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Decriminalization and Initiation into Cannabis Use

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Abstract

In this paper we investigate whether decriminalizing cannabis use leads to an increase in its uptake. To do so, we use individual level information from a general population in Australia. Australia provides an interesting case study for examining this issue because it has decriminalized the use of cannabis in half of its states and territories. The remaining states have moved from a strict criminal regime to depenalization via diversion programs over the study period. For this reason, our analysis pays special attention to the status quo with which decriminalization is compared. In modeling cannabis uptake, we use a discrete-time hazard model which also takes unobserved state differences into account. Decriminalization seems to shift the age distribution of uptake of cannabis towards younger age groups while leaving the proportion of those who will start using cannabis unchanged. This suggests that decriminalization effects when individuals start using cannabis, rather than whether or not they start.

Keywords: cannabis use; decriminalization; cannabis policy

JEL codes: C41, I10, I18

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1 Introduction

The issue of cannabis' legal status is never far from the policy agenda. In 2010 for example, the US state of California held a referendum on whether cannabis should be made legal. In 2001, Portugal decriminalized the use of cannabis along with all other drugs. In 2004, Britain reclassified cannabis from a Class B to a Class C drug, which effectively decriminalized it and then reversed the decision in 2008, controversially ignoring the recommendations of its own advisory body.[1] In jurisdictions in which there has been a softening of the criminal justice stance on cannabis, the motivating factor has typically been a concern that harsh criminal sanctions are disproportionate to the harm caused by cannabis consumption.[2] Among opponents of liberalization, on the other hand, there is concern that such policy changes will increase cannabis use and recent evidence suggests that the cannabis consumption, especially early initiation and long term heavy use, may be associated with adverse outcomes such as reduced mental health and lower educational attainment (Hall and Degenhardt, 2009; Macleod et al., 2004). This being the case, the central question faced by policy makers contemplating a liberalization of their jurisdiction's cannabis policy is whether such a move will lead to an increase in cannabis use, and if so, by whom and by how much.

Cannabis users account for 80% of the 200 million illicit drug users in the world (UNODC, World Drug Report, 2010). In countries such as the US, the UK and Australia, over 30% of the population have used cannabis and they have done so despite it being illegal. There has been much concern about the economic and social costs of maintaining harsh criminal sanctions for its use. Over the past four decades, these concerns have culminated in the decriminalizing of the use of cannabis in many jurisdictions. Given this experience, it seems reasonable to expect there to be clear cut evidence as to the effect of decriminalization on the use of cannabis. Unfortunately, the literature provides more questions than answers, with published studies reporting conflicting results.

Previous studies have focused on the effect of decriminalization on whether people have used cannabis in the past year or month, or the frequency with which it is used conditional on being a user. Each of these measures relate to the stock of users, which is comprised of those who started use in previous periods and have not quit, and those who start use in the current period. In assessing the likely impact of decriminalization, its effect on the uptake decision is of particular interest. In part, this is because all else being equal, those contemplating using cannabis for the first time are more likely to be sensitive to policy

[1] While the Police and Criminal amendment Act (PACE) 1984 was also amended to make possession of a class C drug an arrestable offence, the London Metropolitan Police issued an Police Standard Operating Procedure which postulated a presumption against arrest for adult cannabis possession, with a decision to arrest requiring justification (Room et al., 2010)

[2] The exception, perhaps, is California where raising government revenue was also a driving motivation.

changes than those who have been using for some time and have yet to quit. An additional reason for focussing on the impact of decriminalization on uptake is that initiation into cannabis use typically occurs in the teenage years when the brain is still developing, and is therefore vulnerable in ways the adult brain is not. For example, recent evidence suggests that cannabis use during puberty may be associated with long term cognitive deficits even though cannabis use in adulthood is found to have no such effect (Schneider, 2008).

This is the first study to empirically investigate the effect of decriminalization on the rate of cannabis initiation. We do so using a discrete-time hazard model. The empirical analysis is based on individual level information from a general population in Australia. Australia provides an interesting case study for examining this issue because it contains states that have decriminalized the use of cannabis as well as states that have depenalized without changing the legal status of the drug. In addition to considering the impact of decriminalization on a dimension of cannabis use not previously studied, we also extend the literature by relaxing the assumption of a homogenous treatment effect of the policy regime. Allowing for a heterogenous effect with respect to age is especially relevant in studying initiation into cannabis use because this decision is often taken in youth, and adults and minors face different restrictions under the law. For example, decriminalization of cannabis typically applies to adults only. Therefore, one may reasonably expect a different response from adults and minors to the introduction of decriminalization. We accommodate this in our empirical specification.

A further contribution of this study is that it overcomes the shortcomings of earlier research in properly classifying jurisdiction's legal regimes for cannabis use (Pacula et al., 2005). As discussed in more detail below, previous studies have misclassified jurisdictions that maintain criminal sanctions for cannabis use offences as decriminalized. They have also included in the comparison group jurisdictions with heterogeneous legal regimes, including strictly criminal and depenalized. At best, this makes it difficult to interpret their findings, at worst, it renders their findings unreliable. We overcome this issue by collecting information on laws pertaining to cannabis use in Australia so as to be able to accurately categorize each jurisdiction. Decriminalization is defined in this study as the removal of the criminal status and all criminal sanctions for the use of cannabis. Under decriminalization, the personal use of cannabis remains illegal but is a civil offense. The alternatives to decriminalization are defined as (1) a strict criminal regime, and (2) a depenalized regime where simple cannabis offenses are diverted from the criminal justice system through, for example, the use of cautions.

In our empirical analysis of cannabis uptake we are careful to account for unobserved state differences that may be correlated with the policy variables. Our results demonstrate that failing to account for unobserved differences between states that do and do not introduce decriminalization leads to incorrect inference. The results also demonstrate

the importance of allowing for heterogeneous treatments. For example, assuming a homogenous treatment effect framework and accounting for state specific time invariant unobserved characteristics, we find no significant impact of decriminalization on the uptake of cannabis. However, this "average" effect masks an increase in the rate of uptake amongst those under the age of 18 that is balanced by a decline in uptake amongst those eighteen years and older. In essence, decriminalization shifts the age distribution of uptake of cannabis towards younger age groups while leaving the proportion of those who will start using cannabis unchanged. Overall, this suggests that decriminalization effects *when* individuals start using cannabis, rather than *if* they will start using cannabis.

2 Background

2.1 The Economic Framework

Decriminalization may affect the consumption of cannabis through its influence on the full price of its use. For an illegal good such as cannabis, the full price is not simply the money price paid to purchase the good but also includes associated costs such as the time cost of locating and purchasing it, and the expected cost of the health and legal consequences of use. The latter cost depends on the risk of being caught and punished for engaging in an illegal activity and the severity of punishment in the event of apprehension (Grossman, 2005). Decriminalizing cannabis use, by eliminating criminal sanctions, will reduce the expected cost of punishment and thereby the full price of the good. Further, changes in cannabis legislation and law enforcement may influence how potential users view the harmfulness of the drug. For example, decriminalization may be viewed as a signal that cannabis consumption is not harmful. To what extent this occurs is unknown as, to our knowledge, no empirical study has fully examined the subject. The effect of changes in perceived harm, on the other hand, has been analyzed. For instance, Bachman et al. (1998) report that the increase and the subsequent decrease in the use of cannabis in the US over the period 1976-1996 is partly explained by changes in perceived risk (and disapproval). Pacula et al. (2001) confirm this result. Together, the potential reduction in perceived harm and the reduced cost of punishment associated with decriminalization imply a higher level of demand at any given money price. That is, the demand curve for cannabis is expected to shift out. To the extent that decriminalization applies to growing cannabis for personal use, the supply curve may also shift out. The unambiguous impact of these effects is to increase the equilibrium quantity traded. Therefore, we should expect to see a greater use of cannabis following decriminalization.[3]

[3]The impact on the equilibrium price depends on shifts in the supply curve and the elasticity of supply. Suppose that the supply curve does not shift. If the supply curve is infinitely elastic, then the money price will remain unchanged. However, Pacula et al (2010) find some evidence that the supply for cannabis curve

2.2 Previous literature

Predictions from economic theory not withstanding, the empirical literature fails to provide unambiguous evidence that decriminalization leads to increased cannabis use.[4] For the United States, for example, Thies and Register (1993), Pacula (1998) and Dinardo and Lemieux (2001), each report no significant evidence that decriminalization impacts on use, whereas Saffer and Chaloupka (1999) find that decriminalization is associated with a 7.6% increase in annual use and a 8.4% increase in monthly use of cannabis, Chaloupka et al. (1999a) report that decriminalization is associated with a 5% increase in annual use but has no significant impact on monthly use, and Chaloupka et al. (1999b) report that monthly use of cannabis is 1% higher in states that have decriminalized. Similarly, there is also conflict across studies as to the effect of decriminalization on the frequency of use amongst users. Chaloupka et al. (1999a) and Pacula (1998) find no significant effect of decriminalization on frequency of use conditional on being a users whereas Chaloupka et al. (1999b) do find that decriminalization increases the frequency of use amongst users.

A long recognized weakness of the studies discussed above is that they identify the effect of decriminalization from cross-sectional variation in the use of cannabis across decriminalized and non-decriminalized states (Farrelly et al., 2001).[5] This approach fails to account for the potential for decriminalized and non-decriminalized states to differ in unobserved ways (such as sentiment towards cannabis use or enforcement of cannabis laws) that also impact on cannabis use. Failing to account for these differences, say through including state fixed effects, leads to inconsistent estimates of the effect of decriminalization on cannabis use.

More recently, studies based on US data have also been criticized for their systematic misclassification of jurisdictions as decriminalized states. In a careful evaluation of cannabis legislation in the US, Pacula et al. (2005) find that not all of the so-called eleven original decriminalized states actually removed the criminal status of cannabis use. Further, they found that punishment for cannabis offenses can be harsher in states that have

is upward sloping. In this case, the increase in demand induced by a liberalization of cannabis policy will lead to an increase in the money price of cannabis, which will ameliorate the net impact on demand. Even if the supply of cannabis is upward sloping, it is likely that higher prices will attract new suppliers leading to long run increase in supply. In this case, it is unclear whether the long term effect of liberalizing the policy on cannabis use will be to increase or reduce its money price. While the impact on price of both the demand and supply curve shifting out is ambiguous, the effect on the quantity demanded in unambiguously higher.

[4]Extensive international literature reviews are found in studies Pacula (2010), Room et al (2008) and Williams (2004).

[5]In some studies, this is because the analyses are based on just one or two waves of survey data. In the case of studies that pool several waves of survey data, investigating the effect of decriminalization precludes controlling for state fixed effects because there has been no change in the criminal status of cannabis use in the US over the period examined.

decriminalized the possession and use of cannabis compared to those that have not. This arises because penalties can be reduced via depenalization without decriminalizing, and in some instances, the penalties are in fact lower in depenalized states than in decriminalized states. As a consequence, previous research has compared decriminalized states to a group of non-decriminalizing states, some of which have implemented various forms of depenalization and some of which have not. This highlights the need to not only carefully define what is meant by decriminalization, but also to define the alternative regime with which it is being compared.

Similar to studies based on US data, studies using Australian data provide conflicted evidence on the effect of decriminalisation on cannabis use. For example, Cameron and Williams (2001) and Damrongplasit et al. (2010) report that living in a state that has decriminalized the use of cannabis is associated with an increase in the probability of using cannabis in the past year of 2% and 4-16%, respectively. In contrast, Williams (2004) finds no evidence that either participation or frequency of cannabis use is sensitive to its criminal status when estimation is based on a pooled sample of males and females aged fourteen years or older.[6]

Most of the weaknesses discussed in relation to the US literature are also issues for the Australian studies. For example, the use of cross-sectional variation to identify the effect of decriminalization is an issue for the studies by Cameron and Williams (2001) and Damrongplasit et al. (2010). The latter study uses more recent data and therefore also suffers from failing to account for the widespread adoption of cannabis depenalization via diversion or cautioning programs that occurred in Australia from 1999. However, an important strength of studies based on Australian data is that unlike in the US, decriminalization in Australia has uniformly led to the removal of the criminal status and criminal sanctions for simple cannabis offences. Therefore, like is being compared to like when decriminalization is discussed in the Australian context.

Several studies have also investigated the impact of cannabis policy changes in Europe. Unlike the inter-state comparisons employed in the US and Australia, European based studies have often, due to the way the policy change is implemented, relied on before-and-after comparisons for the same country/state. This approach is unable to disentangle the impact of the cannabis policy change from other factors that change over the same time period, making causal inference difficult.

The decriminalization of all drugs in Portugal in 2001 has gained particular public interest. The policy change was introduced together with a wide range of demand and

[6]However, there is some evidence that living in a state that has decriminalized the consumption of cannabis is associated with a higher probability of use among males aged 25 years or older. Decriminalization does not appear to increase the likelihood of cannabis use among young males or females. This is consistent with Cameron and Williams (2001) who report that the effect of living in the state that decriminalized cannabis use is being driven by individuals aged over 30 years old.

supply side policies, including increased resources for prevention, harm reduction, treatment, social reintegration, and supply reduction. While acknowledging the difficulty in isolating the specific impact of decriminalization in the face of such comprehensive reforms, Hughes and Steven (2007, 2010) still conclude that the decriminalization of cannabis in Portugal has not lead to major increases in drug use. Similarly, Greenwald (2009) finds that decriminalization has had no adverse effect on drug usage rates in Portugal. Pudney (2010) examines cannabis use, cannabis availability and attitudes to cannabis among young people in the UK before and after the "quasi-decriminalization" in 2004. He finds evidence of a fall in cannabis use and availability following decriminalization as well as a shift away from favourable attitudes toward cannabis use over time.[7] In line with this, evaluations of the Dutch drug policy seem to generally agree that the introduction of the coffee-shop system has not lead to increases in cannabis use (MacCoun 2010; van Laar and van Ooyen-Houben, 2009; Korf, 2002). Further, a simple comparison of the last year prevalence rates of cannabis use across eight European countries (Italy, Slovakia, United Kingdom, Denmark, Finland, Portugal, Hungary and Greece) before and after a change in their national cannabis policies show no clear pattern with respect to the different policies introduced (Hughes et al. 2011). Although the methodological challenges makes it difficult to draw firm conclusions, European studies provide no evidence that liberalizing cannabis laws and enforcement practices has had any effect on prevalence rates.

2.3 Cannabis Use in Australia

Similar to other Western countries, the use of cannabis for non-medical purposes began to rise in Australia from the early 1970's (Donnelly and Hall, 1994). Household surveys representative of the Australian population have been conducted since 1985. Information from these surveys has been used to graph the prevalence of lifetime cannabis use amongst 14-40 year olds over the period 1985-2007. Figure 1 shows that cannabis is widely used by Australians. In 1985 more than 40% of 14-40 year olds reported having ever used cannabis. The prevalence of lifetime use has grown steadily from 1988 until its peak in 1998, at which time almost six out of ten Australians aged 14-40 had used cannabis in their lifetime. Since the late 1990's the prevalence of lifetime use has declined somewhat. Nonetheless, in 2007, around 50% of 14-40 year olds reported that they had used cannabis at at least one in their lifetime. This decline in the prevalence of lifetime use is commonly reported in many western countries.

[7] Room et al. 2010 shows that the trend toward less cannabis use is also evident in the general UK population.

2.4 The Legal Environment

The legal environment surrounding cannabis use varies across Australia's eight states and territories. South Australia (SA), Western Australia (WA), the Australian Capital Territory (ACT) and the Northern Territory (NT) have decriminalized cannabis use, adopting a system of cannabis expiation or infringement notices. Under this system, it is still an offence to use, possess, or grow cannabis for personal use, but (for small quantities) the offence is punishable by payment of a fine, with no criminal conviction recorded. Strictly speaking, this system is called prohibition with civil penalties. South Australia was the first to adopt this system, introducing it in 1987. The Australian Capital Territory followed suit in 1992, the Northern Territory in 1996, and Western Australia in 2004. In South Australia and the Northern Territory, decriminalization applies only to individuals aged 18 years and older. It applies to those aged 17 and older in Western Australia and adults and minors in the Australian Capital Territory. The fines currently imposed in the decriminalized states range from $100-$200.

Diversion programs became the norm in the non-decriminalizing states following the 1999 Council of Australian Government-Illicit Drug Diversion Initiative. This initiative aimed to divert minor drug offenders from the criminal justice system. The Illicit Drug Diversion Initiative was accompanied by a national framework, principles of best practice for diversion and government funding (Hughes and Ritter, 2008). Unlike decriminalization, diversion programs do not require legislative changes. Often, they are based on a change to police guidelines so that individuals charged with minor cannabis offenses are diverted from the criminal justice system. The upper threshold for eligibility into diversion programs differs across states ranging from 15-50 grams. The number of cautions that an individual may be issued also varies from one to three. Under police diversion programs in New South Wales and Victoria, on admitting to the offence a caution notice is issued and an educational brochure is provided along with referral information for optional education. Queensland has a diversion program that requires eligible offenders to agree to undertake a drug assessment or brief intervention that includes an education program. Western Australia also introduced a diversion program prior to decriminalizing cannabis in 2004. Overall, the sanctions imposed under diversion and cautioning programs are generally less harsh than those that apply for similar offenses under decriminalization.

Prior to states introducing decriminalization or a systematic diversion framework, the legal regime is taken to be strictly criminal.[8] The potential penalties for simple possession

[8]Programs intending to divert cannabis users from the criminal justice system started to appear from the early 1990's. However, these early efforts often relied on informal mechanisms such as police discretion not to charge an offender, were applied on an ad-hoc basis, and the form they took differed across states. As diversion was not systematically applied during this period, we consider the regime to be strict criminalization.

of up to one gram of cannabis under a strictly criminal regime include fines ranging from $500-$6000 and jail terms ranging from 0-2 years.

3 Data

3.1 The National Drug Strategy Household Survey

This research draws on information collected in the Australian National Drug Strategy Household Survey (NDSHS). The NDSHS is a cross-sectional survey managed by the Australian Institute of Health and Welfare on behalf of the Commonwealth Department of Health and Ageing. It is designed to provide data on awareness, attitudes and behavior relating to licit and illicit drug use by the non-institutionalized civilian population in Australia. The sampling framework is a multistage stratified sample design, where stratification is based on geographic region. In each sampled household, the respondent is the person with the next birthday who is at least 12 years of age for the 2007 and 2004 waves, and the person with the next birthday who is at least 14 years of age for the 2001 and 1998 waves.[9] Household surveys like the NDSHS only select respondents among the non-institutionalized civilian population. We pool information from the 1998, 2001, 2004 and 2007 waves for the analysis that follows.

The focus of the analysis is on the decision to start using cannabis. This information is provided retrospectively by responses to the question "About what age were you when you first used marijuana/cannabis?". This question was asked of everyone who reported having ever used cannabis. By combining the information on age at first use with the assumption that individuals are at risk of starting use from the age of 12, we are able to form a pseudo-panel from the cross-sectional data.[10]

Our sample is comprised of individuals aged 20-40 years of age at the time of survey. We choose 20 as a lower age limit as uptake generally occurs before this age, hence the extent of censoring of the duration until uptake is minimized. We choose 40 as the upper age limit as initiation into cannabis occurs rarely after this age. Because we construct "histories" for each sample member from the age of 12 (when they are first considered to

[9] Self-completion questionnaires and computer assisted telephone interviewing (CATI) methodologies were used to survey respondents in 2007 and 2004. Face to face interview combined with sealed self-completion sections were additionally used in 2001. Self completion questionnaires and face to face interviews with self-completion sealed sections were used in 1998.

[10] To illustrate, suppose a person reports first using cannabis at age 17. We then know that they did not use cannabis for ages from 12 through to 16. From this information we form an indicator for the uptake of cannabis which takes on the value of is zero for all ages from 12 until 16 and takes the value of one at the age of 17, when use is reported to first occur. The respondent is represented in the sample used for estimation from the age that they are first at risk of cannabis use, which we assume to be 12 years old, until the age at which use is reported to have first occurred. Those who have never used are represented in the data up until the age at interview.

be at risk of uptake), the estimation sample is comprised of those aged 12-40 and spans the calendar time period 1970-2007. It is noteworthy that our sample period covers the introduction of decriminalization in all four of the decriminalizing states.

The time varying covariates controlled for in the model must also be available for individuals from the time they are assumed to first be at risk of starting cannabis use. The time varying covariates we are able to account for are policy variables describing the legal status of cannabis use, the state level unemployment rate proxying for the opportunity cost of time and calendar time fixed effects. In addition to the time varying covariates, we also account for the following personal characteristics: gender, whether the respondent is of Aboriginal descent, whether the respondent was born in Australia, an indicator for having a low level of educational achievement (no more than 10th grade) and year surveyed.

There are two potential sources of measurement error that we need to bear in mind in the analysis that follows. First, we are using retrospective information on the age when cannabis is first used and recall error is always a potential issue when using this type of information. We note however, that given the relative youth of the sample (20-40 years old at the time of survey) recall error is not expected to have a large impact on our results. A further potential source of measurement error arises from matching the state level policy variables to individuals at each age they are at risk of starting cannabis use. This is an issue because we only observe respondents' state of residence at the time of survey, and must therefore assume they have not moved states. Although making this assumption is less than a perfect solution, it seems a reasonable approximation because there is very little interstate migration in Australia. For example, for the states of New South Wales and Victoria, annual interstate arrivals represent between 1.1% and 1.6% of the states' population in any given year over the period 1988-2007, while departures represent 1.2% to 2.1%.[11] Nonetheless, to the extent that the assumption that individuals in our sample do not move state is incorrect, the effect of this measurement error problem is most likely to bias the coefficients on the policy variables towards zero.

3.2 Descriptive Statistics

After pooling the four waves of the NDSHS, our sample consists of 31,540 individuals aged 20 to 40 years at the time of survey for whom we have complete data on the age of first cannabis use and the other control variables. Sample means are reported in Table 1 for the full sample and for subsamples based on whether the respondent lives in a state that decriminalizes cannabis use during the sample period (SA, ACT, NT, WA) or a state that does not introduce decriminalization during the sample period (NSW, VIC, QLD, TAS). For brevity we will refer to the former states as "treatment" states and the latter

[11] Information on arrivals and departures are from Australian Bureau of Statistics catalogue no.3105.0.65.001 - Australian Historical Population Statistics, 2008.

as "control" states.

Table 1 shows that 57% of individuals in the sample have used cannabis in their lifetime. Amongst those who have ever used cannabis, the average age of initiation is 17.6 years. Males account for 41% of the sample and the average age at survey is 30.8 years. Approximately 34% of the sample have a low level of educational attainment. The vast majority of survey respondents live in a capital city (70%) and are born in Australia (80%). Just 2% of those surveyed are of Aboriginal descent. In terms of birth cohorts, around 1% of the sample were born in the 1950's, 37% were born in the 1960's, 47% were born in the 1970's and 15% were born in the 1980's. The average state level unemployment rate of 7.04% reported in Table 1 is the average for the year in which individuals are 12 years of age. A comparison across treatment and control groups reveal that the two samples differ significantly in terms of lifetime prevalence of cannabis use, with 62% of those living in treatment states having ever used cannabis compared with 54% of those living in control states. In terms of other observed characteristics, the control and treatment groups appear to be similar with the exception that members of the treatment sample are more likely to live in a capital city compared to members of the control group (77% compared to 66%) .

Table 2 summarizes information on the age at which cannabis is first used for the treatment and control groups. It reveals that, in addition to differences in the proportion of people who ever use cannabis, there are also differences in the likelihood of starting to use cannabis before the age of 18. Specifically, it shows that 37% of respondents from the treatment states start using cannabis over the ages 12-17 compared to 30% of respondents from the control states. Table 2 also reveals very similar proportions in treatment and control groups first using cannabis over the ages 18-25 (24% in the treatment group versus 23% in the control group) and 26-40 (2% in the treatment and control group).

Figure 2 provides more detailed information on the uptake of cannabis. It graphs the hazard rate for starting cannabis use for those living in treatment and controls states separately. Starting rates are transition rates from non-use to use for each particular year of age, conditional on not having used up until that age. In calculating age-specific starting rates, those who have not started to use cannabis at the time of survey are considered to have a duration until use that is right censored. Inspection of Figure 2 confirms the observations from Table 2. Specifically, it shows that the hazard of starting cannabis use for treatment and control states diverge up until the age of around 18 years, with transition rates into cannabis use higher in the treatment states. The hazard rates then begin to converge from the age of 18.

It is unclear from this descriptive analysis the extent to which these differences are attributable to decriminalization and the extent to which they reflect unobserved characteristics that differ between states that do and do not decriminalize cannabis use. In order to disentangle these effects, we use the pseudo-panel formed from the cross-sectional data,

containing 391,370 person-age observations, in the following analysis.

4 Empirical Methods

We model the uptake of cannabis using the discrete time hazard function, where the hazard of person i starting cannabis use at age j is given by:[12]

$$h_{ij} = h(j \mid x_{ij}) = P(T_i = j \mid T_i \geq j, x_{ij}). \tag{1}$$

The observed characteristics, x_{ij}, that we control for are: gender, having a low level of education (an indicator for dropping out of school with a 10^{th} grade education or less), Australian born, Aboriginality, living in a capital city, and year surveyed. These characteristics are assumed to be known at the time an individual first faces the decision of whether to initiate cannabis use. In the case of the education variable, this requires the assumption that education represents ability and that this ability is known to the individual from the time he first faces the decision to use cannabis. The education variable will not fulfill this requirement if, at the time an individual decides to start using cannabis, he is uncertain as to whether he will drop out of school before completing 10^{th} grade or, if there exist unobserved characteristics that impact both educational attainment and cannabis use (see for example, Heckman, Stixrud and Urzua (2006) who allow latent cognitive and noncognitive skills to determine education and cannabis use).

The decision to start using cannabis is also likely to be influenced by time varying characteristics and circumstances such as family situation, experiences at school, cannabis supply conditions, the price of cannabis, and the price of other drugs (substitutes and complements). Unfortunately, this type of information is not available in the NDSHS and we are therefore unable to account for these influences.[13] We are, however, able to account for the policy environment by including an indicator equal to one at ages for which the state in which the respondent resides has decriminalized cannabis use, and an indicator equal to one for ages at which the state in which the respondent resides has depenalized cannabis use by introducing a cautioning or diversion program. Indicators for state of residence are included to account for time invariant state level characteristics that impact on the decision to start using cannabis, calendar time fixed effects account for nation wide shocks that may impact on the uptake of cannabis, and the state level unemployment rate is included to proxy for the opportunity cost of time.

[12] The following discussion draws heavily on Jenkins (2005).

[13] We note however, that many of these factors are likely to be endogenous and it is therefore not clear how one should proceed if they were available. Variables reflecting the respondent's current circumstance, such as marital status, that are collected as part of the NDSHS are not useful for modeling cannabis uptake because they represent events that may have taken place long after the individual started to use cannabis.

The probability of remaining a non-user of cannabis at age j is given by the survival function:

$$S_{ij} = S(j|x_{ij}) = P(T_i > j \mid x_{ij}) = \prod_{k=1}^{j}(1 - h_{ik}) \tag{2}$$

Those who start using cannabis during the observation period have completed spells of not using cannabis. Their probability of starting cannabis at time period j is given by:

$$\begin{aligned} P(T_i = j|x_{ij}) &= h_{ij}S(j-1|x_{ij}) \\ &= h_{ij}\prod_{k=1}^{j-1}(1 - h_{ik}) \\ &= \frac{h_{ij}}{1 - h_{ij}}\prod_{k=1}^{j}(1 - h_{ik}) \end{aligned} \tag{3}$$

Let c_i be an indicator for completed spells, so that $c_i = 1$ if the spell is complete and $c_i = 0$ if it is right censored. Then the sample likelihood function is given by:

$$\begin{aligned} \ell &= \prod_{i=1}^{n}[P(T_i = j|x_{ij})]^{c_i}[P(T_i > j|x_{ij})]^{(1-c_i)} \\ &= \prod_{i=1}^{n}\left(\frac{h_{ij}}{1 - h_{ij}}\right)^{c_i}\prod_{k=1}^{j}(1 - h_{ik}) \end{aligned} \tag{4}$$

Taking logs leads to the following:

$$log\ell = \sum_{i=1}^{n} c_i log\left(\frac{h_{ij}}{1 - h_{ij}}\right) + \sum_{i=1}^{n}\sum_{k=1}^{j} log(1 - h_{ik}) \tag{5}$$

Now define a new binary indicator, $y_{ik} = 1$ if individual i makes the transition to cannabis use at age k and $y_{ik} = 0$ otherwise. Then we can write the log likelihood function as:

$$\begin{aligned} log\ell &= \sum_{i=1}^{n}\sum_{k=1}^{j} y_{ik} log\left(\frac{h_{ik}}{1 - h_{ik}}\right) + \sum_{i=1}^{n}\sum_{k=1}^{j} log(1 - h_{ik}) \\ &= \sum_{i=1}^{n}\sum_{k=1}^{j}[y_{ik} log h_{ik} + (1 - y_{ik})log(1 - h_{ik})] \end{aligned} \tag{6}$$

This has the same form as the log likelihood function for a model with a binary dependent variable, y_{ik}. In order to estimate the model, a functional form must be specified for h_{ik}. We use the complementary log-log hazard rate (cloglog). This has the advantage that it can be derived from the continuous time proportional hazard model.[14]

[14] Alternatively, a logit or a probit specification (non-proportional hazard specification) can be employed, which in most cases gives similar results.

Assuming the cloglog functional form, the hazard rate for cannabis uptake at age k conditional on x_{ik} is given by:

$$h_{ik} = 1 - \exp(-exp(\theta(k) + \beta' x_{ik})) \tag{7}$$

where the duration dependence $\theta(k)$, is modeled flexibly as piecewise constant using age dummies and individuals are assumed to be at risk of starting cannabis use from the age of 12. Equivalently, this model can be written as:

$$-log(-log(1 - h_{ik}) = \theta(k) + \beta' x_{ik}. \tag{8}$$

5 Results

5.1 Baseline Results

Table 3 contains coefficient estimates from maximum likelihood estimation of four specifications of the model for the uptake of cannabis use. In addition to the duration dependence terms, each specification includes the individual level control variables gender, having a low level of education, Australian born, Aboriginality, living in a capital city, year surveyed, the state level unemployment rate, a full set of calendar dummies and an indicator equal to one at ages for which cannabis use is decriminalized in the respondents state of residence. The specification in column 2 also includes an indicator equal to one at ages for which the state in which the respondent resides had depenalized cannabis use by introducing a diversion program for adults. The specification in column 3 additionally includes state fixed effects while, in column 4, the effect of the policy variables are permitted to vary according to whether the respondent is a minor or an adult under the law. All standard errors are clustered at the state level.

The first column reports results for a specification which is similar in spirit to the typical approach found in the literature in that the effect of decriminalization is identified from cross-sectional variation across decriminalized and non-decriminalized states.[15] The estimates from this specification suggest that decriminalization has a positive effect on cannabis uptake and this effect is statistically different from zero at the 10% level of significance. On the basis of these estimates, living in a regime in which cannabis use has been decriminalized is associated with a 10% increase in the rate of uptake compared to an otherwise similar individual living in a regime in which cannabis has not been decriminalized.

[15]Specifically, it fails to account for unobserved time invariant state level heterogeneity that may be correlated with a states tendency to decriminalize cannabis, and the alternative with which decriminalization is compared is heterogenous, including strict and depenalized regimes.

In this specification, the comparison group with which decriminalization is being compared consists of both strict criminal regimes and depenalized regimes and the mix changes over time, making interpretation somewhat murky. In order to address this issue, the specification in column 2 includes an indicator for depenalization (equal to one for ages at which cannabis use has been depenalized for adults in the respondents' state of residence and zero otherwise). The comparison regime is now one in which cannabis use offenses are dealt with through the criminal justice system and criminal penalties apply. It should also be noted that the policy variables included in specification 2 describe the legal environment faced by adults.

As can be seen from the results reported in column 2 of Table 3, we find that compared to living in a state in which cannabis use is a strictly criminal offense, living in a state that has decriminalised cannabis use is associated with an increase in the rate of uptake. Accounting for depenalization reduces the coefficient estimate on the indicator for decriminalization slightly but it remains significant at the 10% level. We find that depenalization has a negative but statistically insignificant effect on cannabis uptake compared to living in a state with a strictly criminal cannabis policy. Given that depenalization is less punitive than decriminalization (in that fines are levied in decriminalized states and not in depenalized states), this may suggest that there are unobserved differences in the uptake of cannabis use between states that decriminalize and states that do not that is correlated with the policy environment.

We address the issue of unobserved heterogeneity that is correlated with cannabis policy by including state level fixed effects. The results from doing so are reported in column 3. A test of the null hypothesis that the set of state indictors are jointly zero is rejected with p-value smaller than 1%, providing strong evidence of differences across states in the age at first using cannabis. The coefficients on the state indicators show differences in uptake relative to the comparison state, NSW, which is in the set of control states (states that do not introduced decriminalization during the sample period). As can be seen from Table 3, each of the treatment states (states which do introduce decriminalization during the sample period) have a significantly higher baseline transition rate into cannabis use compared to NSW. In contrast, the coefficients on the indicators for the control states are not statistically significant or significantly negative, indicating baseline hazards that are no higher than in NSW. As can be seen, once we account for these state level differences, there is no evidence that cannabis policy (decriminalization or depenalization) affects cannabis uptake.

A possible reason that we fail to detect an impact of policy on cannabis uptake is that the estimated model assumes a homogenous effect for each of the policies. However, this may not be the case. Specifically, it is reasonable to expect that adults and minors respond differently to the policy environment set for adults. The empirical hazard functions

graphed in Figure 1 provide *prima facie* evidence that suggests this may be the case. In order to investigate this more formally, we augment the model reported in column 3 with interaction terms between the policy variables (decriminalization and depenalization) and an indicator equal to one for the ages at which the respondent is a minor (aged less than eighteen).

The results from estimating the specification allowing for heterogenous policy effects is reported in column 4 of Table 3. They show that when the interaction terms between policy variables and being a minor are included in the model, the coefficient estimate on decriminalization becomes significantly negative while the coefficient estimate on the interaction term between being a minor and living in a decriminalized state is positive. The negative coefficient on the indicator for decriminalization indicates that compared to an otherwise similar adult living in a state that has a strictly criminal policy for cannabis use, living in a decriminalized state reduces the rate of initiation into cannabis by 12%. In order to find the effect of decriminalization for minors, we exponentiate the sum of the coefficient on decriminalization and the interaction term. We find that minors who live in a state that has decriminalized cannabis use have a hazard rate of uptake that is 12% higher than an otherwise similar minor living in a state in which its use is a criminal offense (p-value of 0.08). In terms of the effect of depenalization, we find no significant difference in the uptake of adults who live in states that have depenalized compared to those who live in a criminalized state. Similarly, minors who live in a depenalized regime are not found to have an uptake rate significantly different from an otherwise similar person living in a strictly criminal regime (p-value=0.95).

All in all, the results from specification 4 suggest that compared to someone living in a strictly criminal regime, decriminalization increases the rate of uptake of cannabis amongst minors and reduces the uptake amongst adults. Depenalization has no significant impact on the uptake of cannabis amongst adults or minors compared to those living in a strictly criminal regime.

Turning to the results for the individual level control variables, we see from Table 3 that being male, having low educational attainment and being born in Australia have a positive and statistically significant influence on cannabis uptake. These effects are stable across the four model specifications. Also being of Aboriginal descent increases the hazard of cannabis uptake but the influence decreases somewhat in models excluding the state fixed effects. In comparison to the 1998 survey we see that the coefficients for the subsequent survey variables (survey 2001, 2004 and 2007) are statistically significant and negative in models that exclude state fixed effects. Living in a capital city and the state specific unemployment rate are found to have no statistically significant effect on cannabis initiation.

In order to get a better sense of the impact of decriminalization on cannabis use, we

use the results from estimation reported in column 4 of Table 3 to predict hazard and survival functions before and after the introduction of decriminalization. The predicted hazard and survival functions are for an Australian born, non-Aboriginal male who lives in a capital city, who has more than a low level of education and lives in SA. Year effects, survey wave effects, the depenalization policy variables and the unemployment rate are set to zero. The results are graphed in Figure 3.

A comparison of the hazard functions for a treated state pre and post treatment shows that the effect of introducing decriminalization is to shift the hazard function for initiation into cannabis use to the left. Since the effect of decriminalization is allowed to differ for adults and minors, those living in a decriminalized regime and who are under the age of 18 have a higher rate of uptake compared to an otherwise similar individual living in a criminalized regime, while those living in a a decriminalized regime aged 18 years and older have a lower rate of uptake compared to an otherwise similar individual living in a strictly criminal regime. Inspection of the survival functions reveals that by the age of 40, there is little difference in survival rates across the two scenarios, with 47.1% predicted to use cannabis by age 40 amongst those living in a state after decriminalization is introduced compared to 46.6% before decriminalization is introduced. However, there are differences at earlier ages. For example, the proportion of those aged 15 and younger who have used cannabis is 12.7% after decriminalization is introduced compared to 11.4% before decriminalization is introduced. Among the population aged 16 and younger, the proportions are 20.8% and 18.3% respectively. This suggests that decriminalization affects when a person first uses cannabis but not whether or not they ever use it.

5.2 Sensitivity analysis

To investigate the robustness of our findings we performed a range of sensitivity analyses. These include examining issues relating to the reporting of individuals such as recall error and differences across cohorts as well as issues relating to the policy variables such as accounting for polices that apply to minors. We also further explore the hypothesis that decriminalization affects when a person first uses cannabis but not whether or not they ever use it using a split population model. Finally, we explore the robustness of our results by using a placebo test, where we examine the impact of a legal regime for cannabis use on the uptake of cigarettes. The results of these analysis are reported in Tables 4 and 5.

This study uses retrospective information about when individuals first started to use cannabis and this poses the potential problem of recall error. If respondents make errors in the age they report first using cannabis, the parameter estimates for the starting rate are likely to be biased. In order to investigate this issue, we include the respondent's age at survey as an additional control variable in the model. If there exists a systematic misreporting in the form of forward telescoping for example, then distant events are perceived

as more recent and we would expect a positive coefficient on the age at survey variable. As shown in Table 4, we find a positive but statistically insignificant coefficient on age at survey, suggesting that forward telescoping is not a serious issue in these data. Moreover, the sign, magnitude and significance of the policy variables and their interactions are unaffected by the inclusion of the proxy for recall error.

We also examine the robustness of the results to accounting for differences in the uptake of cannabis across different birth cohorts. To do so, we include a set of indicators for being born in the 1950's, the 1960's, the 1970's, with being born in the 1980's as the comparison category. The results are reported in column 2 of Table 4. We find that although these indicators are jointly significant (p=0.00), their inclusion does not alter our findings.

One of the interesting aspects of our results is that decriminalization increases the rate of uptake amongst minors even though, generally speaking, it does not generally apply to them. The ACT is an exception in that the legislation introduced in that jurisdiction applies to both minors and adults. This leads us to ask whether the finding that decriminalization effects youth is being driven by youth in the ACT, for whom cannabis use is in fact decriminalized. In order to investigate whether this is the case, we include an interaction between residing in the ACT, age less than eighteen, and living in a state where cannabis has been decriminalized. The results in the third column of Table 4 show that although the point estimate on this interaction term is positive, it is statistically insignificant, indicating no differential response to decriminalization in the ACT. Moreover, the coefficient estimates for the policy variables are not much affected by including the additional interaction term, although the effect of decriminalization for minors becomes marginally insignificant at the 10% level (p-value=0.11).

We next investigate whether the responsiveness of minors to decriminalization is in fact attributable to a more generally liberal policy stance in states that decriminalize. We explore this issue by including variables accounting for cannabis policy for minors, allowing for different effects of the policy for adults (for whom we expect no effect) and minors. Specifically, we introduce an indicator equal to one for ages at which the respondent lives in a state with a system of depenaliztion for minors in place and an interaction term between the depenalization for minors indicator and being an adult (that is, over the age of 17). The results are reported in column 4 of Table 4. They show that we find no significant effect of depenalizing cannabis use for minors (on either minors or adults). As before, depenalization for adults has no impact on the uptake of cannabis by adults or minors. Importantly, after accounting for cannabis policies covering adults and minors we find that decriminalization increases the rate of cannabis uptake amongst minors (p-value=0.08) and decreases the rate of uptake amongst adults.

The final set of coefficient estimates reported in Table 4 are from estimating a split population model. In contrast with the models estimated above, which assume that all

in the population are at risk of starting cannabis use, the split population model allows a proportion of the population to never start. Because it allows for different types: those who are susceptible to cannabis use, and those who are not, the split population model accounts for unobserved heterogeneity in the population. Given that many never use cannabis, this formulation seems a natural way to address unobserved heterogeneity in the uptake of cannabis.

The sample log likelihood function for uptake at age j for the split population model is given by

$$\sum_{i=1}^{n} ln\ell_i = \sum_{i=1}^{n} c_i ln[(1-d)h_{ij}S_{ij-1}] + (1-c_i)ln[d+(1-d)S_{ij}] \tag{9}$$

where d is the probability of being the type who never starts using cannabis.[16] The results in column 5 of Table 4 show that after accounting for the fact that some will never start using cannabis, decriminalization only affects those less than 18, increasing the rate at which they initiate into cannabis use. This is consistent with our findings above, that decriminalization affects when, not if a person starts cannabis use.

We next use a placebo test to examine the robustness of our findings. In particular, we examine the relationship between decriminalization and initiation into cigarette use. Changes in the legal regime governing cannabis use should not directly impact on the uptake of cigarette use. Any evidence of a significant effect suggests that our results are picking up other changes that occurred around the same time as the introduction of decriminalization that impacted on cigarettes use and cannabis use. In other words, the estimated effect of decriminalization is spurious. As shown in Figure 4, the hazard rate of initiation into cigarette use does not differ across treatment states (who decriminalize over the sample period) and control states (who do not decriminalize over the sample period). Moreover, the results in Table 5, which repeat the four specifications for cannabis use reported in Table 3, provide no evidence of a spurious correlation. Indeed, none of the policy variables are individually or jointly significant in any of the four specifications.

Although not reported, we also investigate whether it is appropriate to pool males and females when studying initiation into cannabis use and whether the response to cannabis policies differs by gender. On the basis of a likelihood ratio test, we reject the null hypothesis of common coefficients for males and females (p-value=0.00). Nonetheless, the qualitative nature of the results are unchanged. For adult males and females, decriminalization is found to reduce the rate of cannabis uptake, while for minors decriminalization is found to increase the rate of uptake amongst females. We note that while the effect of decriminalization for males less than 18 years of age does not reach statistical significance

[16] In this model, censored observations consist of those who are of the type who will never start using cannabis as well as those who will start but are yet to do so.

at conventional levels (p-value=0.14), this is more likely a reflection of the reduced sample size rather than a genuine null effect.

6 Discussion

This paper is the first to analyse the effect of liberalizing cannabis policy on initiation into cannabis use. We argue that understanding the impact of the policy environment on uptake is of significant interest since cannabis is a drug of dependence and so those deciding whether to start use are more likely to be sensitive to policy changes compared to more experienced or dependent users. We examine the effect of liberalizing cannabis laws via decriminalization and depenalization, allowing for heterogenous responses for adults and minors. In specifications that account for time invariant differences across states and assume a homogenous response to the policy environment, we find no evidence that liberalizing the legal regime through either decriminalization or depenalization has a significant effect on the uptake of cannabis. In other words, decriminalizing cannabis use or introducing a diversion program for simple cannabis offenses does not influence the uptake of cannabis once time invariant differences across jurisdictions are accounted for. However, when we allow for the policy response to differ for adults and minors we find that decriminalization increases the rate of uptake for minors and reduces it for adults. In effect, decriminalization shifts the distribution of the hazard rate of cannabis initiation to the left, implying that those who start using cannabis tend to do so at an earlier age than would otherwise have been the case.

In addition to focussing on an outcome that is arguably of great relevance to policy makers, our analysis also overcomes several shortcomings in the literature. When examining the treatment effect of decriminalization we have been careful in defining the alternative regime with which decriminalization is compared and we have taken into account that the alternative does change over the study period as diversion programs are introduced. By accounting for state fix effects we have avoided mixing the effect of decriminalization with unobserved characteristics of the states choosing this particular drug policy. In the sensitivity analyses we have also examined whether the results could be influences by recall bias, cohort effects, the particular decriminalization policy in ACT, the introduction of diversion programs for minors, or unobserved heterogeneity that leads to some fraction of the population not being vulnerable to cannabis uptake through the use of the split population model. In addition, we have examined whether our findings are spurious using a placebo test in which the outcome is the uptake of cigarette use. The main conclusions have remained unchanged across all models; decriminalization increases uptake amongst minors but reduces it for adults so that overall, there is no increase in the proportion of the population who will use cannabis, only a reduction in the age of first

use amongst those who will use.

The robustness of the results not withstanding, there are several caveats to be kept in mind when interpreting these results. Measurement error is a potential issues with these data. While we find no significant evidence of recall bias in the age at first use that is systematically related to age at survey, there remains the potential for random error in the reporting of age of first use. Similarly, our analysis is based on the assumption that respondents lived in their current state of residence since the time they were first at risk of using cannabis. To the extent that this assumption fails and does so at random, we are likely to underestimate the impact of cannabis policy of the age at first use. Interpretation of our findings is also somewhat complicated by the fact that, where cannabis has been decriminalized, so has the growing of cannabis for personal use. Consequently, our estimates reflect the reduced form effect that includes shifts in the demand curve and the supply curve.

Given that decriminalization is expected to lead to increased consumption via a reduction in the full price of cannabis, the lack of an effect on the proportion new cannabis users may seem unexpected. There are, however, a number of factors that may contribute to explaining the puzzle. It may be, for instance, that the enforcement practice by the police changes less than the formal policy change would suggest. This would be the case if cannabis laws were not fully enforced prior to liberalizing the policy. Also, we have only explored the impact of cannabis policy changes on initiation into use and decriminalization may have worked primarily through other channels such as quitting behaviour or intensity of use. Finally, the explanation for our findings may lie in the fact that drug use is influenced by many factors other than the legal environment, something which is illustrated by the many countries and states experiencing substantial variation in drug using trends during periods of unchanged drug policy. Thus, there might have been factors counteracting the possible increase in cannabis initiation stemming from the liberalization in drug legislation.

Overall, what should one take away from this study? Given that we find that decriminalization does not impact on the proportion of the population who will ever use cannabis, one could infer that a legal regime of decriminalization is preferred to one of criminalization. However, this ignores the fact that decriminalization leads to uptake at earlier ages amongst those who will become users. The results from this paper show, for example, that decriminalizing cannabis use increases the proportion of people who have used cannabis by age 15 by 11% (from 11.4% to 12.7%). In an earlier paper also using Australian data, van Ours and Williams (2009) show that starting cannabis use by age 15 leads to a reduction in years of education of 0.8 years for males and 1.3 years for females. Given wages increase by 7-10% for every additional year of education, the costs in terms of lifetime earnings for those induced into early cannabis use by decriminalization is likely to

be substantial. However, it is unclear how these costs compare to the savings from decriminalizing cannabis use, such as reduced criminal justice expenditures and reduced harm from engaging in an illegal activity. A better understanding of the benefits of alternatives to criminlization is needed in order to determine whether optimal policy is criminalization or decriminalization - or indeed depenalization.

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Table 1: Sample Means

	Full Sample	Treatment Sample	Control Sample
ever use cannabis	0.57	0.62	0.54
start age	17.61	17.48	17.69
male	0.41	0.42	0.40
age at survey	30.80	30.54	30.94
low education	0.34	0.35	0.34
Australian born	0.80	0.81	0.80
Aboriginal	0.02	0.03	0.02
lives in a capital city	0.70	0.77	0.66
survey_yr01	0.31	0.31	0.32
survey_yr04	0.30	0.23	0.34
survey_yr07	0.22	0.18	0.24
cohort1950	0.01	0.02	0.01
cohort1960	0.37	0.39	0.37
cohort1970	0.47	0.47	0.47
cohort1980	0.15	0.12	0.16
VIC	0.19	0.00	0.30
QLD	0.18	0.00	0.27
WA	0.14	0.40	0.00
SA	0.09	0.25	0.00
TAS	0.05	0.00	0.08
ACT	0.06	0.17	0.00
NT	0.06	0.17	0.00
unemployment rate	7.04	6.76	7.19
N	31540	10910	20630

Table 2: Age at First Use

	Control (%)	Treatment (%)
never start	45.59	37.70
start at ages 12-17	29.68	36.57
start at ages 18-25	22.93	23.79
start at age $>$ 25	1.79	1.93
total	100	100

Table 3: Hazard Model for Cannabis Uptake

	1	2	3	4
decriminalized	0.0994*	0.0865*	-0.00790	-0.134*
	(0.0508)	(0.0499)	(0.0621)	(0.0727)
decrim*age < 18				0.249***
				(0.0629)
diversion		-0.0998	-0.0116	-0.0699
		(0.111)	(0.125)	(0.134)
diversion*age < 18				0.0770
				(0.0775)
control states				
VIC			-0.0890***	-0.0887***
			(0.00706)	(0.00686)
QLD			0.0294	0.0288
			(0.0231)	(0.0232)
TAS			0.0185	0.0177
			(0.0529)	(0.0531)
treatment states				
WA			0.241***	0.242***
			(0.0262)	(0.0263)
SA			0.131*	0.126
			(0.0799)	(0.0810)
ACT			0.135***	0.136***
			(0.0261)	(0.0266)
NT			0.319***	0.321***
			(0.0235)	(0.0240)
individual characteristics				
male	0.205***	0.205***	0.206***	0.206***
	(0.0140)	(0.0140)	(0.0136)	(0.0136)
low education	0.262***	0.262***	0.255***	0.254***
	(0.0266)	(0.0266)	(0.0258)	(0.0259)
Australian born	0.434***	0.434***	0.445***	0.444***
	(0.0738)	(0.0738)	(0.0747)	(0.0748)
Aborig	0.0955**	0.0945**	0.0422	0.0425
	(0.0465)	(0.0467)	(0.0574)	(0.0576)
lives in a capital city	0.0307	0.0311	0.0415	0.0412
	(0.0335)	(0.0334)	(0.0346)	(0.0347)
other controls				
survey_yr01	-0.162*	-0.163*	-0.0965	-0.0971
	(0.0969)	(0.0970)	(0.102)	(0.103)
survey_yr04	-0.170**	-0.171**	-0.0918	-0.0915
	(0.0849)	(0.0851)	(0.0959)	(0.0969)
survey_yr07	-0.213**	-0.214***	-0.137	-0.139
	(0.0829)	(0.0829)	(0.0915)	(0.0914)
ur_person	-0.0145	-0.0144	0.00534	0.00548
	(0.0200)	(0.0200)	(0.0166)	(0.0167)

Note: The the table reports coefficient estimates and standard errors in parentheses; standard errors are clustered at the state level; ***, **, * indicates significance at a 1% 5% or 10% level.
Although not reported, all models include calendar year fixed effects. Duration dependence is modeled using 16 age indicators (single year indicators for ages 12-25, an indicator for 26-30, an indicator for 31-35) with an indicator for 35-40 as the omitted category).

Table 4: Sensitivity Analysis

	(1)	(2)	(3)	(4)	(5)
decriminalized	-0.134*	-0.105	-0.134*	-0.136*	-0.018
	(0.0725)	(0.0702)	(0.0730)	(0.0810)	(0.054)
decrim*age < 18	0.249***	0.200***	0.246***	0.251***	0.101*
	(0.0629)	(0.0609)	(0.0636)	(0.0628)	(0.057)
diversion	-0.0703	-0.0373	-0.0700	-0.0562	-0.08
	(0.134)	(0.136)	(0.134)	(0.116)	(0.076)
diversion*age < 18	0.0778	0.0133	0.0770	0.0431	-0.031
	(0.0771)	(0.0783)	(0.0776)	(0.0746)	(0.083)
survey_age	0.0169				
	(0.0338)				
cohort1950		-0.0236			
		(0.107)			
cohort1960		-0.220**			
		(0.0962)			
cohort1970		-0.259***			
		(0.0682)			
ACT*decrim*age < 18			0.0143		
			(0.0269)		
diversion_kids				-0.0319	
				(0.0703)	
diversion_kids*age> 17				0.0531	
				(0.170)	
Pr(never fail)					0.265
p-value of LR test Pr(never fail)=0					(0.000)

Note: The the table reports coefficient estimates and standard errors in parentheses; standard errors are clustered at the state level; ***, **, * indicates significance at a 1% 5% or 10% level.
Controls are the same as included on column 4 of Table 3.

Table 5: Hazard Model for Cigarette Uptake

	(1)	(2)	(3)	(4)
decriminalized	-0.0107	-0.00579	-0.0596	-0.0608
	(0.0463)	(0.0393)	(0.0642)	(0.111)
decrim*age < 18				0.00164
				(0.0688)
diversion		0.0428	0.0471	0.0447
		(0.110)	(0.0937)	(0.121)
diversion*age < 18				0.00441
				(0.0804)
VIC			0.104***	0.104***
			(0.00329)	(0.00310)
QLD			0.0817***	0.0817***
			(0.00604)	(0.00587)
TAS			0.0907***	0.0907***
			(0.00747)	(0.00752)
WA			0.108**	0.108**
			(0.0445)	(0.0429)
SA			0.0500***	0.0500***
			(0.0146)	(0.0146)
ACT			0.170***	0.170***
			(0.0188)	(0.0191)
NT			0.150***	0.150***
			(0.0159)	(0.0161)

Note: The the table reports coefficient estimates and standard errors in parentheses; standard errors are clustered at the state level; ***, **, * indicates significance at a 1% 5% or 10% level.
Controls are the same as included on column 4 of Table 3.

Figure 1:

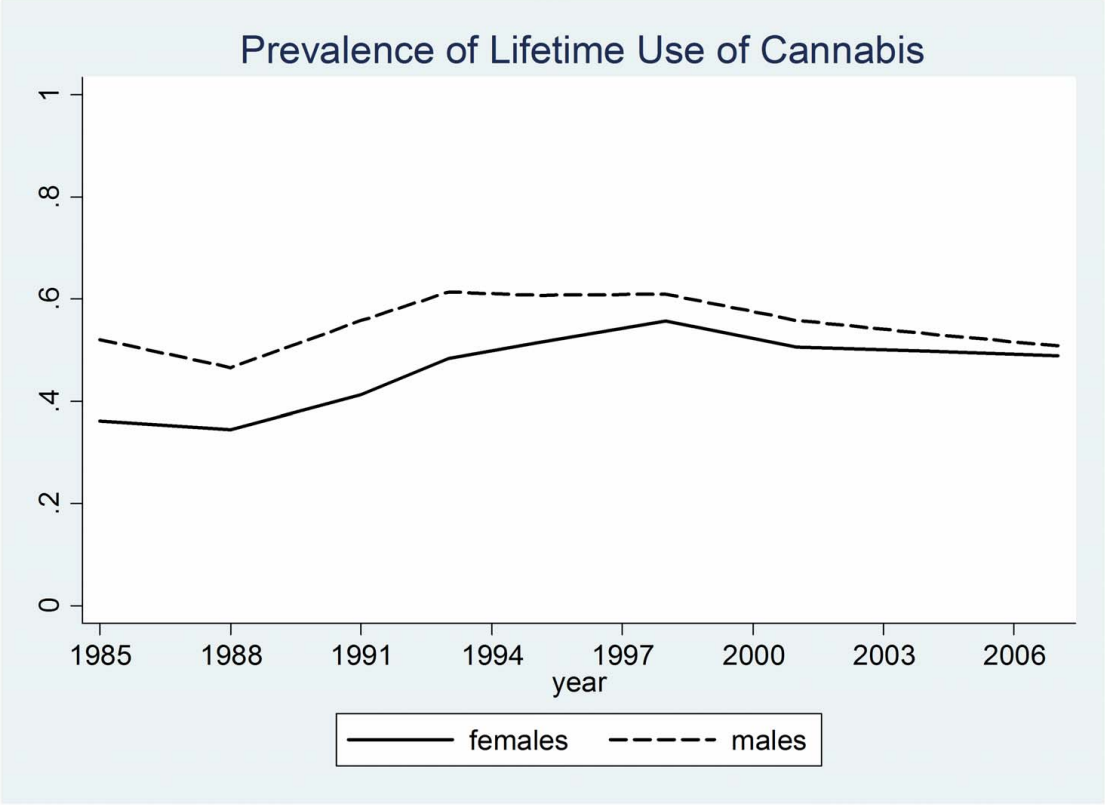

Prevalence of Lifetime Use of Cannabis
0
.2
.4
.6
.8
1
1985
1988
1991
1994
1997
2000
2003
2006
year
females
males

Figure 2:

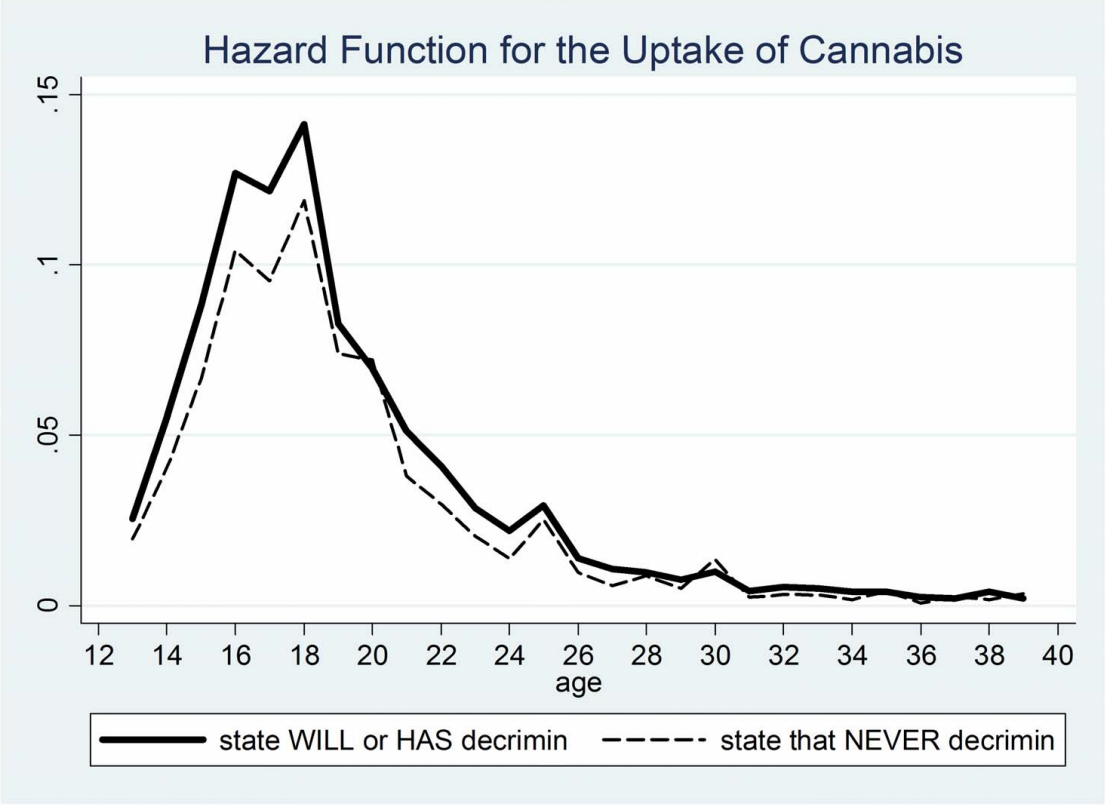
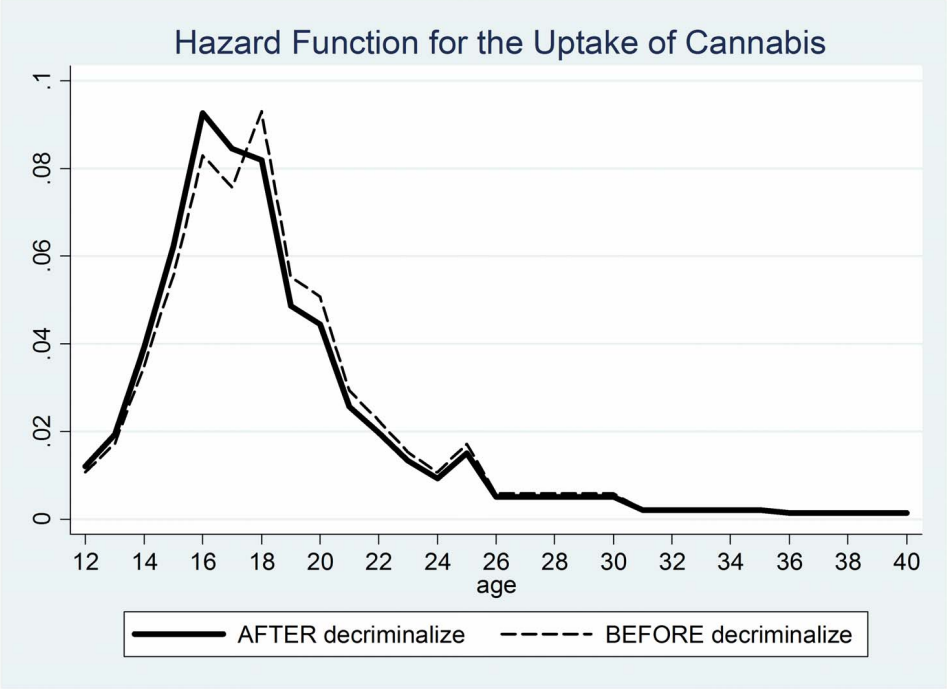

Hazard Function for the Uptake of Cannabis
.15
.1
.05
0
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
age
state WILL or HAS decrimin
state that NEVER decrimin

Figure 3:


Hazard Function for the Uptake of Cannabis
0
.02
.04
.06
.08
.1
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
age
AFTER decriminalize
BEFORE decriminalize

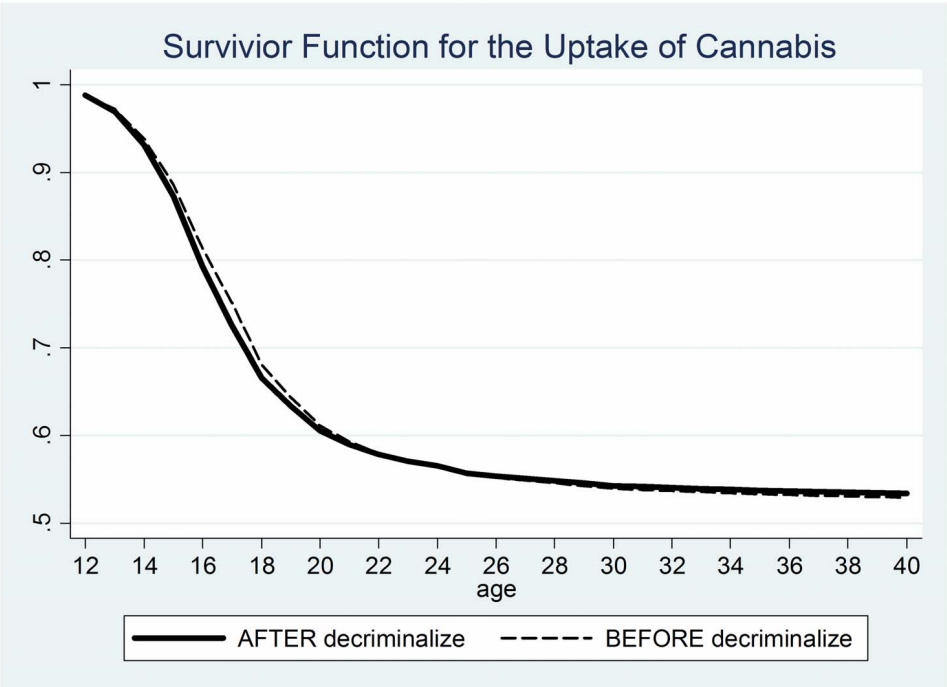
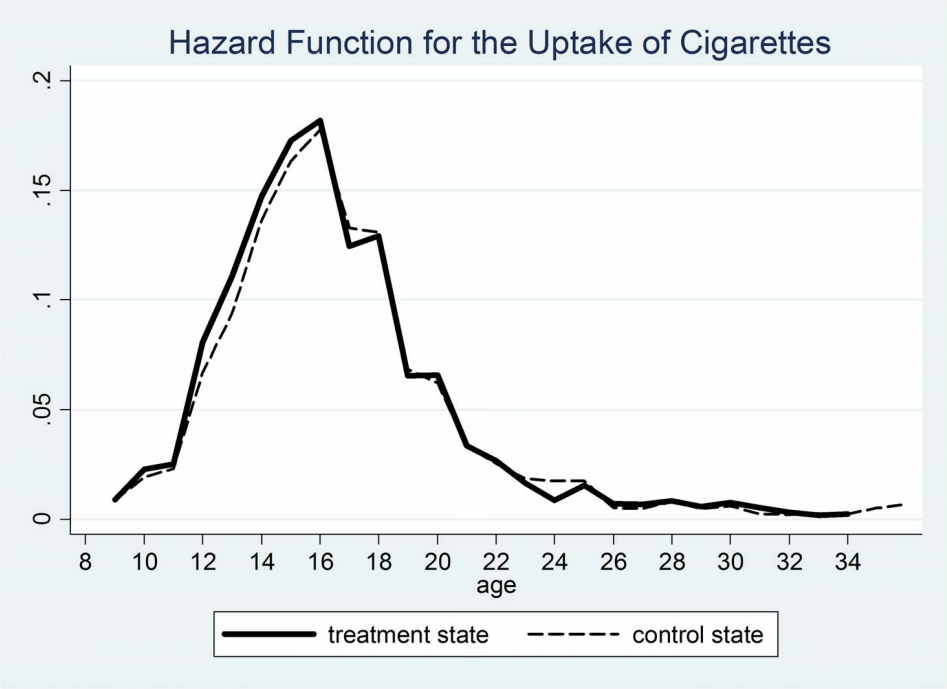

Survivior Function for the Uptake of Cannabis
.5
.6
.7
.8
.9
1
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
age
AFTER decriminalize
BEFORE decriminalize

Figure 4:


Hazard Function for the Uptake of Cigarettes
0
.05
.1
.15
.2
8
10
12
14
16
18
20
22
24
26
28
30
32
34
age
treatment state
control state