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DRIVERS LICENSE REQUIREMENTS AND ROAD SAFETY: EVIDENCE FROM A NATURAL EXPERIMENT IN MEXICO

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Drivers license requirements and road safety: Evidence from a natural experiment in Mexico

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Abstract

In Mexico, the procedure for obtaining a driver's license is far from being a standardized process that is applied uniformly in each of its thirty-two states, including Mexico City. In fact it is quite the opposite, since most of the road traffic legislation is in charge of state governments, or decentralized even further to municipal governments. We are particularly interested in the fact that some municipalities have mandatory written and/or driving tests, while others do not require new drivers to pass any sort of test in order to obtain a driver's license. In this study we present evidence suggesting that we can think of those differences as exogenous and exploit them, while controlling for various confounding factors, to find whether there is an effect of applying different requirements such as driving and/or written tests to new drivers on road safety measures such as road traffic accidents (RTAs) and fatal road traffic accidents (FRTAs). We find that abolishing both tests, driving and written, is related to an increase of more than 1,800 RTAs per 100k population of ages 15 to 19. This effect seems to more than double the rate of accidents, on average. Also, abolishing both tests is related to an increase of more than 50 FRTAs per 100k population in the same age group, which means that FRTAs triples after tests have been abolished. If we look at total population's RTAs the effect is smaller, 400 more RTAs per 100k population and 25 more FRTAs per 100k population of all ages. These results are robust to different specifications and survive several falsification tests.

To my parents
who have always given me great support.

Special thanks to my professors at El Colegio de México who have taught me the value of pursuing meaningful ideas, and to my classmates for motivating me into this quest.

Contents

1 Introduction

In Mexico, the procedure for obtaining a driver's license is far from being a standardized process that is applied uniformly in each of its thirty-two states, including Mexico City. In fact it is quite the opposite, since most of the road traffic legislation is in charge of state governments, or decentralized even further to municipal governments. In this study we present evidence suggesting that we can think of those differences as exogenous and exploit them, while controlling for various confounding factors, to find whether there is an effect of applying different requirements such as driving and/or written tests to new drivers on road safety measures such as road traffic accidents (RTAs) and fatal road traffic accidents (FRTAs).[1]

The variation in driver's licenses requirements occurs because there is no federal law on road traffic, and state governments (who sometimes relegate it further to local governments) have the autonomy to regulate road traffic themselves (Valenzuela, 2008).[2] The reason why in some places such requirements were eliminated, as mentioned by The Economist (2011),[3] appears to have been the result of a public policy with the aim of tackling corruption and other inefficiencies in the public sector. In the past, while driving tests were nearly universal, this sort of bureaucratic process was highly inefficient and plagued with corruption (Perez, 2008). Some, but not all governments, simply decided to abolish tests in order to fix this and thus transformed the process of obtaining a driver's license into a very simple bureaucratic procedure that has no room for corruption. In such places the authorities are incapable of discriminating between good and bad drivers and their Departments of Motor Vehicles (DMVs) have lost the ability to influence new drivers driving skills. This allows us to think of the elimination of driving and/or written tests as a natural experiment with which we can estimate the effect of such tests (or lack of) on road safety.

This effect can be seen as the cost of tackling corruption and state inefficiencies, a cost that has been transferred into society versus other ways of dealing with such issues. This study help us to understand the general equilibrium implications of such a policy in terms of the economic and health costs. Also, if performing driving tests to new drivers has an effect on road safety, then the fact that they are not being administered in many of Mexico's states is interesting in its own. This is so, because road traffic fatalities are among the leading causes of death in Mexico and in the world according World Health Organization (WHO, 2009) and the Pan-American Health Organization (PAHO, 2009).[4] In that sense, all measures that can help us prevent road traffic fatalities should be put into practice.

The literature on safety and accidents analysis has long been concerned with finding the determinants of road safety including those factors that are exogenous to policy making, like geographical and meteorological factors, as well as those that are endogenous to policy making, like speed limits or mandatory driving education. Therefore, by the exploitation of this natural experiment this study contributes to the literature of the determinants of road safety by introducing a new factor that has rarely been subject to analysis, the implementation of written and/or driving tests to new drivers.

We have data on the 87 largest municipalities in Mexico for a period of 12 years (1997 - 2008) with which

[1] We do this due to the fact that different requirements are not randomly assigned.

[2] Interview with Arturo Cervantes Trejo, director of the National Center for Accident Prevention (CENAPRA). "Por ejemplo, no existe una Ley Federal de Tránsito y Vialidad; todos los municipios tienen autonomía por el artículo 115 constitucional para regular el tránsito y la vialidad, lo que genera una gran heterogeneidad de leyes y reglamentos. Cualquiera emite una licencia sin la mayor normatividad; no existe un registro nacional de conductores, el de vehículos apenas empieza."

[3] "Road safety in Mexico, the lawless roads. How half of Mexico ended up without driving tests." http://www.economist.com/node/21531484

[4] Organización Panamericana de la Salud (OPS).

we estimate a fixed effects model where we control for various possible confounding factors and preexisting conditions. We find that abolishing both tests, driving and written, is related to an increase of more than 1,800 RTAs per 100k population of ages 15 to 19. This effect seems to more than double the rate of accidents, on average. Also, abolishing both tests is related to an increase of more than 50 FRTAs per 100k population in the same age group, which means that FRTAs triples after tests have been abolished. If we look at total population's RTAs the effect is smaller, 400 more RTAs per 100k population and 25 more FRTAs per 100k population of all ages. These results are robust to different specifications and survive several falsification tests.

2 Road safety and licensing in Mexico

2.1 Road safety

Road safety is among the leading causes of death in the world. Every year about 1.3 million people in the world loose their life in the roads (WHO, 2004; WHO, 2009). According to the World Health Organization (WHO) road traffic injuries were the ninth cause of death worldwide in 2004 and by 2030 it is estimated to become the fifth one, leaving behind lung cancer, diabetes and HIV. Among age groups, road traffic injuries are the leading cause of death for people between 15 and 29 years old worldwide. This phenomenon is not evenly distributed among countries, more than 90% of deaths and injuries caused by RTAs occur in low and medium income countries where only half of the matriculated vehicles exist. RTAs are also the cause of enormous economic loses, in most countries this accounts for 1% to 3% of their GDP. Road safety has such an impact on public health that recently the General Assembly of the United Nations officially proclaimed 2011-2020 as the decade of action for road safety (WHO, 2009). According to the last Pan-American Health Organization (PAHO) report on road safety (PAHO, 2009) road traffic injuries where the second leading cause of death among people ages 15 to 29 in the Americas region.[5] Mexico in the PAHO (2009) report has an adjusted mortality rate of road traffic equal to 21.7 deaths per 100,000 population a year.[6] This is more than 5 points larger that the regional mean (15.8) and its the second largest rate; Venezuela holds the largest with 21.8.

Several epidemiological studies have been performed to estimate the total number of road traffic fatalities in developing countries due to suspected sub reporting in the official figures in this type of country (Bartels et al., 2010; Bhalla et al., 2009; Odero et al., 1997).[7] Bartels et al. (2010) for example, developed a methodology that uses all existing sources of information within a country to triangulate to a national figure of road traffic injuries. They estimated that in Mexico in 2005 almost 20,000 people died due to road traffic injuries and almost one million were injured. These figures are larger than official ones (16,682 deaths in 2005). When analyzing the trend for the period 1997-2008 they found that both figures (their estimations and official numbers) had very similar upward trends, which suggests that sub reporting was systematic.[8] This could be explained by the fact that official data is largely dependent upon police reporting which has been shown to under report non-fatal crashes in most developing countries (Aeron-Thomas, 2000; Amoros,

[5]The leading cause of death was violence.

[6]This was calculated for the 2006-2007 period.

[7]Epidemiology is considered the core science of public health, epidemiological studies study the distribution and determinants of disease frequency (Rothman, 2002).

[8]Bartels et al. (2010) Figure 6.

Martin, & Laumon, 2007). According to Mexico's National Center for Accident Prevention (CENAPRA), the economic cost of RTAs in Mexico rises to 1.3% of GDP annually before accounting for the intangible costs, once we account for them the figure could rise to 4% of GDP (CENAPRA, 2009). All of this makes it important to study road safety and to better understand the determinants behind RTAs.

2.2 Licensing in Mexico

In Mexico, every state has the autonomy to issue its own state's law of traffic & transportation. These documents contains all applicable regulations regarding road traffic and thus the rules and requirements needed to obtain a driver's license. Sometimes these requirements are clearly stated in the law, and sometimes these are stated in broader ways and left for DMV authorities to interpret as they see fit. For example, the law of traffic & transportation of the state of Chihuahua (Ley de vialidad y tránsito para el estado de Chihuahua) article 53 strictly announces that driving and written tests are to be performed to new drivers at all DMVs within the state. This means that every DMV within the state must follow these rules. In other cases, like in the state of Colima, the law of traffic & transportation of the state of Colima (Ley de vialidad y transporte del estado de Colima) in its article 4 establishes that it is a faculty of each DMV to issue driver's licenses without strictly specifying the requirements that are to be asked to the applicants. This is what we mean when we say that most of the road traffic regulation is in charge of state governments and sometimes it is further decentralized to municipal governments.

When someone wants to get a diver's license in Mexico he must present himself at his municipality's DMV. A few requirements are homogeneous like the minimum driving age, presenting an official identification, proof of residence in the municipality and paying a fee.[9] Performing a driving and/or written test is the one requirement that varies throughout the country. For instance, the minimum age for obtaining a driver's license is 18 everywhere and it is always possible to obtain a driving permit at age 16 under a few more requirements like proof of insurance and parents consent. These permits are usually valid for 6 months or a year while a driver's license is usually valid for 2 to 5 years, depending on the fee paid.

Also to note is that, by law any person holding a valid driver's license of any state can drive in any of the 31 states and in Mexico City freely. This is unfortunate for the purposes of this study. Furthermore, we do not know what proportion of active drivers within each state has no license or a license from a different state. Nevertheless, in order to obtain a license one must show a proof of residence in the municipality where he wants to get the license. This makes it harder for people to go to another municipality only to get their license, but still it is well known that at least some people do it in Mexico to avoid having to pass certain tests. Also, law requires for people to obtain a new license when they change their place of residence (although enforcement is probably low). When we estimate the effect of driving and/or written tests on road safety all of this will introduce a bias if the people driving in a different municipality or state than the one where they obtained their license are not equally distributed and cause or are involved in RTAs.[10] We will first assume that they are, and further try to correct for this bias in a robustness check.

[9]The fee is not the same for every DMV. We were unable to collect historical data on the different fees charged at all DMVs. Actual fees have a mean of $192.81 mexican pesos per year of validity, standard deviation is $88.80.

[10]Municipalities who perform tests but that are nearby others where these are not being performed are more likely have regular drivers who did not have to pass these tests.

3 Literature on road safety analysis

The literature on road safety and accident analysis has long been interested in finding the main factors that explain road safety. Most of this work has been done by economists and epidemiologists in the field of health economics and epidemiological analysis. A wide variety of factors have been showed to affect road safety outcomes using very different methodologies. We do a brief review of this literature focusing on the studies that we find relevant for our analysis and those for which we believe this study represents an improvement. First, we describe the different methodological approaches that have been used for analyzing similar phenomena. This allows us to place our study within a methodological framework and understand its strengths and weaknesses when it comes to the empirical strategy, and also to understand how far our study stands from the ideal experiment. Second, we discuss the body of work that has been interested in estimating the effect of driving tests and driving education on road safety. The reason for including some literature on the effect of driving education on road safety in this review is because we believe that it is relevant to know the effect that has been found on other forms of policies that try to affect road safety by improving driver's skills. While the implementation of driving tests is far from being a substitute for mandatory driving education, we believe that the imposition of the former can be viewed as an incentive for obtaining the latter before one presents himself at the local DMV. The imposition of tests will give incentives to the person interested in obtaining a driver's license to get some driving instruction before he presents the test, this is an indirect form of encouraging driving education. Finally, we review the body of work interested in finding the exogenous factors that explain road safety. Based on these studies we will then justify the selection of our control variables with which we will control for preexisting differences.

3.1 Different methodologies

There are various ways for studying the factors that determine road safety. The methodologies that are commonly preferred are: randomized control trials (RCTs), quasi-experimental approaches, and ecological designs (Peck, 2011). We discuss briefly these methodologies and mention which of these apply for our study along with their pros and cons.

The RCT design represents the gold standard for findings causal effects because of the randomized assignment of the treatment. In our case we do not have a random assignment of the driver's license requirements but we can control for several factors until both our populations (with and without written and/or driving tests) are comparable in at least some broad sense. Our study is more of a quasi-experimental design. Quasi-experimental designs are generally defined as retrospective or prospective comparisons between groups after adjusting for preexisting differences. The main problem with this kind of study is that it is subject to model specification errors and confounding by omitted variable bias, thus the need to do robustness checks to convince the reader that in our study one should not worry about these problems. Finally, while the ideal study should be done with data at the individual level we do not have such data. Thus, we follow an ecological design which we define next.

Ecological designs are defined as those in which data is an aggregate measure such as the number of RTAs over a period of time in a specific region. This kind of studies is widely used in the road safety literature, especially for international or inter-regional comparisons of road safety. (Seaver et al., 1979; Robertson et al., 1978; Robertson, 1980; Levy, 1988, 1990; Bester, 2001; Page, 2001; Jones et al., 2008) The disadvantage of these designs is that they are often subject to confounding, endogeneity bias, and problems in generalizing ecological relationships of the behavior of the entities analyzed. For our purposes, data on individual traffic accidents was difficult to obtain compared to aggregate data which was found in easily accessible statistical records like Mexico's National Statistics and Geography Institute (INEGI).[11] To minimize these problems inherent in our design we use the longest range of data available and organize it in a panel comprising Mexico's larger urban areas and all of the years for which data was available.[12] This allows us to control for unobserved factors that we assume are constant across urban area and/or across years along with other potentially time-varying confounding factors for which we actively control for.

3.2 Driver's license requirements and road safety

The most recent efforts done to study the effect of abolishing driving tests that we are aware of are Perez et al. (2009) and Grabiszewski & Horenstein (2011). Perez et al. (2009) performed a quasi-experimental study were they studied the effect of the elimination of a driving test requirement in order to drive light motorcycles in Barcelona, Spain. They found that relaxed licensing leads to a significant increase in the mean number of accidents involving light motorcycles as compared to accidents involving all other vehicles. Grabiszewski & Horenstein (2011) do a similar analysis to Perez et al. for Mexico City where driving tests were abolished in January 2004. They find the opposite, there were more accidents before, while the driving tests were enforced, than after January 2004. They also do a panel data analysis for a group of states, where they estimate the effect of having a driving tests on road safety. They find that mandatory driving tests do not increase road safety. They interpret their findings as being driven by a reverse Peltzman effect, where the lack of regulation actually increases driver's precautions because the pool of drivers may be worse than before, making the roads safer (Peltzman, 1975). Our study is similar in spirit to Grabiszewski & Horenstein (2011), but there are important and relevant methodological differences. First, our unit of observation is the municipality. The fact that we know for a fact that there are states like Guanajuato that show variation in the requirements within the state makes it inappropriate to do the analysis at the state level. Second, we use a larger set of controls based on those variables for which we observe that our sample is not properly balanced. The fact that the different requirements where not randomly assigned makes it inappropriate to estimate the effect without properly controlling for preexisting conditions based on observable factors.[13] Third, our main results focus only on population ages 15 to 19 because we know that this group is binding to the treatment (written and/or driving tests). People older than this may have received their license many years ago and thus the effect of the tests on road safety may be very difficult to estimate precisely. Finally, we where able to retrieve a larger data set on the treatments that include information on driving and written tests separately, both from law records as well as from the DMVs directly.

Not so recent literature include Stock et al. (1983) who, in a study done in the United States concluded that drivers who passed an optional final driving test within a structured training program had a 7% lower rate of accidents. Another US study performed by Lyles, Narupiti and Johar (1995) compared the number of accidents between heavy load drivers who passed and those who failed an optional driving tests. Drivers who had passed the test had an 11% lower accident rate. Of course the fact that tests were optional in both

[11] www.inegi.gob.mx

[12] In our analysis we use all cities with populations larger than 250,000 on the first year of our panel which was 1997. This gives a total of 87 urban areas.

[13] Grabiszewski & Horenstein (2011) only control for population and corruption indexes.

cases induces a selection problem where only the best drivers decide to undertake such tests. Hagge and Romanowicz (1996) studied the effect of a change in the difficulty of driving tests in California for heavy load drivers, tests became more difficult. They found that the number of accidents actually increased in 5%.[14]

The literature on driving education and road safety has long found mixed results also. The first formal quasi-experiment that studied the relationship between driver education and road traffic accidents while controlling for the non-random assignment was Harrington (1972). After adjusting for self-selection bias he found that training reduced crashes only for females. Concerning RCTs, the most influential studies are those based on the Dekalb, Georgia county study. The Dekalb study comprises a randomized experiment of different intensities of driver's training and a control group. The data has been analyzed by various authors. Stock et al. (1983) found neither big difference across treatment intensities nor between treated and control. Lund et al. (1986) improved the identification strategy by allowing for different exposure and found similar results. Vermick et al. (1999) and later Peck (2011) are both extensive reviews of this literature. Peck (2011) emphasizes the difficulty of obtaining data large enough to get the desired statistical power needed to reliably find an effect given that traffic accidents are such rare events. He argues that the sample size in most of the RCT studies so far made it impossible to reliably detect a 5% reduction of crashes in a 12-month period. If these studies wanted to reliably detect this with an 80% confidence, the sample size should have been of about 70,000 individuals. Still, there have been some studies who have found an effect relying on aggregate data.

Ecological designs such as Levy (1988) and Levy (1990) exploit annual aggregate data at the state level organized as a panel for over 10 years. In his first study he used pooled data regressions and found that 54% of the variation in road traffic fatality rates can be explained by minimum driving ages, the fact that a state has mandatory driving education, and curfew laws. Raising driving age one year has the largest impact. At the mean, a one year increase of minimum driving age decreases road traffic fatality rates in 50%. In the second study Levy tries to disentangle the effect of mandatory driving education into two components: age and experience. He finds that the age effect is the most important and that experience can be neglected, i.e. that the effect of mandatory driving education operates though retarding the age at which people begin to drive and thus lowering exposure, and not because people are more experienced drivers.

In summary, we find that studies with data at the individual level are very difficult to perform because of a sample size problem that probably makes them cost-inefficient, Peck (2011). This may be the reason why RCT and quasi-experimental studies have not been able to find convincing evidence that supports the hypothesis that driving education reduces road traffic accidents. On the other side, ecological designs along with all of their weaknesses have proven the best way to analyze this type of phenomenon in particular. These studies have found an effect of minimum driving ages and mandatory driving education on RTA, however evidence suggests that the effect operates though lowering exposure and not because of improved driving skills.

3.3 Exogenous determinants of road safety

It is important to take into account the exogenous factors that have been found to affect road safety measures in order to control for preexisting differences in our study. We consider a series of studies that have been devoted to find the main determinants of road safety. Page (2001) tries to build a national indicator of road

[14] For a comprehensive review of this literature and other issues related to road safety refer to Elvik & Vaa (2005).

safety policy between countries once the factors that cannot be affected by policy are controlled for. He finds that one should control for the following: population, vehicle fleet, percentage of urban population, percentage of youngsters, percentage of active and employed population, alcohol consumption and percentage of buses and coaches in the vehicle fleet. Bester (2001) does a similar analysis but focuses also on what is the best way to define the dependent variable (rate, absolute number, log, etc.). He finds that the most accurate model to explain road casualties has accidents per 100,000 passengers as a dependent variable and vehicle ownership and the level of development of the population as explanatory variable. We use a measure of accidents per 100,000 population which is only slightly less good compared to accidents per 100,000 passengers regarding the fit of the model in Bester's study. Finally, we consider the work of Noland & Quddus (2004) who do a exercise similar to Page's (2001) but for the United Kingdom only. They use a spatial analysis approach and find that road casualties can be explained by land use and area deprivation, road characteristics, traffic flow and demographics. This gives us a broad idea of what kind of variables we should be looking at when controlling for preexisting differences. We do not have data on all the variables mentioned above, sometimes because they are not reported, or just not available. But we do have variables in all the broad categories mentioned, that is: exposure, routes, vehicle fleet, demographics, and a broad range of socioeconomic variables. By controlling for them we adjust for preexisting differences in each municipality in our study.

4 Data

Data comes from various sources; most of it is publicly available, however a relevant part of our database was constructed by ourselves. In this section we discuss what our data set looks like, how we obtained the information and the institutions that gather it. We also discuss the quality of our data mentioning, when we suspect, if there are problems such as measurement errors or misreporting. We constructed a panel data set containing information on the 87 largest urban municipalities in Mexico from 1997 to 2008.[15] By largest we mean those municipalities with population grater than 250,000 in the first year of our sample. Because data on driver's license requirements was sometimes collected directly by phone at each DMV, the size of inclusion (250,000 population as of 1997) was chosen arbitrarily to keep a large but still manageable number of municipalities from which we would have to recover information. Four states did not have any municipality that matched the size of inclusion so we decided to take each of these states as a whole.[16]

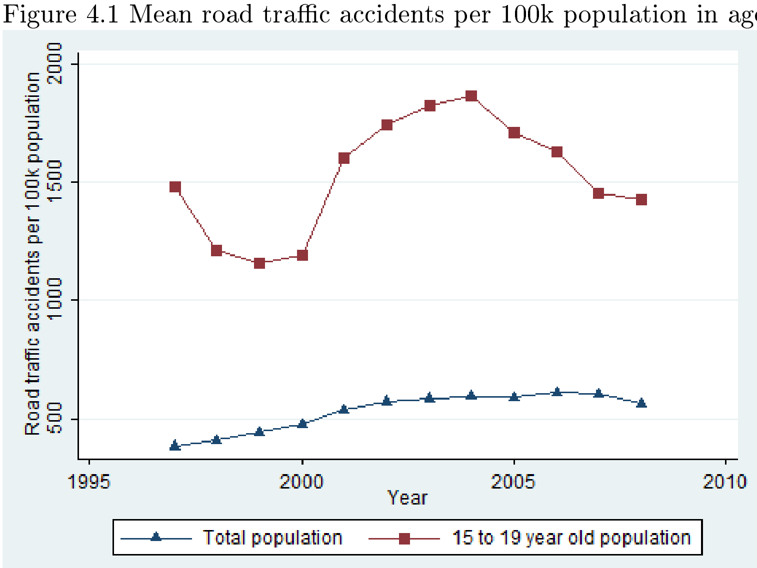
4.1 Dependent variables

Data on RTAs was obtained from the Urban and Suburban Road Traffic Accidents Statistics (ATUS), a project belonging to Mexico's National Statistics and Geography Institute (INEGI). This particular variable is generated through a decentralized process that begins with a police officer at every traffic accident. Data is generated at each municipality and then recovered and processed by INEGI. The processing of data is done meticulously to ensure that misreporting is minimal (INEGI, 2009). Once the data is transferred from the source questionnaires a validation process is run to find possible misreporting and trend inconsistencies. Upon validation, RTAs are reported on yearly figures at national, state and municipality level.

[15] Municipalities are the second-level administrative divisions in Mexico after state.
[16] Aguascalientes, Baja California Sur, Tlaxcala and Zacatecas.

RTAs are classified into fatal and non-fatal. The latter consist on RTAs were human lives have been lost, not necessarily in situ. There is also data on RTAs by gender and age group of the driver. We focus on 15 to 19 year-old drivers of both sexes because they are the binding age group to our treatment.[17] One problem with this data is the fact that the driver's license information is not captured at the time of the accident. So we do not know if the person involved in the accident even had a license. This has strong implications on our results since we will only be able to identify the intention to treat effect (ITT) on each DMV's area of influence and not necessarily the treatment on the treated (TOT) effect.[18] The fact that information on the driver's license is non-reported also means that we cannot differentiate accidents involving drivers from other areas. This will induce a bias in cities where drivers from other areas represent a non-negligible proportion. Most of the municipalities in our study are quite isolated from each other, and metropolitan areas which include two or more municipalities have always the same requirements. This can be appreciated in the maps that are included in the appendix of this study. Only in the valley of Mexico we observe municipalities with different requirements that are close enough for people to presumably live and work in municipalities with different requirements, these are the state of Mexico and Mexico City. Until data on driver's license is reported in Mexico's road traffic statistics there is no direct way to control for this issue. And finally, because there are so many hit-and-run accidents (one in every 10 accidents reported that the driver ran away) and it is impossible to know the age composition of this group, we will further assume that hit-and-run are evenly distributed among ages, which may not necessarily be the case.

Figure 4.1 Mean road traffic accidents per 100k population in age group.



Source: Author's own calculation. Data from INEGI, Urban and Suburban Road Traffic Accidents Statistics (ATUS) 1997-2008.

In figure 4.1 we graph the mean of our dependent variable, mean RTAs involving 15 to 19 years old per 100,000 population in that age group, for each year in our sample. In the same graph we include mean RTAs per 100,000 population (of all ages). This gives us an idea of how much larger rates are among youngsters

[17]We found that for an average of 3.4% of municipalities RTAs were not classified by ages each year, only the total RTAs was reported. Instead of leaving a missing value for that municipality/year we decided to take the average rate of RTA for that age group in the two previous and the two following years and input that value.

[18]For a comprehensive discussion on the difference between this effects refer to Angrist & Pischke (2009).

than among all ages. RTAs affect young people more than they affect any other age group. They are at the highest risk of suffering an accident. Also, this is the age group relevant for our study because it comprises the age at which people become legally eligible to obtain a driver's license. Hence, any legislation change that affects the requirements needed to obtain a driver's license will affect this age group the most. Figure 4.2 shows the same graph but for FRTAs. We can observe that population of ages 15 to 19 is also at higher risk of being involved in a fatal accident that the rest of the population for every year.

Figure 4.2 Fatal mean road traffic accidents per 100k population in age group.

Source: Author's own calculation. Data from INEGI, Urban and Suburban Road Traffic Accidents Statistics (ATUS) 1997-2008.

4.2 Data on the different driver's license requirement

Data on driver's license requirements was collected in three stages. First, an Internet investigation was done in order to identify the level of government responsible for road traffic regulation and the phone number of each DMV. Second, a phone interview was conducted to each DMV to find out the actual status of requirements and to investigate the past requirements, i.e. if tests had ever been abolished or implemented. Finally, a comparative law study was carried out to find out the changes in the legislation regarding each of the 32 laws of traffic & transportation of the 31 states and Mexico City.

First we will discuss our interviews with the authorities. Needless to say, this approach can be controversial due to the inherent problems of measurement error that result when data is collected directly from people who may or may not give accurate information, because information is sensitive or because they simply do not remember. In order to minimize these issues the following scheme was followed. First we investigated if road traffic was state or locally regulated at each of the 31 states and Mexico City. This provided us with information on which entities provide the service of issuing driver's licenses and the scope of its action. When road traffic regulation was done at the state level we assumed that the same rules applied to all municipalities in the state and thus we had only to find out the rules in one municipality to know the rules on the rest.[19] When road traffic regulation was in charge of local authorities we assumed nothing and

[19] We made a few random phone calls to other municipalities within states to verify whether this was true. As we expected,

conducted phone calls to each municipality's DMV. Second, when in the phone and in order to avoid talking with people who did not know when driving tests had been abolished we tried to speak with the person who had worked the longest at the DMV and who had something to do with the issuing of licenses. As long as this person is aware of the requirements needed to get a driver's license we did not care about the rank (if he or she is the head of the office or simply the police officer who is in charge of performing the test). Finally, in order to eliminate the incentives of lying about the abolition of tests we conducted our inquiring as if we were interested in the time of response of the DMV and the measures done in order to simplify the process. This was done this way because the simplification of processes is an active policy that is very highly regarded between different bureaucratic offices in Mexico (Perez, 2008).[20] This part of the research was by far the most excruciating task of all and we by no means are ready to assure that our data is perfectly accurate.[21]

Now, to gain a better understanding of historical requirements regarding driver's licenses we conducted a research on the historical records of traffic & transportation state laws. We used the national state legislation record, which is available online at www.ordenjuridico.gob.mx, and a private law compilation: *Compilación Jurídica Mexicana*, managed by Legatek.[22] With this we were able to construct a unique database for our 87 municipalities. The database describes changes in the municipalities's road traffic laws referring to the imposition of driving and or written tests. We know when the law specifically required driving and/or written tests and when the law was ambiguous about it or simply did not mention it. For those municipalities/years for which we could not find the relevant information we left a missing value. Once we had both types of data, the one obtained by phone and the one obtained from law records, we merged it into a single database where we gave preference to law records when filling information about the past requirements. Both tables are found in the Appendix of this study.

requirements where the same.

[20]In fact we found out that people were very open to share with us how fast it was to obtain a driver's license and most DMV websites actually showed the average time in minutes that it took to get a license, from where we also could get a sense on the lack of tests.

[21]One possible way to improve this study is by correcting these errors in our data. Of course that would mean to have a greater access to local and state governments and great deal of time and resources.

[22]http://www.leginfor.com/

Table 4.1 Number of municipalities under each type of treatment and total population of ages 15 to 19 at the begining and at the end of our sample period.

		Driving test		
		No	Yes	Total
Written test	No	27 municipalities 1,677,307	3 municipalities 163,449	30 municipalities 1,840,756
Written test	Yes	9 municipalities 436,612	48 municipalities 2,640,278	57 municipalities 3,076,890
	Total	36 municipalities 2,113,919	51 municipalities 2,803,727	87 municipalities 4,917,646

1997

2008

		Driving test		
		No	Yes	Total
Written test	No	33 municipalities 1,950,521	0 municipalities 0	33 municipalities 1,950,521
Written test	Yes	21 municipalities 988,549	33 municipalities 2,113,543	54 municipalities 3,102,092
	Total	54 municipalities 2,939,070	33 municipalities 2,113,543	87 municipalities 5,052,613

Source: Author's own calculation. Data on different treatment status was constructed by ourselves, data on population of ages 15 to 19 is from INEGI.

Table 4.1 shows how written and driving tests looked like in the first and in the last year of our sample, in the 87 municipalities in our study. By 1997, 27 municipalities did not perform any test to new drivers where a total of 1,677,307 people of ages 15 to 19 lived. By 2008, the number of municipalities who did not perform any tests had grown to 33 and represented a total of 1,950,521 people of ages 15 to 19. This means that the total number of youngsters who do not have to pass neither a written nor a driving tests in order to obtain a drivers license grew by more than one fourth of a million in our sample period. The number of municipalities that perform both tests went from 48 to 33 in our sample period, this accounted for reduction of more than half a million youngsters who no longer required to pass a test.

4.3 The control variables

Data on our control variables was obtained from public access sites, mainly INEGI. Data on length of roads, cars sold, GDP,[23] median age of population, HDI index and schooling index was obtained from administrative records of socioeconomic and economic aggregated data available in INEGI's bank of information. Population and registered vehicles was obtained from SIMBAD, the state and municipal data set system of INEGI.[24]

[23]GDP is in prices of 2003.

[24]http://www3.inegi.org.mx/sistemas/descarga/

The Mexican Transparency International branch, Mexican Transparency organization, provided us with the corruption indexes.[25] Finally, data on the ruling party at each state was constructed from available information at each of the state government websites.

Table 4.1 Summary statistics by treatment status, 1997

	Driving test			Written test		
	Yes	No	*t*	Yes	No	*t*
Cars sold	2,114	1,930	-0.41	2,335	1,802	-1.20
	(276)	(357)		(319)	(314)	
Buses sold	1,478	1,551	0.19	1,530	1,505	-0.05
	(348)	(178)		(421)	(158)	
Length of roads	644	800	0.30	579	829	0.44
	(470)	(255)		(501)	(272)	
Registered vehicles	83,249	110,174	1.07	77,267	110,488	1.35
	(20,825)	(14,550)		(19,622)	(14,777)	
Reg. vehicles per 100 population	14.18	20.65	1.79	12.53	20.84	2.51
	(2.80)	(2.37)		(2.50)	(2.17)	
Registered motorcycles	1,287	1,683	0.45	1,891	1,324	-0.50
	(795)	(412)		(1057)	(403)	
Corruption index*	11.13	11.32	0.05	12.24	10.71	-0.40
	(2.30)	(3.28)		(2.26)	(3.10)	
PAN	0.22	0.12	-0.70	0.13	0.18	0.25
	(0.14)	(0.08)		(0.13)	(0.10)	
PRI	0.75	0.88	0.86	0.87	0.81	-0.36
	(0.15)	(0.08)		(0.13)	(0.10)	
PRD	0.03	0.00	-0.93	0.00	0.02	0.95
	(0.03)	(0.00)		(0.00)	(0.02)	
GDP per capita	47.55	78.51	1.78	44.69	76.76	1.99
	(3.16)	(17.10)		(2.89)	(15.84)	
Median age	23.14	24.06	0.95	22.93	24.07	1.27
	(0.30)	(0.92)		(0.34)	(0.83)	
Male/Female rate	95.81	95.32	-0.31	95.65	95.46	-0.13
	(0.67)	(1.42)		(0.76)	(1.30)	
HDI	0.81	0.83	1.53	0.81	0.83	1.71
	(0.01)	(0.01)		(0.00)	(0.01)	
Schooling index	0.85	0.86	0.40	0.85	0.86	0.40
	(0.00)	(0.01)		(0.00)	(0.01)	
Exposure	0.008	0.014	0.89	0.008	0.014	0.82
	(0.004)	(0.005)		(0.005)	(0.005)	
Price**	214.84	160.08	-2.05	204.21	186.50	-0.68
	(23.12)	(14.40)		(4.77)	(25.52)	

Standard errors are in parenthesis and where calculated clustering by state.*Values for 2001 ** Values for 2010

Source: Author's own calculation.

Table 4.1 shows summary statistics by treatment status in the first year of our sample, 1997. By treatment we mean if driving or written tests are being administered in a particular municipality that year.[26] This table

[25] http://www.transparenciamexicana.org.mx/

[26] The excluded category is municipalities where these tests are not being administered.

allows us to perceive what preexisting differences among municipalities look like. In general both groups of municipalities, those who administered tests and those who did not, are fairly balanced. Their main differences are: registered vehicles per 100 population, municipalities with no tests have a higher number of registered vehicles than with municipalities with tests; GDP per capita, also municipalities with tests have higher levels of income, and finally; human development index in the same sense. Only for the case of registered vehicles per 100 population we can reject the hypothesis that difference of means equals zero at the 5% level. Also, the price for obtaining a driver's license (as expected) is higher in places where test are administered, but we only have current data and not data from 1997. Instead of concluding that our sample is well balanced we conduct a more stringent form of testing preexisting conditions acknowledging the fact that there are various mixes of treatments.

Table 4.2 shows the same variables but presented in a different and somewhat more stringent form regarding the tests of difference of means. It organizes municipalities into four disjoint groups depending on what mixture of treatments they receive. Groups are referred to as: "None", if neither a driving tests or a written test is administered; "Driving", if only a driving tests but not a written tests is administered; "Written", if only a written but not a driving tests is administered, and; "Both", if both tests are administered. It is important to notice that the "Driving" group is not very interesting because it is only rarely observed that a municipality applies a driving test without applying a written tests. By 1997 only 3 municipalities (Morelia, Uruapan and San Luis Potosí) in our sample had this kind of mixture and by 2010 there was none. Separating our sample into four disjoint groups means that we need to conduct six different tests of difference in means for each variable in order to determinate if there are preexisting differences indeed. Now, we will neglect the group "Driving" for the reasons that we stated above and only focus on the test of difference in means between the other three groups (columns 5, 6 and 7). We observe that groups are again balanced in most cases. We mention only those variables for which we can reject the hipothesis that difference of means equals zero at the 5% level: registered vehicles per 100 population, registered motorcycles, corruption index, dummy indicating that PRI rules the state government, GDP per capita and price. These are the variables for which we will actively control for when estimating the effect of driver's license requirements on road safety.

Table 4.2 Summary statistics differentiating by 4 disjoint types of treatment, 1997.

Table 2. Summary statistics differentiating by 4 disjoint types of treatment.

	Treatment				t		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	None	Driving	Written	Both	W vs. B	N vs. W	N vs. B
Cars sold	2,299	2,660	1,560	1,866	0.73	-1.90	-0.83
	(367.9)	(229.4)	(140.2)	(395.1)			
Buses sold	1,490	1,882	1,442	1,522	0.25	-0.09	0.06
	(481.2)	(149.4)	(236.7)	(197.5)			
Length of roads	618.8	298.0	719.9	858.2	0.22	0.12	0.36
	(622.2)	(31.3)	(590.9)	(288.5)			
Registered vehicles	74,348	103,539	109,951	110,588	0.01	0.73	1.39
	(21,920)	(17,788)	(42,539)	(15,536)			
Reg. vehicles per	11.73	19.74	21.53	20.71	-0.21	2.42	2.58
100 population	(2.52)	(0.83)	(3.15)	(2.53)			
Registered	1,605	4,465	335.0	1,509	2.56	-1.12	-0.08
motorcycles	(1,148)	(999.8)	(146.4)	(439.2)			
Corruption index*	12.63	8.77	6.62	11.48	1.36	-2.33	-0.27
	(2.46)	(1.62)	(0.89)	(3.49)			
PAN	0.15	0.00	0.44	0.13	-1.48	1.07	-0.13
	(0.16)	(0.00)	(0.22)	(0.08)			
PRI	0.85	1.00	0.44	0.88	2.03	-1.50	0.13
	(0.16)	(0.00)	(0.22)	(0.08)			
PRD	0.00	0.00	0.11	0.00	-0.99	0.97	.
	(0.00)	(0.00)	(0.11)	(0.00)			
GDP per capita	45.74	35.29	53.00	81.21	1.52	0.95	2.00
	(3.28)	(2.27)	(6.81)	(17.60)			
Median age	23.00	22.33	23.56	24.17	0.58	0.92	1.15
	(0.38)	(0.35)	(0.47)	(0.96)			
Male/Female rate	95.94	93.00	95.41	95.47	0.03	-0.34	-0.28
	(0.78)	(0.33)	(1.32)	(1.55)			
HDI	0.81	0.81	0.82	0.84	0.95	0.65	1.73
	(0.01)	(0.02)	(0.01)	(0.01)			
Schooling index	0.85	0.84	0.85	0.86	0.51	-0.29	0.38
	(0.00)	(0.01)	(0.01)	(0.01)			
Exposure	0.009	0.003	0.007	0.016	1.21	-0.21	0.82
	(0.006)	(0.000)	(0.005)	(0.006)			
Price**	204.211	-	230.537	160.079	-1.23	0.47	-2.87
	(5.113)	-	(55.658)	(14.621)			

Standard errors are in parenthesis and where calculated clustering by state.*Values for 2001 ** Values for 2010

Source: Author's own calculation.

5 Empirical strategy

Our aim here is to justify that driver's license requirements such as driving and/or written tests can be thought as exogenous to RTAs. This will allow us to correctly identify the effect of requirements on road safety once we control for preexisting differences. In this section we will conduct a test of exogeneity for our dependent variable along with a justification for that matter, followed by the specification strategy and the regression framework that we intend to use in order to estimate the effect.

5.1 Test of exogeneity

In our sample we observe 4 possible categories of municipalities regarding the abolition or implementation of driving and/or written tests. These are showed in Table 5.1 as,

- Never had: Municipalities that throughout our sample period never had a driving or a written test.
- Abolished: Municipalities that started our sample period with a test and at some point abolished it.
- Implemented: Municipalities that started our sample period without a test and at some point implemented one.
- Always had: Municipalities that throughout our sample period always had a driving or a written test.

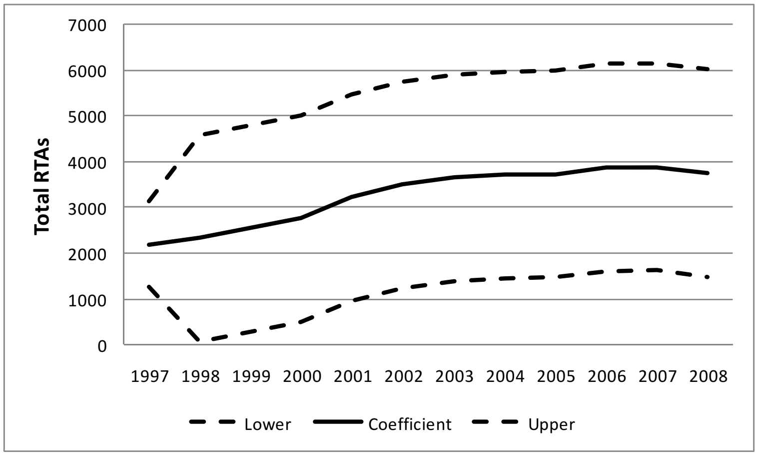
Table 5.1 Number of municipalities that never had, abolished, implementation or always had tests within our sample period. 1997-2008.

	Driving test		Written test	
	Freq.	%	Freq.	%
Never had	26	29.89	15	17.24
Abolished	26	29.89	16	18.39
Implemented	10	11.49	15	17.24
Always had	25	28.74	41	47.13

Source: Author's own calculation.

We observe that in both cases, driving and written tests, almost 40 percent of our sample either abolished or implemented tests and the remaining 60 percent either never had or has always had a test. If we were certain that the decision of the authorities upon what requirements to ask to new drivers when obtaining a new driver's license was independent of RTAs, then the estimation of the effect would be straight-forward once we controlled for confounding factors and preexisting differences. But we cannot assume this right away. It is possible, for example, that driving and/or written tests had been abolished because RTAs where low or that they had been implemented because RTAs where very high. In this case we would have a problem of reverse causality when estimating the effect of requirements on road safety. We wish to exclude this possibility and prove that, whatever the cause was for abolishing driving and/or written tests, RTAs did not play any role. As long as trends were non negative before the abolition of tests, for example, we can assume that RTAs did not play a role in the decision of the authorities of abolishing them.

Figure 5.1 RTAs trend in the sample period (1997 - 2008)



Source: Author's own calculation. Data from INEGI, Urban and Suburban Road Traffic Accidents Statistics (ATUS) 1997-2008.

In Figure 5.1 we observe the overall trend of RTAs along with 95 percent confidence interval bands. This trend is never negative, which gives us the hint that maybe the abolition of tests is more likely to be exogenous to RTAs than the implementation of tests. The fact that the trend is positive could be a cause for the implementation but not for the abolition of written and/or driving tests. In order to conclude this we estimate the linear trend for each of the four categories, and for the categories "abolished" and "implemented" we estimate it only for the years before the change in policy (before the abolition or the implementation respectively). We do it separately for the case of driving and written tests. Tables 5.2 and 5.3 contain these estimates.

Table 5.2 Different trends in RTAs before the change in policy by categories. Driving tests. 1997-2008

	Driving tests			
	Never had	Abolished	Implemented	Always had
Time	49.7	66.69	55.33	174.44
	(15.64)	(38.84)	(219.34)	(65.32)
Constant	-98,212	-132,000	-104,000	-344,000
	(31342.69)	(77676.93)	(439042.38)	(130876.03)
r^2	0.030	0.020	0.000	0.020
N	364	168	68	350
F	10.09	2.95	0.06	7.13

Source: Author's own calculation. Estimated equation is: $RTA_{it} = \delta_0 + \delta_1 t + e_{it}$ where $t < t_{\text{change in policy}}$. Standard errors are shown in parenthesis below each coefficient.

Table 5.2 shows the results of a regression of RTAs against time for all four categories separately, and only using observations prior to the change in policy, when a change in policy was made. We observe that trends are always non negative. Municipalities that have never had a driving test show a statistically significant upward trend in RTAs, same as municipalities that have always had a driving tests. In the case of municipalities that abolished or implemented driving tests, coefficients are positive but statistically not different from zero. In Table 5.3 we observe RTAs trend for the case of written tests. Results are very similar to those for driving tests. Hence, it seems that the abolition of driving and/or written tests can be thought as independent of RTAs, since RTAs trends were non negative prior to the abolition. For the case of municipalities who implemented driving and/or written tests we believe that stronger assumptions have to be made in order to conclude that RTAs had nothing to do in the decision of the authorities of implementing them. For this reason we exclude this category from our sample and estimate only the effect of abolishing requirements on RTAs, taking municipalities who have tests as the reference group.

Table 5.3 Different trends in RTAs before the change in policy by categories. Written tests. 1997-2008

	Written tests			
	Never had	Abolished	Implemented	Always had
Time	40.06	19.8	118.57	128.35
	(18.83)	(20.21)	(78.65)	(50.26)
Constant	-79,241	-38,726	-234,000	-253,000
	(37731.74)	(40416.44)	(157371.86)	(100693.46)
r^2	0.020	0.010	0.020	0.010
N	210	110	93	574
F	4.53	0.96	2.27	6.52

Source: Author's own calculation. Estimated equation is: $RTA_{it} = \delta_0 + \delta_1 t + e_{it}$ where $t < t_{\text{change in policy}}$. Standard errors are shown in parenthesis below each coefficient.

5.2 Regression framework

We estimate the following model using a fixed effects panel data framework that comprises 68 municipalities during a period of 12 years (1997-2008),[27]

$$\begin{aligned} Y_{it} &= \alpha + \beta_1 DrivAbolish_{it} + \beta_2 BothAbolish_{it} + \gamma X_{it} + \sum_{t=1}^{11} \varphi_t Year_t + \\ &+ \sum_{j=1}^{31} \sum_{t=1}^{11} \rho_{jt} \left(State_j * Year_t \right) + c_i + e_{it} \end{aligned} \tag{5.1}$$

where Y_{it} is a measure of road safety in municipality i in year t for population ages 15 to 19, $DrivAbolish$ is a dummy variable indicating that written tests have been abolished, $BothAbolish$ is a dummy variable indicating that driving tests and also written tests have been abolished,[28] X_{it} is a vector of covariates with which we control for preexisting differences and confounding factor across municipalities,[29] and $Year_t$ is a dummy variable indicating each of the $t \in [1, 12]$ years for which we have data. $(State_j * Year_t)$ is an interaction that captures state/year specific fixed effects. This way we can control for very specific factors that cause road traffic accidents in each state/year. Finally c_i captures municipality specific fixed effects, and e_{it} is an error term which we assume to be uncorrelated with any of our independent variables. The

[27] We have data for 87 municipalities but we excluded those that implemented written and/or driving tests. Thus we are left with 68.

[28] We do not observe writing tests being abolished before driving tests are.

[29] These variables are: rate of RTAs involving people ages 25 to 29, population ages 15 to 19, number of cars registered per 100 population, motorcycles registered, state's corruption index, political party in the state government, GDP per capita, state's human development index (UNDP, 2010), and male/female rate in population.

identification assumption for correctly estimating the effect is strict exogeneity of the regresors conditional on c_i (Wooldridge, 2002). Robust standard errors are assumed, and they are calculated clustering at the state level.

The coefficients of interest are β_1 and β_2. Both this parameters capture the average effect of abolishing written test and driving tests respectively on road safety measures within a municipality in a year. These are intent to treat effects (ITT), this is, the effect of having certain mix of requirements at a municipality disregarding how many people actually get their licenses. For example, it could be that imposing driving tests will discourage licensure or encourage getting it elsewhere where tests are not mandatory, both these issues are taken into account as part of the effect since we cannot control for the rate of licensure.

6 Results

6.1 Main Results

We now turn to the results of our estimations. Table 6.1 shows our estimation results of equation (5.1) for two different measures of road safety: RTAs and FRTAs per 100K population of ages 15 to 19. The parameters are estimated using fixed effects as well as random effects, but the random effects model is rejected by a Hausman tests.[30] The parameters of interest, β_1 and β_2, are on the first two rows along with their standard errors in parenthesis below. We begin by looking at the first column of Table 6.1 which shows fixed effects estimations for RTA per 100K population of ages 15 to 19. Our results suggest that the ITT effect of abolishing driving tests is negative, that is, it reduces RTAs. This result is counter-intuitive but we cannot reject the null hypothesis that β_1 is zero. Written tests abolishment comes only after driving tests have already been abolished (this is what we observe in the data), that is why β_2 can only estimate the ITT effect of abolishing both tests. This effect is positive indicating that abolishing both tests actually increases RTAs by an order of 1,800 more accidents per 100,000 population of ages 15 to 19. The rate of RTAs involving people ages 15 to 19 years old ranges from 0 to 19,000 in our sample, with a mean of 1,523. This means that the effect of abolishing both tests seems to more than double the rate of accidents, on average. Perez et al. (2009) in their study of relaxed licensing in Barcelona also found very large effects. In their study, the relative risk of being injured as a motorcyclist (whose driving tests had been abolished) as compared to being injured in any other type of vehicle went from negligible to 1.46 and kept growing in the subsequent years.[31] This effect is similar if we run random effects model as wells as most of the estimates. If we look at the rest of the parameters we observe that they are consistent with the literature on road safety. A higher corruption index, which may be considered as a proxy for willingness to bribe the authorities into not taking the tests is related to more accidents. Similar results where found in other studies like Anbarci et al. (2006), Bertrand et al. (2007), Hua et al. (2010), and Vereeck et al. (2007). Also, a higher GDP per capita is related to higher casualties as found by Bishai et al. (2006) and Kopits & Crooper (2005) for the case of developing countries like Mexico.

If we look at columns 3 and 4 in Table 6.1 we observe the estimation of equation (5.1) again, but for the case of FRTAs per 100K population of ages 15 to 19. We do this to learn if there is an effect on mortality rates rather than only on the frequency of accidents. The mean value of fatal road traffic accident per 100K

[30]Null hypothesis that random effects is consistent is rejected at the 1% level. $\chi^2_{44} = 348.67 \quad p - value = 0.0000$
[31]By the third year it had grown to 1.77, meaning that the probability of being injured as a motorcyclist was almost double.

population in our age group is 16.7 per municipality per year. Again we observe a negative effect of abolishing driving tests but when we consider the abolition of both tests the effect is clearly positive. Abolishing both tests is related to an increase of 55 FRTAs per municipality, as compared to those who have both tests. Again this is a large effect, meaning that abolition of both tests more than triples FRTAs in a municipality, on average.

Table 6.1 RTAs and FRTAs per 100k population of ages 15 to 19.

	RTA1519		Fatal RTA1519	
	Fixed Effects	Random Effects	Fixed Effects	Random Effects
	(1)	(2)	(3)	(4)
	Coef./(S.E.)	*Coef./(S.E.)*	*Coef./(S.E.)*	*Coef./(S.E.)*
Driving test abolished	-173.1	-1,015.8	-19.07	-5.93
	(216.9)	(573.5)	(4.66)	(7.29)
Both tests abolished	1,801.5	1,971.6	55.64	24.32
	(543.2)	(815.1)	(17.10)	(9.05)
RTA2529	-0.34	-0.33	0.00	0.00
	(0.24)	(0.24)	(0.00)	(0.00)
Population1519	-0.01	0.00	0.00	0.00
	(0.02)	(0.00)	(0.00)	(0.00)
Cars reg. p/100 pob	9.88	18.27	0.44	0.69
	(27.53)	(20.89)	(0.35)	(0.33)
motorcycles registered	-562.2	-464.0	-36.26	-8.99
	(188.1)	(180.0)	(12.83)	(3.95)
Corruption index	155.5	226.2	6.14	-0.02
	(41.7)	(54.7)	(0.86)	(1.29)
PAN	-141.7	2,877.1	-15.82	37.72
	(367.8)	(907.1)	(5.67)	(11.09)
PRI	926.4	3,070.2	11.46	33.87
	(316.1)	(865.7)	(8.02)	(11.06)
GDP per capita	3.68	-22.81	0.16	-0.33
	(0.58)	(13.03)	(0.04)	(0.14)
HDI	-	3,576.7	-	-81.70
	-	(5,724.6)	-	(137.08)
Rate Male/Female	-120.9	-165.5	3.28	-1.52
	(117.1)	(80.7)	(7.92)	(0.78)
Constant	10,460.0	11,167.3	-364.2	227.9
	(11,535.6)	(9,709.9)	(768.4)	(99.2)
Year dummies	Yes	Yes	Yes	Yes
(State*Year) dummies	Yes	Yes	Yes	Yes
R^2	0.58	0.67	0.20	0.21
N	816	816	816	816

Source: Author's own estimation. Standard errors are in parenthesis. Robust standard errors are assumed, clustered at the state level.

We are interested in knowing what happens with our results if we do not control for state/year fixed effects, and also if the effect that we find is translated into population of all ages, or if it only exists for population ages 15 to 19 years old. First, because our results are so different than those of Grabiszewski & Horenstein (2011) while we are both looking at the same phenomena during practically the same sample years, we argue that including a large set of controls is vital to correctly identify the effect. Second, because we are looking only at a specific age group, we are interested in knowing if the effect is also present for the whole population. We would expect there to be a smaller effect that could be explained by two interrelated factors: 1) the fact that youngsters put such a heavy load on RTAs which makes the effect still visible when we analyze population of all ages; 2) the fact that there are spillover effects, i.e., youngsters that do not have to pass a written and/or driving tests make the roads more dangerous for everyone and not only for them.

To test for the first hypothesis we simply estimate the effect without including state/year fixed effects. Results are found in the first two columns of Table 6.2. We observe that most of the coefficients change substantially, including the two most interesting ones for this study: β_1 and β_2. This calls for the importance of adding state/year dummy controls in order to correctly identify the effect of driver's license requirements on road safety. To test whether the effect is present for the whole population we estimated equation (5.1) for RTAs per 100K population of all ages (column 3) and RTAs per 100K population population of all ages minus people of ages 15 to 19 (column 4). Abolishing both tests again increases the rate of RTAs but the effect is about a fifth of the effect for youngsters only. If we subtract RTAs involving people of ages 15 to 19 the effect is reduced even more but is still positive and statistically significant. Hence, it seems that both, the heavy load of youngsters on RTAs and spillover effects are relevant when analysing the whole driving population.

Table 6.2 RTAs and fatal RTAs per 100k population (all ages)

	RTA1519	Fatal RTA1519	RTA	RTA - RTA1519
	Fixed Effects	Fixed Effects	Fixed Effects	Fixed Effects
	(1)	(2)	(3)	(4)
	Coef./(S.E.)	*Coef./(S.E.)*	*Coef./(S.E.)*	*Coef./(S.E.)*
Driving test abolished	1,142.27	1.8	-9.66	-8.86
	(770.00)	(5.58)	(47.59)	(44.94)
Both tests abolished	-1,878.5	-12.6	405.7	267.54
	(772.87)	(6.37)	(72.92)	(72.31)
RTA2529	-0.36	0.00	0.23	0.29
	(0.19)	(0.00)	(0.04)	(0.04)
Population1519	-0.02	0.00	0.00	0.00
	(0.02)	(0.00)	(0.00)	(0.00)
Cars reg. p/100 pob	4.31	0.15	5.34	4.60
	(11.39)	(0.20)	(5.54)	(6.41)
motorcycles registered	-275.5	-8.9	-54.4	-8.96
	(155.2)	(4.9)	(42.5)	(39.32)
Corruption index	13.74	-0.15	19.43	8.26
	(34.68)	(0.35)	(9.65)	(10.76)
PAN	-62.2	15.9	-100.0	-115.61
	(272.10)	(12.0)	(63.32)	(59.48)
PRI	212.12	15.7	73.48	-26.41
	(234.78)	(11.4)	(47.93)	(49.68)
GDP per capita	-1.11	0.04	1.03	0.76
	(2.70)	(0.01)	(0.13)	(0.10)
HDI	-	-	-	-
	-	-	-	-
Rate Male/Female	-205.52	-4.70	-16.25	-3.56
	(178.07)	(2.23)	(16.76)	(12.81)
Constant	21,906.8	478.2	1,270.5	134.8
	(17,235.2)	(0,217.3)	(1,630.3)	(1205.6)
Year dummies	Yes	Yes	Yes	Yes
(State*Year) dummies	No	No	Yes	Yes
R^2	0.17	0.07	0.75	0.79
N	816	816	816	816

Source: Author's own estimation. Standard errors are in parenthesis. Robust standard errors are assumed, clustered at the state level.

In summary, we find that abolishing driving tests while maintaining everything else unchanged is related with an increase in RTAs and FRTAs among population of ages 15 to 19. Regarding written tests less can be said since abolition of written test is always preceded by the abolition driving tests, but we observe that municipalities that have abolished all kinds of tests have on average more accidents and also more fatal ones. Of course, since this is an ITT effect it captures the effect of changing the requirements for obtaining a driver's license in the municipality and not necessarily the pure effect of performing written and/or driving tests on road safety. Other factors like the rate of licensure may be affected than in turn have an effect on road safety. Finally, we observe that our estimations hold if we focus on the whole driving population instead of just the age group that we think is relevant. But these estimates are smaller, thus inferring that our choice of age group is in fact relevant in order to find the effect of abolishing written and/or driving tests.

6.2 Confounders and threats to identification

Despite all of this, valid concerns regarding our estimations include the following:

1. The data set on the status of the requirements was constructed by ourselves relying on phone calls and law records, this is subject to measurement error. A way of addressing this issue would be to count with better data regarding the changes in policy.

2. We are not able to control for the rate of licensing which may be crucial to these policy changes. People may decide to go elsewhere to get their license or even drive without a license if written and/or driving tests are being applied. Knowing how people change their behavior toward licensure once tests have been abolished is crucial to understand the treatment on the treated effect.

3. We do not know if people involved in an accident even had a license nor if he was driving outside of his municipality of residence. We are only able to estimate the intent to treat effect of a change in the requirements regarding driver's licenses in the municipalities area of influence.

4. There are reasons to believe that the effect may not necessarily be immediate, this is, affecting the rate of accidents in the immediate next period that the change in policy. It would be important to study the dynamics behind it in order to determine for how many periods does it last and when does it peak.

Next, we explore a way of dealing with concerns about people driving in a different municipality other than where they obtained their license and the persistence of the effect in the years ahead. Also, we conduct various falsification tests in order to asses the validity of our estimates.

7 Robustness and additional empirical checks

We begin this section by doing a falsification test. It consists on estimating the effect of diver's license requirements on a different age group for which we suspect that there should be no effect, or the minimum spillover effect. This is RTAs per 100K women aged 35 to 39. This age group holds one of the lowest mean accident rates in our sample.[32] We expect β_1 and β_2 to be non different from zero or very close to zero. We find just that, β_1 is not statistically different from zero and β_2 is very small and only marginally statistically different from zero. The results from this exercise are found on Table 7.1 in the first column. The magnitude of the effect of abolishing both tests is one sixth of the estimate for youngsters. Thus we can conclude that the effect of requirements on road safety is possibly the largest on the relevant age group (youngsters) and what we observe in other age groups are just spillovers.[33]

Another exercise consist on estimating equation (5.1) using a different dependent variable, this is RTAs involving people of ages 15 to 19 per 100K vehicles registered instead of per population in that age group. The results from this exercise are found on Table 7.1 in the last two columns. This is to rule out the possibility that the results are driven by the choice of our dependent variable, this is, driven by population. We observe that the signs of the estimates are the same as in the original estimation. Magnitudes are naturally different

[32]The mean value of RTAs per 100K women of ages 35 to 39 is a fourth of the mean of RTAs per 100K population and 1/12 of the the mean of RTAs per 100K population of ages 15 to 19.

[33]Also possible is that there are other factors different from written and/or driving tests that are correlated with RTAs (and tests) which we are not being able to identify.

since our dependent variable now measures a slightly different thing and the precision with which these estimates are measured is very low. We can conclude that although our estimates are not driven by the choice of the dependent variable, the choice of the dependent variable allows us to estimate the effect in a more precise way.[34]

Table 7.1 RTAs per 100k women ages 35 to 39 and RTA1519 per 100k vehicles registered.

	RTA3539 Women Only		RTA1519 per 100k vehicles	
	Fixed Effects	Random Effects	Fixed Effects	Random Effects
	(1)	(2)	(3)	(4)
	Coef./(S.E.)	*Coef./(S.E.)*	*Coef./(S.E.)*	*Coef./(S.E.)*
Driving test abolished	40.83	-38.82	-238.8	-517.4
	(53.27)	(79.42)	(292.8)	(587.8)
Both tests abolished	285.6	-53.08	931.6	1,233.4
	(103.0)	(99.36)	(577.1)	(862.9)
RTA2529	0.10	0.11	-0.20	-0.19
	(0.02)	(0.02)	(0.13)	(0.13)
Population1519	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Cars reg. p/100 pob	4.75	4.74	-44.87	-17.33
	(4.69)	(3.55)	(34.37)	(21.71)
motorcycles registered	-28.1	-30.0	-157.72	-8.12
	(57.7)	(32.9)	(273.4)	(162.4)
Corruption index	17.24	-361.9	64.19	93.79
	(7.13)	(10.62)	(38.06)	(79.11)
PAN	-68.66	-2,016.2	-165.6	1,535.6
	(52.04)	(151.3)	(395.9)	(1311.2)
PRI	106.5	-2,496.3	137.7	1,669.1
	(47.21)	(153.3)	(307.0)	(1361.3)
GDP per capita	0.57	53.59	1.52	-2.72
	(0.17)	(1.27)	(1.06)	(9.75)
HDI	-	-690.8	-	310.3
	-	(1,254.8)	-	(6445.5)
Rate Male/Female	11.68	10.28	78.86	-70.39
	(37.11)	(9.81)	(202.2)	(91.74)
Constant	-1,706.7	270.5	-7,488.9	5,296.2
	(3,683.2)	(1,470.8)	(19760.7)	(11475.2)
Year dummies	Yes	Yes	Yes	Yes
(State*Year) dummies	Yes	Yes	Yes	Yes
R^2	0.60	0.60	0.58	0.57
N	816	816	806	806

Source: Author's own estimation. Standard errors are in parenthesis. Robust standard errors are assumed, clustered at the state level.

Next we exploit the time series structure of our data to test whether the effect is maintained throughout time, this is, if the effect can be found in past and in future realizations of our variables. Along with this we run a falsification tests to test if the effect is present when nobody in our age group is old enough to legally drive. The first column in Table 7.2 shows our original estimates of RTAs per 100k population of ages 15 to 19 in order to make comparisons. The second column presents the results of estimating equation (5.1) with four lags in the dependent variable ($RTA1519_{i,t-4}$). This is our falsification tests, in $t-4$ the age group is

[34]Maybe because data on population is less prone to measurement error than data on registered vehicles.

composed of people whose ages range from 11 to 15 years old. The minimum age to get a driving permit in Mexico is 16, so there is no one in this age group who is legally allowed to drive. For this reason we believe that there should be no effect of abolishing any tests on this group's rate of accidents. In fact this is exactly what we find, both β_1 and β_2 are very small in magnitude and are not statistically different from zero.

On the other side, we would except the effect of abolishing written and/or driving tests to remain after a few years, since some of the people in our age group are only then becoming able to legally drive. The third column of Table 6.4 shows the results of estimating equation (5.1) with two leads in the dependent variable ($RTA1519_{i,t+2}$).[35] In $t+2$ our age group is composed of people whose ages range from 17 to 21 years old. We observe that the effect of abolishing both tests (β_2) is almost the same as our original estimates. The rest of the estimates vary only a little bit.

Finally, we perform an alternative specification to see if we can estimate something closer to the treatment on the treated (TOT) effect. The last column in Table 6.4 is an estimation of equation (5.1) excluding the municipalities of Mexico City and the state of Puebla. After a visual inspection of our data we observe that, given the proximity of these municipalities to other municipalities where tests are non mandatory, these are likely to be the municipalities where the incentives to get your license elsewhere are higher.[36] For the rest of the country, the municipalities where you do not have to pass any test are further apart from those where test are mandatory. We expect that, if getting your license elsewhere is a large enough issue, then excluding these municipalities would correct our estimates (upward or downward).[37] If this is not a big issue then the estimates would be the same without these municipalities. We observe that both of our estimates β_1 and β_2 rise in absolute value which is a sign that these issues do play role in the effect of abolishing written and/or driving tests.

[35]The choice of leads is arbitrary, results are similar in (t+1) and (t+3).

[36]The maps needed to make this analysis are found in the appendix.

[37]If drivers who got their license elsewhere (where tests are non mandatory) are a non negligible proportion of all drivers we would expect estimates to be higher, for example.

Table 7.2 RTAs per 100k population of ages 15 to 19. Regression on lags and leads of the dependent variable and alternative specification.

	RTA1519	RTA1519 (t-4)	RTA1519 (t+2)	RTA1519*
	Fixed Effects	Fixed Effects	Fixed Effects	Fixed Effects
	(1)	(2)	(3)	(4)
	Coef./(S.E.)	*Coef./(S.E.)*	*Coef./(S.E.)*	*Coef./(S.E.)*
Driving test abolished	-173.1	132.8	-510.3	-2,501.0
	(216.9)	(85.83)	(157.0)	(356.0)
Both tests abolished	1,801.5	-5.95	1,752.0	4,246.6
	(543.2)	(152.2)	(266.1)	(785.7)
RTA2529	-0.34	0.03	-0.11	-0.31
	(0.24)	(0.30)	(0.12)	(0.24)
Population1519	-0.01	-0.01	0.00	0.00
	(0.02)	(0.02)	(0.02)	(0.03)
Cars reg. p/100 pob	9.88	-2.84	28.93	23.23
	(27.53)	(27.08)	(18.59)	(36.02)
motorcycles registered	-562.2	62.0	-357.6	-416.1
	(188.1)	(236.6)	(106.3)	(746.2)
Corruption index	155.5	112.9	56.20	-453.7
	(41.7)	(17.74)	(25.46)	(35.3)
PAN	-141.7	-558.7	-838.4	120.7
	(367.8)	(66.4)	(184.2)	(376.9)
PRI	926.4	-1,587.3	448.9	1,175.8
	(316.1)	(102.2)	(155.8)	(446.6)
GDP per capita	3.68	-1.47	1.19	1.31
	(0.58)	(0.29)	(0.36)	(1.57)
HDI	-	-	-	-
	-	-	-	-
Rate Male/Female	-120.9	-91.29	-381.68	1.99
	(117.1)	(200.40)	(75.0)	(167.8)
Constant	10,460.0	10,337.1	36,377.6	3,103.6
	(11,535.6)	(18,241.4)	(7101.5)	(17164.0)
Year dummies	Yes	Yes	Yes	Yes
(State*Year) dummies	Yes	Yes	Yes	Yes
R^2	0.58	0.65	0.70	0.62
N	544	816	806	624

Source: Author's own estimation. Standard errors are in parenthesis. Robust standard errors are assumed, clustered at the state level. *Equation estimated excluding the municipalities in Mexico City and in the state of Puebla.

8 Conclusions

In conclusion, we have found that given the nature of the Mexican decentralized legislation towards road traffic, the variation among the different requirements needed to obtain a driver's license can be seen as exogenous to road safety. This allows us to estimate the effect of requirements such as written and driving tests on the rate of road traffic accidents and on the rate of fatal road traffic accidents. We estimate these effects for youngsters as well as for population of all ages. Our main result is that the abolition of such tests is related to an increase of road traffic accidents and fatal road traffic accidents in youngsters, and in a smaller magnitude for population of all ages. A possible explanation for this could be the existence of spillovers effects given that the high risk group (youngsters) coexists with all other age group in the roads.

These results are rather robust to different specifications

Our analysis is not free of caveats. The fact that we constructed the database of the different requirements in each of the municipalities by ourselves relying on phone calls to DMV offices and law records found online and at the university's library makes it very prone to measurement error. One possible way of improving this study would be to verify the data on these requirements. Another issue concerns the data on road traffic accidents which does not contain information on the driver's license or his place of residence, nor do we have data on the rate of licensure in each municipality. We have reasons to believe that implementing tests to new drivers changes the rate of licensure. Being able to correct for this issue could improve the estimation since we were only able to estimate an intent to treat (ITT) effect of the change in requirements on road safety measures.

9 Appendix

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Figure 9.1 Municipalities who perform and who do not perform driving tests.

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Acapulco de Juárez	-	-	-	-	-	-	-	-	-	-	-	-
Aguascalientes	X	X	X	X	X	X	X	-	-	-	-	-
Ahome	X	X	X	X	X	X	X	X	X	X	X	X
Álvaro Obregón	X	X	X	X	X	X	X	-	-	-	-	-
Apodaca	X	X	X	X	X	X	X	X	X	X	X	X
Atizapán de Zaragoza	-	-	-	-	-	-	-	-	-	-	-	-
Azcapotzalco	X	X	X	X	X	X	X	-	-	-	-	-
Baja California Sur (state)	-	-	-	-	-	-	-	-	-	-	-	-
Benito Juárez	X	X	X	X	X	X	X	-	-	-	-	-
Benito Juárez	X	X	X	X	X	X	X	X	X	X	X	X
Cajeme	X	X	X	X	X	X	X	X	X	X	X	X
Campeche	X	X	X	X	X	X	X	-	-	-	-	-
Cárdenas	-	-	-	-	-	-	-	-	-	-	-	-
Celaya	-	-	-	-	-	-	-	-	-	X	X	X
Centro	-	-	-	-	-	-	-	-	-	-	-	-
Chihuahua	-	-	-	-	-	-	-	-	-	-	X	X
Chimalhuacán	-	-	-	-	-	-	-	-	-	-	-	-
Coacalco de Berriozábal	-	-	-	-	-	-	-	-	-	-	-	-
Coatzacoalcos	-	-	-	-	-	-	-	-	-	-	-	-
Colima (state)	X	X	X	X	X	X	X	X	X	X	X	X
Coyoacán	X	X	X	X	X	X	X	-	-	-	-	-
Cuauhtémoc	X	X	X	X	X	X	X	-	-	-	-	-
Cuautitlán Izcalli	-	-	-	-	-	-	-	-	-	-	-	-
Cuernavaca	-	-	-	-	-	-	-	-	-	-	-	-
Culiacán	X	X	X	X	X	X	X	X	X	X	X	X
Durango	X	X	X	X	X	X	X	X	X	X	X	X
Ecatepec de Morelos	-	-	-	-	-	-	-	-	-	-	-	-
Ensenada	X	X	X	X	X	X	X	X	X	X	X	X
Gómez Palacio	-	-	-	-	-	-	-	-	-	-	-	-
Guadalajara	-	X	X	X	X	X	X	X	X	X	X	X
Guadalupe	X	X	X	X	X	X	X	X	X	X	X	X
Guasave	X	X	X	X	X	X	X	X	X	X	X	X
Gustavo A. Madero	X	X	X	X	X	X	X	-	-	-	-	-
Hermosillo	X	X	X	X	X	X	X	X	X	X	X	X
Irapuato	X	X	X	X	X	X	X	X	X	X	X	X
Ixtapaluca	-	-	-	-	-	-	-	-	-	-	-	-
Iztacalco	X	X	X	X	X	X	X	-	-	-	-	-
Iztapalapa	X	X	X	X	X	X	X	-	-	-	-	-
Juárez	-	-	-	-	-	-	-	-	-	-	X	X
La Magdalena Contreras	X	X	X	X	X	X	X	-	-	-	-	-
León	X	X	X	X	X	X	X	X	X	X	X	X
Matamoros	X	X	X	X	X	X	X	X	X	X	X	X
Mazatlán	X	X	X	X	X	X	X	X	X	X	X	X
Mérida	X	X	X	X	X	X	X	X	X	X	X	X
Mexicali	X	X	X	X	X	X	X	X	X	X	X	X
Miguel Hidalgo	X	X	X	X	X	X	X	-	-	-	-	-
Monterrey	X	X	X	X	X	X	X	X	X	X	X	X
Morelia	X	X	X	X	X	X	X	-	-	-	-	-
Naucalpan de Juárez	-	-	-	-	-	-	-	-	-	-	-	-
Nezahualcóyotl	-	-	-	-	-	-	-	-	-	-	-	-
Nicolás Romero	-	-	-	-	-	-	-	-	-	-	-	-
Nuevo Laredo	X	X	X	X	X	X	X	X	X	X	X	X
Oaxaca de Juárez	X	X	X	X	X	X	X	X	X	X	X	-
Othón P. Blanco	X	X	X	X	X	X	X	X	X	X	X	X
Pachuca de Soto	-	-	-	-	-	-	-	-	-	-	-	-
Puebla	X	X	-	-	-	-	-	-	-	-	-	-
Querétaro	X	X	X	X	X	X	X	X	X	X	X	X
Reynosa	X	X	X	X	X	X	X	X	X	X	X	X
Salamanca	-	-	-	-	-	-	-	-	-	X	X	X
Saltillo	-	-	-	-	-	-	-	-	-	-	-	-
San Luis Potosí	X	X	X	X	X	X	X	X	X	-	-	-
San Nicolás de los Garza	X	X	X	X	X	X	X	X	X	X	X	X
Santa Catarina	X	X	X	X	X	X	X	X	X	X	X	X
Tampico	-	-	-	-	-	-	-	-	-	-	-	-
Tapachula	X	X	X	-	-	-	-	-	-	-	-	-
Tehuacán	X	X	-	-	-	-	-	-	-	-	-	-
Tepic	X	-	-	-	-	-	-	-	-	-	-	-
Tijuana	X	X	X	X	X	X	X	X	X	X	X	X
Tláhuac	X	X	X	X	X	X	X	-	-	-	-	-
Tlalnepantla de Baz	-	-	-	-	-	-	-	-	-	-	-	-
Tlalpan	X	X	X	X	X	X	X	-	-	-	-	-
Tlaquepaque	-	X	X	X	X	X	X	X	X	X	X	X
Tlaxcala (state)	X	X	X	X	X	X	X	X	X	X	X	-
Toluca	-	-	-	-	-	-	-	-	-	-	-	-
Tonalá	-	X	X	X	X	X	X	X	X	X	X	X
Torreón	-	-	-	-	-	-	-	-	-	-	-	-
Tultitlán	-	-	-	-	-	-	-	-	-	-	-	-
Tuxtla Gutiérrez	X	X	X	-	-	-	-	-	-	-	-	-
Uruapan	X	X	X	X	X	X	X	-	-	-	-	-
Valle de Chalco Solidaridad	-	-	-	-	-	-	-	-	-	-	-	-
Venustiano Carranza	X	X	X	X	X	X	X	-	-	-	-	-
Veracruz	-	-	-	-	-	-	-	-	-	-	-	-
Victoria	-	-	-	-	-	-	-	-	-	-	-	-
Xalapa	-	-	-	-	-	-	-	-	-	-	-	-
Xochimilco	X	X	X	X	X	X	X	-	-	-	-	-
Zacatecas (state)	-	-	-	-	-	-	-	-	-	-	-	-
Zapopan	-	X	X	X	X	X	X	X	X	X	X	X

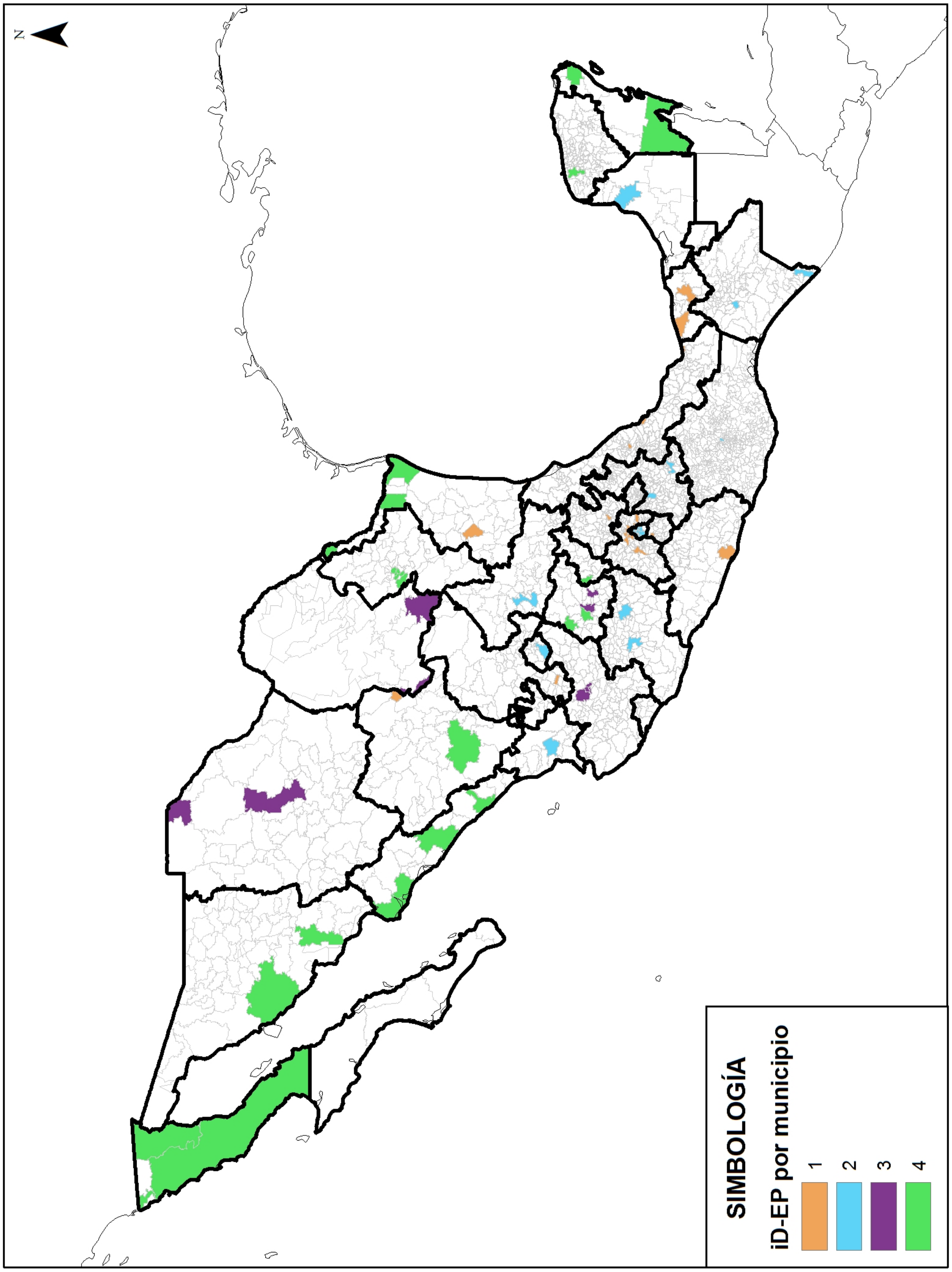
Source: Author's. Legend: "x" means that the test is mandatory and "-" means that it is not.

Figure 9.2 Municipalities who perform and who do not perform written tests.

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Acapulco de Juárez	X	X	X	X	X	X	X	X	X	X	X	X
Aguascalientes	X	X	X	X	X	X	X	X	X	X	X	X
Ahome	X	X	X	X	X	X	X	X	X	X	X	X
Álvaro Obregón	X	X	X	X	X	X	X	-	-	-	-	-
Apodaca	X	X	X	X	X	X	X	X	X	X	X	X
Atizapán de Zaragoza	-	-	-	-	-	-	-	-	-	-	-	-
Azcapotzalco	X	X	X	X	X	X	X	-	-	-	-	-
Baja California Sur (state)	X	X	X	X	X	X	X	X	X	X	X	X
Benito Juárez	X	X	X	X	X	X	X	-	-	-	-	-
Benito Juárez	X	X	X	X	X	X	X	X	X	X	X	X
Cajeme	X	X	X	X	X	X	X	X	X	X	X	X
Campeche	X	X	X	X	X	X	X	X	X	X	X	X
Cárdenas	-	-	-	-	-	-	-	-	-	X	X	X
Celaya	X	X	X	X	X	X	X	X	X	X	X	X
Centro	-	-	-	-	-	-	-	-	-	X	X	X
Chihuahua	X	X	X	X	X	X	X	X	X	X	X	X
Chimalhuacán	-	-	-	-	-	-	-	-	-	-	-	-
Coacalco de Berriozábal	-	-	-	-	-	-	-	-	-	-	-	-
Coatzacoalcos	-	-	-	-	-	-	-	X	X	X	X	X
Colima (state)	X	X	X	X	X	X	X	X	X	X	X	X
Coyoacán	X	X	X	X	X	X	X	-	-	-	-	-
Cuauhtémoc	X	X	X	X	X	X	X	-	-	-	-	-
Cuautitlán Izcalli	-	-	-	-	-	-	-	-	-	-	-	-
Cuernavaca	-	X	X	X	X	X	X	X	X	X	X	X
Culiacán	X	X	X	X	X	X	X	X	X	X	X	X
Durango	X	X	X	X	X	X	X	X	X	X	X	X
Ecatepec de Morelos	-	-	-	-	-	-	-	-	-	-	-	-
Ensenada	X	X	X	X	X	X	X	X	X	X	X	X
Gómez Palacio	-	-	-	-	-	-	-	-	-	-	-	-
Guadalajara	-	X	X	X	X	X	X	X	X	X	X	X
Guadalupe	X	X	X	X	X	X	X	X	X	X	X	X
Guasave	X	X	X	X	X	X	X	X	X	X	X	X
Gustavo A. Madero	X	X	X	X	X	X	X	-	-	-	-	-
Hermosillo	X	X	X	X	X	X	X	X	X	X	X	X
Irapuato	X	X	X	X	X	X	X	X	X	X	X	X
Ixtapaluca	-	-	-	-	-	-	-	-	-	-	-	-
Iztacalco	X	X	X	X	X	X	X	-	-	-	-	-
Iztapalapa	X	X	X	X	X	X	X	-	-	-	-	-
Juárez	X	X	X	X	X	X	X	X	X	X	X	X
La Magdalena Contreras	X	X	X	X	X	X	X	-	-	-	-	-
León	X	X	X	X	X	X	X	X	X	X	X	X
Matamoros	X	X	X	X	X	X	X	X	X	X	X	X
Mazatlán	X	X	X	X	X	X	X	X	X	X	X	X
Mérida	X	X	X	X	X	X	X	X	X	X	X	X
Mexicali	X	X	X	X	X	X	X	X	X	X	X	X
Miguel Hidalgo	X	X	X	X	X	X	X	-	-	-	-	-
Monterrey	X	X	X	X	X	X	X	X	X	X	X	X
Morelia	-	-	-	-	-	-	-	X	X	X	X	X
Naucalpan de Juárez	-	-	-	-	-	-	-	-	-	-	-	-
Nezahualcóyotl	-	-	-	-	-	-	-	-	-	-	-	-
Nicolás Romero	-	-	-	-	-	-	-	-	-	-	-	-
Nuevo Laredo	X	X	X	X	X	X	X	X	X	X	X	X
Oaxaca de Juárez	X	X	X	X	X	X	X	X	X	X	X	X
Othón P. Blanco	X	X	X	X	X	X	X	X	X	X	X	X
Pachuca de Soto	X	X	X	X	X	X	X	X	X	X	X	X
Puebla	X	X	X	X	X	X	X	X	X	X	X	X
Querétaro	X	X	X	X	X	X	X	X	X	X	X	X
Reynosa	X	X	X	X	X	X	X	X	X	X	X	X
Salamanca	X	X	X	X	X	X	X	X	X	X	X	X
Saltillo	-	-	-	-	-	-	-	-	-	-	-	-
San Luis Potosí	-	-	-	-	-	-	-	-	-	X	X	X
San Nicolás de los Garza	X	X	X	X	X	X	X	X	X	X	X	X
Santa Catarina	X	X	X	X	X	X	X	X	X	X	X	X
Tampico	X	X	X	X	X	X	X	X	X	X	X	X
Tapachula	X	X	X	X	X	X	X	X	X	X	X	X
Tehuacán	X	X	X	X	X	X	X	X	X	X	X	X
Tepic	X	-	-	-	-	-	-	-	-	-	-	-
Tijuana	X	X	X	X	X	X	X	X	X	X	X	X
Tláhuac	X	X	X	X	X	X	X	-	-	-	-	-
Tlalnepantla de Baz	-	-	-	-	-	-	-	-	-	-	-	-
Tlalpan	X	X	X	X	X	X	X	-	-	-	-	-
Tlaquepaque	-	X	X	X	X	X	X	X	X	X	X	X
Tlaxcala (state)	X	X	X	X	X	X	X	X	X	X	X	-
Toluca	-	-	-	-	-	-	-	-	-	-	-	-
Tonalá	-	X	X	X	X	X	X	X	X	X	X	X
Torreón	-	-	-	-	-	-	-	-	-	-	-	-
Tultitlán	-	-	-	-	-	-	-	-	-	-	-	-
Tuxtla Gutiérrez	X	X	X	X	X	X	X	X	X	X	X	X
Uruapan	-	-	-	-	-	-	-	X	X	X	X	X
Valle de Chalco Solidaridad	-	-	-	-	-	-	-	-	-	-	-	-
Venustiano Carranza	X	X	X	X	X	X	X	-	-	-	-	-
Veracruz	-	-	-	-	-	-	-	X	X	X	X	X
Victoria	X	X	X	X	X	X	X	X	X	X	X	X
Xalapa	-	-	-	-	-	-	-	X	X	X	X	X
Xochimilco	X	X	X	X	X	X	X	-	-	-	-	-
Zacatecas (state)	-	-	-	-	-	-	-	-	-	-	-	-
Zapopan	-	X	X	X	X	X	X	X	X	X	X	X

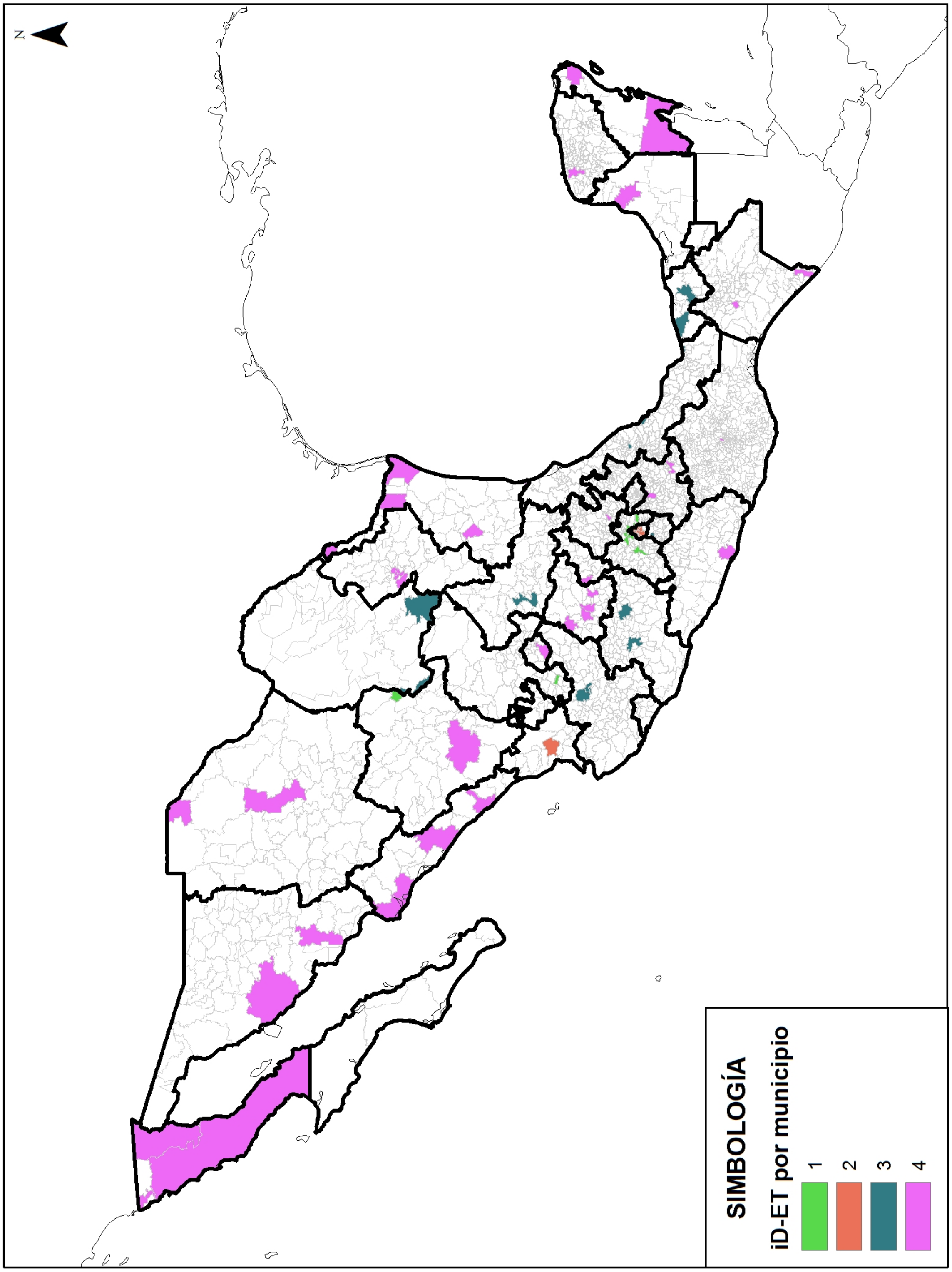
Source: Author's. Legend: "x" means that the test is mandatory and "-" means that it is not.

Figure 9.3 Municipalities who never had, abolished, implemented, and always had driving tests.



Source: Author's. Legend: 1=Always had, 2=abolished, 3=implemented, and 4=never had.

Figure 9.4 Municipalities who never had, abolished, implemented, and always had written tests.



Source: Author's. Legend: 1=Always had, 2=abolished, 3=implemented, and 4=never had.

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