

# THE EFFECT OF CIGARETTE PRICES AND ANTISMOKING POLICIES ON THE AGE OF SMOKING INITIATION\*

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## ABSTRACT

This study differs from most previous studies on smoking initiation by studying the *age* of smoking onset, and not merely smoking initiation. We apply duration analysis to estimate the determinants of the age of smoking initiation by using data from a questionnaire mailed to a sample of smokers in Sweden. We examine the impact of individual characteristics and public policies such as laws, regulations and cigarette prices, on the age of smoking initiation. Public policies do not show a significant effect on the age of smoking initiation. However, since the effects are difficult to measure, the insignificant parameters of public policies should be interpreted with caution. The significance of time trend might reflect long term effects of public policies. We also discuss the effects of public policies at some length in light of our results. Moreover, we find that men start smoking at younger age than women, and that smokers with smoking parents start at a younger age than smokers with non-smoking parents.

**Key words:** Age of starting smoking, duration analysis, policy

**JEL classification:** C41, I18

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# 1 INTRODUCTION

Thousands of, in particular, young individuals start smoking every year in Sweden and this pattern is viewed as a social and economic problem. The decision to start smoking is different from most other decisions in life, since it may result in a harmful addiction and adverse health effects later in life. Several economic models have been proposed to explain consumption of addictive goods. The most common is the rational addiction model by Becker and Murphy (1988), where rational consumers maximize their lifetime utility when addictive goods exist in the consumption bundle. This approach has been developed by e.g. Orphanides and Zervos (1995), who introduce uncertainty related to the harm of addictive goods due to unfamiliarity. Their extension may provide explanations for why individuals experiment with these types of goods, only to regret it later. Suranovic et al. (1999) add a bounded rational behavior into the traditional rational addiction model, by assuming that individuals maximize their utility of today's consumption rather than over their total lifetime and, thus, this resembles a myopic approach. In a related paper, Gruber and Köszegi (2000) discuss present biased time inconsistent preferences in the rational addiction framework, and point out that the importance of harm to future own health (internalities) is not fully considered in the rational addiction model. Basically, the developments of the rational addiction model try to capture myopic behavior and time inconsistent preferences, which in particular surround teenagers' decision to pick up the habit of smoking.

There is a widespread policy maker concern about the individuals who start smoking and thus it is of interest to investigate the determinants of smoking initiation in order to be able to affect this pattern. In particular, what effects do policies such as information campaigns, taxation, laws and regulations have on smoking initiation. A growing amount of literature in economics examines smoking participation. The majority of these studies have used cross-section data, where a significant negative relationship between price and participation has been found.<sup>2</sup> Only a few studies have analyzed longitudinal data and these have in most cases found no significant effect of cigarette prices on smoking initiation (e.g. DeCicca et al., 2001). Tauras et al. (2001) state three possible reasons for the insignificant price effects; recall bias, mismatch

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<sup>2</sup> See Chaloupka and Warner (2000) for an overview of the determinants of cigarette demand.

between price and location (this is especially the case in the US as it may be difficult to match state cigarette prices/taxes and place of residence) and youth access restriction. In addition, the transition from a non-smoker to a smoker may also be explained by personal characteristics of individuals, e.g. parental smoking and peer group effects (Leibenstein 1950, Lewit et al 1981) and general trends in society such as fashion and awareness of health risks related to smoking.

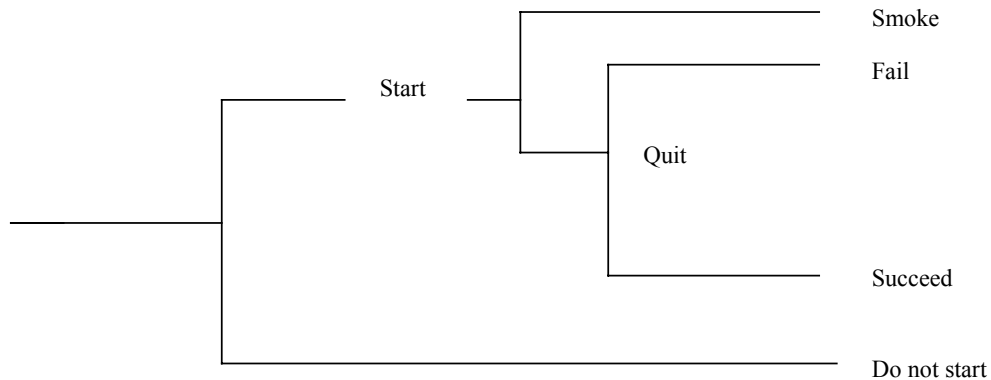
The objective of this paper is to, by means of a duration analysis, analyze the determinants of the age of smoking initiation amongst youth and young adults from a Swedish sample consisting of smokers and previous smokers. We follow the split population duration approach as in Douglas (1998), Douglas and Hariharan (1994) and Forster and Jones (2000), but we only concentrate on the duration part, which analyses the age of smoking initiation conditional on becoming a smoker. Particularly, we study the effect of public policies such as cigarette prices, laws and regulations on the age of smoking initiation, information campaigns and personal characteristics. Thus, our paper differs from previous ones since we make explicit use of the possibility of disentangling these effects in a duration analysis, with a particular focus on the age of smoking onset. In the empirical part of the paper, we use data from a postal survey in Sweden.

The remainder of the paper is organized as follows. In Section 2, we give an overview of previous research on the determinants of smoking initiation. Section 3 describes the data and provides an overview of cigarettes prices, laws and regulations and information campaigns in Sweden. In Section 4 we discuss potential econometric models along with issues regarding the model specification and in Section 5 we present the results from the estimations. Finally, Section 6 concludes the paper.

## 2 BACKGROUND

Jones (1995) provides an overview of the decisions analyzed in relation to smoking; whether to start smoking, to attempt quitting, and to succeed in quitting (see Figure 1).

Figure 1. Decision tree of smoking decision



These three discrete choices have been analyzed by using binary choice models. However, it may be of interest to study not only whether or not a transition takes place, but also the time that elapse before any of these events take place, and in the latter case duration analyses have been used. In this paper we concentrate on the “start-smoke” branch in Figure 1, and in particular on the age of smoking initiation and its determinants conditional on becoming a smoker.

The economic literature on smoking initiation consists of two main streams of quantitative research. First, cross sectional studies, which use binary choice models in the analysis of smoking participation, suggest strong evidence of a negative relationship between smoking initiation and price on cigarettes (e.g. Lewit and Coate 1982; Chaloupka and Wechsler 1997).<sup>3</sup>

The second stream of research has used duration models to analyze smoking initiation, where the focus is on the duration before an individual starts smoking. Douglas and Hariharan (1994) and Douglas (1998), using the American *National*

*Health Interview Survey*, find no evidence that higher prices of cigarettes would have an impact on teenager smoking initiation. However, Douglas and Hariharan (1994) find that higher lifetime educational attainment and being a female increase, the age of smoking initiation. Using panel data from *National Education Longitudinal Survey* of 1988, where the respondents were interviewed in 8<sup>th</sup> grade, and then were re-surveyed twice with a two-year interval, DeCicca et al (2001) suggest a negative relationship between taxes and smoking initiation. This effect, though, disappears when accounting for differences among states. Forster and Jones (2000) use retrospective data on smoking related behavior from a representative sample of individuals over age 18 in the UK using the *Health and Lifestyle Survey*, and they estimate the tax elasticity of the age of smoking initiation to +0.16 for men and +0.08 for women.<sup>4</sup> Their analyses do not include any information on public policies such as information campaigns, laws and regulations, but by using a fourth polynomial of the calendar years they may control for exogenous events such as changes in these policies as well as general changes in attitudes over time, e.g. changes in the awareness of adverse health effects from smoking. Tauras et al (2001) use data on three cohorts of students enrolled in 8<sup>th</sup> and 10<sup>th</sup> grade, and up to three follow-ups with two-year intervals. They find that price elasticities of smoking initiation vary substantially depending on the consumption measure, where the price elasticity of smoking initiation with respect to “any kind of smoking behavior” is estimated to -0.271, -0.811 with respect to smoking 1-5 cigarettes a day, and -0.955 for at least ½ pack per day. They also include youth access laws and find that these policies decrease the number of youths that start smoking.

Moreover, there have been several studies that have focused primarily on the effects of different public policies on smoking behavior. Lewit et al. (1981) and Saffer and Chaloupka (2000), find that tobacco-advertising bans are effective in reducing smoking participation. A closer investigation is provided by Saffer and Chaloupka

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<sup>3</sup> Lewit and Coate (1982) estimate price elasticities for participation by age; -0.74 for individuals 20-25, -0.44 for individuals 26-35, -0.15 for individuals over 35 years, i.e. the younger the person the more sensitive to price changes. Chaloupka and Wechsler (1997) estimate the average price elasticity of participation among college students to fall between -0.520 and -0.536.

<sup>4</sup> An advantage with their study compared to the US studies is that the taxation on cigarettes is homogenous in the UK. Since the level of taxation on cigarettes and, hence, prices of cigarettes differ across states, there is a potential problem using retrospective data in the US if you do not account for migration, in which case a complete record of the places of residence is required in order to match prices of cigarettes with the place of residence.

(2000), who conclude that a *comprehensive* ban on tobacco advertisement can reduce tobacco consumption, while a *limited* ban will have no or small effects. Hu et. al. (1995) argue that the tobacco industry responds to information campaigns by increasing other advertising activities and lobbying, which thus reduces the effect of these campaigns.<sup>5</sup>

There are also a number of studies on the effects of other types of smoking restrictions such as smoking bans in the workplace. Evans et al. (1999) show that smoking participation is lower at workplaces with smoking bans, and that the bans per se are likely to have caused the lower smoking participation and not a result of a sample selection. Several other studies (e.g. Wasserman et al. 1991, Chaloupka and Saffer 1992, Ohsfeldt et al. 1999) show that stricter restrictions induce a lower smoking prevalence. It should also be mentioned that implementation of smoking regulations can induce social norms that change attitudes towards smoking (e.g. Nyborg and Rege, 2000).

### 3 DATA

#### 3.1 SURVEY

The data was gathered using a questionnaire<sup>6</sup> that, in the fall of 2000, was mailed to 935 individuals in the counties of Norrbotten and Västerbotten in the northern part of Sweden. All subjects had been identified as smokers in a previous study.<sup>7</sup> Seven questionnaires were returned as undeliverable because the individuals had moved. The overall response rate was 57%, or 527 respondents.

The measure of the starting age is based on the answer to the question “*How old were you when you started to smoke every day?*”. In the sample, the age of smoking initiation varies from 7 to 57 years. Since our focus is on the effect of cigarette prices and public policies on the age of smoking initiation among youth and young adults, we

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<sup>5</sup> For a discussion on and a review of studies on tobacco advertisement, see Saffer (1998). See Ringold and Calfee (1989), Cohen (1989) and Pollay (1989) for a discussion on how the informational content in cigarette advertisements change with contemporary health concerns.

<sup>6</sup> The questionnaire consists of four parts: (i) questions on smoking habits, health risks, social context of the smoking behavior and attitudes towards anti-smoking policies, (ii) a choice experiment evaluating hypothetical policies, (iii) a contingent valuation experiment on health risks associated with smoking and (iv) socioeconomic questions.

<sup>7</sup> The sample was identified in a study on the health effects of moist snuff by Kjell Asplund at Umeå University Hospital, from whom we obtained the sample register.

restrict our analysis to individuals who were older than 9 when they started smoking, since individuals younger than 10 are probably less affected by information campaigns. In our sample only one individual started at an age younger than 10. On the contrary, older individuals are clearly aware of the health risks, i.e. less sensitive to policies, and moreover are probably less sensitive to changes in the price level. It is likely that there were other factors in life that turned them into habitual smokers. For these reasons, individuals who were 25 or older when they start smoking are excluded (43 individuals). Moreover, we also exclude smokers born before 1935 (51 smokers) and after 1965 (23 smokers). In the former case due to lack of price data from before 1945, and in the latter case there are too few respondents in this particular segment of the sample, which would then make the estimations sensitive to single observations. Finally, due to non-item responses 24 smokers are excluded. Thus, the final sample includes 385 individuals.

### 3.2 TOBACCO CONTROL POLICIES IN SWEDEN ADDRESSING SMOKING ONSET<sup>8</sup>

In Sweden, several public policies have been implemented over the last decades, and one important objective of these has been to prevent individuals from *starting* to smoke. The expected effect of these policies on the decision to start smoking can be separated into two groups: some individuals who potentially would start smoking without policies will not start and some individuals will delay their decision to start. There are typically two options available for the government to affect the smoking decision namely public policies such as information, laws and regulations and prices.

In the early 20<sup>th</sup> century, temperance and religious movements tried to inform and influence public opinion against the use of tobacco, but since the middle of that century active policies targeting smoking related behavior have been undertaken. The non-governmental work was, in 1955, concentrated into National Association against Tobacco (RMT), later renamed the National Association for the Enlightenment of Tobacco's Harmful Effects (NTS).<sup>9</sup> In 1960, the Swedish tobacco monopoly published the fact that carcinogenic substances had been identified in tobacco smoke. From the beginning of the 60s, the government started sponsoring information campaigns aimed

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<sup>8</sup> This section is based upon Magnusson and Nordgren (1994) and Tobaksfakta (2001)

<sup>9</sup> Riksförbundet mot tobaken (RMT), later renamed Nationalföreningen för upplysning om tobakens skadeverkningar (NTS)

at communicating research results on the health consequences of smoking to the general population. In 1964, an information campaign directed towards children and youth was performed, primarily by distributing free teaching aids to all schools in Sweden. In 1974, VISIR - VI Som Inte Röker (We who do not smoke) - was established, which is a popular movement promoting smokeless environments and targeting children in particular.<sup>10</sup> In 1977, a new law was established, requiring the content of certain harmful substances to be declared on the tobacco packets.<sup>11</sup> In 1979, a law (1978:764) was introduced to temperate marketing of tobacco. In practice, this meant that advertisements now had to include health warnings and declarations of cigarette contents. In 1979, an independent organization, A Non-Smoking Generation, was founded, and its aims were to inform and inspire children and adolescents not to use tobacco. The activities of the organization included efforts to affect the public opinion by information and programs in schools, campaigns and at entertainment and sporting events. General guidelines on how to limit tobacco smoke in public premises were published in 1983 (AFS 1983:10). In 1986, the marketing laws were tightened by restricting marketing to fewer places. It should be noted that during the period studied in this paper there were no youth access laws in Sweden. Below in Table 1, we summarize the major public policies from 1945-1989.

**Table 1.** Policies in Sweden 1945-1989

Year	Policy	Type
1955	RMT established	Information
1960	Tobacco Monopoly Information brochure	Information
1964	Government subsidized information directed towards children	Information
1974	VISIR	Information
1976	WHO report	Information
1977	Declaration of contents	Tighter marketing laws
1979	Laws on marketing of tobacco	Tighter marketing laws
1979	A Non-Smoking Generation	Information
1983	General guidelines on how to limit tobacco smoke in public premises	Regulation
1986	Laws on marketing of tobacco tightened	Tighter marketing laws

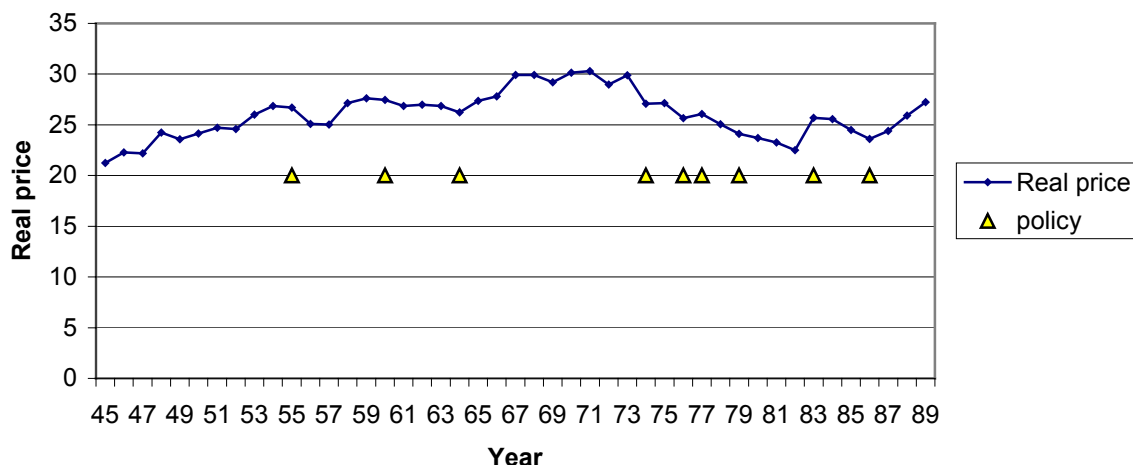
Figure 2 plots the real price of a pack of twenty cigarettes at the 1995 price level for the period 1945-1989. Moreover, in order to see the co-variation between public policies

<sup>10</sup> Publications of international official reports, describing health damages from smoking, include Royal College Of Physicians (1962) and US Department of Health, Education and Welfare (1964).



and cigarette prices, we also indicate the “policy years” from Table 1. Since the first policy in 1955, information campaigns and new laws and regulations have been implemented when prices are relatively low. This is an interesting aspect, especially if there is a negative correlation between smoking initiation and cigarette price.

**Figure 2.** Real price of a pack of twenty cigarettes, 1945-1989 (in 1995 price level)



Source: SCB (various issues)

### 3.3 DESCRIPTIVE STATISTICS

In the analysis of the determinants of smoking initiation, we use three sets of covariates: personal characteristics, public policies and a time trend. Several studies have indicated that the age of starting may differ between genders, and we therefore control for gender by creating the variable *MALE*. Furthermore, previous studies have indicated that parental smoking behavior may be an important covariate. Hence, we create the dummy variables *MUMSMOKE* indicating that only the mother smoked, *DADSMOKE* if only the father smoked and *BOTHSMOKE* if both parents smoked. In order to study if there is a socio-economic gradient, we classify the respondents into social classes. The main occupation of a respondent’s parents during the respondent’s childhoods is used to determine the social class rather than the respondent’s current social class, since it is important that the covariates are exogenous to the decision to start smoking. Using, for instance, the highest obtained academic degree or the current social class of the

<sup>11</sup> See SFS 1996:941 for how marketing is regulated in Sweden.

respondents, could be problematic due to the risk of endogeneity and, moreover, social class mobility is not uncommon in Sweden. A similar approach was applied in Tauras et al (2001) as they use extensive information on parental characteristics as covariates. The social class background, where the social class is determined by the highest social class of his/her parents, shows that around 18% belonged to either social class I or social class II, both of which consist of white collar workers, while the remaining 82% belonged to social class III workers (blue collar workers). Thus, the dummy variable *SOCWHITE* indicates that at least one of the respondent's parents belonged to either social class I or social class II during the respondent's childhood. Furthermore, we want to test the hypothesis of whether the public policies have significant effects on the age of smoking initiation. *LNPRICE* is defined as the logarithm of the average price of twenty cigarettes deflated by the consumer price index, and *PRICE CHANGE LAST YEAR* and *PRICE CHANGE NEXT YEAR* measure percentage price changes between lagged and current price on one hand, and current and leaded price on the other. In Sweden there is a common cigarette price throughout the country and thus there is no mismatch problem as discussed in Tauras et al (2001). Furthermore, in order to be able to identify campaign years and when laws and regulations were introduced, we create a covariate called *POLICY*. We also separate this variable into *INFO* (information campaigns) and *LAW* (laws and regulations). Furthermore, *INFOYEAR+1*, *INFOYEAR+2* and *INFOYEAR+3* measure lagged effects of campaigns. Tighter smoking bans are not included in our study (even though these, of course, could be relevant policies) since the first formal regulation on these issues came into effect in 1993. During the period studied, there may also have been general changes in the attitudes towards smoking, which may be caused by changes in fashion and by increased awareness of the health effects from smoking, and this may have an effect on the age of smoking initiation. Furthermore, the number of voluntary agreements regarding smoking bans in public transportation, workplaces, schools, theatres, cinemas and at concerts have been increasing, especially from the early eighties, which may also have an impact. Hence, it is important to control for and separate out general trends from the impact of the other covariates on the age of smoking initiation. We therefore create the variable *YEAR*, which is defined as calendar year minus 1900. We also create the variable *YEARSQ* by raising the variable *YEAR* to the power of two and then

dividing it by 100 and *YEARCUB* by raising the variable *YEAR* to the power of three and dividing it by 10000, to allow for differences over time and to pick up general changes over time. Forster and Jones (2000) motivate their choice of including a time trend by capturing the secular trend in smoking participation, particularly associated with the cumulative impact of increased awareness of the health risks of smoking since the early 1960s and changes in perceptions of smoking over time. In Table 2, we present the descriptive statistics of the covariates used in the analysis.

**Table 2.** Descriptive statistics

Covariate		mean	Std	min	max
PRICE	the average price of twenty cigarettes deflated by the consumer price index	26.016	2.281	21.251	30.299
PRICE CHANGE LAST YEAR	$(PRICE_t - PRICE_{t-1})/PRICE_t$	0.005	0.044	-0.103	0.123
PRICE CHANGE NEXT YEAR	$(PRICE_t - PRICE_{t+1})/PRICE_t$	-0.007	0.045	-0.141	0.093
MALE	=1 if male, zero otherwise	0.410	0.493	0	1
DADSMOKE	=1 if only the father smoked, zero otherwise	0.301	0.459	0	1
MUMSMOKE	=1 if only the mother smoked, zero otherwise	0.101	0.302	0	1
BOTHSMOKE	=1 if both the father and the mother smoked, zero otherwise	0.184	0.388	0	1
SOCWHITE	=1 if social class I or II, zero otherwise	0.184	0.388	0	1
POLICY	=1 if a policy, zero otherwise	0.200	0.405	0	1
INFO	=1 if an information campaign, zero otherwise	0.133	0.344	0	1
INFOYEAR+1	=1 if an information campaign, zero otherwise	0.133	0.344	0	1
INFOYEAR+2	=1 if an information campaign, zero otherwise	0.133	0.344	0	1
INFOYEAR+3	=1 if an information campaign, zero otherwise	0.133	0.344	0	1
LAW	=1 if a new law or regulation, zero otherwise	0.089	0.288	0	1
YEAR	Calendar year -1900	67.000	13.134	45	89
YEARSQ	$(\text{Calendar year} - 1900)^2/100$	46.577	17.665	20.250	79.210
YEARCUB	$(\text{Calendar year} - 1900)^3/10000$	33.467	18.345	9.113	70.497

## 4 MODELING APPROACH

How can one explain the age of smoking onset? An individual starts smoking at age  $t$  if the sum of current benefits and costs and expected future benefits and losses are greater than zero. Current net benefits include effects such as peer group, social approval/disapproval, cigarette prices, exposure to advertisements and other smokers etc. Current disutility from future losses typically includes adverse health effects from smoking. Thus, it is possible that the perception of future losses depends on information, where information campaigns and laws and regulations may be important. Finally, withdrawal costs, meaning the discomforts that arise when consumption is

reduced or eliminated, are zero before addiction is built up (Suranovic et al 1999).<sup>12</sup> Although in a reduced form, we test what effect cigarette prices (affecting current benefits), information campaigns and stricter regulations (affecting current benefits and expected future losses), gender, socioeconomic status when growing up and parental smoking habits (affecting current benefits) have on the age of smoking onset.

The probability that an individual has started smoking at age  $t$  can be written as  $F(t)=\text{Prob}(T<t)$  and, consequently, the probability that an individual has not started smoking at that age is given by the survival function  $S(t)=1-F(t)$ . The hazard rate describes the likelihood that an individual starts smoking at age  $t$  conditional on him/her being a non-smoker at age  $t-1$ , such that

$$\lambda(t) = \frac{-d \log S(t)}{dt} = \frac{f(t)}{S(t)}, \quad (1)$$

where  $f(t)$  is the density function. The hazard function provides a convenient way to summarize the probability of smoking initiation, conditional on that the individual not having already started at a younger age. There are several possible parametric models to choose among. The Weibull model assumes the hazard rate to be either monotonically increasing, monotonically decreasing or constant with age, which describes that individuals are either more likely to start smoking the older they are conditional on still being a non-smoker, less likely and the same, respectively. The exponential model assumes a constant hazard rate and is thus nested in the Weibull model. A log-logistic or a lognormal model allows for non-monotonic hazard rates. These models follow the shape of an initially increasing hazard rate followed by a decreasing hazard rate. Finally, a very flexible specification is obtained by using the generalized gamma model, which nests all the mentioned models, except the log-logistic model.

Another problem to consider is the unobservable sources of heterogeneity that may affect the hazard rate and if present, may result in inconsistent parameter estimates. This becomes apparent when different individuals have potentially different survival distributions, meaning that the age of smoking initiation is generated by different stochastic processes. To some extent we may control for heterogeneity by including covariates, but unobservable heterogeneity may still exist, for example related to peer

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<sup>12</sup> Fenn et al (2001) test if smokers turned “rational” after 1979 when addictive characteristics became publicly communicated by the 1979 Surgeon General, but find that smokers seem to always have been

group effects. The standard econometric approach to this problem in duration analyses is to assume that an unobservable random variable enters the hazard rate multiplicatively. By assuming that the unobservable variable is gamma distributed, a parametric model with heterogeneity can be estimated. It is important to link the price and whether or not there was a public policy, to each individual and to every age when he/she was at risk of starting to smoke. This approach was applied in e.g. Douglas (1998) and Forster and Jones (2000), who link tax/price of cigarettes to individuals in this way. We follow their approach, and public policies enter as time variant covariates in our data set. In the estimation we use the same approach as in Forster and Jones (2000); by expanding the data set on the age of smoking initiation. The sample used in this study is restricted to individuals who are non-smoker at age of 9. Thus the earliest age of smoking initiation observed in the sample is therefore 10. Thus, we define the length of a spell as age-9, i.e. the analysis is conditional on the individual being a non-smoker at the age of 9.

Given the availability of several competing models, it becomes relevant to statistically compare them in order to choose a preferred model. The selection of an econometric model is a straightforward exercise in the case where the models are nested, for instance with the gamma model, Weibull model, lognormal model and exponential model, where a likelihood ratio test can be applied in the selection process. However, in our case all of the discussed models are not nested. By using Akaike Information Criterion, it is possible to compare non-nested models as well. Akaike Information Criterion, is defined as

$$AIC = -2(\log L) + 2(c + q + 1) \quad (2)$$

where  $c$  defines the number of covariates and  $q$  the number of specific parameters to be estimated in the model (Akaike, 1974).

## 5 RESULTS

We begin by studying the survival curve, which is plotted in Figure 3. The survival curve shows that the hazard rate is non-monotonic. As can be concluded from the

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“rational”, as opposed to “myopic”.

survival curve, the hazard rate increases from the age of 10 up to the age of 18-20, and then declines. This shape suggests that either a lognormal, a log-logistic or a generalized gamma distribution can be suitable for modeling the data. Moreover, we estimate models with these distributions both with and without heterogeneity. The heterogeneity is assumed to be gamma distributed.<sup>13</sup> The shape of the survival curve does not indicate any problems with recall bias in the form heaped observations as discussed in Jones and Forster (2000).

**Figure 3.** Survival curve

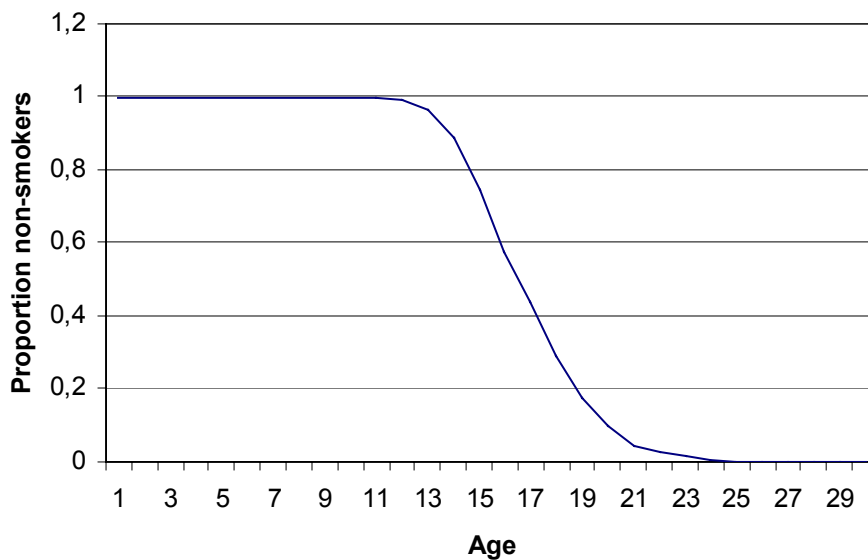


Table 3 displays the calculated Akaike Information Criterion for the mentioned six specifications. The table suggests that there is no problem with heterogeneity, as the differences in the calculated Akaike Information Criterion are close to two between the specifications with and without heterogeneity in each case, which is a result of the log likelihood function not improving.<sup>14</sup> We also experience this in the estimations as the models with heterogeneity always converged to more or less the same estimates as the models without heterogeneity. Based on the Akaike Information Criterion, we choose the generalized gamma model without heterogeneity, since it shows the lowest value.

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<sup>13</sup> We estimate the models in accelerated time failure format, which essentially means that a standard regression model is applied to the log of survival time.

**Table 3.** Akaike Information Criterion

Parametric model	Without heterogeneity	With heterogeneity
Lognormal	199.9	201.9
Log-logistic	207.5	209.5
Generalized gamma	195.3	Does not converge

We use a RESET test to check the null hypothesis of no omitted variables and/or no misspecification, by including the second power of the predicted values as an extra covariate in the model. In a Wald test, we cannot reject the null hypothesis at the 5% level (p-value 0.59). Table 4 presents the estimates from the generalized gamma model without heterogeneity.

**Table 4.** Parameter estimates from the generalized gamma distribution without heterogeneity<sup>15</sup>.

Covariate	Coefficients	P-value
LNPRICE	-0.498	0.172
MALE	-0.049	0.126
DADSMOKE	-0.024	0.518
MUMSMOKE	-0.029	0.589
BOTHSMOKE	-0.080	0.070
SOCWHITHE	0.024	0.542
POLICY	-0.057	0.151
YEAR	0.539	0.075
YEARSQ	-0.852	0.066
YEARCUB	0.440	0.063
CONSTANT	-7.354	0.280
ln( $\sigma$ )	-1.197	0.000
$\kappa$	0.337	0.016
RESET		0.586
Individuals	385	
Observations	2984	

The estimated coefficients on the socio-economic characteristics are in line with expectations. The results show that men who start smoking do so at a younger age than

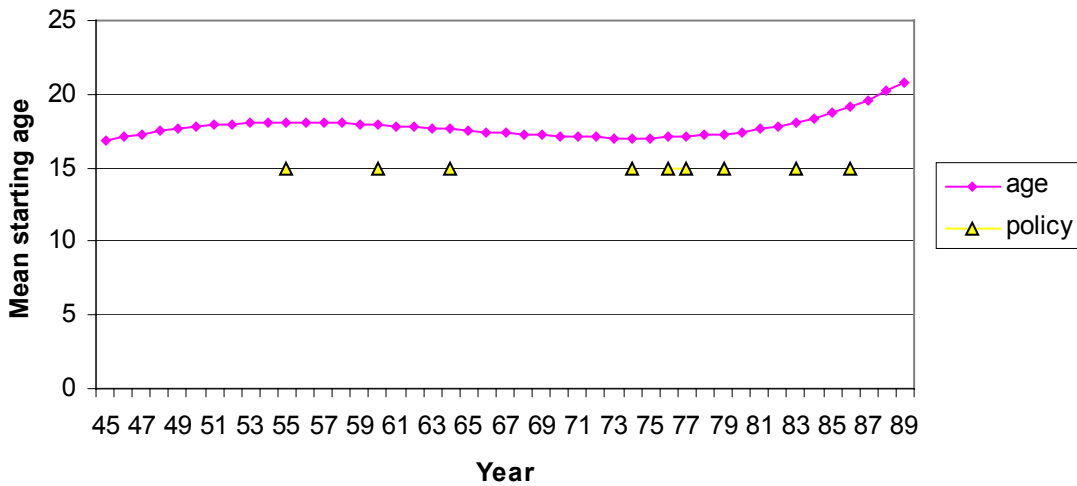
<sup>14</sup> As can be seen in Equation 2, when there is one extra parameter to be estimated, the Akaike Information Criterion increases by two.

<sup>15</sup> The generalized gamma hazard function is:

$$\lambda_i(t; x_i(t)) = \frac{\frac{|\kappa|}{\Gamma(\kappa^{-2})} (\kappa^{-2})^{\kappa^{-2}} \exp[\kappa^{-2}(\kappa z - e^{\kappa z})]}{\sigma \left[ 1 - I \left( \kappa^{-2}, \kappa^{-2} \exp\left(\frac{z}{\sqrt{\kappa^{-2}}}\right) \right) \right]},$$

women. We also find that parental smoking implies that individuals will start at an earlier age, but only if both parents are smokers (compared to when both parents are non-smokers) the effect is significant at 10% level. The social class status is statistically insignificant, and it should be noted that we let an individual's teenage years determine his/her heritage. Public policies, both in terms of cigarette prices and information campaigns, and laws and regulations, do not affect the age of smoking initiation. We do however find a significant effect of the time trend, which indicates that there are general changes that affect awareness of and attitudes towards smoking related to the age of smoking initiation, but in the short term unrelated to public policies. Figure 4 depicts the predicted mean age of smoking initiation in different calendar years, using the Table 4 estimates and the mean values of the covariates in Table 3 except for the calendar year covariates (YEAR, YEARSQ and YEARCUB). As can be seen, the starting age is lowest (below 17 years) in the beginning of the period studied and in the early seventies, while it is highest at the end of the period, reflecting some underlying changes during the time period.

**Figure 4.** Mean age of smoking initiation 1945-1989.



Our results on the socio-economic covariates are similar to previous studies, both with regards to gender differences as well as to the influence of parental smoking (e.g.

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where  $z = \frac{[\ln t - \beta x_i(t)]}{\sigma}$  and  $I(k, a)$  is the incomplete gamma function if  $\kappa \neq 0$ .



Douglas and Hariharan, 1994; Forster and Jones, 2000). The measurement of the socio-economic gradient is not comparable to the measurement used in previous studies, except for Tauras et al (2001), since we base the measure on social class status during a respondent's childhood rather than on his/her social class or his/her highest obtained academic degree – factors that are potentially endogenous, which may explain the insignificant effect we found contrary to previous studies (e.g. Forster and Jones, 2000).

Forster and Jones (2000) find positive effects of an increased tax rate on the age of smoking initiation, while our results indicate insignificant effects of changes in prices. The comparison is, however, not direct since we use price instead of tax. As Tauras et al. (2001) show, the more cigarettes an adolescent smokes (or plans to smoke), the more likely it is that increased taxes have an effect on smoking initiation. This could of course also be valid regarding the age of starting. The effects of price are stronger once an addiction is established, and the amount consumed is greater. Emery et al (2001) find that prices are likely to moderate the amount smoked and slow down the progression to addiction for adolescents, but prices have no effect when it comes to experimentation. We have not evaluated how much each individual smoked and how they paid for the cigarettes when they started their habits, which can help explain insignificant price effects. However, it may not only be the current price of cigarettes that determines smoking initiation, but also the price levels in the period before (myopic) and after (rational) that affects the age of smoking initiation. However, in a joint test of leaded and lagged prices, we cannot reject that these effects are equal to zero at the 5% level (p-value= 0.16). If we follow the Gruber and Köszegi (2000) arguments that a tobacco tax should also correct for “internalities,” and thereby correct for young people's possible misperceptions and time inconsistencies,<sup>16</sup> the level of tax could be increased. Moreover, if it were possible to decrease youth smoking, we would also have less adult smokers (Gruber 2001).

The parameter of campaigns and new laws, measured by POLICY, on the age of smoking initiation is not significant. Note that the causality between campaigns and the decision to start smoking or the age of smoking onset is not clear. If more, and in particular younger, individuals start smoking, then an information campaign might be

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<sup>16</sup> Unrealized intentions to quit are a common feature of smoker preferences (Burns 1992, USDHHS 1994), which can be seen as evidence of time inconsistent, rather than time consistent preferences.

launched to countervail this trend. However, if policy makers launch campaigns when there are upward trends in smoking initiation, one might even find the “perverse” results of more people starting during information campaigns. Similarly, information campaigns themselves may trigger rebellious behavior, which may result in individuals starting to smoke. In general, it may be difficult to directly study the effect of public policies. Furthermore, there may be a delayed effect and an announcement effect of a policy, but in a joint test where we both lead and lag the time varying covariate POLICY, we cannot reject that these covariates are equal to zero at the 5% level (p-value 0.10) This does not, of course, rule out a potential importance of policies, but the direct effect on the age of smoking initiation might not be claimed.

It may be the case that the policy variable is too broadly defined to pick up any effects. Thus, we separate information campaigns from laws and regulations by constructing the dummy variables INFO and LAW. Furthermore, it is likely that the effect of an information campaign is delayed and/or affects a several year period. To allow for this we lag the information campaign variable for 1 to 3 years by creating INFOYEAR+1, INFOYEAR+2 and INFOYEAR+3. Furthermore, if we take a dynamic approach, we also create two price variables (PRICE CHANGE LAST YEAR and PRICE CHANGE NEXT YEAR) to denote the change in price in percent from the previous year to the current year, and from the current year to the next. The results of the models are presented in the Appendix. However, neither of the specifications affects the previous findings.

## **6 CONCLUSIONS**

Generally, there has been remarkably little research done regarding the effect of public policies on the age of smoking initiation. This is surprising given, the importance from a public health perspective, and the weight given to this issue by the government, revealed by taxes, laws, regulations and information campaigns. The present paper has sought to provide an analysis of the effects of these factors on the age of smoking initiation. We found little evidence on beneficial effects of public policies, on the age of smoking onset by using a sample consisting of smokers and previous smokers only. The

point estimates of the policy variables are small and insignificant. This is in line with previous research on the effect of policies on the age of smoking initiation, but it may also be a result of the way we introduced the policy variables into the model. We also estimated some alternative models, but the results were robust with regard to policy impacts on the age of smoking initiation. A reason for the insignificant effect of prices may depend on the prices not having fluctuated much during the period studied. In future research it would be interesting to investigate if the substantial increase in prices in Sweden during the late 1990's has had an effect on the age of smoking initiation. The insignificant effect of new laws and regulations, and of information campaigns on the year of starting may indicate that the policies have a more long-term effect in that they change the general attitude towards smoking. This may partly explain the pattern found in the time trend. Our results also show that the age of smoking initiation is not determined randomly, but rather explained by personal characteristics — particularly parental smoking and gender. In sum, it is difficult to argue that our results show that public policies have a direct effect on the age of smoking onset. However, it may be the case that the main contribution of public policies is to change attitudes and the awareness of the effects of smoking, which would be a long-term effect. The proportion of smokers in the 16-24 age group has decreased in Sweden over the last decades, which may indicate the main effect of public policies during the 70's, namely those aimed at restraining individuals from starting. In closing, the paper suggests that the age of smoking initiation is, to a substantial degree, determined by personal characteristics and general trends in the society, and to a lesser extent by specific policies. However, we do believe public policies are a very important tool for affecting long-term trends, and the effect of the policies should therefore be evaluated over the long-run as individuals seem to adjust their behavior accordingly. If subsequent research supports this conjecture, this has implications for the design of future public policies, especially as the impact may be slow.

## REFERENCES

- Akaike, H. (1974). "A new look at the statistical model identification," *IEEE Transaction and Automatic Control* AC-19, 716-723.
- Burns, J. (1992). "Looking to the future," in J. Burns , ed. Special Report: *Business and Health*, 21-22.
- Becker, G. S. and K. M. Murphy (1988). "A theory of rational addiction," *Journal of Political Economy*, 96(4): 675-700.

- Chaloupka, F. J. and H. Saffer (1992). "Clean indoor air laws and the demand for cigarettes," *Contemporary Policy Issues*, 10(2): 72-83.
- Chaloupka, F. J. and H. Wechsler (1997). "Price, tobacco control policies and smoking among young adults," *Journal of Health Economics*, 16(3): 350-73.
- Chaloupka, F. J. and K. E. Warner (2000). "The economics of smoking," Chapter 29 in *Handbook of health economics*, edited by A. J. Culyer and J. P. Newhouse, Amsterdam, Elsevier.
- Cohen, J. (1989). "Counting advertising assertions to assess regulatory policy: when it doesn't add up," *Journal of Public Policy and Marketing*, 8, 24-29.
- DeCicca, P., D. Kenkel, and A. Mathios (2001). "Putting out the fires: will higher taxes reduce the onset of youth smoking?" Forthcoming in *Journal of Political Economy*.
- Douglas, S. (1998). "The duration of the smoking habit," *Economic Inquiry*, 36(1): 49-64.
- Douglas, S. M., and G. Hariharan, (1994). "The hazard of starting smoking: estimates from a split sample duration model," *Journal of Health Economics*, 13(2): 213-30.
- Emery, S., M. M. White, and J. P. Pierce (2001). "Does cigarette price influence adolescent experimentation?" *Journal of Health Economics*, 20(2): 261-270.
- Evans, W. N., M.C. Farrelly and E. Montgomery (1999). "Do workplace smoking bans reduce smoking?" *American Economic Review*, 89(4): 728-47.
- Fenn, A. J., F. Antonovitz, and J. R. Schroeter (2001). "Cigarettes and addiction information: new evidence in support of the rational addiction model," *Economics Letters* 72: 39-45.
- Forster, M, and A.M. Jones (2000). "The role of tobacco taxes in starting and quitting smoking: duration analysis of British data," University of York.
- Gruber, J. (2001). "Youth smoking in the 1990's: why did it rise and what are the long-run implications?" *American Economic Review*, 91(2): 85-96.
- Gruber, J. and B. Köszegi (2000). "Is addiction 'rational'? Theory and evidence," *NBER Working Paper 7507*.
- Hu, T.-W., H.-Y. Sung, and T. E. Keeler, (1995). "The state antismoking campaign and the industry response: The effects of advertising on cigarette consumption in California," *American Economic Review*, 85(2): 85-90.
- Jones, A. M. (1994). "Health, addiction, social interaction, and the decision to quit smoking," *Journal of Health Economics*, 13: 93-110.
- Jones, A. M. (1995). "A microeconomic analysis of smoking in the UK Health And Lifestyle Survey," Discussion Paper 139, University of York.
- Lewit, E.M., D. Coate, and M. Grossman (1982). "The potential for using excise taxes to reduce smoking," *Journal of Health Economics* 1(2): 121-145.
- Lewit, E. M., D. Coate, and M. Grossman (1981). "The effects of government regulation on teenage smoking," *Journal of Law and Economics*, 24(3): 545-69.
- Leibenstein, H. (1950). "Bandwagon, snob, and Veblen effects in the theory of consumers' demand," *Quarterly Journal of Economics*, 64(2): 183-207.
- Magnusson, S. and P. Nordgren (1994). (in Swedish) Om tobak, bakgrund och kommentarer till tobakslagen (Publica, Fritzes, Stockholm).
- Nyborg, K. and M. Rege (2000). "The evolution of considerate smoking behavior," *Discussion Paper No. 279*, Statistics Norway, Oslo.
- Ohsfeldt, R., R. G. Boyle and E. I. Capitano (1999). "Tobacco taxes, smoking restrictions, and tobacco use," in *The Economic Analysis of Substance Use and Abuse* edited by Chaloupka, F. J., M. Grossman, W. K. Bickel, and H. Saffer, The University of Chicago Press, Chicago.
- Orpahnides, A and D. Zervos (1995). "Rational addiction with learning and regret," *Journal of Political Economy*, 103, 739-758.
- Pollay, R. W. (1989). "Filters, flavors, flim-flam, too! On 'health information' and policy implications in cigarette advertising," *Journal of Public Policy and Marketing*, 8, 30-39.
- Ringold, D. Jones and J. E. Calfee (1989). "The informational content of cigarette advertising 1926-86," *Journal of Public Policy and Marketing*, 8, 1-23.
- Royal College Of Physicians (1962). *Smoking and health*, Summary and report of the Royal College of Physicians of London on smoking in relation to cancer of the lung and other diseases, Pitman Publishing, New York.
- Saffer, H. and F. J. Chaloupka (2000). "The effect of tobacco advertising bans on tobacco consumption," *Journal of Health Economics*, 19(6):1117-37.
- Saffer, H. (1998). "Economic issues in cigarette and alcohol advertising," *Journal of Drug Issues*, 28(3): 781-793.

- SCB (various issues), Statistics Sweden.
- Stigler, G. J. and G. S. Becker (1977). "De gustibus non est disputandum," *American Economic Review*, 67(2): 76-90.
- Suranovic, S.M., R.S. Goldfarb and T.C. Leonard (1999). "An economic theory of cigarette addiction," *Journal of Health Economics* 18: 1-29.
- Tauras, J. A., P. M. O'Malley, and L. D. Johnston (2001). "Effects of price and access laws on teenage smoking initiation: A national longitudinal analysis," *NBER Working Paper 8331*.
- Tobaksfakta (2001). <http://www.tobaksfakta.org/>
- Torelli, N. and U. Trivellato (1993). "Modelling inaccuracies in job-search duration data," *Journal of Econometrics*, 59, 187-211.
- U.S. Department of Health and Human Services (1994). *Preventing Tobacco Use Among Young People: A Report of the Surgeon General*. Atlanta, Georgia: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health.
- US Department of Health, Education and Welfare (1964). *Smoking and health*, Report of the Advisory Committee to the Surgeon General of the Public Health Service, PHS Publication No. 1103, US Department of Health, Education and Welfare, Public Health Service, Center for Disease Control.
- Wasserman J., W. G. Manning, J. P. Newhouse, and J. D. Winkler. (1991). "The effects of excise taxes and regulations on cigarette smoking," *Journal of Health Economics*, 10(1): 43-64.

## APPENDIX

**Table A.1.** Parameter estimates from the lognormal distribution without heterogeneity.

Covariate	<i>Model 1</i>		<i>Model 2</i>	
	Coefficients	P-value	Coefficients	P-value
LNPRICE	-0.993	0.135	-0.466	0.201
PRICE CHANGE LAST YEAR	0.400	0.501		
PRICE CHANGE NEXT YEAR	-0.548	0.261		
MALE	-0.055	0.089	-0.050	0.114
DADSMOKE	-0.025	0.508	-0.025	0.487
MUMSMOKE	-0.029	0.591	-0.028	0.616
BOTHSMOKE	-0.081	0.067	-0.080	0.071
SOCWHITHE	0.021	0.608	0.025	0.490
INFO	-0.068	0.227	-0.043	0.294
INFOYEAR+1	-0.099	0.115		
INFOYEAR+2	-0.061	0.325		
INFOYEAR+3	0.012	0.851		
LAW	-0.020	0.846	-0.014	0.874
YEAR	0.521	0.100	0.537	0.070
YEARSQ	-0.794	0.101	-0.850	0.062
YEARCUB	0.396	0.108	0.439	0.058
CONSTANT	-5.817	0.417	-7.397	0.266
ln( $\sigma$ )	-1.202	0.000	-1.196	0.000
$\kappa$	0.330	0.027	0.335	0.005
RESET		0.107		0.410
Individuals		385		385