Intervention analysis of the safety effects of a legislation targeting excessive speeding in Canada

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Abstract

Excessive speeding is a safety concern on all Canadian roads, consequently, numerous countermeasures have been considered to mitigate this problem. Whether it is excessive speeding, street racing or stunt driving, these activities subject all road users to extreme risk. To address this problem, three Canadian provinces, namely, British Columbia, Ontario and Quebec, introduced severe sanctions against drivers who exceed speed limits by high margins. Among other sanctions, the legislation involved the immediate suspension of an offender's license and the impoundment of his/her vehicle. In this paper, intervention analysis of the collision data, from the three provinces was conducted to identify the safety effects on the legislation. The main aim of the analysis was to identify any changes in the time series behavior of the collision data after the implementation of the intervention (legislation). The changes were assessed for statistical significance, and the magnitude of the change was quantified. In general, the findings showed that the legislative changes were associated with drops in province-wide fatal collisions substantiating the safety benefits of introducing such legislations to target excessive speeders.

Keywords:

Autoregressive Integrated Moving Average, Intervention Analysis, Excessive Speeding, Severe Collisions, Severe Sanctions.

1. Introduction

Excessive speeding is an issue on roads all over Canada, and many countermeasures have been considered in various provinces to overcome this challenge. Regardless of their motives, excessive speeders expose themselves and other road users to extreme risks.

Research has shown that excessive speeders and speed racers are, in general, aggressive drivers with considerably more traffic infringements and crashes compared to the average driver (Leal & Watson 2011). Subsequently, more attention and severe sanctions have been considered when dealing with such offenders. This includes higher monetary penalties, more demerit points, and the use of vehicle-related sanctions to accompany license suspensions. Vehicle-related sanctions such as vehicle impoundment laws are set with the aim of improving safety by preventing drivers convicted of dangerous offences from driving, sending severe warnings to both the general driving population and offenders in particular. Vehicle impoundment is the confiscation of an offender's vehicle for a temporary period; this is slightly different from vehicle forfeiture, where the vehicle is taken away permanently.

Vehicle-related sanctions have been adopted as a penalty for different types of offences. However, previous studies show that the main reason these policies have been implemented is to counteract drivers who have been suspended or unlicensed to drive while suspended (DWS) or drive while unlicensed (DWU). Reasons for suspension can vary, but one common reason is driving under the influence (DUI) of alcohol. Realizing the potential value of such practice in improving road safety and given the aggressive nature of excessive speeders, traffic safety officials around the world and in Canada have started adopting vehicle related sanctions and administrative license suspensions to address dangerous driving behavior such as excessive speeding and stunt driving.

In Canada, three Canadian provinces (British Columbia, Ontario and Quebec) recently adopted severe sanctions to address the issue of excessive speeding. Under the new laws, drivers who violate speed limits by a certain margin, deemed too high, are subject to a variety of sanctions including immediate license suspension, hefty fines and vehicle impoundment. The next sub-section provides details of the legislative changes at each of the three provinces.

1.1 Legislative Changes

Different provinces adopted different definitions for excessive speeding. In Ontario, the margin at which the fines came into effect was 50 km/h, 40 km/h in BC, and in Quebec the margin was defined depending on the speed limit on the road (40 on 60 km/h roads, 50 on 70-90 km/h roads and 60 on 100 km/h roads).

In BC, drivers caught under the new legislation are subject to mandatory license suspension of 3, 7, or 30 days, and vehicle impoundment ranging from 3 to 30 days. In Ontario, the changes included instant 7-day license suspension and a 7-day vehicle impoundment. After conviction, the driver is also subject to a fine in the range of $2,000–$10,000, 6 demerit points, and possible imprisonment. In Quebec, the offender is subject to an immediate 7-day license suspension, double speed fine, and double demerit points. Repeat offenders in Quebec are also subject to a 30-day vehicle impoundment along with a 30-day license suspension. Before the introduction of the new legislation the margin by which drivers violated speed limits only affected the monetary value of the speed ticket and the number of demerit points. For more information about the fines before the law in BC see Motor Vehicle Act BC (2009) and Quebec see SAAQ (2001). Both administrative license suspensions and administrative vehicle impoundment were not part of the previous laws. In the province of Alberta, where severe sanctions are yet to be adopted against excessive speeders, the current fine for exceeding the speed limit by 50 km/h or more is $474. In addition, the driver is also subject to a mandatory court appearance where the judge could impose a license suspension after conviction (Alberta Government 2017).

The legislative changes are believed to have had a positive effect on traffic safety in those three provinces, and fatality statistics show that there has been a drop in the number of traffic fatalities since the implementation of the new law. However, this drop cannot be attributed to the new policy unless statistical data analysis shows that the intervention did indeed have a statistically significant effect on decreasing fatalities once the impact of other variables has been controlled. Other variables include other legislative changes that also took place during the duration of the study period. For instance, in BC an impaired driving law was implemented with the Excessive Speeding Legislation (ESL) and then discontinued 13 months later. Similarly, Ontario implemented impaired driving laws two years after the implementation of the ESL. In Quebec, the ESL was paired with a distracted driving law. Moreover, both Ontario and Quebec enforced speed limiters for trucks in January of 2009. All these legislative changes had to be accounted for before attributing any safety improvements to the ESL. All province-wide legislation that were implemented or cancelled during the study period are detailed in Table 4.

1.2 Study Objectives

Consequently, this paper aims to analyze the effects of the excessive speeding legislation (ESL) on collision counts at varying severity levels using interrupted time series analysis. Fatal and injury collision data at each of the three provinces which adopted the legislation were analyzed and the intervention's effects were assessed. The developed models were augmented to account for confounding factors including other legislation which was in place during the analysis period (see Table 4) and collision counts per million litres of fuel sold as a proxy for exposure. A total number of 12 intervention models were developed, and the significance of the intervention was tested in each case.

2. Literature Review

Deterrence theory states that compliance to laws and legislation is mainly due the fear of being caught. This fear is known to deter (discourage) drivers from violating the law and is a function of three factors: (1) the apparent severity of the law, (2) the certainty and the speed in which an offender is penalized, and (3) the administrative penalties associated with the law (Watson 2004). Moreover, deterrence is also a function of the amount of enforcement and publicity a law receives.

Deterrence can be achieved in two forms: general and specific. General deterrence is the impact of the threat of legal punishment on the public at large (i.e. the effect of the knowledge of people getting punished under a law on the behavior of the general population). Specific deterrence, on the other hand, is the effects of a law on the behavior of individuals who have been subject to punishment.

In the past, speeding offenders were mainly subject to monetary fines and demerit points, however, these penalties have not achieved desired deterrence effects particularly when dealing with aggressive drivers such as excessive speeders. Castillo-Manzano & Castro-Nuño (2012) found that positive impacts of demerit points die out rapidly. According to the paper, demerit point systems could result in 15-20% reductions in accidents, fatalities and injuries, however, these effects vanish within 18 months of the introduction of the policy.

Fleiter et al. (2010) formed a focus group study to investigate the factors influencing driver speed. The analysis revealed that apart from financial stress, monetary fines did not seem to have any deterrence effects on some speeders. Moreover, Fleiter et al. (2007) found that even demerit points were not effective in deterring speeders.

To achieve higher deterrence rates, severe sections including license suspensions and vehicle related sanctions have been commonly used by legislators. Although they have been adopted to counteract speeders, license suspensions, and vehicle sanctions have also been considered when dealing with other types of offenders. License suspensions were first introduced as penalties against impaired drivers, this was found to have encouraging specific deterrence effects (Homel 1989; Mann et al. 1991), however, not many studies were able to find general deterrence effects for post-conviction license suspension (Asbridge et al. 2009). As a result, legislators started considering administrative license suspensions (ALS), where license suspension occurs before conviction. Studies which analyzed the effects of ALS found that, as expected, the policy did result in significant general deterrence (Asbridge et al. 2009; Wagenaar & Maldonado-Molina 2007).

As means of preventing suspended drivers from driving while suspended (DWS), license suspension laws were combined with vehicle related sanction in many parts of North America. The studies that have assessed the effectiveness of vehicle related sanctions and their conclusions can be found in Table 1 as well as in the study by Voas & DeYoung, 2002.

Most studies that have evaluated this type of legislation conclude that vehicle impoundment does have an effect on specific deterrence (i.e. drivers who were sanctioned under the law did stop DWS), and hence, an alleged improvement in the safety of other road users see, for examples, DeYoung (1999) and Voas et al. (1997).

In recent years, severe sanctions including vehicle impoundment have also been considered to deter excessive speeders and stunt drivers, although the policies have been implemented in a few provinces and states, to the extent of our knowledge, only a limited number of previous studies consider the effectiveness of such legislation on collision statistics and fatalities.

Meirambayeva et al. (2014a) studied the effects of the excessive speeding legislation in Ontario on violation rates (i.e. the number of drivers caught driving at excessive speeds). The violations before and after the introduction of the law were compared, and it was found that the rates dropped for in males (general deterrent effect); whereas, the rates were almost constant for females.

Leal (2010) assessed the effects of anti-street racing/stunt driving laws on violations in Queensland, Australia, and found that the vehicle impoundment policy did result in the reduction of street racing/stunt driving infringements in the offender sample (specific deterrence).

In one of the few papers which studied the road safety impacts of excessive speeding legislation, Meirambayeva et al. (2014b), found that the policy was effective in reducing speed-related casualties for males in the young male age group of 16-25 years in Ontario. A statistically significant drop of 58 casualties per month was reported from 140 casualties in the pre law period as per figures presented in the paper. However, there was no effect for 'mature' males aged 26-65 years. The paper argues that, since excessive speeding offence and stunt driving activities are highest in the young male age group, the findings seem reasonable.

In general, as pointed out in Table 1, previous studies showed that there was some sort of deterrence associated with imposing severe sanctions (e.g., vehicle impoundment policies) against drivers who commit extreme offences; however, not much work has been done to understand the effects on traffic collisions and fatalities. As a result, this paper tries to help provide better insight into value of these laws and sanctions in traffic safety using direct safety indicators as our dependent variable.

Even though, the review shows that severe sanctions seem to have some effects on both general and specific deterrence, it is worth noting that policy makers are often reluctant to implement these laws due to the different issues. Notable issues include the liability issues, legal issues and even funding burdens. Voas et al. 2000; Peck & Voas 2002; Voas & DeYoung 2002 provide a thorough discussion of those issues.

3. Dataset Description

Monthly fatal and injury collision counts for each of the three provinces were collected. The collision data covered a period of time before implementing the law (pre-intervention data) and after the legislation had come into effect (post-intervention data). The number of data points before and after the intervention varied by province as seen in Table 2.

The data originated from several different sources. BC collision data originated from police reports and was obtained from the Insurance Corporation of British Columbia (ICBC). In Ontario, the collision data was obtained from Ontario Road Safety Annual Reports (ORSAR) which is compiled by Ontario's Ministry of Transport (MTO). The Quebec collision data was obtained from the Société de l'assurance automobile du Québec (SAAQ).

Each data point represented the number of collisions in a particular month, and the data were available for fatal and injury collisions. The reason only fatal and injury collisions were considered is that speed is more likely to be a factor in those types of collisions compared to non-severe collisions. The overall time trends of the data are provided in Table 3; the intervention date is marked on each of the figures. Moreover, the descriptive statistics of the data are found in Table 2.

In order to avoid potential biases in the results, exposure measures had to be included in the analysis. Since the monthly numbers of vehicle miles travelled (VMT) were not available, a surrogate measure of exposure was collected. Motor vehicle fuel sales per month at each province, which is published by Statistics Canada, were assembled for a similar period of time during which collision counts were available and were used in the analysis. Fuel sales have been used as a measure of traffic exposure in previous studies as well, see, for example, Fridstrøm et al. 1993; Fridstrøm 1999.

In addition to collision counts and exposure measures, information regarding the implementation or withdrawal of traffic laws affecting collisions during the analysis period was essential. The policies, which took place during the analysis period for each province, can be found in Table 4.

4. Methodology

The Box-Jenkins methodology (Box & Jenkins 1976) was used to analyze the collision data. This involves developing Autoregressive Integrated Moving Average (ARIMA) models for the time series data. Interrupted time series analysis is then performed to assess the magnitude and the significance of the potential effects of the intervention on the series.

The Box-Jenkins methodology is commonly used in analyzing time series data since it accounts for the fact that time series observations are not independent (i.e. it considers autocorrelation between collision observations from consecutive time periods). While taking into account autocorrelations, ARIMA intervention analysis also permits the addition of covariates to the model such as intervention terms; these terms can then be used in assessing the intervention effects. Finally, ARIMA modelling also delivers a forecasting model, which could be used to predict future collisions while taking into account effects of the new legislation.

The concept of ARIMA time series analysis attempts to explain as much variation in the data as possible before attributing any variation to exogenous factors, which include the implementation of a new law. As evident from the name, in an ARIMA analysis the time series Y_t is assumed to follow an Autoregressive Integrated Moving Average model, which includes three terms (p, d, q):

$$\text{ARIMA }(p, d, q)$$

where, p represents the number of autoregressive (AR) terms; d represents the number of differences required in case of a non-stationary series; and q represents the number of moving average (MA) terms.

When time series data includes seasonal variation, the ARIMA model is often extended to account for that variation using additional seasonal terms; in that case, the model becomes the following:

$$\text{ARIMA (p, d, q)(P, D, Q)}_{\text{s}}$$

where, s represents the number of periods per season and the uppercase terms represent the seasonal part of the model.

The notation of the ARIMA model proceeds as follows. Let Y_t represent the time series, where Y_t is the observation at time t, and let αt (error term) be a white noise process, $\alpha_t \sim N(0,\sigma^2)$. If B were to represent the backward shift operator of the seasonal period, defined such that $B^kY_t = Y_{t-k}$, then the ARIMA equation can be written as follows:

$$(1-\varphi_1 B^1 - \ldots.\varphi_p B^p)(1-\phi_1 B^{(s\times 1)} \ldots - \phi_P B^{Ps})(1-B)^d (1-B)^D Y_t = (1-\vartheta_1 B^1 - \ldots\vartheta_q B^q)(1-\theta_1 B^{(s\times 1)} \ldots \theta_Q B^{Qs})\alpha_t \quad [1]$$

where, $\varphi_1 to\ \varphi_p$ are the non-seasonal AR parameters; $\emptyset_1\ to\ \emptyset_P$ are the seasonal AR parameters; $\vartheta_1\ to\ \vartheta_q$ are the non-seasonal MA parameters; and $\theta_1\ to\ \theta_Q$ are the seasonal MA parameters.

The Box-Jenkins methodology is a four-step iterative procedure. The steps, listed below, are applied to the pre-intervention data to develop an ARIMA model, which is then combined with a transfer function to perform the intervention analysis. Since the methodology works only for a stable dataset, the effects of the seasonal variation within the data as well as long-term trends in the data must be removed before applying any of the steps that follow:

1. **Tentative identification**: In this stage, historical data are used to tentatively identify an appropriate Box-Jenkins model.
2. **Estimation**: The data is then used to estimate the parameters of the tentatively identified model.
3. **Diagnostic checking**: In order to check the adequacy of the tentatively identified model, various diagnostics are performed in this stage. If needed, an improved model is suggested; this model is then regarded as a new identified model. If a new model is identified, steps 2 and 3 are repeated.
4. **Forecasting**: Once the final model is obtained, it is used to forecast time series values.

Intervention can affect the response in several ways. This includes causing the level of a series to change or even causing changes in the trend. As first demonstrated by Box & Tiao (1975), transfer functions can be used to model an intervention effect and determine whether there is evidence that a change in the series has actually occurred and, if so, its nature and magnitude.

Intervention analysis, which can also be referred to as interrupted time series analysis, involves assessing the effects of an intervention by introducing an intervention term into the ARIMA model. The intervention term is represented through a transfer function, which models the behavior of the change in the series.

In intervention models, after suitable transformation, the general model for the ARIMA time series Y_t previously shown in equation 1 becomes the following:

$$(1-\varphi_1 B^1 - \ldots \varphi_p B^p)(1-\phi_1 B^{(s\times 1)} \ldots - \phi_P B^{Ps})(1-B)^d (1-B)^D Y_t = (1-\vartheta_1 B^1 - \ldots \vartheta_q B^q)(1-\theta_1 B^{(s\times 1)} \ldots \theta_Q B^{Qs})\alpha_t + \omega I_t \quad [2]$$

where, ω is the intervention parameter representing an unknown permanent change in the mean due to the intervention, and I_t is the function modelling the effect of the intervention on the mean level of the series. The combination of ωI_t is also known as the transfer function.

The effect of the intervention on the mean function can often be specified using some parameters. Commonly used functions in this specification are the step and pulse functions. In this project, since the policy is expected to have permanent effects on the mean level of collisions, the intervention was represented using a step function (equation 3). Due to the limited amount of post-intervention data, the policy was also assumed to have abrupt effects on the response.

$$I_t = \begin{cases} 0 & if \quad t < T \\ 1 & if \quad T \geq t \end{cases} \quad [3]$$

where, T is the time (t) at which the intervention was implemented.

5. Modelling Procedure

Developing ARIMA models for time series data is an iterative process. The main aim was to develop models for fatal and injury collision data for each of the three provinces.

Consequently, the process described in the next few paragraphs and illustrated in Figure 1 was repeated for each response variable.

The dataset was first split into pre-intervention and post-intervention data. The pre-intervention data includes the observations, which were recorded before the legislation was implemented; this is also known as the baseline period. The post-intervention data, on the other hand, includes the observations after the policy was implemented.

The time trends of the pre-intervention data were first observed. This was done to ensure that the data was stationary and that no differencing or transformations were required. In addition to checking for non-stationarity by inspection, the Augmented Dicky Fuller (ADF) test was run for each of the datasets.

The test showed that all the data from BC and ON were stationary, and thus, no transformations were required for these provinces. In the case of QC, the fatal collision and the injury collision data were both non-stationary in mean; this implied that the data had to be differenced. The variance was constant for all datasets; therefore, no transformations were required and the analysis was performed on the actual collision counts.

After the stationarity issues were resolved, correlation structures were explored. In each case, the plots of the ACF (autocorrelation) and the PACF (partial autocorrelation) functions were observed to help identify the order appropriate for a tentative ARIMA model. The parameters for this model were then estimated using the pre-intervention data only.

Diagnosis of the tentative model was then performed; this included a number of steps:

1. Ensuring that the residuals of the model represent white noise (i.e. the residuals are random with no patterns). This was done by checking the ACF plots of the residuals and by running the Box-Ljung test. The Box-Ljung test is a portmanteau test that tests the overall randomness of the series based on a number of lags. A large *p*-value (>0.1) indicates randomness, which was ensured in all of the developed models, as seen in Table 5.
2. Testing for potential outliers was also performed. Additive and innovative outliers (AO/IO) were then accounted for only if they were seen to have effects on the modelling results.
3. Checking the significance of the parameters in the selected model. Insignificant parameters were dropped from the model only when it was seen that this improved the model quality.
4. Comparing the Akaike information criterion (AIC) of different models. Model selection is based on AIC minimization; hence, when comparing different models, the model with the lowest AIC was selected.

If the model did not satisfy the requirements, a different model was estimated and assessed. After several iterations, the ARIMA model that best satisfied the diagnostic checks for the pre-intervention data was identified. The order of the model selected in each case is shown in Table 5.

After finalizing the ARIMA model for the pre-intervention data, it was possible to assess the intervention effects.

5.1 Intervention Modelling

In the ARIMA intervention analysis process, the ARIMA model developed for the pre-intervention data was combined with a transfer function that best captures the hypothesized change that occurred due to the intervention. This combined model is known as the ARIMAX model. As already mentioned, it was assumed that the change was rapid and permanent in each of the cases; hence, it was possible to model the behavior using a step function.

The next stage was to estimate the parameters of a combined model (ARIMAX model) using the full dataset (pre- and post-intervention data). The same diagnostic checks of the Box-Jenkins procedure were also applied to the ARIMAX model and adjustments were made to the model when required. Other policies, which took place during the study period, were also integrated into the ARIMAX model. After finalizing the models, the significance of the model parameters including the intervention term was assessed.

All stages of analysis were carried out using statistical analysis software R v3.1.1, in which the TSA, tseries and lmtest packages were used. In order to account for exposure, the number of collisions per million litres of gasoline sold was computed. The gasoline sale estimates represented the sales of fuel used by road motor vehicles only. The analysis was repeated twice, once using the number of collisions and then once using the number of collisions per million litres of gasoline.

The orders of the ARIMAX models selected, along with the AIC estimate, are presented in Table 6. Table 7 shows the parameter estimates for the all the models, in addition to the standard error associated with each estimate. This also includes the estimates computed for the intervention terms in every model. Abbreviations are used to represent the policy names, and more information about these policies can be found in Table 4.

For further verification of the model's fit, fitted plots for each of the estimated models were developed; a thumbnail of these figures is provided in Table 8. It is evident from the plots that the models are a good fit for the original data and that the behavior of the series is captured in the models. The p-values for the Box-Ljung test, recorded in Table 6, also indicate that the residuals of each model are random; this behavior is also reflected in the ACF plot of the residuals (not shown in the paper).

6. Results

The outcomes of the analysis varied among different provinces and for different severity levels. The variation between the outcomes was examined in terms of the statistical significance of the intervention term as well as its magnitude and direction. A summary of the effects is provided in Table 9. Datasets where the policy was associated with a significant reduction in collisions are shown in italics. In the next three sub-sections, further elaboration of the results is provided.

6.1 Ontario

In Ontario, it was found that the legislative change related to excessive speeding was associated with a statistically significant drop in fatal collisions. This observation did not change when the exposure-based analysis was conducted. The mean number of fatal collisions for the post-intervention period decreased by 11 fatal collisions (representing a 18.3% drop) when compared to the pre-intervention time period, as evident in Table 9.

A drop in the mean number of injury collisions was also observed in Ontario. However, further testing showed that this decrease was not statistically significant. The reduction was quantified to be around 96 injury collisions. The analysis accounting for exposure confirmed the findings.

6.2 British Columbia

In British Columbia, the effects of the excessive speeding policy on fatal collisions were similar to those observed in Ontario. The trend dropped by around 22% in the post-intervention period, a decrease that was deemed statistically significant, as can be inferred from the *p*-value shown in Table 9.

The findings with respect to injury collisions in BC suggest that there was a significant increase in the mean number of collisions in the period after the intervention, however, it is worth mentioning here that the model shows that the Impaired Driving Law (IDL), which was implemented in BC at the same time as the excessive speeding legislation (ESL) but later discontinued, was associated with a significant drop in the mean of injury collisions. Thus, there was a statistically significant drop in the number of injury collisions in BC but that drop was only observed in the period when both the IDL and the ESL were in effect together. After the IDL was cancelled in November 2011, a slight increase in the level of injury collisions occurred. In each case, analysis using exposure-factored collision counts yielded the same results in terms of significance and the directional behavior of the series after the intervention.

6.3 Quebec

Before presenting the results for Quebec, it is important to note that the ESL was paired with a new distracted driving legislation (DDL). Since it is not possible, statistically, to separate the effects of the two laws, the effects described in the next few paragraphs, and displayed in Table 9, cannot be fully accredited to the ESL alone.

The mean fatal collision data in Quebec, in the post-intervention data dropped slightly when compared to pre-intervention period. The drop was quantified to be around 5.5%; however, unlike Ontario and BC, the change was not statistically significant.

In contrast, analysis of injury crashes showed a statistically significant decrease in the mean number of collisions. The decrease is estimated to be around 325 collisions. Similar conclusions were reached when accounting for exposure.

7. Concluding Remarks

As evident from the findings in the previous section, the initial hypothesis that the legislative changes related to excessive speeding were effective in reducing fatal collisions seems valid. The introduction of the legislative changes was associated with a statistically significant drop in the mean number of fatal crashes in both British Columbia and Ontario. This finding indicates the presence of some general deterrence effect, in other words, the introduction of the law possibly influenced speeders in general to reduce their speeds, hence, a reduction in fatal crashes.

In Quebec, a decrease in the fatal collisions was also present; however, the change was not statistically significant. The failure to observe a statistically significant drop could be related to different publicity or enforcement levels at the province, although data is not available to verify this conclusion. Another reason could be related to the severity of the sanctions in Quebec. As already mentioned, unlike Ontario and BC, in Quebec vehicle impoundment is only applied to re-offenders (i.e. an offender’s vehicle was only impounded if it was the second time that offender was caught under the law).

In the case of injury collisions, the results were not as consistent as fatal collisions. The mean number of injury crashes dropped in Ontario, but the drop was not statistically significant. A statistically significant drop was also observed in Quebec.

Although, as mentioned in the previous section, a significant increase in injury collisions was observed in BC, this finding must be interpreted with caution, as the new policy was enforced at the same time as the Impaired Driving Law. When the two laws were in effect, the model estimated a statistically significant decrease in injury collisions. Due to the fact that the Impaired Driving Law was discontinued, the model attempted estimating separate effects for the ESL. This was done using the portion of the post-intervention period in which the impaired driving law was cancelled (26 observations). The issue here is that this is a relatively short period, which may not be sufficient to capture the full effects of the excessive speeding policy alone; thus, further analysis once more data is available may be required to validate the finding.

Since, Nilsson, (1982) introduced the power models it has been accepted that, as speed increases, collision severity increases exponentially. Therefore, it seems fairly reasonable that more significant reductions were observed in collisions with higher severity levels. This is particularly true when considering that the legislative changes were imposed against excessive speeding and stunt driving activities.

The results are also consistent with other work assessing the impacts of ESL. Brubacher et al. (2014) observed a 21% reduction in fatalities since the inception of the policy in BC (a 22% reduction was observed in this study). Similarly, Meirambayeva et al. (2014b), found that Ontario’s policy was effective in reducing speed-related casualties for males in the young male age group of 16-25 years. In fact, this study extends the findings observed in previous work through the analysis of fatal and injury collisions of different causes. The analysis shows that the impacts of the policy extend to include all fatal collisions. This is reasonable when considering that, while speed might not be the main factor in all severe collisions, it is still one of the contributing factors in those type of collisions (NHTSA 2012).

There is no doubt that publicity and enforcement have significant effects on the deterrence. The more publicity and the higher enforcement a legislative change receives the more likely it is for drivers to change their behavior in response to the new laws. With that being said, the lack of such data meant that this could not be evaluated in this study, nevertheless, since the assessment was not actually carried out to compare the outcomes from three provinces, this could be seen as a tolerable limitation of the study.

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