

On aging cannabis users: a welfare economics analysis.

Short title: On aging cannabis users.

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In this chapter we studied the implications of an increasing share of adults in the population of cannabis users in a welfare economics approach. This demographic process is already significant in Italy, which is leading European greying: a decrease in birthrate and youth, and an increasing proportion of older people in the general population. We hypothesize that adult users go through a process of social integration and normalization, through which they change their patterns of use and socio-economic status. In order to verify the empirical relevance of the share of adults and the above hypotheses, we interviewed a targeted, non representative, sample of cannabis users: visitors at the biggest Italian cannabis fair. Our data suggest that the role and weight of adults in the cannabis market is quantitatively significant and qualitatively different from that of younger people. We analyzed the links between the aging issue and the views supporting cannabis market restrictions (defined as paternalism, economics externalities, and moral externalities). Finally, we developed a model where we demonstrated how the utility of cannabis market restrictions decreases as the share of adults in the cannabis user population increases.

Keywords: cannabis, aging, normalization, social integration, paternalism, externalities, welfare, regulation.

## **1. Introduction**

The literature on the cannabis market has been mostly focused on consumption by young people, for example students (e.g. ESPAD studies). The reason for this may be twofold. Firstly, it is supposed that cannabis consumption may severely harm adolescent's development (Hall, 2009; Zammit, Allebeck, Andreasson, Lundbers, & Lewis, 2002). Secondly, because for many years the dominant view has been – and often still is in the public and political discourse – that cannabis consumption is mostly limited to young people. However, several indicators suggest that the share of adults in the cannabis consumer population is increasing, and it is not negligible anymore (e.g. EMCDDA statistics). This demographic transition, which we define as aging, is already visible in Italy, a country that is leading European greying: a decrease in birth-rate and youth, and an increasing proportion of older people in the general population. In Italy, the share of adults (aged 30 years and above) reported for illegal drug possession has steadily increased: from 11% in

1990, to 27% in 2015 (DPA, 2016, p.179). In 2017, the share of adults reported for illegal cannabis possession was 21% (DPA, 2018, p.56). If the typical evolution of cannabis consumer's careers goes through a process of normalisation (Parker, Williams, & Aldrige, 2002; Duff, Asbridge, Brochu, Cousineau, Hathaway, Marsh, & Erikson, 2012) and social integration (Duff & Erikson, 2014), where consumers' habits (i.e. patterns of use and supply) and socio-economic status change during the transition from adolescence, through young adulthood to adult, this change in cannabis consumers age distribution may have policy implications, that we are here going to investigate, by using a welfare economics model.

In this welfare economics approach to the cannabis market, the aim is to identify the optimal tolerable quantity of cannabis consumption. The quantity that, when comparing the benefits of cannabis consumption restrictions and the cost of their implementation, maximises social welfare. Therefore, we define an objective function, which includes the benefits coming from market restrictions. In particular, we hypothesize that these benefits decrease as the share of adults in the population of cannabis consumers' increases. Then, we cross this objective function with a cost function, which includes the cost of market restrictions implementation. The result of this social welfare maximization process is that the optimal tolerable quantity of cannabis consumption is increasing as the share of adults in the population of cannabis consumers increases.

In order to verify the empirical relevance of the normalisation and social integration process, we collected a dataset on consumption habits and socioeconomic status of cannabis consumers through semi-structured interviews of visitors at the biggest Italian cannabis fair event (Canapa Mundi, IV edition, 2018). The particular setting of the interviews biased the sample toward an over representation of frequent consumers (those that are more significant from an economic standpoint). Our data confirms the normalisation and social integration hypotheses as: cannabis consumption by adults (in this chapter defined

as 30 years and older) is more solitary, more frequent and less exhibited than that of young people. Adults, contrary to young adults, consume cannabis for relaxation rather than for intoxication. Adults supply comes more from domestic cultivation than from the (more visible) supply of street dealers. Finally, adult cannabis consumers' education, employment and job level are akin to the rest of the contemporary population.

## **2. Three approaches supporting cannabis market restrictions**

The objective function of our model includes the benefits coming from cannabis market restrictions. The views supporting these restrictions may be classified into three categories: paternalism, economic externalities and moral externalities. These are three kinds of market failures. According to paternalism, market fails because of consumers' irrationality. While, in the presence of negative externalities, market may fail to capture the negative impact that cannabis consumption causes on society. Because of these failures, the quantity of cannabis consumed in the market is excessive. Therefore, restrictions are useful to contain consumption within its optimal tolerable quantity. If these restrictions are effective, social welfare benefits from the containment of excessive cannabis consumption.

### **2.1 Paternalism**

Paternalism may be defined as a solution to a market failure, where: agents (the economic term for people) may make irrational choices, therefore, regulations are useful to prevent this risk. If rationality is defined as the ability of an economic agent to process his available information in order to prevent the risk of systematic errors (Fama,1970). By irrational choices we mean that agents may be unable to use their endowments, including available information, in order to maximize their expected lifetime utility. Irrational choices may be

caused by agents' having limited information and/or agents' inability to correctly process their information (while it is assumed that the regulator is better informed and/or it has better processing abilities). As time is needed both to collect information, and to develop the abilities to process this information, the paternalistic view fears that before a certain age it is unlikely that agents' information and/or abilities are sufficient enough to allow them to make rational choices. Therefore, this view may support the many restrictions applied to young people, who, before a certain age, have limited civil rights.

In the case of cannabis, the application of paternalistic restrictions for young people may be motivated by the fear that they may not yet be conscious of the health risks caused by smoking cannabis and, therefore, they may be involved in an irrational consumption, which reduces their expected lifetime utility. The paternalistic view seems less suited for adult consumers, who have had more time to collect and process information about the health risks implied by smoking cannabis. In fact, assuming agents' rationality, Becker & Murphy (1988) showed that it is theoretically possible to have a rational drug consumption: that is a consumption of a drug which is compatible with the maximization of expected lifetime utility (where drug is defined as a substance which is dangerous for the health and which may cause addiction and/or tolerance).

In Europe, the distinction between young and adult consumers is traditionally applied in the market regulation of tobacco and alcohol, where paternalistic restrictions are applied to young people, who cannot purchase these drugs. In the case of cannabis, paternalistic restrictions were motivated by the wider consumption of this substance among young people, especially teenagers, while the number of adult consumers was negligible. Therefore, from this standpoint, the paternalistic approach loses generality as the share of adults in the population of users increases.

## **2.2 Economic externalities**

In the economic literature, externalities are the effects on society caused by the action of another agent  $j$ , which are not compensated in the market. In particular, negative economic externalities are defined those cases where  $j$ 's actions reduce  $i$ 's utility without a monetary compensation. When there are economic externalities, the market equilibrium is sub-optimal. In particular, if agent  $j$ 's consumption causes negative externalities, the resulting market equilibrium is one of over-consumption, i.e. the quantity consumed is above that which would maximize social welfare. This result supports market regulations aimed at reducing excessive consumption.

In the case of cannabis, the negative economic externalities are the costs, caused by individual consumption, which are paid for by society. These costs accumulate mainly in health care costs, production losses, and damages to others caused by consumers' misconduct (as in driving accidents). The health care costs are caused by the risk of incurring in diseases caused by cannabis consumption, in particular by smoking cannabis. The cost of treating these diseases are, at least partially, paid for by society through the National Health System. Moreover, as well as the risk of incurring these diseases, the productivity of cannabis consumers may be reduced. This productivity loss reduces the supply of goods and services available to society and, therefore, reduces social welfare. In actuarial terms, the expected value of these two kinds of externalities is proportional to consumer life expectancy. In particular, expected production losses are inversely proportional to the residual consumers' working life, so that they are negligible for retired people.

A different kind of economic externality consists of the revenues accruing to those criminals, who are (illegally) supplying cannabis. In fact, this is not an externality caused by consumption itself, but an unintended consequence of prohibition, which constraints cannabis trade in the illegal market. Whilst, the criminals may use the revenues coming from

cannabis sales to finance other illegal activities, whose successes reduces social welfare. We suppose that, compared to young users, adults' cannabis supply comes more from domestic cultivation than from street dealers. Accordingly, the revenue from (illegal) cannabis sales are decreasing as the share of adult users increases. Moreover, we suppose that their heavier reliance on domestic cultivation makes the adult supply less detectable, so that it is costlier to implement restrictions.

### **2.3 Moral externalities**

We define moral externality as the non-monetary damage that agent  $i$ 's action imposes upon another agent  $j$ , without compensation. While economic externalities may be quantified in monetary terms (such as health care costs or value of production losses), moral externalities do not reduce income or production, but they harm society through the exhibition of behaviour, which is ethically disapproved of. Note that moral externalities come from the exhibition of immoral behaviour. According to this, if a behaviour is not public exhibited, it does not cause moral externalities; moreover, in order to cause a moral externality, agent  $j$ 's behaviour should be judged as immoral by some other agent  $i$ . In sociological terms, we define moral externalities as caused by the exhibition of immoral behaviour by deviant people. When moral externalities are present, agent  $j$  may try to restrict agent  $i$ 's behaviour to prevent him/her from causing the externalities and, if the people affected by the moral externalities are powerful enough, restrictions on agent  $i$ 's behaviour may be imposed.

Cannabis consumption may be associated with immoral behaviour (Hathaway, Comeau, & Erickson, 2011). But, we suppose that the moral externalities caused by adult consumption are less than those caused by young consumers. We believe, because of the qualitative shift in consumption and supply patterns and status, which seems to occur along cannabis consumer's careers, between adolescence and adulthood. According to Grosso (2018), the typical drug consumer's career starts at adolescence, it is often motivated by emulation

inside of small groups of peers, and it is mainly occasional and collective. Then, around the age of 30 years, the typical cannabis consumer's habits change. Most consumers leave the market before reaching the age of 34-35 years, but a minority of them continues to consume cannabis, although in a quite different way. Adult cannabis consumers who continue to use cannabis go through a process, where their consumption becomes an individual daily habit, and they become "socially integrated" (Sznitman, 2007; Duff et al., 2012, 2014). Given our above definition of moral externality, we think that the change in users habits and status from young adult to adult causes less moral stigma because we suppose that: a) there is less exhibition (because of the shift from collective to individual consumption, and from street dealers supply to domestic cultivation) and b) adult users are socially integrated people.

We suppose that there is also a significant difference between young users and adults on the side of cannabis supply. We suppose that adult users supply comes relatively more from regular dealers and, specifically, from domestic cultivation, while young users rely more upon street dealers, whose trade is often conducted in public. Therefore, this difference in supply habits makes cannabis purchases by adults less visible or inexistent. As there is a reduction in the exhibition of the drug immoral trade by adults, there is also a decrease in the moral externalities caused by drug supply to adults compared to young people.

### **3. Empirical analysis**

The empirical analysis studies a dataset collected through semi-structured interviews to a non-random sample of visitors at the biggest Italian cannabis fair event (Canapa Mundi, 2018). Given its suburban location and a non-trivial entrance fee, it may be presumed that we got a distorted sample, where very involved people are over represented. The (printed) questionnaire was administered to 626 visitors, and it was about consumption and supply habits, considerations for consumption, and socio-demographic characteristics. The data collected was both quantitative and qualitative. The qualitative variables were measured

through self-reported and/or structured grading. The respondents were grouped according to their class of age (Table 1); thereafter, we split the sample into two subsets: where we grouped the first two age classes into young consumers, while people 30 years and above were grouped as adult consumers. This cut-off age (30 years) is similar to the one standardly used by EMCDDA statistics, which uses the term young adults for the group aged between 15 and 34 years. We picked a lower cut-off age because, firstly, our main sources of official data (DPA, 2016, 2018, and DCSA, 2016), use this kind of partition, secondly, it is at the age of 30 that the process of normalisation usually starts, as it is revealed by the structural shift in our sample data (particularly for female users).

Table 1 About here

### 3.1. Consumption patterns and habits

An overwhelming majority of participants declared themselves as regular and/or frequent consumers (Table 2). In fact, most of them (three quarters) declared to consuming cannabis every day, a minority once a week or once per month, and very few once a year. Accordingly, most of participants (about two thirds) declared consuming more than 10 grams of cannabis per month, while a minority (one quarter) of them declared to consume between 3 and 9 grams, or less. Because the estimates for the total population of Italian cannabis consumers are lower than the findings by Van Laar, Frijns, Trautmann & Lombi, (2013a, p.20), who estimated: 41% chippers (i.e. infrequent users), 37% occasional, 12% regular, and 10% intensive, our results confirm that our sample is distorted. But this sample distortion allow us to focus on those consumers, regular and frequent, that are more important from an economic standpoint, because they demand most of the cannabis (Van Laar et al. (2013a, p.20) estimated that in Italy almost three quarters of the cannabis is consumed by intensive consumers, and one quarter by regular consumers).



Almost all of the participants (96%) claimed to consume cannabis through direct inhalation of burnt fumes, a way of consumption (joint) that is very dangerous for consumers' health. About two thirds of participants declared consuming cannabis together with other people, while the remaining third consumed cannabis alone, without any company.

Our data shows that there are differences in the frequency and quantity consumed throughout a cannabis consumers' career. Occasional consumption is higher for young users than for adults, and, conversely, daily consumption is higher for adults than for young users. Our findings confirm the positive correlation between consumers' age and frequency of consumption already found in Van Laar, Frijns, Trautmann & Lombi, (2013b, p.93). Accordingly, the quantity of cannabis consumed by people older than 30 is higher than that consumed by younger ones. These figures suggest that, although the cannabis market is mainly populated by young consumers, the weight of adult demand is higher than its share in the total population of consumers.

Our data also shows that there is another variation in consumption habits between young and adult cannabis consumers: young people consume cannabis socially more than adults do. In particular, three quarters of the under 30 years participants declared to consume in company, while adults' share is one half; conversely the share of those participants who declared consuming alone is higher for adults (almost one half) than for young users (one quarter).

Table 2 about here

### 3.2. Motives for cannabis use

The questionnaire investigated on two motives for cannabis use: recreation and relaxation. We asked the participants to assign a value ranging from 0 to 5 to each of these categories. Recreational consumption (getting high) scored an average value of 3.25; the average value

of cannabis consumption for relaxation was 4,25 (Table 3). Our findings are in line with Van Laar et al. estimates (2013b, p.103), where, among the population of Italian cannabis consumers, other considerations dominate over potency.

In particular, the recreational properties of cannabis are on average more appreciated by young consumers than by adults. The average value attributed to recreation by young respondents was higher than that attributed by adults, and only a few of young participants attributed none (0) or very low value (1) to the recreational motivation; while one adult on five attributed none (0) or very low value (1) to this motive. Whilst, relaxation is more appreciated by adults than by young consumers: the attributed average value was higher for adults and most of them awarded relaxation the maximum value (5).

Table 3 about here

### 3.3. Cannabis dependence

In the questionnaire, participants were asked to rank their cannabis dependence on a scale ranging from 0 (no dependence) to 5 (heavy dependence). The distribution of answers was very skewed toward cannabis dependency (average value: 3.24; asymmetry index = -,496). About two thirds of participants perceive themselves as dependent on cannabis (attributing a value of at least 3 to their cannabis dependence). In particular, almost one third of adult participants attributed to their cannabis dependence the maximum value (5), while corresponding percentage among young participants was much lower (Table 3). The CAST screening on the Italian population of cannabis consumers confirms that, from 2007 on, the modal class of age of problematic consumers is above 35 years old (38.6%) (DPA, 2018, p.108).

### 3.4. Supply

In the questionnaire, participants were also asked about their cannabis supply sources (Table 4). The modal source of supply was through friends, then, home dealers and domestic cultivation, while a few of participants said to rely on street dealers. According to these figures, it may be that the supply to frequent consumers comes from a kind of customer market, where transactions occur mostly within permanent customer relations, instead of arm's length transactions with occasional dealers. This finding contrasts the IFC-CNR estimate along which, in Italy, street dealers supply cannabis most of users (DPA, 2018, p.66). It looks as if the cannabis market is dichotomous: while most of consumers are occasional and rely on street dealers, the minority of frequent consumers rely more on customer relations. Moreover, our data shows that cannabis supply to adults is different from the one to young people. Adult consumers rely more upon domestic cultivation than young ones, while young consumers' supply comes more from friends and dealers.

Table 4 about here

### 3.5. Consumers' socio-economic status

#### 3.5.1 Age

In our sample, most of participants' age was between 20 and 40 years, and a few were over 40 years or teenagers (Table 1). Moreover, the share of adult consumers (over 30 years) was about one third of the total sample, a share slightly higher than the share of adults reported by Italian police for illegal cannabis possession (DPA, 2016, p.179). Therefore, our results show that adult cannabis consumption is very significant. Moreover, this result is interesting because it comes from the analysis of a selective biased sample, where very involved people are over-represented. Therefore, we can suppose that the weight of adult consumers in the cannabis market is more than proportional to their share in the users' population.

### 3.5.2 Gender

In our sample, most of participants were male (Table 1). Moreover, men consume more cannabis than women (Table 2). The percentage of daily consumers is higher for males than for females, while the percentage of occasional consumers is higher for females. Along with a higher frequency of consumption, the share of male participants who declared to consume more than 10 grams of cannabis per month is larger than that of females, while the share of participants who declared to consume less than 2 grams of cannabis per month is larger for females. Altogether, these results confirm the traditional belief that cannabis is mostly consumed by males (van Laar et al, 2013b, p.81).

However, we found a significant difference in consumers' careers between genders (Table 1). The representation of consumers in the younger age classes (<30 years) is higher for females than for males. But, the proportion of females suddenly drops down in the age group 30-39 years, and it continues to decrease at older ages. Conversely, the male rate remains relatively more stable as consumers get older. In particular, its drop in the age group of 30-39 years is less dramatic. Therefore, we can suppose that female cannabis consumption is more concentrated in younger age groups, while, given the sudden drop in female rate after the critical age of 30, adult cannabis use is dominated by males.

Finally, females consume cannabis together with others relatively more than males. The percentage of those who consume cannabis mostly, or only, together is higher for females than for males; while the percentage of those who consume cannabis mostly, or only, alone is higher for males than for females (Table 2).

### 3.5.3 Perceived health

Our questionnaire asked participants to declare their self-perceived health on a scale ranging from 0 to 5. An overwhelming majority of participants declared themselves to be

very healthy people: two thirds ranked themselves in the highest class of health, and one fifth in the second one; while only one participant of ten ranked him-herself in the lowest categories (from 0 to 2). The very high perception of health is common among participants, irrespective of their consumption habits (as frequency of use or quantity consumed). In our sample the perceived health initially increases from young consumers until the age class 30-39, where it peaks, then it decreases along with participants' age, but not dramatically, as most of participants aged 50 or over still ranked themselves in the highest class of health. Altogether, we guess that these results indicate that cannabis consumption is not very harmful for health, or, that it systematically alters consumers' perceptions, making them feel healthy.

#### 3.5.4. Education

As to their level of education (Table 5), most participants declared themselves as educated people: many reported having a high school degree, and over one quarter a university degree (a level of education well above the Italian standard). In particular, the highest rate with a high school degree was in the age group 20-29 years; while the highest rate with a university degree was in the age group 30-39 years. The highest rate with high school degree was among those who declared monthly use of cannabis, while the highest rate with a university degree was among those who declared a yearly rate of consumption. But, also intensive consumers declared to having a high level of education: most of daily consumers declared to having a high school diploma and one quarter of them a university degree. We should not forget that our sample is distorted. First, it mostly consists of school-age people; second, we suppose that it is the result of self-selection process, caused by entrance fees and transportation costs. Therefore, it is likely that our sample overestimate the education level of the cannabis consumers' population. The finding that the education attainment of intensive users is similar or better than the general population was also found in Dutch and

Australian samples of heavy or long term users (Van der Pol, Liebrechts, de Graaf, ten Have, Korf, van den Brink, & van Laar, 2013; Copeland, Swift, & Rees, 2001; Reilly, Didicott, Swift & Hall, 1998) .

### 3.5.5. Occupation

Participants reported a very high occupation rate, as one of ten participant declared to be unemployed or out of the workforce. This employment rate is much higher than that of the Italian population ([http://dati.istat.it/Index.aspx?DataSetCode=DCCV\\_TAXOCCU1](http://dati.istat.it/Index.aspx?DataSetCode=DCCV_TAXOCCU1)). Our results are in line with those of Van Laar et al. (2013b, p.94); Copeland et al. (2001), and Reilly et al. (1998). Whilst, Van der Pol et al. (2013) found that frequent users are more often unemployed or unable to work. The above remarks on sample distortion are also applicable here: it may be that non-negligible entrance fees and transportation costs inhibited low income (non working) people from attending the fair. Therefore, it is likely that our data overestimate the employment rate of the cannabis consumer population. We classified the participants' occupations into three categories: high, medium and low. The highest one consists of managers, entrepreneurs, and high-skill white-collar positions; the second category includes clerks and skilled blue collar jobs, the lowest category includes all low or no-skill blue collar occupations. The average level of participants' occupation was quite high (Table 5). In fact, most reported to have high or medium level occupations. Over one quarter of participants were students. Although the above statement about sample bias still applies, the occupation rate and level in our sample are better than that of the general Italian population, therefore we can suppose that our data empirically deny the hypothesis that cannabis consumption is incompatible with the achievement of users' social integration.

Table 5 about here (?)

## 4. Conclusions

This study was motivated by the observation of the increasing share of adult cannabis

consumers. According to police data, this demographic phenomenon, defined as aging, is already significant in Italy, a country which is leading European greying. Although the literature is still focused on the young populations consumption of cannabis, some studies suggested that cannabis consumption by adults is different from that of young people (Maturo, 2008; Buso & Grosso, 2009; Duff et al., 2012). In fact, most of the consumers reduce, or quit, consumption as they become adult. But a minority of them who continue to consume into adulthood, go through a process through which they change their habits and status. Therefore, we suppose that these changes may have policy implications, whose relevance is going to grow because of the current European demographic trend.

We studied this aging issue in a welfare economic approach, as in Becker, Grossman & Murphy (2006). In our model the issue is to find the optimal tolerable quantity of consumption, that is the quantity which maximizes social welfare. We identify this optimal quantity by crossing the benefits of cannabis market restriction with the cost of implementing this restriction. In particular, we group the views supporting market restrictions into three categories: paternalism, economic and moral externalities. Then, we showed the actuarial motives whereby the utility of restrictions, dictated by paternalism or by economic externalities, is inversely related to the residual consumers' expected life. Moreover, we argued that the above changes in adult consumers' habits and status reduce the moral externalities caused by their consumption.

In order to empirically verify the normalisation hypothesis, we interviewed visitors at the biggest Italian cannabis fair (Canapa Mundi, 2018). Because of this location, we collected a distorted sample, where frequent consumers were over-represented. From an economics point of view, this sample distortion allowed us to focus on these important consumers, who, although being less numerous than the occasional consumers, demand most of the cannabis and are more likely to suffer from the harmful health consequences of cannabis

dependence. From this point of view, the most important result coming that came from our sample data is that, on average, adult people consume more cannabis than young ones, and more frequently, so that the economic relevance of adults' demand on the market is more than proportional to their share in the population of consumers. A finding which increases the economic relevance of cannabis consumption by adults.

Moreover, compared to young people, adults consume cannabis relatively more individually than socially, and they consume cannabis for relaxation purposes rather than as a recreational activity. Adults' cannabis supply comes relatively more from domestic cultivation than from street dealers. Finally, the education and occupation of the adult respondents are better than the average of the Italian population. Altogether, we believe that our results support the hypotheses of normalisation and social integration of adult cannabis users.

Ultimately, our model shows that the benefits of restrictions are inversely related to the share of adult consumers in the population. That is, as aging progresses, the social benefit of market restrictions is lower, and the optimal tolerable quantity of cannabis consumption increases. We acknowledge that it is not very simple to translate into operational terms this quantification of the optimal degree of tolerance. Nevertheless, our results may suggest the use of different policies for adults or young people. That is, keeping the current restrictions on young users, but lowering the restriction on adult cannabis consumption. An age-based regulation already applied in several cases (tobacco, alcohol, gambling, pornography, etc.).

## **5. Addendum: the model**

This is a welfare economics model, where the issue of regulating the cannabis collapses in finding the cannabis market size which maximizes social welfare, that is the optimal tolerable quantity ( $Q^*$ ) of cannabis consumption. The value of  $Q^*$  is found by comparing benefits and costs of market restriction. Therefore, we define an objective function (4), which includes the



benefits coming from market restrictions, and a cost function (7) which includes the cost of restriction implementation. Crossing this objective function with the cost function, we get the optimal tolerable quantity of cannabis market size ( $Q^*$ ), that is the quantity which maximizes social welfare (9). Because we guess that the benefits of market restriction are inversely related to the share of adult consumers in the cannabis consumers' population ( $t$ ), we show that the optimal tolerable quantity of cannabis market size ( $Q^*$ ) is increasing as this share ( $t$ ) grows (10).

Defined ( $t$ ) as an index of the share of adult consumers in the population of cannabis consumers, and ( $Q$ ) as the quantity of cannabis consumption, we define a Paternalist utility function as:

$$1) P = p(t, Q);$$

where:  $p'(t) < 0$  and  $p'(Q) > 0$ .

Then we define a moralist utility function as:

$$2) M = m(t, Q);$$

where:  $m'(t) < 0$  and  $m'(Q) > 0$ .

Finally, we define externalities as:

$$3) E = e(t, Q);$$

where:  $e'(t) < 0$  and  $e'(Q) > 0$ .

The objective function, defined as the Social Cost of cannabis consumption, is:

$$4) SC = s(P(t, Q), M(t, Q), E(t, Q))$$

where:  $s'(P) > 0$ ;  $s'(M) > 0$ ;  $s'(E) > 0$ .

We assume that the amount of cannabis consumption ( $Q$ ) depends on prohibition implementation effort ( $e$ ):

$$5) Q=q(e),$$

where  $q'(e)<0$ ;

but, if this effort is costly:

$$6) C=c(e),$$

where:  $c'(e)>0$ ,

then, the cost function is:

$$7) C=c(e(Q)),$$

where:  $c'(Q)<0$ .

We define a Social Welfare Function as:

$$8) SWF = f(SC(t,Q), C(Q))$$

where:  $f'(SC)<0$  and  $f'(Q)<0$ .

According to the above assumptions, maximizing this SWF respect to  $Q$  results a quantity of optimal consumption ( $Q^*$ ) which is positively related to the share of adults among the population of cannabis consumers:

$$9) Q^*=q(t),$$

where:

$$10) q'(t)>0.$$

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## TABLES

Table 1. Age and gender distribution

Age	<20	20-29	30-39	40-49	50+	Total
(n)	(55)	(346)	(159)	(43)	(19)	(622)
Gender						
Male	7%	54%	29%	8%	3%	72%
Female	14%	60%	17%	5%	3%	28%

Table 2. Cannabis consumption patterns by age group and gender.

	Occasional	Daily	> 10 grams	Socially (mostly)	Socially (only)	Alone (mostly)	Alone (only)
Age							
Adults	21%	79%	70%	49%	6%	39%	6%
Young	26%	74%	60%	65%	10%	23%	2%
Gender							
Males	8%	79%	67%	58%	8%	31%	4%
Females	15%	68%	54%	63%	12%	22%	2%

Table 3. Motives for use and self-perceived cannabis dependence.

	Recreation (avg.)	Recreation (0-1)	Relax (avg.)	Relax (5)	Can dependent (5)
Adults	3.0	21%	4.3	62%	31%
Young	3.4	10%	4.2	53%	19%

Table 4. Cannabis supply source, in % per age group.

Age	< 20	20-29	30-39	40-49	50+	Total
Domestic cultivation	6	18	28	35	16	21
Friends	53	48	40	30	53	45
Home dealers	36	29	25	26	21	28
Street dealers	6	5	6	9	5	5
National Health System	0	1	1	0	5	1
Total	100	100	100	100	100	100

Table 5. Education and occupation per age, in % per age group.

Age	< 20	20-29	30-39	40-49	50+	Total
Education						
None	0	0	1	0	0	0
Elementary school	0	0	0	2	0	0
Primary school	67	11	14	12	32	17
Secondary school	33	63	45	51	53	55
University degree	0	26	41	35	16	28

Total	100	100	100	100	100	100
<b>Occupation</b>						
Blue collar	2	6	4	2	0	5
Skilled blue collar	8	26	45	29	38	30
White collar	4	19	42	56	56	27
Student	85	33	1	2	0	27
Unoccupied	2	15	6	10	6	11
Total	100	100	100	100	100	100