

ERASMUS UNIVERSITY ROTTERDAM

Erasmus School of Economics

Master Thesis Policy Economics

Swiss response to the 1999 Weapons Act:

The impact of a federal gun control reform on firearm suicides in Switzerland

Abstract: I investigate the causal impact of a specific means reduction case that stems from the Weapons Act, implemented in 1999, on the number of firearm suicides across the Swiss population. Using a difference-in-differences design that regards the younger age deciles as the treatment group and the older deciles as the control group, I construct dual comparisons to see the differential impact of the reform on the completed firearm suicides. My identification strategy is based on the idea that older people would be less affected by the reform since the gun ownership rate among them is higher. Evidence shows that there has already been a decreasing trend in the total number of suicides and that the Swiss population has experienced a decrease in their tendency to commit firearm suicides above and beyond the general decreasing trend. Most dual comparisons produced results that are in line with my identification strategy, that is, younger cohorts experienced larger decreases in firearm suicides relative to the older cohorts, however, there are also a few conflicting results. In general, according to the evidence, the Weapons Act had a deterrent impact on the number of firearm suicides committed by the Swiss. Lastly, it should be noted that the range of variables and the length of the observation period prior to the reform included in my dataset are not extensive as desired, which could partly incapacitate causal inference.

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Date Final Version: November 18, 2021

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I.Introduction

According to the most recent estimates, one person dies by suicide every minute globally, making it over 700.000 deaths annually. Relative to other causes of death worldwide, suicide still stands out as it accounted for 1,3% of all deaths in 2019 (WHO, 2021). On top of its tragic nature that leads one to terminate their own life, these striking statistics seem enough to study suicide as a public health issue while drawing increasing attention from different fields. Increased efforts for suicide prevention including awareness campaigns, support lines, risk identification, mental health treatments, and means reduction seemed to work fine at first glance as suicide rates have been decreasing in every region except the Americas during the 21st century (WHO, 2021). However, this pleasant trend is not sufficient to draw the causal link between the prevention measures and the decrease in suicide rates because there may be other factors that influence the pattern, such as changes in norms and values and/or increase in overall wellbeing worldwide. Moreover, even if we can successfully factor out the impact of culture and wealth, the decrease that we observe is still a combination of several suicide prevention measures. Thus, we need to look beyond the simple statistics in order to identify the measures that work and the measures that do not.

This paper tries to identify the causal impact of a specific means reduction case on the suicide rates among the Swiss population through exploiting the exogenous variation caused by a change in the Swiss firearm legislation. At the beginning of 1999, the Weapons Act became effective as the first federal gun control law in Switzerland. With the assumption that no other factors (norms and values) and prevention measures (awareness campaigns, support lines, etc.) systematically affected the patterns of suicides with and without firearms, the effect of the Weapons Act will appear in the number and rate of suicides following the reform. Hence, this paper essentially tries to find out whether the 1999 Weapons Act had a reducing effect on the number and the rate of firearm suicides in Switzerland.

The paper proceeds as follows: First, philosophical perspectives on suicide and suicide prevention are introduced to form the basis for a sound public policy discussion. Then, correspondingly, I discuss two different approaches to suicide from the literature. On one hand, suicidal ideation is considered a deviation from rationality. Regarding this *irrational* behavior, the concept of impulsivity will be discussed to set the framework for how means reduction could work

to prevent suicides. On the other hand, suicide is regarded as part of rational thinking performed within the boundaries of economic theory. Consequently, suicide as rational behavior will be discussed. The following section will introduce the concept of lethality and how it relates to the choice of method, particularly firearms. Then, the Weapons Act and what it entails regarding the causal identification for the effectiveness of our specific means reduction case will be described thoroughly. Next, the source, and the type of data, as well as the empirical method used will be explained. Then, I will present the main estimation results. Ultimately, the article will conclude with a policy discussion.

II. Should we prevent suicides?

General perspectives on whether we should prevent suicides have usually been contingent on the dominant views concerning the act of suicide. Throughout the western civilization, which had been dominated by Judeo-Christian principles until the secular enlightenment, suicide was a highly sinful act as life is given by God and it is, therefore, God's property. For approximately fifteen centuries (6th through late 20th), it had been prohibited by the Catholic Church to hold funerals for people who died by suicide. In such a setting, preventing a potential suicide is desirable since it means restraining that person from committing a major sin. However, the Church -and its equivalents among other religions- neither oversees the public policy nor influences the public attitude regarding suicide in today's social order. Contemporary western ideologies prevalent in today's paradigm see one's life as their own property, not God's. Taking that into consideration, one can see suicide prevention as a violation of our values centered around individual rights and civil liberties. Moreover, preventing one from committing suicide would mean paternalistically attacking that person's *autonomy*, the principle of which is described by Beauchamp (2003) as "an obligation to respect the decision-making capacities of autonomous persons by not limiting their liberty to effect their choices".

On the other hand, respecting people's autonomy and other individual freedoms does not mean letting all the suicides happen. Not everyone has a flawlessly functioning mental capacity, especially when their suicidal thoughts are intensified. As Beauchamp (2003) argues, suicide prevention is paternalistic only when the subject is fully autonomous. In other words, paternalism does not apply when the suicidal individual lacks mental capacity. Similarly, according to Brandt

(1975), a deeply depressed individual will conceive the future lousier than usual. Hence, it would be legitimate, non-paternalistic, and perhaps even morally obligatory to prevent them from committing suicide.

However, the picture becomes ambiguous when empirically testing the relationship between suicide and mental health. There is substantial variation among the studies showing that relationship. Battin (1995) showed the variation among the findings on the frequency of mental illness in suicide attempts, ranging from 20 to 100 percent. Furthermore, while the studies point to a 90% rate of mental illness among deaths by suicide in the developed world (Hawton & Van Heeringen, 2009), two studies from China report rather lower prevalence rates such as 63% and 48% (Yang et al., 2005; Zhang et al., 2010). According to Phillips (2010), such a divergence is not due to methodological differences since they are all psychological autopsy studies, but a product of the discrepancies across different cultures regarding the expression and the manifestation of a bad mental state. In other words, what is considered a mental illness can differ across different cultures even today. Nevertheless, the general convention is that suicide risk is higher for people with mental illnesses, which eventually justifies the prevention of at least part of the suicides.

After all, suicide is still being subject to endless philosophical debates because of its naturally shady decision-making process, and it is also being subject to public policy debates due to being one of the most common causes of unnatural, therefore preventable, causes of death worldwide. The ambiguity in the decision-making becomes visible when trying to provide a universally valid answer to the following question: Is the decision to commit suicide a conscious individual choice that should be accepted, or a wrongly conceived judgement regarding one's own life that should be prevented from happening? There is no clear-cut answer to the question. No single theory can explain suicide as a whole. Different fields focus on different types of suicides while basing their approaches on different assumptions. Epidemiology, for instance, concentrates more on impulsive suicides to produce preventive measures for people who exhibit a greater risk of committing suicide because of having less stable mental health.

Suicide as an impulsive decision

Impulsivity, a constructed concept in psychology, has been defined differently among experts. To keep it broad and inclusive, one could describe impulsive behavior as containing risk-taking, deciding swiftly, and lack of planning (Eysenck & Eysenck, 1977), acting on the spur of the moment and lack of careful thinking (Patton et al., 1995), and lack of consideration for the negative consequences (Moeller et al., 2001). Correspondingly, impulsivity provides justification for suicide prevention regarding the moral-philosophical discussion, since an impulsive suicide attempt does not reflect the individual's genuine considerations between life and death.

Impulsivity provides an avenue for suicide prevention also from a practical perspective. More impulsive attempts are considered to have higher potential regarding how to prevent them. This is not a misperception as long as lethal means of suicide are not available to potential suicide attempters when their impulsivity peaks. The reasoning behind this idea is that a non-impulsive suicide attempt is a product of deliberate thinking, therefore exhibits a more consistent intent and wish to die, whereas an impulsive suicide attempt entails an instant reaction to a moment of extreme psychological fluctuation (Williams et al., 1980). Hence, "means reduction" focuses more on impulsive attempts to disable people from accessing the lethal methods based on the belief that suicidal ideation will fade away.

Suicide attempts differ regarding how impulsive they are since impulsivity is a spectrum rather than a binary conception. Several studies pointed out patterns that provide evidence for the prevalence of impulsive suicide attempts. In a systematic review of 90 studies, Owens et al. (2002) found that the vast majority of fatal and non-fatal self-harming actions are not repeated in the following years. Particularly, it has been documented that only two percent of self-harm survivors died by suicide during the following year. Furthermore, the duration between the first suicidal thought and the actual attempt is negatively associated with the impulsivity of a suicide act since it reflects the idea of an instant reaction and lack of thorough planning. Following this reasoning, Simon et al. (2001) surveyed 153 suicide survivors that engaged in nearly lethal attempts and found that 24% of them accomplished the suicide attempt in less than five minutes, and 71% in less than an hour after first considering it. Similarly, Deisenhammer et al. (2008) interviewed 82 patients in

a psychiatric university hospital who recently had attempted suicide and discovered that 39 (47.6%) of them had completed their attempts in less than 10 minutes of consideration.

Although there is no universal standard to define and measure the impulsivity of a suicide attempt, the abovementioned studies and many more show that a significant proportion of suicide attempts are instant actions that do not involve deliberate planning. While preventing non-impulsive suicide attempts requires a more profound understanding of the underlying psychological factors, many impulsive attempts can be averted through means reduction since the risk of suicidal behavior disappears quickly. There are other approaches to suicide with rather different focuses regarding how they position the choice to commit suicide into human reasoning.

Suicide as a rational choice

Sociologists and epidemiologists conceptualize suicidal ideation as a deviation from rational thinking. Following Durkheim's *Le Suicide* in 1897, many attempts have been made to understand the factors that drive irrational suicidal action within and across societies. Later, economists also started studying suicide, which they did so within the framework of rational choice theory. Similar to Becker's seminal conceptualization in "The economic approach to human behavior" that situates various types of human action (crime, marriage, education) within economic thinking, Hamermesh and Soss (1974) used economic theory to understand what influences the decision to commit suicide, even before Becker's work. They attempted to explain the variation in suicide rates through a utility-maximizing agent that attempts suicide when their "discounted lifetime utility" becomes non-positive. When the model is optimized, the rate of suicide should be positively related to age and unemployment, and negatively related to permanent income. All three predictions are confirmed in their empirical estimation concerning the sign of their regression coefficients, although not statistically significant. The authors also found out that the rate of suicide is sensitive to the cyclical fluctuations in the economy similar to permanent income.

Kimenyi and Shughart (1986) presented further evidence to explain suicide as part of rational behavior as opposed to the conventional psychological and sociological approaches. Using the variation across time between 1940-1980 for the United States, they not only confirmed the results obtained by Hamermesh and Soss but also extended the model to include the price of health

care and divorce rates. After all, these studies showed economic variables affect suicide rates, and that economic theory can produce useful insights regarding how this impact occurs.

Although both studies contributed to the economic understanding of suicide, their scope has been somewhat limited since they only concern completed suicides on an aggregate level, perhaps due to the unavailability of ideal data. To account for these, Marcotte (2003) extends the standard model by including a positive probability of survival using individual-level data. An important note from the study is that the individual's decision is in fact between attempting or not attempting suicide, as opposed to choosing between life and death in the preceding literature. Hence, the individual compares her expected lifetime utility when attempts suicide to her expected lifetime utility when no attempt is made. According to Marcotte's model, an individual attempts suicide not only when her discounted lifetime utility reaches zero as Hamermesh and Soss (1974) argued, but also when the attempt is associated with higher expected future utility. An increase in utility following a suicide attempt seems counterintuitive, given the severe bodily injuries and psychological traumas it may lead to. However, a suicide attempt can also be a signal to demand more attention, care, and resources. Marcotte empirically tested these arguments using individual-level data from National Comorbidity Survey by comparing suicide attempters with people that contemplated but did not attempt suicide. Results show that attempters benefited from an immediate income increase relative to the contemplators. Moreover, harder suicide attempts coincide with stronger effects. Therefore, Marcotte's arguments that include higher future utility among suicide attempters and a suicide attempt as a "cry for help" are empirically supported.

Marcotte's extended model is also useful for considering how means reduction would work based on the economic theory of suicide. The individual decides to attempt suicide when her expected lifetime utility conditional on the attempt together with the distaste for the act of suicide exceeds her lifetime utility in case of no attempt. Hence, a suicide attempt itself entails a cost because it is typically an unpleasant act. While Marcotte does not define this distaste explicitly, one can think of factors such as pain, fear, familial considerations, and physical and financial efforts to acquire the means to attempt suicide as elements of disutility. Such efforts include purchasing the necessary material and setting up the hanging mechanism if the individual is planning to hang herself, or purchasing a gun and some ammunition if a firearm is to be used in the suicide attempt. In the absence of preventive measures, the effort is relatively lower. When

preventive measures are in place, such as a firearms restriction, the individual may have to exert more effort to obtain the firearms, such as going into the black market or applying for a firearms license. Thus, the propensity to commit suicide will decrease because of increased distaste for the act of suicide.

However, an individual genuinely planning to kill herself following rational calculations is not likely to give up just because the suicide attempt becomes more distasteful than initially expected. Instead, it is more logical to expect the “cry for help” type of suicide attempters to give up following the means reduction measures since the increased distaste matters more for those who plan to be alive after the attempt. Nevertheless, given that some of the “cry for help” type attempters may not survive after the attempt although they do not have an actual intent to die, means restriction could still prevent unintended deaths resulting from rationally attempted suicides

In conclusion, suicide is not necessarily an irrational choice that is made at the moment of psychological crises. A number of studies show that a suicide attempt can also be a rational choice that follows rational thinking, and is affected by the change in economic factors such as income and unemployment. Both types of suicides discussed above, rational and impulsive, might be prevented through means reduction as suggested by the theoretical arguments and empirical findings among the works of diverse fields such as economics, sociology, epidemiology, and psychology.

III. Lethality and firearms

Lethality is another key aspect of suicide attempts in pursuit of effective prevention strategies. Different methods entail different case-fatality rates. The prevalence of a specific method varies considerably across different geographies, depending on the cultural, legal, social, and economic contexts, as well as the availability of the method. Firearms appear to be the most lethal method in many countries, with the most striking case fatality rates of 90% in the US and Australia (Elnour & Harrison, 2007; Conner et al., 2019).

Besides the extreme lethality they exhibit, firearms also are used frequently as a suicide method. According to a recent statistic from CDC, firearms were used in half of the fatal suicides in the US in 2018. Men have a significantly higher tendency to use firearms when attempting

suicide. A different pattern has been observed in Europe. In a study that investigates the gender-specific suicide methods covering the member countries of the “European Alliance Against Depression”, Värnik et al. (2008) identified “hanging” as the most common method for both males and females (54.3% and 35.6). Across Europe, firearms appear as the most preferred method only by men in Switzerland. The difference between the US and European countries is notable, albeit not surprising given the firearm ownership rate of 120.5 (per 100 citizens) in the US compared to 18.2 in the EU (Karp, 2018; Nicholls et al., 2019). Switzerland stands well above the European average with 27.6 civilian firearms per 100 residents.

It is intuitive to think that greater gun availability means a higher risk of suicide. Researchers have documented an abundance of evidence showing that more suicides occur in households, cities, states, and countries in which firearms are more available. Lester (1987) studied the relationship between gun availability and firearm suicide rates on the state level in the US and found a significant correlation between them. Miller et al. (2002) investigated the association between gun ownership and rates of suicide in the US between 1988-1997 and discovered a disproportionately higher rate of suicides in the states with higher firearm availability. Since those studies might suffer from endogeneity, more studies have been done to extrapolate the causal impact of the change in gun availability on the number of suicides. To identify the causal effect of gun availability on male suicides, Andrés and Hempstead (2011) examined the impact of firearm legislations between 1995-2004 on the number of male suicides in the US. Their results show that regulations that reduce the availability of firearms have lowered the number of suicides. Similarly, Kapusta et al. (2007) showed the deterrent effect of the adoption of the Austrian firearms law in 1997 on the number of suicides during the years following the reform.

However, the argument has not gone without dispute. The possibility of substitution from restricted to available means has been widely discussed and empirically investigated. Lester (1987) was aware of such a possibility as he addressed the higher rate of suicide using other means when firearms are less accessible. Nonetheless, he concluded that the substitution is far from complete. For instance, detoxification of domestic gas in the UK resulted in a decline in the overall number of suicides (Kreitman, 1976). Parallel to Lester’s (1987) conclusion, Miller et al. (2002) argued based on their evidence that incomplete substitution towards other means takes place when firearms become less available. In a detailed review study concerning the risk of substitution

between suicide methods, Daigle (2005) investigated many means restriction cases from all around the globe and concluded that little or no substitution took place between methods.

In correspondence with the common use of firearms in suicide attempts in Switzerland, firearms' excessive lethality in suicide attempts, and behavioral responses to the changes in firearm legislation, it is worth examining the impact of the Swiss Weapons Act that became effective in 1999 on the occurrence of suicides among the Swiss population from a public policy perspective. Reisch et al. (2013) have conducted a similar study to investigate the effect of "Army XXI" reform on the suicide rates in Switzerland. They use a natural experimental design to identify men between 18-43 as the affected (treatment) group, and women between 18-43 and men between 44-53 as the comparison groups. The study showed that the rate of firearm suicides and the number of all suicides fell after the reform. They estimate the rate of substitution from firearms to other means as 22%, which is consistent with the previous studies. Although the Weapons Act and Army XXI are similar reforms in the sense that they eventually reduce firearm availability, Army XXI mainly concerns the size of the army and army-related firearms whereas the Weapons Act affects the entire population in terms of firearm acquisition and possession.

IV. The 1999 Weapons Act

Prominent for its military custom, Switzerland has been a distinct country in Europe concerning the acquisition, possession, and use of firearms. Conscription is part of being a citizen of Switzerland for men. Alternatives are now provided, such as various civil services and financial compensation. Citizens can have their military guns back and store them at home by paying the required fee after their military services. Moreover, shooting contests are part of Swiss tradition, particularly with younger generations' participation. Hunting is another popular activity in the country that contributes to Swiss' above-average firearm ownership.

Although weapons have been playing an important role in Swiss culture, their regulation had been executed on a cantonal level until 1999, January 1st, when the first federal gun control law became effective. The purpose of the Federal law on weapons, weapon accessories, and ammunition is to combat the misuse and to regulate the acquisition, import, export, storage, carrying, and production of weapons, weapon accessories and ammunition. Military and police administrations remained unaffected by the law. The reform sets a standard definition of a firearm

and specifies conditional requirements regarding the possession and the usage of firearms. It also entails the requirement of a weapon acquisition license to purchase a weapon. According to Weapons Act, individuals with criminal records, mental illnesses, or any other condition that shows a clear element of risk must not be given the license.

There are two main avenues through which the Weapons Act reduces gun availability when potential suicide committers are experiencing the climax of their suicidal ideations. First, the person planning to commit suicide with a firearm must demonstrate capability and mental stability to buy the weapon. People who fail to meet these criteria cannot access firearms at the peak of their suicidal crises. Given the evidence showing the short duration of extreme mental fluctuations and little planning involved in the attempts, not being able to access firearms when impulsivity peaks will prevent potential suicides. Second, the person planning to commit suicide with a firearm should go through a procedure that takes time. While waiting for the procedures to be completed, suicidal ideation will fade away.

Moreover, in a population-based cohort study, Wintemute et al. (1999) showed that recent handgun purchasers are entitled to a significantly higher risk of suicide by a handgun. They found that the suicide rate among recent purchasers was 57 times higher than that among the general population. Although the study has a sample only drawn from California and therefore is not necessarily externally valid, the findings reinforce the connection between suicide and firearm acquisition.

Following the arguments that the evidence clearly supports, I expect the Weapons Act to have a deterrent effect on the number of firearm suicides, and overall suicides, unless there is complete method substitution which is unlikely. To isolate the impact of the Weapons Act on the suicidal attitude of the Swiss from the counterfactual scenario, I attempt to factor out the common trends in the population. I do this by investigating the change in the age distribution of suicide deaths following the Weapons Act. The identification strategy is based on the expectation that older cohorts are less affected by the reform because they were more likely to have already purchased firearms when the reform became effective. To illustrate this with a simple example, assume that the gun ownership rate is 50% among people older than 65 and 25% among people

younger than 65. Then, the reform would affect 50% of people older than 65 and 75% of people younger than 65 who do not already own a firearm.

Evidence from the United States confirms this assumption regarding the age distribution of firearm ownership. According to the National Firearms Survey, 27% of the people older than 65 own a gun whereas the rate is 16% for those between 18 and 25 (Hepburn et al., 2007). Regarding the rate of firearm availability, which is typically higher than the rate of ownership, 37.2% of the people older than 65 live in a household with at least one firearm. This is considerably lower for people younger than 30 with 25.8% (Smith, 2001).

Ultimately, I divide the people who died by suicide in Switzerland between 1995-2005 into age deciles to compare the cohorts' pre-reform and post-reform suicide numbers. If Weapons Act has reduced the number of firearm suicides, then the proportion of younger cohorts in all completed firearm suicides should decrease after the reform. In other words, firearm suicides by younger should decrease relatively more compared to older people. The absolute number of people who died by firearm suicide, or suicide by any method, could fall, rise, or stay the same depending on the national or global suicide trends. The exogenous variation caused by the reform is expected to have a differential effect with respect to age on the Swiss population.

V. Data and Method

Data

My primary data source is the cause of death registers from the Swiss Federal Statistical Office. The data is registered based on the ICD-10 coding system, the 10th version of the International Statistical Classification of Diseases and Related Health Problems used in reports and statistics for causes of death. It contains observations between 1995-2005 and includes four variables concerning method, gender, age, and year. I construct a categorization of methods used in completed suicides in such a way that some subcategories are merged into the main categories: firearms, drowning, hanging, jump, poisoning, vehicle, other, and unspecified. For instance, suicides listed as X81 (Intentional self-harm by jumping or lying before moving object) and X82 (Intentional self-harm by crashing of motor vehicle) are both under the category "vehicle". A more detailed breakdown of the specific causes of death and the corresponding methods in my

classification is in the Appendix. Switzerland has adopted ICD-10 at the beginning of 1995. There is a degree of inconsistency between the records before and after 1995 since the cause of death registers between 1980-1995 have been coded according to ICD-8. Hence, observations before 1995 were dropped to have a coherent dataset.

Empirical Method

Variations of difference-in-differences analysis will be performed. Since the entire population is expected to be affected by the reform, there is not a pure control group to provide a counterfactual for firearm suicides. However, as explained above, older cohorts are expected to be less affected than younger ones. I will compare pairs of age cohorts in combinations to extract the differential impact of the reform across cohorts. In each dual comparison, the younger cohort is expected to be affected more by the reform. Therefore, the older cohort and the younger cohort will be the control group and the treatment group in each comparison, respectively. The main specification to be estimated is:

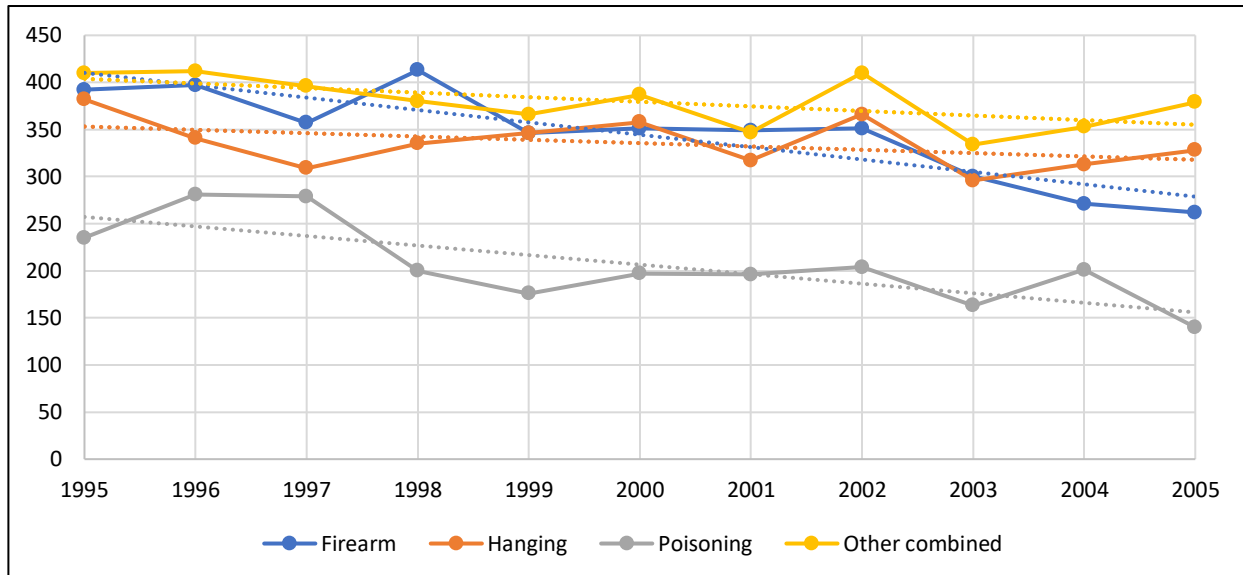
$$Firearm = \beta_0 + \beta_1 age_{ai} \cdot post_i + \gamma_t + \beta_2 age_{ai} + \varepsilon_i$$

where *Firearm* denotes the incidence rate of firearm suicides, $post_i$ is a dummy variable that takes the value of 1 if individual i committed suicide in the post-reform (1999-2005) period and 0 if the suicide completed in the pre-reform (1995-1998) period, age_a is a dummy variable equal to 1 if the person belongs to the a^{th} cohort, γ_t denotes the year fixed effects, and ε is the error term. The coefficient of interest is β_1 as it is the interaction term. Following that, I construct a differences-in difference matrix to present the differential impact of the Weapons Act on different age groups. According to the identifying assumption of this study, impact differentials are expected to be larger among the cohort pairs that have larger age gaps between each other. For instance, the comparison between the 8th cohort (the control group) and the 2nd cohort (the treatment group) will expose a larger difference than the comparison between the 4th cohort (the control group) and the 3rd cohort (the treatment group). While a cohort will be used as the control group when compared with a younger cohort, the same cohort will be used as the treatment group when compared with an older one.

Descriptive statistics

Figure 1.1 shows the number of suicides by different methods between 1995-2005 for men and women combined. In the beginning, firearms appear to be the most common method while accounting for more than a quarter of all completed suicides, closely followed by hanging. However, at the end of the observation period, more suicides were completed by hanging than by firearms. The total number of suicides, as well as the number of suicides by each method displayed on the figure, exhibit a decreasing trend during the observation period, as shown by the trendlines. Also, the trendlines in Figure 1.1 point to a sharper decrease for firearm suicides and suicides by poisoning than for suicides by hanging and other methods combined.

Figure 1.1: Evolution of suicides by most common methods

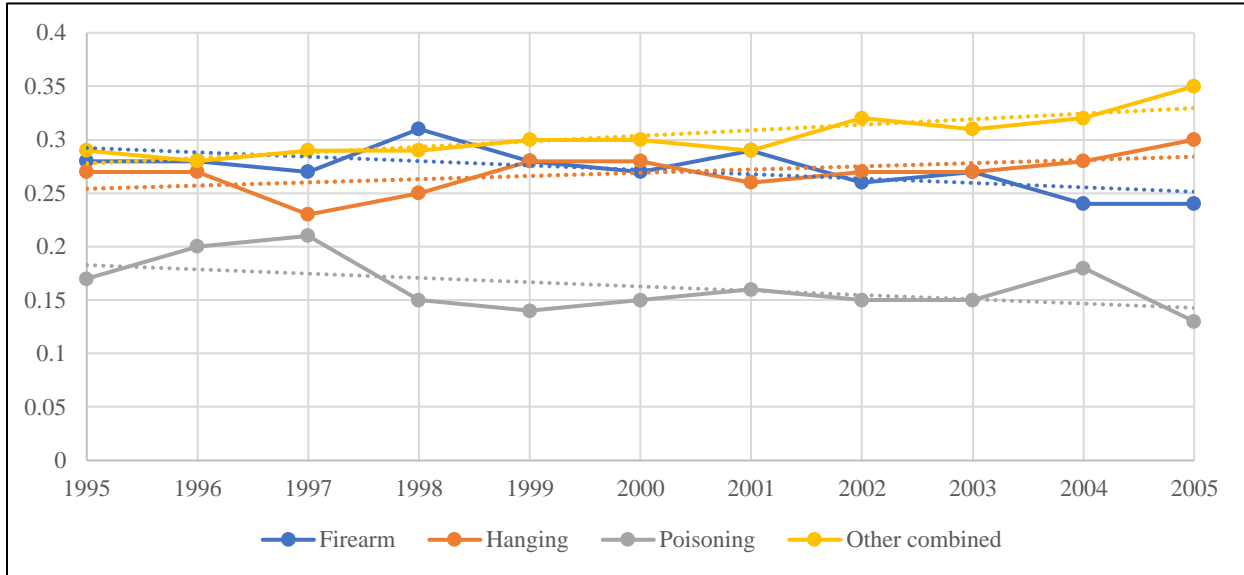


Notes: Yearly number of suicides by the most common methods shown in the figure. The markers connected through the solid lines represent the number of suicides completed through the corresponding method and the dotted lines represent the trendlines that best fit the data points. “Other combined” includes the suicides completed through drowning, jumping, vehicle crash, other methods, and the suicides that remain unspecified. Table 5.1 in the Appendix includes more detailed information regarding the evolution of suicides.

Figure 1.2 presents the proportion of the most common methods among all suicides committed in that year from 1995 to 2005. An advantage of Figure 1.2 is that it factors out the yearly changes in the total number of suicides since it concerns proportions. Clearly, firearms and poisoning have become less popular methods for committing suicide, whereas suicides by hanging have increased gained popularity. On aggregate, other methods have also become more popular. The reader can refer to the Appendix to see the breakdown of “other combined” as it contains

suicides completed through drowning, jumping, vehicle crash, other, and the suicides that remained unspecified.

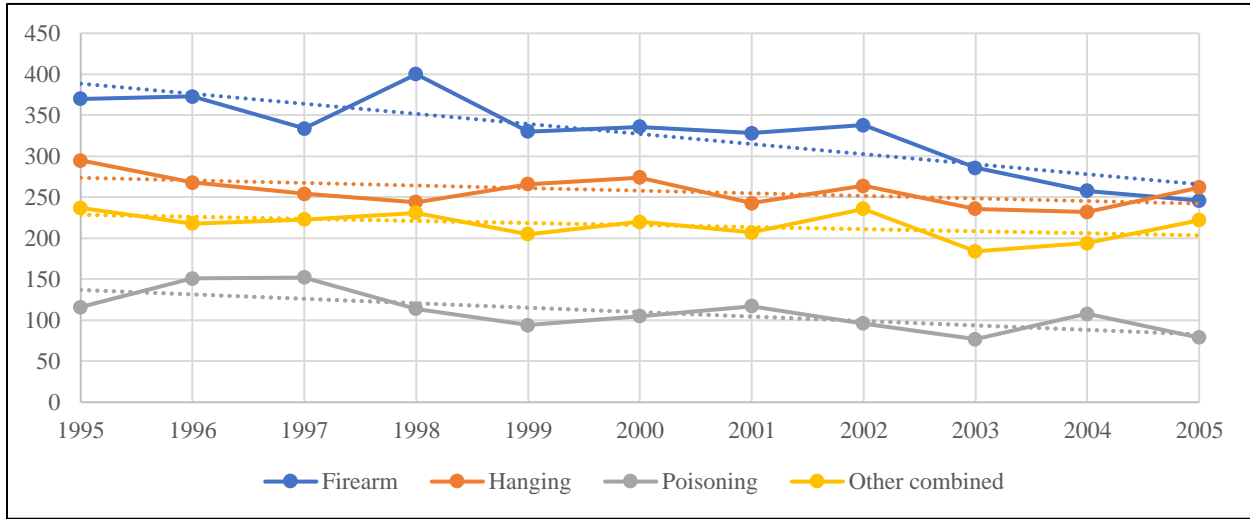
Figure 1.2: Evolution of suicides by most common methods in proportion



Notes: Proportion of suicides completed through each of the common methods to all suicides completed in that year shown in the figure. The markers connected through the solid lines represent the proportion of suicides completed by the corresponding method across all suicides and the dotted lines represent the trendlines that best fit the data points. “Other combined” includes the suicides completed through drowning, jumping, vehicle crash, other methods, and the suicides that remain unspecified. Table 5.1 in the Appendix includes more detailed information regarding the evolution of suicides.

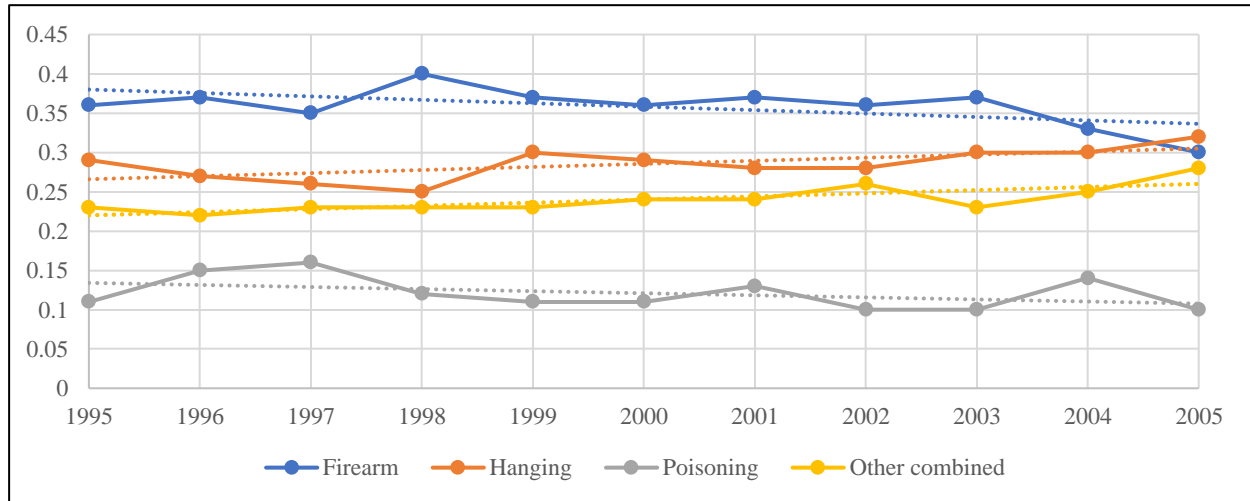
Figure 2.1 shows the yearly evolution of completed suicides by males. Apparently, men committed the vast majority (72%) of suicides. Similar to all (men and women) suicides shown in the previous figure, a decreasing trend is evident regarding the suicides completed by men between 1995 and 2005. Men have a stricter preference to use firearms when committing suicide as they account for 95% of all firearm suicides. Again, towards the end of the observation period, firearms have lost popularity to some extent, and hanging has become the most common method of suicide.

Figure 2.1: Evolution of male suicides by most common methods



Notes: Yearly number of male suicides by the most common methods shown in the figure. The markers connected through the solid lines represent the number of suicides completed through the corresponding method and the dotted lines represent the trendlines that best fit the data points. “Other combined” includes the suicides completed through drowning, jumping, vehicle crash, other methods, and the suicides that remain unspecified. Table 5.2 in the Appendix includes more detailed information regarding the evolution of male suicides.

Figure 2.2: Evolution of male suicides by most common methods in proportion



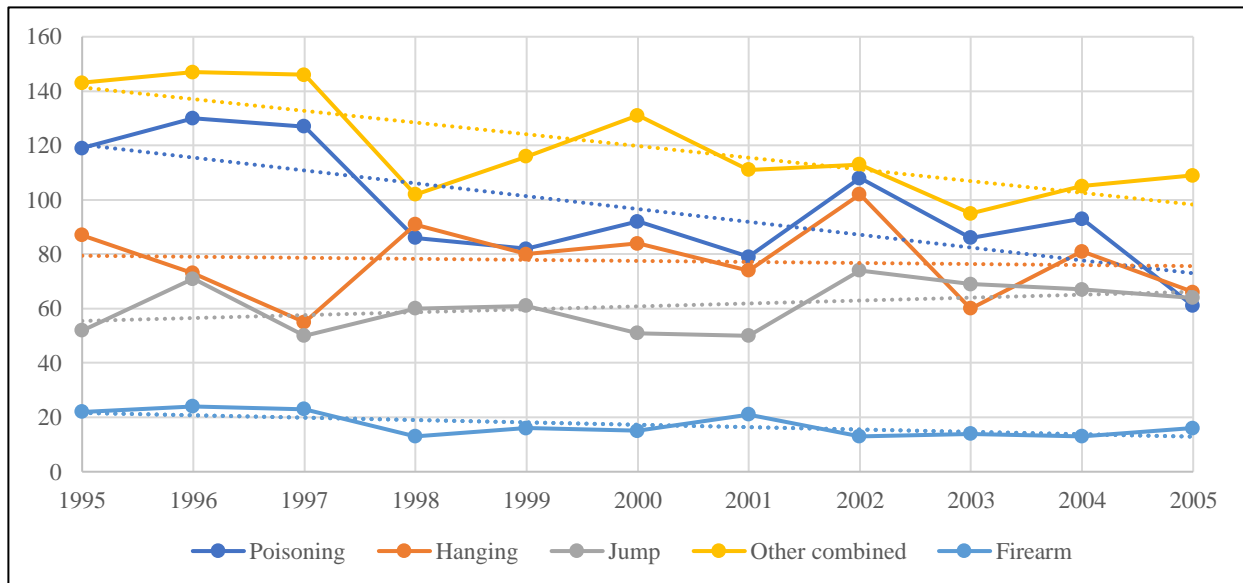
Notes: Proportion of male suicides completed through each of the common methods to all suicides completed in that year shown in the figure. The markers connected through the solid lines represent the proportion of suicides completed by the corresponding method across all suicides and the dotted lines represent the trendlines that best fit the data points. “Other combined” includes the suicides completed through drowning, jumping, vehicle crash, other methods, and the suicides that remain unspecified. Table 5.2 in the Appendix includes more detailed information regarding the evolution of male suicides.

Figure 2.2 presents the evolution of male suicides by different methods in proportion to all completed suicides. Rates of firearm suicides and suicides by poisoning experienced a decrease throughout the period. When the change in the total number of suicides is factored out, the trendline

points to a 4 percent decrease in the proportion of firearm suicides in all completed suicides, from 38% in 1995 to 34% in 2005.

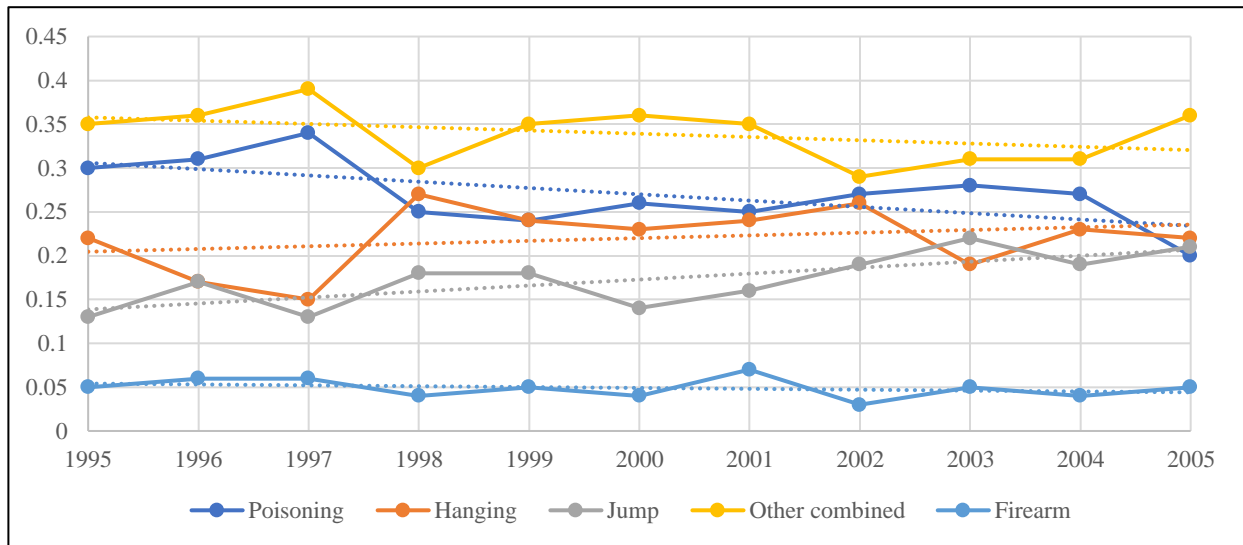
Figures 3.1 and 3.2 are replications of Figures 2.1 and 2.2, respectively, concerning females only. First, the total number of suicides displays a decreasing trend during the period. Second, there are considerable differences between the preferences of women and men. Women used firearms only in 5% of the completed suicides as opposed to 36% for men. The most preferred method is poisoning, 27 percent, followed by hanging with 22 percent and jumping with 17 percent. The number of female suicides by each method exhibits significantly more year-to-year variance, except for firearms. While the number of suicides by jumping has increased over the observation period, it has fallen for every other most common method. Compared to 1995, poisoning has become less popular, hanging and jumping have become more popular, and the use of firearms has more or less stayed the same in 2005.

Figure 3.1: Evolution of female suicides by most common methods



Notes: Yearly number of female suicides by the most common methods shown in the figure. The markers connected through the solid lines represent the number of suicides completed through the corresponding method and the dotted lines represent the trendlines that best fit the data points. “Other combined” includes the suicides completed through drowning, vehicle crash, other methods, and the suicides that remain unspecified. Table 5.3 in the Appendix includes more detailed information regarding the evolution of female suicides.

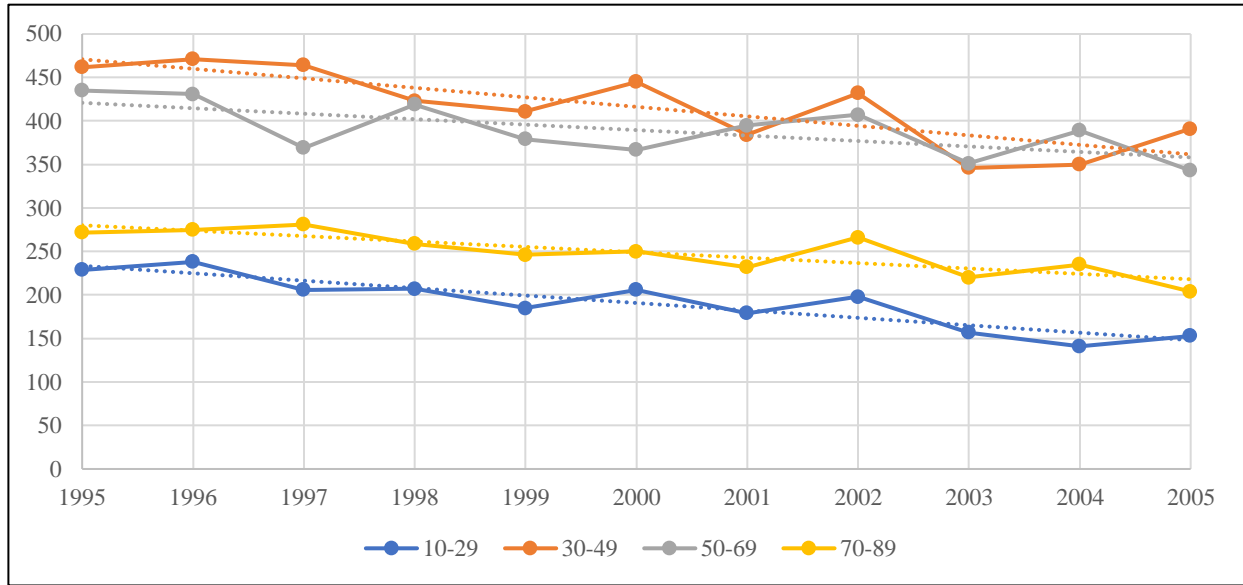
Figure 3.2: Evolution of female suicides by most common methods in proportion



Notes: Proportion of female suicides completed through each of the common methods to all suicides completed in that year shown in the figure. The markers connected through the solid lines represent the proportion of suicides completed by the corresponding method across all suicides and the dotted lines represent the trendlines that best fit the data points. “Other combined” includes the suicides completed through drowning, vehicle crash, other methods, and the suicides that remain unspecified. Table 5.3 in the Appendix includes more detailed information regarding the evolution of female suicides.

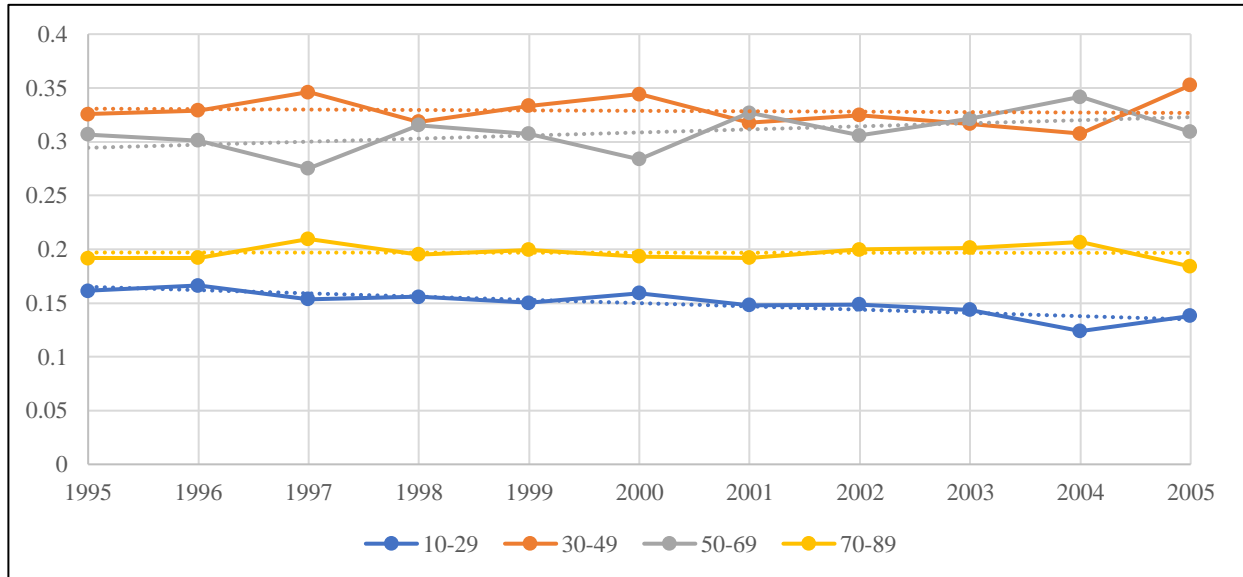
Figure 4.1 presents the yearly evolution of the number of completed suicides by age groups and Figure 4.2 shows the rate of suicides completed by that age group among all suicides completed in that year, both with trendlines. First, the total number of suicides is decreasing for each age group during the period. Second, people aged between 30 and 49 have completed the highest number of suicides, slightly higher than people in their fifties and sixties. These two groups together are responsible for nearly two-thirds of all completed suicides between 1995 and 2005. According to Figure 4.2, the youngest age group has become relatively less likely to commit suicide, whereas the group between 50 and 69 has become more likely to do so. The other two groups, 30-49 and 70-89, have virtually stayed the same over ten years. Lastly, observations with ages higher than 90 are excluded from the figure as the number of such observations is too few. The reader can find tables with more detailed age breakdowns and observations with suicides completed by people aged ninety or older in the Appendix.

Figure 4.1: Evolution of suicides by age groups



Notes: Yearly number of suicides completed by each age group shown in the figure. The markers connected through the solid lines represent the number of suicides completed by the corresponding age group and the dotted lines represent the trendlines that best fit the data points.

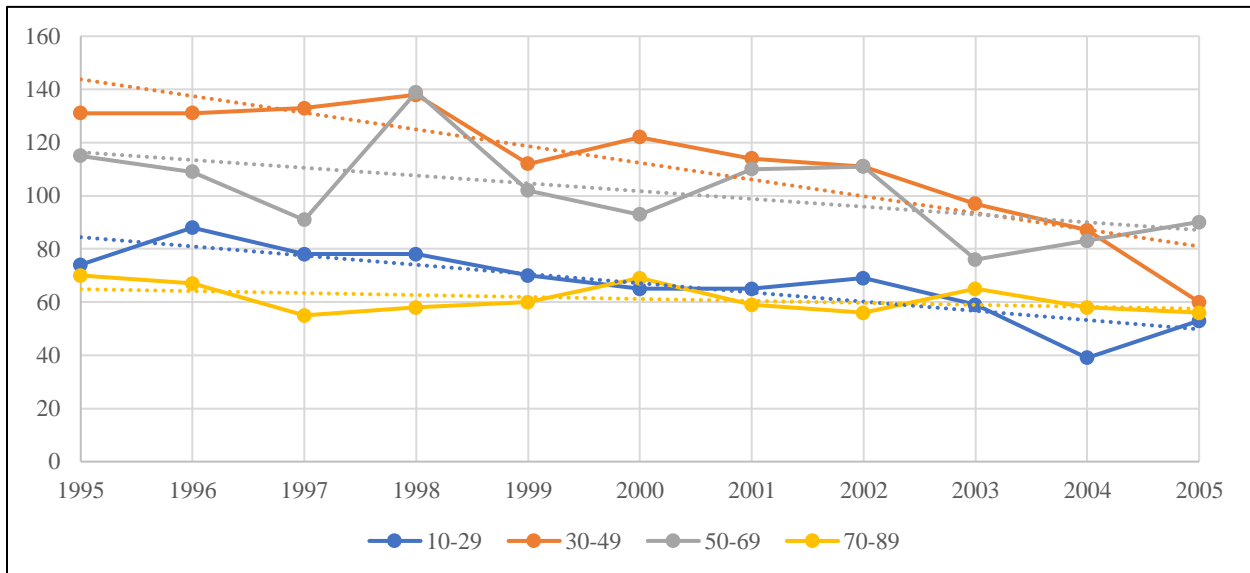
Figure 4.2: Evolution of suicides by age groups in proportion



Notes: Proportion of suicides completed by each age group across all suicides completed in the year shown in the figure. The markers connected through the solid lines represent the proportion of suicides completed by the corresponding age group and the dotted lines represent the trendlines that best fit the data points.

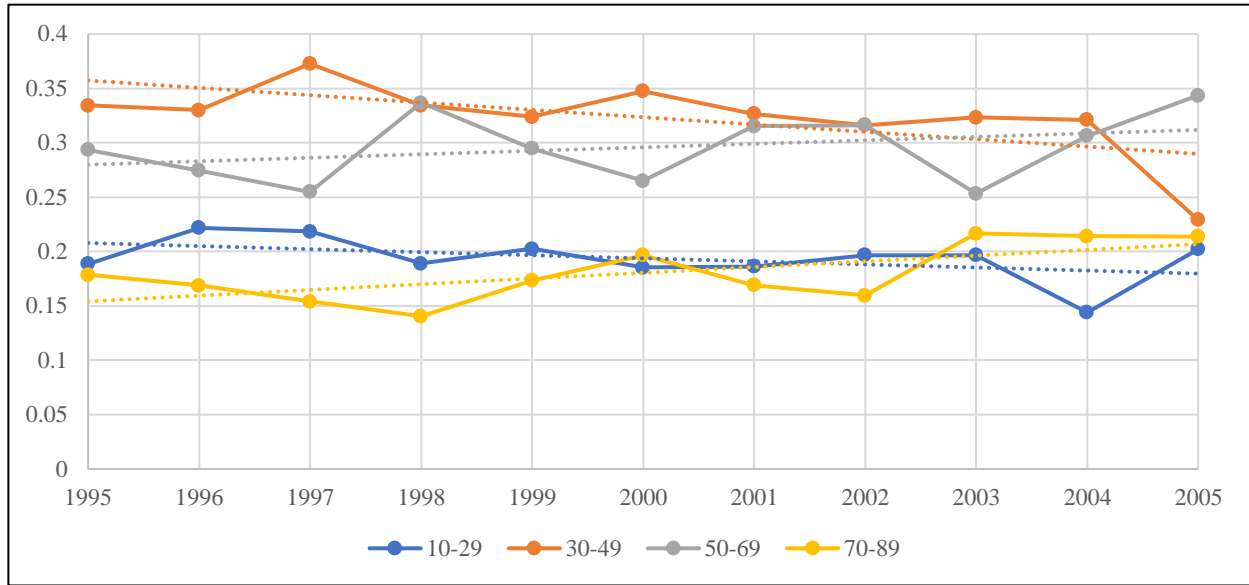
Figures 5.1 and 5.2 replicate the previous figures while concerning firearm suicides only. The distribution of firearm suicides across the age groups I have constructed is similar to that of all suicides. The number of firearm suicides is declining for each age group during the observation period. Also, slopes of the trendlines show that the decline in firearm suicides is excessive of the decline in all suicides as the number of firearm suicides has trendlines decreasing more sharply. Figure 5.2 alone shows that the two younger age groups have become relatively less prone to commit firearm suicides while their older counterparts have been accounting for a higher share of completed firearm suicides towards the end of the observation period. This is exactly what is expected from my identification as younger people committed fewer firearm suicides after the reform relative to the older ones.

Figure 5.1: Evolution of firearm suicides by age groups



Notes: Yearly number of firearm suicides completed by each age group shown in the figure. The markers connected through the solid lines represent the number of firearm suicides completed by the corresponding age group and the dotted lines represent the trendlines that best fit the data points.

Figure 5.2: Evolution of firearm suicides by age groups in proportion



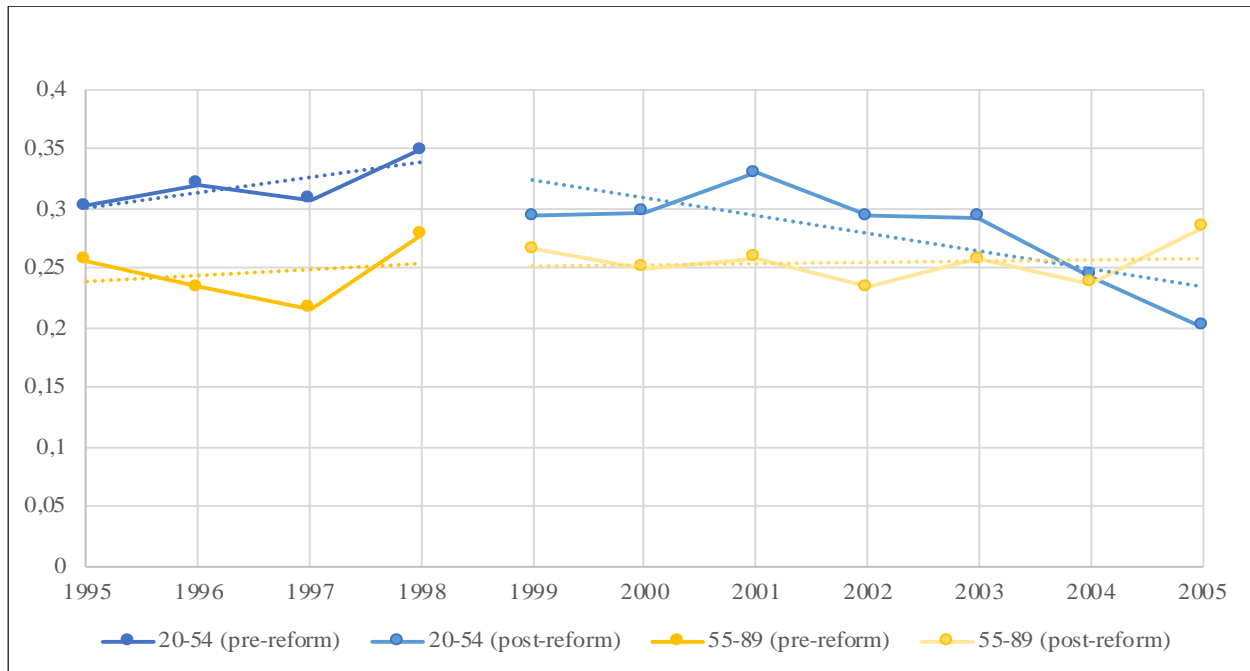
Notes: Proportion of firearm suicides completed by each age group across all firearm suicides completed in the year shown in the figure. The markers connected through the solid lines represent the proportion of firearm suicides completed by the corresponding age group and the dotted lines represent the trendlines that best fit the data points.

The presented descriptive statistics support the assertions of this study. First, there has been a decrease in people's tendency to commit firearm suicides above and beyond the decreasing trend in all completed suicides. Second, the proportion of younger people that committed suicide using a firearm among all age groups has fallen during the same period. This is in line with my hypothesis that the younger cohorts have been more affected by the reform. Nevertheless, these figures and what they express are not enough to uncover a causal relationship between the implementation of the Weapons Act and the number of firearm suicides for two main reasons. First, I do not yet emphasize the implementation of the Weapons Act to make a comparison between the pre-reform and the post-reform levels. Second, the age groups I constructed are rather rudimentary, making it less plausible to run the investigation based on my identification with respect to age. I attempt to eliminate these limitations and focus on statistically expressive analyses in the next section.

VI. Main results

First, I divide the sample -excluding the 1st and the 9th cohorts- into two age groups, the 20-54 and the 55-89. Then, I construct a scatter plot to show how the proportion of firearm suicides evolves differently after the reform for each age group. Apparently, in Figure 6, there is an upward sloping trend for the 20-54 group in the pre-reform period, replaced by a downward sloping trend following the reform. For the older group, there is a slightly increasing trend that barely changes after the reform. This implies that their tendency to commit firearm suicides almost did not change. At the end of the observation period, in 2005, the proportion of firearm suicides finally becomes lower for the 20-54 group than the 50-89 group. However, one should understand that this is a crude comparison containing two aggregated age groups as opposed to my main identification strategy that includes cohorts divided by ten-year intervals. Hence, Figure 6 alone is not powerful evidence that the Weapons Act has been effective in preventing firearm suicides.

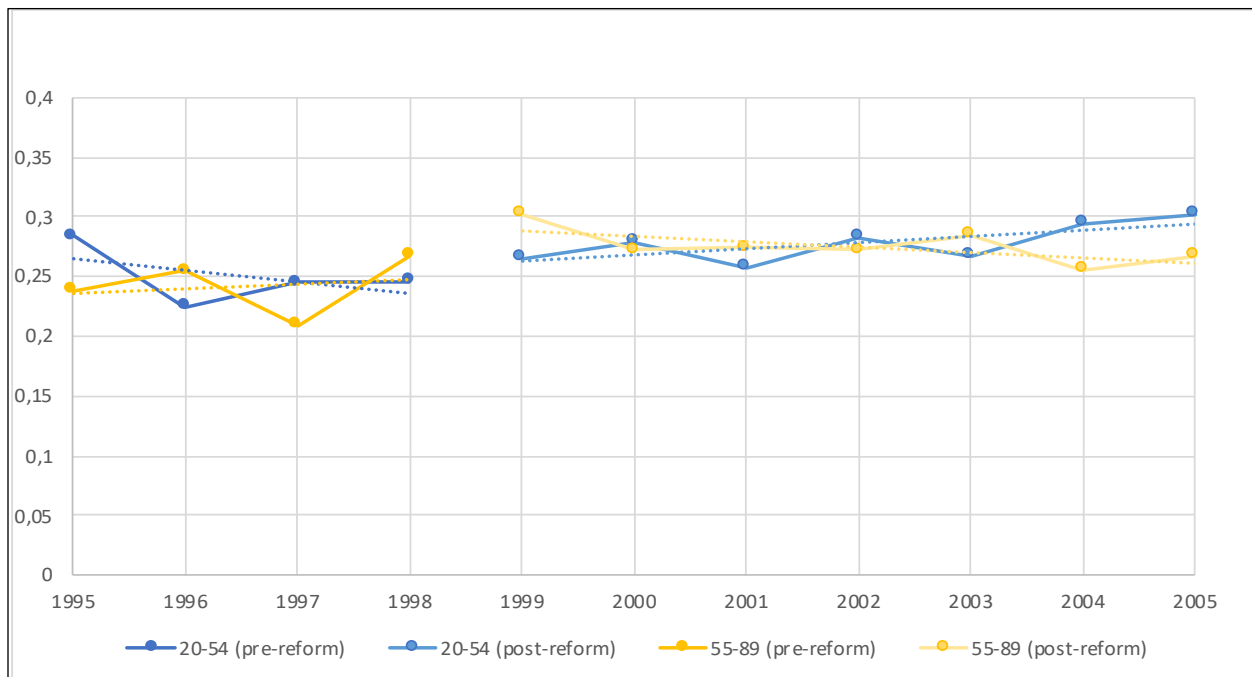
Figure 6: Proportion of firearm suicides before and after the reform for each group with linear trends



Notes: Proportion of firearm suicides in all suicides before and after the reform for two age groups shown in the figure. The markers connected through the solid lines represent the proportion of firearm suicides completed by the corresponding age group and the dotted lines represent the trendlines that best fit the data points.

Next, I construct two more scatter plots to replicate Figure 6 with the other most common suicide methods to see whether they expose an identifiable pattern. Figure 7 shows the evolution of suicides by hanging, whereas Figure 8 concerns the suicides by poisoning while replicating Figure 6 regarding age and year. As seen in Figure 7, the two age groups intersect many times before and after the reform, not displaying a consistent pattern. This is also reflected by the trendlines, as they are all nearly horizontal. Also, the difference between the values for the age groups is rather small in each year. Thus, Figure 7 does not reveal a notable difference for suicides by hanging between the pre-reform and the post-reform periods.

Figure 7: Proportion of suicides by hanging before and after the reform for each group with linear trends

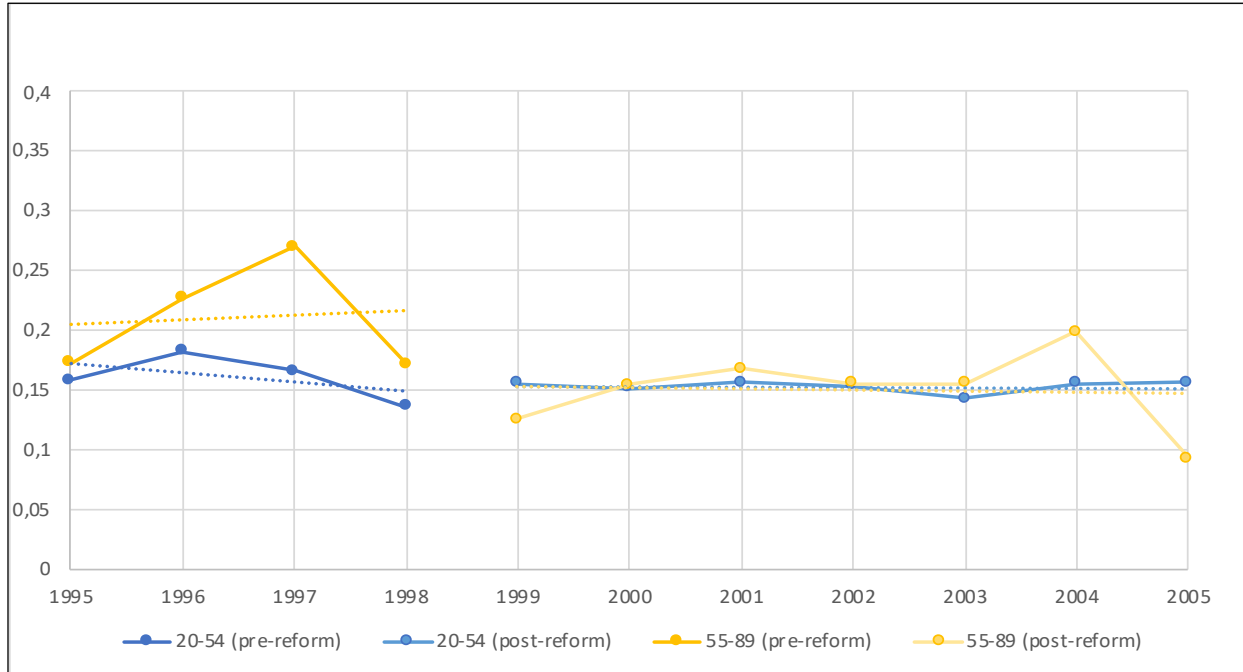


Notes: Proportion of suicides completed through hanging in all suicides before and after the reform for two age groups shown in the figure. The markers connected through the solid lines represent the proportion of suicides through hanging completed by the corresponding age group and the dotted lines represent the trendlines that best fit the data points.

All four trendlines in Figure 8 are also almost horizontal, and the two post-reform trendlines are nearly identical for the two age groups. There are again many intersection points between the age groups in the post-reform period. There is hardly any distinguishable trend change in the proportion of suicides by poisoning following the reform. Figure 7 and Figure 8 together show that the trend changes in the proportion of firearm suicides are non-trivial. The concerns regarding Figure 6 being a crude comparison apply to Figure 7 and Figure 8. Hence, the analysis

will continue in a more detailed manner regarding the construction of the age groups and statistical significance.

Figure 8: Proportion of suicides by poisoning before and after the reform for each group with linear trends



Notes: Proportion of suicides completed through poisoning in all suicides before and after the reform for two age groups shown in the figure. The markers connected through the solid lines represent the proportion of suicides through poisoning completed by the corresponding age group and the dotted lines represent the trendlines that best fit the data points.

In order to have a closer look at the change in firearm suicides, I construct Table 1.1. It presents the average number of firearm suicides before and after the reform for each cohort. The columns represent the age groups from the 2nd to the 8th decile, whereas the rows represent the pre-reform and post-reform periods and the change in the number of firearm suicides averaged over each period. The results largely confirm our expectation that the younger cohorts would respond more to the deterrent effect of the Weapons Act. Only the oldest age group experienced a tiny increase in the number of firearm suicides after the reform. The pattern among the six age deciles fairly coincides with what is expected, except the 6th decile that has been subject to a relatively large decrease statistically significant at 5%.

Table 1.1: Number of firearm suicides before and after the reform

	20-29	30-39	40-49	50-59	60-69	70-79	80-89
1995-1998	69.75	67.25	66	65.5	48	39.25	23.25
1999-2005	50.86	46.57	53.86	61	34	37	23.43
Difference	-18.89** (0.006)	-20.68** (0.011)	-12.14* (0.075)	-4.5 (0.552)	-14** (0.044)	-2.25 (0.601)	0.18 (0.937)

Notes: The number of firearm suicides completed by each age deciles averaged separately over the pre-reform (1995-1998) and the post-reform (1999-2005) periods shown in the table. The values for “Difference” show the change in the yearly average number of firearm suicides based on the pre-reform levels. The first, the ninth, and the tenth deciles are excluded from the table because of having very low number of observations.

P-values for the mean differences given in parentheses.

*Statistically significant at 10%

**Statistically significant at 5%

An important limitation of Table 1.1 is that it only focuses on the number of suicides while not controlling for the total number of suicides in the subsample. Hence, the change in the number of firearm suicides could either be part of a change in the overall suicide trend, or a movement independent of the overall number of suicides. Table 1.2 compares the proportion of firearm suicides in all completed suicides before and after the reform for each age group. Hence, each value in Table 1.2 is calculated by dividing the corresponding value from Table 1.1 by the total number of suicides in that year among that cohort.

The largest and the only statistically significant (at 10%) mean difference is among people in their 80s, and the change is positive, meaning that the 8th decile experienced an increase in the proportion of firearm suicides compared to all suicides. The 7th cohort also experienced an increase in their tendency to commit firearm suicides, but the rate of change is low. All age groups other than the 7th and the 8th deciles have become less inclined towards suicide using a firearm after the treatment. The largest negative change is among the 3rd decile, although my identification expects a larger change for the youngest cohort which only experienced a tiny decrease.

After all, findings from Table 1.1 and Table 1.2 show that all age groups except the 8th had lower numbers of firearm suicides after the reform. Possibly, the number of firearm suicides

committed by the people in the 8th decile would have increased even more in the absence of the Weapons Act. Also, all age groups except the oldest two committed fewer firearm suicides in proportion after the reform. The pattern points to a differential impact decreasing with age except for the 2nd (smaller than expected) and the 6th (larger than expected) cohorts.

Table 1.2: Rate of firearm usage in all completed suicides before and after the reform

	20-29	30-39	40-49	50-59	60-69	70-79	80-89
1995-1998	0.394	0.313	0.276	0.284	0.262	0.253	0.201
1999-2005	0.384	0.265	0.247	0.264	0.232	0.263	0.249
Difference	-0.010 (0.726)	-0.048 (0.149)	-0.029 (0.340)	-0.020 (0.426)	-0.031 (0.415)	0.010 (0.715)	0.049* (0.095)

Notes: The proportion of firearm suicides completed by each age decile in all completed suicides averaged separately over the pre-reform (1995-1998) and the post-reform (1999-2005) periods shown in the table. The values for “Difference” show the change in the yearly average proportion of firearm suicides based on the pre-reform levels. The first, the ninth, and the tenth deciles are excluded from the table because of having very low number of observations.

P-values for the mean differences given in parentheses.

*Statistically significant at 10%

**Statistically significant at 5%

Regression results from the main difference-in-differences specification with yearly fixed effects for each comparison pair are presented in Table 2. The dependent variable is a dummy that equals 1 if the observation includes a firearm suicide and 0 otherwise. I excluded comparisons that contain consecutive cohorts from the analysis to eliminate trivial results since consecutive cohorts only have a small age difference. Also, gender is controlled for through a dummy variable. Alternatively, I control for the first and the second polynomials for the variable age to see if they provide better fitting results. The results from those specifications are nearly the same as the results in Table 2. Hence, I do not report them separately. Each point in the 5x5 matrix represents a comparison of two cohorts where the rows correspond to treatment groups and the columns to control groups. Hence, one would expect to see negative coefficient estimates for each point on the table according to my hypothesis. Negative coefficients imply that the deterrent effect of the Weapons Act on firearm suicides is relatively larger among the younger age group.

Except for four specifications between the 2nd and 5th, 2nd and 6th, 2nd and 7th, and 4th and 6th cohorts, every other specification produced negative coefficients. The null hypothesis that the reform has an impact of equal magnitude on the two age groups is rejected for three groups at 5% and for the other two groups at 10% significance levels. Four of those significant coefficients include the 8th age decile and one includes the 7th age decile as the control group. The interpretation of the coefficients is that belonging to the a^{th} age decile (2nd to 6th, represented by the rows) after the Weapons Act entails a relatively larger risk of dying by suicide using a firearm by β_1 , hence, a negative coefficient implies a smaller risk. The biggest impact differential, observed between the 3rd and the 8th age deciles, is around 0.08, which is the difference between the pre-reform and post-reform differences in the proportion of firearm suicides for the 3rd and the 8th cohorts.

Table 2: Firearm suicides: results from 15 specifications using different cohort pairs

	40-49	50-59	60-69	70-79	80-89
20-29	0.0101 (0.0283)	0.0168 (0.0284)	0.0165 (0.0303)	-0.0113 (0.0312)	-0.0432 (0.0342)
30-39	-	-0.0214 (0.0259)	-0.0201 (0.0277)	-0.0516* (0.0286)	-0.0811** (0.0314)
40-49	-	-	0.0023 (0.0264)	-0.0219 (0.0273)	-0.0544* (0.0301)
50-59	-	-	-	-0.0305 (0.0274)	-0.0607** (0.0302)
60-69	-	-	-	-	-0.0613** (0.0311)

Notes: Coefficient estimates from difference-in-differences specifications using yearly fixed effects for combinations of age groups shown in the table. The age groups in the first column are the treatment group and the age groups in the first row are the control group in each dual comparison. A negative coefficient indicates a relatively larger reduction in the firearm suicides committed by the treatment group following the reform.

Standard errors given in parentheses.

*Statistically significant at 10%

**Statistically significant at 5%

Table 3.1 reproduces Table 1.1 where suicides by hanging, the other most common method, is the variable of interest instead of firearm suicides. There is no obvious pattern that can describe the findings in Table 3.1. A decrease significant at 10%, and an increase significant at 5% are observed among the 2nd and the 5th cohorts, respectively. The 4th, the 6th, the 7th, and the 8th cohorts have been subject to little or no change since 1999. Among the youngest, nine fewer suicides have been completed by hanging on average each year after the reform.

Since Table 3.1 has similar limitations to Table 1.1, the proportion of suicides by hanging for each age group is shown in Table 3.2. All cohorts have either experienced an increase or virtually no change in the proportion of suicides by hanging following the reform. The 6th cohort has gone through the largest increase with 0.06. The rate of change is 25% while statistically significant at 5%. The 5th and the 8th cohorts have also experienced large increases while the difference is statistically significant only for the 5th cohort. One could observe a somewhat vague pattern that the difference increases as we move from younger to older groups, apart from the 7th and the 8th deciles. This pattern is suspicious as the Weapons Act is not directly linked to the suicides by hanging other than method substitution and spillovers. What I mean by spillovers is increases in the proportions of other methods because of the decrease in the proportion of firearm suicides, as the proportion of all methods must sum up to unity for each cohort. In other words, when the rate of firearm suicides falls for a specific cohort following the reform, the rate of suicides by all other methods combined must increase by the same amount. However, the pattern observed in the proportion of suicides by hanging contradicts this logic. Several deciles have experienced increases in the proportion of suicides by hanging larger than or equal to the decreases in the proportion of firearm suicides. The spillovers should be smaller than the actual change in the firearm suicides as they are diffused across the methods, which is not the case here.

Table 3.1: Number of suicides by hanging before and after the reform

	20-29	30-39	40-49	50-59	60-69	70-79	80-89
1995-1998	39	54.75	66	59	43.5	36.5	26
1999-2005	30	47.43	66.71	69.86	43.29	34.29	26
Difference	-9.00* (0.067)	-7.32 (0.25)	0.71 (0.93)	10.86** (0.041)	-0.21 (0.964)	-2.21 (0.274)	0 (1)

Notes: The number of suicides by hanging completed by each age deciles averaged separately over the pre-reform (1995-1998) and the post-reform (1999-2005) periods shown in the table. The values for “Difference” show the change in the yearly average number of suicides by hanging based on the pre-reform levels. The first, the ninth and the tenth deciles are excluded from the table because of having very low number of observations. P-values for the mean differences given in parentheses.

*Statistically significant at 10%

**Statistically significant at 5%

Table 3.2: Rate of suicides by hanging in all completed suicides before and after the reform

	20-29	30-39	40-49	50-59	60-69	70-79	80-89
1995-1998	0.219	0.254	0.276	0.257	0.237	0.235	0.226
1999-2005	0.218	0.270	0.302	0.305	0.296	0.244	0.274
Difference	0.000 (0.958)	0.016 (0.464)	0.026 (0.302)	0.049** (0.034)	0.060** (0.046)	0.009 (0.485)	0.049 (0.125)

Notes: The proportion of suicides through hanging completed by each age decile in all completed suicides averaged separately over the pre-reform (1995-1998) and the post-reform (1999-2005) periods shown in the table. The values for “Difference” show the change in the yearly average proportion of suicides through hanging based on the pre-reform levels. The first, the ninth, and the tenth deciles are excluded from the table because of having very low number of observations.

P-values for the mean differences given in parentheses.

*Statistically significant at 10%

**Statistically significant at 5%

A similar logic applies to method substitution. The increases in the rate of suicides by hanging cannot be explained by incomplete method substitution since it should also be diffused

across the other methods. This, too, is a controversial finding since significant changes occurred in suicides by hanging even though there has not been a policy change -to my knowledge- that would have a relevant direct impact.

I construct Table 4 presenting the coefficient estimates from a regression similar to the main specification to investigate suicides by hanging have changed after the policy change. In this difference-in-differences design, the dependent variable is again a binary variable, equal to 1 if the suicide is completed by hanging and 0 if by other means. Same as Table 2, the specification controls for gender and yearly fixed effects. Only 4 of the 15 comparisons produced positive coefficients. In 11 of the 15 comparisons, the younger cohorts have become less prone to complete suicide by hanging relative to the older cohorts following the reform. However, only one of these comparisons, the one between the 2nd and the 6th deciles, has produced a statistically significant difference at 5%. The magnitude of coefficients does not point to a certain pattern when changing the age difference between groups. A notable difference between the two specifications -from Table 2 and Table 4- is that the R^2 produced by the regressions concerning firearm suicides ranges between 0.0844 - 0.1307 whereas the regressions concerning suicides by hanging produced R^2 values between 0.0012 - 0.0113. This means that the Weapons Act explains a much larger part of the variance in firearm suicides than that in suicides by hanging. Hence, although Table 3.1 and Table 3.2 produced suspicious results that partly conflict with my main findings presented in Table 2, regression results from Table 4 show that the evidence is not sufficient to invalidate those findings.

Overall, the results provide suggestive evidence that the Weapons Act had a deterrent effect on firearm suicides. Changes observed among firearm suicides after the reform are larger and more significant. The differential impact concerning firearm suicides with respect to age is consistent with my identification strategy and visible in each part of the empirical analysis. Regression results regarding firearm suicides are also statistically more significant than the results from suicides by hanging.

Table 4: Suicides by hanging: results from 15 specifications using different cohort pairs

	40-49	50-59	60-69	70-79	80-89
20-29	-0.0299 (0.0283)	-0.0454 (0.0283)	-0.0613** (0.0298)	-0.0078 (0.0301)	-0.0476 (0.0331)
30-39	-	-0.0295 (0.0271)	-0.0471 (0.0291)	0.0091 (0.0295)	-0.0315 (0.0328)
40-49	-	-	-0.0293 (0.0285)	0.0226 (0.0291)	-0.0178 (0.0327)
50-59	-	-	-	0.0389 (0.0291)	-0.0010 (0.0326)
60-69	-	-	-	-	0.0161 (0.0334)

Notes: Coefficient estimates from difference-in-differences specifications using yearly fixed effects for combinations of age groups shown in the table. The age groups in the first column are the treatment group and the age groups in the first row are the control group in each dual comparison. A negative coefficient indicates a relatively larger reduction in the suicides by hanging committed by the treatment group following the reform.

Standard errors given in parentheses.

*Statistically significant at 10%

**Statistically significant at 5%

VII. Conclusions and Discussion

A policy change in Switzerland to regulate the acquisition and possession of firearms creates a natural experiment to analyze the impact of a means reduction case on the evolution of firearm suicides. Previous studies have well documented the positive relationship between gun availability and firearm suicides. Miller et al. (2002) and Lester (1987) showed the correlation between the availability of firearms and suicides in the United States. Regarding the causal link between suicide and gun availability, Andrés and Hempstead (2011) and Kapusta et al. (2007) have documented that the restrictive legislations have lowered the number of suicides. Reisch et al. (2013) studied the impact of Army XXI on firearm suicides by dividing the population into the treatment (men between 18-43) and control (women between 18-43 and men between 44-53)

groups. I applied a similar strategy but in a more detailed manner, aiming to expose a clearer causal impact, as well as to compensate for the lack of depth in my data. My identification strategy is that older people would respond less to the reform since a higher proportion of them had already owned a gun. Although there is no available data for firearm ownership by age in Switzerland - to my knowledge-, evidence from the United States support the argument that older people are more likely to own a gun and live in a household with a gun (Hepburn et al., 2007; Smith, 2001). Therefore, my two main contributions are, first, analyzing the impact of the Weapons Act as a policy change that provides a case for means reduction, and second, forming a spectrum when assigning the treatment and the control groups rather than having a binary division.

What I find out is, first, a general declining trend in the number of suicides for each method between 1995-2005. Second, there is a declining trend in the number of firearm suicides above and beyond the general suicide trend. Third, younger cohorts mostly experienced relatively larger reductions regarding both firearm and non-firearm suicides compared to the older cohorts, albeit with some exceptions. Fourth, the evolution of firearm suicides after the reform by age groups is not accompanied by another identifiable pattern among other common suicide methods. Fifth, difference-in-differences comparisons produced statistically more significant coefficients and explained a greater part of the variations in the dependent variable.

However, some controversial findings lead to suspicions about the validity of this study. First, in the main specification, 4 out of 15 comparisons produced positive coefficients, indicating that the younger age groups became relatively more prone to committing firearm suicides than the older counterparts in those comparisons. Second, some older cohorts have experienced fairly large and statistically significant increases in suicides by hanging after the reform, although there was not a relevant policy change in the timeline that would have such an impact.

In the light of this empirical investigation, it is indeed evident that firearm suicides have been reduced following the implementation of the Weapons Act. Most of the evidence supports the causal link between the Weapons Act and the decrease in the number of firearm suicides. However, although the observed pattern is mainly in line with my a priori expectations, there are also conflicting elements as explained. Hence, the proposed identification strategy is perhaps not strong enough to expose the true causal impact of the reform. Two main limitations may potentially

have obscured my empirical analysis. First, the dataset that I could access only included four variables: method, gender, age, and year. This made it impossible to include covariates such as marital status, employment status, history of suicide attempt, etc., in the regressions. Hence, the explanatory power of my model remains limited, which also explains the considerably low R^2 values. Second, the pre-reform period includes only four years of observations, which is less than desired. The reason is that the cause of death registers before 1995 were coded according to the ICD-8 system. A longer observation period would have increased the reliability of the pre-reform trends, which is important in difference-in-differences designs.

The natural experiment caused by the Weapons Act is crucially important from a public policy perspective because randomized controlled trials are ethically controversial when it comes to investigating the phenomenon of suicide. That is why, even though the primary intention of the reform was neither means reduction nor suicide prevention by any means, the findings from this study can help policymakers understand the potential effectiveness of future policies that aim to reduce the availability of suicide methods.

One major concern regarding the implementation of suicide prevention strategies is using the scarce resources for people who decided to take their own lives that can be otherwise allocated to other public health issues. It is difficult to make a fully objective statement whether it is justifiable to spend public resources to nudge people to stay alive especially when such efforts are in vain. Nonetheless, first, the evidence mostly shows that the Weapons Act actually had a deterrent effect on the number of firearm suicides and saved many lives. Second, given the impulsive nature of many suicide attempts, and the short duration of the desire to commit suicide in many cases, such nudging is not necessarily paternalistic and therefore is likely justifiable.

VIII. References

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IX. Appendix

Table 5: Methods listed and their corresponding ICD-10 descriptions

Method	Subcategories
Poisoning	<p>X60: Intentional self-poisoning by and exposure to nonopioid analgesics, antipyretics and antirheumatics</p> <p>X61: Intentional self-poisoning by and exposure to antiepileptic, sedative-hypnotic, antiparkinsonism and psychotropic drugs, not elsewhere classified</p> <p>X62: Intentional self-poisoning by and exposure to narcotics and psychodysleptics [hallucinogens], not elsewhere classified</p> <p>X63: Intentional self-poisoning by and exposure to other drugs acting on the autonomic nervous system</p> <p>X64: Intentional self-poisoning by and exposure to other and unspecified drugs, medicaments, and biological substances</p> <p>X65: Intentional self-poisoning by and exposure to alcohol</p> <p>X66: Intentional self-poisoning by and exposure to organic solvents and halogenated hydrocarbons and their vapours</p> <p>X67: Intentional self-poisoning by and exposure to carbon monoxide and other gases and vapours</p> <p>X68: Intentional self-poisoning by and exposure to pesticides</p> <p>X69: Intentional self-poisoning by and exposure to other and unspecified chemicals and noxious substances</p>
Hanging	<p>X70: Intentional self-harm by hanging, strangulation, and suffocation</p>
Drowning	<p>X71: Intentional self-harm by drowning and submersion</p>

Firearms	<p>X72: Intentional self-harm by handgun discharge</p> <p>X73: Intentional self-harm by rifle, shotgun, and larger firearm discharge</p> <p>X74: Intentional self-harm by other and unspecified firearm discharge</p>
Jump	<p>X80: Intentional self-harm by jumping from a high place</p>
Vehicle	<p>X81: Intentional self-harm by jumping or lying before moving object</p> <p>X82: Intentional self-harm by crashing of motor vehicle</p>
Other	<p>X75: Intentional self-harm by explosive material</p> <p>X76: Intentional self-harm by smoke, fire, and flames</p> <p>X77: Intentional self-harm by steam, hot vapours and hot objects</p> <p>X78: Intentional self-harm by sharp object</p> <p>X79: Intentional self-harm by blunt object</p> <p>X83: Intentional self-harm by other specified means</p>
Unspecified	<p>X84: Intentional self-harm by unspecified means</p>

Notes: The left-hand side shows the methods used in the analysis based on my categorization according to ICD-10 whereas the right-hand side shows the detailed breakdown of the specific causes of death included in each category. Those descriptions are retrieved from the International Statistical Classification of Diseases and Related Health Problems 10th Revision.

Table 6.1: Methods used in completed suicides between 1995-2005

Year	Firearm	Drowning	Hanging	Jump	Poisoning	Vehicle	Other	Unspecified	Total
1995	392 (0.28)	99 (0.07)	382 (0.27)	128 (0.09)	235 (0.17)	131 (0.09)	43 (0.03)	9	1,419
1996	397 (0.28)	91 (0.06)	341 (0.27)	152 (0.11)	281 (0.20)	108 (0.07)	46 (0.03)	15	1,431
1997	357 (0.27)	99 (0.07)	309 (0.23)	127 (0.09)	279 (0.21)	103 (0.08)	40 (0.03)	27	1,341
1998	413 (0.31)	68 (0.05)	335 (0.25)	143 (0.11)	200 (0.15)	105 (0.08)	40 (0.03)	24	1,328
1999	346 (0.28)	83 (0.07)	346 (0.28)	126 (0.10)	176 (0.14)	99 (0.08)	35 (0.03)	23	1,234
2000	351 (0.27)	86 (0.07)	358 (0.28)	131 (0.10)	197 (0.15)	107 (0.08)	39 (0.03)	24	1,293
2001	349 (0.29)	76 (0.06)	317 (0.26)	142 (0.12)	196 (0.16)	84 (0.07)	36 (0.03)	9	1,209
2002	351 (0.26)	78 (0.06)	366 (0.27)	167 (0.13)	204 (0.15)	103 (0.08)	36 (0.03)	26	1,331
2003	300 (0.27)	44 (0.04)	296 (0.27)	148 (0.14)	163 (0.15)	88 (0.08)	33 (0.03)	21	1,093
2004	271 (0.24)	64 (0.06)	313 (0.28)	145 (0.13)	201 (0.18)	87 (0.08)	37 (0.03)	20	1,138
2005	262 (0.24)	67 (0.06)	328 (0.30)	154 (0.14)	140 (0.13)	86 (0.08)	48 (0.04)	24	1,109
Total	3,789 (0.27)	855 (0.06)	3,691 (0.27)	1,563 (0.11)	2,272 (0.16)	1,101 (0.08)	433 (0.03)	222 (0.02)	13,926

Notes: Number of suicides completed through each method by the entire population of Switzerland is given in the table. Proportion of suicides by the corresponding method among all suicides are given in the parentheses. The proportions given in the last row are the mean proportions for the respective method over the observation period.

Table 6.2: Methods used in completed suicides between 1995-2005 for men

Year	Firearm	Drowning	Hanging	Jump	Poisoning	Vehicle	Other	Unspecified	Total
1995	370 (0.36)	44 (0.04)	295 (0.29)	76 (0.07)	116 (0.11)	87 (0.09)	27 (0.03)	3	1,018
1996	373 (0.37)	39 (0.04)	268 (0.27)	81 (0.08)	151 (0.15)	59 (0.06)	31 (0.03)	8	1,010
1997	334 (0.35)	42 (0.04)	254 (0.26)	77 (0.08)	152 (0.16)	71 (0.07)	17 (0.02)	16	963
1998	400 (0.4)	31 (0.03)	244 (0.25)	83 (0.08)	114 (0.12)	70 (0.07)	30 (0.03)	17	989
1999	330 (0.37)	36 (0.04)	266 (0.3)	65 (0.07)	94 (0.11)	63 (0.07)	24 (0.03)	17	895
2000	336 (0.36)	31 (0.03)	274 (0.29)	80 (0.09)	105 (0.11)	63 (0.07)	29 (0.03)	17	935
2001	328 (0.37)	33 (0.04)	243 (0.28)	92 (0.10)	117 (0.13)	53 (0.06)	24 (0.03)	5	895
2002	338 (0.36)	34 (0.04)	264 (0.28)	93 (0.10)	96 (0.10)	61 (0.07)	28 (0.03)	20	934
2003	286 (0.37)	16 (0.02)	236 (0.30)	79 (0.10)	77 (0.10)	57 (0.07)	17 (0.02)	15	783
2004	258 (0.33)	22 (0.03)	232 (0.30)	78 (0.10)	108 (0.14)	54 (0.07)	29 (0.04)	11	792
2005	246 (0.30)	29 (0.04)	262 (0.32)	90 (0.11)	79 (0.10)	49 (0.06)	40 (0.05)	14	809
Total	3,599 (0.36)	357 (0.04)	2,838 (0.28)	894 (0.09)	1,209 (0.12)	687 (0.07)	296 (0.03)	143 (0.01)	10,023

Notes: Number of suicides completed through each method by the males in Switzerland is given in the table. Proportion of suicides by the corresponding method among all suicides are given in the parentheses. The proportions given in the last row are the mean proportions for the respective method over the observation period.

Table 6.3: Methods used in completed suicides between 1995-2005 for women

Year	Firearm	Drowning	Hanging	Jump	Poisoning	Vehicle	Other	Unspecified	Total
1995	22 (0.05)	55 (0.14)	87 (0.22)	52 (0.13)	119 (0.30)	44 (0.11)	16 (0.04)	6	401
1996	24 (0.06)	52 (0.12)	73 (0.17)	71 (0.17)	130 (0.31)	49 (0.12)	15 (0.04)	7	421
1997	23 (0.06)	57 (0.16)	55 (0.15)	50 (0.13)	127 (0.34)	32 (0.08)	23 (0.06)	11	378
1998	13 (0.04)	37 (0.11)	91 (0.27)	60 (0.18)	86 (0.25)	35 (0.10)	10 (0.03)	7	339
1999	16 (0.05)	47 (0.14)	80 (0.24)	61 (0.18)	82 (0.24)	36 (0.11)	11 (0.03)	6	339
2000	15 (0.04)	55 (0.15)	84 (0.23)	51 (0.14)	92 (0.26)	44 (0.12)	10 (0.03)	7	358
2001	21 (0.07)	43 (0.14)	74 (0.24)	50 (0.16)	79 (0.25)	31 (0.10)	12 (0.03)	4	314
2002	13 (0.03)	44 (0.11)	102 (0.26)	74 (0.19)	108 (0.27)	42 (0.11)	8 (0.02)	6	397
2003	14 (0.05)	28 (0.09)	60 (0.19)	69 (0.22)	86 (0.28)	31 (0.10)	16 (0.05)	6	310
2004	13 (0.04)	42 (0.12)	81 (0.23)	67 (0.19)	93 (0.27)	33 (0.10)	8 (0.02)	9	346
2005	16 (0.05)	38 (0.13)	66 (0.22)	64 (0.21)	61 (0.20)	37 (0.12)	8 (0.03)	10	300
Total	190 (0.05)	498 (0.13)	853 (0.22)	669 (0.17)	1,063 (0.27)	414 (0.11)	137 (0.04)	79 (0.02)	3,903

Notes: Number of suicides completed through each method by the females in Switzerland is given in the table. Proportion of suicides by the corresponding method among all suicides are given in the parentheses. The proportions given in the last row are the mean proportions for the respective method over the observation period.

Table 7.1: Age distribution of completed suicides between 1995-2005

Year	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	Total
1995	48 (0.034)	181 (0.128)	218 (0.154)	244 (0.172)	227 (0.160)	208 (0.147)	159 (0.112)	113 (0.080)	21 (0.015)	1,419
1996	41 (0.029)	197 (0.138)	221 (0.154)	250 (0.175)	235 (0.164)	196 (0.137)	155 (0.108)	120 (0.084)	16 (0.011)	1,431
1997	44 (0.033)	162 (0.121)	222 (0.166)	242 (0.180)	210 (0.157)	159 (0.119)	155 (0.116)	126 (0.094)	21 (0.016)	1,341
1998	39 (0.029)	168 (0.127)	201 (0.151)	222 (0.167)	247 (0.186)	172 (0.130)	151 (0.114)	108 (0.081)	20 (0.015)	1,328
1999	42 (0.034)	143 (0.116)	182 (0.148)	229 (0.186)	224 (0.182)	155 (0.126)	149 (0.121)	97 (0.079)	12 (0.010)	1,233
2000	40 (0.031)	166 (0.128)	213 (0.165)	232 (0.179)	224 (0.173)	143 (0.111)	150 (0.116)	100 (0.077)	25 (0.019)	1,293
2001	51 (0.042)	128 (0.106)	171 (0.141)	213 (0.176)	243 (0.201)	152 (0.126)	132 (0.109)	100 (0.083)	19 (0.016)	1,209
2002	29 (0.022)	169 (0.127)	195 (0.147)	237 (0.178)	248 (0.186)	159 (0.119)	149 (0.112)	117 (0.088)	28 (0.021)	1,331
2003	42 (0.038)	115 (0.105)	164 (0.150)	182 (0.167)	225 (0.206)	126 (0.115)	139 (0.127)	81 (0.074)	19 (0.017)	1,093
2004	30 (0.026)	111 (0.098)	145 (0.127)	205 (0.180)	242 (0.213)	147 (0.129)	139 (0.122)	96 (0.084)	23 (0.020)	1,138
2005	31 (0.028)	122 (0.110)	154 (0.139)	237 (0.214)	202 (0.182)	141 (0.127)	128 (0.115)	76 (0.069)	18 (0.016)	1,109
Total	437 (0.031)	1,662 (0.119)	2,086 (0.150)	2,493 (0.179)	2,527 (0.181)	1,758 (0.126)	1,606 (0.115)	1,134 (0.081)	222 (0.016)	13,925

Notes: Number of suicides completed by each age decile is given in the table. Proportion of suicides by the corresponding cohort among all suicides are given in the parentheses. The proportions given in the last row are the mean proportions by the respective cohort over the observation period. One observation with age higher than 100 is excluded.

Table 7.2: Age distribution of completed firearm suicides between 1995-2005

Year	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	Total
1995	9 (0.023)	65 (0.166)	58 (0.148)	73 (0.186)	62 (0.158)	53 (0.135)	43 (0.110)	27 (0.069)	2 (0.005)	392
1996	7 (0.018)	81 (0.204)	65 (0.164)	66 (0.166)	66 (0.166)	43 (0.108)	43 (0.108)	24 (0.060)	2 (0.005)	397
1997	14 (0.039)	64 (0.179)	74 (0.207)	59 (0.165)	55 (0.154)	36 (0.101)	35 (0.098)	20 (0.056)	0 (0.000)	357
1998	9 (0.022)	69 (0.167)	72 (0.174)	66 (0.160)	79 (0.191)	60 (0.145)	36 (0.087)	22 (0.053)	0 (0.000)	413
1999	11 (0.032)	59 (0.171)	51 (0.147)	61 (0.176)	58 (0.168)	44 (0.127)	36 (0.104)	24 (0.069)	2 (0.006)	346
2000	8 (0.023)	57 (0.162)	53 (0.151)	69 (0.197)	68 (0.194)	25 (0.071)	49 (0.140)	20 (0.057)	2 (0.006)	351
2001	9 (0.026)	56 (0.160)	52 (0.149)	62 (0.178)	78 (0.223)	32 (0.092)	35 (0.100)	24 (0.069)	1 (0.003)	349
2002	6 (0.017)	63 (0.179)	60 (0.171)	51 (0.145)	73 (0.208)	38 (0.108)	33 (0.094)	23 (0.066)	4 (0.011)	351
2003	11 (0.037)	48 (0.160)	45 (0.150)	52 (0.173)	53 (0.177)	23 (0.077)	45 (0.150)	20 (0.067)	3 (0.010)	300

2004	6 (0.022)	33 (0.122)	41 (0.151)	46 (0.170)	53 (0.196)	30 (0.111)	27 (0.100)	31 (0.114)	4 (0.015)	271
2005	3 (0.011)	50 (0.191)	24 (0.092)	36 (0.137)	44 (0.168)	46 (0.176)	34 (0.130)	22 (0.084)	3 (0.011)	262
Total	93 (0.025)	645 (0.170)	595 (0.157)	641 (0.169)	689 (0.182)	430 (0.113)	416 (0.110)	257 (0.068)	23 (0.006)	3,789

Number of firearm suicides completed by each age decile is given in the table. Proportion of suicides by the corresponding cohort among all suicides are given in the parentheses. The proportions given in the last row are the mean proportions by the respective cohort over the observation period.