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Three essays on the evaluation of public policies in the field of addictions

Elisa Benedetti

Supervisor: Paolo Brunori
PhD Pogram Coordinator: Ugo Pagano

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Abstract

This dissertation, composed of three essays, aims at providing an evaluation of selected public policies in the field of addictions, focusing on drugs and gambling. Evaluation is increasingly recognised as essential for effective policymaking, helping to empirically verify that policies and programmes have the desired effect, provide value for money and do not have negative unintended consequences. In the case of socially undesirable behaviours, policy evaluation is frequently challenged by the limited data available.

To tackle this challenge, the analyses proposed in the present work make use of novel datasets which combine epidemiological, financial, political and administrative data.

On the one hand, addictive behaviours constitute an enormous source of revenue for organized crime and for national governments, in the case of legal substances or behaviours such as gambling. On the other hand, they represent a cost for public authorities, e.g., for public health and law enforcement reasons. For these reasons, over the years several policy approaches have been implemented to contrast the externalities produced by the spread of addictive behaviours, however very limited work has been performed to evaluate their effects.

The present dissertation aims at contributing to the literature seeking to provide evidence on the possible intended and unintended effects of public policies on addictions, focusing on selected policies aimed at regulating cannabis consumption and gambling.

The first chapter is aimed at analysing the effects that the drug policy reforms implemented in Europe in the last 15 years had on youth cannabis consumption behaviours. In fact, cannabis is the most used illicit drug and accounts for the largest share of the European illicit drug market. To tackle this longstanding problem, a broad set of reforms to national cannabis control policies have been implemented, but their effectiveness in achieving the desired results is still unclear. This essay analyses the association between selected categories of cannabis policy reforms and changes in cannabis availability and use

among adolescents. Data from 20 European countries across 15 years were drawn from a novel database of the European school Survey Project on Alcohol and other Drugs. The influence of policy changes on reported access to cannabis and different frequencies of use was estimated through an identification strategy based on a Differences-in-Differences model, which application is allowed by the fact that only thirteen out of the twenty countries included in the analysis implemented relevant reforms. The findings suggest that selected categories of reforms influence the availability and prevalence of cannabis among adolescents. In particular, some forms of restrictive interventions reduce the general prevalence of use and more liberal reforms seem to cause an increase in the share of students approaching cannabis. However, none of the analysed reforms seems to have been able to influence the consumption habits of frequent users.

The second chapter deepens the analysis of the effects of drug policy changes by focusing of the reform that in the period 2006-2014 criminalised the possession of cannabis for personal use in Italy. The chapter addresses a key question in the ongoing policy debate over cannabis' legal status as to whether removing or increasing penalties attached to cannabis use and possession leads not only to changes in the proportion of cannabis users, but also to changes in the dynamics of cannabis use. Empirically investigating this aspect is a growing field of study. This paper aims at extending previous research by studying the effect of increasing penalties on initiation into cannabis use. This is done in the Italian context where, despite the relevant drug policy reforms implemented over the last 30 years, very little econometric studies have been performed to evaluate their effects. In order to identify the effect of criminalisation on the transition into cannabis use, the paper exploits the policy change that in the period from 2006 to 2014 increased the penalties attached to cannabis possession in Italy. For this, a unique dataset pooling seven waves (2001-2017) of the Italian Population Survey on Alcohol and other Drugs (IPSAD) is used. The empirical investigation is based on a Complementary Log-Log regression model to analyse the starting rate, that is, the transition rate from non-use to use. The results suggest that the introduction of higher punishments for cannabis possession has a significant, although limited, effect in reducing the uptake of cannabis. However the research highlights that this relative achievement need to be evaluated against the backdrop of the social consequences of criminalisation.

The third chapter is aimed at assessing the market effects of limiting the supply of gambling products. This is done by exploiting the effects of the local policies that imposed restrictions on the supply of offline entertainment machines implemented in the years 2017-2018 by some municipalities in one of the Northern regions of Italy. The market effects of reducing the allowed functioning time of offline entertainment machines are assessed both on the level of the gross gambling turnover and on its composition in terms

of possible shifts towards online gambling products. Although the policy should have applied to the entire regional territory, some municipalities did not approve the necessary implementing acts, whilst others imposed functioning time restrictions with varying level of intensity. This variation is exploited using a regression-based Differences-in-Differences (DiD) design with continuous treatment with a unique dataset recording yearly gambling turnover by type of game in the years 2016, 2017, and 2018 matched with data on municipal acts collected for the study and socio-demographic variables. The results suggest that the implemented policies actually reduced the gambling consumption through offline entertainment machines. However, no significant reduction of the total gambling consumption was observed. In fact, focusing on the composition of gambling turnover there is evidence of a shift toward online gambling products. These results support the argument that limiting the physical availability of entertainment machines is an effective policy for reducing the amount of resources invested by consumers in this type of game. At the same time attention should be paid to the possible unintended effects on the shift towards other gambling products, which by definition cannot be subject to similar restrictions.

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Chapter 1

The impact of cannabis policy changes on cannabis use among adolescents: evidence from Europe

Abstract

Cannabis is the most used illicit drug and accounts for the largest share of the illicit drug market. To tackle this longstanding problem, a broad set of reforms to national cannabis control policies have been implemented in Europe, but their effectiveness in achieving the desired results is still unclear. This paper analyses the association between selected categories of cannabis policy reforms and changes in cannabis availability and use among adolescents. Data from 20 European countries across 15 years were drawn from a novel database of the European school Survey Project on Alcohol and other Drugs. We estimate the influence of policy changes on reported access to cannabis and different frequencies of use. Our identification strategy is based on a Difference-in-Differences (DiD) design, which application is allowed by the fact that only thirteen out of the twenty countries included implemented relevant reforms. Our results suggest that selected categories of reforms influence the availability and prevalence of cannabis among adolescents. In particular, some forms of restrictive intervention reduce the general prevalence of use and more liberal reforms seem to cause an increase in the share of students approaching cannabis. However, none of them seems able to influence the consumption habits of frequent users.

Keywords: cannabis use and availability; drug policy; adolescents; ESPAD; policy impact; Differences-in-Differences.

JEL Codes: C21, I12, I18, K42

1.1 Introduction

Cannabis policy is a topic of constant discussion and changes worldwide. This is because, notwithstanding the coordinated efforts to disrupt cannabis market, both supply and consumption indicators have constantly increased over the past decades (UNODC, 2017). Since 2012, some jurisdictions in United States, Uruguay, and more recently Canada, have legalised the production, distribution, and sale of cannabis for non-medical purposes. In Europe, a renewed debate about reforms to the national policies limiting access and restricting the use of cannabis has developed (Rogeberg et al., 2018; EMCDDA, 2017a). In fact, although there is some European Union regulation concerning cannabis trafficking offences, legislative responses to unauthorised cannabis use and minor possession are still primarily responsibility of individual member states and therefore little harmonised (Edwards & Galla, 2014; Boekhout van Solinge, 2002). Although draft laws for cannabis legalisation have been proposed in some national parliaments, to date no government has expressed support for this idea, but several countries have implemented policy reforms modifying the size of the penalties for trafficking and use-related offence (EMCDDA, 2017a). Focusing on the latter, despite a general trend to reduce punishments, few countries moved in the opposite direction. This results in a variety of policy approaches running in parallel in Europe, which range from administrative to criminal offences (Hughes et al., 2018), with the notable exception of the Netherlands where a system of limited distribution has evolved since the 1970s. Furthermore, some countries legally treat cannabis like other drugs, whilst in others penalties for cannabis are lower, typically because the level of harm that the use of the drug may cause is taken into consideration (Pacula et al., 2005).

Despite the foregoing heated debate around the legal treatment of cannabis possession, it is surprising to note that empirical research on the effects of the different types of control policies is still limited (Pacula et al., 2014). Most of the existing literature has tried to test the hypothesis based on the theory of crime developed by Becker (1968), that higher penalties for drug possession would discourage cannabis use by making the lifetime cost associated to a possible punishment higher than the expected benefits of drug use. Gathering scientific evidence firstly on whether and which type of cannabis policy reforms are able to affect the availability of the substance and the prevalence of use, and secondly by which type of users and by how much seems crucial in order to support the design of effective policies (Williams and Bretteville-Jensen, 2014).

In recent years increasing attention has been devoted to the effects that depenalisation of cannabis possession for personal use might have on the consumption behaviour of young people (Anderson and Rees, 2014; Pacula et al., 2014). This is because, cannabis is by far the most popular illicit substance among youth, particularly in Europe, where adolescents show higher prevalence of cannabis use compared to the adult population (EMCDDA, 2017b). Furthermore, research

shows that initiation into cannabis use typically occurs during the mid to late teens (van Ours, 2006; Williams & Bretteville-Jensen, 2014) and that there is a strong positive relationship between early first use and the length and intensity of cannabis consumption during adulthood (Pudney, 2004; Etilé, 2006; van Ours and Williams, 2007). Since those who initiate cannabis use early are more likely to continue using the drug later in life (van Ours and Williams, 2007), gathering evidence on possible effects of cannabis policies on today's adolescent consumption, may provide useful insights into the long-term effects of policy reforms on consumption among the general population. Despite the fact that policies ruling cannabis-related offences are primarily targeted at adults, an adolescent deciding whether to use cannabis for the first time is likely to be sensitive to its criminal status (Williams and Bretteville-Jensen, 2014). It is also presumable that, by contributing to shape the background drug culture of a society, drug policies may indirectly influence adolescent cannabis use (Pudney, 2010).

The available literature analysing the possible effects of drug policies on youth participation in cannabis use has provided mixed evidence and mainly focused on a single type of policy, i.e. decriminalisation (Pacula, 2010). Some works did not find significant effects (Thies and Register, 1993; Pacula, 1998; DiNardo and Lemieux, 2001; Williams, 2004; Anderson et al., 2012; Williams and Bretteville-Jensen, 2014), whilst some others did find that youth demand for cannabis is significantly related to its legal status (Pacula et al. 2003), and that depenalisation significantly increases it (Model, 1993; Saffer and Chaloupka, 1999; Damrongplasit et al., 2010). However, the possible effects seem more evident on the extensive margins (decision whether or not to use cannabis), rather than on the intensive margins (how frequently cannabis is used).

Some studies went further, analysing the differential impact that cannabis policies might have on different consumption behaviours. Overall, the evidence found suggest that where an effect has been found it has been more likely observed on extensive margins (decision whether or not to use cannabis), rather than on the intensive margins (how frequently cannabis is consumed by those who are already users) (Thies and Register, 1993; Pacula, 1998; Chaloupka, Grossman and Tauras, 1999; Farrelly et al., 2001; Hall and Pacula, 2003; Williams, 2004).

All the aforementioned studies are based on data sources from the United States and Australia, whilst to the best of our knowledge due to the lack of comparable data very little work has been performed in Europe, and mainly focused on a single country perspective (Reinarman et al., 2004; Reinarman, 2009; Simon-Morton, 2010; Shi et al., 2015; Ceverny et al., 2017).

Despite the scarcity of previous studies, Europe constitutes an interesting case for conducting this type of research, particularly because the cannabis law reforms passed over the last 20 years in many countries generated significant variations in the intensity and trajectory of policy changes (towards a decrease or decrease of penalties), which offer and optimal ground for research (EMCDDA, 2011 and

2017a).

In this light, the first aim of this study aims is to contribute to address the lack of an European perspective on the links between drug law reforms and the perceived easy access to cannabis, used as a proxy of availability, and patterns of use of this substance among adolescent students in Europe.

we have the unique opportunity to base our analysis on comparable data from the European school Survey Project on Alcohol and other Drugs (ESPAD), collected with a standardised methodology from nationally representative samples of 16 years-old students in 20 European countries, covering a period of more than 15 years (1999-2015).

The second aim is to be able to distinguish in this analysis different types of users. In fact, as in the case of adults, also when focusing on teenagers, it is important to acknowledge the fact that cannabis market is segmented into a number of different types of consumers and that the same policy might have differential or null effect on them (Pacula, 2010). In order to do this, we first explore the link between the various policy changes and the prevalence of use (measured as any use in the last year) and then we deepen the analysis by focusing on three types of adolescents consumers based on different thresholds of frequency of use: experimental use (only once or twice in a year), non-frequent use (use in the year but less than 20 times per month) and frequent use (daily or almost daily cannabis use, i.e. 20 or more times per month).

Our identification strategy is based on a Differences-in-Differences model, which application is allowed by the fact that only 13 out of the 20 countries analysed implemented relevant cannabis policy changes in our observation period, leaving us with a group of seven countries that did not undergo any reforms.

Our findings indicate that selected categories of changes in the regulation of cannabis possession for personal use seem to affect the perceived availability and prevalence of use among adolescent students. In particular, consistently with the hypothesis based on the theory of crime, some forms of restrictive interventions are linked to a reduction in the overall proportion of cannabis users. Consistently, more liberal reforms are associated with an increase in the share of students approaching cannabis. However, when restricting our analysis to frequent users we do not find evidence of a significant association between any type of policy reforms and changes in the share of of this type of consumers.

The rest of paper is is structured as follows: Section 1.2 reviews existing theoretical and empirical literature on the topic, Section 1.2 provides a description of the policy classification adopted and an analysis of each country's reform, Section 1.4 presents the data used, Section 1.5 describers the empirical model, Section 1.6 shows our results, Section 1.7 provides some robustness checks and Section 1.8 discusses the results and concludes. Other robustness checks and other insights are provided in the Appendix in Section 1.9.

1.2 Literature review

Generally, cannabis legislation reforms are based on different theories concerning the sensitivity of the demand to changes in sanctions and penalties (Pacula et al., 2005; Shi et al., 2015). In particular, much debate has focused on the effectiveness of the use of governments' coercive power in influencing drug consumption (Dave and Kaestner, 2002; Glied, 2002; Zhao and Harris, 2004; Cunningham and Finlay, 2015).

Penalty approaches are inspired by the notion from the theory of crime (Becker, 1968) that use should decline as the cost of the drug and the size of the punishment increase. Consequently, policies driven by this approach are designed to deter use both constraining supply in order to make the drug difficult to obtain and expensive, and providing disincentives to demand by setting strict and certain consequences of detention (DeSimone and Farrelly, 2003; Room et al., 2010). It follows that laxer policies would cause an increase in availability and social acceptability of use, as well as a reduction of the fear of punishments and perceived risk. This would altogether lead to an increase in the prevalence, frequency, quantity of cannabis used and related problems (Reinarman et al., 2004; Reinarman, 2009). Furthermore, it is believed that a more liberal stance on cannabis, by sending a wrong message of social acceptability about drug use in general, would increase the access to more dangerous forms of illegal substances (Pudney, 2010). On the opposite side, depenalisation policies question the effectiveness of legal sanctioning in reducing the use and the associated harm of drugs (Damrongplasit et al. 2010), and favour the implementation of some mix of legislative and regulatory structures other than the criminal law. At individual user-level, a criminal charge is seen as a too severe penalty relative to the crime itself, implying high costs, e.g. in terms of reduced educational attainment and future employment opportunities (Becker et al., 2006; Room et al., 2010; Damrongplasit et al. 2010; Williams and Bretteville-Jensen, 2014; Kopp and Ogrodnik, 2017; Wang and Xie, 2017). From a societal point of view, criminalization is deemed to be too expensive in terms of enforcement, adjudication and incarceration costs, relative to the results achieved (Simons-Morton et al., 2010). In this view, maintaining a strong prohibition line in the face of high and persistent demand implies that cannabis consumers have to turn to the unregulated black market, where they are more likely to enter into direct contact with sellers of other illicit and to move on to use them (Damrongplasit et al. 2010; Simons-Morton et al., 2010). Depenalisation would therefore reduce drug trafficking and facilitate the separation of a regulated market for cannabis from the market of other harder drugs (Grube and Nygaard, 2001; Stockwell, 2001). An important point is that at a societal level, a more liberal approach would have small or no positive effect both on the prevalence and on the frequency of cannabis use. The example typically brought is the Netherlands where the prevalence of cannabis use, both among adults and youth, is not higher than in other European countries or the United

States (Reinarman, 2004; Hughes and Stevens, 2010). Public resources diverted from deterrence, would then be more efficiently employed in public education and prevention, as well as greater availability of treatment services for addiction (Pacula, 2010).

As highlighted in Section 1.1, despite the strong views around cannabis legal status, econometric studies examining the effect of policy reforms on youth have produced mixed evidence. Thies and Register (1993), Pacula (1998), DiNardo and Lemieux (2001), Williams (2004) and Anderson et al. (2012) reported insignificant effects of cannabis decriminalisation on youth individual smoking decisions. In contrast, Model(1993), Saffer and Chaloupka (1999), Pacula et al. (2003), Damrongplasit et al. (2010) did find that the demand for marijuana is significantly related to its legal status, and that depenalisation significantly increases participation in cannabis use by youth. Among the most recent studies, Williams and Bretteville-Jensen (2014) found no evidence of significant long run effect of decriminalisation on initiation into cannabis use in either the adult population or youth, but only a decrease in the age of onset during the first years after adoption of the policy.

Some studies also analysed the policy impact on different consumption behaviours. Chaloupka et al. (1999) estimated that cannabis decriminalisation was associated with higher reported use in the past year, but did not increase the probability of more recent use or the number of occasions in which users consumed cannabis. Similarly, Farrelly et al. (2001) and Hall and Pacula (2003) provided evidence that the decision to start using cannabis is affected by changes in the legal penalties and related enforcement for its possession, but the frequency of use among those who are already cannabis users is not. Differently, the studies conducted by Thies and Register (1993), Pacula (1998) and Williams (2004) found no evidence that decriminalisation significantly increases either participation in cannabis use by youth, or frequency of use among current cannabis users. In other words, these findings suggest that if there is any effect of changes in legal penalties on consumption behaviours, these are more likely to be displayed on the probability that an adolescent will ever use cannabis, but there is no evidence of impact on the share of adolescent frequent users.

All the aforementioned studies are based on data sources from the United States and Australia. In Europe, far less literature is available. The first study exploring possible links between different drug policies and user practices restricted the analysis to the Netherlands, the only European example of a system of licensed cannabis shops, comparing representative samples of young experienced cannabis users in Amsterdam and in San Francisco, a city with similar characteristics but subject to a criminalization policy regime (Reinarman et al., 2004). Interestingly the study found that perceived availability was not different nor there were significant differences concerning the age of uptake of cannabis use and the frequency of use. The only major difference was that American respondents were three times more

likely to report being able to purchase other illicit drugs from their cannabis sources (Reinarman et al., 2009). Simon-Morton (2010), by comparing the liberal policy of the Netherlands with the United States and Canada, also found results that are inconsistent with the hypothesis based on the theory of crime (Becker, 1968) that strict laws and enforcement would prevent adolescent cannabis use. Ceverny et al. (2017), exploiting restrospective information on the age of first cannabis use, did not find any evidence that the decriminalisation implemented in the Czech Republic in 2010 induced an earlier uptake of cannabis use among youngsters. Based on official statistics regarding the yearly amount of cannabis seizures reported by the police, the author suggested that this was possibly due the lack of changes in the illegal supply of the drug as a result of the policy, hypothesis supported by the absence of significant changes in the share of consumers reporting easy access cannabis.

1.3 Institutional setting: European policy classification

A cross-country analysis for the European case is challenged by the difficulty of trying to capture the complexity of policy changes across heterogeneous legal systems within broad definitions like depenalisation, decriminalisation, or prohibition. Furthermore, it is well known that drug laws tend to be complicated, subject to interpretation, and enforced variably (Simons-Morton, 2010), particularly in relation to trafficking offences where the penalty range allowed in countries' laws may depend on a variety of defined aggravating circumstances (EMCDDA; 2017a). We therefore focus on a particular aspect of the reforms that allows to make a more sensible direct comparison between countries, which is the treatment of cannabis possession for personal use.

To do so, we adopt a refined categorisation of the types of change in law for cannabis possession proposed by the European Monitoring Centre for Drugs and Drug Addiction (EMCDDA, 2017a). Based on this categorisation, the five main types of policy changes addressing cannabis personal possession are classified as follows: reforms removing the prison sentences for minor offences ($RPSMO$); reforms reducing the maximum prison sentence ($RMPS$); reforms facilitating the closure of minor cases ($FCMC$); reforms increasing the non-prison penalty ($INPP$); and reforms increasing the prison penalty (IPP). Then, we analysed the national legislation of those countries that were not comprised in the EMCDDA categorisation and added them to the analysis. We also performed a review of policy changes implemented, and provided a description of the situation pre- and post-reform in each country in order to allow for a more meaningful interpretation of results. The outcome of this analysis is reported in Table 1.1. An additional, more detailed, description of the policy changes implemented in each country is provided in Section 1.9.1

Table 1.1: Classification of changes in cannabis law regarding possession for personal use occurred in Europe from 2001 to 2014

Form of change	Country	Year	Before change	After change
RPSMO	Portugal	2001	Criminal offence punishable with up to one year's imprisonment.	Decriminalised and offenders are referred to a commission deciding on the administrative sanction to apply (e.g. a fine).
	Slovenia	2005	Criminal offence punishable by up to 30 days imprisonment, 5 days for a small quantity of drug.	Decriminalised and is now punishable by a fine.
	Croatia	2013	Criminal offence punishable by up to 3 years' imprisonment.	Decriminalised and in any amount is punished by a fine.
RMPS	Finland	2001	Criminal offence punishable by up to 2 years in prison.	The maximum penalty was lowered to 6 months in prison, allowing the prosecutor to deal with the majority of cases with a fine.
	Greece	2006-2013	Criminal offence punishable by up to 5 years in prison.	The maximum penalty was lowered to 1 year in prison (not entered in the criminal record).
	Czech Republic	2010	Personal possession of "greater than small" quantities of cannabis resulted in a jail sentence of up to 2 years.	Personal possession of cannabis for personal use is punishable by up to 1 year.
	Romania	2004	The penalty applied to the possession for personal use ranged from 2 to 5 years in prison, without distinction by drug.	Drugs were distinguished between high risk and risk categories: the penalty for cannabis (risk category) was lowered to 6 months' to 2 years' imprisonment.
	Slovak Republic	2005	Criminal offence punished by up to 3 years imprisonment.	Up to 3 doses punished by up to 3 years imprisonment, for a larger amount by up to 5 years (previously categorised as a trafficking offence).
FCMC	Poland	2011	Criminal offence punished by a maximum of 3 years imprisonment	The possession of drugs for personal use may now remain unpunished, subject to the discretion of the prosecutor/judge.

Source: Authors' elaboration on EMCDDA (2017a); RPSMO = Removal of the prison sentences for minor offences; RMPS = Reduction of the maximum prison sentence; FCMC = Facilitation of closure of minor cases; INPP = Increase of the non-prison penalty; IPP = Increase of the prison penalty

Table 1.1: (Continued)

Form of change	Country	Year	Before change	After change
INPP	Denmark	2004	Criminal offence but did not result in prosecution, and was instead punished by a warning.	It remains a criminal offence: normal response for minor quantities is a fine, the size of which depends on type/quantity of the drug involved.
	Italy	2006-2014	Decriminalised and cannabis classified as a soft drug punishable with administrative sanctions. In 2006 the distinction between soft and hard drugs was eliminated. The administrative sanctions for soft drugs increased with hard drugs to a max. of 1 year.	In 2014, the Constitutional Court repealed the 2006 law and penalties for minor personal use offences were reinstalled to 1-3 months for cannabis and other less dangerous drugs.
	Ukraine	2010	Administrative offence if in the amount of a small size.	If the amount of drugs possessed does not exceed the 'small' amount, it remains an administrative offence, but the legal threshold of "small", "large" quantities have been significantly reduced. Over the "small" threshold, a criminal case is opened.
IPP	Hungary	2013	Criminal offence, punished by up to two years imprisonment.	Punishment remains up to two years in prison if it involves small quantities, but other penalties are now one to five years for a basic offence, increasing significantly in certain circumstances.

Source: Authors' elaboration on EMCDDA (2017a); RPSMO = Removal of the prison sentences for minor offences; RMPS = Reduction of the maximum prison sentence; FCMC = Facilitation of closure of minor cases; INPP = Increase of the non-prison penalty; IPP = Increase of the prison penalty

Note that three countries that implemented policy reforms were excluded from the analysis because the related ESPAD data are not available for all the considered years: the United Kingdom, which in the time window from 2004 to 2009 lowered the maximum penalties for personal possession from five to two years' imprisonment; Estonia and Luxembourg which in 2002 and 2001 respectively decriminalised cannabis use and possession for personal use; and Belgium that in 2003 differentiated the personal possession of cannabis from that other controlled substances, setting the penalty to a fine based on an anonymous police report.

1.4 Data

Our empirical analysis is based on data from the European school Survey Project on Alcohol and other Drugs (ESPAD). ESPAD is a repeated cross-sectional multinational survey conducted every four years since 1995, designed to provide nationally representative and comparable data on substance use and other risk behaviours among 16 years-old students in Europe (Kraus et al., 2016).

In this survey a cluster sampling design is used to sample the students who turn 16 years of age in the given survey year. In the majority of countries, class is the last unit in a multistage stratified sampling procedure. Participating countries adhere to common research guidelines to guarantee consistency in sampling, questionnaires, and survey implementation, and conform to the respective national ethics and data protection regulation. A standardized anonymous questionnaire is voluntarily completed in the classroom setting with paper-and-pencil (the only exceptions are the Netherlands and Latvia which in 2015 used the computer-assisted mode). Detailed information about survey representativeness, data collection methodology, and country participation rates in each survey year are reported in the dedicated reports (Hibell et al., 2000, 2004, 2009, 2012; Guttormsson et al., 2015). Sampling frame coverage, school, class and student participation rates were generally high in the considered period.

For the present analysis, starting from the individual level data about 306,693 students collected in five ESPAD data collection waves (1999, 2003, 2007, 2011 and 2015) we calculated annual prevalences for each country of a subset of variables referring to cannabis use and perceived availability, obtaining a balanced panel covering 20 countries in the interval 1999-2015 (a total of five observations per country). Table 1.2 provides an overview of the initial sample by country and year.

Table 1.2: Sample size by country and year

	1999	2003	2007	2011	2015	Total
Croatia	3454	2823	2947	2953	2490	14667
Czech Rep.	3478	3078	3805	3826	2689	16876
Denmark	1497	2442	844	2105	1624	8512
Finland	2945	3182	4902	3692	3960	18681
France	2177	2090	2843	2463	2641	12214
Greece	2160	1871	2990	5654	3168	15843
Hungary	2669	3037	2758	2995	2692	14151
Iceland	3342	1503	3421	3242	2604	14112
Italy	4041	4693	9396	4657	3878	26665
Latvia	2238	2782	2231	2542	1059	10852
Malta	3593	3363	3601	3307	3171	17035
Netherlands	2613	2019	2055	2030	1680	10397
Norway	3582	3631	3077	2684	2320	15294
Poland	3208	5770	2080	5818	11645	28521
Portugal	3496	2827	3049	1889	3355	14616
Romania	2304	4214	2224	2678	3327	14747
Slovak Rep.	2402	2098	2390	1902	2179	10971
Slovenia	2304	2706	3037	3113	3390	14550
Sweden	3243	3142	3078	2451	2485	14399
Ukraine	2833	3998	2336	2132	2291	13590
Total	57579	61269	63064	62133	62648	306693

The 20 countries considered are divided into those that underwent cannabis policy changes: Croatia, Czech Republic, Denmark, Finland, Greece, Hungary, Italy, Poland, Portugal, Romania, Slovak Republic, Slovenia and Ukraine; and those that did not: France, Iceland, Latvia, Malta, the Netherlands, Norway, Sweden.

Information on the perceived ease of access to cannabis is provided by responses to the question: "How difficult do you think it would be for you to get marijuana or hashish (cannabis) if you wanted?". This question was asked to every student answering the questionnaire, both those who reported having ever used cannabis and those that did not. The answer options are: "Impossible"; "Very difficult"; "Fairly difficult"; "Fairly easy"; "Very easy"; "Don't know". To our purpose, the proportions of students in each country answering 'fairly easy' or 'very easy' were merged to indicate perceived easy availability.

Information on the use of cannabis is provided by responses to the question: "On how many occasions (if any) have you used marijuana or hashish (cannabis)?". This question was asked with reference to three different timeframes: in the lifetime, in the last 12 months and in the last 30 days. The answer options for all timeframes

are: “0”; “1-2”; “3-5”; “6-9”; “10-19”; “20-39” and “40 or more”. Using the information regarding cannabis use in the last 12 months and in the last 30 days, individuals were classified into different types of users: all users (at least once in the last 12 months); experimenters (only 1-2 times in the last 12 months); non-frequent users (all users in the last 12 months, excluding those having reported use in the last 30 days with a frequency equal to or higher than 20-29 times); frequent users (having reported use in the last 30 days with a frequency equal to or higher than 20-29 times). Using the same categorisation, we replace the reported use in lifetime to the reported use in the last 12 months to conduct a sensitivity analysis in Section 1.7. In this additional analysis individuals are therefore classified as follows: all users (at least once in the lifetime); experimenters (only 1-2 times in the lifetime).

In Table 1.3 we report the descriptive statistics for our outcome variables. Overall, our proxy of cannabis availability shows an average constant path across the years, while the use of cannabis has a slight increase in the 1999-2015 interval. In particular, the frequent use of cannabis involved on average the .41 percent of students in 1999 and the .68 percent in 2015.

Table 1.3: Descriptive statistics of outcome variables

Prevalence (%)	N. Countries	**1999** Mean *St. D.*	**2003** Mean *St. D.*	**2007** Mean *St. D.*	**2011** Mean *St. D.*	**2015** Mean *St. D.*
Perceived cannabis availability	20	30.42 *13.92*	32.15 *15.15*	33.07 *16.03*	31.34 *12.49*	30.38 *11.52*
Use of cannabis in the last year (any)	20	11.42 *6.40*	12.54 *8.44*	12.01 *8.54*	12.95 *6.77*	12.11 *7.05*
Experimental use of cannabis in the last year (only one or two times)	20	5.00 *2.26*	5.63 *2.89*	5.50 *3.13*	6.26 *3.06*	5.68 *3.03*
Frequent use of cannabis (20 or more per month)	20	0.41 *0.41*	0.60 *0.62*	0.63 *0.68*	0.67 *0.60*	0.68 *0.64*
Use of cannabis in the lifetime (any)	20	15.07 *8.08*	17.08 *10.25*	15.99 *10.70*	16.82 *9.31*	15.65 *9.04*
Experimental use of cannabis in the lifetime (only one or two times)	20	6.36 *2.77*	7.10 *3.07*	6.84 *3.52*	7.48 *3.79*	6.58 *3.40*

Notes: Author’s elaboration on ESPAD data. Cannabis availability= percentage of students rating cannabis as either ‘fairly easy’ or ‘very easy’ to obtain. Use of cannabis in the last year: use of cannabis >=1-2 times in the last 12 months. Experimental use of cannabis (in the last year): use of cannabis =1-2 times in the last 12 months. Frequent use of cannabis: use of cannabis >= 20-29 times in the last 30 days. Lifetime use of cannabis (any): use of cannabis >=1-2 times in the lifetime. Experimental use of cannabis (in the lifetime): use of cannabis =1-2 times in the lifetime. Sample size: Average (country/year)= 3066.93 students, Min= 844 (Denmark 2007), Max= 11645 (Poland 2015).

1.5 Empirical model

In order to investigate the relationship linking the policy changes (treatments) and the perceived availability and consumption of cannabis among adolescents, we use a Differences-in-Differences (DiD) approach. The basic strategy of DiD is to compare the difference in outcomes after and before the intervention between the treated and the untreated groups. The use of DiD allows to avoid the endogeneity problems typical of comparisons between heterogeneous groups (for an overview see Meyer, 1995). In this framework, the identification of the effect of a policy on the outcome of interest is based on the assumption that the policy is exogenous with respect to the outcome (Besley and Case, 2000; Heckman, 2000). In our case, there might be the concern that this condition is not fully met, as reforms concerning cannabis use might be influenced by changes in individual preferences and behaviours, including cannabis use. This issue is less of a concern once country and year fixed effects are controlled for, as in our case (Cohen and Einav, 2003; Williams and Bretteville-Jensen, 2014). Moreover, policy reforms are the outcome of a political process, which is complex, lengthy and uncertain. Whether and when legislation is passed seem therefore to depend on a mix of political, administrative and ideological factors unlikely related to changes in cannabis use (Levitt, 1996; Cohen and Einav, 2003; Palali and van Ours, 2014) and can therefore be considered plausibly exogenous to an individual's decision to use the substance (Williams and Bretteville-Jensen, 2014). In line with Braakmann et al. (2014), the idea underlying our approach is that individuals will react to policy reforms when the new law comes into effect, and not to the possible earlier political debate or announcement, as what is expected to matter for individual changes in behaviour is the actual punishment in place. To rule out the opposite hypothesis we test the existence of anticipated changes in behaviour by performing a parallel trend test in Section 1.7.2 where we lead of one survey period (corresponding to four years) those policy reforms that in our analysis show a significant effect. In this paper we are interested in the effect of different categories of policy changes. More in details, as reported in Table 1.1, we have five different treatments: Removal of the prison sentences for minor offences ($RPSMO$); Reduction of the maximum prison sentence ($RMPS$); Facilitation of the closure of a minor case ($FCMC$); Increase of the non-prison penalty ($INPP$); Increase of the prison penalty (IPP).

On the basis of the generalized DiD, we estimate the effect of all the considered policies in the same regression, which is given by the following equation:

$$Y_{st} = \theta_s + \lambda_t + \beta_1 RPSMO_{st} + \beta_2 RMPS_{st} + \beta_3 FMCM_{st} + \beta_4 INPP_{st} + \beta_5 IPP_{st} + \beta_6 X_{st} + \varepsilon_{st} \tag{1.1}$$

Where:

- θ_s are country-level fixed effects;
- λ_t are time-level fixed effects;

- $RPSMO_{st} = 1$ in countries and years Removing the prison sentences for minor offences;
- $RMPS_{st} = 1$ in countries and years Reducing the maximum prison sentence;
- $FCMC_{st} = 1$ in countries and years Facilitating closure of minor cases;
- $INPP_{st} = 1$ in countries and years Increasing the non-prison penalty;
- $IPP_{st} = 1$ in countries and years Increasing the prison penalty;
- X_{st} is a vector control variables containing country level per-capita GDP and share of urban population (World Bank, 2018). Per-capita GDP is used to proxy for the country socio-economic conditions, which have been associated with youth consumption of psychoactive substances (see Svensson and Hagqui, 2010 and Shi et al., 2015). The share of urban population, calculated using the World Bank population estimates and urban ratios from the United Nations World Urbanization Prospects, serves as a proxy for the level of urbanisation of a country, which has been identified as a risk factor for substance misuse (see Schifano (2008) for a review).

Estimated β_i, for each one of the five policy categories ($i = 1, \dots 5$), is the difference between the average outcome observed in the treated countries after the implementation of the reforms, and the average outcome that would be expected for the same countries, in the same time periods, given their level of GDP per capita and level of urbanisation. Italy and Greece, in which the analysed reforms remained in force for a limited period, the dummy variable corresponding to the reform assumes value equal to one only in those years.

These parameters can be interpreted as the possible effect of the reforms on the outcome under the assumption of equal trends in the absence of treatment. That is, we are assuming that changes in the country prevalence of cannabis use and availability would have moved in tandem in absence of treatment. The validity of this assumption cannot be proved but can be assessed testing the existence of common trends in periods before the reforms were implemented. In the case of cannabis legislation reforms in Europe we do not find evidence to reject the null hypothesis of equal trends, see Section 1.7.2 for details. In the next section we report the results of our regression using the different proxies of cannabis availability and use described in Section 1.4 as outcome Y_{st}. The robustness of our results is checked in Section 1.7 through a sensitivity analysis and the mentioned parallel trend test. The following robustness checks are provided in the Appendix in Section 1.9: 1) single-group estimates with related parallel trend test in case of significative results and sensitivity analysis on the lifetime use dependent variables; 2) specifications of the models presented in Section 1.6 and sensitivity analysis without control variables, as X_{st} could be endogenous when measured at the same time of the policy reforms;

3) specifications of the models presented in Section 1.6 and sensitivity analysis excluding Italy from the $INPP$ group, since it is among the countries where the policy effect is significative. Finally, in the Appendix in Section 1.9 figures showing cannabis perceived availability and use trends are also provided.

1.6 Results

On the basis of our research questions, this section presents the estimates of our model on two main outcomes: perceived availability and patterns of use of cannabis.

1.6.1 Policy changes and perceived availability

The examine the relationship between the different policy changes and the perceived availability of cannabis we first look at the whole population in our dataset, including also non-users. Table 1.4 shows that the only policy changes showing a significant effect on the share of adolescent students reporting easy availability of cannabis are those increasing the non-prison penalties ($INPP$). Indeed, with the significance of .049, $INPP$ is linked to a reduction in the perceived availability of 5.8 percentage point. All the other policy categories seem to have no significant effect.

Table 1.4: Policies and share of of students considering easy to find cannabis

	All students	Non-frequent users	Frequent users
Perc. GDP	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
Urban Pop.	0.311	0.360	-0.050*
	(0.412)	(0.402)	(0.021)
RMPS	-2.158	-2.093	-0.065
	(2.508)	(2.448)	(0.130)
RPSMO	-2.034	-2.134	0.100
	(3.199)	(3.122)	(0.166)
FCMC	6.568	6.604	-0.036
	(4.954)	(4.835)	(0.257)
INPP	-5.783*	-5.675*	-0.108
	(2.891)	(2.821)	(0.150)
IPP	-1.855	-1.640	-0.036
	(5.826)	(5.685)	(0.257)

Sample size: Average (20 countries/5 years) = 3092.35 students, Min = 844 (Denmark 2007), Max = 11645 (Poland 2015); =". p<0.1 * p<0.05 ** p<0.01 *** p<0.001"

Since we are interested in investigating how perceived availability changes when distinguishing between different types of subjects, we specify our model

distinguishing non-frequent users and frequent users. In fact, one of the main issues of considering the availability perceived by all students (comprising both users and non-users) is that results could be biased by the fact that the frequent use of cannabis can affect its perceived availability. In fact, frequent consumers might have stable access to supply networks which is not affected by the imposition of exogenous policy restrictions (Coomber and Turnbull, 2007). Therefore, also in cases where cannabis availability is generally perceived as lowered (for example because it is more difficult to see small street cannabis dealing), we could find that there is no effect for frequent purchasers of larger quantities. In order to verify this, in the second column of Table 1.4 we present the outcome estimated excluding frequent users. The results are substantially unchanged: only $INPP$ with a significance of .048 is linked to a decrease of 5.7 percentage points on this outcome. In the third column, we present the estimates on the share of adolescents reporting a frequent use. Confirming our hypothesis, no policy reform seem to significantly affect the availability perceived by this sub-population.

1.6.2 Policy changes and cannabis use

Based on our hypothesis that different policy reforms might have different effects on different types of users, Table 1.5 reports the estimates of our DiD on different outcomes as follows: in the first column on the share of all those students reporting any use in the past year; in the second column, only those students who tried the drug and did not repeat the experience (only once or twice in the past year), in the third column all those who reported use in the past year excluding the frequent users, and in the fourth column the focus is restricted to the share of frequent users.

Table 1.5: Policies and students using cannabis (in the last year)

	All users	Experimenters	Non-frequent users	Frequent users
Perc. GDP	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Urban Pop.	0.060	-0.011	0.079	-0.049*
	(0.208)	(0.077)	(0.211)	(0.022)
RMPS	0.497	0.994*	0.554	-0.087
	(1.265)	(0.469)	(1.184)	(0.136)
RPSMO	1.033	0.985	0.886	0.067
	(1.614)	(0.599)	(1.503)	(0.173)
FCMC	6.607*	2.849**	6.588**	-0.011
	(2.499)	(0.927)	(2.341)	(0.268)
INPP	-3.333*	-1.792**	-3.239*	-0.109
	(1.458)	(0.541)	(1.374)	(0.156)
IPP	-0.959	-0.032	-0.588	-0.225
	(2.939)	(1.090)	(2.715)	(0.315)

Sample size: Average (20 countries/5 years) = 3092.35 students, Min = 844 (Denmark 2007), Max = 11645 (Poland 2015); =". p<0.1 * p<0.05 ** p<0.01 *** p<0.001"

Results in the first column show that only two types of policy induce a change in the size of the population of cannabis users: the Facilitation of closure of minor cases (FCMC), with a significance of .010, is linked to an increase in the share of users by 6.6 percentage points, whilst the Increase of the non-prison penalty (INPP) with a significance of .025, is linked to a decrease of 3.3 percentage points. Results in the second and third column show that the same effects are observed with a higher significance both if we just focus on experimenters and if we widen the scope to the share of all non-frequent users. Moreover, when looking at the experimental users, with a significance of .038 the Reduction of the maximum prison sentence is associated with an increase of 1 percentage point. Interestingly, results in the fourth column show that when restricting the analysis on "frequent" users, all policy coefficients lose statistical significance. These findings are consistent with what suggested by Farrelly et al. (2001) and Hall and Pacula (2003), who also found that changes in the general prevalence of cannabis users following policy reforms are mainly driven by changes in the share of those not making a frequent use.

1.7 Robustness Checks

In this section, we examine the reliability of our results by means of two robustness checks: a sensitivity analysis and a parallel trend test. Further checks are provided in Section 1.9.

1.7.1 Sensitivity analysis

To perform this analysis we focus on the main finding of this paper, which is that the influence of the different drug policy reforms investigated on adolescent cannabis users is strongly related to their frequency of use. In order to check the robustness of this finding we re-estimate the specifications of model presented in Section 1.5 concerning the share of users (any type) and only the share of experimental users, choosing as outcome variable the reported use in the lifetime instead of the use in the last year. As Table 1.6 shows, the effects on the share of students having used cannabis at least once in their lifetime are in line with the effects on share of students having used cannabis at least once in the last year presented in Table 1.4.1. In particular, the policies increasing the non-prison penalty (INPP) have a significant negative effect, whilst the one facilitating the closure of minor cases (FCMF) has a significant positive effect. Also the estimate concerning the share of students reporting having tried cannabis only once or twice in their lifetime is in line with our results: the policies that reduced the maximum prison sentence (RMPS) and those that facilitated the closure of minor cases (FCMC) show a positive effect, whilst the one that increased the non-prison (INPP) had a negative effect.

Table 1.6: Policies and students using cannabis (in lifetime)

	All users	Experimenters
Perc. GDP	0.000	0.000
	(0.000)	(0.000)
Urban Pop.	-0.065	0.039
	(0.245)	(0.098)
RMPS	1.921	2.016**
	(1.494)	(0.597)
RPSMO	1.434	1.463.
	(1.906)	(0.762)
FCMC	7.963**	3.646**
	(2.951)	(1.179)
INPP	-5.443**	-2.458***
	(1.722)	(0.688)
IPP	-0.075	0.522
	(3.470)	(1.387)

Sample size: Average (20 countries/5 years) = 3092.35 students, Min = 844 (Denmark 2007), Max = 11645 (Poland 2015); =". p<0.1 * p<0.05 ** p<0.01 *** p<0.001"

1.7.2 Parallel trend test

The validity of the DiD model relies on the assumption of the presence of equal trends of country prevalences, had the considered policy reforms not taken place. A formal test for the assumption of common trends which is also suitable for multivalued treatments and several groups is provided in Angrist and Pishke (2009) and used among others in Boschi et al. (2014). The idea is to include the treatment dummy for the pre-treatment period. This way, if the outcome trends between treatment and control groups are the same, then the coefficient associated to those dummies should be insignificant, i.e. the DiD is not significantly different between the two groups in the pre-treatment period. Adapting this test to our case study, we have augmented all the policies showing a significant effect by one lead (which in our case corresponds to a four-year interval). For convenience, we show the results for the main outcomes investigated in this study: 1. availability of cannabis (the share of students considering easy to find cannabis); 2. the share of cannabis users (individuals having reported any use in the last year); 3. the share of experimenters (students having used cannabis only once or twice last year). As shown in Table 1.7.2, the coefficients associated to the leaded treatments are all non-significant, not providing evidence against the assumption of parallel trends in the absence of the policy reforms under investigation.

Table 1.7: Parallel trend test estimates

	Perceived availability (all)	All users (last year)	Experimenters (last year)
Perc. GDP	0.000	0.000	0.000
	(0.001)	(0.000)	(0.000)
Urban Pop.	-0.005	0.079	-0.024
	(0.597)	(0.298)	(0.109)
RMPS	-2.024	0.385	0.468
	(3.024)	(1.483)	(0.574)
RPSMO	-4.902	-0.845	0.372
	(4.370)	(2.137)	(0.772)
FCMC	7.484	6.780.	2.146
	(6.767)	(3.978)	(1.432)
INPP	-6.875.	-1.721	-1.252.
	(4.027)	(1.977)	(0.712)
lead(RMPS)			0.814
			(0.661)
lead(FCMC)		-0.503	1.048
		(3.418)	(1.234)
lead(INPP)	-1.733	-2.000	-0.533
	(3.635)	(1.772)	(0.641)

Sample size: Average (20 countries/5 years) = 3092.35 students, Min = 844 (Denmark 2007), Max = 11645 (Poland 2015); =". p<0.1 * p<0.05 ** p<0.01 *** p<0.001"

As anticipated in Section 1.5, a range of other rubstnesss checks has been conducted, including single-group estimates with related parallel trend test in case of significative results and sensitivity analysis on the lifetime use dependent variables; specifications of the models presented in Section 3.6 and sensitivity analysis without control variables; specifications of the models presented in Section 3.6 and sensitivity analysis excluding Italy from the $INPP$ group, since it is among the countries where the policy effect is significative. The results shown in 1.9 substantially confirm our main findings related to the significative effects of the increase of the non-prison penalties (INPP) and the facilitation of closure of minor canses (FCMC).

1.8 Discussion and conclusions

This paper investigates the effects of the cannabis policy changes occurred in 13 European countries in the period 2001-2014, both on the perceived availability of cannabis and on the prevalence and patterns of use of this substance by adolescent students, focusing on experiments, non-frequent users and frequent users.

We use five waves of the ESPAD survey (1999, 2003, 2007, 2011 and 2015), in order for our data to cover the period before and after the implementation of each of the national drug policy reforms. Policies have been grouped on the basis of the categorisation proposed by EMCDDA (2017a), which identified five main types of policy reforms focusing on the treatment of cannabis possession for personal use, and for each country a description of the situation pre- and post-reform has been provided.

Our findings are based on a DiD model. Regarding the availability of cannabis, we find that none of the more liberal reforms seem to be linked to an increase in the perception of easy access to this substance by the general population of students. Among the more restrictive reforms, only those increasing administrative charges for people found with a small quantity of the substance and lowering the threshold for possession to be classified as a crime are linked to a reduction in the perceived availability. We also verify the hypothesis that this might be different for frequent users due to the fact that presumably they have access to stable supply networks which might not be visible or accessible for individuals who not make frequent use. Interestingly, confirming previous findings, the effects observed among the whole student population are confirmed only when restricting the attention to non-frequent users, but not when focusing on frequent users. This result suggests that although diffused availability (small-scale street dealing or exchange between peers) may be affected by some forms of restrictive measures increasing the penalties for the possession of small quantities (INPP), the latter might not affect the bigger-scale supply networks which are presumably well established for frequent users. This might also explain why the increase of the prison penalties (IPP), which left the punishment for the possession of small quantities unchanged does not seem to have an effect on the general perception of cannabis availability.

With respect to the use of cannabis, we show that only some drug policy reforms seem to have had an influence. In line with previous findings described in our literature review, different results are obtained for different types of consumers. When considering all types of users, two categories of policies show an effect: among the more restrictive ones, only the one increasing the non-prison penalties (INPP) seem to significantly reduce overall cannabis use, and among the more liberal interventions, only the one favouring the discontinuation of criminal proceedings for minor cases (FCMC) is linked to an increase. These results are confirmed when focusing on experimental users or excluding frequent users from the analysis. Furthermore, those reforms reducing the maximum prison penalty for cannabis possession (RMPS) show a positive effect on the share of experimental users only. When finally considering only frequent users, i.e. students smoking cannabis daily or almost daily, the policy effects observed before disappear and no reforms seem to have an effect. These results offer two main insights. On one side the fact that only some of the reforms reducing the penalties for cannabis possession show a positive effect might be interpreted as a confirmation of previous findings, which indicate that more liberal approaches to cannabis possession are not automatically linked to an increase in cannabis use and in those cases where this happens, it might be limited to an experimental use. On the other side, the main declared objective of reforms increasing penalties is to deter cannabis use as a public health objective. Our results confirm that some of these reforms are linked to a reduction in the share of students approaching this substance, which is in line with this objective. However they do not provide evidence confirming an effect on the share of frequent users, which are presumably those subject more likely to develop use-related health consequences.

This study has some limitations that we aim to address in future research. First, our analysis is based on country-level prevalences, which do not account for individual-level factors (like family socio-economic status, parental education and monitoring etc.) that may however contribute to influence cannabis use by young people. This is because, while a number of individual-level variables are available in the last waves of the ESPAD study for many countries, they are not available for the whole time span and countries considered. Confronted with this trade-off, consistently with our research question we opted for maintaining in the analysis many countries and the largest time span possible to be able to provide an European picture. Second, being cannabis use one of the outcomes, it is possible that the reference population in each sub-group changes due to the reforms. Third, since our estimates rely on self-reported survey data, there might be the concern that changes in drug policy influence the way individuals answer the survey. For example, if with more liberal policies and less severe punishment in place people were more prone to admit drug use when asked about it in a survey. Although issues of truthfulness are more likely to arise when surveys are administered by personal interview, whilst in our case the ESPAD survey is anonymous and self-administered

respecting privacy conditions, we cannot completely rule out this hypothesis. This is one of the trade-offs that research on socially undesirable and illegal behaviours is confronted with. Finally, this research does not include an analysis of the effects of drug policies on the illegal market and on the use of other substances. While in the first case such an analysis is challanged by the limited availability of data, in the second case it is an interesting perspective for extending this research.

1.9 Appendices

1.9.1 Policy changes in Europe

In this section we provide a detailed description of the policy changes implemented in each country which are summarised in Section 1.2.

Removal of the prison sentences for minor offences: Portugal, Slovenia and Croatia decriminalized cannabis personal possession. In Portugal, prior to the 2001 reform, drug possession, acquisition and cultivation, when for personal use, were criminal offences punishable with up to one year's imprisonment. The law passed in July 2001, which is considered the pioneering initiative of decriminalisation in Europe, decriminalised possession of all drugs for personal use. This reduced the maximum punishment for possession of small amounts of drugs from three months' imprisonment to an administrative fine given by the new 'commissions for dissuasion of drug abuse', which prioritised health solutions over punitive sanctions. In Slovenia, the Misdemeanours Act from January 2005 removed prison penalties for all misdemeanours, one of which is possession of drugs for personal use. In this way, the maximum penalty was reduced from 30 days in prison, or five days for a small quantity, to a fine. From January 2013, possession of small quantities of drugs for personal use is no longer a criminal offence, but is classed as a misdemeanour and punishable by a fine. From January 2013, possession of small quantities of drugs for personal use is also no longer a criminal offence in Croatia, but is classed as a misdemeanour punishable by a fine.

Reduction of the maximum prison sentence: in 2006, Greece set quantity limits for personal use and reduced the maximum penalty for possessing drugs, or cultivating cannabis with a view to using it at one year. Then, in 2013 it removed the quantity limits introduced just a few years earlier, allowing the judge to decide, based on a range of factors like purity, quantity, and characteristics of the particular user. In the Czech Republic, from January 2010 the new Penal Code applied a lower maximum punishment for cannabis (one year in prison) than for other drugs (unchanged at two years) for personal possession of a quantity that the law defines 'greater than small', which amount has been later specified by the Supreme Court in specific guidelines to be used in judicial cases. In Romania, changes to the Criminal Code entered into force in 2004, reduced penalties for supply and possession for personal use of a number of substances, including cannabis. In the latter case, a fine or a prison sentence from three months to two years can be imposed. In 2005, the Slovak Republic amended its Criminal Code widening the definition of 'possession for personal use' from one to three doses of any illicit substance, while leaving the maximum punishment unchanged. Two new penalties can also be given to those offenders: monitored home imprisonment for up to one year, or community service of 40 to 300 hours. The change also introduced a new offence of 'possession of a larger amount for personal use', defined as up to 10 doses, punishable by up to five

years in prison. The same offence previously would have been considered trafficking with a higher prison penalty.

Facilitation of the closure of minor cases: in Poland a particular form of depenalisation came into force in 2011. Although no changes were operated to the criminal penalty punishing personal possession, the prosecutor and the judge were given the option to discontinue criminal procedures in cases where individuals are caught in possession of small amounts of illegal substances for private use.

Increase of the non-prison penalty: in Denmark, a guideline for prosecutors, later integrated in the drug law, issued in 2004, set out that the normal response for minor drug possession offences should be a fine, not a warning as it was before. At the end of 2006 Italy removed the sentencing distinctions between two classes of illicit drugs to reaffirm that all substances, regardless of their effects, are dangerous and damaging. Furthermore it increased the maximum duration of administrative sanctions, such as the withdrawal of driving licence, to one year for any illicit drug. This resulted in a higher penalty for possession of cannabis for personal use. Subsequently, in February 2014, the Constitutional Court declared that amendment illegitimate for unrelated reasons and repealed the law, so that now the duration of the punishments foreseen is set at one to three months. In Ukraine, the 2010 Order of the Ukrainian Ministry of Health amended the table of quantity thresholds, lowering it also for cannabis so that the possession of the same small amount of the substance classed as an administrative offence before, after 2010 became an criminal offence.

Increase of the prison penalty: in Hungary, where until 2013 drug use itself was not punishable by law whilst possession of drug was already a crime, drug consumption became illegal and considered as serious as possessing a small amount of substance. Both offences are now punishable by one to five years in prison.

1.9.2 Other robustness checks

Table 1.8: Reduction of the prison sentence for minor offences

	Availability (all students)	All users (last year)	Experimenters (last year)	Frequent users	All users (lifetime)	Experimenters (lifetime)
Perc. GDP	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Urban Pop.	0.346	0.086	-0.086	-0.036	-0.053	-0.100
	(0.675)	(0.354)	(0.142)	(0.034)	(0.437)	(0.200)
RPSMO	-1.354	1.127	1.116	-0.042	1.616	1.500
	(3.364)	(1.765)	(0.709)	(0.168)	(2.179)	(0.900)

Table 1.9: Reduction of the maximum prison sentence

	Availability (all students)	All users (last year)	Experimenters (last year)	Frequent users	All users (lifetime)	Experimenters (lifetime)
Perc. GDP	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Urban Pop.	0.196	0.110	0.009	-0.035	0.110	0.065
	(0.664)	(0.429)	(0.140)	(0.033)	(0.429)	(0.182)
RPSMO	-1.770	1.784	0.859	0.224	1.784	1.855**
	(2.505)	(1.619)	(0.528)	(0.121)	(1.619)	(0.685)

Table 1.10: Facilitation of the closure of minor cases

	Availability (all students)	All users (last year)	Experimenters (last year)	Frequent users	All users (lifetime)	Experimenters (lifetime)
Perc. GDP	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Urban Pop.	0.464	0.300	0.030	-0.037	0.206	0.050
	(0.656)	(0.335)	(0.137)	(0.034)	(0.417)	(0.185)
FCMC	7.598	6.634*	2.550*	-0.148	7.498*	3.050*
	(5.018)	(2.560)	(1.048)	(0.244)	(3.189)	(1.415)

Table 1.11: Facilitation of the closure of minor cases - Parallel trend test estimates

	All users (last year)	Experimenters (last year)	All users (lifetime)	Experimenters (lifetime)
Perc. GDP	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Urban Pop.	0.103	-0.048	-0.063	-0.066
	(0.352)	(0.141)	(0.431)	(0.189)
lead(FCMC)	1.108	1.098	1.082	0.582
	(2.553)	(1.024)	(3.127)	(1.373)

Table 1.12: Increase of the non prison penalties

	Availability (all students)	All users (last year)	Experimenters (last year)	Frequent users	All users (lifetime)	Experimenters (lifetime)
Perc. GDP	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Urban Pop.	0.038	-0.024	-0.130	-0.034	-0.164	-0.164
	(0.653)	(0.338)	(0.131)	(0.033)	(0.173)	(0.173)
INPP	-5.369.	-3.613*	-2.182***	-0.110	-3.090***	-3.090***
	(2.910)	(1.506)	(0.582)	(0.147)	(0.769)	(0.769)

Table 1.13: Increase of the non prison penalties - Parallel trend test estimates

	Availability (all students)	All users (last year)	Experimenters (last year)	All users (lifetime)	Experimenters (lifetime)
Perc. GDP	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Urban Pop.	0.305	0.083	-0.067	-0.086	-0.078
	(0.669)	(0.348)	(0.141)	(0.424)	(0.186)
lead(INPP)	-0.052	-1.121	-0.463	-2.079	-1.034
	(2.951)	(1.536)	(0.620)	(1.871)	(0.820)

Table 1.14: Increase of the prison penalties

	Availability (all students)	All users (last year)	Experimenters (last year)	Frequent users	All users (lifetime)	Experimenters (lifetime)
Perc. GDP	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Urban Pop.	0.331	0.066	-0.020	-0.038	0.066	-0.028
	(0.682)	(0.443)	(0.146)	(0.034)	(0.443)	(0.196)
IPP	-1.632	-1.316	-0.388	0.213	-1.316	0.146
	(6.154)	(3.997)	(1.318)	(0.301)	(3.997)	(1.764)

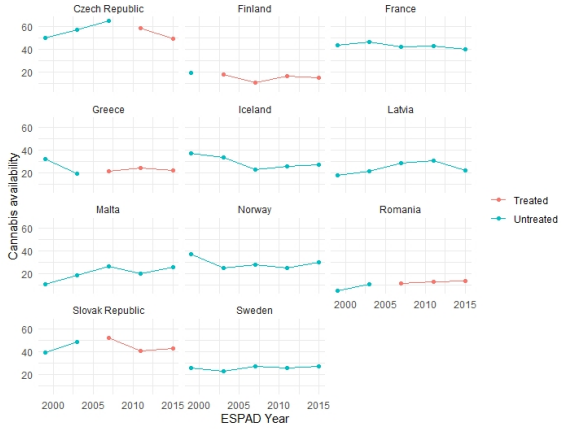
Table 1.15: Estimates and robustness check without controls

	Availability(all students)	All users(last year)	Experimenters(last year)	Non-frequent users	Frequent users	All users(lifetime)	Experimenters(lifetime
RMPS	-2.387	0.191	0.908.	0.779.	-0.086	1.691	1.911**
	(2.458)	(1.241)	(0.464)	(0.430)	(0.128)	(1.470)	(0.592)
RPSMO	-2.199	0.923	1.007	0.845	0.001	1.242	1.494.
	(3.212)	(1.623)	(0.606)	(0.574)	(0.167)	(1.922)	(0.774)
FCMC	6.234	6.022*	2.672**	2.531**	0.059	7.548**	3.454**
	(4.725)	(2.387)	(0.892)	(0.849)	(0.246)	(2.827)	(1.138)
INPP	-6.083*	-3.364*	-1.754**	-1.858***	-0.131	-5.443**	-2.398***
	(2.846)	(1.438)	(0.537)	(0.506)	(0.148)	(1.703)	(0.686)
IPP	-1.122	-0.964	-0.118	-0.398	-0.393	-0.499	0.620
	(5.749)	(2.904)	(1.085)	(1.036)	(0.300)	(3.440)	(1.385)

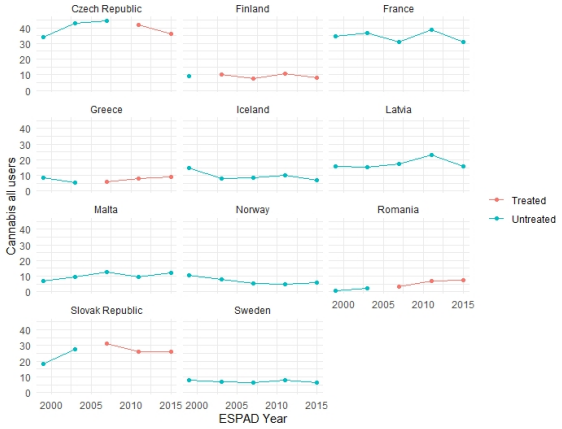
Table 1.16: Estimates and robustness check without Italy

	Availability (all students)	All users (last year)	Experimenters (last year)	Frequent users	All users (lifetime)	Experimenters (lifetime)
Perc. GDP	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Urban Pop.	-0.103	0.267	-0.032	-0.009	0.097	-0.063
	(0.807)	(0.409)	(0.153)	(0.041)	(0.484)	(0.196)
RMPS	-2.704	0.500	0.931.	-0.085	1.816	1.883**
	(2.667)	(1.352)	(0.507)	(0.135)	(1.600)	(0.648)
RPSMO	-2.635	0.814	1.063	0.088	1.291	1.489.
	(3.446)	(1.748)	(0.655)	(0.174)	(2.067)	(0.838)
FCMC	6.270	6.468*	2.697**	-0.035	7.572*	3.477**
	(5.219)	(2.647)	(0.992)	(0.264)	(3.131)	(1.269)
INPP	-5.552	-3.047	-1.847*	-0.021	-5.786*	-2.718**
	(3.794)	(1.924)	(0.721)	(0.192)	(2.276)	(0.922)
IPP	-1.113	-1.436	0.002	-0.346	-0.654	0.767
	(6.231)	(3.160)	(1.184)	(0.315)	(3.738)	(1.515)

Figure 1.1: Trends in RMPS and controls groups

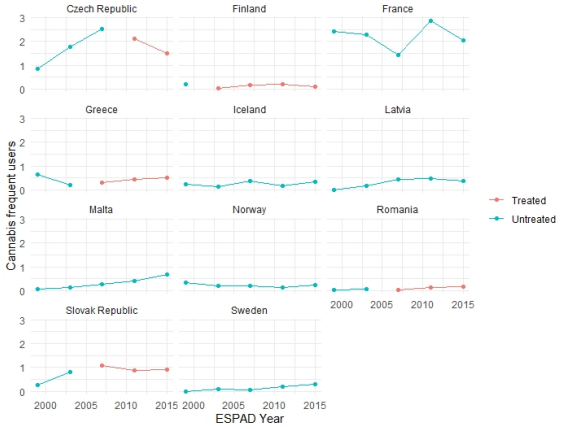


(a) Perceived availability of cannabis



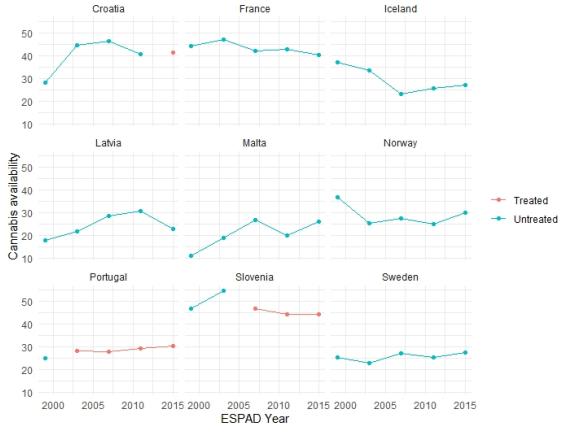
(b) All users

(c) Experimenters (last year)

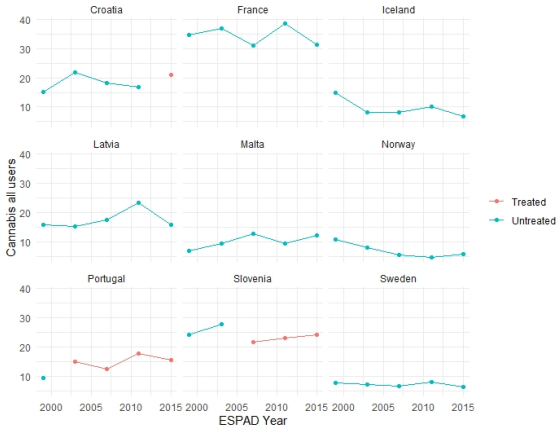


(d) Frequent users

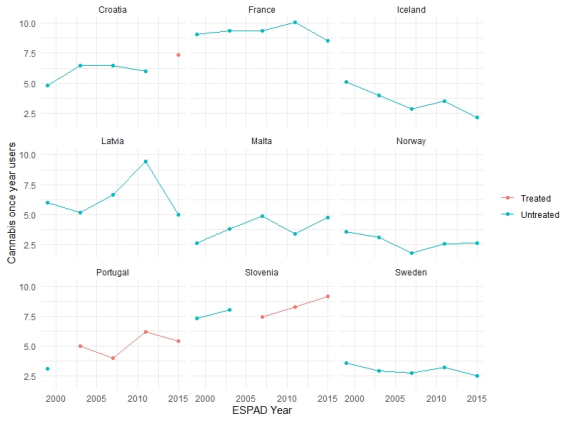
Figure 1.2: Trends in RPSMO and controls groups



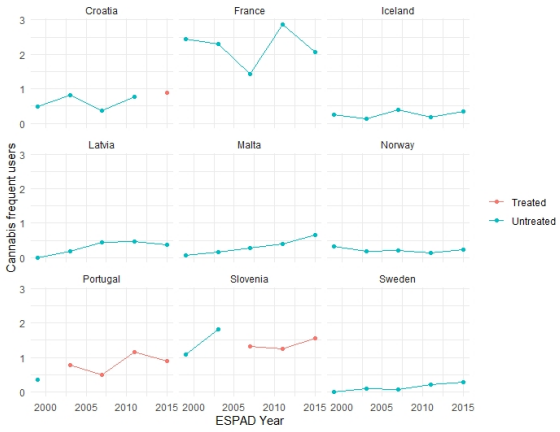
(a) Perceived availability of cannabis (all students)



(b) All users (lifetime)

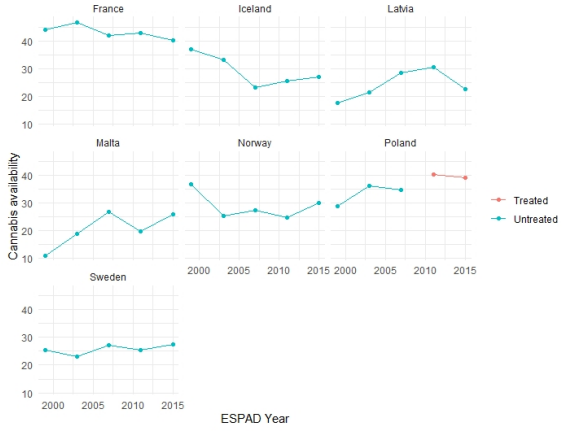


(c) Experimenters (last year)

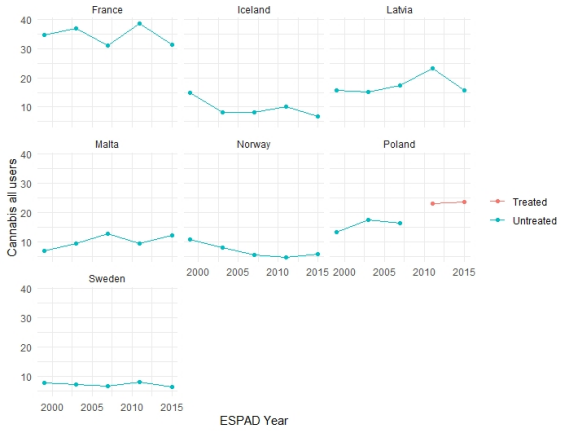


(d) Frequent users

Figure 1.3: Trends in FCMC and controls group

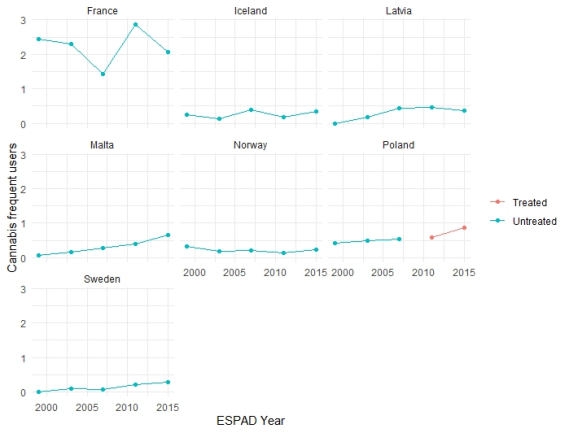


(a) Perceived availability of cannabis (all students)



(b) All users (lifetime)

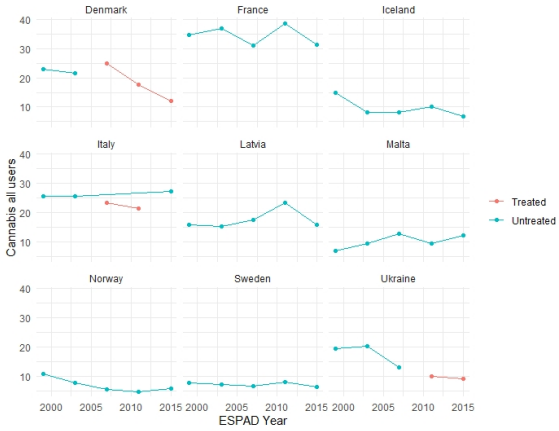
(c) Experimenters (last year)



(d) Frequent users

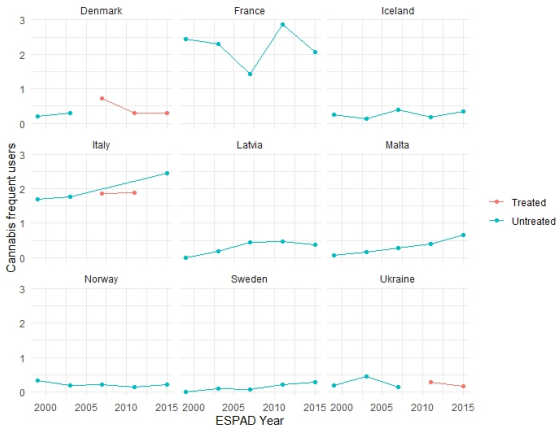
Figure 1.4: Trends in INPP and controls groups

(a) Perceived availability of cannabis (all students)



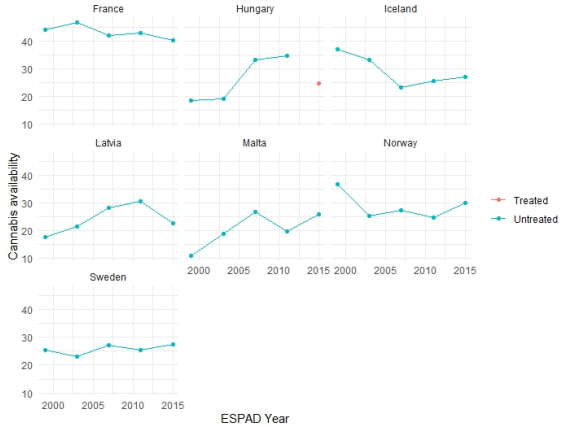
(b) All users (lifetime)

(c) Experimenters (last year)

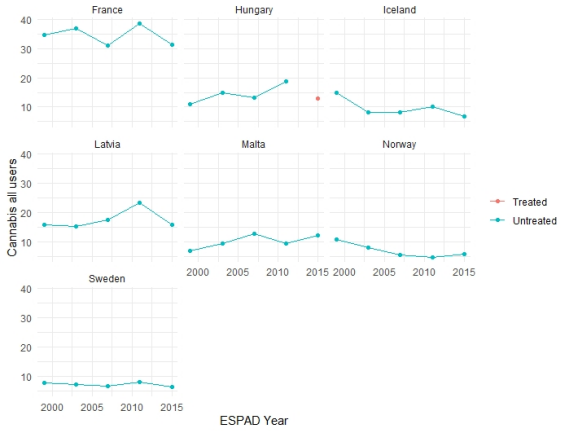


(d) Frequent users

Figure 1.5: Trends in IPP and controls groups

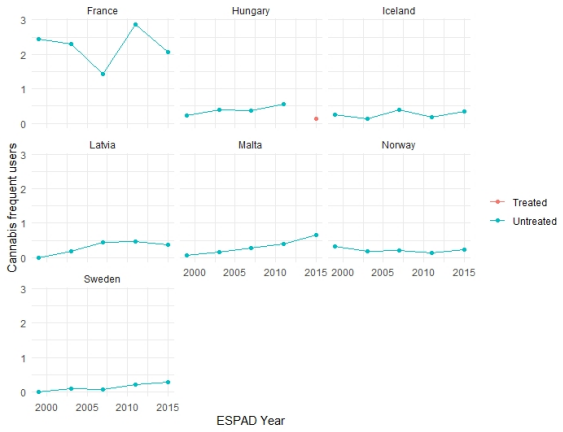


(a) Perceived availability of cannabis (all students)



(b) All users (lifetime)

(c) Experimenters (last year)



(d) Frequent users

Chapter 2

Criminalisation and the onset of cannabis use

Abstract

A key question in the ongoing policy debate over cannabis' legal status is whether removing or increasing penalties attached to cannabis use and possession leads to an increase in cannabis use. Empirically investigating the effects of policy changes on the dynamics of cannabis is a growing field of study. This paper aims at extending previous research by studying the effect of increasing penalties on initiation into cannabis use. This is done in the Italian context where, despite the relevant drug policy reforms implemented over the last 30 years, very little econometric studies have been performed to evaluate their effects. In order to identify the effect of criminalisation on the transition into cannabis use, we exploit the policy change that in the period from 2006 to 2014 increased the penalties attached to cannabis possession in Italy. For this, we use a unique dataset pooling seven waves (2001-2017) of the Italian Population Survey on Alcohol and other Drugs (IPSAD). Our empirical investigation uses a Complementary Log-Log model to analyse the starting rate, that is, the transition rate from non-use to use. Our results suggest that the introduction of higher punishments for cannabis possession has a significant, although limited, effect in reducing the uptake of cannabis. However as the adult age approaches, the effect of criminalisation in reducing the probability of cannabis uptake seems to diminish.

Keywords: Cannabis; Policy change; Age of onset.

JEL Codes: H75; I12; I18; K42

2.1 Introduction

Cannabis is the most used illicit drug. Between 3.3% and 4.4% of the global population aged 15–64 used cannabis in 2017, accounting for 164–219 million people (UNODC, 2019). More informative about the extent of cannabis use is the prevalence among young individuals, where cannabis use is most concentrated. In Europe, an estimated 14.4% of people aged 15-34 used cannabis in the last year. When only 15- to 24-year-olds are considered, the prevalence of cannabis use reaches 18%, corresponding to 10.1 million young adults (EMCDDA, 2019).

In this framework, economics literature focusing on this substance has been growing in recent years. Its distinguishing feature with respect to other disciplines, is that it seeks to empirically determine the causal nature of the relationship that runs from policy to cannabis use and between this and its potential health and socio-economic consequences. These three topics are intrinsically linked. In fact, a key concern voiced in policy debates on cannabis, which lays the basis for prohibition policies (Cêrvený et al., 2017), is that cannabis use has harmful health effects.

With respect to the first relationship, empirically investigating the policy impact of removing or increasing penalties attached to cannabis use and possession on the extensive and intensive margins of cannabis use has been a fertile topic for research in recent times, but the evidence produced is mixed (Thies and Register, 1993; Pacula, 1998a; Saffer and Chaloupka, 1999; Chaloupka et al., 1999; Cameron and Williams, 2001; Farrelly et al., 2001; DiNardo and Lemieux, 2001; Pacula et al., 2003; Hall and Pacula, 2003, Williams, 2004; Damrongplasit et al., 2010; Anderson et al., 2011; Adda et al., 2013; Anderson and Rees, 2014; Pacula et al., 2015).

With respect to the consequences of cannabis use, despite a substantial quantity of epidemiological studies and a growing number of econometric studies, no robust evidence has been provided about the negative health effects of cannabis use. In particular, as highlighted by the review conducted by van Ours and Williams (2015), the main findings indicate that there do not appear to be serious health effect for moderate cannabis use, also in terms of mental health and well-being. What research indicates is that an important feature in assessing the impact of policies on the dynamics of cannabis use is the age of onset. In fact, most people that start using drugs do so at a relatively young age. If initiation has not occurred at a particular age, which is drug-specific, they are very unlikely to do so at a later age. For cannabis, initiation into use typically occurs during the mid to late teens (van Ours, 2007). Early initiation into cannabis is associated with a longer duration of use, and in terms of the indirect health effects, the literature has produced evidence that early onset of cannabis use is associated to reduced educational attainment in terms of school performance (Lynskey and Hall, 2000; Register et al., 2001; Macleod et al., 2004; Roebuck et al., 2004; Chatterji, 2006; van Ours and Williams, 2009; Mokrysz et al., 2016).

Although in recent years some countries have legalised cannabis, jurisdictions

which take a "soft" approach to this substance are an exception to the rule and, to a large extent, those who decide to start using cannabis do so under the threat of administrative or criminal prosecution. Understanding the margins to which policies might be effective in influencing the age at which people first get into contact with cannabis is important. In fact, although most cannabis users do not experience adverse consequences from its use and a significant proportion of those who try the substance use it for a short period or on a regular basis but at low levels, others will become long-term heavy users (van Ours, 2006), and the likelihood of experiencing adverse consequences is greater among those who start early (Hall, 2009).

To study the effect of policies on the dynamics of cannabis use, information is needed from the time that the individual was first confronted with the choice to use a particular drug. Unfortunately, this type of information is most often not available, and this paucity of good data justifies the scarcity of econometrics research on the dynamics of cannabis use (van Ours and Williams, 2015). The few studies investigating the effects of cannabis policy changes on the uptake of cannabis use are focused on decriminalisation.

Cêrvený et al. (2017) investigated the effect that the decriminalisation of the possession for personal use passed in the Czech Republic in 2010 had on the age of onset of use among youngsters. By applying a mixed proportional hazards framework to model the transition to cannabis use, they found that the policy change did not affect the age of onset of cannabis use.

Palali and van Ours (2015) analysed the effect of the availability of cannabis shops stemming from the quasi-legalised cannabis regulation in the Netherlands and found that youngsters living within 20 kilometres from cannabis shops are more likely to start using cannabis earlier than those leaving farer.

Finally, Williams and Bretteville-Jensen (2014) analysed the effects of decriminalisation in some Australian States exploiting the variation in the timing of introduction across territories. They found that when considering a homogenous treatment effect of decriminalisation, no significant effect on uptake is detected. However, when looking at youngsters, cannabis decriminalization affected the uptake of cannabis among them in the first five years following the policy change.

This paper has a twofold objective. First, it aims at extending previous research about the effects of drug policy reforms on the age at which cannabis is first used. While previous studies have focused on decriminalisation, this paper aims at investigating the effect of criminalisation, i.e. an increase of penalties for cannabis use and possession. The second is to do it in the Italian context where, despite the relevant drug policy reforms implemented over the last 30 years, very little econometric studies have been performed to understand their population-level effects. To our knowledge, the only studies performed so far exploited the legislative gap which since December 2016 allowed to sell cannabis products with low level of tetrahydrocannabinol (C-light) to estimate the displacement effect on the illegal supply of marijuana (Carrieri et al., 2019a) and the impact on prescription drug

sales (Carrieri et al., 2019b).

Our empirical investigation uses a Complementary Log-Log regression model to study the starting rate, that is, the transition rate from non-use to use of cannabis. In order to identify the effect of criminalisation on this transition, we exploit the policy change that in the period 2006-2014 increased the penalties attached to cannabis possession. For this, we use a unique dataset pooling seven waves of the Italian Population Survey on Alcohol and other Drugs (IPSAD). Our results suggest that the introduction of higher punishments for use and possession has a significant, although relatively limited, effect in reducing the uptake of cannabis.

The rest of this paper is organised as follows. Section 2.2 provides the institutional background for this study by reviewing the evolution of the legal environment for cannabis use in Italy. Section 2.3 presents the data by first providing an overview of long term trends in cannabis use onset in the Italian context and then describing the dataset used. Section 2.4 describes the empirical methodology used for analysing the effect of criminalisation on the initiation into cannabis use. Section 2.5 reports the results. Section 2.7 concludes with a discussion of findings.

2.2 Institutional setting

The first legislation concerning illicit drugs in Italy dates back to 1923, with various revisions in 1934 and 1954, all aimed at repressing the traffic of drugs and considering drug use as a mental disease to be treated with compulsory hospitalisation. After the approval of the United Nations convention on drugs of 1961, its principles were translated in the Italian legislation in 1975. Through law 685 of 1975, for the first time a distinction was made between different drugs and between dealers and consumers (D'Egidio, 2019).

In 1990, it was approved the Presidential Decree 309/90, commonly referred to as Jervolino-Vassalli from the names of its promoters, which amended the penal code defining the possession of drugs for personal use as an administrative offence and introducing the term "greater than small" quantity and an ad hoc evaluation of the specific circumstances of the offence to be made by the judge as a threshold distinguishing between a criminal offense and an administrative offense. Furthermore, drugs were differentiated in the penal code, according to their health and social risks, in two groups "soft drugs" and "hard drugs", cannabis and its derivatives constituting the first group, with different criminal penalties attached to distribution and trafficking.

In 2006, the approval of Law n. 49, commonly called Fini-Giovanardi from the names of its promoters, introduced several changes. The policy change was motivated by the government with two main points. The first is that the lack of a defined threshold for distinguishing possession for personal use from possession with intent of dealing was attributing a discretionary power to the judge, who was responsible for deciding about the alleged destination of the drug possessed by the

charged individual. The second was the social danger posed by drugs and drug users, the latter being harmful for individual health independently form their nature (D'Egidio, 2019).

On the basis of these motivations, the law substantially increased both the penalties attached to cannabis possession for personal use and for dealing and trafficking, making it more likely for users to fall in the latter crime. Table 2.1 provides a summary overview of the main changes.

Table 2.1: Penalties for the possession of cannabis (1990-2019)

	1990-2005 and from 2014 onwards	2006-2014
Possession for personal use		
Quantity threshold	No threshold defined. "Small quantity" defined by judicial court case by case on the basis of weight, quantity of psychoactive component and specific circumstances of the offence, excluding distribution and supply.	For cannabis, 500 milligrams of psychoactive component.
Penalty	Administrative sanctions for a maximum of three months. For first time offence: policy warning. For repeated offences: suspension of driving license and/or passport, to be decided by judicial court. Deferral to addiction treatment services foreseen as an alternative to punishment. For minor citizens: police warning and possible information to family.	Administrative sanctions for a maximum of one year. For first time offence: suspension of driving license, prohibition of leaving home in fixed hours, order to appear in police station two times per week. Deferral to addiction treatment services compulsory in addition to punishment. For minor citizens: police warning, information to family and referral to addiction treatment services.
Possession with intent to distribute or supply		
Quantity threshold	No threshold defined. Possession for quantities "greater than small".	Above 500 milligrams of psychoactive component.
Penalty	For cannabis, from two to six years incarceration and a fine from €25.822 a €258.228. Penalties reduced to one third in case of minor offences.	For all substances comprising cannabis, from 6 to 20 years incarceration and a fine from €26.000 to €260.000 for all other offences. Penalties reduced to 1 to 6 years incarceration and a fine from €3.000 to €26.000 for minor offences.

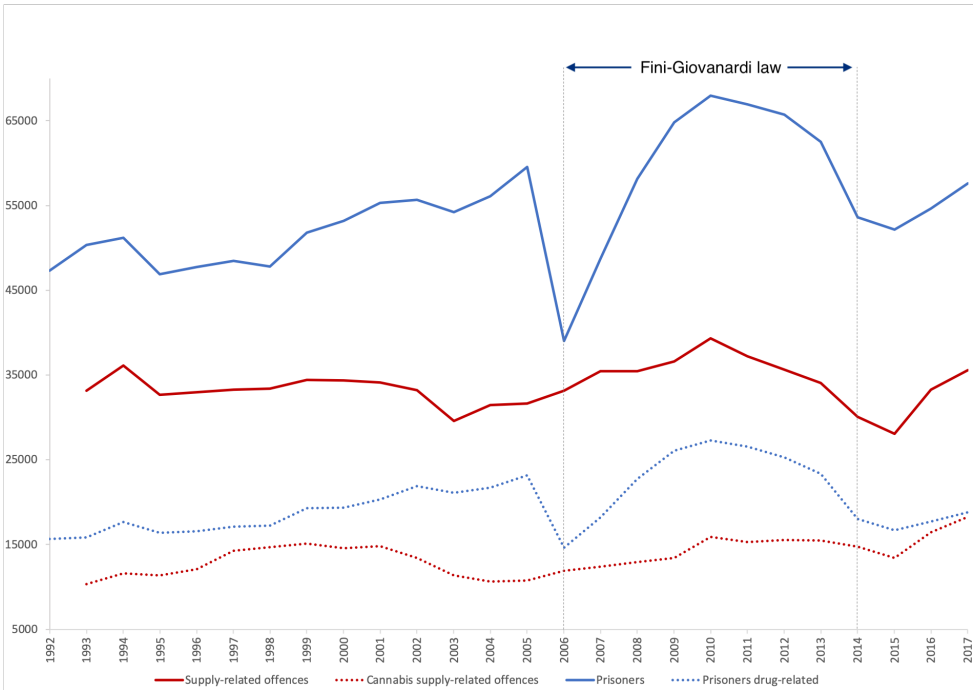
Source: Author's elaboration based on information from the Ministry of Justice

Briefly, defined quantity limits were applied for the possession of drugs for personal use on the basis of the psychoactive component contained in it, in the case of cannabis 500 milligrams of Tetrahydrocannabinol (THC). The administrative penalties for the possession of drugs were raised and their applicable length raised to one year, and complemented by the compulsory deferral to addictions treatment services. Furthermore, the criminal penalties attached to the possession of cannabis above the threshold ranged from one to six years imprisonment for minor offences, and from six years to twenty years for more serious charges.

During the eight years in which the new policy was into force, a harsh national debated developed. Opponents voiced that for consumers it was difficult, if not impossible, to know the quantity of psychoactive principle contained in the drugs carried, especially due to the great variability in the potency of substances available

on the market in recent years (EMCDDA, 2019), making it uncertain for the know consequences of their use. Furthermore, the new policy was accused to have disproportionately increased the social costs for drug users, with a substantial increase observed in the number of drug supply-related complaints and attached penal consequences as well as of the number of individuals in jail for minor drug-related offences (Scandurra, 2019). This is because, for the same "small" amount of drug carried, drug consumers or addicts that before the policy would have been charged with administrative sanctions, under the new policy received penal sentences often encompassing incarceration. Figure 2.1 illustrates the trend of the number of individuals receiving a complaint for drug supply-related offences and of the individuals in jail over the period 1992-2017. For the latter indicator, the portion of individuals receiving a complaint for cannabis supply-related and for the former the portion of the individuals in jail for drug-related offences are provided. Concerning both the amount of drug and cannabis supply-related offenders an increasing trend can be observed as of 2006, the year in which the Fini-Giovanardi law entered into force, which reached the peak of 39,340 individuals charged in 2010. In 2014, the share of the total drug-supply complaints due to cannabis reached 49%. Although not reported here, the application of the Chow structural break test (Chow, 1960) shows a non-significant effect of a time trend before 2006 and a significant and positive one from that year on. The same applies to 2014. Observing the trend of the total prison population, we note an increasing trend until 2005, followed by a sudden drop in 2006. This is because in the same year, due to the overcrowding of prison facilities and the inability of the prison system to guarantee the respect of human rights in jail, a pardon was approved which reduced the prison population by 34.5%. Interestingly, only two years after the approval of the Fini-Giovanardi law the prison population had again reached the level of 2005, and its maximum in 2010 (67,961 individuals). Also the share of individuals in prison for drug-related offences over the total individuals in prison reached the maximum of 40% in the years 2009-2011.

Figure 2.1: Number of drug supply-related offenders and prison population (1992-2017)



Source: Author's elaboration based on official data sources: Ministry of Interior - Central Directorate of Anti-Drug Services (DCSA) for drug supply-related offenders; Ministry of Justice - Prison Administration Department (DAP) for prison population.

In 2014, a sentence of the Constitutional Court declared law 49 of 2006 illegitimate and repealed it, not on the basis of its contents but due to the procedure of its adoption, inserted in the framework of a much broader legislative initiative covering as first topic the funding for the upcoming Olympic games. Shortly after, legislative decree n. 36 brought back the legislative framework for drug use and possession to the provisions foreseen by the Jervolino-Vassalli law as of 2015.

To summarise, cannabis possession for personal use was decriminalised in Italy in 1990. The policy in force in the period 1990-2005 made a distinction between "hard" and "soft" drugs, with related differentiation in the criminal penalties attached to the possession of quantities of cannabis not considered for personal use. The latter concept was defined case by case on the basis of the specific circumstances. In the period 2006-2014, although cannabis possession for personal use remained an administrative offence, a defined quantity fixed the threshold between possession for personal use and for distribution and trafficking, and the administrative penalties for the former were raised. Furthermore, the legal distinction between "soft" and "hard" drugs was de facto eliminated, and cannabis was equalised to harder drugs substantially increasing the criminal penalties attached to the possession of quantities above the set threshold. Since 2015, when the 2006 law was repealed, the pre-existing system came back into force.

2.3 Data

This research uses individual level data on the age at which cannabis is first used from the IPSAD survey, a cross-sectional survey conducted since 2001 by the Institute of Clinical Physiology of the Italian National Research Council (CNR-IFC). IPSAD is the only study providing nationally representative data on substance use, gambling and other risk behaviours adopted by the Italian population aged 15-74. Data are collected through postal self-administered and anonymous paper and pencil questionnaires (PAPI) from a proportional stratified randomized sample, extracted

from the registry lists of selected municipalities in the sampling frame. A detailed description of the survey methodology is provided in the Annual Report to the Parliament on Drugs and Drug Addiction (DPA, 2014).

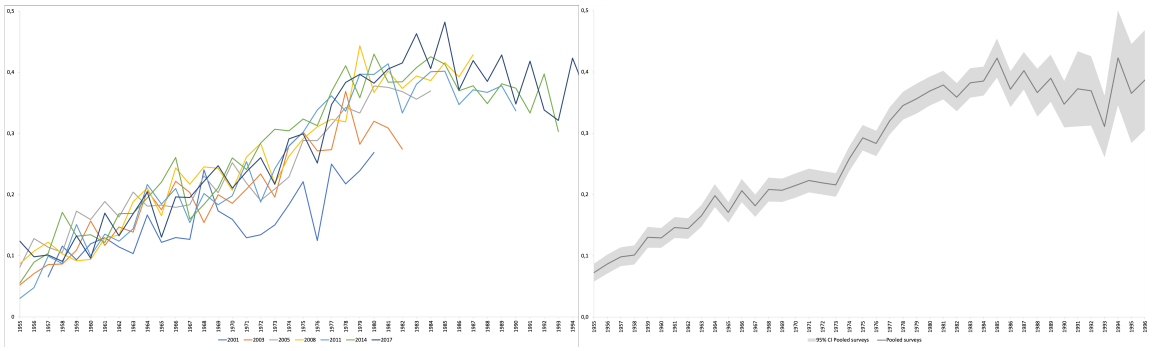
For the present study the 2001, 2003, 2005, 2008, 2011, 2014 and 2017 waves of IPSAD were pooled (77,650 observations in total). Data from the 2014 and 2017 surveys have been weighted by CNR-IFC to adjust the sample to the socio-demographic composition of the target population. Information on the decision to start using cannabis is self-reported retrospectively by responses to the question "What age were you when you first used cannabis?".

Before proceeding to the description of how the final dataset for our empirical analysis was built, for purely descriptive purposes it is interesting to get an overview of the long term trends of the initiation of cannabis use in Italy that can be offered by our dataset.

2.3.1 Long term trends in cannabis use onset

In order to illustrate long term trends in the rate of initiation of cannabis use in Italy, Figure 2.2 shows the prevalence of the reported first use of cannabis in the at-risk age range 10-20 years among individuals aged 20 years or more, for the birth cohorts from 1955 to 1996.

Figure 2.2: Proportion of cannabis first use at age less or equal to 20 among older than 20 years, by birth cohort (1955-1996)



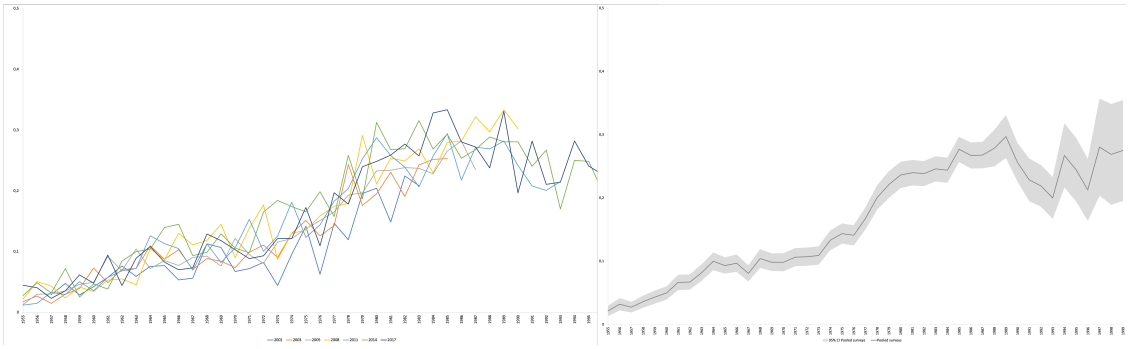
(a) By survey (2001 - 2017) **(b)** Pooled surveys (2001 - 2017)

Source: Author's elaboration on the IPSAD data.
Note: In (a) each line represents a survey wave. In (b) the grey line represents the pooled surveys' trend and the light grey band represents the 95% confidence interval of the pooled surveys' trend.

Looking at the pooled survey trend, it is possible to note that over 45 years the prevalence of cannabis use has been increasing from the 7.27% observed among the birth cohort of 1955 to the 38.68% of the birth cohort of 1996. Focusing on the subpopulation of interest in this paper, we observe a rather stable increase from the 36.89% observed in 1980 to the peak of 42.27% reached in 1985, corresponding to the lower and upper bound of the birth cohort who was never exposed to the Fini-Giovanardi law in their at-risk period. Starting from the 1986, i.e. the first birth cohort exposed to the Fini-Giovanardi law, the prevalence of onset of cannabis use decreases to reach the minimum of 31.09% in 1993, when it starts to increase again.

In Figure 2.3, the focus is restricted on the at-risk age range 10-17 years, among individuals aged 17 years or more.

Figure 2.3: Proportion of cannabis first use at age less or equal to 17 among older than 17 years, by birth year (1955-1999)



(a) By survey (2001 - 2017) **(b)** Pooled surveys (2001 - 2017)

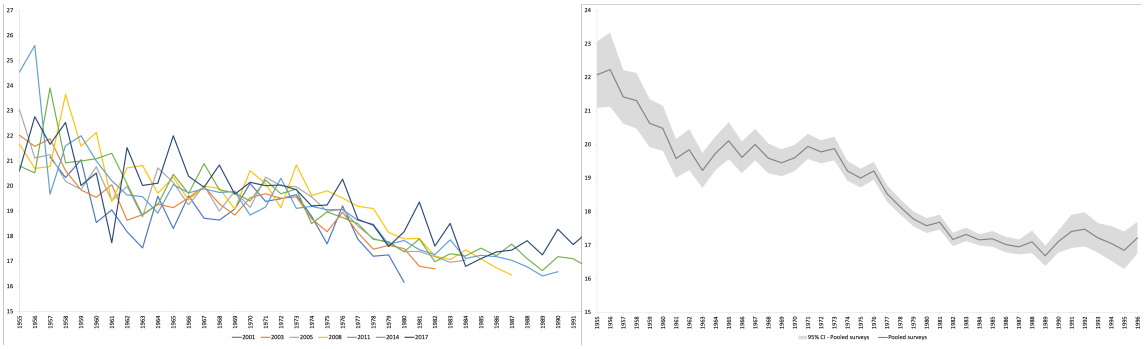
Source: Author's elaboration on the IPSAD data.
Note: In (a) each line represents a survey wave. In (b) the grey line represents the pooled surveys' trend and the light grey band represents the 95% confidence interval of the pooled surveys' trend.

The long term trend shows that over 45 years the onset of cannabis use has been increasing across birth cohorts, from 2.15% observed among those born in 1955, to 27.5% among those born in 1999.

In particular, we observe an increasing trend from the 23.62% of birth cohort of 1980 to the 27.68% of the birth cohort of 1985, corresponding to the group who was never exposed to the Fini-Giovanardi law in their at-risk period. After a decrease observed in 1986-1987, to then increase again up to the 29.69% observed among those born in 1989, i.e. the first birth cohort of the second group. Since 1990, we notice an overall decreasing trend until 1996, with the minimum of 20% observed among those born in 1993, followed by an increase in the last three birth cohort until the 27.5% in 1999.

Figure 2.4 shows the average reported age of first cannabis use among those aged 20 or more, by birth year.

Figure 2.4: Average age of cannabis first use among older than 20 years, by birth year (1955-1996)



(a) By survey (2001 - 2017) **(b)** Pooled surveys (2001 - 2017)

Source: Author's elaboration on the IPSAD data.
Note: In (a) each line represents a survey wave. In (b) the grey line represents the pooled surveys' trend and the light grey band represents the 95% confidence interval of the pooled surveys' trend.

The long term trend shows a decrease of the age at which cannabis is first used, from 22.1 years reported among those born in 1955 to 17.2 among the younger cohort born in 1996.

Looking more closely at our subpopulation of interest, we notice a decrease from 17.6 among those born in 1980 to 16.7 observed among those born in 1989, i.e. the last age cohort of the second group. Then the age of first use starts to increase until 1992 when it returns to 17.5, the level observed in 1980, to then decrease again to 16.9 in 1995.

2.3.2 Descriptive analysis

We now proceed to the description of the further steps followed in building our final dataset. Using the reported information on the age of fist cannabis use, individual histories were formed by assuming that sample members are at risk of uptake from the age of 10 until the age of 20. On this basis, in order for our sample to span the calendar time period 1980-2017, covering the passing of Jervolino-Vassalli law in 1990, i.e. decriminalisation, and the period 2006-2014 during which the Fini-Giovanardi law was into force., we right-cut our sample to the birth cohort of 1980, who entered their at-risk period of life in 1990. In the calculations, individuals that have not started using at the time of the survey are considered to have a right-censored duration of non-use. Furthermore, following the example of Cêrvený et al. (2017), individuals that indicate to have started using cannabis at the age of 9 are assumed to have started at age 10 to take into account possible age heaping. Individuals having reported a lower age of first use have been excluded from the analysis due to possible misreporting. The estimation sample is therefore comprised of 24,020 individuals aged 15-37 at the time of the survey, for whom histories on cannabis uptake were constructed from the age of 10 to 20 years. As noted by Williams and Bretteville-Jensen (2014), the relatively young age of the sample allows to minimize the potential issues of censoring and recall error with respect to age at first use.

It has to be noted that to the purpose of our estimation, the dataset has been structured in a way that individual observations are not structured as vectors but as sub-matrices, where each vector corresponds to one year of life of the individual during her period at risk (10-20) in our observation period of interest (1990-2017).

Sample means for the data used in the present analysis are reported in Table 2.2. To give a better idea of the composition of the sample, for purely descriptive purposes we report this

information not only for the full sample but also for subsamples based on whether the respondent was exposed to the criminalisation period during her period at risk of cannabis uptake (10-20 years): the first group was never exposed (born between 1980 and 1985), the second group was partially exposed (at least four years of exposure - born between 1986 and 1989 or between 2000 and 2002) and the third group was consistently or fully exposed (at least four years of exposure - born between 1990 and 1999).

Table 2.2: Sample means

	Full sample	Never exposed	Partially exposed	Consistently/fully exposed
Female	0.56	0.57	0.56	0.54
Age at survey	22.22	24.78	20.68	19.24
North-West	0.29	0.27	0.31	0.32
Nort-East	0.26	0.26	0.26	0.26
Centre	0.18	0.18	0.18	0.19
South	0.16	0.17	0.16	0.16
Islands	0.10	0.11	0.09	0.07
Low education	0.27	0.12	0.35	0.47
Ever use cannabis	0.36	0.41	0.32	0.29
Age of cannabis first use	16.85	17.23	16.43	16.41
Ever use tobacco	0.66	0.75	0.66	0.51
Age of tobacco first use	15.52	15.73	15.25	15.36
Survey year 2001	0.03	0.05	0.01	0.00
Survey year 2003	0.08	0.11	0.10	0.00
Survey year 2005	0.30	0.39	0.35	0.05
Survey year 2008	0.20	0.19	0.18	0.23
Survey year 2011	0.17	0.10	0.19	0.29
Survey year 2014	0.09	0.07	0.06	0.17
Survey year 2017	0.14	0.09	0.12	0.26
Obs.	*24020*	*11010*	*7186*	*5824*

Note: the Never exposed group consist of individuals born between 1980 and 1985; the Partially exposed group consist of individuals born between 1986 and 1989 or between 2000 and 2002; the Consistently or fully exposed group consist of individuals born between 1990 and 1999. Data coming from the 2014 and 2017 are weighted.

Table 2.2 shows that females account for 56% of the sample. The average age when individuals have participated in the IPSAD survey is 22.22 years, and 27% of individuals have a low educational background. 36% of individuals in our sample of 15–37 years-old individuals have used cannabis in their lifetime. Amongst those who have ever used cannabis, the average age of initiation is 16.85 years. 66% of individuals have used tobacco in their lifetime, and the average age of initiation is 15.52 years.

A comparison between the three groups (individuals not exposed to the Fini-Giovanardi law, individuals who lived at least four years of their at-risk period under the Fini-Giovanardi policy regime, and individuals who lived more than four years under the policy regime) reveals that they differ in terms of lifetime prevalence of cannabis use, with 41% of those in the first group having ever used cannabis compared with 32% of those in the second group and 29% of those in the third group. Concerning the age of first cannabis use, the first group shows a slightly higher age (17.23) compared to the other two groups (16.43 and 16.41 respectively). Concerning the share of individuals with a low educational level, a difference can be noted between the three groups: 12% in the first group, 35% in the second, and 47% in the third. In terms of other observed characteristics,

the three groups appear to be similar with the exception of the survey year in which they have been interviewed.

Figure 2.5 shows the hazard rate for starting cannabis use in the at-risk period 10-20 years of age for the three groups defined above separately. The hazard rate is the transition rate from non-use to use for each particular year of age in the period at risk that we consider (10-20 years of age), conditional on not having used up until that age. In calculating age-specific starting rates, for individuals who have never used cannabis in their at-risk period, we assume that the duration until cannabis use is right-censored at their survey age. It can be noted that the hazard of starting cannabis use for the three groups each have peaks at age 16, and that the Not exposed and Consistently or fully exposed groups have a further peak at 18. Furthermore, uptake declines substantially after the age of 18 in each group. Figure 2.5 also shows that up to age 13 only a few percent of individuals start to use cannabis, and that until age 16 the hazard is lower for those who were never exposed to the Fini-Giovanardi law, whilst the picture reverts as of the age of 16. At age 19 the hazard for the Never exposed and Consistently or fully exposed groups converge, whilst by the age of 20, the Never exposed group has higher hazard and the two exposed groups converge.

Figure 2.5: Hazard function for the uptake of cannabis

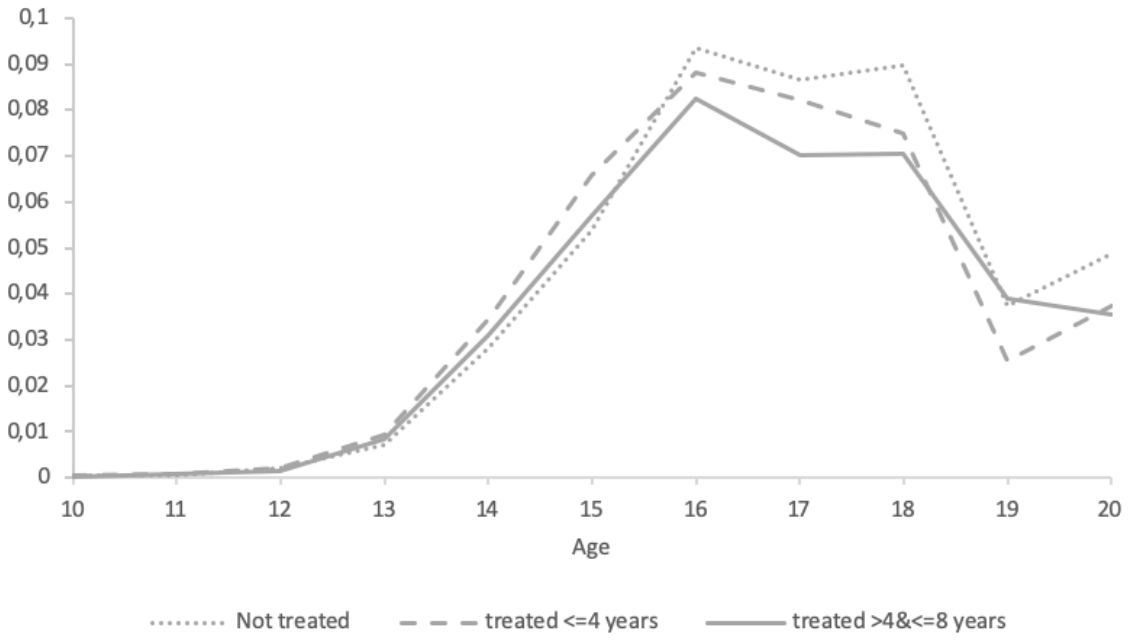
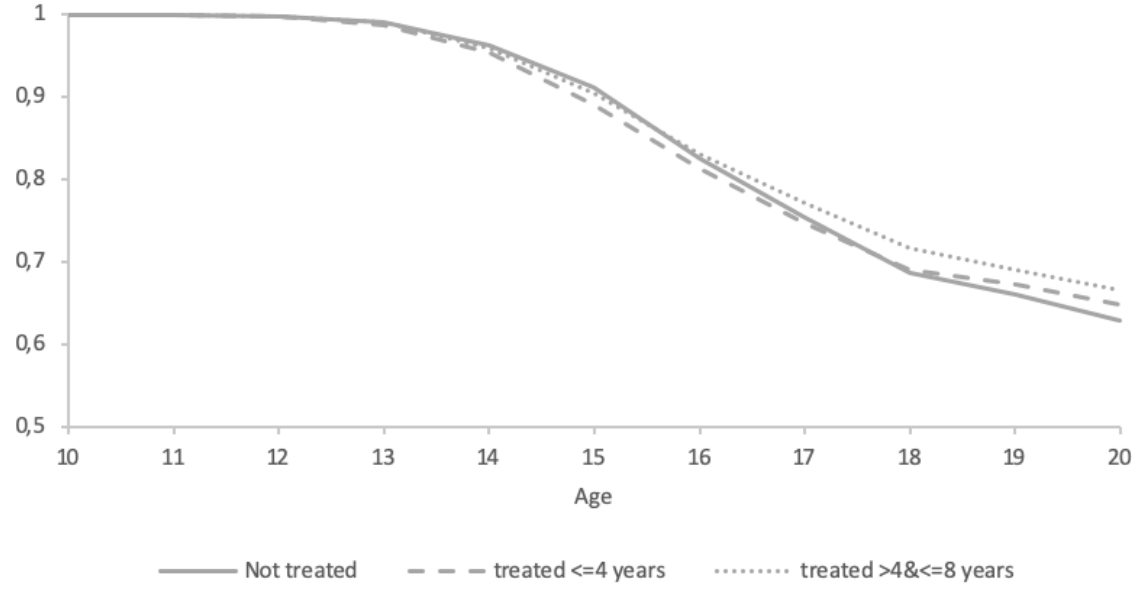


Figure 2.6 graphs a non-parametric estimation survival functions for the three groups. The survival function is the probability of not using cannabis until at least age T. Without censoring this function would just correspond to the empirical distribution of the data (Rodríguez, 2005). This is useful for descriptive purposes to see the shape of the survival function.

Figure 2.6 shows that the probability of not using cannabis declines starting from age 13 for all groups, and that the three groups do not differ consistently in terms of survival probability over the analysed at risk-period. By age 20, 66.5% in the Consistently or fully exposed group have not used cannabis compared to 64.7% in the Partially exposed group and 62.8% in the Never exposed group.

Figure 2.6: Survival function for the uptake of cannabis



Although the distinction between the three groups in not used in the analysis, this description has been useful in that it has shown the presence of some differences between those that spent some of or all their at-risk period of life under criminalisation and those who did not.

2.4 Empirical model

With the aim of estimating the effect of criminalisation on the uptake of cannabis we exploit the timing of the introduction of the policy. We pool cross-section population surveys, using a retrospective question in order to reconstruct personal histories about their spells in the state of interest, i.e. non-use of cannabis. Since individuals were asked about the age of their first use of cannabis and also their age at the time of survey, we are able to determine the time-frame in which they might have been affected by the new policy which remained into force from 2006 to 2014.

Consequently, the framing of the questions contained into the survey allow us to reconstruct year by year the life of the subjects in an event history form. Of course, considering events at a yearly interval requires to rely on discrete-time events with interval-censoring, time-varying and time invariant covariates. Besides the fact that Flinn and Heckman (1982) highlight how time-varying covariates can generate the unintentional endogenisation of exogenous effect in presence of a strong time trend, in a logarithmic model this shortcoming can be mitigated by the usage of a dichotomic variable (Alisson, 1982). This is precisely the case of the inclusion of a dummy indicating if the policy reform is in place during a certain year.

The Complementary Log-Log regression model is widely-used in order to deal with survey or treatment data transformed into an event-history form (Richardson, 2009; Southey et al., 2003), since it results in a closed-form marginal likelihood (Ten Have, 1996). Moreover, Prentice and Gloeckler (1978) highlight how, if the Cox (1972) proportional hazard model solved the problem of dealing with censored survival data with covariates, the present class of models goes forward, solving also the problem of tied events because of simultaneuous multiple failures.

Thus, a generalized linear model for Complementary Log-Log regression can be estimated as (Penman and Johnson, 2009):

$$log[-log(1-\pi_i)] = \mathbf{X}^{\mathbf{T}}\beta = \beta_0 + \beta_1 \text{period-at-risk}_i + \sum_{h=1}^{H} \gamma_h z_{i,h} + \sum_{g=1}^{G} \delta_g w_{i,g} + \psi d_i \tag{2.1}$$

where

$$\pi_i = h_i = 1 - exp(-exp(\beta_0 + \beta_1 \text{period-at-risk}_i + \sum_{h=1}^{H} \gamma_h z_{i,h} + \sum_{g=1}^{G} \delta_g w_{i,g} + \psi d_i)) \tag{2.2}$$

represents the predicted probabilities over a linearised range between $[-\infty; +\infty]$, and it can be interpreted as the specific value over the hazard function h. Coherently with Williams (2014), the baseline hazard is discretely represented by the age of each individuals, following them during the period at-risk, which is settled between 10 and 20 years old. Thus, the coefficient β_1 captures the effect of a linear increase in age across the prescribed range, in conditioning the probability of starting cannabis usage. Moreover, z_h identifies the set of the h individual characteristics. w_g represents the set of covariates referring to other controls, and d is an indicator equal to one for ages at which the respondent was exposed to the new policy reform, all composing the matrix $\mathbf{X}$ that collects the variable values for each individual in each age of her at risk period, comprised in the observation time window considered in the analysis (1990-2017).

In particular, the individual characteristics included are gender, and an indicator equal to one if individual interrupts her schooling at the lower-secondary level. This indicator should be interpreted as a proxy of the individual background, since it is possible that someone would start using cannabis during this period, but it is very unlikely if she comes from a high socio-economic environment. This indicator will be also interacted with the policy, in order to investigate if there are significant differences in the behavior of low-educated individuals at the confluence of the reform. Moreover, the set of other time invariant indicators includes macro-region of residence (to account for unobserved time invariant regional factors that impact on cannabis uptake and that are potentially correlated with regional level availability of cannabis), the year surveyed (to account for possible survey-specific effects) and birth year fixed effects (to account for common shocks that may impact on cannabis uptake).

The dummy variables for the macro regions of residence, defined on the basis of the NUTS 1 geographical breakdown, group the 20 Italian regions as follows: North West (Piemonte, Valle d'Aosta, Liguria, Lombardia); North East (Trentino-Alto Adige, Veneto, Friuli - Venezia Giulia, Emilia – Romagna); Centre (Toscana, Umbria, Marche, Lazio); South (Abruzzo, Molise, Campania, Puglia, Basilicata, Calabria; Islands (Sicilia, Sardegna).

Table 2.3: Correlation matrix of macro region of residence, per capita GDP and unemployment rate

	Macro region	Per capita GDP	Unemployment rate
Macro region	1		
Per capita GDP	-0.4898	1	
Unemployment rate	0.8027	-0.6009	1

Note: The Macro region variable is coded as follows: 1= North West; 2= North East; 3= Centre; 4= South; 5= Islands.

Although we decided not to include any regional level time varying variable to proxy for the socio-economic characteristics of the environment of individuals, due to the problems caused by the inclusion of time varying variable highlighted by Flinn and Heckman (1982) and discussed before, it has to be noted that there exists a strong correlation between Italian macro regions and per capita GDP (which could have functioned as a proxy of the income level) and unemployment rate (which could have functioned as a proxy of the opportunity cost of time). In fact it exists a

strong regional disparity in Italy: as shown in Table 2.3 **??** southern regions and islands perform far worst on both indicators (lower per capita GDP and higher unemployment rate) than northern regions.

At this point, it is necessary to identify the functional form of the baseline hazard for the prescribed period at risk. Following Jenkins (2008), it is possible to get an idea of the natural form of our data performing a non-parametric estimation using a dummy variable for each different age at risk:

$$log[-log(1-\pi_i)] = \mathbf{X^T}\beta = \beta_0 + \sum_{m=11}^{20} \beta_m \text{period-at-risk}_{i,m} + \sum_{h=1}^{H} \gamma_h z_{i,h} + \sum_{g=1}^{G} \delta_g w_{i,g} + \psi d_i \tag{2.3}$$

Then, each functional form can be estimated and compared to it. In particular, we can show estimation for a logarithmic,

$$log[-log(1-\pi_i)] = \mathbf{X^T}\beta = \beta_0 + \beta_l log(\text{period-at-risk}_{i,l}) + \sum_{h=1}^{H} \gamma_h z_{i,h} + \sum_{g=1}^{G} \delta_g w_{i,g} + \psi d_i \tag{2.4}$$

quadratic

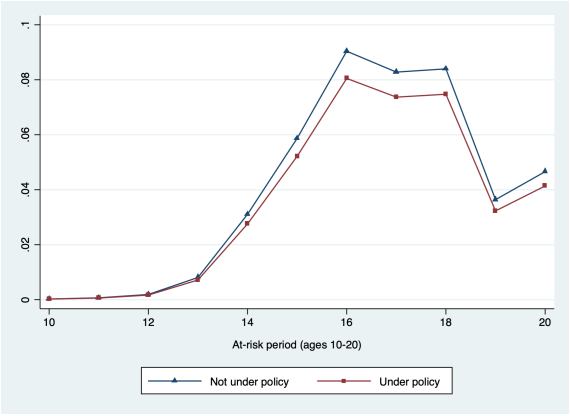
$$log[-log(1-\pi_i)] = \mathbf{X^T}\beta = \beta_0 + \sum_{q=1}^{2} \beta_q \text{period-at-risk}^q_{i,q} + \sum_{h=1}^{H} \gamma_h z_{i,h} + \sum_{g=1}^{G} \delta_g w_{i,g} + \psi d_i \tag{2.5}$$

and cubic functional form.

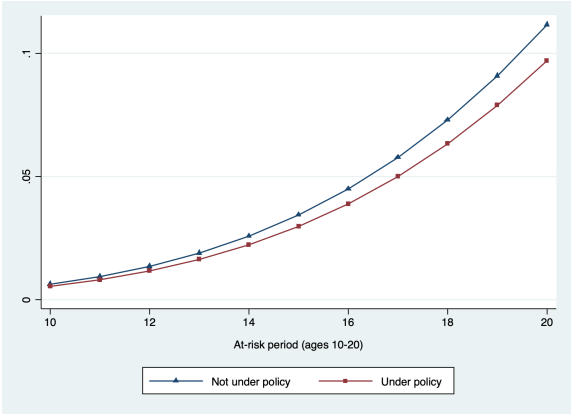
$$log[-log(1-\pi_i)] = \mathbf{X^T}\beta = \beta_0 + \sum_{c=1}^{3} \beta_c \text{period-at-risk}^c_{i,c} + \sum_{h=1}^{H} \gamma_h z_{i,h} + \sum_{g=1}^{G} \delta_g w_{i,g} + \psi d_i \tag{2.6}$$

As shown in Figure 2.7, keeping the non-parametric function as a benchmark in order to identify the most parsimonious functional form among the three proposed, it is easy to see that the logarithmic provides the worst approximation to our data. Helping ourselves with the estimation of the pseudo log-likelihood and the information criterias, the choice ends up on the cubic functional form.

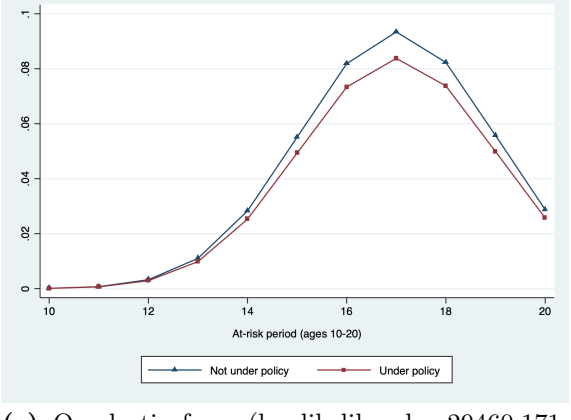
Figure 2.7: Baseline hazard functions for the uptake of cannabis



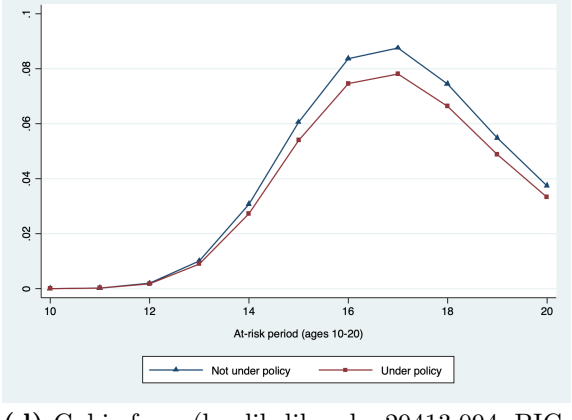
(a) Non-parametric form (log-likelihood: -29316.248; BIC: 58644.5; AIC: 58706.29)



(b) Logarithmic form (log-likelihood: -31087.628; BIC: 62181.26; AIC: 62212.15)



(c) Quadratic form (log-likelihood: -29460.171; BIC: 58928.34; AIC: 58969.54)



(d) Cubic form (log-likelihood: -29413.094; BIC: 58836.19; AIC: 58887.6)

Finally, we perform two checks to assess the robustness of our estimates. Since the decision to focus on the age range 10-20 years as the period of life when an individual is at risk of uptaking cannabis use might appear arbitrary, especially looking at Figure 3.5, which shows a new increase in the rate of uptake at age 20 (likely corresponding to the starting age of the University period for a number of individuals), we expand our at-risk period to the age range 10-25. Secondly, we perform a falsification test by examining the relationship between criminalisation and initiation into tobacco use. As suggested by the 'gateway" theory (Kandel, 2004), the onset of tobacco smoking might function as a stepping-stone to the onset of cannabis use. This hypothesis has been confirmed by intertemporal demand studies that consider how the use of one drug at one point in time influences the use of another drug at a later point in time, which found that prior use of tobacco increased the likelihood of later cannabis use (Pacula, 1998b; Beenstock and Rahav, 2002; van Ours, 2007). Changes in the policy regime governing cannabis use should not directly impact on the uptake of cigarette use. Evidence of a significant effect would suggest that our results are picking up other changes that occurred around the same time as the introduction of criminalisation and that impacted on both cigarette use and cannabis use. In other words, our estimates of the effect of criminalisation would then be biased or at least spurious. As of the interpretation of coefficient estimates, following Williams and Bretteville-Jensen (2014) and Cêrvený et al. (2017) $((exp(\beta) - 1) * 100)$ - where b in this case can be any coefficient - can be read as the percentage change in the probability of cannabis uptake.

2.5 Results

Table 2.4 reports the coefficient estimates of three different specifications of our Complementary Log-Log regression model for the uptake of cannabis use. In addition to the control variables listed in the table, all specifications include a full set of calendar birth year dummies. Specification 2 adds the macro-region of residence, specification 3 includes an interaction term between the policy change and the low education indicator (interruption of schooling at the lower-secondary level). The top row of the table shows the effect of the policy change on the starting usage of cannabis.

Table 2.4: Parameter estimates for the rate of uptake of cannabis (at-risk period 10-20)

	(1)	(2)	(3)
Policy change	-0.154*	-0.153*	-0.169 .
	(0.0701)	(0.0711)	(0.0863)
Individual characteristics			
Gender (ref. Male)	-0.274***	-0.276***	-0.276***
	(0.0500)	(0.0493)	(0.0494)
Education low	-0.0452**	-0.0520**	-0.0695*
	(0.0172)	(0.0166)	(0.0339)
Education low*Policy change			0.0618
			(0.0929)
Other controls			
North east		-0.0151	-0.0149
		(0.0667)	(0.0665)
Centre		0.0657	0.0656
		(0.0709)	(0.0711)
South		-0.302***	-0.302***
		(0.0329)	(0.0328)
Islands		-0.250***	-0.249***
		(0.0621)	(0.0622)
Surveys			
Survey yr 2003	0.147***	0.164***	0.161***
	(0.00855)	(0.0194)	(0.0227)
Survey yr 2005	0.257***	0.250***	0.244***
	(0.0144)	(0.0255)	(0.0317)
Survey yr 2008	0.441***	0.395***	0.385***
	(0.0186)	(0.0220)	(0.0343)
Survey yr 2011	0.352***	0.321***	0.314***
	(0.0278)	(0.0437)	(0.0515)
Survey yr 2014	0.439***	0.408***	0.402***
	(0.0296)	(0.0359)	(0.0429)
Survey yr 2017	0.462***	0.474***	0.472***
	(0.0320)	(0.0434)	(0.0475)

Note: The table reports coefficient estimates and standard errors in parentheses. Standard errors are clustered at survey level.
=". p<0.1 * p<0.05 ** p<0.01 *** p<0.001". Although not reported, all models include birth year fixed effects. Data for the 2014 and 2017 surveys are weighted.

The estimates from the first specification (column 1) suggest that the increase of penalties for cannabis possession has a negative effect on cannabis uptake and that this effect is statistically

significant at the 5% significance level. On the basis of these estimates, having been exposed to the new policy in the at-risk period of life (10-20 years) is associated with a 14.27% ((exp(-0.154)-1)*100)) decrease in the rate of uptake of cannabis compared to an otherwise similar individual not exposed to the new policy. The remainder of the table shows how individual characteristics affect the rate of uptake of cannabis use. Women have a lower starting rate than men by 23.97%. Having dropped out of school at the lower-secondary level affects negatively the risk of uptaking cannabis use, although the coefficient shows a relatively small effect (-4.40%). All the survey year dummies, which have been included to control for possible survey-specific effects, show a positive effect on the rate of uptake of cannabis use compared to the 2001 survey, ranging from the 15.84% to the 58.72% of the 2005 and 2017 survey years respectively. This might also be an indication of the long term trends in cannabis use discussed in Section 2.3.1 which show that uptake by the age 20 has been increasing over time. Specification 2 allows also the region of residence to influence the rate of cannabis use uptake. Being from the North Eastern or Central regions of Italy has no significant effect compared to North Western regions (baseline). Still compared to being from the North Western regions, residing in the Southern regions and Islands decreases the risk of uptake by 26.07% and 22.12% respectively. The other coefficients show similar values to those of the first specification. In the third and final model we account for the fact that not everyone exposed to the policy change might be affected the same way. Specifically, we are interested in understanding if the fact of having a low educational level somehow modifies the effect of having lived under the criminalisation period in the at risk-period of life. This seems somehow to strengthen the effect of criminalisation (to get the hazard rate we have to exponentiate the sum of the coefficient for the policy variable and for the interaction term and subtract one from this quantity as shown by Cleves et al., 2016), but not significantly. The coefficient of criminalisation remains negative and significant, although with a lower intensity (5% significance level). As in the case of specification 2 all other coefficients remain substantially similar.

In order to get a better sense of the estimated effect of criminalisation on cannabis uptake, we use the coefficient estimates reported in column 3 of Table 2.4 to predict hazard and survival functions for individuals who lived their at-risk period of life under criminalisation and those who did not. Furthermore, we distinguish between individuals with a higher and a lower risk profile. Based on the coefficients in Table 2.4 we define a higher risk profile as being male, with an educational level higher than lower secondary school and living in a central region, and a lower risk profile as being female, with a low educational level and living in a southern region. The results are graphed in Fig.2.8 and 2.9.

Figure 2.8: Predicted hazard rates for cannabis uptake for lower and higher risk individuals not under the policy and under the policy

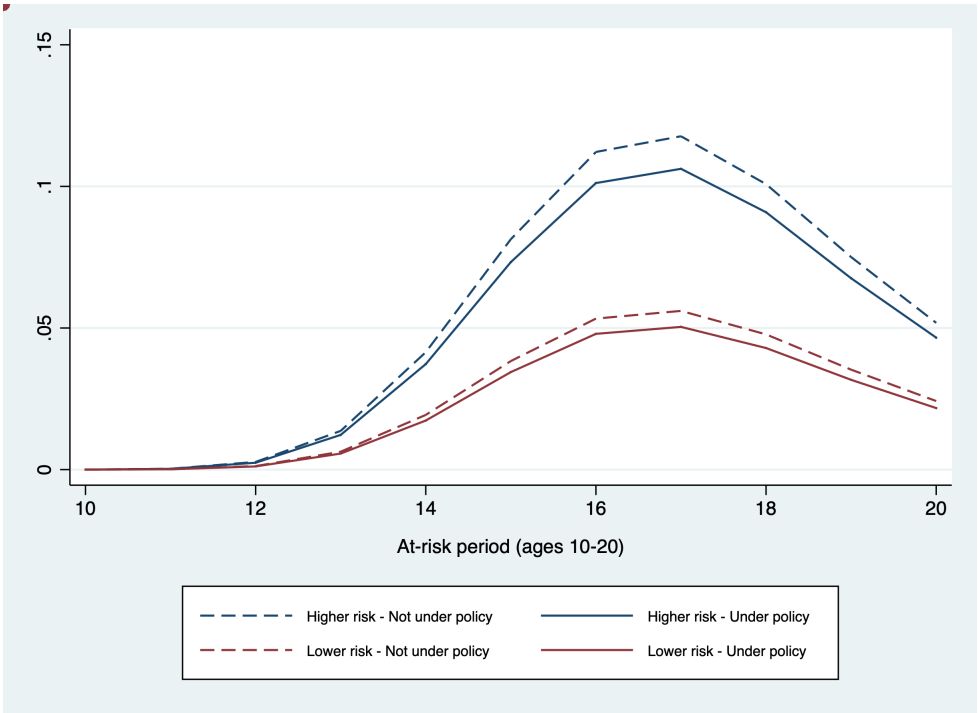


Figure 2.9: Predicted survival functions for cannabis uptake for lower and higher risk individuals not under the policy and under the policy

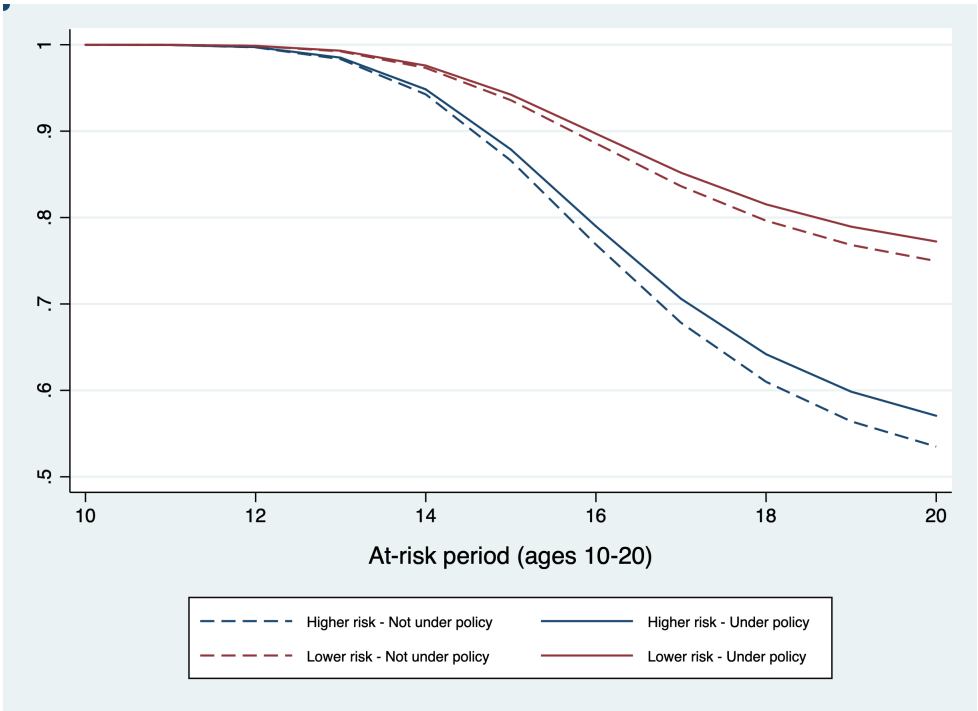
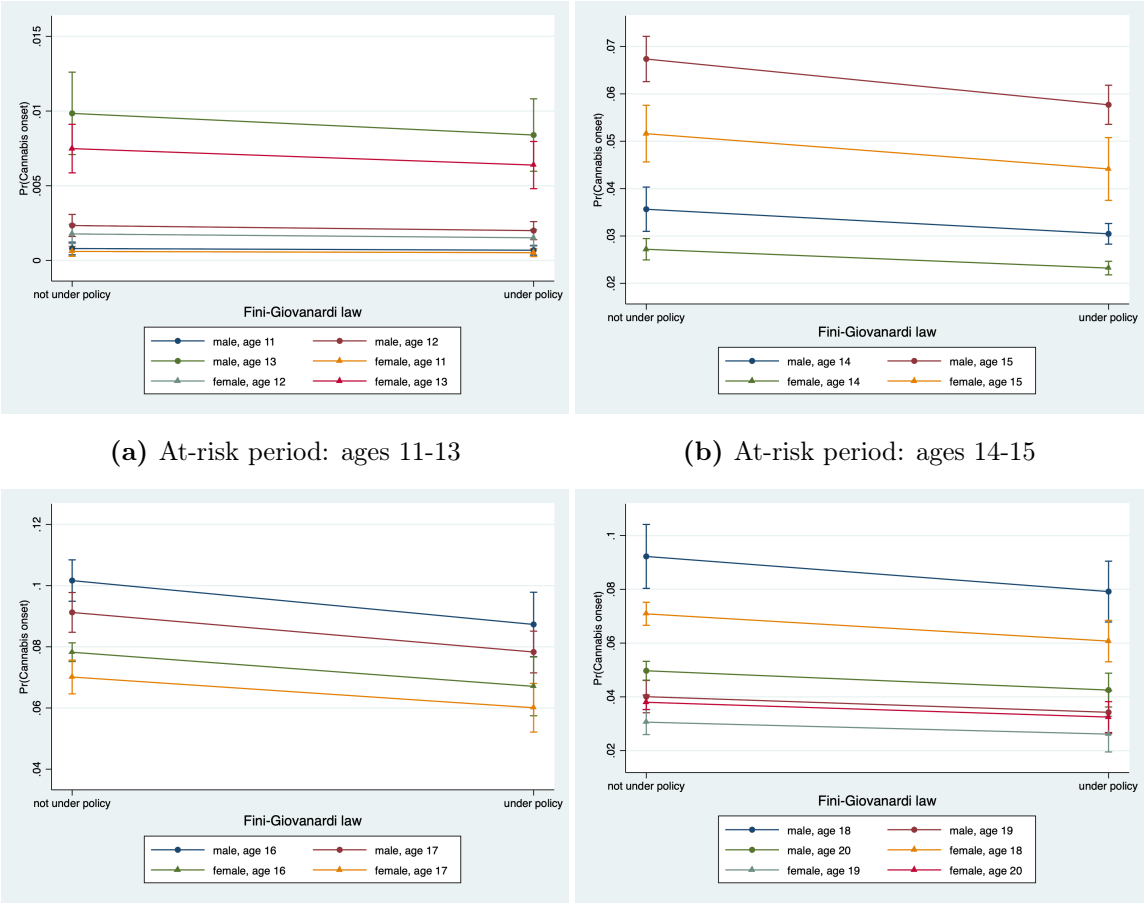


Figure 2.10 allows for an inspection of the marginal effects of age on the probability of cannabis uptake. It confirms that criminalisation does not seems to affect the probability of starting to

use cannabis in the younger ages (11-12 years). It starts to lower the probability of uptake as age increase, particularly between 15 and 18 years. As of age 19 the effect of criminalisation in reducing the probability of cannabis uptake visibly diminish.

Figure 2.10: Marginal effects of age on the probability of cannabis onset, by policy regime and gender (95% CIs).



(a) At-risk period: ages 11-13

(b) At-risk period: ages 14-15

(c) At-risk period: ages 16-17

(d) At-risk period: ages 18-20

A first look at the hazard functions reveals that the uptake of cannabis starts to increase at age 13, reaches the maximum at age 17 and decreases thereafter. A comparison of the hazard functions shows that the effect of introducing criminalisation is to lower the hazard function for initiation into cannabis. On the other hand, as of age 13 an individual not under criminalisation faces a hazard which is almost double than the one of an otherwise similar individual under criminalisation. This suggests that criminalisation seems to affect whether an individual ever uses cannabis but does not seem to lead to uptake at a later age than would otherwise occur under decriminalisation. Furthermore, comparing the two profiles it can be noted how an individual with a higher risk profile faces a slightly higher hazard than an individual with lower risk profile under decriminalisation compared to criminalisation. It can also be noted that by the age of 20 the hazard functions for higher risk and lower risk profiles almost converge both under criminalisation and decriminalisation. This seems to suggest that factors like gender and socio-economic background, which play a role in determining the hazard of cannabis uptake at early ages, progressively diminish their effect as age increases. Figure 2.9 shows the predicted survival function. Since the survival function is based on the cumulative hazard function, it estimates different values for each different value of the time-variyng covariates. For this reason, to portray the effects of various predictors on the survival function, we rely on the device of plotting it for hypothetical individuals who are, in some

sense, prototypical (Singer and Willett, 1993). We do so by defining prototypical higher risk and lower risk individuals with the same characteristics described in the case of the hazard function, but specifying the year of birth: 1981 for those not exposed to criminalisation and 1994 for those under the criminalisation policy. Due to the choice of plotting the survival function between two types of individuals as much different as possible, we can note as in their case we can observe that the two survival functions, both under criminalisation and not, do not tend to converge as in the case of the hazard function.

2.6 Robustness checks

To investigate the robustness of our findings we perform two kinds of checks. First we expand the considered at-risk period to include the age range 10-25 years. Second we perform a kind of placebo test where we examine the effect of criminalisation on the uptake of tobacco smoking. The first of our robustness checks is motivated by the fact that there might be modifications in the rate of uptake after age 20, which is the beginning of the adult life and for a number of individuals corresponds to the starting age of the University period. Table 2.5 reports the estimates of the model specifications reported in Table 2.4 based on the at-risk period 10-25 years of age. The first thing to note is that there are no signs of major changes with respect to the estimates based on the age window 10-20. The coefficients for the criminalisation indicator slightly increase (-16.80% in the full model, column 3, compared to the corresponding -15.54% estimated on the age window 10-20) together with their statistical significance (0.1%). The coefficient of gender is slightly smaller (-24.11% vs the corresponding -22.66% in the age window 10-20) and the coefficient for low education level is slightly bigger (-8.26% vs -6.71%).

Table 2.5: Parameter estimates for the rate of uptake of cannabis (at-risk period 10-25)

	(1)	(2)	(3)
Policy change	-0.172***	-0.173***	-0.184***
	(0.0483)	(0.0490)	(0.0510)
Individual characteristics			
Gender (ref. Male)	-0.255***	-0.257***	-0.257***
	(0.0438)	(0.0431)	(0.0431)
Education low	-0.0648***	-0.0713***	-0.0863**
	(0.0145)	(0.0145)	(0.0296)
Education low*Policy change			0.0518
			(0.0793)
Education low*Policy change			
Other controls			
North east		-0.00839	-0.00819
		(0.0694)	(0.0693)
Centre		0.0736	0.0735
		(0.0698)	(0.0700)
South		-0.292***	-0.292***
		(0.0406)	(0.0405)
Islands		-0.243***	-0.243***
		(0.0672)	(0.0672)
Surveys			
Survey yr 2003	0.121***	0.140***	0.138***
	(0.00877)	(0.0191)	(0.0220)
Survey yr 2005	0.233***	0.227***	0.222***
	(0.0124)	(0.0242)	(0.0295)
Survey yr 2008	0.414***	0.369***	0.361***
	(0.0192)	(0.0236)	(0.0333)
Survey yr 2011	0.300***	0.272***	0.265***
	(0.0293)	(0.0460)	(0.0524)
Survey yr 2014	0.391***	0.361***	0.356***
	(0.0325)	(0.0390)	(0.0451)
Survey yr 2017	0.412***	0.424***	0.422***
	(0.0342)	(0.0450)	(0.0486)

Note: The table reports coefficient estimates and standard errors in parentheses. Standard errors are clustered at survey level.
=". p<0.1 * p<0.05 ** p<0.01 *** p<0.001". Although not reported, all models include birth year fixed effects. Data for the 2014 and 2017 surveys are weighted.

Our second robustness check is a falsification test. In particular, we examine the relationship between criminalisation and initiation into cigarette use. As explained in Section 2.4, finding evidence of a significant effect of criminalisation of the uptake of tobacco use would suggest that our results are picking up other changes that occurred around the same time as the introduction of criminalisation and that impacted on both cigarette use and cannabis use. Table 2.6 reports results for age at initiation into cigarette use using the same specifications used showed in Table 2.4.As can be seen from Table 2.6, the policy variables are insignificant. This suggests that our findings with respect to the effect of criminalisation on cannabis uptake are robust.

Table 2.6: Robustness check: Parameter estimates for the rate of uptake of tobacco (at-risk period 10-20)

	(1)	(2)	(3)
Policy change	0.0360	0.0355	0.0397
	(0.0548)	(0.0551)	(0.0555)
Individual characteristics			
Gender (ref. Male)	0.170***	0.169***	0.169***
	(0.0224)	(0.0231)	(0.0231)
Education low	0.217***	0.217***	0.221***
	(0.0455)	(0.0451)	(0.0521)
Education low*Policy change			-0.0156
			(0.0505)
Other controls			
North east		0.0962	0.0961
		(0.0643)	(0.0643)
Centre		0.0667	0.0668
		(0.0481)	(0.0481)
South		0.0301	0.0301
		(0.0341)	(0.0341)
Islands		-0.0141	-0.0141
		(0.0312)	(0.0314)
Surveys			
Survey yr 2003	0.0961***	0.106***	0.107***
	(0.0109)	(0.0151)	(0.0157)
Survey yr 2005	0.215***	0.225***	0.227***
	(0.0190)	(0.0222)	(0.0242)
Survey yr 2008	0.215***	0.212***	0.215***
	(0.0176)	(0.0182)	(0.0245)
Survey yr 2011	-0.139***	-0.126***	-0.124***
	(0.0241)	(0.0286)	(0.0317)
Survey yr 2014	-0.202***	-0.201***	-0.200***
	(0.0228)	(0.0244)	(0.0269)
Survey yr 2017	-0.160***	-0.148***	-0.148***
	(0.0311)	(0.0331)	(0.0333)

Note: The table reports coefficient estimates and standard errors in parentheses. Standard errors are clustered at survey level.
=". p<0.1 * p<0.05 ** p<0.01 *** p<0.001". Although not reported, all models include birth year fixed effects. Data for the 2014 and 2017 surveys are weighted.

2.7 Discussion and conclusions

Cannabis users have been estimate to be 188 million in 2017, corresponding to 3.8 per cent of the global population (UNODC, 2019). In the European Union, 27.4% of the population have used cannabis and they have done so despite the threat of administrative or criminal prosecution. This has raised a number of concerns due to the economic and social costs of maintaining harsh sanctions. In fact, considerable policing resources go into cannabis control, with over half of the 1.2 million use or possession for personal use offences reported in 2017 related to cannabis (EMCDDA, 2019). These concerns have lead a number of countries to decriminalise or diminish sanctions implied by cannabis possession for personal use over the last 20 years. Few countries on the contrary have raised penalties, amongst which Italy. The question of whether cannabis policy changes are able to modify cannabis use remains a central topic.

In order to contribute to this debate, the present paper investigates the policy effect on a specific aspect, which is the uptake of cannabis.

To do so, we exploit the timing of the policy reform that in the years 2006-2014 increased the sanctions for cannabis possession in Italy. Our empirical framework is based on a Complementary Log-Log model for studying the policy effect on the onset of cannabis use. Our results suggest that the introduction of higher administrative penalties has a significant, although limited, effect in reducing the uptake of cannabis. In particular, criminalisation seems to affect whether an individual ever uses cannabis but does not seem to lead to uptake at a later age than would otherwise occur under decriminalisation. Also, as we approach the adult ages, the effect of criminalisation in reducing the probability of cannabis uptake seems to diminish. Our results also indicate that women have lower chances of starting to use than men, particularly at a very early ages. This is in line with what found by previous studies similar to ours (Cêrvený et al., 2017; Williams and Bretteville-Jensen, 2014) and more generally by literature on the role of gender in cannabis use (Greaves and Hemsing, 2020). Having a low educational level affects negatively, although with a small effect, the risk of uptaking cannabis use. The fact that those who have dropped out of schooling at the secondary education level have a lower risk of starting to use cannabis could appear struggling against previous finding highlighting a link between poor school performance and cannabis use. However, it has to be noted that studies among adolescents, such as Lynskey and Hall(2000) or Mokrysz et al. (2016), are focused on the school performance between users and not still who are still in education. In our case, we need to consider that those who interrupt schooling at a so early stage are very different. Not only they have a much lower educational level, but also they probably loose a great part of their peers social network, due to the fact they probably have to start working, moving soon to the "adults' world". So, for example, they cannot experiment the peer influence which can arise in a context such as the university environment. From this point of view, our result according to which the very lowest educated individuals have less chances to become cannabis users seems reasonable. Also, our result is in line with another study conducted in the Czech Republic which found that those having dropped out of school at the secondary level without graduation have a lower risk to start using (Cêrvený et al., 2017). Finally, our results also show that residing in regions of the South of Italy has a significant, although limited, effect in reducing the chance of starting to use cannabis. This might be a possible indication of different levels of cannabis availability on the national territory. Also, it must be considered that there is a strong socio-economic disparity between Italian regions, with the Southern ones having the lowest per capita GDP and unemployment rate. In this light, and considering that relatively low proportion of those who try cannabis become frequent or daily users, our results are in line with previous studies indicating that youth from a wealthier socio-economic background have a higher risk of cannabis experimentation but are less prone to progress into frequent use (Gerra et al. 2020; Moor et al., 2015; Beck et al. 2013; Bowes et al. 2013; Legleye et al. 2011).

The main potential explanation of our findings is that criminalisation may have discouraged people from starting to use cannabis due to the higher expected life-time costs associated with

increased penalties, as suggested by Becker's theory of crime (1968). In fact, the new policy not only increase the administrative penalties for small quantities possessed, but can be seen as a partial criminalisation (shift from administrative to criminal penalties). By setting a low threshold for distinguishing possession as an administrative offence from a criminal one, people who before would have been charged with administrative sanctions, under the new regime may have incurred in a prison sentence. Furthermore, whilst before it was left to the judicial court to define possession for dealing taking into consideration a number of aggravating circumstances beyond the quantity carried, the new threshold eliminated this option. Also, being the threshold based not on the total quantity of the drug possessed, but on the level of psychoactive component contained in it, it made the threat of penalties for potential users rather unclear, as this level cannot be verified without forensic analysis and it is well known that the potency of cannabis products has been dramatically increasing over the last decade (EMCDDA, 2016). The policy reform also provided for higher punishment for drug possession by minors.

However, we also show that this deterrence effect is relatively limited. This is an important issue from a policy perspective. In fact, since we show that uptake of cannabis use typically occurs by the age of 18, the fact that the policy has only a limited effect on early uptake might signal that also the overall effect of the policy in terms of public health is limited. Given the evidence that early cannabis initiation increases the risk of dependence and longer duration of use, a reduced effect on earlier ages might mean also a reduced impact on these public health consequences. A further potential explanation for our results is that potential consumers may have found the access to cannabis more difficult than before. Unfortunately, we cannot verify the hypothesis of perceived changes in the illegal cannabis market from our data, but this is in line with the findings presented in the first chapter of this thesis. Also, in light of the findings of the first chapter, criminalisation might have discouraged the "less motivated" individuals would have simply tried the substance, but not discouraged those who would progress into frequent, and therefore more dangerous, use.

As the previous studies on the topic of uptake of cannabis use are focused on decriminalisation, it is not possible to make a direct comparison with our findings, although some useful insight can be drawn. In fact, it has been shown that in the Australian case, there was the unintended consequence of an increase in cannabis uptake for the first five years after decriminalisation, with no evidence of long run effects (Williams and Bretteville-Jensen, 2014). In the Czech Republic instead evidence suggests that decriminalisation did not affect the age of onset of cannabis use at all, although the authors highlight that the lack of statistically significant results might also be due to the relatively small sample size (Červený et al., 2017).

Moreover, the effect on the onset of cannabis use is one aspect of the broader spectrum of the intended and unintended consequences that need to be taken into consideration when studying the effects of drug policies. In fact, benefits such as the one analysed in this paper, should be balanced against the social costs of increasing penalties, both for individual users and for the community as a whole. The official data presented in the second section of this paper show that under criminalisation of cannabis not only cannabis-related complaints substantially increased, but also the population in prison for drug-related offences. This against the fact that just one year before the policy reform a pardon has been approved due to the overcrowding of the Italian prison facilities.

This study comes with some limitations. The main one is the reliance on self-reported survey data. From this limitation two potential sources of measurement error can arise. The first is a lack of honesty in responses to the questionnaire. This concern is partially mitigated by the fact that IPSAD, the survey that provided the data analysed, is anonymous and self-administered, whilst issues of truthfulness are more likely to arise when surveys are administered by personal interview due to the presence of others while responding. The second is that retrospective information can be subject to recall bias. Since the age at which cannabis is first used is retrospectively reported, there is the possibility that errors are made in accurately remembering this information. The

young age of our sample (15-37) partially mitigates this concern, as recall error is not expected to have a large impact since we focus on a sample of individuals for whom events concerning cannabis use have happened rather recently. Most importantly, we don't dispose of a clean counter-factual as in the case of other studies which, focusing on federal states, exploited the variations in the timing of introduction of the policy across territories. In our case, the policy reform took place at the central level and was implemented at the same time on the whole national territory. This implies the risk of endogenisation of a time trend in our data. Looking at the description of the long term trends in cannabis use provided in Section 2.3, two things can be noted: the proportion off cannabis first use at age less or equal to 20 has been increasing over time and the average age of first use has substantially diminished. This indication does not support the hypothesis of an endogenisation of the time trend in our analysis, as in this case our estimate would be positive and not significant. However, although trying to make the best use of the available data, not having a counterfactual we are unable to exclude that the change in the rate of uptake observed would have taken place even in absence of the policy change. Finally, since over the last 20 years several European countries changed their drug policies, it would be interesting to compare our findings with other countries having implemented a similar policy.

Chapter 3

Assessing the impact of regional policy interventions limiting gambling supply: a quasi-natural experiment

Abstract

This paper exploits the effects of restrictions imposed on the supply of offline entertainment machines through a reduction of the allowed functioning time by some municipalities in one of the Northern regions of Italy. We assess their market effects both on the level of the gross gambling turnover and on its composition in terms of possible shifts towards online gambling products. Although the policy should have applied to the entire regional territory, some municipalities did not approve the necessary implementing acts, whilst others imposed functioning time restrictions with varying level of intensity. We exploit this variation using a regression-based Differences-in-Differences (DiD) design with continuous treatment with a unique dataset recording yearly gambling turnover by type of game in the years 2016, 2017, and 2018 matched with data on municipal acts collected for the study and socio-demographic variables. The results suggest that the implemented policies actually reduced the gambling consumption through entertainment machines. However no significant reduction of the total gambling consumption was observed. In fact, focusing on the composition of gambling turnover we find a shift towards online gambling products. These results support the argument that limiting the physical availability of entertainment machines is an effective policy for reducing the amount of resources invested by consumers in this type of game. At the same time attention should be paid to the possible unintended effects on the shift towards other gambling products, which by definition cannot be subject to similar restrictions.

Keywords: Gambling; Regional policy; Municipalities; Differences-in-Differences.

JEL Codes: H75; L83; R11

3.1 Introduction

During the last decade, a number of European countries started a process of progressive liberalization of the gambling sector with the aim of fighting illegal gambling and collecting an increasing amount of tax revenues, bringing to a substantial increase in the market volumes (Combs et al. 2008, Paton et al., 2009; Walker et al., 2011; Di Bella et al. 2015; Gandullia and Leporatti, 2018; Resce et al., 2019).

This process has been particularly relevant in Italy where, since 2003, in order to boost gambling revenues, the Italian government adopted a dual strategy: it first increased the availability of games characterized by high payouts and high rate of re-investment of winnings (e.g. entertainment machines) and simultaneously reduced the tax rates applied to these types of games (Gandullia Leporatti, 2018; Resce et al. 2019).

In particular, the introduction of slot machines represented a great innovation in the gambling market as it brought gambling closer to citizens. Since 2003, slot machines can be placed in cafe, tobacco shops, stations and supermarkets without being confined to casinos. Therefore, gambling consumption has become a constant presence in routine life for more and more people (Di Bella et al., 2015). This was coupled in 2011, by the introduction of video-lotteries, which compared to slot-machines are characterised by higher possible stakes and winnings.[1].

The process of liberalisation lead to a massive growth in the Italian gambling market which is proved by the 462% increase in the gross turnover[2], that in 18 years (2000-2018) passed from 19 to more than 106,5 billions euros, with two major peaks corresponding to the introduction of the mentioned entertainment machines in 2003 and 2011 (UPB, 2018; ADM, 2019).

This huge development of gambling market inflamed the debate on morality of gambling promotion by the government. In fact, the gains in tax revenues were not devoid of social costs: the number of people devoting a significant amount of money in gambling products increased with the amount of available public games, as well as the prevalence of gambling addiction which rapidly became a public health issue, with the prevalence of gamblers in the general population aged 15-64 who are at severe risk of developing addiction rising from 0.33 in 2007 to 1.04 in 2017 (Colasante et al., 2012; Bastiani et al., 2013; Molinaro et al., 2018; Cerrai et al., 2018; Resce et al., 2019). There is also substantial evidence to suggest that entertainmentmachines is the predominant type of gambling most often associated with addiction problemsand reported by patients requesting help to treatment services not only in Italy, but in severalcountries across the world (Dowling et al., 2005; Nower and Blaszczynski, 2009; Lund, 2009; Gainsbury et al., 2014; Scalese et al., 2015; Rossow and Hansen, 2016).

Faced with the increasing social costs of gambling addiction, over the past years some Italian regions have started to implement policies aimed at reducing the availability of entertainment machines in order to discourage consumption.
In this scenario, the Region of Piedmont constitutes an excellent case study as in May2016 imposed to its municipalities to pass acts suspending the functioning of entertainment machines for a

[1]Slot machines – Amusement with Prizes (AWP) are a particular type of entertainment machines characterised by small bets (the maximum bet is 1 €), fast playing time and relatively modest winnings (up to 100 €). The game consists in matching symbols on mechanical reels that spin and stop to reveal one or several symbols. Legalised in 2003, when they accounted for only 2% of the total gambling gross turnover, new slots became so popular that in 2006 already constituted alone 43% of the total gross turnover in Italy. Videolotteries (VLT), similar to new slots but with the possibility to place higher bets (maximum 10 €) and higher payout (up to 5,000 €), two years after their introduction in 2010 had already attracted almost 25% of the overall collection of bets, share remained essentially stable until today.

[2]The gross gambling turnover refers to the actual amount gambled by participants with gambling operators.

minimum of three hours per day. This produced a policy shock, which however was not uniform on the entire regional territory. In fact in the period 2016-2018 a number of municipalities did follow up to the regional order, but the number of hours that each of them imposed varies greatly. Consequently, municipalities with high number of suspension hours were more affected by the policy change than municipalities with a lower suspension time. Furthermore, some others did not pass any regulatory act, thus leaving gambling shops free from restrictions. This creates the opportunity to identify the effect of this exceptional policy intervention through a quasi-natural experiment.

At present very little is known about the economic effects of these kind of restrictions and about their potential for inducing changes in consumers' behaviour. Understanding how people react to limitations to the availability of gambling is of utmost importance for designing effective public health policies (Ladouceur et al., 2009). Furthermore, the analysis presented in this paper contributes to the literature focused on the impact of specific gambling facilities availability on specific gambling products (Paton and Williams, 2013; Walker and Jackson, 2008). These are hotly debated issues, particularly following the massive expansion of gambling and related addiction worldwide (Markham et al. 2016).

We exploit the variation in the presence and requirements of municipal regulations in order toidentify the effect of the policy using a Differences-in-Differences (DiD) framework. To achievethis, we use a unique dataset running from 2016 to 2018 that was built using several sources ofdata. Data including the gross gambling turnover and the number of entertainment machineswere made available by the Italian Monopoly Agency (ADM) at the municipal level. These datawere then matched with data about the presence of municipal regulations, the date in which theact was passed and the number hours of suspension imposed. This is an appealing and uniquefeature of this dataset, as no data were publicly available about this aspect of the institutionalsetting and had to be collected by running an investigation across all the municipalities in theregion. Finally we linked the above set of data to municipal socio-demographic and politicalvariables provided by the National Institute of Statistics (ISTAT) and the Ministry of Interiors.

We estimate the effects of the policy intervention on the amount invested by citizens in entertainment machines, and on the total amount invested in gambling products, i.e. gross gambling turnover. By estimating the impact on the Gambling Specialisation Index, we also assess possible consequences on the composition of the total gambling turnover. We find that the imposition of limitations to the functioning time of entertainment machines actually led to a reduction in the amount invested by citizens in this type of games. Interestingly we also find that the policy did not impacted significantly on the total gambling market, but on its composition increasing in the share of the total gross gambling turnover generated by products provided exclusively online. These results are robust to a number checks and make a threefold contribution to the literature on the regional impact of gambling. First, and to the best of our knowledge, whilst several studies have analysed the possible displacement of old products by new gambling products, the economic implications of setting restrictions to physical availability of entertainment machines have not been studied previously. Second, the focus on municipalities as the geographical unit of analysis is hardly found in the related literature.Third, and although of utmost importance for policy making, the possible effects on limitations to offline gambling on the demand for online gambling are rarely investigated due to the limited availability of reliable data.

The remainder of this paper is structured as follows: in Section 3.2 we provide background information about the institutional setting; in Section 3.3 we review the literature on previous findings about the effects of policies constraining the supply of gambling and their potential implications; in Section 3.4 we describe our data and in Section 3.5 the empirical model used for the present analysis. Section 3.6 describes and discusses the results, Section 3.7 provides some robustness checks that are further extended in Section 3.9. Section 3.8 concludes.

3.2 Institutional setting

In 2012 the emergence of gambling as a public health problem prompted the Italian government to plan a legislative intervention. This was aimed on one side to acknowledge gambling addiction as a pathology (like drug addiction) and consequently plan adequate levels of public healthcare services. On the other side it was meant to avoid the spread of the phenomenon by limiting access to gambling by the most at risk population. This lead to the passing of Law 189/2012 which included the treatment of gambling addiction among the Essential Levels of Health Service[3] and, among other preventative measures, the planning of a series of measures concerning specifically entertainment machines. This focus is due the fact that it is generally acknowledged that land-based forms of gambling such as electronic gambling machines are the most harmful types of gambling for communities (Productivity Commission, 2010), due to their high addictive power and widespread availability that are deemed to induce problematic behaviors and related social costs more than other products (Resce et al. 2019).

Concerning this last provision, although the regulation of the gambling market in Italy is a central state competence, with regions having very limited decision power insetting rules, supply, and no power in setting tax rates, the failure of the central government to approve an implementing decree specifying the guidelines to follow, lead Italian regions and municipalities to act autonomously approving their own laws, generating a high variability in the different provisions applied. Since 2012, 20 out of the 21 Italian Regions approved regional laws for the prevention, contrast and treatment of gambling addiction (Marotta, 2019).

It is in this framework that in 2016, through the approval of Regional Law n.9/2016, amongst other interventions, the Piedmont Region ordered to the municipalities within its territory to approve municipal regulations in the form legal acts imposing the suspension of the functioning of entertainment machines, both AWP-New Slots and VLT-videolotteries, on their territory for a minimum of at least three hours per day. This imposition, motivated by the need to guarantee public order, raised complaints of gambling operators which took both the Piedmont Region and a number of its municipalities to court to repeal their legislative interventions, based on the fact that public order is an exclusive competence of the central government. Whilst at a first instance administrative courts issued sentences favorable to gambling operators preventing those municipalities to implement their acts, subsequently they started to reject the appeals, based on the acknowledgement of both the high potential of entertainment machines in terms of addictive power and the competence of regional and local authorities to protect public health by preventing the spread of gambling addiction in the most vulnerable segments of society (Viapiana, 2017). These heavy limitations imposed by the Piedmont Region, which are acting as reference for other regions in Italy that are in the process of formulating similar policy initiatives, not only have raised a number of concerns, particularly among gambling operators, but are also feeding a harsh national debate on the balance between the limitation to the entrepreneurial freedom of gambling providers, the interest of the central government which is increasingly dependent on revenues earned from gambling taxation, and the duty to protect citizens' health by public institutions in general (Viapiana, 2017).

At almost four years from the approval of Regional Law n.9/2016, not all the municipalities have complied with the obligation to set restrictions to the machines' functioning time. Some others have instead adhered to the minimum threshold defined by the region, i.e. only three hours of suspension, others instead went further by increasing them by different amounts, up to a maximum of 18 hours.

The Piedmont region is an interesting case study for the analysis of the effects of limitations imposed on the supply of gambling, and specifically of entertainment machines. This is in fact the

[3]Essential Levels of Health Service (LEA) is a list of health care services that the central government requires to be guaranteed in all Italian Regions.

only Italian region in which the policy of suspension has been applied, and to our knowledge one of the rare if not the only example in Europe.
The two main issues of interest concern both market effects, i.e. the effectiveness of this policy in reducing both the resources invested by citizens in entertainment machines and the possible unintended consequences, and public health, i.e. the ability to curb the spread of problem gambling in the population. This study is aimed at providing an empirical response to the first question.

3.3 Literature review

Both in the scientific community and in the public debate it is widely recognised that there is a significant absence of credible research on the effectiveness of specific interventions to guide and inform policy decision-making aimed at tackling the spread of gambling addiction (Blaszczynski et al., 2011). Over the past decade, in several countries policy initiatives supported by both governments and gambling industry have focused on the objective of minimising gambling harms through approaches based on the personal responsibility of consumers Blaszczynski et al. (2011); Miller et al. (2016). Departing from the basic assumption that the final choice of whether to engage in gambling remains with the individual, these initiatives foresee provisions requiring gambling operators to ensure that games of chance are safe and fair and that players have appropriate information available (e.g. about the possible risk of addiction) to make informed decisions. However, they have been criticised for failing to comprehensively address the harms associated with gambling products and their proliferation in different physical and online environments (Reith, 2007; Deans et al. 2016). Social scientists and public health researchers have increasingly advocated for research that recognises the sociocultural, environmental, and commercial determinants of gambling harm (Korn et al.,2003; Adams and Rossen, 2012) and public health policy responses that take a comprehensive approach to the prevention of gambling harm (Sulken et al., 2018)).In this regard, fewer policy initiatives have instead addressed the economic factors as it is the case for the implementation of restrictions to gambling supply. These initiatives are based on the theory of total consumption model (TCM), which originates from studies of the distribution of alcohol consumption. The theory posits that there is a strong association between the total consumption and the prevalence of excessive and problematic consumption in a population.The policy implication of the TCM is that policy measures which effectively lead to a reduction of the total consumption, will most likely also reduce the extent of harmful consumption and related harms (Rossow, 2018). Given the contentious nature of these initiatives, as in the case of the Piedmont region, public data are often not available and empirical research into their impact is needed to feed a public debate which very often cannot rely on scientific evidence base. In the absence of representative survey data at local level split by gambling product providing information about the actual number of citizens who gamble, their gambling frequency and expenditure in the different types of games, the way in which we try to address this gap is to look at administrative data concerning the gross turnover, i.e. the total amount of money that is bet, and at direct measures of the availability of entertainment machines. This allows us to have only a partial view of a complex phenomenon, but it does provide some insights into the possible direct and spill-over effects of policy initiatives that to the best of our knowledge have not been investigated before in Italy.Previous experiences of restrictions on availability of entertainment machines are found in Norway, New Zealand and Australia, where gambling on these type products increased dramatically in the 1990s in response to technological development and liberalization of gambling policy. In those cases, the restrictions proved effective in inducing to significant decreases in total gambling turnover, which was only partially compensated by an increase in other forms of gambling, and there was evidence suggesting that they also lead to fewer gambling and gambling problems (Storer et al., 2009; Rossow et al., 2017).
In addition, most of the international (e.g. Clotfelter Cook 1991; Beckert and Lutter, 2009)

and national (Sarti and Triventi, 2012; Gandullia, 2018) literature is concordant in claiming that lower income individuals are those more attracted by gambling consumption and that gambling products are generally regressive at a regional level, with important implications in terms of the equity of the current system (Resce et al. 2019).In the Italian case, using macro regional data of gambling consumption, Gandullia and Leporatti (2018) found that supply-side variables, as measured by the number of shops allowed to provide gambling products, do not seem to influence total gambling consumption, measured by total turnover. They conclude that the number of concessions (i.e., the number of shops allowed to provide gambling products) has only a minor impact on gambling consumption, which partially mitigates concerns about the role of liberalizing gambling products in the explosion of the market, whereas the number of different legalized gambling products still matters in increasing the share of potential gamblers. Concerning our third research questions, it is relevant to look at the potential effects on online gambling due to the fact that online gambling platforms, operated in part by registered bookmakers, provide individuals with instantaneous gambling venues in their pockets via mobile phone technology and can be used for placing bets on events or playing skill games, like online poker. It is therefore possible that the imposition of a reduction in the supply of the main offline games, i.e. entertainment machines, might trigger a shift of consumers towards online gambling products. There are at least four reasons which might support this hypothesis. One is that previous research has shown that when asked about the advantages of gambling on the Internet versus gambling in land-based venues, Internet gamblers typically cite accessibility and convenient access (Gainsbury, Wood, Russell, Hing, and Blaszczynski, 2012; Griffiths and Barnes, 2008; Wood and Williams, 2010; Wood, Williams, and Lawton, 2007). This might suggest the fact that Internet gambling could be used when other venues are inaccessible. The second is that it has also been shown that a high proportion of Internet gamblers are likely to also engage in some form of offline gambling, whilst a very small portion of them plays exclusively online (Wardle Griffiths, 2011). Another property of online gambling, which is common to entertainment machines and valued by many players, is the privacy that it guarantees during gambling sessions. One of the several criticisms to entertainment machines(both slot machines and videolotteries) is in fact that they do not require any interaction with others and are generally placed in environments which allow the protection from others'view, whilst on the contrary gambling in a social setting could potentially provide some kind of "safety net" for over-spenders. This is also one of the main motivations at the basis of the administrative court sentences rejecting the appeals of gambling operators against the restrictions imposed by the Piedmont regional law. The fourth reason is that Internet gambling is global, accessible and has 24-hour availability online gambler can gamble in a variety of places including casinos, betting shops, amusement arcades and bingo halls. Therefore, when availability of entertainment machines is heavily restricted, it might be tempting to replace them with other forms of games which are instead always available online. Researchers have in fact raised concerns about the ubiquitous nature of internet technologies, and how this may generate greater exposure and accessibility to gambling products for populations, thus increasing prevalence and risk (Thomas et al., 2012; Deans, 2017).

3.4 Data

Our empirical analysis is based on an unique database recording longitudinal information on municipalities in the Piedmont region, built using several data sources.

The first set of data concerns administrative information about gambling. Despite the relevance of the Italian gambling market in the European panorama, accessible datasets on Italian gambling turnover and points of sale are still a rarity; in particular, no municipal-level data split by gambling products, offline and online channels are currently publicly accessible. Recently, the Italian Monopoly Agency (ADM), which regulates the Italian gambling market, has started

to perform ad-hoc data extractions upon request by public authorities (regions, provinces and municipalities). However, so far, data at municipal level have not been the object of standardised data extractions as not of immediate interest for the regulatory purposes of ADM (ADM, 2017). The datasets about gambling turnover and entertainment machines object of our analysis were obtained upon request by the Piedmonte region, which made it available for the present study. Yearly datasets for the years 2016, 2017 and 2018 containing information about three dimensions of gambling which were extracted in different formats were provided: turnover from offline gambling and turnover from online gambling, both by gambling product and municipality, and number of entertainment machines by type (AWP and VLT) and municipality. Concerning online gambling, it must be noted that consumers willing to gamble on gambling website need to open a gambling account and provide personal data, among which their social security number (codice fiscale). Therefore, online gambling turnover data can be provided by ADM at municipal level detail, no matter the device used to access gambling websites (smartphone, tablet, computer), because the amount gambled by each consumer is linked to the municipality of residence through this code. It is important to note that the data provided by ADM refer only to legal gambling activities. Therefore, turnover from unauthorised offline or online gambling activities is not included as no official figures are available. Specifically, concerning online gambling, the Italian regulatory system foresees that only authorised operators, both Italian and foreign, who received a regular licence from ADM can offer gambling services in Italy. Non-authorised operators have the duty to ensure that their website is not reachable from the Italian territory, otherwise ADM can block it. To have an approximate idea of the phenomenon, in the period 2006-2018 about 8,000 unauthorised gambling websites were blocked, of which 1,042 only in 2018 (ADM, 2019). The most recent estimates produced by the financial police services refer to 2015 and quantify the turnover from illegal gambling in 25 billions of euros, of which 7% attributable to illegal online gambling (Spallone et al. 2019).
Following conversion and harmonisation procedures on the different datasets, the administrative data on the gambling turnover by type of game and on the number of working entertainment machines (VLT and AWP) for the years 2016, 2017 and 2018 were linked by municipality. The final dataset obtained contains municipal-level information about the number of entertainment machines and about the total gross gambling turnover broken down by distribution channel (offline and online) and by the following games: VLT and AWP machines and machines with non-monetary prizes; Big Match, Virtual betting, Sport betting lotteries and with fixed payout; Bingo; instant lotteries, traditional lotteries, remote lotteries; Lotto; V7 - multiple bet on horse racing, agency horse racing, national horse betting; Superenalotto, Win for life, Eurojackpot; Betting exchange, Playsix and skill games.

To get a better idea of the characteristics of these games Table 3.1 provides an overview of the minimum payout paid back to gamblers and of the average tax rate applied to the difference between turnover and payout.

Table 3.1: Gambling payout and taxation by type of game

Game	Payout	Tax rate
Slot machines - AWP	70%	63,3%
Videolotteries - VLT	85-88%	50%
Big Match Virtual betting Sport betting - fixed payout Sport betting - lotteries	75%	18%
Bingo	70%	37%
Instant lotteries	75%	13%
Traditional lotteries	70%	15%
Lotto	70%	15%
V7 Agency horse racing National horse betting	57-71%	43%
Superenalotto	60%	70%
Winforlife	65%	76%
Eurojackpot	50%	76%
Betting exchange Playsix Skill games	80-90%	20%

Notes: Payout refers to the minimum share of the turnover (total amount gambled) that by law has to be paid back to gamblers in the form of winnings. Taxation refers the average tax rate applied to the different types of game, which for allowing comparison is provided as the average rate applied to the difference between turnover and payout. Source: ADM, 2019.

To the purpose of our analysis, the above public games and related gross turnover were grouped into categories based on their common characteristics and the classification provided by UPB (2018) and Gandullia and Leporatti (2018). Among these characteristics, we considered also the channel(s) through which they are provided to consumers: exclusively online, i.e. through authorised website etc.; exclusively offline, i.e. in specific physical places like gambling points, bars etc.; hybrid, i.e. both online and offline. This information is essential to analyse possible shift in the composition of gambling turnover.

A description of each category of games and related characteristics is provided in Table 3.2.

Table 3.2: Description of public games available in the dataset and categorisation adopted

Category	Short description	Type of game	Distribution channel
Entertainment machines	Entertainment machines where the aim is to match symbols on mechanical reels that spin and stop to reveal one or several symbols.	Entertainment machines with non-monetary prizes	Exclusively land-based
		Slot machines - AWP Videolotteries - VLT	
Sport betting	Predict the outcome of sports events.	Big Match	"Hybrid games": both land-based and online
		Virtual betting Sport betting - fixed payout rate 75% Sport betting - lotteries	
Bingo	Tombola based on the extraction among 90 numbers	Bingo	"Hybrid game": both land-based and online
Lotteries	Buying instant (immediate extraction) or deferred (later extraction) lottery tickets.	Instant lotteries	"Hybrid games": both land-based and online
		Traditional lotteries Remote lotteries	
Lotto	Predict a combination of numbers among 1 and 90.	Lotto	"Hybrid game": both land-based and online
Horse racing	Predict the outcome of horse races.	V7 - multiple horse racing	"Hybrid games": both land-based and online
		Agency horse racing National horse betting	
Numerical games	Predict a combination of numbers.	Superenalotto	"Hybrid games": both land-based and online
		Winforlife Eurojackpot	
Remote gambling	Online prediction games.	Betting exchange Playsix	Exclusively online
Skill games	Online skill games in which ability is more relevant than chance (e.g. Bridge, chess) and online poker.	Skill games	Exclusively online

The second set of data concerns municipal-level socio-demographic characteristics. We use data on population size, density and territorial extension of municipalities from the Italian National Institute of Statistics (ISTAT), and data on the average municipal per capita income from the Ministry of Economy and Finance (MEF).

We complemented the above information with a third set of data on municipal elections and politicians from the Italian Ministry of the Interior (Ministero degli Interni) and specifically: age, gender, educational level and political party of the mayor, average age of the municipal council and gender composition. For the choice of the political variables above we followed the relevant literature in the field of policy decision making at municipal level. Age (Alesina et al. 2019), gender (Chattopadhyay and Duflo 2004; Rehavi, 2007; Gagliarducci and Paserman 2012; Funk and Gathmann, 2015; Brollo and Troiano 2016), educational level (Besley et al. 2011) and, clearly, political party have all been shown to matter in a variety of ways for policy choices. Alesina et al. (2019) have shown how younger politicians have an incentive to adopt more long-term and strategic policies compared to their older colleagues. An emerging literature in political economy is concerned with gender and policymaking: whilst in the Italian context Gagliarducci and Paserman (2012) found little evidence of differences in policy outcomes, recent articles (Funk and Gathmann, 2015) highlighted important gender differences in preferences for policies and found evidence of gender affecting policy decisions, with a higher engagement of women in the areas of health and welfare policy (Rehavi, 2007). Finally, concerning the political party, in line with Alesina et al. (2019) we distinguish between center-left and center-right.

Table 3.3 reports the description of the variables included in our analysis.

Table 3.3: Variable descriptions and sources

Domain	Variable	Description	Source
Socio-demographic and economic context	Population	Total resident population	ISTAT
	Size	Surface of the municipality in square kilometres	ISTAT
	Population density	Population density, measured as the number of people per square kilometre	ISTAT
	Per capita income	Per capita disposable income	IMEF
Political context	Age of mayor	Age of the municipal mayor, in years	IMI
	Gender	Gender of the municipal mayor, equals to 1 if mayor is a woman	IMI
	Mayor with degree or more	Equal to 1 if municipal mayor has a university (or higher) degree	IMI
	Centre-left party	Equal to 1 if municipal mayor belongs to a Centre-left party	IMI
	Average age of municipal council	Average age of municipal council members, in years	IMI
	Females in municipal council	Share of female members in municipal council	IMI
Gambling expenditure	Per capita gambling turnover	Per capita total gross gambling turnover over total population	ADM
	Per capita entertainment machines turnover	Per capita gross turnover of entertainment machines (Slot machines + Videolotteries) over total population	ADM
Gambling supply	AWP machines per capita	Per capita number of Slot Machines (AWP) per 1,000 residents	ADM
	VLT machines per capita	Per capita number of Videolotteries (VLT) per 1,000 residents	ADM

Notes: ISTAT stands for Italian National Institute of Statistics. IMEF stands for Italian Ministry of Economy and Finance. IMI stands for Italian Ministry of the Interior. ADM stands for Italian Customs and Monopoly Agency.

To analyse variations in the composition of gambling turnover by distribution channel of products, we computed the Gambling Specialization Index (GSI) (Coppola and Romanelli, 2013). For each municipality, using the ADM data on gambling turnover the GSI was applied on the following categories: products distributed exclusively through offline channels (entertainment machines); products defined as hybrid, i.e. distributed both through the offline and online channels (Sport betting; Bingo, Lotteries; Lotto; Horse racing and numerical games); products distributed exclusively through the online channel (Skill games). This allows to identify possible shifts from entertainment machines, provided only onsite and which have been subject to the suspension of functioning time, and games provided partially or exclusively online, the latter not subject to physical restrictions by definition. This index is computed as follows:

$$GSI_{i,m} = \frac{Turnover_{i,m}/Turnover_{tot,m}}{Turnover_{i,Piedmont}/Turnover_{tot,Piedmont}} \tag{3.1}$$

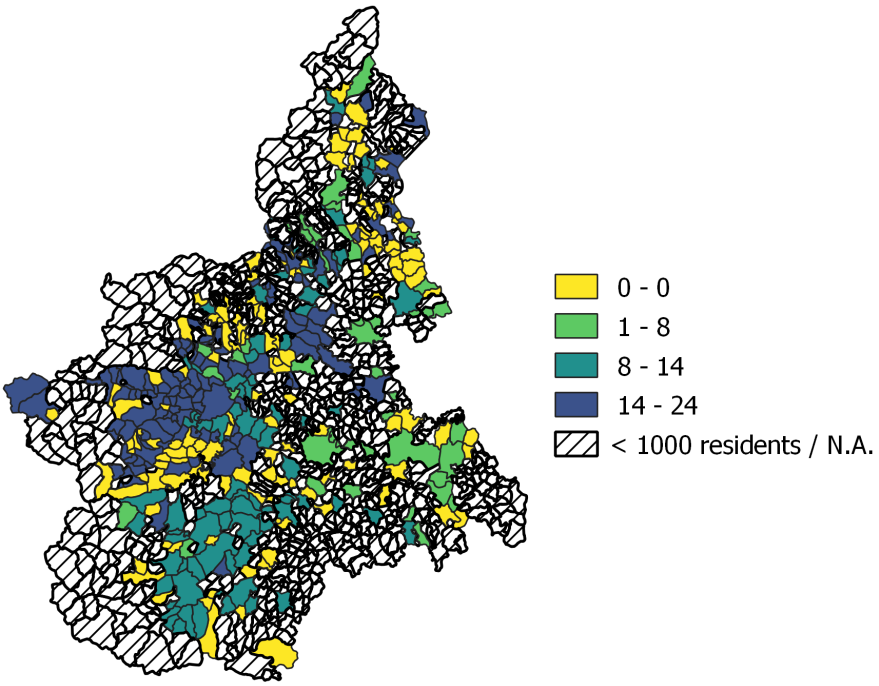
where the numerator represents the ratio between the turnover of game category by distribution channel i in municipality m and the total gambling turnover of the same municipality, and the denominator represents the same ratio computed for the entire region (i.e., Piedmont). A gambling specialization index greater than one implies that the municipal percentage turnover is higher than the regional percentage turnover in that category of gambling product. We will interpret any significant variations in the index as changes in the composition of the gambling turnover.

The fourth set of data pertains to the number and characteristics of the municipal regulations in place in the region. Since no such information was available, these were collected to the purpose of this study. Specifically, to obtain information about the compliance of each municipality with the provision of Article 6 of the Regional Law 9/2016 by the municipalities in the region, a request to provide information on whether a local regulation was passed and a copy of the act was sent to all the administrators of the municipalities. Data were then extracted about the date of entry into force of the regulation and the number of suspension hours imposed to the functioning of entertainment machines on the territory of competence. Only municipalities with more than 1,000 residents were included. Given their very limited size and gambling expenditure, those municipalities below this threshold (N=593, corresponding to 49.8% of the total) were excluded from the study design. Our analysis is based on 370 municipalities that responded to the official request, accounting for 61.9% of the target municipalities. 37.3% of them declared that they were not compliant with the regional law, i.e. they did not approve any municipal regulation. For the others we recorded the date of the municipal act and the number of hours imposed for the suspension of the functioning of entertainment machines. Table 3.4 shows the staggered adoption of regulations by the municipalities in our sample and Figure 3.4 provides an overview of their geographical distribution. A comparison between and the municipalities that were included in the study and those that were not is provided in Table 3.32.

Table 3.4: Municipalities in the sample by type of regulation and year of adoption

	2016	2017	2018
Municipalities with regulation	33	213	232
Municipalities with no regulation	337	157	138
Total	370	370	370

Figure 3.1: Geographic distribution of municipalities included in the sample, with number of suspension hours for entertainment machines (year 2018)



Source: Author's elaboration based on the number of hours of suspension of the entertainment machines' functioning obtained through the review of the municipal regulations in place in the Piedmont region.
Note: N/A indicates those municipalities for which the authors have no information regarding the presence of a municipal regulation.

3.5 Empirical model

In Table 3.5 we report the descriptive statistics for the variables used in the empirical model. On average, the municipalities in our sample had a population of 10,114 residents and a population density of 361.21 residents per square kilometers. With the exception of the capital Turin and few other medium-size cities, the others were all medium-small. The average per capita income was 14,542€bper year, whilst the per capital gambling turnover, i.e. the total amount spent in gambling products was 1,279.47€. On average, the amount spent per capita in entertainment machines was 695.08€bper year.

Table 3.5: Summary statistics (years 2016-2018)

	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
Suspension hours	0.00	0.00	11.00	8.18	16.00	18.00
Resident population	1003.00	2395.00	3756.00	10114.00	15245.00	890529.00
Density	23.86	125.91	209.89	361.21	414.86	6849.64
Per capita income	7807.00	13507.00	14389.00	14542.00	15245.00	25001.00
Age of mayor	25.00	47.50	54.00	54.23	62.00	84.00
Share of females in municipal council	0.00	0.24	0.32	0.32	0.38	0.62
Average age of municipal council	37.45	47.34	50.06	49.99	52.51	64.22
Per capita gambling turnover	70.78	642.22	993.38	1279.47	1633.88	11388.81
Per capita turnover from entertainment m.	0.00	193.68	408.75	695.08	850.31	9960.53
GSI for entertainment m.	0.00	0.43	0.82	0.78	1.14	2.08
GSI for "hybrid" and online games	0.06	0.85	1.20	1.22	1.62	2.35
GSI for "hybrid" games	0.01	0.73	1.03	1.11	1.40	3.56
GSI for online games	0.00	0.60	1.07	1.33	1.88	5.81

GSI = Gambling Specialisation Index

In order to estimate the causal relationship between the adoption of local regulations limiting the functioning hours of entertainment machines (treatment) and gambling consumption we exploit the number of suspension hours to set up a Differences-in Differences (DiD) study design. Indeed, among municipalities adopting intervention to limit the time functioning of entertainment machines, the number of hours that each of them imposed varies greatly (see Figure 3.4). Following the seminal approach of Card (1992), we use a DiD with continuous treatment, using the number of suspension hours as the intensity treatment variable. The basic approach of DiD is to compare the difference in outcomes after and before the intervention between two groups (treated and the untreated). The use of DiD allows to avoid the endogeneity problems typical of comparisons between heterogeneous groups (for an overview see Meyer, 1995). In this framework, the identification of the effect of a policy intervention on the outcome of interest is based on the assumption that the intervention is exogenous with respect to the outcome (Besley, Case, 2000; Heckman, 2000). In the case of DiD with continuous treatment, the treatment is modelled as a continuous variable, and every treated unit is identified by the intensity of the policy, i.e. the number of suspension hours in our case. This strategy has been used in a number empirical applications focusing on public health policies. A DiD with continuous treatment has been recently employed by Carrieri et al. (2019) to estimate the effect of low-THC cannabis legalisation on the illegal supply of marijuana.

Formally, we have a population of municipalities observed over three years [2016, 2017, 2018]. We distinguish two groups: $Treated$ refers to municipalities adopting local regulations to restrict the functioning time of entertainment machines, and $Untreated$ refers to municipalities with no regulation. The estimated model is:

$$Y_{it} = \theta_i + \lambda_t + \beta_0 X_{it} + \beta_1 Treat_{it} \times Hours_{it} + \varepsilon_{it} \tag{3.2}$$

Where:

- Y_{it} is the outcome of interest in municipality i at year t. We test the effect of policy on five main outcomes: 1. total per-capita gambling turnover; 2. per-capita gambling turnover from entertainment machines; 3. Gambling Specialisation Index for "exclusively land-based" games; 4. Gambling Specialisation Index for all games ("hybrid" and online games), excluding "exclusively land-based"; 5. Gambling Specialisation Index for "hybrid games"; and 6. Gambling Specialisation Index for "on-line games";
- θ_i is municipal-level fixed effect;

- λ_t is time-level fixed effect;
- X_{it} is a vector of time-variant municipal level covariates that includes the socio-demographic and economic context (population, density, and per capita income), the political context (gender, age, educational level and political party of the mayor in charge; gender composition and average age of the municipal council), and local availability of entertainment machines;
- $Treat_{it} = 1$ if the municipality i is $Treated$ at time t, and $Treat_{it} = 0$ otherwise.
- $Hours_{it}$ is the number of suspension hours fixed in the regulation of municipality i at time t.

The specification in (2) is the generalised DiD with continuous treatment (see Bertrand, 2004 and Hansen, 2007). The parameter of interest is β_1, which captures the effect of the continuous treatment (i.e. local regulations times number of hours of restrictions on the functioning of the entertainment machines $Treat \times Hours_{it}$) on the gambling market at municipal level in the considered year between 2016 and 2018. To strengthen the plausibility of the exogeneity assumption, since unobservable local-level variables and time common trends may bias the coefficients on the local regulation variables, our model accounts for municipal and year fixed effects. Both dependent and independent variables in our models have been normalised on the standard deviations due to the difference between unit measures of gambling turnover and the other regressors in order to allow for an easier interpretation of coefficients. However estimates of our models without standardisation are also provided.

Concerning the fact that our data cover only legal gambling, the existence of websites that provide gambling products illegally might imply that people willing to gamble offline confronted with the restrictions, might turn to illegal websites. If so, since illegal gambling turnover is not included in our data, this might lead to a downward bias in our estimates. However, any change in access to unauthorised gambling websites should be systematically different both across municipalities experiencing different intensities of treatment and with respect to municipalities without restrictions to represent a threat to our strategy. Furthermore, our data do not allow to control for the possible displacement of gamblers from municipalities imposing the reduction of functioning of entertainment machines to neighbouring municipalities without restrictions. If this would be the case we would observe a reduction of offline gambling in treated municipalities and an increase in non treated municipalities, leading to upward estimates. On this point, as shown by the literature reviewed, it has to be considered that immediate proximity is a crucial factor in triggering gambling engagement. A qualitative research conducted in the Piedmont region to investigate the opinions of gamblers about the restrictions imposed, seem to confirm that if entertainment machines are no longer available in the usual known places (bars or tobacco shops close to home), few gamblers are willing to travel to other municipalities with no restrictions to still be able to gamble (Rolando et al., 2020). This suggests that cross-municipality mobility for gambling should not be a major issue in our case.

3.6 Results

This section presents the estimates of the model presented in Section 3.5. In order to answer to our research questions, in this section we present the outcomes on which the local policy intervention is hypothesised to have an effect: total turnover from gambling and turnover from entertainment machines. We then analyse the effect that the implementation of the policy had on total gambling turnover, using the GSI Index described in Section 3.4 to identify if there was a shift of gambling consumption from entertainment machines, as the only product available exclusively land-based, to "hybrid" products which are both available land-based and online, or to exclusively online products.

3.6.1 Effect of local interventions on gambling turnover

In order to explore whether the selective reduction of gambling supply operated through restrictions to the availability of entertainment machines determined a general reduction of the gambling turnover, we estimate the policy effect on the per capita overall gambling turnover (without distinguishing by type of gambling product).

Table 3.6 reports the Differences-in-Differences estimation of the effect of local policies run on the per capita total gambling turnover, after controlling for other local socio-demographic characteristics (measured by resident population, density and per capita income), political features (captured by gender, age, educational level and affiliation to political parties, a dummy for Center-left party, as well as by characteristics of the municipal council, like the share of females and average age) and local gambling supply-side variables (measured by the amount of per capita entertainment machines, both AWP-slot machines and VLT-videolotteries, available in each municipality).

Table 3.6: Estimated effect of municipal policies on total per capita gambling turnover

	Per capita gambling turnover
DiD	-0.026
	(0.017)
VLT machines per capita	0.278***
	(0.020)
AWP machines per capita	0.058**
	(0.022)
Population	4.340
	(3.057)
Age of mayor	-0.059.
	(0.033)
Mayor with degree or more	0.068
	(0.079)
Gender of mayor (ref. Male)	0.186.
	(0.112)
Centre-left party	0.052
	(0.096)
Share of females in municipal council	0.050.
	(0.028)
Average age of municipal council	0.073*
	(0.030)
Per capita income	-0.306
	(0.234)
Population density	-4.216*
	(1.885)

Unbalanced Panel: 314 Municipalities, 3 Years, 852 Obs. Both dependent and independent variables are normalised on the standard deviations. =". p<0.1 * p<0.05 ** p<0.01 *** p<0.001".

Results in Table 3.6 show that adoption of the municipal policy did not affect significantly the total amount spent by citizens in gambling products.

We then proceed by restricting the analysis to the gambling turnover generated by entertainment machines.

Table 3.7: Estimated effect of municipal policies on per capita gambling turnover from entertainment machines

	Per capita turnover entertainment machines
DiD	-0.050**
	(0.017)
VLT machines per capita	0.306***
	(0.020)
AWP machines per capita	0.067**
	(0.023)
Population	4.853
	(3.088)
Age of mayor	-0.063.
	(0.034)
Mayor with degree or more	0.027
	(0.080)
Gender of mayor (ref. Male)	0.155
	(0.113)
Centre-left party	0.067
	(0.097)
Share of females in municipal council	0.027
	(0.028)
Average age of municipal council	0.062*
	(0.030)
Per capita income	-0.425.
	(0.236)
Population density	-4.510*
	(1.904)

Unbalanced Panel: 314 Municipalities, 3 Years, 852 Obs. Both dependent and independent variables are normalised on the standard deviations. =". p<0.1 * p<0.05 ** p<0.01 *** p<0.001".

Results in Table 3.7 show that the application of policies is significantly associated to a decrease in the gambling turnover generated by entertainment machines. This means that ceteris paribus, the higher the number of suspension hours, the lower the per-capita turnover from entertainment machines at municipal level. With these evidences, we can exclude a time shifting in entertainment machine gamblers which totally compensate the time in which the machines are forced to be turned off.

3.6.2 Effect of local interventions on the "hybrid" and "on-line" components of gambling turnover

To better investigate if there was a shift in the composition of gambling turnover from entertainment machines to other gambling products, and specifically to online gambling products we computed the gambling specialization index (GSI) for all types of products together excluding entertainment machines, i.e. for "hybrid" and on-line games, and then separately for hybrid games, i.e. those products which are available both offline and online, and for online games, i.e. those which are available exclusively online, for each municipality in the Piedmont region.

In Table 3.8 we first analyse the policy effect on the GSI for entertainment machines exclusively available offline.

Table 3.8: Estimated effect of municipal policies on Gambling Specialisation Index for "exclusively land-based" games (i.e. entertainment machines)

	GSI for "exclusively land-based" games
DiD	-0.106**
	(0.035)
VLT machines per capita	0.191***
	(0.040)
AWP machines per capita	0.094*
	(0.045)
Population	1.098
	(6.165)
Age of mayor	0.021
	(0.067)
Mayor with degree or more	-0.026
	(0.160)
Gender of mayor (ref. Male)	-0.247
	(0.226)
Centre-left party	0.073
	(0.194)
Share of females in municipal council	0.030
	(0.056)
Average age of municipal council	0.027
	(0.060)
Per capita income	-1.497**
	(0.471)
Population density	-9.690*
	(3.802)

Unbalanced Panel: 314 Municipalities, 3 Years, 852 Obs. Both dependent and independent variables are normalised on the standard deviations. =". p<0.1 * p<0.05 ** p<0.01 *** p<0.001".

Results in Table 3.8 confirm that the policy induced a significant reduction in the amount dedicated to entertainment machines relative to the entire amount spent in gambling products.

This evidence shows that the continuous treatment, which has led to a reduction in the per capita expenditure on gambling from entertainment machines (Table 3.7), also provoked a significant change in the composition of the gambling turnover, with a reduction in the share of turnover generated by entertainment machines.

In Table 3.9 we then proceeded by analysing the policy effect on the GSI for all games (both "hybrid and "exclusively on-line"), excluding entertainment machines.

Table 3.9: Estimated effect of municipal policies on Gambling Specialisation Index for all games excluding "exclusively land-based" (i.e. entertainment machines)

	GSI excluding "exclusively land-based"
DiD	0.083**
	(0.030)
VLT machines per capita	-0.115**
	(0.035)
AWP machines per capita	-0.107**
	(0.039)
Population	-3.728
	(5.311)
Age of mayor	-0.025
	(0.058)
Mayor with degree or more	0.061
	(0.138)
Gender of mayor (ref. Male)	0.155
	(0.195)
Centre-left party	0.025
	(0.167)
Share of females in municipal council	0.022
	(0.048)
Average age of municipal council	0.030
	(0.052)
Per capita income	1.639***
	(0.406)
Population density	11.411***
	(3.276)

Unbalanced Panel: 314 Municipalities, 3 Years, 852 Obs. Both dependent and independent variables are normalised on the standard deviations. =". p<0.1 * p<0.05 ** p<0.01 *** p<0.001".

Results in Table 3.9 show that the policy had a significant and positive effect on this outcome. This indicates that there was a shift in the composition of gambling turnover from entertainment machines towards other categories of games.

To further investigate this result, in Table 3.10 we estimated the policy effect on the GSI calculated for "hybrid products", i.e. those games which are available both land-based and online (Sport betting, Bingo, Lotteries, Lotto, Numerical games and Horse racing).

Table 3.10: Estimated effect of municipal policies on Gambling Specialisation Index for "hybrid games"

	GSI for "hybrid games"
DiD	0.018
	(0.032)
VLT machines per capita	-0.101**
	(0.037)
AWP machines per capita	-0.122**
	(0.042)
Population	-3.003
	(5.692)
Age of mayor	-0.018
	(0.062)
Mayor with degree or more	-0.241
	(0.148)
Gender of mayor (ref. Male)	0.244
	(0.209)
Centre-left party	-0.061
	(0.179)
Share of females in municipal council	-0.052
	(0.052)
Average age of municipal council	-0.044
	(0.055)
Per capita income	1.341**
	(0.435)
Population density	9.867**
	(3.511)

Unbalanced Panel: 314 Municipalities, 3 Years, 852 Obs. Both dependent and independent variables are normalised on the standard deviations. =". p<0.1 * p<0.05 ** p<0.01 *** p<0.001".

In this case, we do not notice any significant changes in the GSI index following the policy, suggesting that there was no appreciable shift towards other categories of "hybrid" games. Concerning the change in the sign of the coefficient of per capita income variable, negative in the case of the GSI for exclusively land-based products (Table 3.8) and positive for the GSI of all games excluding land-based products and of hybrid games (Tables 3.9 and 3.10 respectively), it is worth noticing that this is line with previous findings (Resce et al., 2019), indicating the existence of pro-rich games, more concentrated among wealthier individuals, and pro-poor games, more concentrated among poorer individuals. Entertainment machines belong to the latter category. Concerning the change in the sign of the coefficient of population density variable, this might reflect the fact that, with respect to other gambling products, entertainment machines tend to attract fewer gamblers who bet higher amounts. This might imply the fact that a higher population density affects negatively the share of the total gambling turnover held by entertainment machines, as the relative weight of these gamblers is lower compared to small municipalities. The meaning of the change in the signs of the VLT and AWP machines is more intuitive to grasp, as to an increase in the number of machines corresponds an increase in the relative share of the gambling turnover generated by the machines themselves, when considering the relative share of gambling turnover generated by other gambling products the effect is negative.

Finally, in Table 3.11 we estimate the effect of the policy on the GSI calculated for those games which are only available on-line.

Table 3.11: Estimated effect of municipal policies on Gambling Specialisation Index for "online games"

	GSI for "online games"
DiD	0.084*
	(0.033)
VLT machines per capita	-0.054
	(0.038)
AWP machines per capita	-0.032
	(0.043)
Population	-2.226
	(5.805)
Age of mayor	-0.021
	(0.063)
Mayor with degree or more	0.285.
	(0.150)
Gender of mayor (ref. Male)	-0.033
	(0.213)
Centre-left party	0.080
	(0.183)
Share of females in municipal council	0.081
	(0.053)
Average age of municipal council	0.082
	(0.057)
Per capita income	0.907*
	(0.444)
Population density	5.891
	(3.580)

Unbalanced Panel: 314 Municipalities, 3 Years, 852 Obs. Both dependent and independent variables are normalised on the standard deviations. =". p<0.1 * p<0.05 ** p<0.01 *** p<0.001".

In this case we notice a significant increase of the GSI as a consequence of the implementation of local regulations. This means that the relative weight of online games in the gambling market underwent a significant increase.

Overall, these results provide evidences of a shifting effect from offline to online games. The shifting effect of the policy does not only affect the composition of the market, but it is substantial, since it affects positively the amount invested by citizens in on-line gambling (see Table 3.18 in the Appendix, Section 3.9, which have a constant availability, relative easy access and guarantee a high payout similar to the one of entertainment machines (85-90% for the latter, 74-85% for the former).

3.7 Robustness Checks

The main assumption on which a DiD strategy rests upon is that the dynamics of the outcome variables are similar before the treatment across the groups (no pre-trends). In the absence of parallel trends, the effect of the treatment is not identifiable. A formal test for the assumption of common trends which is also suitable for a number of treatments and several groups is provided in Angrist and Pishke (2009) and used, among others, in Boschi et al. (2014). The idea is to include the treatment for the pre-treatment period. This way, if the outcome trends between treatment and control groups are the same, then the coefficient associated to those dummies should be insignificant, i.e. the DiD is not significantly different between the two groups in the pre-treatment period. Adapting this test to our case study, we have augmented the policy ($Treatment \times Hours$) by one lead (which in our case corresponds to one year). In the Appendix, we show the results for the main outcomes investigated in this study: 1. total per-capita gambling turnover (Table 3.12); 2. per-capita gambling turnover from entertainment machines (Table 3.13); 3. Gambling Specialisation Index for "exclusively land-based" games (3.14); 4. Gambling Specialisation Index for all games ("hybrid" and online games), excluding "exclusively land-based" (Table 3.15); 5. Gambling Specialisation Index for "hybrid games" (Table 3.16); 6. Gambling Specialisation Index for "on-line games" (Table 3.17); 6. per-capita gambling turnover from on-line games (Table 3.19). As shown in Tables 3.12-3.17, 3.23 and 3.19, the coefficients associated to these leaded treatments are all non-significant, not providing evidence against the assumption of parallel trends in the absence of the treatments under investigation. Furthermore, in Section 3.9 we perform a range of sensitivity analyses on all our outcome measures (Tables 3.24- 3.31): separated estimates for municipalities governed by centre-left and non-centre left parties, estimates excluding those municipalities that changed party during the observed period, estimates including only the municipalities with more than 1500 residents, estimates excluding the regional capital Turin. Our results remain substantially unchanged, with the only exception of of centre-left governed municipalities, where we do not find significant changes in the turnover from entertainment machines and from online games. This results should be interpreted with caution due to the small number of centre-left governed municipalities. We also show the results of our models excluding the control variables to rule out the hypothesis of endogeneity that might arise when control variables are measured at the same time as the outcomes.

3.8 Conclusions

Gambling has become increasingly common in developed societies. In the Italian case, in line with the global trend, in the last decades there have been a series of reforms that have considerably expanded gambling supply, leading to a massive expansion of the gambling market with a contemporary increase in the prevalence of problematic gambling behavior in the population. The different types of gambling products have contributed differently to this growing market and to

the increasing gambling disorders. In particular, the growth in the gambling turnover observed in the last 18 years is mainly due to the revenues produced by the introduction of entertainment machines on the market. Epidemiological literature has shown that this category of products is also strongly associated with problematic gambling behaviours and addiction.

To tackle this public health problem, confronted with the lack of specific guidelines by the central government, some Italian regions have implemented different policies aimed on one side at planning appropriate levels of care for gambling addiction, on the other at forcing their municipalities to set limits to gambling supply, particularly through entertainment machines, with the aim of preventing the further spread of problem gambling behaviours in the population.

In the present paper we investigate the impact of municipal policies that in the years 2017-2018 were introduced in some municipalities of the Piedmont region to impose a temporary daily suspension of the functioning time of entertainment machines had on the gambling market using a regression-based DiD model with continuous treatment. As treatment intensity variable, we exploit the number of suspension hours imposed by municipal regulations. Departing from the hypothesis that limitations imposed on a category of offline games might have induced an increase in the amount invested by gamblers in online gambling products, we also applied the GSI Index to assess whether the policies had the effect of changing the composition of gambling turnover: we tested this hypothesis for exclusively land-based games, i.e. entertainment machines, "hybrid" gambling products, i.e. gambling products which are distributed both offline and online, and "exclusively online" products, i.e. products which are only available online.

The estimates show that the municipal policies reduced the turnover generated by entertainment machines, and that this effect was proportional to the suspension time imposed on the functioning of the machines. However, no significant reduction was caused to the overall gambling turnover, indicating that the amount invested overall by citizens in gambling products remained substantially unchanged.

Our results also illustrate that some changes occurred in the composition of the gambling market. In the face of a significant reduction in the relative contribution of entertainment machines to the total gambling turnover, we observe a significant increase in the relative contribution of online gambling products.

The local policies limiting gambling supply investigated in the present work had the aim of reducing access to entertainment machines both for the general population, based on the assumption that interventions reducing overall gambling are likely also to reduce problem gambling incidence, and for those gamblers who already have a problematic behaviour. Our results suggest that this kind of policy is effective in reducing the turnover generated by entertainment machines, proportional to the suspension time imposed. Notwithstanding that, the gambling market did not reduce significantly and there are indications of a partial shift towards online games.

Although shading light on some market dynamics, the findings of this study do not allow to draw any conclusions with respect to the effect that the analysed interventions had on the prevalence of problem gambling behaviour and addiction in the population, as they are only based on administrative data about gambling turnover. To have a more comprehensive picture of the phenomenon and of the effectiveness of the analysed policies with respect to their primary objective, further studies should extend the analysis to survey data providing information about the actual number of citizens who gamble and their gambling behaviour as well as administrative data about the demand for healthcare services dedicated to problem gamblers.

3.9 Appendix

Table 3.12: Robustness check 1: Estimated effect of leaded municipal policies on total per-capita gambling turnover

	Per capita gambling turnover
lead(DiD)	-0.015
	(0.038)
VLT machines per capita	0.157***
	(0.030)
AWP machines per capita	0.002
	(0.025)
Population	4.144
	(6.184)
Age of mayor	-0.064.
	(0.039)
Mayor with degree or more	0.074
	(0.096)
Gender of mayor (ref. Male)	0.578***
	(0.155)
Centre-left party	0.041
	(0.157)
Share of females in municipal council	0.006
	(0.039)
Average age of municipal council	0.108*
	(0.044)
Per capita income	0.289
	(0.362)
Population density	4.966
	(5.235)

Unbalanced Panel: 303 Municipalities, 2 Years, 542 Obs. Both dependent and independent variables are normalised on the standard deviations. =". p<0.1 * p<0.05 ** p<0.01 *** p<0.001".

Table 3.13: Robustness check 2: Estimated effect of leaded municipal policies on per-capita gambling turnover from entertainment machines

	Per capita turnover entertainment machines
lead(DiD)	-0.016
	(0.037)
VLT machines per capita	0.140***
	(0.029)
AWP machines per capita	0.021
	(0.025)
Population	1.809
	(6.026)
Age of mayor	-0.078*
	(0.038)
Mayor with degree or more	-0.004
	(0.094)
Gender of mayor (ref. Male)	0.410**
	(0.151)
Centre-left party	0.095
	(0.153)
Share of females in municipal council	-0.035
	(0.038)
Average age of municipal council	0.071.
	(0.042)
Per capita income	0.406
	(0.353)
Population density	5.091
	(5.102)

Unbalanced Panel: 303 Municipalities, 2 Years, 542 Obs. Both dependent and independent variables are normalised on the standard deviations. =". p<0.1 * p<0.05 ** p<0.01 *** p<0.001".

Table 3.14: Robustness check 3: Estimated effect of leaded municipal policies on Gambling Specialisation Index for "exclusively land-based" games (i.e. entertainment machines)

	GSI for "exclusively land-based" games
lead(DiD)	-0.040
	(0.055)
VLT machines per capita	0.053
	(0.043)
AWP machines per capita	0.044
	(0.036)
Population	-7.278
	(8.894)
Age of mayor	-0.045
	(0.056)
Mayor with degree or more	-0.038
	(0.139)
Gender of mayor (ref. Male)	-0.191
	(0.223)
Centre-left party	0.019
	(0.225)
Share of females in municipal council	-0.095.
	(0.055)
Average age of municipal council	0.004
	(0.063)
Per capita income	0.086
	(0.521)
Population density	3.265
	(7.529)

Unbalanced Panel: 303 Municipalities, 2 Years, 542 Obs. Both dependent and independent variables are normalised on the standard deviations. =". p<0.1 * p<0.05 ** p<0.01 *** p<0.001".

Table 3.15: Robustness check 4: Estimated effect of leaded municipal policies on Gambling Specialisation Index for all games ("hybrid" and online games), excluding "exclusively land-based" (i.e. entertainment machines)

	GSI excluding "exclusively land-based"
lead(DiD)	0.041
	(0.058)
VLT machines per capita	-0.052
	(0.045)
AWP machines per capita	-0.040
	(0.039)
Population	3.088
	(9.399)
Age of mayor	0.026
	(0.059)
Mayor with degree or more	0.128
	(0.146)
Gender of mayor (ref. Male)	0.120
	(0.236)
Centre-left party	0.110
	(0.238)
Share of females in municipal council	0.145*
	(0.059)
Average age of municipal council	0.049
	(0.066)
Per capita income	0.418
	(0.551)
Population density	1.217
	(7.957)

Unbalanced Panel: 303 Municipalities, 2 Years, 542 Obs. Both dependent and independent variables are normalised on the standard deviations. =". p<0.1 * p<0.05 ** p<0.01 *** p<0.001".

Table 3.16: Robustness check 5: Estimated effect of leaded municipal policies on Gambling Specialisation Index for "hybrid games"

	GSI for "hybrid games"
lead(DiD)	-0.062
	(0.057)
VLT machines per capita	-0.092*
	(0.045)
AWP machines per capita	-0.052
	(0.038)
Population	7.874
	(9.242)
Age of mayor	0.035
	(0.058)
Mayor with degree or more	-0.322*
	(0.144)
Gender of mayor (ref. Male)	0.594*
	(0.232)
Centre-left party	0.055
	(0.234)
Share of females in municipal council	0.034
	(0.058)
Average age of municipal council	-0.038
	(0.065)
Per capita income	0.000
	(0.542)
Population density	-3.173
	(7.824)

Unbalanced Panel: 303 Municipalities, 2 Years, 542 Obs. Both dependent and independent variables are normalised on the standard deviations. =". p<0.1 * p<0.05 ** p<0.01 *** p<0.001".

Table 3.17: Robustness check 6: Estimated effect of leaded municipal policies on Gambling Specialisation Index for "on-line games"

	GSI for "online games"
lead(DiD)	0.104
	(0.080)
VLT machines per capita	0.008
	(0.062)
AWP machines per capita	-0.004
	(0.053)
Population	-3.536
	(12.882)
Age of mayor	0.001
	(0.081)
Mayor with degree or more	0.449*
	(0.201)
Gender of mayor (ref. Male)	-0.398
	(0.324)
Centre-left party	0.091
	(0.327)
Share of females in municipal council	0.162*
	(0.080)
Average age of municipal council	0.091
	(0.091)
Per capita income	0.590
	(0.755)
Population density	4.687
	(10.905)

Unbalanced Panel: 303 Municipalities, 2 Years, 542 Obs. Both dependent and independent variables are normalised on the standard deviations. =". p<0.1 * p<0.05 ** p<0.01 *** p<0.001".

Table 3.18: Estimated effect of municipal policies on per capita gambling turnover from online games

	Per capita turnover online gambling
DiD	0.083*
	(0.037)
VLT machines per capita	0.013
	(0.043)
AWP machines per capita	0.038
	(0.048)
Population	-1.346
	(6.528)
Age of mayor	0.005
	(0.071)
Mayor with degree or more	0.334*
	(0.169)
Gender of mayor (ref. Male)	0.094
	(0.239)
Centre-left party	0.071
	(0.206)
Share of females in municipal council	0.121*
	(0.059)
Average age of municipal council	0.082
	(0.064)
Per capita income	0.402
	(0.499)
Population density	2.081
	(4.026)

Unbalanced Panel: 314 Municipalities, 3 Years, 852 Obs. Both dependent and independent variables are normalised on the standard deviations. =". p<0.1 * p<0.05 ** p<0.01 *** p<0.001".

Table 3.19: Estimated effect of leaded municipal policies on per capita gambling turnover from "on-line games"

	Per capita turnover online gambling
lead(DiD)	-0.034
	(0.092)
VLT machines per capita	0.187**
	(0.072)
AWP machines per capita	-0.021
	(0.061)
Population	2.580
	(14.882)
Age of mayor	-0.030
	(0.093)
Mayor with degree or more	0.532*
	(0.232)
Gender of mayor (ref. Male)	0.362
	(0.374)
Centre-left party	0.017
	(0.377)
Share of females in municipal council	0.149
	(0.093)
Average age of municipal council	0.229*
	(0.105)
Per capita income	-0.233
	(0.872)
Population density	2.265
	(12.599)

Unbalanced Panel: 303 Municipalities, 2 Years, 542 Obs. Both dependent and independent variables are normalised on the standard deviations. =". p<0.1 * p<0.05 ** p<0.01 *** p<0.001".

Table 3.20: Estimated effect of municipal policies on per capita gambling turnover from all games ("hybrid" and online games), excluding "exclusively land-based" (i.e. entertainment machines)

	Per capita turnover "hybrid" and online games
DiD	0.055*
	(0.028)
VLT machines per capita	0.050
	(0.032)
AWP machines per capita	0.000
	(0.036)
Population	0.017
	(4.907)
Age of mayor	-0.017
	(0.054)
Mayor with degree or more	0.142
	(0.127)
Gender of mayor (ref. Male)	0.177
	(0.180)
Centre-left party	-0.018
	(0.155)
Share of females in municipal council	0.086.
	(0.044)
Average age of municipal council	0.067
	(0.048)
Per capita income	0.005
	(0.375)
Population density	0.133
	(3.026)

Unbalanced Panel: 314 Municipalities, 3 Years, 852 Obs. Both dependent and independent variables are normalised on the standard deviations. =". p<0.1 * p<0.05 ** p<0.01 *** p<0.001".

Table 3.21: Estimated effect of leaded municipal policies on per capita gambling turnover from all games ("hybrid" and online games), excluding "exclusively land-based" (i.e. entertainment machines)

	Per capita turnover "hybrid" and online games
lead(DiD)	-0.004
	(0.070)
VLT machines per capita	0.120*
	(0.055)
AWP machines per capita	-0.052
	(0.046)
Population	8.327
	(11.339)
Age of mayor	0.006
	(0.071)
Mayor with degree or more	0.251
	(0.177)
Gender of mayor (ref. Male)	0.728*
	(0.285)
Centre-left party	-0.125
	(0.287)
Share of females in municipal council	0.115
	(0.071)
Average age of municipal council	0.155.
	(0.080)
Per capita income	-0.353
	(0.665)
Population density	2.221
	(9.599)

Unbalanced Panel: 303 Municipalities, 2 Years, 542 Obs. Both dependent and independent variables are normalised on the standard deviations. =". p<0.1 * p<0.05 ** p<0.01 *** p<0.001".

Table 3.22: Estimated effect of municipal policies on per capita gambling turnover from "hybrid games"

	Per capita turnover "hybrid" games
DiD	-0.002
	(0.023)
VLT machines per capita	0.068*
	(0.027)
AWP machines per capita	-0.042
	(0.030)
Population	1.497
	(4.083)
Age of mayor	-0.033
	(0.045)
Mayor with degree or more	-0.133
	(0.106)
Gender of mayor (ref. Male)	0.185
	(0.150)
Centre-left party	-0.107
	(0.129)
Share of females in municipal council	0.008
	(0.037)
Average age of municipal council	0.019
	(0.040)
Per capita income	-0.431
	(0.312)
Population density	-2.057
	(2.518)

Unbalanced Panel: 314 Municipalities, 3 Years, 852 Obs. Both dependent and independent variables are normalised on the standard deviations. =". p<0.1 * p<0.05 ** p<0.01 *** p<0.001".

Table 3.23: Estimated effect of leaded municipal policies on per capita gambling turnover from "hybrid games"

	Per capita turnover "hybrid" games
lead(DiD)	0.030
	(0.053)
VLT machines per capita	-0.009
	(0.041)
AWP machines per capita	-0.062.
	(0.035)
Population	10.740
	(8.584)
Age of mayor	0.042
	(0.054)
Mayor with degree or more	-0.173
	(0.134)
Gender of mayor (ref. Male)	0.790***
	(0.216)
Centre-left party	-0.222
	(0.218)
Share of females in municipal council	0.025
	(0.054)
Average age of municipal council	0.002
	(0.061)
Per capita income	-0.320
	(0.503)
Population density	1.143
	(7.267)

Unbalanced Panel: 303 Municipalities, 2 Years, 542 Obs. Both dependent and independent variables are normalised on the standard deviations. =". p<0.1 * p<0.05 ** p<0.01 *** p<0.001".

Table 3.24: Sensitivity analysis: total gambling turnover

	(1)		(2)	(3)		(4)		(5)		(6)		(7)	
DiD	-4.106		-0.038	-0.026		-0.026		-0.021		-0.026		-0.041	*
	(2.774)		(0.136)	(0.018)		(0.017)		(0.017)		(0.017)		(0.021)	
VLT machines per capita	157711.490	***	1.529	0.276	***	0.278	***	0.284	***	0.278	***		
	(11375.091)		(1.026)	(0.020)		(0.020)		(0.022)		(0.020)			
AWP machines per capita	11512.005	*	-0.314	0.057	*	0.058	*	0.062	**	0.058	*		
	(4479.494)		(0.425)	(0.023)		(0.022)		(0.022)		(0.022)			
Population	0.094		-84.549	1.593		4.340		4.715		4.340			
	(0.066)		(151.724)	(4.839)		(3.057)		(2.979)		(3.057)			
Age of mayor	-6.199	.		-0.062	.	-0.059	.	-0.053		-0.059	.		
	(3.532)			(0.036)		(0.033)		(0.033)		(0.033)			
Mayor with degree or more	74.072			0.063		0.068		0.065		0.068			
	(86.152)			(0.088)		(0.079)		(0.077)		(0.079)			
Gender of mayor (ref. Male)	202.270	.		0.356	*	0.186	.	0.176		0.186	.		
	(121.868)			(0.150)		(0.112)		(0.109)		(0.112)			
Centre-left party	57.074					0.052		0.058		0.052			
	(104.704)					(0.096)		(0.093)		(0.096)			
Share of females in municipal council	511.119	.	-0.536	0.047		0.050	.	0.040		0.050	.		
	(282.662)		(0.523)	(0.030)		(0.028)		(0.028)		(0.028)			
Average age of municipal council	19.365	*	0.480	0.087	**	0.073	*	0.061	*	0.073	*		
	(7.885)		(1.042)	(0.031)		(0.030)		(0.031)		(0.030)			
Per capita income	-0.197		-4.193	-0.346		-0.306		-0.489	*	-0.306			
	(0.150)		(12.079)	(0.242)		(0.234)		(0.246)		(0.234)			
Population density	-8.655	*	19.165	-3.911	.	-4.216	*	-5.251	**	-4.216	*		
	(3.870)		(38.720)	(2.117)		(1.885)		(1.922)		(1.885)			
Standardised coefficients	NO		YES	YES		YES		YES		YES		YES	
Only centre-left party	NO		YES	NO		NO		NO		NO		NO	
Exclude centre-left party	NO		NO	YES		NO		NO		NO		NO	
Only municipalities that did not change party	NO		NO	NO		YES		NO		NO		NO	
$>$ 1.500 residents	NO		NO	NO		NO		YES		NO		NO	
Excluding Turin	NO		NO	NO		NO		NO		YES		NO	
Wthout controls	NO		NO	NO		NO		NO		NO		YES	

Table 3.25: Sensitivity analysis: turnover from entertainment machines

	(1)		(2)	(3)		(4)		(5)		(6)		(7)	
DiD	-6.828	**	-0.050	-0.051	**	-0.050	**	-0.048	**	-0.050	**	-0.073	**
	(2.397)		(0.118)	(0.018)		(0.017)		(0.017)		(0.017)		(0.022)	
VLT machines per capita	148688.244	***	1.460	0.303	***	0.306	***	0.317	***	0.306	***		
	(9829.924)		(0.887)	(0.021)		(0.020)		(0.021)		(0.020)			
AWP machines per capita	11459.436	**	-0.281	0.066	**	0.067	**	0.077	***	0.067	**		
	(3871.009)		(0.368)	(0.023)		(0.023)		(0.021)		(0.023)			
Population	4514.717		-114.245	3.067		4.853		5.025	.	4.853			
	(2872.225)		(131.210)	(4.899)		(3.088)		(2.852)		(3.088)			
Age of mayor	-58.950	.		-0.068	.	-0.063	.	-0.055	.	-0.063	.		
	(31.406)			(4.899)		(0.034)		(0.031)		(0.034)			
Mayor with degree or more	25.535			0.010		0.027		0.026		0.027			
	(74.449)			(0.089)		(0.080)		(0.073)		(0.080)			
Gender of mayor (ref. Male)	144.080			0.321	*	0.155		0.135		0.155			
	(105.314)			(0.152)		(0.113)		(0.104)		(0.113)			
Centre-left party	61.939			0.025		0.067		0.073		0.067			
	(90.481)			(0.030)		(0.097)		(0.089)		(0.097)			
Share of females in municipal council	25.178		-0.721			0.027		0.015		0.027			
	(26.042)		(0.452)			(0.028)		(0.026)		(0.028)			
Average age of municipal council	57.263	*	0.517	0.073	*	0.062	*	0.041		0.062	*		
	(27.998)		(0.901)	(0.032)		(0.030)		(0.029)		(0.030)			
Per capita income	-395.360	.	-7.807	-0.481	.	-0.425	.	-0.600	*	-0.425	.		
	(219.622)		(10.446)	(0.245)		(0.236)		(0.236)		(0.236)			
Population density	-4195.246	*	8.743	-4.491	*	-4.510	*	-5.437	**	-4.510	*		
	(1771.466)		(33.485)	(2.143)		(1.904)		(1.840)		(1.904)			
Standardised coefficients	NO		YES	YES		YES		YES		YES		YES	
Only centre-left party	NO		YES	NO		NO		NO		NO		NO	
Exclude centre-left party	NO		NO	YES		NO		NO		NO		NO	
Only municipalities that did not change party	NO		NO	NO		YES		NO		NO		NO	
$>$ 1.500 residents	NO		NO	NO		NO		YES		NO		NO	
Exclude Turin	NO		NO	NO		NO		NO		YES		NO	
Wthout controls	NO		NO	NO		NO		NO		NO		YES	

Table 3.26: Sensitivity analysis: turnover from hybrid and online games

	(1)		(2)		(3)		(4)		(5)		(6)		(7)	
DiD	2.717	*	0.014		0.055	.	0.055	*	0.063	*	0.055	*	0.069	**
	(1.382)		(0.157)		(0.029)		(0.028)		(0.029)		(0.028)		(0.025)	
VLT machines per capita	8875.838		0.900		0.051		0.050		0.041		0.050			
	(5665.981)		(1.181)		(0.033)		(0.032)		(0.036)		(0.032)			
AWP machines per capita	-22.039		-0.238		-0.001		0.000		-0.014		0.000			
	(2231.255)		(0.490)		(0.037)		(0.036)		(0.038)		(0.036)			
Population	5.764		41.400		-3.611		0.017		0.832		0.017			
	(1655.554)		(174.704)		(7.814)		(4.907)		(5.008)		(4.907)			
Age of mayor	-5.675				-0.016		-0.017		-0.022		-0.017			
	(18.103)				(0.059)		(0.054)		(0.055)		(0.054)			
Mayor with degree or more	48.047				0.174		0.142		0.135		0.142			
	(42.913)				(0.142)		(0.127)		(0.129)		(0.127)			
Gender of mayor (ref. Male)	59.706				0.266		0.177		0.199		0.177			
	(60.703)				(0.242)		(0.180)		(0.183)		(0.180)			
Centre-left party	-5.951					.	-0.018		-0.016		-0.018			
	(52.153)						(0.155)		(0.157)		(0.155)			
Share of females in municipal council	29.081	.	0.255		0.083		0.086	.	0.087	.	0.086	.		
	(15.010)		(0.602)		(0.048)		(0.044)		(0.046)		(0.044)			
Average age of municipal council	22.554		0.133		0.082		0.067		0.084		0.067			
	(16.138)		(1.199)		(0.051)		(0.048)		(0.051)		(0.048)			
Per capita income	1.670		7.585		0.036		0.005		-0.128		0.005			
	(126.590)		(13.909)		(0.391)		(0.375)		(0.414)		(0.375)			
Population density	44.748		37.557		1.035		0.133		-0.799		0.133			
	(1021.075)		(44.584)		(3.419)		(3.026)		(3.231)		(3.026)			
Standardised coefficients	NO		YES		YES		YES		YES		YES		YES	
Only centre-left party	NO		YES		NO		NO		NO		NO		NO	
Exclude centre-left party	NO		NO		YES		NO		NO		NO		NO	
Only municipalities that did not change party	NO		NO		NO		YES		NO		NO		NO	
$>$ 1.500 residents	NO		NO		NO		NO		YES		NO		NO	
Exclude Turin	NO		NO		NO		NO		NO		YES		NO	
Wthout controls	NO		NO		NO		NO		NO		NO		YES	

Table 3.27: Sensitivity analysis: turnover from hybrid games

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
DiD	-0.065	Estimate	-0.003	-0.002	-0.004	-0.002	0.023166
	(0.706)	-0.148 *	(0.024)	(0.023)	(0.024)	(0.023)	(0.024)
VLT machines per capita	7307.444 *	(0.050)	0.070 *	0.068 *	0.102 ***	0.068 *	
	(2895.691)	0.342	(0.027)	(0.027)	(0.029)	(0.027)	
AWP machines per capita	-1583.580	(0.374)	-0.043	-0.042	-0.048	-0.042	
	(1140.319)	-0.344 .	(0.031)	(0.030)	(0.031)	(0.030)	
Population	310.292	(0.155)	-2.946	1.497	1.969	1.497	
	(846.098)	124.933 .	(6.518)	(4.083)	(4.066)	(4.083)	
Age of mayor	-6.897	(55.297)	-0.046	-0.033	-0.031	-0.033	
	(9.252)		(0.049)	(0.045)	(0.044)	(0.045)	
Mayor with degree or more	-27.612		-0.179	-0.133	-0.130	-0.133	
	(21.931)		(0.119)	(0.106)	(0.105)	(0.106)	
Gender of mayor (ref. Male)	38.358		0.239	0.185	0.168	0.185	
	(31.023)		(0.202)	(0.150)	(0.148)	(0.150)	
Centre-left party	-22.126			-0.107	-0.097	-0.107	
	(26.654)			(0.129)	(0.127)	(0.129)	
Share of females in municipal council	1.718	-0.059	-0.002	0.008	0.013	0.008	
	(7.671)	(0.190)	(0.040)	(0.037)	(0.038)	(0.037)	
Average age of municipal council	4.025	-0.424	0.035	0.019	0.019	0.019	
	(8.248)	(0.380)	(0.042)	(0.040)	(0.042)	(0.040)	
Per capita income	-89.329	1.054	-0.367	-0.431	-0.669 *	-0.431	
	(64.696)	(4.402)	(0.326)	(0.312)	(0.336)	(0.312)	
Population density	-426.186	-69.787 **	-0.760	-2.057	-3.486	-2.057	
	(521.837)	(14.112)	(2.852)	(2.518)	(2.624)	(2.518)	
Standardised coefficients	NO	YES	YES	YES	YES	YES	YES
Only centre-left party	NO	YES	NO	NO	NO	NO	NO
Exclude centre-left party	NO	NO	YES	NO	NO	NO	NO
Only municipalities that did not change party	NO	NO	NO	YES	NO	NO	NO
$>$ 1.500 residents	NO	NO	NO	NO	YES	NO	NO
Exclude Turin	NO	NO	NO	NO	NO	YES	NO
Wthout controls	NO	NO	NO	NO	NO	NO	YES

Table 3.28: Sensitivity analysis: turnover from online games

	(1)		(2)	(3)		(4)		(5)		(6)		(7)	
DiD	2.782	*	0.157	0.085	*	0.083	*	0.098	*	0.083	*	0.082	*
	(1.233)		(0.239)	(0.039)		(0.037)		(0.039)		(0.037)		(0.032)	
VLT machines per capita	1568.393		1.028	0.012		0.013		-0.032		0.013			
	(5055.355)		(1.798)	(0.044)		(0.043)		(0.048)		(0.043)			
AWP machines per capita	1561.541		-0.040	0.038		0.038		0.023		0.038			
	(1990.791)		(0.745)	(0.049)		(0.048)		(0.050)		(0.048)			
Population	-304.528		-52.684	-2.687		-1.346		-0.563		-1.346			
	(1477.134)		(265.815)	(10.371)		(6.528)		(6.619)		(6.528)			
Age of mayor	1.222			0.018		0.005		-0.005		0.005			
	(16.152)			(0.078)		(0.071)		(0.072)		(0.071)			
Mayor with degree or more	75.659	*		0.423	*	0.334	*	0.320	.	0.334	*		
	(38.288)			(0.189)		(0.169)		(0.171)		(0.169)			
Gender of mayor (ref. Male)	21.348			0.178		0.094		0.142		0.094			
	(54.161)			(0.321)		(0.239)		(0.241)		(0.239)			
Centre-left party	16.175					0.071		0.065		0.071			
	(46.533)					(0.206)		(0.207)		(0.206)			
Share of females in municipal council	27.363	*	0.433	0.126	*	0.121	*	0.118	.	0.121	*		
	(13.393)		(0.915)	(0.063)		(0.059)		(0.061)		(0.059)			
Average age of municipal council	18.529		0.587	0.090		0.082		0.107		0.082			
	(14.399)		(1.825)	(0.067)		(0.064)		(0.068)		(0.064)			
Per capita income	91.000		10.344	0.390		0.402		0.421		0.402			
	(112.948)		(21.162)	(0.518)		(0.499)		(0.547)		(0.499)			
Population density	470.934		119.916	2.239		2.081		2.001		2.081			
	(911.034)		(67.836)	(4.538)		(4.026)		(4.271)		(4.026)			
Standardised coefficients	NO		YES	YES		YES		YES		YES		YES	
Only centre-left party	NO		YES	NO		NO		NO		NO		NO	
Exclude centre-left party	NO		NO	YES		NO		NO		NO		NO	
Only municipalities that did not change party	NO		NO	NO		YES		NO		NO		NO	
$>$ 1.500 residents	NO		NO	NO		NO		YES		NO		NO	
Exclude Turin	NO		NO	NO		NO		NO		YES		NO	
Wthout controls	NO		NO	NO		NO		NO		NO		YES	

Table 3.29: Sensitivity analysis: GSI of exclusively land-based games (entertainment machines)

	(1)	(2)		(3)		(4)		(5)		(6)	
DiD	0.000	-0.107	**	-0.106	**	-0.104	**	-0.106	**	-0.051	***
	(0.117)	(0.037)		(0.035)		(0.035)		(0.035)		(0.014)	
VLT machines per capita	0.032	0.194	***	0.191	***	0.194	***	0.191	***		
	(0.884)	(0.041)		(0.040)		(0.044)		(0.040)			
AWP machines per capita	-0.111	0.094	*	0.094	*	0.101	*	0.094	*		
	(0.366)	(0.046)		(0.045)		(0.045)		(0.045)			
Population	-54.231	0.056		1.098		1.703		1.098			
	(130.681)	(9.837)		(6.165)		(6.020)		(6.165)			
Age of mayor		0.019		0.021		0.042		0.021			
		(0.074)		(0.067)		(0.066)		(0.067)			
Mayor with degree or more		-0.094		-0.026		-0.012		-0.026			
		(0.179)		(0.160)		(0.155)		(0.160)			
Gender of mayor (ref. Male)		-0.090		-0.247		-0.280		-0.247			
		(0.305)		(0.226)		(0.220)		(0.226)			
Centre-left party				0.073		0.098		0.073			
				(0.194)		(0.188)		(0.194)			
Share of females in municipal council	-0.583	0.016		0.030		0.032		0.030			
	(0.450)	(0.060)		(0.056)		(0.056)		(0.056)			
Average age of municipal council	-0.247	0.032		0.027		-0.006		0.027			
	(0.897)	(0.064)		(0.060)		(0.062)		(0.060)			
Per capita income	-6.569	-1.479	**	-1.497	**	-1.848	***	-1.497	**		
	(10.404)	(0.492)		(0.471)		(0.498)		(0.471)			
Population density	-9.626	-9.484	*	-9.573	*	-11.488	**	-9.609	*		
	(33.350)	(4.304)		-4.413		(3.885)		(3.802)			
Standardised coefficients	YES	YES		YES		YES		YES		YES	
Only centre-left party	YES	NO		NO		NO		NO		NO	
Exclude centre-left party	NO	YES		NO		NO		NO		NO	
Only municipalities that did not change party	NO	NO		YES		NO		NO		NO	
$>$ 1.500 residents	NO	NO		NO		YES		NO		NO	
Exclude Turin	NO	NO		NO		NO		YES		NO	
Wthout controls	NO	NO		NO		NO		NO		YES	

Table 3.30: Sensitivity analysis: GSI of hybrid games

	(1)	(2)		(3)		(4)		(5)		(6)
DiD	-0.052	0.018		0.018		0.003		0.018		0.030587
	(0.080)	(0.034)		(0.032)		(0.033)		(0.032)		(0.030)
VLT machines per capita	-0.274	-0.101	**	-0.101	**	-0.084	*	-0.101	**	
	(0.599)	(0.038)		(0.037)		(0.041)		(0.037)		
AWP machines per capita	-0.025	-0.121	**	-0.122	**	-0.121	**	-0.122	**	
	(0.248)	(0.043)		(0.042)		(0.043)		(0.042)		
Population	97.746	-2.730		-3.003		-3.186		-3.003		
	(88.630)	(9.099)		(5.692)		(5.669)		(5.692)		
Age of mayor		-0.030		-0.018		-0.033		-0.018		
		(0.068)		(0.062)		(0.062)		(0.062)		
Mayor with degree or more		-0.295	.	-0.241		-0.237		-0.241		
		(0.166)		(0.148)		(0.146)		(0.148)		
Gender of mayor (ref. Male)		0.238		0.244		0.251		0.244		
		(0.282)		(0.209)		(0.207)		(0.209)		
Centre-left party				-0.061		-0.069		-0.061		
				(0.179)		(0.177)		(0.179)		
Share of females in municipal council	0.186	-0.059		-0.052		-0.021		-0.052		
	(0.305)	(0.056)		(0.052)		(0.053)		(0.052)		
Average age of municipal council	-0.109	-0.053		-0.044		-0.005		-0.044		
	(0.609)	(0.059)		(0.055)		(0.058)		(0.055)		
Per capita income	2.394	1.363	**	1.341	**	1.433	**	1.341	**	
	(7.056)	(0.455)		(0.435)		(0.469)		(0.435)		
Population density	-48.988	10.005	*	9.867	**	10.249	**	9.867	**	
	(22.618)	(3.981)		(3.511)		(3.658)		(3.511)		
Standardised coefficients	YES	YES		YES		YES		YES		YES
Only centre-left party	YES	NO		NO		NO		NO		NO
Exclude centre-left party	NO	YES		NO		NO		NO		NO
Only municipalities that did not change party	NO	NO		YES		NO		NO		NO
$>$ 1.500 residents	NO	NO		NO		YES		NO		NO
Exclude Turin	NO	NO		NO		NO		YES		NO
Wthout controls	NO	NO		NO		NO		NO		YES

Table 3.31: Sensitivity analysis: GSI of online games

	(1)	(2)		(3)		(4)		(5)		(6)	
DiD	0.122	0.087	*	0.084	*	0.087	**	0.084	*	0.074	*
	(0.117)	(0.035)		(0.033)		(0.033)		(0.033)		(0.029)	
VLT machines per capita	-0.258	-0.055		-0.054		-0.062		-0.054			
	(0.881)	(0.039)		(0.038)		(0.041)		(0.038)			
AWP machines per capita	0.140	-0.033		-0.032		-0.032		-0.032			
	(0.365)	(0.044)		(0.043)		(0.042)		(0.043)			
Population	-16.662	-0.540		-2.226		-2.702		-2.226			
	(130.256)	(9.289)		(5.805)		(5.610)		(5.805)			
Age of mayor	0.649	-0.004		-0.021		-0.031		-0.021			
	(0.449)	(0.070)		(0.063)		(0.061)		(0.063)			
Mayor with degree or more		0.341	*	0.285	.	0.268	.	0.285	.		
		(0.169)		(0.150)		(0.145)		(0.150)			
Gender of mayor (ref. Male)		-0.028		-0.033		-0.013		-0.033			
		(0.288)		(0.213)		(0.205)		(0.213)			
Centre-left party				0.080		0.059		0.080			
				(0.183)		(0.175)		(0.183)			
Share of females in municipal council		0.099	.	0.081		0.062		0.081			
		(0.057)		(0.053)		(0.052)		(0.053)			
Average age of municipal council	0.335	0.082		0.082		0.082		0.082			
	(0.894)	(0.060)		(0.057)		(0.057)		(0.057)			
Per capita income	5.343	0.870	.	0.907	*	1.168	*	0.907	*		
	(10.370)	(0.464)		(0.444)		(0.464)		(0.444)			
Population density	62.065	5.317		5.891		7.316	*	5.891			
	(33.241)	(4.064)		(3.580)		(3.620)		(3.580)			
Standardised coefficients	YES	YES		YES		YES		YES		YES	
Only centre-left party	YES	NO		NO		NO		NO		NO	
Exclude centre-left party	NO	YES		NO		NO		NO		NO	
Only municipalities that did not change party	NO	NO		YES		NO		NO		NO	
$>$ 1.500 residents	NO	NO		NO		YES		NO		NO	
Exclude Turin	NO	NO		NO		NO		YES		NO	
Wthout controls	NO	NO		NO		NO		NO		YES	

Table 3.32: Descriptive statistic for municipalities included and excluded from the study

	Municipalities included						Municipalities excluded					
	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
Resident population	1003.00	2395.00	3756.00	10114.00	7262.00	890529.00	47.00	328.00	606.00	763.90	1050.00	2510.00
Per capita income	7807.00	13507.00	14389.00	14542.00	15245.00	25001.00	4798.00	12540.00	13634.00	13677.00	14793.00	22349.00
Age of mayor	25.00	47.50	54.00	54.23	62.00	84.00	21.00	47.00	56.00	55.70	65.00	84.00
Mayor with degree or more	0.00	0.00	0.00	0.42	1.00	1.00	0.00	0.00	0.00	0.26	1.00	1.00
Gender of mayor (ref. Male)	0.00	0.00	0.00	0.19	0.00	1.00	0.00	0.00	0.00	0.17	0.00	1.00
Centre-left party	0.00	0.00	0.00	0.03	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00
Share of females in municipal council	0.00	0.24	0.32	0.32	0.38	0.62	0.00	0.17	0.31	0.28	0.38	0.85
Average age of municipal council	37.45	47.34	50.06	49.99	52.51	64.22	31.08	47.15	50.69	50.58	54.15	65.67
Total gambling turnover	6492945111.00	6492945111.00	6541097886.00	6542058220.00	6592131661.00	6592131661.00	6492945111.00	6492945111.00	6541097886.00	6542058220.00	6592131661.00	6592131661.00
Turnover from entertainment machines	0.00	340323.00	1331609.00	8465398.00	4476298.00	792798787.00	0.00	0.00	0.00	185988.00	194274.00	15194284.00
GSI for entertainment machines	0.00	0.43	0.82	0.78	1.14	2.08	0.00	0.00	0.00	0.41	0.87	2.21
GSI for "hybrid" and online games	0.06	0.85	1.20	1.22	1.62	2.35	0.00	1.16	1.83	1.61	2.08	2.35
GSI for "hybrid" games	0.01	0.73	1.03	1.11	1.40	3.56	0.00	0.30	0.93	1.25	1.96	3.89
GSI for online games	0.00	0.60	1.07	1.33	1.88	5.81	0.00	0.45	1.65	2.09	3.63	5.83

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