Evaluating the Implementation of Longer License Suspensions for Impaired Driving: An Economic Perspective

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An essay submitted to the Department of Economics
in partial fulfillment of the requirements
for the degree of Master of Arts

Queen's University
Kingston, Ontario, Canada
2017

Abstract

As impaired traffic collisions are one of the leading causes of death in Canada, many policies have been implemented in attempt to reduce these rates. One of the most recent reforms adopted by Canadian provinces are longer license suspensions that offenders face for driving with blood alcohol concentration (BAC) limits between 0.05 and 0.08. This study therefore examines the effectiveness of this policy on fatal motor vehicle collisions, and other impaired driving measures. Using longitudinal data from 1998 to 2015 for seven provinces which adopted longer suspensions, this paper uses a panel regression with province and year fixed effects in attempt to examine its overall influence. The findings indicate that increasing license suspensions from the initial 24-hours prior to the reform taking place, is an effective mechanism in reducing fatal motor vehicle collisions at the 99% level of significance. This study also controls for three other policies that may influence either traffic collisions or impaired driving rates, which include: graduated driver licensing (GDL) programs, zero-tolerance laws, and random breath testing (RBT) laws. In addition to these policies, this paper further controls for economic conditions using the unemployment rate and real per capita income over the time period of interest. Doing so illustrates a reduction in actual incidents of fatal traffic collisions of approximately 0.19% following the policy change.

Acknowledgements

I would like to take this time to send my sincerest gratitude to my MA supervisor, Professor Christopher Cotton, who continued to show support and guidance throughout this entire process. This paper could not have been completed without your advice and constructive criticism, and for that, I am extremely grateful. It has been an absolute pleasure working with you this year. I would also like to extend my gratitude to Jeff Moon, the Academic Director at Queen's Research Data Centre, and Wenbo Zhu, a Ph.D Candidate at Queen's University, for always being there to listen and showing endless support and recommendations. I owe a special thank you to the entire Faculty within the Economics Department at Queen's University for a challenging and rewarding experience throughout both my Undergraduate and Graduate studies. Lastly, however certainly not least, I have an endless appreciation for my family and friends who have continued to show encouragement throughout this entire year. I truly would not be here today without such a strong support system.

Contents

1 Introduction

An ongoing issue that has surfaced throughout countries worldwide is one that will likely continue to do so, as it is one of the leading causes of fatal accidents in Canada. In 2015, according to Statistics Canada, there were 72 039 police reported impaired driving incidents, and 122 of those leading to death.[1] Similarly, MADD Canada reports that four people on average are killed daily by traffic collisions involving either alcohol or drugs.[2] The concern regarding impaired driving is therefore a subject that has brought a wide range of heartaches and considerable debate, thus leading to many controversies regarding effective policy controls. Specifically, Canadian jurisdictions have recently made an abundant amount of adjustments in both traffic safety laws, along with alcohol consumption and drinking laws in attempt to decrease impaired driving and the accidents arising from it.

In addition to laws and penalties imposed at a federal level for impaired driving offences, provinces have implemented different legal limits and sanctions that arise for first, second, and third time offenders. Before the recent policy to have longer license suspensions came into effect, those found driving between different legal limits set by each provincial government were immediately faced with a 24-hour license suspension. Following the reform however, first time offenders are now faced with an immediate increased suspension of at least 3 days, and even longer for second and third time offences in most provinces.

As the issue remains such a relevant, controversial, and ongoing topic, much economic literature surrounding different policies related to impaired driving have been

[1] Perreault, S.,"Impaired Driving in Canada, 2015." *Statistics Canada*, Date modified 2016-12-14.

[2] Soloman, R., and Clarizio, M. (2016), "Total Crash Deaths Involving Alcohol and/or Drugs in Canada, by Jurisdiction: 2012." *Madd Canada*, 1.

on the rise. This study therefore presents findings for the effectiveness of the recent policy implication of longer license suspensions adopted by seven Canadian provinces: Ontario, Alberta, New Brunswick, British Columbia, Nova Scotia, Prince Edward Island, and Newfoundland and Labrador. By using longitudinal data from 1998 to 2015, this paper performs a panel regression with province and year fixed effects in order to examine the impact of longer license suspensions on fatal traffic collisions and other impaired driving variables. The data used was gathered from Statistics Canada, CANSIM, through two datasets providing information on mortality rates by specific incident, along with incident-based crime statistics by detailed violation. The latter providing data for total impaired driving rates, impaired operation causing death, and impaired operation causing bodily harm, which are also used as dependent variables in addition to total fatal traffic collisions. Both datasets are presented annually and by province. The findings from the analysis demonstrate a statistically significant reduction in fatal traffic collisions of 0.19 percent for actual incidents and 0.23 percent in terms of rate per 100 000 population following the reform.

The remainder of this paper is structured as follows. Section 2 will discuss specific policies that have been implemented in attempt to reduce impaired driving and promote traffic safety, along with important background information on changes in license suspensions in Canada. Section 3 reviews previous literature that has also studied the effectiveness of policy changes on impaired driving, and therefore summarizes the motivation for this paper. Section 4 presents the empirical model and framework that this paper adopts. Section 5 describes the data sources and variables used throughout this study and the reasoning of doing so. Section 6 presents and examines the results, and finally, Section 7 concludes.

2 Background

2.1 A Brief Background on Policies Aimed to Reduce Impaired Driving

As impaired driving has been one of the leading causes of both criminal offences, along with fatal accidents in Canada, policies aimed to reduce these crimes have been on the rise. Specific strategies to not only help deter the probability of an individual engaging in such risky behaviour, but also general traffic safety policies have been examined in attempt to lower the fatal traffic accidents observed in Canada. This section of this paper thus considers a variety of policies that have been implemented that are both directly and indirectly related to the prevalent concern of impaired driving.

General traffic and driver safety mechanisms have been examined even prior to the concern of driving under the influence of alcohol. One of the most widely used safety measures which is a requirement in all provinces of Canada is the seat belt law, enforcing all individuals within the vehicle to wear their seatbelt at all times. This law was first introduced in Ontario in January of 1976, and by July of 1991, all provinces in Canada followed.[3] It is obvious that the use of seat belts do have a direct impact in saving lives during a traffic collision, as many studies and controlled experiments have proven so. Specifically, according to Canada's Public Health Leader, the additional percentage point increase in the use of seat belts each year can save an estimated 20 lives.[4] Other vehicle and road safety measures such as daytime running lights, Electronic Stability Control (ESC), and speed limit laws have also been introduced in

[3]Canadian Council of Motor Transport Administrators. (2010), "National Occupant Restraint Program 2010." *CCMTA Road Safety Report Series*, 25-53.

[4]Canada's Public Health Leader, "Reducing Deaths and Injuries on our Roads." *CPHA.*

Canada to promote traffic safety. All vehicles being sold in Canada since December of 1989 have daytime running lights, allowing vehicles to be more visible to other automobiles on the road.[5] Additionally, as of September 2011, Transport Canada created the Canada Motor Vehicle Safety Standard, ensuring that all vehicles manufactured after that date have an ESC system to assist drivers with staying in better control.[6]

As young drivers aged 16-24 years of age tend to be more likely involved in traffic collisions, Canadian provinces have adopted what is referred to as Graduated Driver Licensing (GDL) programs. GDL programs were introduced in hopes of giving young and new drivers the opportunity to ease into driving, allowing them an appropriate amount of time to learn and feel more comfortable in different road situations. Doing so allows these new drivers to gain experience and minimize the overall risk of an accident. Most GDL programs throughout Canada have multiple stages prior to actually receiving a complete drivers license. These stages include written and driving evaluations, driving under supervision, restrictions on driving within specific times of the day (i.e. night-time driving), as well as zero tolerance for alcohol consumption.[7] GDL programs in Canada were majorly influenced by a study published in 1990 by Mayhew and Simpson which was funded by the Insurance Bureau of Canada. The study demonstrates that increases in experience rather than simply age alone were greatly correlated with reductions in collisions.[8] In 1994, Ontario and Nova Scotia were the first two provinces to implement a GDL program, with the remaining provinces following shortly after. New Brunswick (1996), Quebec (1997) British Columbia (1998), Newfoundland and Labrador (1999), Prince Edward Island (2000), Manitoba and Al-

[5]Ibid.

[6]Ibid.

[7]Mayhew, D., Simpson, H., and Singhal, D. (2005), "Best Practices for Graduated Driver Licensing in Canada." *The Traffic Injury Research Foundation,* 2.

[8]Ibid., 4.

berta (2003), and finally Saskatchewan (2005) had all adopted a specific version of the GDL program.[9]

Although the GDL programs adopted by each province require new drivers to have zero percent alcohol in their system until reaching a complete license, some provinces have recently implemented further restrictions as well. Four provinces between the time period that this study examines have extended the zero tolerance law for young and new drivers, even after receiving a full license. The provinces include Quebec, Ontario, New Brunswick, and Manitoba, which require these drivers to continue to have zero alcohol in their blood while driving for at least three years following completing the GDL program.[10] Manitoba being the first to adopt this policy in 2006, followed by New Brunswick in 2009, Ontario in 2010, and Quebec in 2012.[11]

Specific strategies directly related to alcohol use and consumption have also been implemented in Canada in addition to zero tolerance laws which could impact impaired driving rates. For instance, the minimum legal drinking age (MLDA) restricts the ability to purchase and consume alcohol depending on an individuals age, and differs between provinces. All provinces have adopted a MLDA of 19 years, excluding Quebec, Alberta, and Manitoba, which have a lower age of 18 years.[12] The implementation of each of these drinking age laws occurred throughout the 1970s and 1980s.[13] In addition, breath alcohol testing was initially introduced in Canada in 1969, and police were approved to use devices to test ones alcohol content within the 1970s if there

[9]Road Safety in Canada. *Transport Canada.* Date modified: 2017-02-07.

[10]Solomon, R., Dumschat, E., and Healey, A. (2015), "The 2015 Provincial Impaired Driving Report." *MADD Canada,* 18.

[11]Young and New Driver Resource Centre (2014). *Traffic Injury Research Foundation, The Issues-Alcohol Impairment.*

[12]The Impact and Effectiveness of Minimum Legal Drinking Age Legislation in Canada. (2017), *Canadian Centre on Substance Abuse,* 1.

[13]Ibid.

was any reason to believe that a driver was impaired.[14] More recently, as of November 2013, random breath testing (RBT) introduced by the Criminal Code of Canada, allows officers to take random breath samples of drivers at any point in attempt to deter the behaviour of impaired driving.[15] Laws placing responsibility of impaired driving on alcohol establishments (i.e. bars and restaurants) rather than the offender have also been implemented. Between 1972 and 1974, the Supreme Court of Canada issued commercial host liability laws in which liquor licences now place restrictions on serving an individual or customer past the point of intoxication.[16] These laws also ensure that the establishment or employee serving alcohol is responsible and has a duty of care to ensure that their customers do not drink and drive.

Further, organizations such as Mothers Against Drunk Driving (MADD Canada) can shift the public perspective on driving under the influence of alcohol or drugs, possibly impacting an individuals decision to engage in such behaviour. MADD Canada is a non-profit organization that initially started as MADD in the State of California in 1980, and later founded in Canada in 1989.[17] Not only does the organization strive to end impaired driving, but also aims to support those affected by alcohol related motor vehicle accidents. These types of organizations provide educational programs and campaigns to the public in order to bring attention to the dangers of drinking and driving, along with ways to prevent it.

In addition to the previously discussed policies aimed to reduce impaired driving and fatal accidents that are associated with it, blood alcohol concentration (BAC) limits are one of the most widely used approaches to assist in minimizing this offence.

[14]Random Breath Testing. (2014), *Canadian Centre on Substance Abuse,* 1-2.
[15]Ibid.
[16]Social Host Liability for Alcohol-Related Accidents, (2016) *Injury Lawyers of Ontario, Inc.*
[17]History and Impact, Madd Canada's History. *MADD Canada.*

BAC is a common measure of alcohol intoxication, as it measures how much alcohol is in an individuals blood, affecting ones vision, reaction time, and performance. The impact of BAC can differ depending on the individual, and may be influenced by gender, weight, and how much food has been consumed in a given time period prior to consuming alcohol.[18] Over the past 35 years, every province has adopted a specific BAC limit or range in which different penalties may be applied in attempt to reduce the fatal collisions arising from impaired driving. Mandatory jail time, monetary fees, educational programs, and longer license suspensions are all penalties that offenders may face if found driving above the legal limit. The latter will thus be the focus of this paper, examining its effectiveness on collisions and incidents related to impaired driving. The next section of this paper will therefore examine the different changes in license suspensions for legal BAC limits that have taken place in Canada.

2.2 A Brief Background on BAC limits and License Suspensions in Canada

In Canada, similar to other countries, impaired driving is a criminal offence resulting in serious consequences. Under the Criminal Code of Canada, an individual is considered impaired and is subject to criminal charges if they fall under one of two categories. The first being a person who operates a motor vehicle, vessel, or aircraft who's ability is impaired in any way by either alcohol or drugs. The second being an individual who consumes an amount of alcohol in which their blood alcohol concentration (BAC) exceeds the legal limit of 80 milligrams per 100 millitres of blood, which was passed by the Parliment of Canada in 1969.[19] Although this limit applies to all jurisdictions across

[18]Blood Alcohol Concentration (BAC), Legal and Administrative BAC Limits. *MADD Canada.*
[19]Perreault, S., "Impaired Driving in Canada, 2015." *Statistics Canada,* Date modified 2016-12-14.

Canada, each province also has further control, in which provincial law enforcement can impose different penalties and license suspensions. There has been a great deal of controversy in regards to the appropriate legal limit and consequences that should be placed upon offenders, resulting in a variety of changes at the provincial level overtime. Specifically, nearly every province has adopted what is referred to as a warn range, in which different penalties can be applied even if an individual is found driving with a BAC below the 0.08 legal limit set by the Criminal Code of Canada. Excluding Saskatchewan and Quebec, all Canadian provinces have adopted a BAC warn range from 0.05 to 0.08. Saskatchewan also adopting a warn range, however having a smaller lower bound from 0.04 to 0.08, and Quebec on the other hand only adopting the legal limit of 0.08.

Although Ontario has implemented a BAC warn range between 0.05 and 0.08 since 1981, it was not until May 1st of 2009 that penalties were raised above the initial 24-hour license suspension. First time offence drivers between these levels now immediately receive a 3-day license suspension. The sanction is further raised for individuals of a second offence to a license suspension of 7 days, and increased to 30 days for third time offenders within the same five-year period.[20] Likewise, Nova Scotia has had a 24-hour license suspension set in place for drivers with a BAC equal to or exceeding 0.05 since December of 1994. It was not until October of 2010 however that these penalties were made more severe. Similarly to Ontario, the provincial government of Nova Scotia set tougher sanctions resulting in 7-day, 15-day, and 30-day license suspensions for first, second, and third time offenders within the same 10-year period.

As of 1979, the province of British Columbia only had a 24-hour prohibition period

[20]Canadian Council of Motor Transport Administrators. (2011), "Strategy to Reduce Impaired Driving 2010." *CCMTA STRID 2010 Task Force,* 5.

if an officer had any reason to suspect that a driver's ability was in any way affected by alcohol or drugs. Under the Immediate Roadside Prohibition (IRP) Program, this penalty changed following September 2010, as British Columbia also adopted the BAC warn range between 0.05 and 0.08.[21] The first sanction for individuals found within this range now results in a 3-day driving prohibition, followed by an increase of 7 days, and 30-days for second and third time offenders within the same 5-year period.[22]

Prior to adopting the BAC range, Alberta also had a similar standing to British Columbia, in which a 24-hour license suspension could be enforced by officers who believed that a driver was in any way driving under the influence of drugs or alcohol. Alberta followed in British Columbia's footsteps, strengthening its sanctions as of September 1st, 2012 through the Traffic Safety Act. These changes to the Traffic Safety Act now result in a 3-day, 15- day, and 30-day license suspension for first, second, and third time offenders.[23]

The province of New Brunswick passed the same BAC warn range in 1985, and tougher sanctions were later implemented in June of 2011. Offenders found driving between the levels of 0.05 and 0.08 in New Brunswick now receive an immediate driver's license suspension for 7 days for both first time, as well as repeated offences.[24] Prince Edward Island adopted this same range in 1997, again resulting in the initial shorter license suspension.[25] Tougher sanctions were further implemented for the province above the 24-hours in September of 2009, including an immediate 7-day, 30-day, and 90-

[21]BC Gov News. (2012), "Tough Drinking-Driving Penalties Now Back in Full Force." Released June 14, 2012.

[22]BC Road Safety. (2016), "British Columbia Immediate Roadside Prohibition Fact Sheet." *Ministry of Public Safety and Solicitor General,* 1-2.

[23]Alberta Transportation, "Alberta's Approach to Impaired Driving." *Government of Alberta.*

[24]New Brunswick Canada. (2011), "Public Safety: New Drinking and Driving Rules Start Today." Released June 24, 2011.

[25]Ibid., 6.

day license suspension for first, second and third offences. Newfoundland and Labrador also had the initial suspension set in place for both first and second offence drivers with BAC levels between 0.05 and 0.08, which was first implemented in 1995. Following the leads of other provinces however, Newfoundland and Labrador adopted a tougher penalty of an immediate 7 day roadside suspension in 2010, and longer penalties of 14-day and 2 months for repeated offences.[26]

Manitoba's government implemented a 24-hour license suspension for those driving with BAC levels above 0.05 since 1998, along with enforcing a mandatory recovery program for individuals who have two or more offences within a 3-year period.[27] In 2011, slight changes were made for second and third time offenders to 15 and 30-day license suspensions, however the initial 24-hour period for first time offenders was retained. It was not until December of 2015 that the government of Manitoba made adjustments to the Highway Traffic Act which raised the penalties for those driving with BAC levels equal to or exceeding the legal limit to 3 days rather than 24-hours for first time offenders. Due to the limitation of traffic collision data following the year that Manitoba adjusted its license suspension past the initial 24-hours, this study therefore excludes this province from the analysis. Refer to section 4 and 5 for more details.

In contrast to the decision made by most provinces to adopt certain sanctions for drivers with alcohol levels between 0.05 and 0.08, Saskatchewan and Quebec both take different stands. Since 1996, Saskatchewan has had a lower warn range from 0.04 to 0.08, resulting in a similar 24-hour license suspension. In July of 2006, Saskatchewan also enforced further penalties for drivers who had a second offence within the same

[26]Ibid.

[27]Canadian Council of Motor Transport Administrators. (2011), "Strategy to Reduce Impaired Driving 2010." *CCMTA STRID 2010 Task Force,* 5.

2-year period to a license suspension of 15 days.[28] Quebec on the other hand has not yet followed the leads of other provinces with penalties and license suspensions for individuals found driving with BAC levels below the legal limit set by the Criminal Code of Canada. Instead, Quebec has maintained criminal charges and an administration suspension for any individual driving with a BAC level over 0.08 since December of 1997.[29] Since both these provinces have implemented different per se legal limits in comparison to the rest of Canada, this study also excludes them in attempt to maintain provinces as closely related as possible with respect to impaired driving laws and regulations. **Table 1** provides a summary of the changes in license suspensions from the initial 24-hour one prior to the reform taking place for first, second, and third time offenders for the provinces chosen in this study.

Table 1: Changes in License Suspensions

Province	**Date**	**License Suspension Change**
Ontario	May 2009	3-day, 7-day, 30-day
Prince Edward Island	September 2009	7-day, 30-day, 90-day
British Columbia	September 2010	3-day, 7-day, 30-day
Newfoundland and Labrador	October 2010	7-day, 14-day, 2 months
Nova Scotia	October 2010	7-day, 15-day, 30-day
New Brunswick	June 2011	7-day
Alberta	September 2012	3-day, 15-day, 30-day

Notes: Manitoba, Saskatchewan, and Quebec have been omitted in this study in attempt to maintain provinces as closely related as possible with respect to impaired driving laws and regulations.

[28] Ibid., 5.
[29] Ibid., 59.

2.3 Possible Effect from Longer License Suspensions

The implementation of harsher penalties through the increase in license suspensions recently adopted by Canadian provinces may have an effect on impaired driving for three fundamental reasons. The first, though may be somewhat obvious, is that longer license suspensions directly lead to less time spent on the road for these dangerous drivers, even if it is only for a limited amount of time. This factor was introduced throughout Eisenberg's (2001) study when considering the effect of a lower BAC legal limit. For instance, following the implementation, individuals that have engaged in drinking and driving now have to wait a longer period of time before they are legally allowed to drive, meaning that there will be less opportunity for them to reoffend.

Beyond this temporary effect of decreasing the time availability for risky drivers to reoffend, the increase in license suspensions may also act as a deterrent effect. This deterrent effect may have an influence on impaired driving because individuals may consciously avoid engaging in the behaviour for the sole purpose of not wanting their license to be taken away for the extended period of time. More precautions may be taken by those likely to engage in the offence, as they now face harsher penalties and internalize higher costs of being convicted.

Finally, it is likely that the new policy adopted by jurisdictions across Canada would have been accompanied by more media and discussion regarding the new upcoming penalties that would be taking place. As discussed in Eisenberg (2001), campaigns regarding the new reform would make drivers more aware and cautious of the consequences that they could face. This would bring more awareness and knowledge to the public regarding the issue that they may have lacked prior to the introduction of the policy, possibly impacting one's decision to drink and drive.

3 Previous Literature

3.1 Literature on Crime Deterrence

Before discussing some of the literature regarding impaired driving deterrence, it is important to first acknowledge some of the studies that have created a foundational framework that have been used and extended for a variety of other work. Literature regarding crime and punishment is certainly not a new one, and is one that is continuing to be a much researched topic. One of the first studies examining the optimal amount of punishment that should be used in order to enforce a specific law and discourage illegal behaviour arises from Becker (1968). Throughout Becker's study, he develops a measure to examine the social losses and costs that tend to arise from different crimes in order to study the amount of expenditure, enforcement, and resources that should be allocated towards minimizing them. It is important to first introduce Becker's model of crime, as it can be applied to the criminal offence of impaired driving as well. Becker's model first introduces the harm and social gain that arises from a particular crime:

$$Hi = Hi(Oi) \tag{1}$$

$$G = G(O) \tag{2}$$

Where Hi and Oi in equation (1) represent the level of harm from the criminal activity and the activity level, respectively. G and O in equation (2) represent the social gain of the crime to the offender and the activity level. Both equation (1) and (2) are increasing in the level of criminal activity. Intuitively, these functions can be applied to understand the basics of impaired driving. From equation (1), it is expected that

the level of traffic accidents (i.e. harm) would increase with the number of offenders (i.e. impaired drivers) on the road. If this is the case, why do individuals still engage in such risky behaviour? To answer this question we can consider equation (2), in which an offender would receive some social gain from driving, such as saving money on not taking a taxi, or not having the inconvenience of leaving their car somewhere. Becker extends equation (1) and (2) in order to develop a relationship that examines the number of offences in a given time period, which can also be used to consider the number of impaired driving offences:

$$Oj = Oj(pj, fj, uj) \tag{3}$$

Where Oj is the number of offences, pj is the probability of being convicted, fj is the punishment, and uj represents other influences. Some of the policies discussed in Section 2.1 and 2.2 of this paper could be captured through pj, fj, and uj of equation (3). Although this framework and the basic foundations can be applied to understand the reasoning behind a particular offence, his study differs from the fundamental goal of this paper because it focuses on all types of crime and punishment, whereas this paper is restricted to impaired driving and the effectiveness of the increase in license suspensions.

Following Becker (1968), many additional studies regarding the deterrence of crime through punishment and enforcement techniques have been studied. Stigler (1974) provides an extension of the former study to develop a rational choice theory of enforcement. Recognizing that perfect detection is costly, and that society gives an expenditure limit on enforcement techniques and tasks, Stigler argues that marginal penalties are needed depending on the severity of the crime. In simpler terms, the

more severe the crime, the higher the punishment should be in order to have effective deterrence. In contrast to studies supporting rational choice theory, Rauhut (2009) provides a game theory approach in which he finds that higher punishment does not actually decrease crime rates, rather diminishes control. Similarly, Lee and McCrary (2009) recognize that some criminals will not respond to higher punishments. Specifically considering young offenders, their results demonstrate that higher punishments may not actually reduce their likelihood to reoffend. Although not directly related to reducing impaired driving, these types of studies all provide theoretical backgrounds on the optimal levels of punishment for general offences.

3.2 Literature Specific to Impaired Driving Deterrence

In addition to studies focusing on the general severity of punishment and crime, there has been an abundant amount of literature specific to the deterrence of alcohol related traffic collisions itself, which extend the formers framework. Benson et al. (1999) for instance expand Becker's model to specifically relate it to impaired driving and traffic fatalities:

$$R = f(D, T) \tag{4}$$

Where R is the driver involvement rate in traffic collisions, being a function of the number of drunk driving offences, D, and traffic safety measures, T. Intuitively, it is obvious that R would be increasing in D and decreasing in T. Similarly to Becker (1968), Benson et al. (1999) conclude that increasing law enforcement would be an effective way to deter impaired driving. This is also supported by Grant (2007), in which he studies the optimal penalty structure for driving under different BAC levels. Specifically, he considers the relationship of penalties to the levels of BAC, concluding

that harsher consequences should be placed upon individuals found driving with a higher BAC level. A more recent study by Grant (2016), performs a structural analysis specifically focused on impaired driving as well, finding results closely related to those of Stigler (1974), again supporting an increase in marginal penalties.

There has also been much research on specific types of enforcement techniques, acting as fundamental motivation for this study through the importance of license suspensions. While using a dummy variable for different U.S. states that implemented types of legislations, Kenkel (1993) considers sobriety checkpoint laws, jail sentences and administrative licence suspensions. His findings suggest that existing sanctions are too lenient, arguing that increases in these types of enforcement would deter impaired driving. This study adopts a similar purpose in hopes to study the effectiveness of the tougher penalty with respect to longer license suspensions that different provinces have recently implemented. Similarly, Muliahy and Sindelar (1994) consider state-level policies and surveys on self-reported incidents, finding consistent results with Kenkel, such that enforcement through license suspensions and minimum fines would possibly deter drunk driving. Muliahy and Sindelar's approach however differentiates itself from this study along with most of the other literature as well, as their results are based primarily on self-reports rather than state level data.

Using annual time-series data from 1982 to 1988, Chaloupka et al. (1993) also find a deterrent effect through administrative laws, however find no significant effect through jail sentences. Henstridge et al. (1997) perform a similar analysis, however focus their study in determining the effect of random breath testing on traffic accidents in Australia. Using a log-linear model, their findings demonstrate an immediate impact following the reform. This study also considers the random breath testing variable as in Henstridge et al. (1997), however use it mainly as a control mechanism. Sloan and

Githens (1994) also examine these effects, however restrict their study to sanctions solely provided by insurance companies. The authors conduct a survey taking place in 1991 with 18 of the most well-known automobile insurance companies in the U.S. in order to study whether or not penalties for impaired driving are effective in reducing the decision to drive under the influence. Results by Sloan and Githens demonstrate that fines and penalties placed upon offenders by insurers do in fact have an influence on decreasing drunk driving.

Much literature has also centred its focus mainly on the impact of alcohol availability rather than types of enforcement. Chaloupka et al. (1991) for instance find that the most effective policy to reduce alcohol-related traffic accidents is through the use of beer taxes. These results are consistent with Ruhm's (1996) findings through studying the effect of beer taxes, drinking laws and other alcohol-control techniques on fatal traffic accidents. Ruhm also controls for the implementation of other laws and policies, as well as the economic conditions at the time that the policy took place. He does so by using per capita income along with the rate of unemployment, which this paper also seeks to control for using a similar technique. Refer to section 4 and 5 of this paper for more details. His conclusions suggest that there is a significant decrease in fatal traffic collisions resulting from the observed increase in beer taxes, though recognizes and addresses that the results may be overestimated. Young and Likens (2000) take a similar approach, examining drinking laws and taxes over 9 years and 48 different U.S. states. Their conclusions differ from Ruhm's however, as their results do not show beer taxes or prices to be statistically significant. Instead, their results are more closely related to those of Mast et al. (1999), finding that beer taxes are either insignificant or positively related to traffic accidents. These inconsistencies in findings may possibly be influenced by limitations on data availability, along with

different control mechanisms taken in each study.

A later paper by Young and Bielinska-Kwapisz (2003) uses instrumental variables for alcohol taxes, finding a negative relationship between traffic fatalities and prices. A study by Baughman et al. (2001) also considers alcohol availability and consumption on road safety. Using panel data in Texas between 1975 and 1996, the study examines whether policy changes on the sale of alcohol, as well as on certain types of alcohol affect traffic accidents. Their conclusions find that in addition to the availability of alcohol, the sale of beverages with higher alcohol content in a specific area have an influence on traffic collisions. Similar studies have also been performed by Sen and Campbell (2009), however focusing primarily on the effects of these policies on child and youth fatality rates, rather than the entire population.

As discussed in section 2.2, setting lower BAC limits has been a technique implemented by many jurisdictions in attempt to reduce impaired driving, and consequently, associated traffic collisions. Although the earlier section of this paper specifically discussed the changes in Canada, this approach has been adopted by many countries, and thus an abundant amount of literature has been focused on the policy implication. Johnson and Fell (1995) for instance consider five U.S. states which adopted a lower per se legal limit of 0.08, from the initial 0.10 in order to study its impact on alcohol-related traffic accidents. Using data before and after the reform, the authors conclude that in addition to other factors and variables considered, the reduction in the BAC limit led to fewer fatal accidents ranging from 4 to 40 percent in the states that were studied. Hingson et al. (1998, 2000) perform a similar analysis. In their (1998) study, the authors specifically consider the policy change in Maine to study its effect on impaired driving convictions. Their (2000) study extends the former, as the authors compare the impact of the reduction in per se legal BAC limits that occurred in

multiple U.S. states, with those that retained the initial higher one. The fundamental difference between the two being the use of comparing nearby states used in the latter. A downfall to the study presented by Hingson et al. however, is that the authors fail to control for other policies that were implemented around the same time period of their policy of interest.

Similar studies have been adopted to consider the same policy change in Austria, as performed by Smith (1988) and Bartl and Esberger (2000). The former finding that decreasing the legal limit lead to a reduction in nighttime traffic accidents by 8.2 percent, and the latter finding a reduction in alcohol related collisions by about 9.4 percent. Foss, Stewart, and Reinfurt (1998) perform a similar analysis, although restrict their study to the reduction of the BAC limit in North Carolina that took place in 1993. Their results differ from those previously discussed however, as they find no significant change in alcohol-related traffic accidents following the policy implementation. Foss, Stewart, and Reinfurt's study also faces a critical limitation due to the fact that it is restricted to only one state. Although these papers all provide interesting findings, many fail to effectively control for other factors throughout their studied time period that may influence their results, as well as lack the consideration of more than one jurisdiction.

The challenges and limitations faced by a number of other studies lead me to the discussion of Eisenberg (2001) and Dee (2001), providing two of the most detailed and in depth analysis of the implementation of a lower BAC limit. I adopt a similar approach in this study, however focus on the implementation of the increase in license suspensions in Canadian provinces rather than the decrease in per se legal limits in U.S states. Both studies use panel annual state-level data provided by the Fatal Accident Reporting System (FARS) in order to study the effectiveness of the policy change on traffic

collisions. Although both studies find reductions in fatal traffic accidents following the reform, Dee's results are found to be more statistically significant. Specifically, Dee finds a reduction in fatal traffic collisions by 7.2 percent following the lower BAC policy, compared to Eisenberg (2001) who only finds a decrease by 2.6 percent. The analysis performed by both these authors consider multiple variables throughout their regressions, extending the standard differences-in-differences method.

Similar to the policy variable of this study, both the papers by Dee (2001) and Eisenberg (2001) also consider administrative license revocation (ALR) as a control. Their measure differs from the one taken in this paper however, because while it only considers whether or not a state has the policy set in place, this study considers the actual increase in the suspension. Both authors also attempt to control for other policies implemented around the same time that the lower BAC legal limit came into effect, as well as economic conditions at the time of the reform. These controls are similar to Ruhm's (1996) as previously discussed.

This paper therefore follows a similar technique, however differentiates itself from the two, as it does not consider the actual change in the legal BAC limit, as most previous literature has focused on. These studies would be measuring and including all sanctions that an individual or offender would receive by a particular province such as license suspensions, monetary fees, mandatory educational programs, and ignition interlock devices. The fundamental goal of this study however, is to focus primarily on the increase in license suspensions from the initial 24-hour penalty for driving with a BAC level above the 0.05 warn range in attempt to evaluate its impact on traffic collisions.

4 Empirical Model

This study adopts a similar model to most of the previous literature discussed in the earlier section of this paper, with a strong emphasis on Eisenberg (2001) and Dee (2001). Specifically, using a panel regression with province and year fixed effects, this paper attempts to interpret the overall influence of the increase in license suspensions from the initial 24-hour period for drivers found with a BAC level between 0.05 and 0.08. I follow a similar empirical strategy to the one taken in Eisenberg (2001) and Dee (2001), however, I use it to study the effect of the harsher sanction rather than the decrease in legal BAC limit. The initial model is a basic panel regression with province and year fixed effects:

$$Y_{it} = B_0 + B_{1it}X_{1it} + P_i + T_t + u_{it}$$

Where subscripts i and t represent province and year, respectively. The dependent variable, Y, represents the traffic incidents (i.e. total fatal motor vehicle collisions, total impaired driving, impaired operation causing death, and impaired operation causing bodily harm); B_0 is a constant; X_1 is an indicator of the new policy of longer license suspensions; P is the province fixed effects (province dummies); T is the year fixed effects (year dummies), and u is the error term.

The basic model is then extended to consider control variables as well, including economic conditions and other policies related to impaired driving. The final empirical specification is as follows:

$$Y_{it} = B_0 + B_{1it}X_{1it} + B_{2it}X_{2it} + P_i + T_t + u_{it}$$

Where all variables represent the same as in the previous regression, and X_2 now represents other controls (i.e. economic conditions and other policies). The variable representing the increase in license suspensions, X_1, is binary, equaling 1 if the reform has been implemented, and 0 otherwise. This is also the case for the other policies that are controlled for through the X_2 variable. Each variable will be further discussed in the next section of this paper. The importance of B_1 in this equation is fundamental to the results of this study, estimating the effectiveness of the increase in license suspensions on each dependent variable. Results from both regressions with and without specific controls will be presented in section 6.

As discussed throughout Eisenberg's (2001) study, the purpose of using province and year fixed effects in this regression is critical in order to control for common changes that are either unobserved or otherwise unable to be controlled for through the X_2 variable. For instance, the province fixed effects variable, P, estimates and captures common differences and trends arising in all provinces for each dependent variable and year t relative to the first year in the time period. Likewise, the year fixed effects variable, T, captures the common differences and trends arising in all years for each dependent variable and province i relative to the first province. These two variables help to control for omitted variable bias and heterogeneity that may arise in each of the dependent variables. Doing so provides an advantage in comparison to some of the techniques adopted in previous literature, as it will restrict the results from observing a relationship between the policy of interest and the dependent variable if there are actually other unobserved factors across each province and year which also have an influence. As argued in Eisenberg (2001), these unobserved factors may include differences in attitudes regarding alcohol use, along with unobserved or unmeasurable traffic safety mechanisms.

5 Data, Variables, and Specifications

This study uses cross-sectional time series data, also referred to as longitudinal or panel data, providing information on multiple provinces over many time periods. Specifically, the time frame examined ranges before and after the policy was implemented in each province, from 1998 through 2015, which is three years following the last province to implement the new reform. It is collected for seven provinces including Alberta, British Columbia, Newfoundland and Labrador, Nova Scotia, New Brunswick, Ontario, and Prince Edward Island. The exclusion of Quebec, Saskatchewan, and Manitoba in this analysis is an attempt to consider provinces as closely related as possible with respect to impaired driving laws and regulations. As previously mentioned in section 2.2 of this paper, Saskatchewan and Quebec have implemented different BAC limits and warn ranges, and Manitoba's sanctions for the time period of interest varied in comparison to the rest.

Dependent Variables

Table 2 displays the list of each dependent variable for this study, along with their summary statistics in real values. Though these summary statistics are reported in real terms, each variable is logged before used in the panel regression, which will be further discussed in the next section of this paper. For each outcome variable presented in the table, there is the actual number of incidents, AI, along with the rate per 100 000 population, R. The reasoning for including multiple dependent variables is due to the fact that perfectly rich data regarding alcohol-related traffic accidents is limited. For instance, there is no dataset available containing information on a drivers specific blood alcohol concentration level when a collision occurred, therefore

this study attempts to investigate the policy effectiveness from alternative perspectives. For that reason, this paper considers four dependent variables related to impaired driving and traffic collisions to study the effect of the increase in license suspensions: total fatal traffic collisions, total impaired driving, impaired operation causing death, and impaired operation causing bodily harm.

From **Table 2**, we can observe that on average, there are roughly 250 fatal traffic collisions per year and province, which averages to about 9.5 in terms of rate per 100 000 population. Likewise, there are about 7577 reported impaired driving incidents per year and province, with roughly 13 of them leading to death, and 56 of them causing bodily harm. **Figure 1** and **2** illustrate the trend of the four dependent variables given in rates per 100 000 population used throughout this study. Although **Figure 1** demonstrates that fatal traffic collisions seem to be on a decline, alcohol-related traffic collisions still remain one of the most frequent causes of death in Canada. It is for this reason that analyzing the effectiveness of certain policies is critical in order to further reduce these rates, acting as fundamental motivation for this study.

The main dependent variable, total fatal traffic collisions, is the total amount of fatal motor vehicle accidents, both alcohol-related and non-alcohol related. This measure was gathered by Statistics Canada CANSIM. The source is annual, providing data on deaths and mortality rates by age standardization, using 2011 population for each Canadian province from 2000 to 2013.[30] As in most previous literature, this variable is usually of most interest, perhaps due to policy makers and regulators being most concerned with reducing incidents of greater severity, such as those leading to death. As other studies have also pointed out however, this measure may not be the most

[30] *Statistics Canada.* No date. *Table 102-0553 Deaths and Mortality Rate (Age Standardization Using 2011 Population), By Selected Grouped Causes and Sex, Canada, Province and Territories, Annual (table).* CANSIM (database). Last updated March 8th, 2017. (accessed May 15th, 2017).

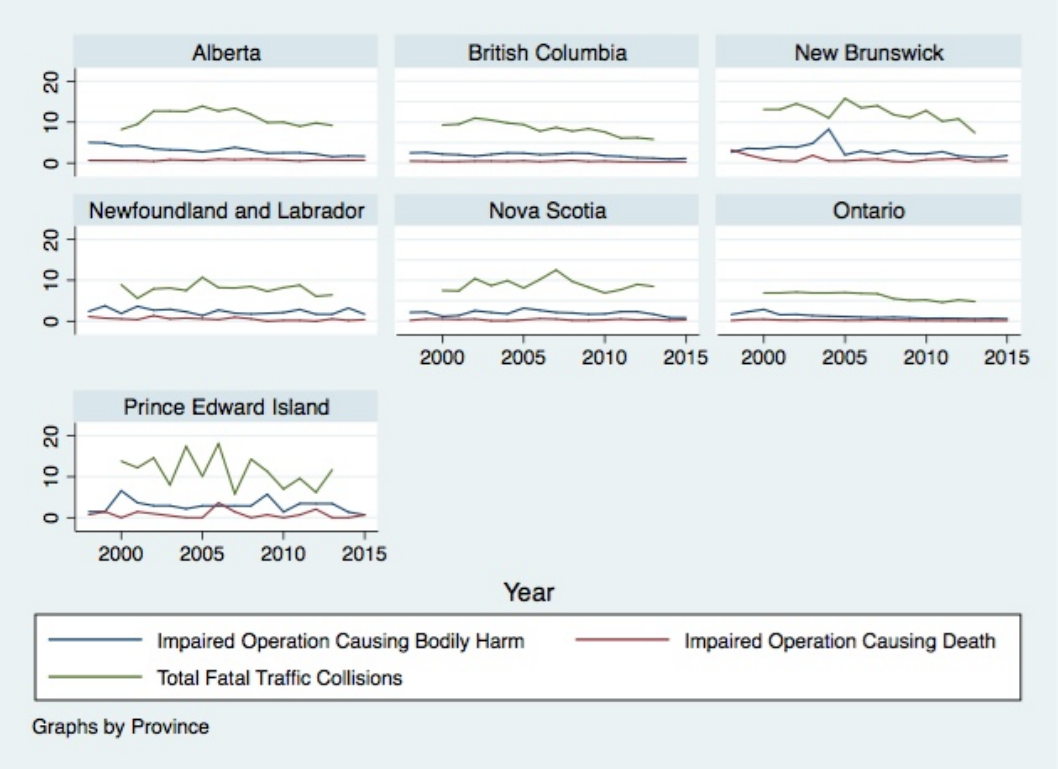

Figure 1: Total Fatal Traffic Collisions, Impaired Operation Causing Bodily Harm and Impaired Operation Causing Death from 1998-2015, Rate per 100 000 Population. *Source: Statistics Canada.*

accurate in measuring the actual effectiveness of the policy change, as it includes all fatal collisions, whether or not a driver was impaired. Although the measure comes with this limitation, there are many advantages to using it as well. The implementation of longer license suspensions may encourage safer driving practices across the entire population, not only those driving with alcohol concentration levels above the legal limit. Likewise, the policy change may even discourage drinking in general, affecting the decision to engage in the behaviour even if it will not increase an individuals BAC above the legal limit.

The remaining dependent variables were also gathered from Statistics Canada CANSIM by a dataset which includes annual incident-based crime statistics by detailed vi-

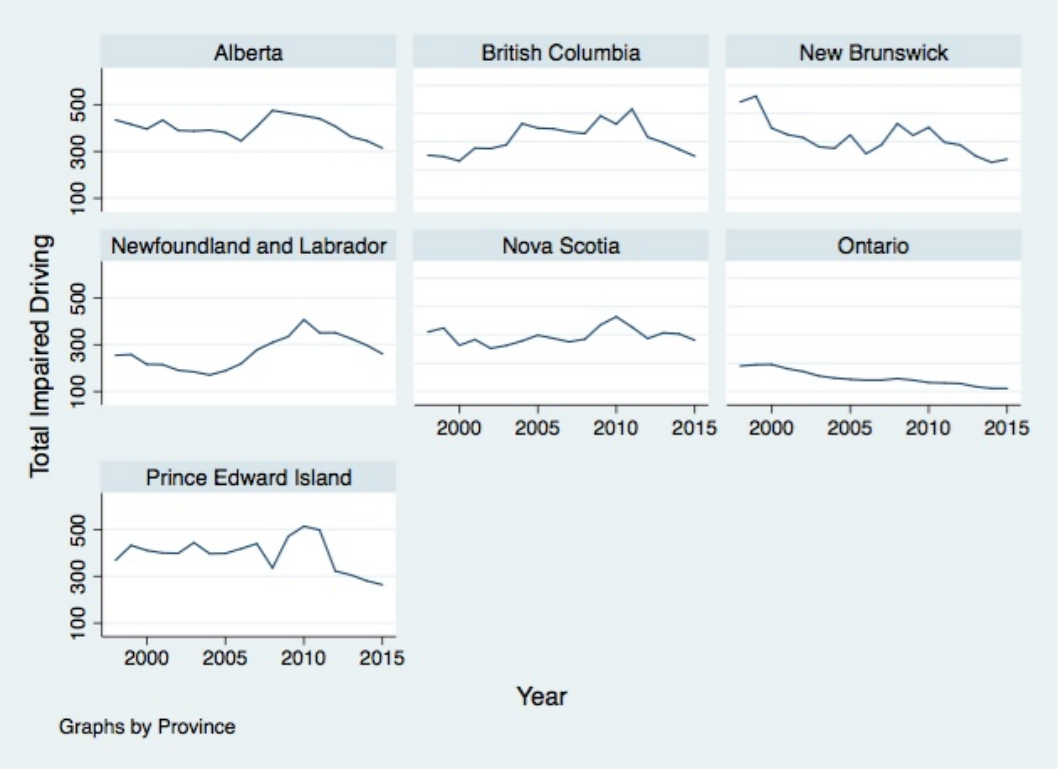

Figure 2: Total Impaired Driving from 1998-2015, Rate per 100 000 Population. *Source: Statistics Canada.*

olation for each province over the years 1998 to 2015. The next dependent variable of interest which was gathered by this second dataset is the total amount of impaired driving incidents. This variable is a measure including the total amount of incidents that were recorded by police, however does not necessarily mean that there was a collision involved. It is important to point out that two downfalls arise from this measure. The first is that since it includes data on all incidents whether or not a collision occurred, increases in this variable may be due to increases in law enforcement and detection techniques rather than the actual number of individuals driving while impaired. The second downfall is that it includes both alcohol-related and drug-related incidents, and therefore may overestimate the number of incidents specifically related to alcohol.

Table 2: Dependent Variables Summary Statistics

Variable	**Number of Obs.**	**Mean**	**Std. Dev.**	**Min**	**Max**
Total Fatal Collisions - AI	98	249.959	260.165	8	873
Total Fatal Collisions - R	98	9.453	2.906	4.6	18.1
Total Impaired Driving - AI	126	7577.444	7091.558	386	22842
Total Impaired Driving - R	126	304.699	94.821	110.79	513.84
Impaired Causing Death - AI	122	13.041	12.328	0	55
Impaired Causing Death - R	124	0.570	0.532	0	3.63
Impaired Causing Harm -AI	126	56.016	58.841	1	335
Impaired Causing Harm - R	126	2.359	1.12	0.58	8.27

Due to the two limitations arising from this particular variable, two other dependent variables have been considered in this study. Impaired operation causing death, and impaired operation causing bodily harm are the remaining outcome variables used in attempt to measure the effectiveness of the reform. Both these measures exclude drug-related incidents, which may lead to a better representation of the effect of the

policy in comparison to the total impaired driving measure previously discussed. These two variables were also gathered by the dataset of annual incident-based crime statistics, by detailed violation from Statistics Canada, CANSIM.[31]

Policy Variable

The main independent variable which is the policy variable of interest represents the implementation of the increase in license suspensions from the initial 24-hours for drivers found driving with BAC levels between 0.05 and 0.08. This variable is a binary indicator, equaling 1 if the policy is in effect, and 0 otherwise. Most of the dates of when the policy was implemented for each province were gathered by either the provincial governments websites in regards to their transportation and driving laws, or the Canadian Council of Motor Transportation Administrators (CCMTA). Refer back to section 2.2 for details regarding when each province adopted longer suspensions. This variable is the primary focus of this study, examining its effectiveness on fatal car accidents and other impaired driving incidents. Its summary statistics are presented in **Table 3**.

Table 3: Policy Variable of Interest Summary Statistics

Variable	**Number of Obs.**	**Mean**	**Std. Dev.**	**Min**	**Max**
License Suspension	126	0.325	0.470	0	1

[31] *Statistics Canada.* No date. *Table 252-0051 Incident-based Crime Statistics, by Detailed Violations, Annual (table).* CANSIM (database). Last updated July 19th, 2016. (accessed May 15th, 2017).

Control Variables

In addition to the increase in license suspensions, as discussed in section 2.1 of this paper, there have been many other policies studied and implemented in attempt to reduce impaired driving along with fatal accidents. For that reason, this paper controls for some of the policies and reforms arising around the same time period as when the longer license suspensions came into effect in attempt to obtain more accurate results. The analysis in this study however does not control for all of the policies and laws as in Eisenberg (2001) and Dee (2001), or all of those discussed in the earlier section for a variety of reasons. Seatbelt laws, minimum legal drinking age laws, commercial liability laws, BAC reductions, and MADD Canada have all been excluded in this study because they were implemented prior to the time period of interest. Likewise, the implementation of certain vehicle safety mechanisms such as ESC systems have also been omitted throughout this analysis, as there is no data available providing information on whether or not the vehicle in the collision had these safety mechanisms installed. Since it is not expected that many of these factors will differ across provinces, they will be captured through the use of the year fixed effects variable. It is for this reason that omitting some of these factors in this analysis will not limit the effectiveness of the empirical strategy, because it relies on actual differences between provinces.

This study therefore specifically controls for three other policies that may have an impact on the dependent variables since they came in effect around the same time frame as the policy of interest: graduated driver licensing (GDL) programs, the extension of zero-tolerance laws for at least three years after obtaining a full license, and random breath testing (RBT). Similarly to the increase in license suspensions, these variables are also binary, equaling 1 if in effect, and 0 if not. The data for the control policies were gathered by Transport Canada's, Road Safety in Canada (2011) Report, as well

as The 2015 Provincial Impaired Driving Report provided by MADD Canada, both providing information on the dates of laws implemented by each province.

This paper also attempts to control for two other variables that have been argued by previous literature to possibly impact driving rates. As presented in studies by Ruhm (1996), Dee (2001), and Eisenberg (2001), economic conditions may play a role in traffic collisions because a strong economy may lead to more jobs, consequently having more drivers on the road travelling to and from work, and thus increasing the risk of a crash. As unemployment rates and real per capita income are often the best measures of economic conditions, this study follows other literature and uses these two measures as control mechanisms. The data for the unemployment rate was gathered by labour force survey estimates (LFS), by all educational attainment, and both sexes aged 15 years and over, which was provided by Statistics Canada, CANSIM.[32] The data for real per capita income used in this study was calculated by dividing gross domestic product (GDP) by the total population for each province over the years 1998-2015. The data used for GDP and population were also both gathered using CANSIM, the former by an annual dataset providing GDP at basic prices for all industries and provinces,[33] and the latter by an annual dataset providing estimates of population for both sexes and all ages.[34] **Table 4** presents the summary statistics for the control variables used in this study, with the policy variables being binary, real per capita income being in real terms, and the unemployment rate being a percentage.

[32] *Statistics Canada.* No date. *Table 282-0004 Labour Force Survey Estimates (LFS), by Educational Attainment, Sex, and Age Group, Annual (table).* CANSIM (database). Last updated January 7th, 2016. (accessed May 21st, 2017).

[33] *Statistics Canada.* No date. *Table 379-0030 Gross Domestic Product (GDP) at Basic Prices, by North American Industry Classification System (NAICS), Provinces and Territories, Annual (table).* CANSIM (database). Last updated November 8th, 2016. (accessed May 21st, 2017).

[34] *Statistics Canada.* No date. *Table 051-0001 Estimates of Population, by Age Group and Sex for July 1, Canada, Provinces and Territories, Annual (table).* CANSIM (database). Last updated September 27th, 2016. (accessed May 21st, 2017).

Table 4: Control Variables Summary Statistics

Variable	**Number of Obs.**	**Mean**	**Std. Dev.**	**Min**	**Max**
GDL	126	0.937	0.245	0	1
Zero-Tolerance	126	0.103	0.305	0	1
RBT	126	0.167	0.374	0	1
Unemployment Rate	126	9.12	3.235	3.5	17.6
Real Per Capita Income	126	0.041	0.013	0.025	0.076

6 Results

From the two regressions specified in section 4, results are obtained which are presented in **Table 5** and **Table 6**. The former demonstrating the impact on the four dependent variables in terms of actual incidents, and the latter demonstrating the impact in terms of rate per 100 000 population. All results include province and year fixed effects and are presented in logarithmic form, excluding the policy variables because they are binary. Column (i) under each dependent variable demonstrates the panel regression in which only the implementation of longer license suspensions along with province and year fixed effects are included. Column (ii) under each dependent variable extends the previous regression to include control variables for other policies and economic conditions. These two models are represented by the first and second equations in the Empirical Model section of this paper, respectively.

When considering the impact on actual incidents as presented in **Table 5**, the results clearly demonstrate that the implementation of longer license suspensions effectively lead to a reduction in total fatal motor vehicle collisions. This can be observed by considering the first two columns under the first dependent variable, indicating a reduction in fatal collisions at the 99% level when both controlling and not controlling for other factors. Specifically, the policy appears to decrease total fatal traffic collisions by about 0.2% when considering the first regression under column (i). Although the policy becomes slightly less significant following the second regression, it still decreases total fatal collisions by about 0.19% for actual incidents, remaining statistically significant at the 99% level. These reductions demonstrate the fundamental finding of this study. This result is more statistically significant than both those found in Eisenberg (2001) and Dee (2001) for their ALR variable. The reasoning is most likely due the differences in the two measures, as this study is focused on the actual increase in the license suspension, rather than just the immediate prohibition period. This may suggest that longer license suspensions seem to have a larger impact on fatal traffic collisions than the mere immediate revocation itself.

Similar findings also arise when considering the third and fourth dependent variable in **Table 5**, providing further evidence of the effectiveness of the reform. Column (i) under the third dependent variable illustrates that the implementation of longer license suspensions leads to a reduction of roughly 0.26% in impaired operation causing death, which is significant at the 95% level. Following controlling for the other factors however, the impact of the policy is no longer statistically significant, though still remains in the expected direction. Likewise, the fourth dependent variable of interest, impaired operation causing bodily harm also appears to decrease actual incidents by about 0.37% following the implementation of the policy. The results become less significant again

once controlling for the unemployment rate, real per capita income, and other policies occurring around the same period of time.

The most surprising results obtained are those arising from the effect on the second dependent variable, total impaired driving. The first column under this dependent variable demonstrates an influence in the opposite direction as expected, though insignificant. Following controlling for the other variables however, the results become even more surprising, as the implementation of longer license suspensions seems to increase total impaired driving incidents reported to police at the 99% level of significance. As previously discussed in the Data, Variables, and Specifications section of this paper however, this variable may not be the best measure, as it also includes drug-related incidents, and does not indicate that a collision occurred. This could misrepresent the amount of incidents related to alcohol use, and thus might not be an accurate measure of the impact of the policy. Specifically, the observed increase in this variable may be due to an increase in law enforcement or detection techniques, leading to more offenders being caught rather than the actual amount of people driving while impaired.

Not only does the implementation of longer license suspensions seem to have an effect on fatal traffic collisions and impaired driving incidents, but other factors come into play when considering the other independent variables that were used as control mechanisms. Specifically, the extension of the zero-tolerance law for at least three years after obtaining a full license, along with the introduction of random breath testing (RBT) both appear to significantly decrease actual incidents of impaired operation causing bodily harm at the 99% level of significance. In addition to these policies, the two variables used for controlling for economic conditions, unemployment rate and real per capita income, also appear to reduce impaired operation causing bodily harm at

the 95% level of significance, the latter also reducing impaired operation causing death at the 90% level.

A similar trend also occurs for these variables when considering the results in terms of rate per 100 000 population, as demonstrated in **Table 6**. The main dependent variable, total fatal traffic collisions, again appears to decrease by approximately 0.25% following longer license suspensions coming into effect when considering the first regression under column (i). Following controlling for other policies and economic conditions through the second regression, the variable still appears to fall by 0.23% and remains statistically significant at the 99% level.

The implementation of the policy also appears to significantly reduce impaired operation causing death by approximately 0.33% however no longer remains significant following the inclusion of other controls. Likewise, impaired operation causing bodily harm appears to fall by about 0.43% following the policy coming into effect, again at the 99% level of significance. Following controlling for other policies and economic conditions however, the results become insignificant, though still in the expected direction. Similarly as demonstrated through terms of actual incidents, other factors that also appear to have an effect on the dependent variables in terms of rate per 100 000 population are zero tolerance laws, RBT laws, unemployment rate, and real per capita income, demonstrating a statistically significant reduction in impaired operation causing bodily harm. The surprising results that were previously observed for the second dependent variable in **Table 5** are also retained in **Table 6**, showing significant results in the unexpected direction for the measure of total impaired driving.

In attempt to fix the problem arising from the second dependent variable in both the results tables, this study repeated the same two regressions, however omitted the last two years of the time period, focusing only on 1998 to 2013 for that specific variable.

The reasoning for this is to study whether or not the implementation of random breath testing (RBT), which occurred in 2013, may have altered the results to observe the increase in amount of offenders being caught, rather than the increase in the actual amount of people engaging in the behaviour. Results are presented in **Table 7**. The findings however still appear to be statistically significant in the unexpected direction.

Though these findings are surprising, they support the fact that the variable may not be the most accurate measure, as there may also be the possibility of reverse causality coming into effect. Referring back to **Figure 2**, illustratating total impaired driving incidents, excluding New Brunswick and Ontario, all provinces seem to be increasing up until around the year when the policy was implemented. This would suggest that as more detection techniques (i.e. R.I.D.E programs for instance) are catching individuals driving while impaired, actual incidents reported by police obviously rise, and thus the policy would have been implemented in attempt to minimize the increasing trend. Although the results seem to illustrate that implementing the reform leads to an increase in reported incidents, it is most likely do to the fact that the reported incidents were already on the rise.

It is also possible that since impaired driving has led to an abundant amount of deaths and heartaches, the social perspective on drinking and driving has likely changed over the years. Individuals may now be more likely to call or report a possible drunk driver as there is much more discussion regarding the topic in comparison to previous years. Although this is likely the case, it is important to recognize that this rate is most likely consistent across provinces, and thus would have been captured through the use of fixed effects in the regression. It is for this reason that the more plausible explanation for the observed wrong-direction result is likely due to the change and development in police enforcement. Prior to the policy of longer license suspensions coming into

effect, police may not have recorded or enforced the penalty for an individual driving with a BAC level of say, 0.06 for instance, since it was only a 24-hour suspension. Police officers therefore may have been more lenient in regards to the offence prior to the law being passed. Following the policy being enforced however, police may now be more likely to actually record the individuals found driving with the same BAC level that they otherwise would have given a simple warning to due to the fact that the punishments are extended and made more severe. The implementation of longer license suspensions for those found driving with BAC levels between 0.05 and 0.08 likely made police more aware that punishments should be given to individuals at that level of intoxication, which would be consistent with these findings and explain the opposite direction of the total impaired driving variable.

7 Conclusion

As there has been an abundant amount of reforms and strategies implemented in order to deter impaired driving, and consequently the traffic accidents associated with it, much literature has been focused on evaluating whether or not they have actually been effective. This study has therefore demonstrated that the policy adopted by many provinces in implementing longer license suspensions for individuals found driving with BAC levels above 0.05 has been effective in decreasing fatal traffic collisions. This paper presents new findings on the impact of the policy change by controlling for other driving laws, along with economic conditions between 1998 and 2015. Specifically, this study shows a statistically significant reduction by 0.19% for actual incidents and a 0.23% decline in the rate per 100 000 population for fatal traffic accidents. Other factors that appear to have a significant impact in decreasing impaired operation causing

bodily harm are zero-tolerance laws, random breath testing (RBT), as well as the unemployment rate and real per capita income that were used as control measures for economic conditions.

Although this study considers the increase in license suspensions from the initial 24-hour prohibition period, it raises the question on what the optimal and most efficient license suspension length for first, second, and third time offenders actually is. Should it now be raised even further from the minimum 3-days, or will increasing the length past a certain period lead to diminishing returns? These questions become fundamental in understanding the appropriate policy structure to effectively deter individuals from driving under the influence, and leave much room for further research. Although alcohol-related traffic collisions are observed to be on the decline, they still remain one of the most frequent causes of death in Canada. It is for this reason that different techniques aimed in reducing these rates will continue to rise, and future research is needed in order to determine the most effective prevention mechanisms.

Table 5: Results of Longer License Suspensions on Fatal Traffic Collisions and other Impaired Driving Incidents, Actual Incidents. *All Results in logarithmic form*

Variables	Total Fatal Collisions		Total Impaired Driving		Impaired Causing Death		Impaired Causing Harm	
	(i)	(ii)	(i)	(ii)	(i)	(ii)	(i)	(ii)
License Suspension	-0.198***	-0.189***	0.026	0.199***	-0.264**	-0.072	-0.369***	0.008
	(0.042)	(0.056)	(0.034)	(0.047)	(0.092)	(0.144)	(0.065)	(0.092)
GDL		0.295 **		0.042		0.420***		0.152
		(0.118)		(0.682)		(0.199)		(0.133)
Zero-Tolerance		-0.091		-0.211***		-0.216		-0.322***
		(0.080)		(0.062)		(0.178)		(0.120)
RBT		-0.014		-0.217***		-0.082		-0.374***
		(0.079)		(0.049)		(0.151)		(0.097)
Unemployment Rate		0.038		-0.238		-0.172		-0.561**
		(0.162)		(0.129)		(0.380)		(0.253)
Real Per Capita Income		0.137		-0.136		-1.364*		-1.247**
		(0.387)		(0.251)		(0.738)		(0.490)
Constant	4.882***	4.962***	8.281***	8.315***	2.185***	-2.233	3.483***	0.498
	(0.022)	(1.122)	(0.019)	(0.718)	(0.052)	(2.092)	(0.037)	(1.404)
No. Obs.	98	98	126	126	115	115	126	126
Within R-Squared	0.201	0.272	0.005	0.254	0.072	0.146	0.216	0.390
Between R-Squared	0.060	0.003	0.078	0.288	0.129	0.327	0.102	0.087
Overall R-Squared	0.011	0.008	0.001	0.143	0.018	0.142	0.029	0.009

Notes: Standard errors are reported in parentheses.
*, **, and *** indicates significance at the 90%, 95%, and 99% level, respectively.

Table 6: Results of Longer License Suspensions on Fatal Traffic Collisions and other Impaired Driving Incidents, Rate per 100 000 Population. *All Results in logarithmic form*

Variables	Total Fatal Collisions		Total Impaired Driving		Impaired Causing Death		Impaired Causing Harm	
	(i)	(ii)	(i)	(ii)	(i)	(ii)	(i)	(ii)
License Suspension	-0.246***	-0.225***	-0.038	0.159***	-0.330***	-0.115	-0.433***	-0.031
	(0.042)	(0.058)	(0.034)	(0.046)	(0.090)	(0.143)	(0.067)	(0.095)
GDL		0.156		-0.059		0.313		0.051
		(0.122)		(0.067)		(0.198)		(0.138)
Zero-Tolerance		-0.096		-0.213***		-0.209		-0.322**
		(0.083)		(0.061)		(0.176)		(0.125)
RBT		-0.032		-0.245***		-0.114		-0.402***
		(0.082)		(0.049)		(0.149)		(0.101)
Unemployment Rate		-0.010		-0.282**		-0.212		-0.604**
		(0.168)		(0.128)		(0.376)		(0.263)
Real Per Capita Income		0.112		-0.138		-1.354		-1.25**
		(0.402)		(0.248)		(0.729)		(0.509)
Constant	2.268***	2.504**	5.675***	5.890***	-0.617***	-4.822**	0.877***	-1.935
	(0.219)	(1.165)	(0.019)	(0.711)	(0.051)	(2.068)	(0.038)	(1.459)
No. Obs.	98	98	126	126	115	115	126	126
Within R-Squared	0.276	0.305	0.010	0.289	0.112	0.173	0.259	0.422
Between R-Squared	0.344	0.004	0.264	0.066	0.000	0.002	0.413	0.033
Overall R-Squared	0.177	0.137	0.010	0.119	0.066	0.007	0.195	0.076

Notes: Standard errors are reported in parentheses.
*, **, and *** indicates significance at the 90%, 95%, and 99% level, respectively.

Table 7: Results of Longer License Suspensions on Total Impaired Driving From 1998-2013. *All Results in logarithmic form*

Variables	Total Impaired Driving - Actual Incidents		Total Impaired Driving- Rate per 100 000 population	
	(i)	(ii)	(i)	(ii)
License Suspension	0.093**	0.194***	0.039	0.153***
	(0.038)	(0.048)	(0.038)	(0.047)
GDL		0.040		-0.052
		(0.070)		(0.069)
Zero-Tolerance		-0.203***		-0.212***
		(0.070)		(0.069)
RBT		-0.157**		-0.177**
		(0.070)		(0.069)
Unemployment Rate		-0.234*		-0.255*
		(0.136)		(0.134)
Real Per Capita Income		-0.110		-0.096
		(0.257)		(0.252)
Constant	8.281***	8.394***	5.674***	5.960***
	(0.018)	(0.735)	(0.018)	(0.722)
No. Obs.	112	112	112	112
Within R-Squared	0.055	0.210	0.010	0.190
Between R-Squared	0.076	0.416	0.254	0.048
Overall R-Squared	0.000	0.212	0.000	0.078

Notes: Standard errors are reported in parentheses.
*, **, and *** indicates significance at the 90%, 95%, and 99% level, respectively.

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