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Using Cigarette Taxes When Smokers Are Heterogeneous: Evidence on Hyperbolic Preferences, Endogenous Preferences, Smoking, and Price Elasticity of Smoking in France.

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Abstract

I use a unique dataset to estimate the relationship between time preferences, social capital, and the decision to start and quit smoking. I find impatient respondents do not differ much from patient ones, but quasi-hyperbolic respondents tend to smoke more often and have much more difficulties quitting. I also find that trust in the community protects from starting and helps quitting, but sense of control encourages starting smoking. These preliminary results strongly suggest that smokers form a heterogeneous population: I argue that such heterogeneity means that taxes on cigarettes are a blunt and inefficient instrument of public health.

Section 1: Introduction

I explore the relationship between self-control and endogenous preferences on one hand, and smoking behaviors - decisions to start and quit and their price elasticity, on the other hand. Albeit empirically grounded – I use a unique survey on health, health-related behaviors, and their determinants – the study addresses a normative issue: is it justified to tax cigarettes and, if so, how can we determine the optimal tax rate?

Leaving aside externalities (medical costs of smoking related diseases, second hand smoke, and consequences of smoking by pregnant women on their fetus) to which I go back below, a sketch of the normative argument is: if one sees, as if often the case in public health circles, smoking as an irrational decision then the area under the demand curve (for cigarettes) does not reflect welfare and, as a consequence, there is no welfare loss generated by the tax. If demand is price elastic, raising taxes will reduce consumption and smoking related diseases, which can only be beneficial. Seen from that same perspective, the only limit to taxing tobacco is smuggling. The addictive nature of nicotine is of course a good reason to think smoking is not a rational behavior; however, it should also be a good reason to think smoking is not price elastic (a fully addictive behavior does not even respond to stimuli). Therefore, welfarist economists have proposed a refined version of the pro-tax normative argument (Warner et al. 1995): smokers are rational when they make the decision to smoke and are therefore responsive to current and anticipated prices. However, there is some heterogeneity in the population, along the age dimension: teen (Warner et al., 1995 use the term children) smokers make a rational decision based on “too high” a rate of discount for future events (Becker and Mulligan, 1997) or imperfect information about the consequences of their decision on their health as adults (Suranovic, Goldfarb, and Leonard, 1999) or on their addiction to smoking (Orphanides and Zervos, 1995). More recently, Gruber and Köszegy (2000) and Gruber and Mullaynathan (2002) have added time inconsistencies as a justification for taxing rational smokers: when they make the decision to start smoking, individuals are rational in the long run (they know they will have to quit at one point) but impulsive in the short run. All these theories share the view that rationality is less than perfect, either because children cannot be expected to share the preferences of adults (endogenous preferences), or because individuals are not consistent in their rationality (self-control issues). Taxes can therefore be used to address and correct these imperfections; in such a view, the tax rate must be determined by standard individual well-being considerations: if discounting is the issue, the optimal tax should only increase the price of current consumption by the difference between the teen’s discount rate and the adult’s one.

In this study, I combine the heterogeneity idea present in Warner et al (1995) with the various imperfect rationalities to suggest there are different kinds of smokers: some ("happy smokers") make a perfectly rational decision, enjoy smoking, and quit before it is too late whereas others get hooked to smoking, will regret their decision, and will not be able to quit on time. As suggested by Glied (2002), using taxes to control smoking implicitly assumes that in most cases initiation leads to uncontrollable addiction and smoking related diseases; if such is the case (and only as much as it is the case) we are justified to tax the young to prevent adult smoking rather than, e.g., help smokers to quit. Every potential happy smoker prevented to smoke (or to smoke as much as they would have liked to) represents a welfare loss of the tax. If we agree upon the existence of happy smokers we must determine the optimal level of the tax by comparing the benefit in terms of prevented hooked smokers, and forgone external costs on non smokers, to the costs of preventing happy smokers to enjoy the experience.

The empirical results presented in this study support the idea that smokers are heterogeneous in their rationality. I can show heterogeneity along the lines of time preferences and social capital. Some individuals are inconsistent in their time preferences as in Gruber and Köszegy (2001) and this affects their decision to start smoking and their ability to quit; it also influences the responsiveness of their quitting and starting behaviors to prices. Some individuals benefit from fewer social capital resources and this affects their smoking behaviors as well (albeit less clearly). Based on such preliminary evidence, it appears that taxes can be a blunt instrument (Warner et al. (1995), Glied (2002)) to prevent smoking and that targeting future hooked smokers to prevent them (and only them) to start smoking, or helping adult smokers to quit could be a more efficient policy tool. More research is needed in the epidemiology of addiction to understand who is at risk of becoming hooked and how we can target these future hooked smokers who regret the "risky decision".

I outline the normative arguments on taxing cigarettes in more details in section 2 below, where I also delineate the four main models of less-than-perfectly-rational addiction and survey what is known about the heterogeneity in determinants of starting and quitting. Section 3 presents the data and methods I use to investigate the issue of heterogeneous motivations for smoking, section 4 presents the empirical findings and section 5 concludes.

Section 2: Taxes and Heterogeneity of Smoking Careers: What Do We Know?

Because this study focuses on the relationship between taxes and smoking behaviors, I start by setting aside the issue of taxes and external costs of smoking (costs imposed by smokers on others): in fact, if tax rates are set according to externalities alone they have nothing to do with the price elasticity of smoking but must only reflect the cost of smoking that is not borne by smokers when they make the decision to smoke.

Externalities are of two main types: costs to public schemes (health care and pensions) or employers (days of work lost), and health consequences. Stoddart et al. (1986), Manning et al. (1989), Viscusi (1989), and Warner et al (1995), based on Canadian and US studies, show that, providing publicly financed health care provision and public pension schemes, premature deaths due to smoking actually subsidize non smokers. Second, environmental smoke is usually seen as a non issue by economists if it happens within the household (a spouse suffering from second hand smoke is supposed to make a decision to stay, therefore costs are internalized). We are left with the external cost of smoking during pregnancy that are born by fetuses (low birth weight): Evans, Ringel and Stech (1999) estimate these costs to 42 to 72 cents per pack in the US, which is comparable to the current level of taxes in the US but much smaller than what Canada (CAD3.5 per pack, Gruber, Sen and Stabile, 2003) or most European countries levy on cigarettes (e.g. €4 per pack in France, http://www.securite-sanitaire.org/ accessed June 18, 2007).

As a result, justifying the level of taxes on cigarettes currently observed in most countries (not the US) requires more than mere external costs imposed on non smokers. It has to do with protecting smokers from themselves and understanding the nature of the choices made by individuals when they decide to smoke. Economists use the rational addiction model (Becker and Murphy, 1988) as their starting point and the applications of rational addiction to smoking are already well known. The normative consequences of seeing smokers as rational and forward looking are presented in Warner et al. (1995), Chaloupka and Warner (2000) survey the empirical tests of the model and Callet and Rist (2003) review the 523 price-elasticities of smoking derived more or less consistently from such a model. I raise two issues not covered in these surveys but that need to be clarified if one wants to contribute to the debate on optimal tobacco taxes:

First, is measuring the elasticity of aggregate consumption or individual daily consumption consistent with the tenets of the rational addiction model? I argue here that in order to

understand the normative consequences of taxing tobacco, we must focus on the careers of smokers and, as a result, measure the elasticity of being a smoker (starting and quitting) rather than the volume smoked per day. Second, where does the debate on rationality and addiction stand now and how should we refine and enrich the empirical investigations of smoking behavior and its relation to tobacco prices and taxes based on the most recent theoretical contributions? I argue here in favour of introducing heterogeneity in smoking behaviors and of measuring it.

In order to clarify this concept of heterogeneous careers, I go back to the basics of tobacco taxes and welfare. The non rational approach to the problem is the public health policy perspective: smoking is a bad and provides no satisfaction to its consumers. However, its consumption responds to stimuli and signals, such as prices. As a consequence, increasing the price of smoking through taxes (or partial prohibition) entails an administrative cost but no welfare loss. Because smoking is detrimental to health, the benefit of the tax is the quantity or quality of lives saved (or, less often, their monetary equivalent). The more price elastic the consumption of such a bad, the higher the benefit and, as a result, the lower the cost-benefit ratio. For instance, van Baal et al. (2007), assuming an elasticity of smoking of -.4 (-.2 on prevalence and -.2 on conditional consumption), no enforcement costs and a discounting rate of 4% on costs and 1.5% on outcomes (QALYs) find a cost per QALY of raising taxes by 15% of €2,000 at 50 years. In such a cost-efficiency exercise, costs are medical costs (cost of longer life minus savings on smoking related diseases). It appears clearly in their simulation that the underlying model is extra-welfarist in the sense that the only outcome of interest is health, measured as the number of QALYs (or their value), not the sum of individual well-beings derived from cigarette consumption and its consequences (Labelle, Stoddart, and Rice, 1994a and 1994b, Pauly, 1994a and 1994b, Culyer and Evans, 1996). And the reason for such an extra-welfarist approach is, as in the debate on the influence of co-payments on health care utilization, the idea that the area under the demand curve has no normative meaning because consumers (of cigarettes or health care) are not sovereign (Rice, 1992). As a result, from such an extra-welfarist perspective, reaching a lower level of consumption through increased prices has no bearing on welfare, just as, in the debate on health care, reaching a lower level of consumption through increased cost-sharing cannot improve welfare[1]. The higher the tax the better and the only limit is acceptability: it is well documented that, past a given (possibly

[1] Note, however, that in the case of tobacco taxes, the extra-welfarist argument is used to support higher taxes whereas in the case of health care utilization it is used to reject higher co-payment.

context dependent) tax level consumers tend to use smuggled goods to go around the tax (e.g. Gruber, Sen, and Stabile, 2003, on the Canadian experience in the 1990s).

Welfarist economists reject the idea of measuring health gains as an outcome or a benefit as paternalistic (Warner et al. 1995): if smokers are rational, they take health losses into account when they make the decision to quit, wait or light up and no public body has the right to weigh these losses differently (more heavily) than themselves. The reason for that is consumer sovereignty: if consumers are rational, the area under the demand curve measures their well-being and any reduction in consumption levels will entail a welfare loss. If consumers are rational, the more elastic the demand and the higher the welfare loss of a tax increase (for no gain at all). Or, to put it more precisely, if consumers are rational, their current consumption level is the result of (maybe not rational) decisions they made earlier: public policy is justified in trying to alter these earlier decisions, made while young, but not to change their current consumption. A tax that would deter smoking initiation could be justified only if the welfare loss of current (adult) smokers is more than offset by the future benefits of teens not initiating smoking. For instance, Tengs et al. (2001) model the gain in QALY of preventing youth initiation versus promoting cessation and find the former to be a more effective strategy.

This raises three types of issues: first, is tax the best tool to deter initiation? Second, what is the link between initiation and adult smoking? Third, why would the decision to start smoking be less rational than the decision to smoke after initiation?

The first issue is a general one: tax is a blunt instrument when behaviors are heterogeneous, as noted by Atkinson and Stiglitz (1976): “the treatment of, say, optimal excise taxation in a world where individuals are assumed to be identical is at best of limited relevance.” Here, smokers are heterogeneous since young individuals faced with the decision to start smoking differ from adult smokers with a history of smoking and faced with the decision to quit and the decision regarding their daily consumption; in technical terms, non smokers considering initiation have no addiction capital influencing their optimal consumption level, and addiction capital lowers average utility of smoking but increases its marginal utility (Gruber and Mullainathan, 2002). However, taxes cannot take heterogeneity into account and are levied similarly on addicted smokers and teens.

Second, taxes are effective only if there is persistence between youth initiating and adult smoking, youth smoking is price-sensitive, and adult initiation is infrequent. Gruber and Zinman (2000) and Glied (2002) find a persistence rate close to 0.50 (each avoided youth initiation translates into 0.5 fewer adult smoker) and Gilleskie and Strumpf (2005) show that persistence makes taxes an effective tool to reduce smoking prevalence in the long run; however, taxes

may be effective but not optimal: Suranovic (2005) or Sajjad and Billimek (2007) suggest that, if the goal is to deter initiation, raising the legal smoking age to 21 would be as effective as raising taxes by 20% (but would not harm current adult smokers) and Glied (2002) remarks that effective cessation programs would be more efficient than youth initiation prevention. Empirically, this heterogeneity across ages (teens versus adults) means that the elasticity to be studied is that of starting and quitting rather than that of participation and conditional consumption. I will follow this analysis of careers of smokers as established by Douglas and Hariharan (1994), Forster and Jones (2001), Douglas (1998), Madden (2001), López-Nicolás (2002), and Grignon and Pierrard (2004b).

Third, why should we think of the decision to start smoking by teens to be less rational than the decision of adult smokers to smoke given their level of addiction capital? Chaloupka and Warner (2000) suggest two main reasons: teens make rational decision but under imperfect information, or preferences are not stable over the life cycle. Imperfect information subdivides itself into two sub-models: Teens under-estimate the risk of becoming addicted to smoking or they under-estimate the consequences of smoking on future health. A rational decision made under such imperfect information leads to regret when adult: addicts are rational not to quit given their current level of addiction but would be better off had they never started to smoke and to accumulate their addiction capital. According to these theories of “rational decision to start smoking under imperfect information”, individuals gain insight on the risk of becoming addicted (Orphanides and Zervos, 1995, Wang, 2007) or of becoming sick (Suranovic, Goldfarb, and Leonard, 1999) through experience. If they are not quick enough learners, they end up being hooked. Taxes can be a good way to convey information and make sure teens commit themselves as adults (what is referred to as Sandmovian externalities, Sandmo, 1983) under perfect information and other standard tools (legal smoking age or cessation programs) are not efficient. In such a framework, the optimal level of taxation should not have anything to do with the price elasticity of initiation but should only reflect the hidden cost of starting smoking; the price elasticity of the decision to start simply reflects the price equivalent of the information gap (if teens are price insensitive, it means they behave under perfect information).

The idea that preferences change over life is a more radical departure from rationality than imperfect information (Grignon and Pierrard, 2004a). Becker and Mulligan (1997) suggest that youths discount future events more heavily than what they will do when adult. Regret is generated by changes in time preferences from one period of life to the next. Beyond discounting, other preferences might change over time as well; for instance, it has been suggested that tastes and preferences regarding health are affected by contextual elements

such as social capital (Folland, 2006), suggesting endogenous preferences. Last, individuals might keep constant preferences but experience inconsistent preferences over time, a trait referred to as self-control (Kan, 2007), dual-selves and cues (Laibson, 2001) or dysfunctional urges (Glazer and Weiss, 2007). One such inconsistent preference is quasi-hyperbolic time discounting, according to which individuals use a higher discount rate for choices made today than for choices made in the future (Ainslie, 1992). Gruber and Köszegy (2001) show that quasi-hyperbolic discounting accounts for all the main features of addictive smoking with regret. Geoffard (2002) and Gruber and Köszegi (2001) also show that, if smoking is caused by changing or inconsistent preferences, taxes can be used as commitment devices: individuals suffering from self-control issues and being aware of their problem are better off if someone prevents them from making choices today that they will regret tomorrow. This is a welfarist version of paternalism and it recommends that the tax corrects the level of disagreement between the two selves. Gruber and Mullainathan (2002) show that potential smokers in Canada and the US are happier where tobacco taxes are higher and Kan (2007) shows that smokers who want to quit strongly and consistently support higher taxes on tobacco.

What do we know empirically about these models? As noted above, there is some suggestive evidence supporting each of the four plausible less than perfect rational addiction and we might certainly find suggestive facts supporting rational addiction as well (Gruber and Köszegy, 2001, point out that there is no clear empirical way to test rational addiction versus quasi-hyperbolic discounting). Here, I suggest that heterogeneity in smoking behaviors is also plausible and should be investigated empirically: rather than looking for a test able to discriminate the true behavior underlying observed careers of smokers, I estimate the strength of some determinants of starting and quitting smoking (namely social capital resources and time inconsistencies) and measure the distribution of these determinants in the population. Before turning to the variables I use to describe these various sub-populations and their behaviors toward smoking I outline the normative consequences of heterogeneity in smoking behaviors and survey the empirical literature on the determinants of starting and quitting smoking with a focus on findings related to heterogeneity.

If smokers are heterogeneous in their smoking careers, tax is even more a blunt instrument than when the opposition was between young smokers deciding to start and adult smokers with an accumulated addiction capital: in the former situation, the welfare loss of adult smokers was to be compared to the present value of the benefit of never smoking for the young. Now, we are faced with the following situation: some smokers may be perfectly rational and forward looking and, as a result, they will quit before smoking becomes harmful (Goldbaum,

2000). As has been shown by the General Surgeon report (Public Health Policy, 1990), smoking is harmful in the long run and damages to health can be reduced dramatically by abstinence: after 15 years without smoking the relative risk of contracting a smoking related cancer or respiratory disease is almost zero. Since the onset of these diseases is rarely before 50 years of age, anyone quitting before 35 can be said to smoke without too much risk. As pointed out in Suranovic (2005) any tax policy deterring these happy smokers from ever smoking would entail a welfare loss. Since a substantial and growing portion of smokers quit before the age of 35 (Pierce and Gilpin (1996) show that 50% of males smokers born I 1885-89 were still smoking at age 75 but that the same percentage will be reached at age 35 for cohorts born 1975-79), the chances that this welfare loss cannot be offset by the benefits of less rational smokers are great. A second group of smokers will become hooked because they have underestimated their own individual propensity to addiction (the rate at which their addiction capital accumulates) or to become sick. Depending on the variance in the distributions of these propensities, a uniform tax might send a wrong signal to all decision makers (e.g. deter potential happy smokers to start and enjoy, but be too low to deter potential hooked smokers). More importantly, if we can determine the factors of high propensity to becoming addicted or sick, a targeted tool (partial ban or cessation program) might be more efficient than a tax. A third group of smokers will become hooked because their time discount rate, or their preferences for health change over time, or because they have two selves with inconsistent preferences. Here again, a tax might send the wrong signal and we would gain to identify who suffers from lack of self-control or low discount rate when young.

The idea of heterogeneous smokers can very well coexist with rational addiction: in Becker and Murphy (1988), the initiation process is prompted by exogenous “stressful” events, which are imagined to be randomly distributed but can as well be thought as determined by social capital resources or time inconsistencies. Gilleskie and Strumpf (2005) empirically show that non observable individual heterogeneity plays a significant role in the smoking status of individuals (independent of their accumulated addiction capital). Orphanides and Zervos (1995) explicitly model heterogeneity in the propensity to become addicted, and Suranovic, Goldfarb, and Leonard (1999) in the risk of becoming sick due to smoking. However, in all these cases, heterogeneity is thought of as random.

Suranovic (2005) simulates lifetime welfare for two categories of smokers (light and heavy smokers): heterogeneity is along the line of daily conditional consumption and this offers a possibility to target the population at risk. The Framingham study (Freund et al. 1992) could not identify any significant relationship between daily consumption and probability to quit but

Nordstrom et al (2000), using a very long term longitudinal study in the US on 388 “continuing” smokers over 25 years (out of 986 smoking at baseline) find that heavier smokers are less likely to quit than moderate, who are less likely than light smokers (all differences are significant at usual thresholds) and Emery et al 2000, identify a small population of hard core smokers who will never quit (1.3% of California’s population). Contoyannis and Jones (2001) confirm on British longitudinal data that light smokers have a higher probability to quit; however, the relationship is not monotonic, since heavy smokers also have a higher probability to quit than moderate smokers. Etilé (2004), using a latent class Poisson model, identifies heterogeneity among teen-agers in France with one class of heavy smokers who do not react to general information on smoking through media but are sensitive to targeted sessions in school and another class of light smokers who react only to general information.

Jones (1996), Contoyannis and Jones (2001), Lahiri and Song (2000), and Clark and Etilé (2002) all find that poor health status or adverse health shocks increase the probability to quit smoking, which lends support to the hidden costs model proposed in Suranovic, Goldfarb, and Leonard (1999). Contoyannis and Jones (2001) cannot show any significant impact of actual survival rates on the probability to quit. Moreover, Adda and Lechene (2004) observe that poor baseline smoking free health status increase the probability to smoke in the future: individuals with a lower endowment of physiological capital would logically tend to draw more out of their health capital (Fogel, (2004), Adda and Lechene 2001, Carbone et al. 2005). Adda and Lechene (2004) also find considerable dispersion around the average in the decision to quit.

Sources of heterogeneity other than past consumption and health shocks are: general forward looking attitudes such as saving, home ownership and seat belt usage (Evans and Montgomery, 1994); helplessness and risk taking traits (Hirschman, Leventhal, and Glynn, 1984); psychosocial factors: Azjen and Fishbein scale of attitudes and normative beliefs, Jessor and Jessor scale of personality and perceived environment, and smoking environment variables (peer pressure) (Chassin et al. 1984).

To the best of my knowledge, the impact of time inconsistent preferences and social capital resources on the decisions to start and quit smoking was never assessed and, as a result, we do not know how heterogeneous smokers and potential smokers are relative to these factors and how efficient a tax on tobacco products could be. I test here the associations between time preference and social capital resources on one hand, and smoking behaviors (starting and quitting) on the other hand. I expect the following:

- impatient respondents should start more often and at a younger age than all other types of respondents, but there should not be any association with quitting among them;
- stating quasi-hyperbolic preferences should be associated with more difficulties quitting smoking (less often and later in life); I also expect those respondents to start more often, but I do not expect any association with the age to start smoking.
- last, social capital resources should protect from starting and, more importantly, help quitting on time.

I do not make any predictions about price elasticity and time preferences or social capital resources; rather, I use the findings on the effect of price on the decisions to start and quit of various sub-populations to draw policy recommendations on the effect of taxes. What matters most for this study is to identify potential differences in price-sensitivity across time preferences attitudes.

I measure associations only, and do not try to control for endogeneity in the measures of time preferences or social capital resources. As a result, I cannot claim any causality from these individual characteristics toward smoking behaviors and the results of this study are suggestive and should lead to further studies aimed specifically at testing causal relationships. However, smoking does not cut individuals off from normal life and it is hard to imagine they would change their preferences because they smoke.

Section 3: Data and Methods

Data

I use a unique general population survey combining questions on smoking behaviors (current and past), health status, socio-demographic characteristics, access to social capital resources, and time preferences: the French survey on health and social protection (ESPS).

I use a series of retrospective questions about smoking (at what age the individual started or quit) from a cross-section. This is therefore not a prospective longitudinal survey of smoking. The price to pay for using retrospective questions is recollection error bias (mostly heaping around rounded values), an issue to which I come back below; however, most prospective studies are limited to the behavior of specific age-groups (usually the young) and I am interested in smoking behaviors along the lifespan.

The survey is conducted every other year and questions on time preferences were introduced in 2002. I use here the 2002 and 2004 waves. These are independent cross-sections and can therefore be pooled to increase sample size.

The survey sample is randomly drawn from an administrative file of the population living in metropolitan France (it excludes Corsica and the overseas territories) and is approximately representative of the French population. The sampling procedure works as follows: social insurance numbers are drawn at random from the administrative file and a telephone interview is sought with someone in the household. Who answers the interview in the household is a matter of voluntary decision and, as a result, significantly more women (62%) end up in the telephone interview dataset. For most questions it does not really matter since the respondent is asked to answer questions about all members of the household. However, the questions on time preference are asked during the phone interview and answered by the respondent for herself/himself only. 6,180 individuals in 2002 and 7,126 in 2004 answered these phone interviews and answered the questions on time preference.

Besides the phone interview, a written questionnaire including questions on health and smoking behaviors is sent to the individual's household and can be filled by anyone willing to do it (it does not have to be the individual randomly drawn). The total number of individuals living in the households receiving the written questionnaire was 20,830 in 2002 (or an average household size of 3.37) and 22,460 in 2004 (3.15 average size). The sub-questionnaire on health and smoking behavior was filled for approximately half of them. Between 82% (in 2002) and 84% (in 2004) of respondents to the telephone interview aged 18 and older filled their written questionnaire on smoking and health. Having dropped 303 observations – 219 in 2002

and 84 in 2004- with implausible answers (age of starting smoking negative or under 10) I can use 10,875 independent observations (4,865 in 2002 and 6,010 in 2004).

Table 1:

Sample sizes	Survey year = 2002	Survey year = 2004
Phone interviews:	6,180	7,126
Written questionnaires:	20,830	22,460
Sub-questionnaire filled:	11,009	17,317
Sub-questionnaire filled and age over 18 ("initial sample"):	10,135	12,624
Phone interview, sub-questionnaire filled properly, and age over 18 ("final sample"):	4,865	6,010

Representativity and non-response bias

As for any general population survey, non response is an issue, with low income and elderly individuals being less prone to answer the survey than young and richer ones. Individuals who are interviewed are weighted (ex post), to correct from non response and weights vary from 0.5 to 1.98. All analyses presented here were estimated based on non weighted observations. The reason I chose to use un-weighted is twofold: first, one-way tables show that the proportions of smokers, never smokers, and ex-smokers, as well as the proportions of various sub-populations defined according to their time preferences were the same with weighted as well as with un-weighted observations. Second, since I exclude observations due to missing data, and the weights are ex-post weights (as opposed to weights reflecting the sampling procedure), there is no guarantee that the weighted sample reflects any true population.

Variable definitions

Smoking behaviors

Smoking status:: I use two questions to define the current state of the respondent, current smoker, ex-smoker, never smoker. Current smokers are those answering "yes" to the question: do you usually smoke? Ex-smokers are those who answered "no" to the previous question and "yes" to the question "have you ever smoked?" Never smokers are those with answers "no" to both questions.

As can be seen from table 2, the distribution across smoking statuses is stable from 2002 to 2004. It is also similar to what is observed in other contexts (e.g. Forster and Jones, 2001) with approximately 50% never smokers and an even split among ever smokers between current and ex smokers. Last, it is similar to what is observed in the more general sample (the 10,135 in 2002 and 12,624 in 2004 aged 18 and over who filled their written questionnaire).

Table 2 gives descriptive statistics for the dependent and independent variables.

Variables	Year: 2002		Year: 2004	
Smoking status, final sample*	N	%	N	%
Current smoker	1289	26.5	1381	23.0
Ex-smoker	1163	23.9	1483	24.7
Never smoker	2413	49.6	3146	52.3
Total	4865	100.0	6010	100.0

Table 2 continued:

Smoking status, larger sample**				
Current smoker	2719	26.8	2950	23.4
Ex-smoker	2263	22.3	2892	23.4
Never smoker	5153	50.8	6782	53.7
	Mean	Median	Mean	Median
Age at starting, final sample, ever smokers	21.88	20	21.70	20
Number of years smoker final sample ex smokers	13.83	10	15.19	12
Time preferences	N	%	N	%
Patient	1216	25.0	1612	26.8
Impatient	2416	50.9	2705	45.0
Quasi-Hyperbolic	378	7.8	647	10.8
Others	795	16.3	1046	17.4
Demographics: Males	1778	36.6	2301	38.3
Demographics: Socio-Economic Status				
Self-employed	451	9.3	584	9.7
Skilled, non manual	558	11.5	743	12.4
Semi-skilled, non manual	1052	21.6	1198	19.9
Unskilled, non manual	1484	30.5	1838	30.6
Skilled, manual	647	13.3	897	14.9
Unskilled, manual	453	9.3	484	8.1
Never in the labour force	220	4.5	263	4.4
Demographics: Education				
Primary only	2529	52.0	3334	55.5
Secondary	809	16.6	933	15.5
Post-secondary	1426	29.3	1705	28.4
DNK	76	1.6	37	0.6
Demographics: age	Mean	Std Dev	Mean	Std Dev
	47.4	16.7	49.1	17.0

The pattern of smoking behaviors has changed in France across the generations responding to the survey: in 1945 and the arrival of American troops in France, French switched from hand-rolled to industrial cigarettes; until the 60s, most cigarettes were without filters (it is only in 1973 that 50% of cigarettes smoked in France have filters, and one must wait until 1988 to reach a proportion of 75%) and 96% were locally produced. In 1980, only 30% of cigarettes smoked in France were blond, and 25% imported. Things changed dramatically in the 1980s with 61% blond cigarettes and 48% imported in 1990 (same figures are 83% and 69% in 2000). As a result, respondents aged 60 and over, who were teenagers in the 1950s were faced with local black tobacco products without filters, whereas respondents aged 40-60 had the option of filter cigarettes. Lastly, those aged 20-40 had the option of imported and blond cigarettes.

Overall consumption per adult and per day increased from 2.68 in 1950 to around 5.7 in the mid 1970s. The first anti-smoking policy, known as the "Loi Veil", was enacted in 1975 and imposed warning labels. A second and much stricter anti-smoking policy, "Loi Evin", was enacted in 1991: it banned advertising on cigarettes (including sponsoring sport events), prepared tax increases (see below), and banned smoking in offices and most public buildings. Starting in 1993, consumption has started to decrease, to 3.89 in 2003.

This health economist started with "*Gauloises brunes sans filtres*" in 1975 and switched to imported blond and filtered cigarettes in 1982, before quitting in 1986.

Durations

Starting age: Current smokers are asked "for how many years have you been a smoker?" which I use to calculate the age they started smoking. For ex-smokers, I calculate the starting age based on two questions: "for how many years were you a smoker" and "which year did you quit?" The average starting age is around 22 years old for ever smokers (but half smokers have started smoking at age 20). This is somewhat higher than what is observed usually: Forster and Jones (2001) find a mean of 18 and a median of 17 for the British population, Douglas and Hariharan (1992) a mean of 17.6 for the US in the 1970s, Douglas (1998) a mean of 18.4 for the US in the 1980s, and Lopez-Nicolas (2002) a mean of 17 for men and 17.4 for women in Spain in the 1990s) and stems partially from the exclusion of those who didn't respond to the telephone questionnaire (on the initial, larger sample, average ages are 21.3 and 21.1 for 2002 and 2004, with a median age of 19 for both years).

Duration of smoking spell

Last I construct a variable reflecting the number of years ever smokers have smoked: for ex-smokers, the average is around 14 years (around 15 in the initial sample). Douglas, for the US, finds a mean duration of smoking for ex-smokers of 9.9 years only. I can therefore describe the typical (average) career of a smoker in the sample I study: starting at age 20, indulging for 15 years and quitting at 35 (Douglas would have them starting at age 18 and stopping at 28).

In some analyses restricted to the population of current smokers I use a series of questions on the number of cigarettes smoked daily (the maximum number of cigarettes ex-smokers used to smoke daily is not known in the survey), and attempts to quit.

All questions on age and duration are retrospective and, therefore, subject to measurement error (Kenkel et al. 2004): individuals may not recall accurately the year they started or quit smoking and might be tempted to "heap" their answer around rounded off values. This shows clearly in the graph below, where frequencies of duration of the smoking spell (for ever smokers) are plotted (graph 1): rounded values at 5, 10, 15, etc. are much more likely than other ones, with a strong deficit on their neighboring values (4 and 6, 9 and 11, etc.).

Graph 1: distribution of durations of smoking for ever smokers – heaping effect.

sm_years	Freq.	
0	3	
1	318	**********
2	422	**********
3	379	**********
4	379	**********
5	641	**********
6	330	**********
7	248	*********
8	284	**********
9	100	****
10	1,348	**********
11	79	***
12	287	**********
13	111	****
14	130	*****
15	933	**********
16	138	*****
17	111	****
18	174	******
19	51	**
20	1,477	**********
21	29	*
22	112	****
23	76	***
24	70	***
25	551	**********
26	58	**
27	67	**
28	80	***
29	27	*
30	832	**********
31	12	
32	56	**
33	31	*
34	34	*
35	215	********
36	17	*
37	12	
38	27	*
39	4	
40	298	**********
41	1	
42	19	*
43	5	
44	16	*
45	46	**
46	9	
47	6	
48	6	
49	3	
50	101	****
52	3	
54	2	
55	11	
58	6	
60	29	*
61	1	
62	1	
64	2	
65	4	
68	1	
72	1	
Total	10,824	

There is no perfect way of correcting for misclassification in non linear models (Kenkel et al. 2004) when the probability of misclassification cannot be estimated (to the best of my knowledge, there is no dataset comparing contemporaneous and recalled smoking status in France) and I will be content to introduce dummy variables for rounded off durations, as suggested by Torelli and Trivelleto (1993).

For the purpose of the study, comparing respondents with various stated time preferences or social capital resources, what really matters is that the probability of misclassification does not vary across types of time preferences. Kenkel et al (2004) show that the main determinant of misclassification is smoker status: ex light smokers tend to forget or discard their spells of past smoking whereas heavy or non smokers (current or past) provide more accurate recollections.

I control that time preferences have only weak association with the number of cigarettes smoked daily by current smokers: Controlling for social capital variables (sense of control and trust in the community) and socio-demographics, individuals who state quasi-hyperbolic preferences smoke the same number of cigarettes per day (conditional on being smokers) and those stating impatient preferences smoke fewer cigarettes (-0.8 compared to an average number of 12.6, significant at the 11% level). As a result, I can trust that the impact of misclassification on the price elasticity of starting and quitting smoking is constant across types of time preferences and does not bias my conclusions on the link between time inconsistencies and smoking behavior. Overall, all price-elasticities are underestimated (Kenkel et al. 2004), as are differences across time preferences groups.

Incidentally, this equation on conditional consumption confirms what Brown et al. (2006) observe on the effect of social capital (they use the proportion of religious associations in the total number of associations in the community and observe it is negatively associated with conditional consumption): stating trust in the community is associated with 1.3 fewer cigarettes per day. However, I also observe that smokers lacking sense of control at work smoke less per day (0.9 cigarettes). Overall, the same conclusion that misclassification does not affect the link between social capital variables and smoking behaviors hold.

Time Preferences

I use two questions to construct four mutually excluding sub-populations. The questions are the following:

1) Would you prefer to get a check of €1,000 now or, with certainty, €1,500 in two years from now?

2) Would you prefer to get a check of €1,000 in five years from now, or, with certainty, €1,500 in seven years from now?

This is a standard set of questions in the (rare) attempts to identify time inconsistencies in surveys (see Thaler, 1981, Ainslie and Haslam, 1992) and each question separately is also standard in attempts at measuring time discounting (Bretteville-Jensen, 1999).

Bretteville-Jensen uses a much higher value (approximately €12,000) in order to elicit a weekly discount rate among illegal drug injectors. In a general population survey aimed at eliciting time preference over two years, a smaller value seems preferable to avoid some contamination by income level (poorer individuals might be encouraged to answer impatiently if the amount is too high). Ainslie and Haslam (1992) use much smaller values ($100 and $150) but preliminary tests with the French population (pre-testing before launching the survey in 2002) showed that with so insignificant a choice almost everyone could afford to be patient (this is somewhat contrary to what Thaler, 1981 observes on a small sample of students: time discount rates are much lower for large amounts, a finding he interprets as the effort of being patient).

An individual answering consistently €1,000 now and in five years is deemed impatient; an individual answering consistently €1,500 in two and seven years is deemed patient. An individual answering €1,000 now but €1,500 in seven years can be characterized as quasi-hyperbolic: she is patient when the choice is in the future, but impatient when the decision has to be made now. The term quasi-hyperbolic encompasses purely hyperbolic preferences (future is discounted by 1/t instead of exp(-t)) and the behavior mixing exponential preferences in the future with a specific weight on current decisions ($U^t(x_t, x_{t+1}, ...) = u(x_t) + \beta \sum_{s \geq 1} \delta^s u(x_{t+s})$)

The symmetrical case of inconsistency is not that easy to characterize: individuals who would prefer to wait now, but are impatient when the choice is set in the future. A possible interpretation, following Rubinstein (2003), is that these individuals don't see any real difference between now and in two years, but see clearly a difference in the amounts proposed (hence, they choose to be patient); but they see a difference between 5 and 7 years, able to offset the difference in amounts and, as a result, opt for impatience. This would mean that the series of two questions capture inconsistencies in time discounting and something else, namely what Rubinstein calls the use of "similarity". Another interpretation is that these individuals think in financial terms and (wrongly) compare options in the following terms: a 50% rate of return in two years, which is more than anything one can hope to get on the financial market, for the first

question but the same rate in seven years for the second option, which represents only 6% per year and is not worth waiting.

I am well aware that these are only matters of interpretation and characterization rather than a true measure of impatience or quasi-hyperbolic discounting. For instance, it is clear that the questions capture urges as much as discounting (individuals who are rational but compete with another self prone to irrational urges); moreover, these are stated rather than revealed preferences and I have no guarantee that these individuals behave in real life as they state in their answers to the survey. I use state-of-the art questions to capture time discounting attitudes in surveys.

Social capital

I use sense of control at work and level of trust in the community. For a definition of "cognitive" social capital, see Lochner, Kawachi, & Kennedy, (1999).

These variables are available for 2004 only and are presented in greater detail in Jusot et al. (2007). The first one is based on the question:

> «Do you fully agree, agree, disagree, or strongly disagree with the following statement? I am in a position to influence the contents of my work »

For those unemployed or out of the labour force, the question refers to their last job. Based on such a variable I construct a dummy variable representing the lack of sense of control (value of 1 if disagree or strongly disagree). 33% of the sample declares having no sense of control at work. The dummy therefore takes a value of 0 for those who sense having control on their job, or the 7% who never were in the labour force.

The second one is based on the question:

> « In case you lost your wallet, would you go to a relevant "service/place" to check somebody found and brought it?»

With the following proposed answers: "Yes, one never knows", "Yes, even though I think it is useless", "No, there is no point since people do not usually bring lost objects to these places", "No, there is no point since I am sure that it has been indeed stolen". I use answer 1 (Yes, one never knows), chosen by two thirds of respondents as indicating trust in the community and construct a dummy variable accordingly.

Overall, I construct two dummy variables to describe social capital, and more social capital is accessed by individuals who have a value of 0 on the variable for lack of sense of control at work and a value of 1 on the variable on trust in the community.

Health status

I use self-assessed health; the survey uses a note out of 10 (from best health possible set at 10 to worst set at 0) and I construct a dummy variable for poor health when the note is (strictly) smaller than 8. 35.5% of respondents in the final sample are in "poor" health, so defined (it is 29.5% in the initial sample).

The survey also contains other measures of health, based on disability status (any limitations in daily activities), BMI and a variable unique to this dataset, measuring risk-life (it is a five class index coded by physicians on the basis of each respondent's self-reported chronic conditions and risk behaviors.

Socio-demographics

I mostly use descriptors of education level (primary education or less, secondary education – including baccalauréat – grade 12 exam, post-secondary education, not stated), and socio-economic status (self-employed, skilled non manual, semi-skilled non manual, unskilled non manual, skilled manual, unskilled manual, never in the labor force[2]), gender and age. Race or ethnicity are not available in the survey.

Compared to the larger initial sample, fewer respondents never in the labor force are in the final sample (answered the telephone interview) (4.5% versus 11%) and more semi or unskilled non manual ones (by 2 to 3 percentage points for semi-skilled, and by 5 to 6 for unskilled). Distributions across education statuses are similar in the final and initial samples. The final sample is much more feminine than the initial one and slightly older as well (by approximately 2.5 years).

Income is known at the household level only. It is a continuous variable even though a small proportion of respondents, who were reluctant to provide a figure, were asked to pick a category. Also, 21.5% of respondents were not willing or able to provide information on their income and I create a special dummy variable for them (*incdnk*). Here I use income without trying to adjust per consumption units. Income does not enter any of the equations on the decision to start and quit: I assume here that there is no strong income effect in participation and that observed income differences result from differences in education or occupation. I use income to characterize the population stating quasi-hyperbolic preferences, to check that stated preferences do not reflect income differences only. For that reason, total income seems to be a better indicator than income per consumption unit. I construct two dummy variables: individuals are assigned to the low income category when they live in a household with less than €1,900

[2] Retired individuals are assigned their last SES while in the labour force.

(approximately $2,800) per month. 29.4% of respondents are in the category “low income”, leaving 49.2% in the category “high income”.

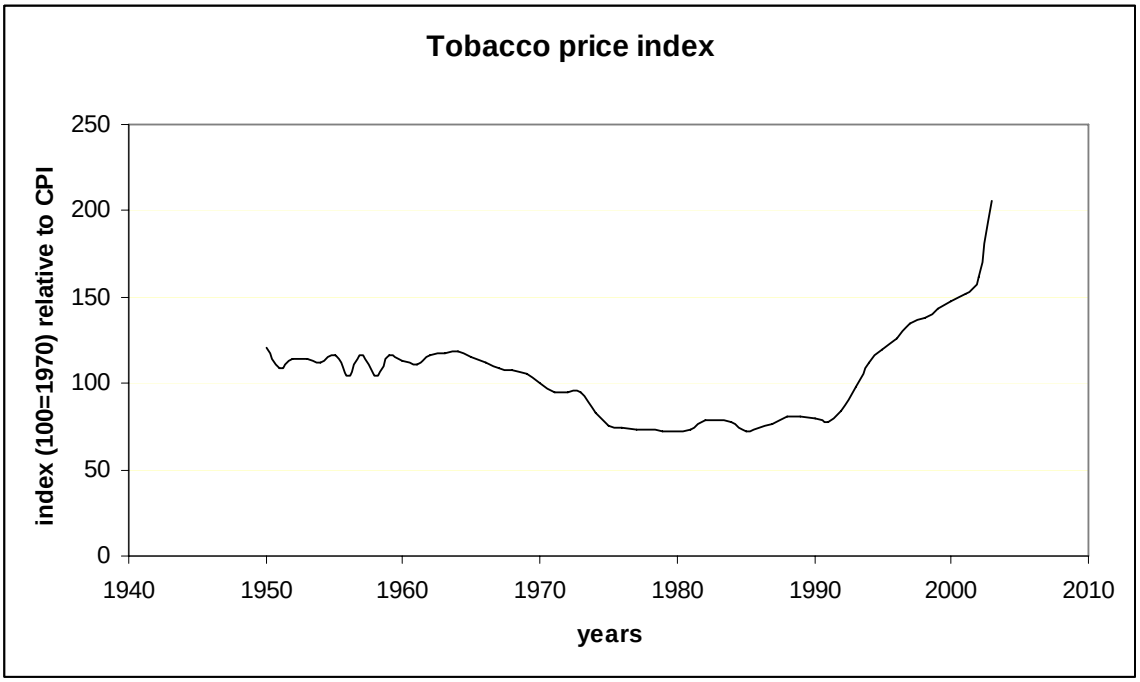
Cigarette prices

Prices used to be set by the administration until a decision by the European Court of Justice in 1994. Suppliers are now free to set prices, but still have to get some kind of ex-post agreement from the government. Approximately 75% of the selling price is made of taxes, and taxes are set nationally (the same tax rate is to be found on the whole of metropolitan France with lower rates in Corsica and overseas territories). The only variation in price to be observed and exploited in this study is therefore variation over time. It has been suggested that, in the U.S., price increases were at least partially endogeneous, firms trying to make up the loss of customers through charging more on hooked ones (Showalter, 1998, Sung et al. 1994); in France, however, as in most Western European countries, tax increases have been so high and make such a substantial part of selling prices that this does not seem to be an issue and it can be safely said that price changes are exogeneous. Moreover, as shown in Kagan and Vogel (1993), anti-smoking policies in France are much less grass-rooted and much more top-down (therefore exogeneous) than in the U.S.

Taxes on cigarettes in France are proportional rather than excise, with a minimum set by the administration, at €4.50 in 2007. Proportional taxes result in increasing the price difference between the most popular (Malboro, which cost €5 per 20 cigarettes in 2006) and the cheapest brands (Fortuna or Bastos, at the minimum price of €4.50 per 20 cigarettes).

I use a series published in Hill and Laplanche (2004) of annual price index for tobacco (includes more than cigarettes: cigars, pipe tobacco and other smokeless tobacco products). Their table 1 gives the “relative” price index (deflated by the consumer price index) from 1950 to 2003. The base year is 1970 and the base value is 100. The minimum is 72.1 (in 1985) and the maximum is 206.4 in 2003, with an average of 104.4.

Graph2: Cigarette prices in France, 1950-2003



As in many other European countries the price of tobacco decreases until the mid 1980s, when it stabilizes. Starting in 1991 (Loi Evin, creating a new series for the Consumer Price Index, leaving tobacco products out), a series of public health motivated increases starts (see chart 1) and the price of cigarettes has increased 164% since then.

There is some concern that official prices do not reflect prices paid by consumers any more, due to smuggling and contraband. Prices are lower in Germany (€4.50), Belgium (€3.58), Italy (€3.12), Luxembourg (€2.90) and Spain (€2.27, source for prices is Tobacco Manufacturers' Association, 2006). According to Besson (2006), occasional purchases of cigarettes in neighboring countries by smokers living in France increased from 2% of total consumption (volumes) in 2002 to 6% in 2004 (Ben Lakhdar (2005) proposes a much higher rate of smuggling, around 12% for 2003, but the estimate relies on the difference between actual decline in sales and decline in the one department with the lowest level of decline, Côtes d'Armor). For my study, it can be said that smuggling is increasing but still of limited impact on total consumption for the period under scrutiny, and official prices can be considered an accurate reflection of prices consumers are faced with when they make their decisions to smoke. True contraband seems to be even less of a concern in France, where sales are

controlled by the state monopoly Altadis and a network of tobacconists who must get accredited by the customs administration.

Method

I do three things to empirically examine heterogeneous behaviors toward smoking and addiction due to time inconsistencies and, to a lesser extent, endogenous preferences (social capital).

First, I characterize a sub-population of time inconsistent individuals, who seem to act as quasi-hyperbolic in their time discounting: using a logistic regression, I identify the main correlates of quasi-hyperbolic discounting. This is mostly a way to control that attitude toward time discounting is not fully explained by other, more objective characteristics, such as income or education. If I found that quasi-hyperbolic discounting simply reflected low income it would mean that the questions are not well tailored to capture a psychological trait.

Second, I use the trait in a multivariate analysis of the two main decisions in smoking behavior: starting and quitting. Since I am interested in the impact of these attitudes on the duration of smoking I use a duration model setting. I predict the age at which an individual starts smoking, controlling for her or his attitude toward discounting, social status, age, sex, education, and social capital. The "failure" in this model is the age at which the individual has started smoking for ever-smokers, and the individual's age for never smokers. Since approximately half the sample never starts smoking I estimate a split population duration model (Douglas and Hariharan, 1992), combining in a single likelihood function a logistic (probability of failing) and an accelerated failure time model (duration conditional on failing). Within the category of parametric accelerated failure specifications, the split population duration model rules exponential and Weibull out (Douglas and Hariharan, 1992). After testing the quality of fit of the two remaining main specifications (Log-normal, and Log-logistic) using the likelihood criterion (AIC), I use the log-logistic specification developed by Forster and Jones in Stata ®. López-Nicolás (2002) and Douglas and Hariharan (1992) use the log-logistic specification of the split population duration model to model the starting hazard of Spanish and American youths.

I then predict the duration of smoking for ever-smokers, using not-quitting as the censoring variable, the total observed duration of the spell for ex-smokers, and the time since the individuals has started smoking for current smokers. Since everyone quits smoking eventually there is no need to use the split population duration model. I compare the goodness of fit of the four parametric specifications and chose the Weibull model, here again similar to what Foster and Jones (2001) observe for the British population, and Lopez-Nicolas (2002) for Spain.

An alternative for cessation could be to predict the probability to smoke for more than 20 years using a logistic specification but this has the main drawback of being restricted to older respondents who have been able to smoke for at least 20 years.

I enter these traits in a standard specification where hazards of starting and quitting are function of socio-economic status, education level, age (reflecting cohort since it is the age at the time of the survey), and sex. I test various specifications where variables describing individual access to social capital are entered in the models (to reflect endogenous preferences and the impact of contexts). I also try variables reflecting health status, but, since health is only measured at the time of the survey and I use retrospective data (see below), there is an obvious endogeneity issue (Schmueli, 1996).

As shown above, the use of retrospective data raises the issue of durations (before starting or quitting) heaped around specific values (multiples of 5 and 10). To control for such an effect I use a series of dummy variables for the “heaped” durations. This is one of four standard methods to handle the issue (Torelli and Trivelleto, 1993) and I choose that particular method because it has been shown to have the strongest impact on the results (Forster and Jones, 2001).

Tauras and Chaloupka (1999) argue strongly against retrospective data and recommend using prospective longitudinal data. It is certainly important to be able to use panel data in order to control for unobservable individual traits explaining a propensity to smoke and which could be correlated with other covariates. It is also important to control for the impact of health status on the decision to quit smoking. The survey I am using is meant to be a panel and the sample interviewed in 2002 was re-interviewed in 2006, with the same questions on smoking behavior.

Since I do not have any information on life expectancy at the time of the survey, I cannot test directly the hidden cost hypothesis suggested by Suranovic, Goldfarb, and Leonard (1999) as Contoyannis and Jones (2001) did.

Third, I test the impact of prices within the hyperbolic discounting sub-population and compare it to the elasticity in the general population and within the impatient population. To do this, I use the same specifications as above (split population duration model and Weibull) but, since I want to use a time-varying covariate (prices per year), I expand my sample to replicate each individual in the sample from birth to starting age (or age for never smokers) or from starting age to cessation age (or age for current smokers). This is standard practice as well (Forster and Jones, 2001). An alternative would be to include some specific prices (for given ages of the individuals, e.g. 15 and 18) in the duration model with no time-varying covariate (that is the strategy followed by Douglas and Hariharan, 1994).

Section 4: Findings

Who is quasi-hyperbolic?

Approximately 10% of the sample stated quasi-hyperbolic preferences for the present (they are patient when future choices are concerned but not for current ones). To the best of my knowledge only two studies have attempted to elicit inconsistent time preferences among human subjects using stated preferences in hypothetical scenarios similar to the ones I use (Thaler, 1981, and Ainslie and Haendel, 1983). The latter study is concerned with alcohol addicts and finds a majority of quasi-hyperbolic respondents. The former uses a sample of students who volunteered to answer the survey and finds wide variation among subjects even though the median results seem to indicate a majority are quasi-hyperbolic. Clearly, the proportions are sensitive to the amounts and the time horizon proposed in the survey.

As shown in table 3 below, it is more an individual trait than the mere reflection of some objective observable characteristic: the pseudo R2 is low in a logistic regression where stating quasi-hyperbolic preferences is the dependent variable and socio-demographics are the independent; SES and sex are never associated with these preferences. Because there are no gender differences in stating quasi-hyperbolic preferences, and I am interested in testing differences across time preferences, I pool males and females in the analyses. The only objective characteristics weakly associated with stating quasi-hyperbolic preferences are as follows: being in the “low income” category increases the likelihood to state quasi-hyperbolic preferences, as well as being educated above secondary level. Younger individuals seem to be more prone to stating quasi-hyperbolic preferences. Overall, however, there is much individual variation in these preferences and it is worth studying its relationship with the decision to smoke.

Table 3: Determinants of stated quasi-hyperbolic preferences.

Logit estimates — Number of obs = 10875
LR chi2(12) = 310.23
Prob > chi2 = 0.0000
Log likelihood = -3240.8072 — Pseudo R2 = 0.0457

Variable	Coef.	Std. Err.	z	P>z
age	-.0337	.0026	-13.15	0.000
male	.0389	.0771	0.51	0.614
income: low	.1817	.0749	2.43	0.015
income: dnk	-.1731	.1125	- 1.54	0.124
education: primary	-.2276	.0946	- 2.41	0.016
education: secondary	-.1758	.1023	- 1.72	0.086
SC: self-employed	-.0405	.1665	- 0.24	0.808
SC: semi-skilled non manual	-.1550	.1190	- 1.30	0.193
SC: unskilled non manual	-.0913	.1275	- 0.72	0.474
SC: skilled manual	-.3735	.1536	- 2.43	0.015
SC: unskilled manual	-.3243	.1700	- 1.91	0.057
SC: never active	-.0057	.1671	- 0.03	0.973
_cons	-.5434	.1514	- 3.59	0.000

Unpublished material from a study conducted by Florence Naudin (at IRDES, Paris, at the time she conducted it) suggests that stating quasi-hyperbolic preferences is linked to other opinions and preferences: she builds a typology of opinions about the opportunity of launching prevention campaigns, adding medical information on the health insurance card, introducing reference pricing for drugs etc. and finds six categories (well informed and favorable, well informed and opposed, well informed and don't know, ill informed and opposed, ill informed and don't know, and motivated by the drug policy only and opposed). Interestingly, the well informed and opposed to prevention and medical information do not differ from the whole population on most socio-demographic variables, including self-rated health and health related behaviors, but this is the category where quasi-hyperbolic preferences are more often stated (personal communication)

This link between quasi-hyperbolic preferences and a variety of opinions indicates that time preferences are not merely a consequence of being a smoker (pure endogeneity case), but seem to reflect a more general psychological trait. Of course, more research is needed in order to elicit psychological differences in time preferences through general surveys.

Impact of time preferences on the hazard of starting smoking

This first table of results checks the validity of the approach: coefficients have the expected signs and my results are qualitatively similar to those of previous studies. The shape coefficient is positive, signaling that the hazard first increases then decreases with age. The reference case is a skilled non manual female with post-secondary education. The probability to start ever is higher for skilled and semi-skilled non manual socio-economic status as well as for skilled manual individuals, but socio-economic status has no bearing on the age of initiation (except for never active individuals who tend to start older when they start); education tends to decrease the probability to start, and delay the onset (low education individuals show an accelerated failure in the table). Males tend to be ever-smoker significantly and strongly more than female and they start younger as well. Older generations tended to smoke less often and later in life.

The same model estimated on the sub-population with time preference answers (respondents to the telephone interview) yields the same results (coefficients and significance). Hence, any impact of the variables measuring heterogeneity in time preferences stem from these variables rather than from the selection process.

Table 4: Starting age, all observations for year 2004

Method: Split Population Duration Model – log-logistic and logistic.

* for the 10% level, ** is for the 5% level, and *** indicates the coefficient is significantly different from 0 at the 0.1% level, When the level is higher than 10% but the statistics is greater than 1, I indicate the level.

Number of obs = 12624
Wald chi2(10) = 632.56
Log likelihood -26008
Prob > chi2 = 0

	Coef.	Std. Err	z	P>z
duration				
Sc1	0.033	0.018	1.86	*
Sc3	-0.009	0.014	-0.66	
Sc4	0.011	0.015	0.75	
Sc5	0.004	0.015	0.24	
Sc6	0.010	0.018	0.52	
Sc7	0.141	0.022	6.33	***
Male	-0.038	0.009	-4.29	***
Lnage	0.288	0.012	23.43	***
primary	-0.036	0.010	-3.49	***
secondary	-0.013	0.011	-1.12	26%
_cons	1.962	0.049	40.31	***
logit				
Sc1	-0.489	0.090	-5.43	***
sc3	-0.026	0.074	-0.35	
sc4	-0.222	0.080	-2.79	***
sc5	-0.033	0.084	-0.39	
sc6	-0.333	0.099	-3.37	***
sc7	-0.984	0.123	-7.98	***
Male	0.888	0.046	19.32	***
Lnage	-1.100	0.067	-16.44	***
primary	0.109	0.057	1.89	*

secondary	0.362	0.067	5.43	***
_cons	3.812	0.265	14.38	***
Shape				
_cons	0.161	0.002	79.09	***

Adding time preferences does not change the coefficients for the socio-demographic variables.

Table 5: coefficients and significance for time preferences (reference = patient, other is included in the model, but not presented here).

Model	Hyperbolic		Impatient	
	Duration	Probability	Duration	Probability
Year 2004 only (n = 6,010)	NS	+0.296 ***	+0.031 **	NS
Year 2002 and 2004 (n = 10875)	NS	+0.233 **	+0.029 ***	NS

Stating quasi-hyperbolic preferences is associated with a higher probability to start smoking, but does not make any difference in the age at which the individual starts smoking; both results are as expected. The correlation is of the same order of magnitude as what I observe for education. From a policy perspective, this result indicates that quasi-hyperbolic individuals might be at risk of smoking even though they might regret it later on, hence some kind of intervention is needed; however, quasi-hyperbolic preferences cannot be traced to a specific starting age and it is therefore not feasible to use age-specific restrictions of access to deter quasi-hyperbolic individuals from starting smoking.

Stating impatient preferences is, rather unexpectedly, associated to an older age at starting smoking, and has no impact on the probability of ever smoking. To the best of my knowledge, this study is the first published attempt at measuring the impact of impatience on the behavior of starting smoking in the general population[3], and it casts some doubts on the generally admitted idea that a high discounting of future events is the main reason why rational individuals make the wrong decision to start smoking when they are young. Since it is one

[3] Reynolds et al. (2003) observe 55 teen-agers (age 14 to 16) and conclude to the absence of any correlation between the discount rate and being a regular smoker (as opposed to never have been a smoker).

strong justification for taxing cigarettes (or restricting access to young adults), my results suggest that taxes and restrictions may miss their target population (youths with high discount rate) and uselessly harm smokers with a reasonable time discounting rate.

Results for the last category (others, who are patient now but impatient in the future) are not detailed here but they indicate that stating such preferences is linked with a higher probability of smoking but with starting older as well, both at the 10% level.

Adding dummies on specific durations (10s and 10s+5) to correct for heaping values in recollection data changes the magnitudes but not the qualitative conclusions: stating quasi-hyperbolic preferences still has no influence on the starting age and the coefficient on participation (probability to ever start) is +0.232 instead of 0.233 (still highly significant). Stating impatient preferences delays the age at starting even more when recall errors are controlled (the coefficient is now +0.074, significant at the 0.1% level) and has no effect on participation. The “other” category also behaves the same as when heaping is not corrected for. All dummies are significant at the 5% level at least, except for duration 25 years.

Entering self-assessed health, lack of sense of control at work and trust in the community as supplementary variables (based on the sample for 2004 only since the social capital variables are not available in 2002) does not change the association between quasi-hyperbolic and impatient individuals and both the probability of and age at starting smoking. Lacking sense of control at work at the time of the survey is associated with a lower (counter-intuitive) probability to start smoking (at the 11% level), as is the sense of trust in the community (similar magnitude, at the 10% level). Associations between social capital and the age at starting smoking are weak, individuals with more trust in their community now being also among those who start earlier (but the coefficient is significantly different from 0 at the 31% level only). Being now in “poor” (note smaller than 8 on a 0-10 scale) health is associated with a higher probability of starting and at a younger age, but reciprocal causality is obviously an issue here (Schmueli, 1996).

Impact of time inconsistencies on the hazard of quitting

Table 6: **Hazard of quitting smoking - all observations (ever-smokers) for the year 2004**

Accelerated time failure, Weibull specification.

*** indicates the coefficient is significantly different from 0 at the 0.1% level, ** is for the 5% level, and * for the 10% level. When the level is higher than 10% but the statistics is greater than 1, I indicate the level.

			Number of obs =	5839
			Lr-chi2(11) =	318.38
Log likelihood	-5844		Prob > chi2 =	0
	Coef.	Std. Err.	z	P>z
Weibull				
Sc1	0.051	0.539	0.94	
Sc3	-0.075	0.041	-1.81	*
Sc4	0.083	0.049	1.69	*
Sc5	0.130	0.049	2.64	***
Sc6	0.184	0.066	2.80	***
Sc7	-0.112	0.087	-1.28	20%
Male	0.054	0.031	1.74	*
Lnage	-0.195	0.082	-2.37	**
primary	0.132	0.035	3.74	**
secondary	0.058	0.039	1.49	14%
Yearstart	-0.019	0.002	-9.80	***
_cons	4.843	0.400	12.10	***

Here again, findings are in line with those of previous studies based on populations in the US, Spain, and the UK: compared to a skilled non manual female with post-secondary education males and less educated smoke longer. Individuals of lower socio-economic status tend to smoke longer as well, except semi-skilled non manual, and, marginally significant, never in the labor force, who quit earlier. Older generations used to quit earlier.

Dropping observations without stated time preferences (keeping the 2,864 respondents to the telephone interview only) and re-running the same model (same covariates) changes some qualitative results: the two socio-economic statuses quitting earlier now show non significant difference with skilled non manuals and the logarithm of age is no longer significant. Males still quit later but the effect is now marginally significant only (z-statistic of 1.14 only). Adding time preferences does not change the effect of socio-demographic variables.

I expect respondents stating quasi-hyperbolic preferences to quit later in life (which might indicate regrets) and results confirm it, albeit marginally: pooling surveys for 2002 and 2004 allows me to show a positive coefficient for the dummy variable 'quasi-hyperbolic' preferences, at the 11% level. The coefficient hardly makes it to significance, but it is important to note that it is very robust to changes in specifications: I drop and add variables, but the coefficient remains almost constant around +0.07. This is approximately the same magnitude as the correlation between secondary education only and age at quitting smoking.

When controlling for heaping of rounded off values, the coefficient is still positive, but somewhat smaller (0.04 instead of 0.07) and, as a result, the z-statistic is quite low (at 0.85). All dummies for duration are highly significant. Therefore, there is a possibility that stating quasi-hyperbolic time preferences is associated with delayed quitting but the result is sensitive to specifications and requires further investigation, possibly involving a refined method for assessing inconsistent time preferences.

The coefficient on the dummy for stating impatient preferences, to the contrary, bounces around 0 and is influenced by the other variables added to control it. Interestingly, once social capital variables are entered, the coefficient on impatient preferences is consistently insignificant.

The two social capital variables have expected signs and large absolute values (same as quasi-hyperbolic time preferences for sense of control at work, and double for trust in the community). These findings show that the observation reported in Lindstrom (2004) that social capital is associated with the probability of being a smoker at the time of the survey has to do with social capital facilitating cessation rather than with preventing starting. This supports once

again the idea that public health policy should concern itself with helping smokers who have difficulties quitting rather than preventing all potential smokers to ever start.

Table 7: Impact of time preferences on time to quit:

Accelerated time failure, Weibull specification.

*** indicates the coefficient is significantly different from 0 at the 0.1% level, ** is for the 5% level, and * for the 10% level. When the level is higher than 10% but the statistics is greater than 1, I indicate the level.

Model	Hyperbolic	Impatient	Other variables
Year 2004 only (n=2864), SES, education, gender, and age	+0.068 (31%)	-0.069 (14%)	
Years 2002 and 2004 (n=5316), SES, education, gender, and age	+0.089 (11%)	-0.041 (25%)	
Year 2004 only, age and sex (n=2864)	+0.080 (24%)	-0.008 (NS)	
Year 2004 only, no control (n=2864)	+0.062 (40%)	+0.083 (*)	
Year 2004 only, age starting only control (n=2864)	+0.056 (45%)	+0.117 (**)	
Year 2004 only, SAH (n=2864)	+0.058 (37%)	-0.010 (NS)	Poor health: +0.080 (**)
Year 2004 only, sense of control (n=2864)	+0.061 (35%)	-0.010 (NS)	Lack of sense of control: +0.076 (*)
Year 2004 only, sense of control and trust (n=2864)	+0.063 (34%)	-0.010 (NS)	Lack of sense of control: +0.066 (*) Trust: -0.173 (***)

Time preferences and (failed) attempts to quit smoking:

I can identify an association between quasi-hyperbolic stated preferences and attempted quits. Among all current smokers, 57% have tried (and failed) to quit smoking and the number of failed attempts is 2.9 among those who tried at least once (1.8 overall, including the 0s). Controlling for social capital and the set of socio-demographic variables, the probability of attempting cessation is marginally higher among those who stated quasi-hyperbolic preferences (at the 23% level), whereas impatient respondents are less prone to trying to quit. Unconditionally to having attempted (i.e. including the 43% of 0s in the regression), the number of failed attempts to quit (for current smokers) is significantly associated with quasi-hyperbolic preferences: on average, these respondents who still smoke have tried 0.45 times more (the average is 1.8) than patient ones and it is significant at the 10% level. Restricted to conditional number of attempted (but failed) quits (average is now 2.9), being quasi-hyperbolic is associated with +0.44 attempts, significant at the 19% level.

A negative binomial regression of the number of attempts confirms a positive association with stating quasi-hyperbolic preferences, significant at the 10% level. Being impatient is not significantly associated with the number of attempts to quit.

Sense of control is negatively associated in the regression with unconditional number as the dependent variable and trust positively in the regression with conditional (strictly positive) number of attempts as the dependent variable.

Among ex-smokers, 53% have succeeded quitting at their first attempt, 20% at their second, 13% at their third, and 13% needed four or more attempts before quitting. An OLS regression cannot identify any significant association between time preferences or social capital and the number of attempts before quitting and this is confirmed in a negative binomial regression.

Impact of time inconsistencies on the price elasticity of starting

Controlling for social status, education, and sex, the price elasticity of starting smoking is estimated +0.203 (higher prices delay smoking initiation) on the sample for 2004 (expanding the pooled sample was too demanding in computation time, and I make the assumption that adding more observations would not change the qualitative conclusions). If I restrict the sample to individuals born after 1940 (I do not have prices prior to 1950), the price elasticity is +0.120 (robust standard error 0.039). This is close to what Lopez Nicolas (2002) finds for Spain (0.07) and Forster and Jones (2001) for the UK (0.08 for males and 0.16 for females).

Correcting for recall errors (heaped values) through dummy variables increases the price elasticity to 0.279 (interval [0.202; 0.355]).

The population stating hyperbolic preferences is more responsive to prices with a starting elasticity of 0.347 but it is not precisely estimated and confidence intervals overlap. Moreover, correcting for recall errors (heaped values) changes the conclusion and respondents stating quasi-hyperbolic preferences are now less price sensitive than the average population. Overall, quasi-hyperbolic preferences don't seem to bear much on the decision of when to start (recall, however, they are associated with a clearly higher probability to ever start).

Respondents stating impatient preferences are slightly more price elastic when it comes to their decision of when to start smoking, but confidence intervals (for the price elasticity, evaluated on impatient individuals and the overall population) overlap considerably and not much can be said about the difference due to impatience. This is an important result since youths' impatience is a major argument in favor of taxing cigarettes. If impatience has no clear impact on the price elasticity of starting smoking then increasing taxes to correct time preferences, especially among teens, may not be the best anti-smoking policy; moreover, this result might provide some insight on the DeCicca et al's (2002) conclusion that the price elasticity of starting smoking between grades 8 and 12 is almost 0: on one hand, teens are impatient, but impatience does not influence elasticity; on the other hand teens are subject to peer influence, can get "free" cigarettes, are less often addicted, all factors contributing to a lower sensitivity to the price of cigarettes (Chaloupka and Warner, 2000, DeCicca et al, 2000, Gruber and Zinman, 2000, Kenkel and Mathios, 2000, Emery et al, 2001)

Impact of time inconsistencies on the price elasticity of quitting

Controlling for age, social status, and education, the price elasticity of the duration before quitting is found to be -0.73 for females and -0.26 for males (an increase in prices of cigarettes accelerates the time before failure, therefore decreases the duration of the smoking spell). This is much smaller in absolute value than what Tauras and Chaloupka (1999) find for young Americans (-1.12 for males and -1.19 for females) and Lopez-Nicolas for Spain (-1.4 for black tobacco), but similar to what Forster and Jones (2001) obtain based on British data (-0.53 for females and -0.41 for males). The difference in price elasticity of quitting between males and females is much larger in France than in Britain.

With the same controls, I re-run the analysis within the population stating hyperbolic preferences and compare the price elasticity with what obtains in the rest of the sample. I do the same thing for the population stating impatient preferences.

Table 8 indicates that the population with quasi-hyperbolic preferences is much more price-sensitive in its decision to quit: even if 95% confidence intervals overlap (-0.40 to -0.27), the point estimate is more than twice as large within the population with quasi-hyperbolic preferences. Impatient individuals on the other hand are less price elastic in their decision to quit and 95% intervals almost don't overlap. The difference for quasi-hyperbolic preferences is confirmed when correcting for heaped durations: all price elasticities are closer to 0, with -0.46 among quasi-hyperbolic preferences (significant at the 5% level, interval [-0.90; -0.02] and -0.04 among non quasi-hyperbolic preferences, not significantly different from 0 (interval [-0.14; +0.06]).

Therefore, it can be concluded with some certainty that stating quasi-hyperbolic preferences is associated with being more price-sensitive when it comes to quitting smoking. However, even among quasi-hyperbolic preferences, price elasticity is quite low.

Table 8: price elasticity of quitting within various populations, controlling for socio-demographics

	Hyperbolic = no	Hyperbolic = yes
Coefficient Ln(price)	-0.40 [-0.54; -0.27]	-0.81 [-1.32; -0.29]
	Impatient = no	Impatient = yes
Coefficient Ln(price)	-0.59 [-0.78;-0.40]	-0.26 [-0.45;-0.08]

Section 5: Discussion and Conclusion

I can identify two sub-populations with specific characteristics influencing their smoking behaviors: a small population stating quasi-hyperbolic preferences for the present (which I take as a proxy for urge or dual self), and a population declaring low social capital resources.

Stating quasi-hyperbolic preferences is associated with a higher probability to start smoking but not with the age at which the individual starts. It is also associated with quitting later in life, as well as with the number of failed attempts at quitting among current smokers (but not with the probability to quit). Both findings indicate quasi-hyperbolic smokers experience regret and a higher likelihood of being hooked in that population. Interestingly, these quasi-hyperbolic smokers with regret are not heavier smokers: they smoke marginally more per day than patient smokers (+0.8 cigarettes per day, not significant). Stating quasi-hyperbolic preferences is not associated with any difference in price elasticity of starting smoking

(probability and age) but is significantly associated with being more responsive to prices in the decision to quit.

Interestingly, being impatient does not influence the probability to start smoking but delays the age at onset of smoking. It has no impact on the age at which a smoker quits smoking and impatient smokers smoke slightly less than patient ones (-0.4, significantly different from 0). They are also significantly less price responsive in their decision to quit.

Individuals with low a level of sense of control and a high level of trust have a smaller probability of starting smoking but those who start do it at the same age. As a consequence there is no clear relationship between social capital and the probability to start smoking. The same holds with conditional consumption (sense of control increases the number of cigarettes smoked but trust in the community reduces it). The relationship is clear though with the probability to quit: lower level of social capital is associated with later age at quitting smoking.

Overall these results suggest heterogeneous behaviors regarding smoking and confirm the idea that taxes might not be the best instrument to control smoking: the benefits accruing to those who might get hooked may not offset the harm caused to those who could smoke and quit without any suffering (on the concept of harm as a component in the evaluation of public heath policies, see Oxman, Lavis and Freithe, 2007). A better knowledge of the determinants of addiction to smoking would also be a useful tool of public health: if a simple test could determine who is quasi-hyperbolic and at risk of becoming hooked with regret, consumers could better regulate and control their consumption of cigarettes: some who currently abstain could enjoy a short and safe spell, whereas others who currently embark on a smoking career would avoid making the wrong decision. Similarly, targeting individuals with low levels of trust in their community or high levels of sense of control at work could be an efficient way to control the detrimental consequences of smoking in the population.

To go beyond these suggestive facts and progress toward the determination of an optimal level of tobacco taxes, I need more than clusters about time preferences. Introducing questions on actual time discount rates at various horizons (and controlling answers for risk aversion and similarity preferences) in a survey on health and smoking would allow estimating the coefficient of extra-discounting for quasi-hyperbolic individuals and the exponential discounting coefficient for all individuals. This in turn would allow calculating the costs and benefits of a tax on tobacco for various sub-populations and comparing the welfare impact of the tax with other tools of smoking prevention policies.

Another improvement would be to use longitudinal data where smoking behaviors post health shocks and statement on time preferences could be observed in a prospective way. This

would allow ruling out endogenous biases through reciprocal causality in the estimation of price elasticities and the impact of various non rationalities (endogenous preferences and time inconsistencies).

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