	Age35-44	Age45-59	Age60-74
1920-1939	.	.	ref.	0.46*
1940-1959	1.83	1.63**	1.16	0.51
1960-1979	1.96*	1.62	1.35	.

Table 11: male/female hazard ratio for each birth year-age group

	Age15-34	Age35-44	Age45-59	Age60-74
1920-1939	.	.	1.42	6.79
1940-1959	11.5	5.15	2.72	4.06
1960-1979	4.20	31.33	1.77	.

Table 11 reports male/female hazard ratios for each birth year-age group based on the parameter estimates arrived at when males and females are separately examined.

It suggests that males consistently have a higher hazard of transition across decade born, age ranges, and the associated calendar years.

Individuals who are married or live with a partner have a lower hazard of becoming a heavy drinker than those who have never married, are single, or are divorced. In particular among those who are married, the hazard of transition to heavy drinking is 63% of the hazard among those who have never married. Among people who are married, family responsibilities may discourage transition. Furthermore those without family responsibilities may have a higher risk of becoming heavy drinkers. Similar to these findings the married male and married female findings are also statistically significant at 5% and 1%. For males who are married, the hazard of transition to heavy drinking is 69% of the hazard among males who are single. The hazard ratio for women who are married is 53% of the hazard among women who are single. With regard to gender differences, the male/female hazard ratio arrived at after separately examining males and females is 1.87, which implies that among people who are married males have a higher hazard than females.

The findings arrived at with the entire sample suggest that daily smokers have a greater risk of becoming heavy drinkers than non-smokers. The hazard ratio for daily smokers is 2.60 and is statistically significant at 1%. Among women this hazard ratio is substantially higher. The hazard among female daily smokers is nearly 4 times that among female non-smokers and this is statistically significant at 1%. The hazard ratio associated with male daily smokers compared to male non-smokers is 2.24; this is statistically significant at 1% and this ratio is much smaller than among women. For occasional smokers compared to non-smokers the

hazard is about 1.61. When separately examining men and women, the hazard of being a heavy drinker for female occasional smokers compared to female non-smokers is 2.20 and this is statistically significant at 5%. With regard to gender differences, the male/female hazard ratio among daily smokers is 0.86. This implies that female daily smokers have a higher hazard of becoming heavy drinkers than male daily smokers. This suggests that smoking is a significant risk factor for alcohol abuse, especially among women. The findings also suggest that daily smokers are more likely to be heavy drinkers than their non-smoking counterparts; this may in part be due to the fact that people can be addicted to these two goods.

Across all sets of estimates there is no statistically significant relationship between alcohol abuse and major depression. The hazard among individuals who suffer from major depression is nearly 30% higher than among those who do not. The statistical insignificance of these major depression findings might be due to the correlation with other explanatory variables, such as smoking. For example people who suffer major depression may be more likely to smoke.

With the entire sample the hazard ratio for each level of education is smaller than 1 and statistically significant. It suggests that people who have not completed high school have a highest hazard in comparison to higher education levels. In particular the hazard ratio for individuals who completed post secondary education is 0.51. Perhaps individuals with higher education know more about the detrimental effects of alcohol abuse and they may pay more attention to their health than those who have not completed high school. Similar findings are arrived at when men and women are separately examined, however among women the education covariates

are not statistically significant. When each gender is separately examined among those with a high school degree and among those who have a post secondary degree the male/female hazard ratio is close to one.

Similarly the employed/unemployed hazard ratio is close to one and only among women is this hazard ratio statistically significant at 5%. Among women who are not in the labor force, the hazard of making the transition to heavy drinking is 50% of the hazard among unemployed women. One possible reason for this is that among women who are not in the labor force family responsibilities may discourage transition. For example, women who are not in the labor force may avoid alcohol addiction when taking care of the children and/or their home in other ways.

With regard to income levels the hazard of transition among those in the middle category is 67% compared to those in the lowest income category. Furthermore only the middle income parameter estimate is statistically significant at 5%. The hazard ratio for each income category is less than 1; thus, individuals with the lowest income have the highest hazard. When the two genders are separately examined, the income hazard ratios among men are not statistically significant. Women whose income is in the middle category have the lowest hazard of becoming heavy drinkers and this is statistically significant at 1%.

Under all three sets of estimates the alcohol price parameter estimate is statistically insignificant. With the entire sample the hazard ratio associated with a one unit increase in the alcohol price index is 1.01. This is consistent with the hypothesis that the price of alcohol has little or no effect on the likelihood of transition. Across

years and provinces the price standard deviation is 6.53. This suggests that a one unit increase in the price is rather small and the hazard ratio associated with a 6.53 unit increase in the price is just 1.07.

Figure1: The Canadian average real price of alcohol for each year

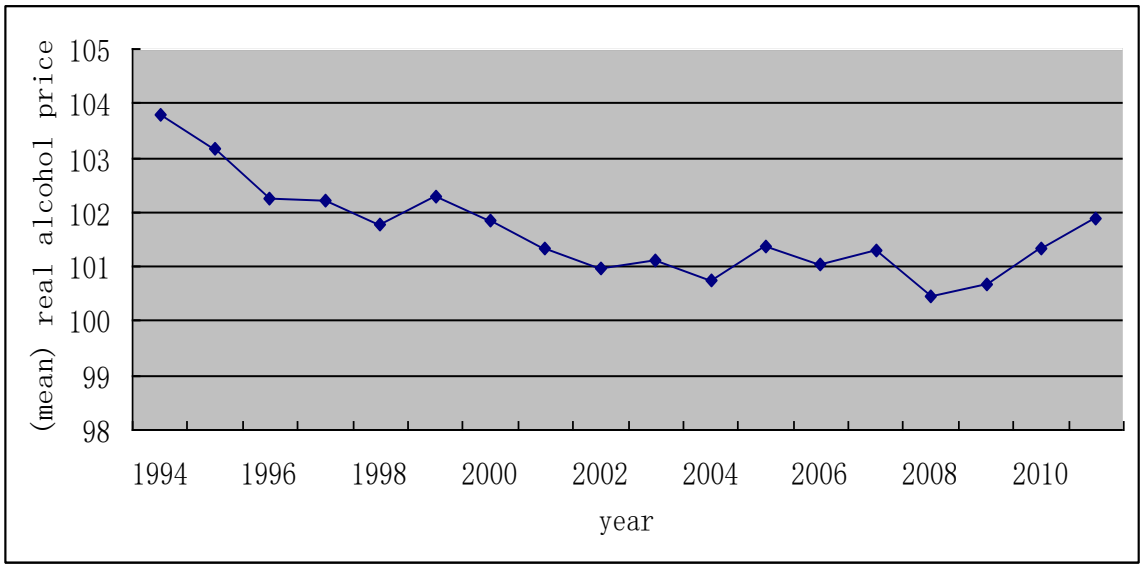
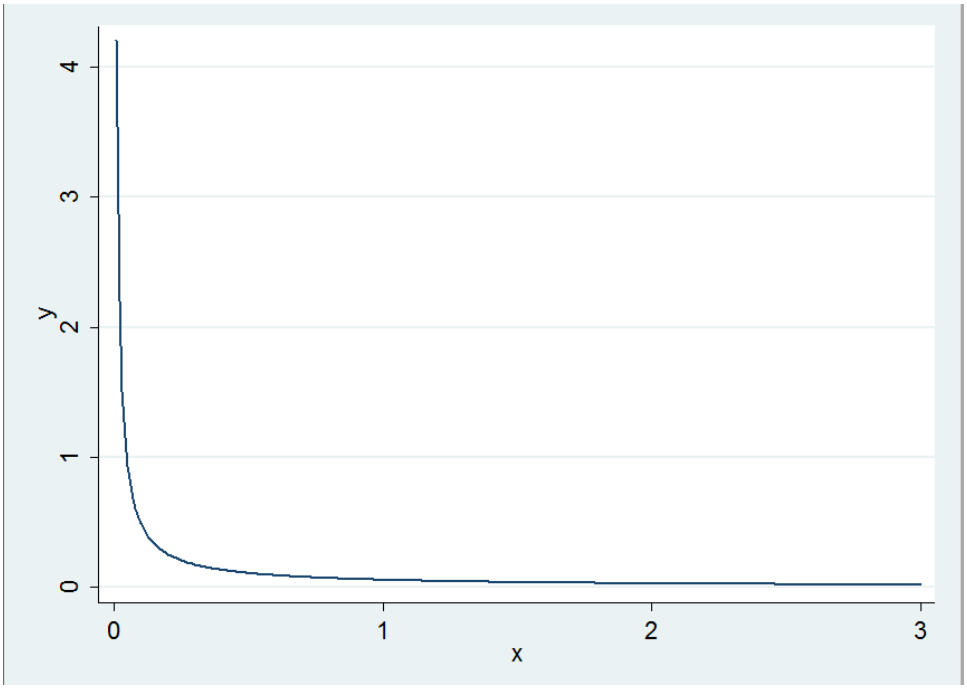


Figure 1 shows that the price of alcohol has been generally falling over calendar time. As mentioned above calendar time enters the model through the birth year plus age covariates. Perhaps the price is statistically insignificant due to correlation with calendar time.

In the field of duration analysis it is potentially valuable to consider unobservable heterogeneity. All of the estimates in Table 9 are arrived at under a complementary log-log model that allows for gamma distributed unobserved heterogeneity. For identification the gamma distribution mean is normalized to one. If an individual's particular value of v then was observed then one could calculate a hazard ratio between this person and another who reports the same covariates and whose value of

v is at the mean. Figure 2 plots the distribution of this hazard ratio implied by the gamma variance estimate arrived at with the entire sample.

Figure 2: Gamma variance estimate



This distribution suggests that a large number of individuals are unlikely to become heavy drinkers. This also suggests that a small number of individuals have a relatively high likelihood of transition. Furthermore this suggests that the mean hazard across individuals who have the same reported characteristics is unlikely to be experienced by any single person.

5. CONCLUSIONS AND DISCUSSION

Survival analysis is used to estimate transition. In particular a PGM hazard model is used to examine risk factors associated with initiating alcohol abuse and policy makers may find this informative. Potential directions for further research are also discussed.

In general the hazard of becoming a heavy drinker for the first time decreases as people become older. In particular individuals who are between 15 and 34 years old have the highest hazard of becoming a heavy drinker. With regard to education the hazard of becoming a heavy drinker generally decreases as education rises. In particular individuals who have not completed high school have the highest hazard of transition. One possible reason is that individuals with higher education know more about the detrimental effects of alcohol abuse and they may pay more attention to their health. Policy makers may find this informative if they want to direct alcohol policies towards people most likely to make this transition and before it first takes place. An alternative interpretation is that high levels of alcohol consumption lowers how far an individual goes in school. For example, students who drink alcohol before examinations may earn lower marks and drop out of school sooner. Furthermore unobserved factors may be associated with both heavy alcohol consumption and low marks in school.

Never marrying, being single or being divorced are also risk factors associated with alcohol abuse. In particular people who are single or divorced have the highest hazard of experiencing transition. Parental alcohol abuse history is also a risk factor.

In particular the transition hazard among individuals whose parents have a history of alcohol abuse is nearly 32% higher than for individuals who do not have a parental alcohol abuse history. This suggests that parental alcohol abuse history may affect the alcohol behaviors of the next generation. However, it is also possible that factors correlated with parental alcohol abuse and unreported in the sample are underlying this finding. For example unobserved stress factors faced across two generations may encourage both of them to drink heavily. Thus, more health education, income, and education support for the next generation might be helpful to weaken the detrimental effects correlated with parental alcohol abuse and further research into this topic may be valuable.

Another risk factor is smoking. In particular daily smokers have about 2.6 times the hazard of experiencing transition to heavy drinking than non-smokers. As mentioned above, an unobserved characteristic is the degree to which individuals are risk averse. For example individuals who are just slightly risk averse or risk lovers may be inclined to smoke and drink heavily. Furthermore when one of these two factors goes down such individuals may raise the other. It is also possible that helping individuals to decrease or give up smoking lowers the hazard of becoming a heavy drinker. Furthermore, increasing the price of cigarettes or raising the opportunity costs of smoking may alter the hazard of becoming a heavy drinker and further research into this cross price elasticity may be valuable.

Findings arrived at with the entire sample suggest that parental alcohol abuse history is associated with a higher hazard of heavy drinking. Furthermore when women and men are separately examined, the parental alcohol abuse hazard ratio among females

is 1.56 and among men this hazard ratio is 1.14. Finally these two sets of results imply that the male/female hazard ratio among individuals whose parents have abused alcohol is closed to 1. This suggests that the hazard of transition is similar among males and females under these circumstances and with all of the other indicator variables set to zero.

In general immigrants are less likely to be heavy drinkers than individuals who are born in Canada. The hazard ratio for female immigrants is 0.46 and for male immigrants is 0.70. Among immigrants the male/female hazard ratio is 2.13, which means that the hazard of transition is very different among this group of males and females and in particular male immigrants are more likely to become heavy drinkers than female immigrants. In contrast when males and females are separately examined the male/female hazard is smaller than one among daily smokers. Furthermore when all individuals are examined together and a gender indicator is included daily smokers have a higher hazard of transition. When the two genders are separately examined the hazard ratio for female daily smokers is 3.07 and for male daily smokers is 2.24. Finally with these two sets of estimates, the male/female hazard ratio is 0.86, which means that daily smoking is a significant risk factor for alcohol abuse, especially among women.

The findings arrived at with the entire sample suggest that men have about 7.10 times the hazard of experiencing transition than women. By the definition, an individual who reports consuming 5 or more drinks at least 52 times in the previous year is considered to be a heavy drinker and this definition is used for both men and women. However, there might be some inherent factors among men and women,

such like different biological make-ups, decide the definition of heavy drinker should be different. The type of alcohol is not considered also, such as beer, wine, and vodka. In the future it may be informative to examine other definitions of heavy drinking for men and women and with regard to the type of alcohol consumed. With regard to immigrants in the future it may be informative to examine how the hazard of heavy drinking changes over the time that they live in Canada.

The robustness of findings across logit, complementary log-log, and PGM hazard models have also been examined. The logit and complementary log-log findings are in Appendices 1 and 2. Under the logit and complementary log-log models men are more likely to be heavy drinkers than women, and people who are married are less likely to be heavy drinkers those who are single. These two sets of findings also suggest that individuals who have parental alcohol abuse history are more likely to become heavy drinkers. Finally under these two models immigrants are less likely to become alcohol abusers and people who have not completed high school have the highest likelihood of becoming heavy drinkers. All of these findings are similar to those arrived at under a PGM hazard model.

The purpose of this paper is to examine risk factors associated with transition from casual to heavy drinking. Based on this data set, there are also some other potential directions. For example in the future it may be informative to examine the transition from not drinking at all to moderate or heavy drinking. Furthermore it may be informative to examine the transition from heavy drinking down to moderate or to not drinking at all.

In the future, it may also be valuable to estimate the male/female findings all together and statistically test all of the male/female findings discussed above. It may also be valuable examine all of the time periods over which individuals have been heavy drinkers over their entire life. If the time since last heavy drinking before cycle 1 is important and correlated with other covariates, some of the findings will change when this factor is accounted for. Thus, asking individuals to list the age levels at which they were heavy drinkers in the past may be informative. In the sample examined just the first transition reported is examined and just a few people report two or more transitions. In the future examining samples in which individuals often report two or more transitions may be valuable.

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APPENDIX 1

Logit regression results: Transition as the dependent variable

Variables	Odds Ratio	z
Age & year of birth		
1920-1939; 60-74	0.42	-3.05
1940-1959; 15-34	1.90	1.03
1940-1959; 35-44	1.52	1.7
1940-1959; 45-59	0.91	-0.39
1940-1959; 60-74	0.35	-2.42
1960-1979; 15-34	1.73	2.24
1960-1979; 35-44	1.09	0.33
1960-1979; 45-59	0.79	-0.34
Province		
NFLD&LABRADOR	0.87	-0.42
PEI	0.61	-1.28
NS	0.74	-0.93
NB	0.68	-1.18
QUE	0.66	-1.89
MAN	1.06	0.33
SASK	0.71	-1.44
ALTA	0.71	-1.86
BC	0.89	-0.66
Marital status		
Married	0.73	-3
Other, Widowed or Separated	1.03	0.23
Urban	1.12	1.14
Smoking		

Daily smoker	2.33	9.03
Occasional smoker	1.61	2.32
Major depression	1.23	0.98
Education		
High school	0.72	-2.3
Some post secondary	0.73	-2.48
Post graduate	0.52	-4.91
Income		
Low_Mid	0.88	-0.6
Mid	0.75	-1.51
Up_Mid	0.78	-1.38
Highest	0.82	-1.01
Men	5.25	17.66
Immigrant	0.77	-1.82
Parental alcohol abuse	1.20	1.74
Employment status		
Employed	0.99	-0.04
Not in labour force	0.91	-0.46
Real price of alcohol	1.03	1.49

APPENDIX 2

Complementary log-log regression results: Transition as the dependent variable

Variables	Coefficient	Z
Men	1.62729	17.5
Immigrant	-0.2537775	-1.8
Parental alcohol abuse	0.1744776	1.73
Age & year of birth		
1920-1939; 60-74	-0.8608502	-3.1
1940-1959; 15-34	0.6276596	1.03
1940-1959; 35-44	0.4078599	1.69
1940-1959; 45-59	-0.097275	-0.41
1940-1959; 60-74	-1.047133	-2.44
1960-1979; 15-34	0.5249477	2.19
1960-1979; 35-44	0.0797909	0.31
1960-1979; 45-59	-0.2422163	-0.35
Province		
NFLD&LABRADOR	-0.1417356	-0.43
PEI	-0.4969062	-1.31
NS	-0.3022093	-0.96
NB	-0.3848894	-1.2
QUE	-0.4140164	-1.92
MAN	0.0421707	0.25
SASK	-0.3446216	-1.49
ALTA	-0.3371666	-1.85
BC	-0.1171517	-0.71
Marital status		
Married	-0.3151327	-3.02

Other, Widowed or Separated	0.0281498	0.23
Urban	0.1090411	1.09
Smoking		
Daily smoker	0.8181231	8.91
Occasional smoker	0.462141	2.31
Major depression	0.1871606	0.94
Education		
High school	-0.3161075	-2.3
Some post secondary	-0.3009699	-2.45
Post graduate	-0.6258181	-4.88
Income		
Low_Mid	-0.1092392	-0.53
Mid	-0.2546426	-1.41
Up_Mid	-0.2271898	-1.3
Highest	-0.1732915	-0.91
Employment status		
Employed	0.0033985	0.02
Not in labour force	-0.0732659	-0.37
Real price of alcohol	0.0266173	1.5

APPENDIX 3

PGM regression results (age and birth year separately): Transition as the dependent variable

Variables	Hazard Ratio	Z
Men	7.11	14.68
Immigrant	0.65	-2.57
Parental alcohol abuse	1.3	1.88
Age		
35-44	0.83	-1.04
45-59	0.6	-2
60-74	0.27	-3.55
Year of birth		
1940-1959	1.15	0.59
1960-1979	1.16	0.45
Province		
NFLD&LABRADOR	1.14	0.35
PEI	0.83	-0.43
NS	1.08	0.2
NB	0.89	-0.31
QUE	0.73	-1.32
MAN	1.06	0.26
SASK	0.9	-0.36
ALTA	0.74	-1.42
BC	0.99	-0.05
Marital status		
Married	0.63	-3.48
Other, Widowed or Separated	0.93	-0.43
Urban	1.22	1.68

Smoking		
Daily smoker	2.6	8.5
Occasional smoker	1.61	2.09
Major depression	1.29	1.09
Education		
High school	0.7	-2.08
Some post secondary	0.73	-2.12
Post graduate	0.51	-4.46
Income		
Low_Mid	0.8	-0.96
Mid	0.67	-1.86
Up_Mid	0.73	-1.51
Highest	0.79	-1.07
Employment status		
Employed	1.01	0.04
Not in labour force	0.91	-0.42
Real price of alcohol	1.01	0.57

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