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Abstract. This article presents the results of an evaluation of administrative laws introduced over time in different Canadian provinces to lower the permitted blood alcohol concentration (BAC) for driving or having care of a motor vehicle to .05% or less. Regression models for longitudinal data were used to estimate the effects of these laws on fatal alcohol-related collisions. Results reveal that significant decreases in the percentage of fatally injured drivers with prohibited BAC levels were recorded following the introduction of the laws. Reductions were observed for drivers of all drinking levels.

Keywords. Driving while impaired, .05% laws, fatally injured drivers, longitudinal data, Canada.

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1. Introduction

In 2010, 2,541 persons died in a motor vehicle crash in Canada and 11,338 were seriously injured. Alcohol was respectively involved in 38.7 and 18.9% of these crashes (Traffic Injury Research Foundation, 2013). As observed in other countries, driving while impaired by alcohol (DWI) is one of the leading causes of criminal injury in Canada (Chamberlain and Solomon, 2002; Perreault, 2013).

In order to prevent alcohol-related traffic injuries, several jurisdictions have – among other strategies – lowered the legal blood alcohol concentration (BAC) limit to operate a motor vehicle. In the United-States for instance, all States have adopted a .08% legal BAC limit while several countries have a .05% or lower legal BAC limit. Recent systematic reviews report that lowering the BAC limit is an effective strategy to prevent alcohol-related crashes (Mann et al., 2001; Fell and Voas, 2006). This strategy seems to affect drivers of all drinking levels (Brooks and Zaal, 1992; Kloeden and McLean, 1994; Hingson et al., 1996 and 2000; Voas et al., 2000; Wagenaar et al., 2007) and its effect is proportional to the level of sobriety checkpoints (Tippetts et al., 2005).

Some experts recently claimed that Canada is lagging behind other countries in its fight against impaired driving by maintaining a .08% BAC limit in its Criminal Code (Chamberlain and Solomon, 2002; Paciocco, 2002; Fell and Voas, 2006). Except for the province of Quebec, all other Canadian provinces have “administrative” BAC laws, forbidding driving or having care of a motor vehicle at levels of approximately .05%. Although no criminal offense is created, drivers found to operate or have care of a vehicle

with a BAC equal or over 0.05% can be issued a temporary licence suspension and a fine.¹

Despite the presence of administrative measures, Chamberlain and Solomon (2002) stress that “(the) introduction of a .05% Criminal Code BAC limit is an essential element of any meaningful reform of Canada’s federal impaired driving laws” (p. iii2). Since provincial laws are only administrative in nature, they do not create an offense and therefore, do not carry penalties. A criminal charge is viewed as a far more serious matter than a provincial charge, let alone a transitory administrative sanction. A criminal offense would lead to a fine, a substantial driving prohibition and a permanent criminal record. Since two sanction regimes are available – a criminal and an administrative one - police officers could be more inclined to issue administrative sanctions since laying charges for DWI under the Criminal Code involves several tasks such as taking the driver to the police station for an additional breath test (with an accredited breathalyser) and filling several forms (Jonah et al., 1999). Favoring the administrative regime over the criminal one could lessen the deterrent power of sanctions [see Solomon and Chamberlan (2002) for an extensive review of arguments for a .05% BAC limit under the Criminal Code].

Empirical evidence regarding the potential of administrative BAC laws is sparse. Most studies have assessed the impact of legal BAC limit under the criminal code. Although Australian States have enacted administrative laws, drivers intercepted with BACs between .05% and .08% are committing an offence and receive a fine and a licence

¹ In Canada, there is two sanction regimes: a criminal and an administrative one. Provisions found in the Criminal Code are into force in all provinces. Driving with a BAC level above .08% constitutes a crime under the Criminal Code. Provinces are not allowed to reform or amend the Criminal Code but they have the possibility to introduce administrative laws. Driving with a BAC level between .05 and .08 % is an infringement according to some provincial administrative laws.

suspension lasting several weeks or months (Brooks and Zaal, 1992; Stewart, 2000).² Provisions found in these administrative laws are closer to those found in criminal than in Canadian administrative laws.³ Vingilis et al. (1988) examined the impact of a 12-hour licence suspension law introduced in Ontario, Canada, on December 17th 1981. Their results indicate that the administrative .05 % BAC law had a small and short-term effect on the proportion of alcohol-related traffic fatalities. Contextual factors such as the absence of media campaign, limited enforcement activities and other unknown causes may be responsible for this limited effect.

Based on the results of previous studies, inductions about the potential of Canadian administrative laws are not only impossible, but also the influence of administrative BAC laws on enforcements patterns has yet to be documented. Studying law enforcement patterns is crucial to understand changes in alcohol-related traffic fatalities. This study is therefore designed to further our understanding about the effect of administrative laws lowering the BAC limit for driving on alcohol-related collisions in Canada. To reach this goal, a longitudinal data analysis over a period of 24 years is used. The main objectives of this study are to: (1) estimate the effects of administrative BAC laws on alcohol-

² In 1991 for instance, a fine of AUS \$500 was issued to drivers arrested with a BAC between .05 and .08% in the Australian Capital Territory. Increased penalties were awarded to recidivists (Brooks and Zaal, 1992). In Western Australia, the driver is likely to receive either a traffic citation or be asked to appear in court. For a first offense, the fine varies between AUS \$250 and AUS \$500 and between three and five demerit points are added to the driver's record.

³ Saskatchewan is the only Canadian province where driving with a BAC between .04 and .08% is sanctioned with four demerit points. Fees to reinstate the driver's licence vary between 0 and CAN \$150 (Canadian Council of Motor Transport Administrators, 2009). Recently, British Columbia introduced immediate roadside prohibition (IRP) for drivers with BAC between .05% and .08%. The driver's licence is automatically suspended for three days and the driver is fined CAN \$300. Vehicle can also be impounded for three days and increased sanctions apply for recidivists (Beirness et al., 2013). This measure is not assessed in the present study since data are available until 2010 and IRP was introduced in September 2010.

related collisions and, (2) assess their effect on enforcement activities. To some extent, our results will permit to determine whether administrative BAC laws have preventive virtues that are similar to criminal laws and whether the introduction of such administrative laws is associated with changes in the rate DWI incidents and persons charged under the Criminal Code.

2. Method

2.1 Data source

Data on the number of drivers fatally injured in motor vehicle collisions and the percent of them who had been drinking were extracted from the Traffic Injury Research Foundation (TIRF) reports on the alcohol-crash problem in Canada. Yearly data were available for all ten Canadian provinces for the 1987-2010 period. Since other factors are likely to affect the road toll, various catalogues from Statistic Canada were also consulted. At last, information on administrative .05% BAC laws was extracted from a report published by the Canadian Council of Motor Transport Administrators (CCMTA) in 2011. A summary of this information is provided in Tables 1 and 2.

2.2 Variables under study

2.2.1 Intervention variable: the introduction of administrative .05% BAC laws

The intervention variable represents the introduction of administrative laws lowering the legal BAC limit to .05% or .04%. Information was extracted from the CCMTA report (2011) prepared for the Standing Committee on Road Safety and Policies (see Table 1 for detailed information on law provisions). The intervention variable was operationalized as a step function. For each Canadian province, the intervention variable was coded 0 for the years before the introduction of the law, and it was coded 1 for the year of the

intervention and the following years. If an administrative BAC law has been introduced prior to 1987, the intervention variable was coded 1 for all years. This was the case for Alberta, British-Columbia, Ontario and New Brunswick where administrative BAC laws were respectively introduced in 1975, 1979, 1981 and 1985 (Table 1). A second intervention variable was created to capture the effect of the introduction of a modification to the existing administrative BAC law. Therefore, this variable was coded 1 for Ontario for years 2009 and 2010 and Saskatchewan for years 2006 to 2010; it was coded 0 elsewhere.⁴

⁴ This second intervention variable had no significant effect, therefore it is not in reported nor discussed further in the remaining of the paper.

Table 1
Administrative BAC laws in Canadian Provinces and their provisions

	Suspension motives	Infringement	Suspension period	Reference period	Reinstatement fees	Assessment	Other
AL	Signs of DWI (1975)	1 st	24 hours	-	-	-	-
BC	Signs of DWI (1979)	1 st	24 hours	5 years	-	-	-
		2 nd	24 hours			-	-
		3 rd	24 hours			Yes	-
MB	BAC over .05% (1998)	1 st	24 hours	3 years	\$50	-	-
		2 nd	24 hours		\$50	Yes	-
NB	BAC over .05% (1985)	1 st	24 hours	-	-	-	-
		1 st	24 hours	-	\$100	-	-
NL	BAC over .05% (1995)	2 nd	24 hours	2 years	\$100	-	-
		3 rd	60 days		\$100	Yes	-
		4 th	120 days		\$100	Yes	-
		1 st	24h		-	-	-
NS	BAC over .05% (1999)	1 st	3 days	5 years	\$150	-	-
		2 nd	7 days		\$150	Yes	-
		3 rd	30 days		\$150	Yes	Ignition interlock
		4 th	30 days		\$150	Yes	Ignition interlock
PEI	BAC over .05% (1997)	1 st	24 hours	-	-	-	-
		-	-	-	-	-	-
QC	BAC over .04% (1996/2006)	1 st	24 hours	5 years	-	-	4 points
		2 nd	15 days		-	Yes	4 points
		3 rd	90 days		-	Yes	4 points

Source: CCMTA STRID 2010 Task Force (2011). Strategy to reduce impaired driving 2010. STRID report: progress in 2010. Prepared for the Standing Committee on Road Safety Research and Policies. CCMTA Road Safety Report Series : Ottawa (Canada).

2.2.2 Dependent variables

A first set of dependent variables was operationalized in order to assess the effect of administrative .05% BAC laws on the proportion of fatally injured drivers with a BAC over the legal limit. Drivers dying within 12 months as a result of injuries sustained in a collision involving a motor vehicle were included in the study. A decrease in the percentage of fatally injured drivers with a positive BAC would mean that administrative .05% BAC laws were effective in reducing the extent of the drinking-and-driving problem.

These variables represent on one hand the BAC categories that are specifically targeted by administrative laws (BACs between .05 and .08%) and on the other hand, categories with higher BACs since some studies found that drivers of all drinking levels were affected by the law (Brooks and Zaal, 1992; Kloeden and McLean, 1994; Hingson et al., 1996 and 2000; Voas et al., 2000; Wagenaar et al., 2007). The following variables were created by dividing the number of fatally injured drivers with a specific BAC by the number of tested drivers that were fatally injured (*100).

1. Percentage of fatally injured drivers with a BAC equal or greater to .05%.
2. Percentage of fatally injured drivers with a BAC greater than .08%.
3. Percentage of fatally injured drivers with a BAC greater than .15%.⁵

⁵ In 2002, changes were made to the BAC categories presented in the CCMTA Road Safety Report Series. The .15% BAC category was changed to .16%. We decided to keep this category even if it could create an experimentation bias (Shadish et al., 2002). To evaluate this potential bias, analyses were conducted separately for the data before 2002 and also with a dummy variable taking the value 0 before 2002 and 1 in 2002 and after and its interaction with the introduction of the .05% BAC laws. Results suggest that this modification had no significant impact on the coefficient estimates of the regression model presented in section 3.

A second set of dependent variables was created to assess the effect of administrative .05% BAC laws on enforcement variables. Two variables were considered.

1. Number of DWI incidents per 100,000 population. Since very few cases of DWI are reported to the police, this variable acts as an indicator of drivers arrested for DWI (Blais and Ouimet, 2005). At this point, the case can be dismissed or criminal charges can be laid down.
2. Ratio between the number persons charged for a DWI offense and the number of DWI incidents. This ratio expresses the relationship between DWI incidents and drivers that are eventually charged for DWI. A decrease in the ratio would indicate that persons were less likely to be charged for a DWI offense over the 1987-2010 period or after the introduction of the .05% BAC laws.

2.2.3 Control variables

Beside administrative laws lowering the legal BAC limit, other factors are likely to affect alcohol-related collisions. Variations in the trend of the following factors could have a significant influence on the proportion of alcohol-related collisions. Descriptive statistics for these variables are presented in Table 2.

Unemployment rate. The labour force consists of people (15 and over) who are currently employed and people who are unemployed but were available to work in the reference week and had looked for work in the past four weeks. Unemployment rate is the percentage of the labour force that is unemployed but is looking for a paid job. Studies have shown that the unemployment rate is likely to be associated with miles driven and

alcohol consumption, two factors likely to affect the road toll (Voas et al., 2000; Gaudry and Lassarre, 2000).

Beer consumption *per capita*. Alcohol consumption alters driver's cognitive and motor functions, which increases the risk of serious traffic collision (Keall et al., 2004; Kruger and Vollrath, 2004). Individuals who drive under the influence of alcohol are more likely to drink beer (Berger and Snortum, 1986). Voas et al. (2000) found a partial correlation between alcohol-related collisions and beer consumption in the United-States. In the present study, beer consumption was expressed as the number of liters consumed each year per inhabitant.

Percentage of the population aged between 16 and 24. Young drivers are overrepresented in collision statistics. Their lack of experience (Rosenberg and Martinez, 1996), lower tolerance to alcohol (Howat et al., 1991), frequent risk-taking behaviours and traffic violations (Assum, 1997) heighten their risk of being involved in a fatal traffic collision. Since data for young drivers were not available for all provinces, the percentage of the population aged between 16 and 24 is used as a proxy.

Incarceration rate per 100,000 population. The effect of incarceration on collisions does not reach a consensus among the scientific community. Ross and Klette (1995) came to the conclusion that the abandonment of mandatory jail for impaired drivers in Norway and Sweden did not produce any adverse effect. Conversely, Blais and Ouimet (2005) found that the increased probability of being jailed for DWI was in part responsible for the improvement of the alcohol-related collision problem between 1980 and 2001 in the Province of Quebec. The incarceration rate is expressed as a ratio between the number of incarcerated offenders and the population.

Police officers per 100,000 population. Police officers devote a large proportion of their time to traffic safety activities (Bayley, 1994). Studies also suggest that the effectiveness of traffic safety laws is dependent upon enforcement activities conducted by police forces (Tippetts et al., 2005; Blais and Dupont, 2005).

2.2.4 Analytical strategy

First, the percentages of fatally injured drinking-drivers are graphically presented over the 24-year study period to determine whether a downward trend is discernable in the data. An identical strategy is used to discern trends in law enforcement patterns.

Second, regression models for longitudinal data (Fitzmaurice, Laird and Ware, 2004) were used to estimate the effect of the administrative BAC laws on the percentage of fatally injured drivers with blood alcohol concentration levels over .05%, .08% and .15% and on the two enforcement indicators respectively. The model parameters were estimated taking into consideration the correlation structure of the repeated observations over time in each province⁶. Few correlation structures were evaluated (exchangeable, autoregressive and independent) and the model with the best Akaike information criterion (AIC) was selected (Fitzmaurice, Laird and Ware, 2004). In addition to the intervention and control variables, the year and year squared were considered in the regression models to capture the overall road toll improvement over time. The one year lag value of the dependent variable was also considered as an independent variable in the models. The provinces were added as a fixed factor to control for missing independent variables, such as the intensity of enforcement activities or other specific interventions causing

⁶ The procedure MIXED in SAS software version 9.3 was used for the longitudinal data analyses.

differences between the provinces that are not captured by the other independent variables in the model.

Table 2
Descriptive statistics for variables under study

Variable name	Mean	Std-Dev.	Range	Sources
Percentage of fatally-injured drivers with positive BACs (n=231)⁷				
BACs ≥ .05%	38.5%	9.3%	0.0% – 66.6%	CCMTA Road Safety Report Series. Alcohol-Crash Problem in Canada (1987-2010).
BACs > .08%	35.9%	9.0%	0.0% – 66.6%	
BACs > .15%	25.9%	7.9%	0.0% – 58.3%	
Law enforcement activities (n=240)				
Rate of DWI incidents per 100,000 population	437.5	226.8	131.5 – 1284.4	Statistics Canada, Incident-based crime statistics (Tables 252-0013, 52-0014 and 252-0051)
Ratio –persons charged of DWI: DWI incidents	0.79	0.11	0.44 – 0.98	Statistics Canada, Incident-based crime statistics (Tables 252-0013, 252-0014 and 252-001)
Control variables (n=240)				
Unemployment rate	9.5%	3.7%	3.4% - 20.1%	Statistics Canada. Labour force survey estimates (Table 282-0002)
Beer consumption (liters per inhabitant)	85.3	9.4	68.4 - 119.6	Statistics Canada. Sales of alcoholic beverages by volume (Table 183-0006)
Percentage of youth (16-24)	12.9%	1.1%	11.2% - 17.2%	Statistics Canada. Estimates of population, by age group and sex (Table 051-0001)
Incarceration rate per 100,000 adults	91.9	36.1	40.1 - 199.8	Statistics Canada. Adult correctional services, average counts of offenders (Table 251-0005)
Police officers per 100,000 population	177.5	18.2	136.8 - 220.2	Statistics Canada. Number of police officers (Table 254-0001)

⁷ The information was missing for the provinces of Prince Edward Island in 1998 to 2003 and 2007, Manitoba in 1987 and Saskatchewan in 1998.

3. Results

3.1 Effects of .05 laws on the percentage of fatally injured drivers with a BAC over the maximum limit

Figure 1 displays trends in the percentage of fatally injured drivers with a BAC over the maximum limit for all ten provinces combined. The series is characterized by a downward trend and most of the decrease occurred prior to 2000 (Vanlaar et al., 2012). For the 1987-2010 period, 38.5% of fatally injured drivers exhibit a BAC of .05% or more. However the vast majority has a BAC over the legal limit found in the Criminal Code. On average, about 35.9% of fatally injured drivers have a BAC greater than .08% while this average is about 2.6% for drivers with a BAC between .05 and .08%.

Figure 1

Trends in the percentage of fatally injured drivers with BACs over the maximum limit

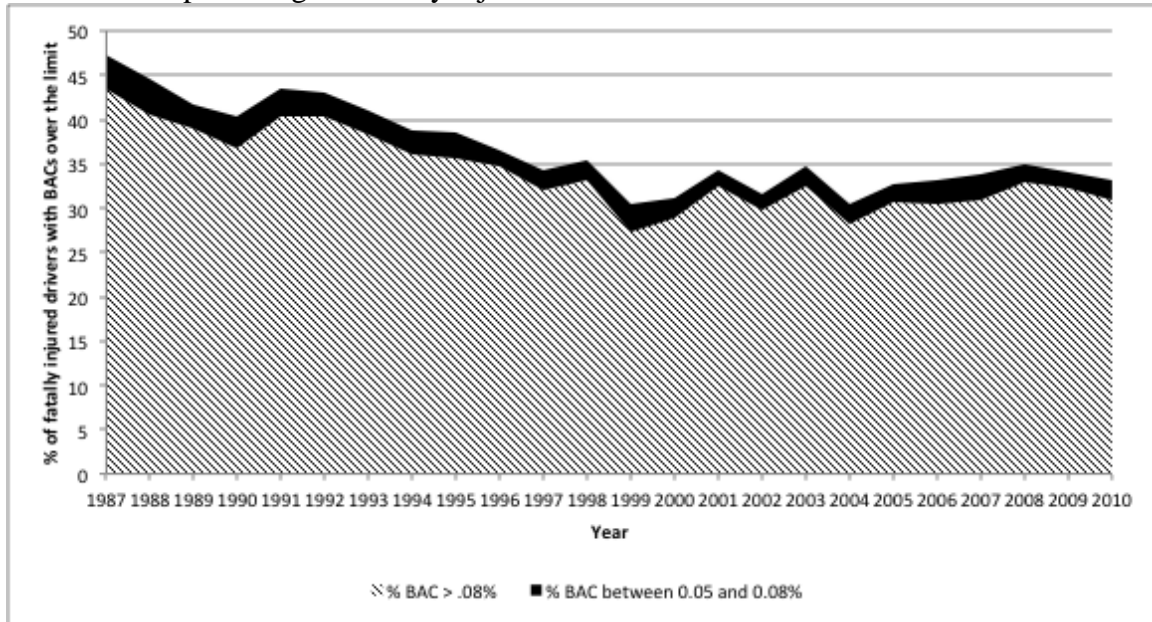


Table 3 reports estimates from the “best” longitudinal regression analysis models. The model with the autoregressive correlation structure and the independent variables *introduction of .05% BAC laws, year trend, beer consumption or incarceration rate and provinces* had the best fit⁸. Overall, results suggest that administrative reforms lowering the permitted BAC limit to .05% or lower are associated with a significant decrease in the percentages of fatally injured drivers with a BAC over the limit. The introduction of administrative laws led to a significant reduction in the percentage of fatally injured drivers with BAC equal or greater than .05% ($\beta = -4.2$; $p = 0.0153$). Significant decreases are also observed for fatally injured drivers with a BAC greater than .08% ($\beta = -3.5$; $p = 0.0413$) or a BAC greater than .15% ($\beta = -4.9$; $p = 0.0052$), suggesting that such laws affect drivers of all drinking levels.

⁸ Diagnostic analyses identified few influential and outlying observations for the Prince Edward Island and Newfoundland provinces. Because Prince Edward Island had seven missing observations and is the smallest Canadian province with only 141,678 inhabitants in 2010, we removed all observations from this province for these analyses plus four other outlying observations from Newfoundland, the second smallest province with 512,972 inhabitants in 2010. The regression models for the percentage of fatally injured drivers with BAC levels over the limit are therefore based on 210 observations. The best models retained were those with the lowest AIC and statistically significant independent variables.

Table 3
Effects of administrative .05% BAC laws on the percentage of fatally injured drivers with a BAC over the maximum limit

Independent variables	BAC ≥ .05%			BAC > .08%			BAC > .15%		
	β	std. error	p-value	β	std. error	p-value	β	std. error	p-value
.05% BAC laws (1=intervention period)									
Year (1987-2010)	-4.1675	1.7030	0.0153	-3.5021	1.7050	0.0413	-4.9258	1.7424	0.0052
Beer consumption	-0.2239	0.0959	0.0205	-0.1822	0.0959	0.0589	-0.2839	0.08944	0.0017
% of youth (16-24)	0.2698	0.0921	0.0038	0.2467	0.0922	0.0081	0.2318	0.08461	0.0067
Incarceration rate	1.4506	0.6909	0.0371	1.4650	0.6916	0.0354	0.08910	0.03761	0.0188
Provinces (reference category = Quebec)									
British-Columbia	9.0765	2.8177		7.6023	2.8179		9.1227	2.8513	
Alberta	0.7666	2.9253		-0.0997	2.9259		1.9032	3.1761	
Saskatchewan	8.7357	3.2408		7.4712	3.2427		3.0184	4.8212	
Manitoba	6.8965	2.8036		5.8877	2.8043		3.1307	3.6214	
Ontario	-0.8345	2.8297		-1.3528	2.8300		2.2010	2.8877	
New Brunswick	10.5690	3.1742		8.9171	3.1757		10.2595	2.9912	
Nova Scotia	6.5732	2.6510		5.9500	2.6510		9.4370	2.5714	
Newfoundland	-1.9220	2.6766		-1.3354	2.6779		2.9115	2.4717	
Intercept	442.34	196.38		358.34	196.35		563.67	182.12	

3.2 Effects of administrative .05% BAC laws on enforcement activities

Trends in law enforcement variables are plotted in Figure 2. DWI incidents appear to dwindle over the 1987-2010 period while persons charged per DWI incidents display an erratic trend. The latest variable started a decrease in 1987 until 1993. The 1994-2000 period is characterized by a rise in the proportion of charges laid down per DWI incidents. As off 2000, the ratio follows a downward trend. Regression analyses will permit to determine whether trends observed in Figure 2 are related to the introduction of administrative BAC laws.

Figure 2

Trends in law enforcement variables

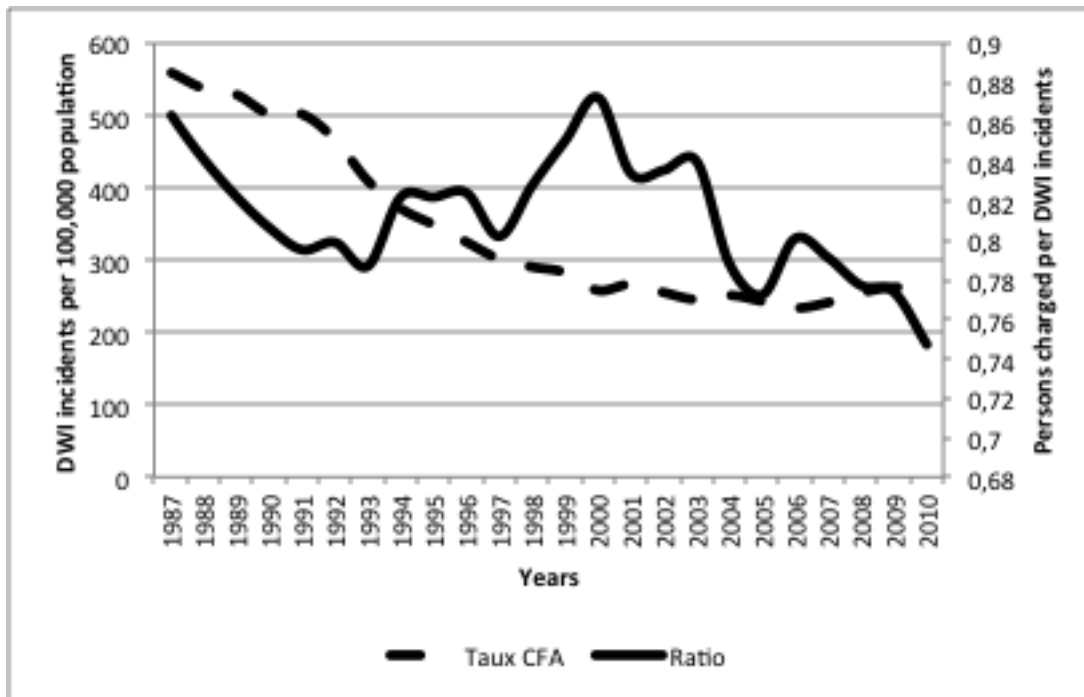


Table 4 presents the results of the longitudinal regression models for the two law enforcement dependent variables i.e. DWI incidents per 100,000 population and ratio between the number of persons charged for DWI and the number of DWI incidents. The

models with the autoregressive correlation structure yielded the best fit. Only the models including all independent variables considered are reported. Removing the not statistically significant variables will result in reduced models with very similar regression coefficients and significance levels as those reported in Table 4 for the remaining statistically significant independent variables. Although all mechanisms involved remained to be investigated, results of the analyses show that the introduction of administrative .05% BAC laws is not statistically associated with changes over time of the two law enforcement variables (DWI incidents reported by police officers under the Criminal code: $p = 0.4160$; ratio between persons charged of DWI under the Criminal code and DWI incidents: $p = 0.4525$).

Table 4

Effects of administrative .05% BAC laws on enforcement activities

Independent variables	DWI incidents per 100,000 population			Ratio between persons charged for DWI and DWI incidents		
	β	std. error	p-value	β	std. error	p-value
.05% BAC laws (1=intervention period)	-11.8812	14.5790	0.4160	-1.7985	2.3894	0.4525
DV year before (one year lag)	0.7304	0.04242	<0.0001	0.0242	0.0688	0.7250
Year (1988-2010) ⁹	-1840.48	638.12	0.0043	302.92	114.01	0.0085
Year squared	0.4590	0.1595	0.0044	-0.0758	0.0285	0.0084
Unemployment rate	-6.3447	3.4148	0.0646	-0.4482	0.4432	0.3130
Beer consumption % of youth (16-24)	-2.6208	0.9942	0.0090	0.4222	0.1536	0.0065
Incarceration rate	-4.8529	6.3041	0.4423	3.1061	1.5888	0.0519
Police officers	0.05750	0.3187	0.8570	0.0670	0.0496	0.1784
	1.6921	0.6585	0.0109	-0.0549	0.1015	0.5892
Provinces (reference category = Quebec)						
British-Columbia	31.0720	28.9408		-15.1987	6.5732	
Alberta	114.67	38.8186		-27.5568	7.6907	
Saskatchewan	63.7334	47.9548		-20.7465	8.8224	
Manitoba	-29.2995	36.5686		-13.3456	7.3919	
Ontario	-32.1434	27.6708		4.3699	6.3315	
New Brunswick	63.3592	32.6202		-6.6395	6.9415	
Nova Scotia	35.9177	27.5650		-7.0762	6.3771	
Prince Edward Island	120.87	42.1703		-14.2438	8.1424	
Newfoundland	158.18	49.6513		-25.4536	8.5556	
Intercept	1844883	638394		-302678	114031	

⁹ Because of the addition of the one-year lag variable in the regression model, only data from year 1988 instead of 1987 can be used in the analyses.

4. Discussion

The main objectives of this study were to estimate the effect of administrative .05% BAC laws on alcohol-related collisions and on law enforcement activities. Results demonstrate that Canadian administrative BAC laws were effective in reducing by 4.1% (95% C.I. 0.8% to 7.5%) the percentage of fatally injured drivers with a BAC limit equal or higher than .05%. As reported in other studies (e.g., Kloeden and McLean, 1994; Voas et al., 2000), drivers of all BAC levels were affected by the introduction of administrative .05% BAC laws in Canada. Decreases of 3.50 (95% C.I. 0.10 to 6.90) and 4.93 (95% C.I. 1.35 to 8.51) were respectively observed for the percentage of fatally injured drivers with BAC greater than .08% and .15%.

Concerns about changes in law enforcement patterns are not supported by our results (Solomon and Chamberlain, 2002; Beirness, 2000). The introduction of administrative .05% BAC laws neither led to changes in the DWI incident rate nor in the probability of being charged for DWI. Based on diminutions observed in alcohol-related collisions, the administrative sanction system seems to effectively complement the criminal justice system.

While .05% administrative BAC laws in Canada do not carry heavy penalties, failing the breath test lead to an immediate driver's license suspension. Under such conditions, the certainty of being sanctioned for failing a breath test is relatively high - in comparison to a criminal case - and the sanction is delivered right after the offense is committed. The certainty and celerity of sanction are two important features of a deterrence regime (Nagin, 1998 and 2013; Blais and Gagne, 2010). Since few provinces introduced new

BAC laws or reforms for the period under study, it was not possible to determine whether administrative laws with longer suspension period and heavier fines were more effective. Although studies use different measures of alcohol-related collisions, our estimates are comparable to those observed in other jurisdictions. In their review, Shults et al. (2001) report that American .08% BAC laws were associated with a median decrease of 7% in alcohol-related fatal collisions. Similar findings are reported in recently published studies (Eisenberg, 2003; Bernat et al., 2004; Tippetts et al., 2005; Kaplan and Gracomo Prato, 2007). In Australia, lowering the maximum BAC limit to .05% led to significant decreases of 11% in night-time serious collisions in New South Wales and of 18% in fatal collisions in Queensland (Henstridge et al., 1997). Lowering the BAC limit to .02% in Sweden was also associated with a 9.7% reduction in fatal collisions (Norstrom and Laurell, 1997) while limiting the BAC for driving to .03% in Japan lessened the level of alcohol-related traffic injuries by 32% (Nagata et al., 2008). At last and as reported in previous studies (Kloeden and McLean, 1994; Brooks and Zaal, 1992; Voas et al., 2000), reducing the permitted BAC limit affects drinking of all levels. In the present study, administrative BAC laws implemented in Canadian provinces were associated with significant diminutions in the percentage of fatally injured drivers with a BAC greater than .08% and .15% (decrease of 3.5% and 4.9% respectively).

Directions for future studies

Comparing results among studies underline that they are still several research gaps to fill and emphasis the need to study what Nagin (1998 and 2013) calls the technology of sanction and sanction regimes. Effects observed are the results of several mechanisms:

“(t)he response of crime rates to a change in sanction policy will depend on the specific form of the policy, the context of its implementation, the process by which people come to learn it, differences in perceptions of the change in risks and rewards that were spawned by the policy, and feedback effects triggered by the policy itself (Nagin, 1998: 4).

Technology of sanction generation refers to documenting the enforcement of provisions found in the law in order to dissociate the intended and the actual policy. Administrative and criminal BAC laws come with different provisions. Besides cultural and social differences, the reform in the Japanese legislation not only lowered the BAC limit to .03% but also increased the fine (from 425 to 4,250 American dollars) and the number of demerit points. Bar owners and passengers could also be held responsible for the DWI incident (Nagata et al., 2008). Studying the technology of sanction permits on one hand to identify provisions likely to affect drivers’ behaviours and on the other hand, delineate the boundaries of feasible policy as prescribed (Nagin, 1998).

The technology of sanction concept is intimately related to the concept of sanction regimes, which “defines the sanctions that are legally available for the punishment of various types of crime and how that legal authority is administered” (Nagin, 2013: 5). In the Canadian case, understanding the technology of sanction for the administrative and the criminal sanction regimes is crucial to pinpoint their respective effects and determine whether shifts from a regime to the other have implications for traffic safety. Our results suggest that enforcing administrative BAC laws had no significant effect on the criminal ones. Additional studies are however necessary to confirm these results. Jonah et al.

(1999) found that police officers are more inclined to enforce administrative than criminal provisions because of the numerous legal and procedural barriers they are confront to when laying down criminal charges.

The inverse relationship between administrative BAC laws and the percentage of fatally injured drivers with BACs of various levels calls for a better understanding of the “policy-to-perception” linkage (see Nagin [1998] on this topic). Few studies have investigated the relationship between law enforcement indicators and variations in the public perceptions about the properties of punishment (Kleck et al., 2005; Homel, 1988). In his seminal work on random breath testing (RBT) in New South Wales, Australia, Homel (1988) show that the introduction of RBT was used as an argument to resist peer pressure to drink-and-drive. Even if deterring individuals to drink-and-drive is the major aim of law enforcement measures, the latest can trigger other preventive mechanisms such as shame, education and normative validation (Andenaes, 1974; Blais and Ouimet, 2005).

5. Conclusion

The results of the present study indicates that Canadian administrative .05% BAC laws were effective in reducing the percentage of fatally injured drivers with prohibited BAC limits of all levels. This improvement occurred without affecting the rate of DWI incidents reported by police officers and the likelihood to be charged for DWI once intercepted for such an offense.

Pooling longitudinal and cross-sectional data allows to increase statistical power and to account for heterogeneity between provinces’ and previous trends. Potential confounding

factors were also controlled for. The effect of the law was however modelled as a step function involving that the effect is immediate and identical for the whole intervention period. Recent studies suggest that the relationship between law enforcement activities or traffic safety measures and collisions is not linear (Elvik, 2011; Carnis and Blais, 2013). The relationship is sometimes characterized by a decay function over time. In other circumstances, additional inputs in terms of enforcement resources do not translate into proportional decreases in traffic injuries. Additional studies are needed on one hand to document issues related to the technology of sanction and on the other hand, to estimate the long-term effect of administrative .05% BAC laws in Canada.

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