Prices & Addictive Propensities: An Analysis of Adolescent Smoking Behavior

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Abstract

A primary policy concern in advocating cigarette prices as a mechanism to reduce adolescent smoking is whether higher prices will prevent them from becoming smokers as adults or will merely delay the initiation. In this paper we examine how prices that individuals face during their adolescent years affect their lifetime propensities of addiction. By estimating a longitudinal model of addiction we find that although prices may exert some short-run influence in terms of delaying initiation, but such an effect will diminish as a transition into adulthood is made. However, the influence that peers and family (parents smoking status and parent-child relationship) exert on individuals during adolescence remains till adulthood. This indicates that reliance on prices alone may not yield the desired policy results. Additionally, we find that state policies that are designed to restrict adolescent access to cigarettes and discourage its consumption exert an influence that also persists till adulthood.

JEL classification: I12 – Health Production; I13 - Government Policy; Regulation; Public Health.

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1. Introduction

Youth smoking is an important public health policy concern today. According to the 'Youth and Tobacco Use' report released by the Center for Disease Control and Prevention (CDC) in December 2003, 4000 youths aged 12-17 try their first cigarette each day in the United States. About 80 percent of adults who are smokers started smoking before they were 25 (Liang et al., 2001) and epidemiological evidence suggest that individuals who avoid smoking in adolescence or young adulthood have significantly lower probabilities of being addicted to smoking. Even though smoking prevalence has decreased steadily over the years, this decrease is primarily due to increased quit rates rather than due to fewer people initiating (National Center for Health Statistics, 2005). Thus, a prime factor behind policies designed to curtail adolescent smoking, besides the obvious concerns regarding smoking related mortality and morbidity, is the assumption that reducing youth smoking initiation will reduce lifetime smoking propensities (Glied, 2002). In such a regard, a key policy concern is how policies aimed at tobacco control towards adolescents are effective in affecting smoking behavior when the adolescents are at an initial stage of smoking or have just made a transition into being addicted. In other words, are we only reducing smoking among adolescents for whom addiction is a less likely outcome, suggesting that polices to increase prices are not target efficient.

An extensive literature in economics has been devoted towards understanding the addictive behavior of adolescents, however, the question of initiation and the relationship between adolescent initiation and addiction has received relatively little attention. In other words, smoking in most studies have been defined as a binary variable where smokers are defined as individuals smoking at least one day out of the past thirty days. This definition fails to accurately account for the different stages of progression a person goes through before becoming an addict, thus modeling the different stages of addiction only as a choice rather than an outcome. Higher cigarette prices thus have emerged as the main policy tool in the effort towards reducing youth smoking. However if such a policy merely defers the initiation into later adolescence or young adulthood, it will not be an efficient strategy and will eventually have very little, or no effect, on the long-term smoking rates (Auld, 2005). If the youth at the margin of smoking take-up who respond to the price policy are those with a lower propensity for addiction and long-term use, policy gains will be exaggerated. The question of how policies aimed at reducing smoking during adolescents affect smoking pattern when a transition into adulthood is made has not been extensively dealt with in the literature. In this paper we examine whether an increase in cigarette price achieves its target policy objective of not only reducing smoking initiation but also eventual addiction when an adolescent makes a transition into adulthood.

Although not quite large in number, there are few studies which undertook examining the impact of prices faced during adolescent on smoking status at a latter period in life (DeCicca et al., 2002; Glied, 2002). However those studies were mostly limited by their definition of smoking or by their inadequate control of lifetime smoking. DeCicca et al. (2002) only concentrated on individual smoking between 8th and 12th grade, while Glied (2002) categorized anyone who smokes one day of the last thirty days as a smoker. Such binary definition of smoking is unable to distinguish between the various stages of addiction an individual goes through before becoming an addict. In this

paper the effectiveness of prices as a smoking reduction mechanism among adolescents is examined by stage conceptualization of smoking, i.e. instead of relying on the widely utilized binary indicator of smoking, we take into account of the fact that an individual's smoking behavior evolves through a sequence of several development stages characterized by different smoking frequencies and intensities (Kathryn et al., 2004; Lloyd-Richardson et al., 2002).

The influence of peers and parents on adolescent smoking behavior has been discussed in the recent literature (Krauth, 2005; Norton et al., 1998; Norton et al., 2003; Powell et al., 2005; Powell and Chaloupka, 2005). Even though the studies found peers and parents to play a significant role in influencing smoking among adolescent, prices still emerged as the main policy instrument. This could be due to the fact that none of the studies till date controlled for the peer and family effects simultaneously. According to the Social Learning Theory, "an adolescents' acquisition behavior and values are based in large part on a complex web of interpersonal social relations" (Lloyd-Richardson et al., 2002).[1] In other words, an adolescent is influenced by his/her peer and family and such influences are reflected by his/her engagement in certain activities. Thus, controlling for both the peer and family effects (in terms of parents smoking status, parent-child relationship, living with both parents, etc.) together in addiction models will enable us to more precisely estimate the influence of price on smoking, i.e. we will be able to identify whether estimated effects of the price when peer and family influence are not controlled simultaneous overestimate its impact by picking up the peer and family influence.

Modeling addiction as a stage specific phenomenon and incorporating the social learning theory into it over a period of time during which an adolescent makes a transition into adulthood will help us in identifying a number of important concerns that would need to be addressed in devising policies aimed towards reducing the long-term smoking rates. From our analysis we would be able to identify the factors that play a more significant role in adolescent smoking behavior. We would also be able to identify the roles that prices, state policies, peer effects and family influence plays at different stages of addiction.

In sum, in this paper we aim to (i) analyze the effectiveness of price and tobacco tax policies as a tool to reduce smoking rates. Or in other words, are these price measures an overestimate and suggest target inefficiencies, i.e. reduce smoking among adolescents for whom addiction was a less likely outcome, (ii) analyze how different factors (price increase along with state policies, family influence, association with friend) affect smoking behavior at various stages of addiction, and (iii) to see how the effects of such factors varies as a transition into adulthood is made. Our analysis will help us identify factors that determined the unobserved propensity to be addicted which will help us in making policy recommendations that will be effective in reducing addiction rates among adolescents.

The remainder of the paper is organized as follows. Section 2 describes our data and econometric models. Section 3 discusses our empirical results and finally Section 4 provides conclusions and policy implications[2].

[1] Edwin Sutherland (1939) first developed a 'differential association theory' to analyze deviant or criminal behavior of adolescent. The theory was later reformulated by Burgess and Akerse (1966) which became the basis for the Social Learning Theory formulated by Bandura (1969).

[2] A detailed literature review section will be added soon.

2. Data and Empirical Model

2.1 Data

The data utilized in our study is The National Longitudinal Study of Adolescent Health (AddHealth). AddHealth consists of data on adolescents in 132 schools nationwide between grades 7 to 12. The in-school portion of the first wave of the survey (1994) contains cross-section data on about 90,000 adolescents. A subset of the initial sample (20,745 respondents), was also interviewed in their home (in-home portion of the data), with follow-up surveys in 1996 and in 2002, when most respondents have made a transition to adulthood. The primary data for our analysis comes from all three waves (1994, 1996, and 2004) of the in-home survey portion of AddHealth. Parents were also interviewed in the first wave of the in-home sample. This allows us to control for a wide range of parent-child relationship measures as well as the smoking status of the parents. Besides smoking information, AddHealth contains an extensive range of variables regarding smoking related state policies and various demographic variables. The sample of our analysis includes all the individuals who were interviewed in all three waves of the survey.

2.1.1 Categorical Smoking Variable

One of the dependent variable of our study is the individual's smoking stage. It's a categorical variable that was created based on the individuals smoking frequency and recency. Following Llyod-Richardson et al. (2002) we categorize people into the following stages of smoking addiction:

(i) Never Smoker - Those respondents who denied ever trying a puff or two of cigarettes. Such adolescents who have never smoked are either unaware of positive reasons to initiate smoking or are ignoring or resisting pressure to smoke (Kathryn et al., 2000).

(ii) Experimental - Those who endorse trying cigarettes, although denied smoking within the past 30 days or ever smoking regularly (i.e. daily smoking). This stage is marked by adolescents trying their first few cigarettes. Experimentation stage has often been characterized of having stronger peer than family influences(Kathryn et al.,2000).

(iii) Intermittent - Those who reported smoking between 1 and 29 out of the past 30 days. This stage is characterized by a gradual increase in the frequency of smoking and an increase in the variety of situations in which cigarettes are used. Adolescents progress beyond the sporadic smoking to smoke on a higher but still infrequent basis.

(iv) Regular - Those who responded smoking on a daily basis within the past thirty days. In this final stage adolescent may experience nicotine dependence, withdrawal symptoms and may find it difficult to quit.

(v) Ex-Smokers - Those who reported quitting smoking; denied smoking with the past 30 days and endorsed regular smoking.

In the previous literature, the most widely used measure of smoking is a dichotomous variable that categorizes smokers as anyone who reported smoking at least one day out of the past thirty days(Chaloupka and Grossman, 1996; Hana and Chaloupka, 2003, 2004;Powell et al., 2005, Powell and Chaloupka, 2005). Price estimates on such binary variables might be an overestimate since it would fail to control for the various stages of addiction that a person might go through. From our definition of smoking stages we can see that a person might have smoked zero days out of the past thirty days and yet could fall into the category of someone who has experimented with cigarettes and has the possibility of making a transition into a regular smoker. This is especially true among adolescents, who might not have yet become a regular smoker but enjoys a high probability of doing so. Also, an ex-smoker is not the same as someone who has never tried smoking. From Table 1 we can see that under the widely used conventional definition of smoking, among the non-smoker sample from our data 37.52 percent are experimental smokers and 3.41 percent are ex-smokers. Thus, an overestimation of price is quite likely without distinctions being made among the various stages of addiction[3].

2.1.2 Peer Measures

According to the Social Learning Theory, an adolescents' source of influence or habit formation is not confined to either friends or parents, but rather a combination of both and as noted before, previous literature has not controlled for both these measures together. From Figure 1, we can see that among those who reports having three or more friends who smoke daily and have at least one parent who smoke, only 13.11 percent are never smokers and 46.11 percent and 26.67 percent are regular and intermittent smokers respectively. Whereas among those who only has at least one parent who smoke but has less than three friends who smokes daily, 40.37 percent are never smokers, with only 8.01 percent and 16.61 percent as regular and intermittent smokers. This demonstrates that it is important to control for both parents and peer smoking behavior together, since having both friends and parents who smokes could have different effect than having either only friends or parents who smokes. We rely on respondents' self-reported number of close friends smoking as a measure of peer effects.

2.1.3 Parent Measures

Since AddHealth interviewed one of the parents also, we can control for the parent-child relationship via not only how the child perceives it to be, but also how the parent perceives it. This will allow us to capture with more precision the role that parents play in influencing an adolescents smoking behavior. Besides the smoking behavior of the parents, it is also the relationship that the child has with his/her parents that is expected to play a vital role in influencing their smoking behavior. Apart from controlling for the respondent's perception of whether he/she thinks that his/her parents care, understand, pay attention etc., we also control for the respondents' parents perception of whether they think they get along well with their children, whether they feel they can trust their children etc. Most literature in economics that controlled for the influence of parents mostly relied on parents smoking status and very limited

[3] A detailed descriptive statistics section will be added soon.

measures of the parent-child relationship from the children's perspective. Powell and Chaloupka (2005) use the importance of parents opinion and discussion with parents on a daily basis as a measure of parent-child relationship. Thus, our study is among the first study to account for the parent-child relationship comprehensively.

2.1.4 Policy Measures

Besides prices an extensive array of state policy measures are controlled for. Like prices, state policy measures have been labeled as one of the most effective policy instruments that could be utilized to curtail smoking among adolescents. State policies such as banning cigarettes sales via vending machine, marketing restrictions on billboards, prohibition of distribution of free samples as promotional tools, state initiating dissemination of information regarding the adverse effect of smoking etc. are all likely to contribute towards preventing adolescents from taking up smoking. Besides these, various other state and local enforcement programs are likely to limit the availability of cigarettes among adolescents.

2.1.5 Demographics

In addition to these measures we also control for socio-demographic factors like age, the grade they are in, family structure and gender. It is important to control for gender since an adolescent female's reasons for taking up smoking might be different than that of a males', thus affecting the efficiency of the policy measures as well (Cawley et al., 2004).

2.1.6 Factor Analysis

Following DeCicca et al. (2006) and Kan and Tsai (2004), instead of relying on multiple indicators to measure the parent-child relationship and state policy measure, we created an index to control for that. The indicators of the parent-child relationship and state policy were obtained after conducting exploratory (principal factor) factor analysis. This is a data reduction technique conducted to minimize correlated regressor problems, collinearity and improve interpretation of mutually exclusive components of responses. Estimates without the indices are unclear in its interpretations, with certain indicators having a negative, certain indicators having a positive relationship and certain indicators being insignificant in explaining the dependent variable. This is likely due to collinearity that exists among the measures. Thus factor analysis was utilized as a statistical technique to find an indicator(s) of orthogonal common factor that will linearly summarize a set of original variables related to the parent-child relationship and state policies (Kan and Tsai, 2004).

Although there is no agreed upon common criteria to be used in deciding the number of factors to be retained, the Kaiser criterion is one of the most utilized method in the literature and that is what we utilized in this study . According to the Kaiser criterion only factors that have eigenvalues greater than 1.0 is retained. Table 2 through 4 reports the factor analysis results. The factor loadings and scoring coefficients of the factor with an eigenvalue greater than 1.0 are presented in Table 3 and 4. From Table 2, for both the parent-child relationship and state policy variables there is only one factor with

eigenvalue greater than 1. This suggests that only one factor is sufficient to summarize all the variables pertaining to the parent-child relationship and anti-smoking state policies. Thus in our regressions we include this single factor as an index for parent-child relationship and anti-smoking state policies.

2.1 Estimation Framework

To estimate the effect of prices faced during adolescent on subsequent smoking status we perform multivariate analysis based on an ordered probit and hazard framework. Apart from controlling for prices we also control for state policies, parental smoking, parent-child relationship and peer effects. The state policy and parent-child relationship index was developed based on exploratory factor analysis, where as parental smoking and peer smoking variables are based on self-reports. We test for whether price faced during 1994 affect smoking status in 1996 and 2002, after controlling for these mentioned variables. In 1996 most of our sample was still between 8th and 12th grade were as in 2002 most of the sample was in their mid twenties and have graduated from college. The 1996 estimates will allow us to infer if any short run effect exist due to prices where as the 2002 estimates will allow us to see if such effect persists into adulthood.

2.1.2 Ordered Probit Model of Addiction

Although the rational addiction model of Becker and Murphy (1988) has been widely utilized in studying smoking behavior, its assumption of perfect foresight and time consistent preferences has been identified as its limitation. The implication of such an assumption is that, since individuals makes their decision with complete information regarding their addictive tendencies and have preferences which remains unchanged, there is no room for `learning and regret'. Orphanides and Zervos (1995) accounted for such limitations by incorporating uncertainty into their model of 'rational addiction with learning and regret' (O-Z model from now on). In their model, each individual possesses a subjective belief regarding his or her addictive tendencies and the harmful side effects of consuming an addictive good. This subjective belief is updated via a Bayesian learning process as the consumption of the addictive good continues. An underestimate of addictive tendency can cause an individual to become an addict because of repeated experimentation, whereas, a realization of the addictive tendency will cause the individual to reverse his or her consumption of the potentially addictive good. This incorporation of subjective believes into the rational-addiction framework helps to explain adolescent experimentation and the importance of social network.

The O-Z model of rational addiction with learning and regret is the basis for estimating an ordered probit model. Under the O-Z model adolescent have heterogeneous capacities for becoming addicted and their subjective assessment of such capacity evolves with experimentation with cigarettes. Thus progression from one stage of smoking into another is a learning process and regret occurs in the event of an irreversible smoking stage, i.e. addiction. Thus an ordered probit model is an appropriate specification where each choice variable (in this case smoking stage) is not arbitrary but rather a result of their level of experimentation.

The ordering of our dependent variable is as follows - Never smoker, Ex-smoker, Experimental Smoker, Intermittent Smoker and Regular Smoker. It is to be noted that since a progression into an ex-smoker could be made from any addictive stage, we are putting it after never smoker based on the number of cigarettes they are likely to have smoked. An ex-smoker by definition has smoked more than never smokers but historically have not smoke as much as the current smokers.

The ordered probit model is estimated both for 1996 and 2002 smoking status after controlling for prices, peer effect, parental characteristics and state policy for 1994. This will allow us to identify if prices faced by adolescents have a significant effect on their smoking status if they continue to be around peers and parents who smoke and also help us to understand if peer and family effects exerts an affect that lasts till their adulthood.

2.1.3 Hazard Model of Transitioning into a Regular Smoker

A policy relevant question that is yet to be empirically estimated is whether an increase in price reduces the likelihood of being addicted when transition into adulthood is made. Thus, for policy evaluation, it is important for us to determine whether prices faced during adolescent will influence the probability of becoming a regular smoker. A regular smoker, as defined in our study, is someone who smoked everyday in the past 30 days, and also those who make a transition into being a regular smoker are the ones who were most at risk of addiction in their adolescent and are also likely to face the most adverse health consequences due to smoking.

We formulate a hazard framework were failure is defined as someone making a transition into being a regular smoker and the onset of risk of becoming a regular smoker is instigated when an individual smokes their first cigarette. Thus the analysis time is the period between trying the first cigarette and the time when an individual becomes a regular smoker. The rest of the sections will explain our choice of non-parametric and parametric estimation techniques.

Non-Parametric Estimation

A non-parametric approach, such as the hazard rates, involves estimating the risk of surviving up to a certain period and this is a good starting point for our analysis since it does not require any distributional assumption on the likelihood function.
In our model the hazard function *h(t)* is the probability that an individual becomes a regular smoker in the given analysis time, conditional upon surviving to the beginning of the interval. Thus the hazard rate is given by

$$h(t) = \lim_{\Delta t \to 0} \frac{\Pr(t + \Delta t > T > t \mid T > t)}{\Delta t}$$

where T is a non-negative random variable denoting the duration time and t is the time period when an individual becomes a regular smoker. The hazard rate can vary from zero (no risk at all) to infinity (the certainty of becoming a regular smoker at

that instance). Estimating the hazard conditional upon certain covariates like price, peer and parent smoking will give us an intuitive sense of the various control variables on lifetime smoking propensities. However, even though the hazard rate will inform us about the evolution of the risk of becoming a regular smoker, it does not allow us to perform multivariate analysis which will enable us to obtain the coefficient estimates of various control variables. This limitation leads us to our parametric estimations.

Parametric Estimation

In order to regress a multivariate model under the hazard framework, a functional form of the hazard function must be specified. The choice of an appropriate functional form is very important, since the results may be very sensitive to its distributional assumption. In this chapter, five hazard specifications are adopted: the Weibull distribution, Exponential distribution, Log-normal distribution, Log-logistic distribution and the Gamma distribution.

The Weibull distribution assumes that the log duration follows the Type II extreme-value distribution. The corresponding hazard function is:

$$h_i(t \mid x_i) = \exp(-x_i \frac{\beta}{\sigma}) \frac{1}{\sigma} t^{\frac{1}{\sigma}-1}$$

where β and σ are the parameters to be estimated. If σ is equal to one, the Weibull model is reduced to the exponential model. Estimates under all five distribution is expected to inform us about how the various covariates effect the duration dependence. However, a common approach to employ in order to select a model is the Akaike Information Criteria (AIC)[4] (Stata Reference Manual). The AIC is defined as

$$AIC = -2(\log likelihood) + 2(c + p + 1)$$

where *c* is the number of model covariates and *p* is the number of model specific ancillary parameters or distributional parameters. Although the model with the highest likelihood is the best fitting model, the preferred model is the one with the smallest AIC value.

3. Empirical Results

3.1 Ordered Probit Estimates

Table 5.1a and 5.1b presents results from the ordered probit model with the 1996 smoking status as the dependent variable. From model I in Table 6.1a we can see that the 1994 prices significantly affected 1996 smoking status and the signs are as expected. A

[4] For a more detailed discussion, see Akaike (1974).

positive sign for never smokers and ex-smoker implies that a higher 1994 price will increase the likelihood of remaining a never smoker and ex-smoker in 1996. Where as a negative sign for all other stages implies that a higher price will reduce the probability of progressing into higher stages of smoking. The state policy index is also significant in influencing 1996 smoking status and the signs are similar to those of prices. However, model I did not take the peer and family effects into account. Estimates from model II reported in table 6.1b shows that if adolescents have at least one parent who smokes their propensity of being a never smoker and ex-smoker decreases while the probability of being an experimental, intermittent and regular smoker increases. The significant parent-child relationship index indicates that adolescents who enjoy better relationships with their parents are more likely to be never smoker and their probability of being at a higher stage of smoking decreases. The peer variable indicates that those who have more friends who smoke are likely to be in a higher stage of smoking. But after taking the peer and parents' variable into account we notice that price cease to be significant. This indicates that a price estimate without controlling for peer and family effects are an overestimate. Thus prices will be unable to deter people from progressing into higher stages of smoking if they continue to be around peers and parents who smoke and might not enjoy a good relationship with their parents. This also holds true for the policy index, which also becomes statistically insignificant after controlling for the peer and family effects.

Table 5.2a and 5.2b presents estimates with 2002 smoking status as the dependent variable, when most respondents have made a transition into adulthood. From model I in table 5.2a we can see that prices ceases to have a significant effect on smoking status where as the state policy index continues to exert a significant influence. Thus it can be argued that a state policy which limits access to cigarettes among adolescents will have a lasting impact in influencing smoking rates than a price increase. An increase in price may deter initiation(without controlling for peer and family measures), as our 1996 model suggests, but it cannot prevent eventual addiction. Thus as conjectured before, prices may not be target efficient, i.e. unable to deter smoking among those who are more likely to be addicted. In model II with parents and peer variables we see that the peer and family effects are significant. Thus having parents and friend who smokes during adolescent will have an impact which will persist till adulthood for all types of smokers. Thus, polices that advocate for price increase will not be efficient in reducing smoking rates since most people who have experimented with cigarettes and are around peers and parents who smoke will eventually become addicted. We also notice that the policy index is still significant. Thus limiting access to cigarettes among adolescents is likely to be more effective. So a policy that aims for creating awareness about the adverse effect of cigarettes and which are targeted towards adolescents who are most at risk is more likely to attain a reduction in smoking rates. Therefore, in sum, an increase in price may be unable to delay initiation or prevent eventual addiction among adolescents who are around peer and parents who smoke, which is widely considered to hold true among the advocates of price policy.

3.2 Hazard Estimates

Multivariate analyses based on the hazard framework were estimated to examine how prices faced during adolescents affects the lifetime propensities of becoming a regular smoker. Figure 2 illustrates the hazard of smoking initiation and we can see that it reaches a peak when individuals are between 15 - 17 years of age. This has lead many studies to suggest that high prices faced during adolescents will deter initiation, which in turn will also reduce the propensity of ever becoming a regular smoker. To test this assumption will be the pivotal purpose of our hazard framework.

Figure 3 illustrates the hazard of becoming a regular smoker. We can see that the hazard reached its peak for individual after five years of trying their first cigarette. From then on it experienced a steady decline but started to rise once again during a person's middle years and then declined. This demonstrates that a learning mechanism is at work that induces a person to become a regular smoker. So a person might not become a regular smoker the instance he/she tries their first cigarette, but might progress into becoming one after some time, maybe due to continued experimentation. The rise in the hazard during the middle years means that those who experimented with cigarettes might becoming a regular smoker once they start their professional careers or are near finishing their formal years of schooling. Both of these instances are highly correlated with an increase in stress levels which could be contributing to the increase in the hazard rates. This provides further evidence that an increase in price experienced during adolescent years might not deter eventual addiction given the learning mechanism that is involved with becoming a regular smoker.

From figure 4 we can see that although those individuals who faced prices which were higher than the national average prices have a lower risk of becoming a regular smoker during the earlier duration periods, but such risk converges with the risk of those who faced either prices which were below or equal to the national average. This illustrates that the benefits of price increase will not have a lasting impact and thus individuals who are more prone to addiction will eventually become addicted irrespective of the prices.

Figure 5 and 6 shows that the hazard rate by parents and peers smoking. From these diagrams we can notice that individuals who have more friends who smoke and who have parents who smoked during adolescent will always have a higher risk of becoming a regular smoker and such risks will persist into adulthood. Therefore, people who are around smokers will exhibit a higher hazard of becoming a regular smoker, with prices having a very little effect.

Even though our non-parametric estimates demonstrated a stronger evidence of peer and family effects than prices, we need to estimate a multivariate analysis to obtain accurate estimates of how all these covariates affects the duration till becoming of a regular smoker. Table 6 presents our parametric estimation results. The reported coefficients are reported log of duration before becoming a regular smoker for each of these observed characteristics. The explanatory variables included in the estimates besides parents, peers, prices, state policy and demography variables are indicator of whether adolescents have easy access to cigarettes.

The interpretation of the reported coefficients deserves some attention. For example, consider the coefficient estimate of -0.409 on 'peer smoke' under the Weibull

distribution. The coefficient means that the predicted log of years before becoming a regular smoker for an individual who has more friends who smoke is 0.409 lower than an individual who has less friends who smoke but has the same other characteristics. This indicates that on average individuals with more smoker friends has higher likelihood of becoming a regular smoker.

Alternatively, the hazard rates can be calculated for each of these variables. For example, the hazard rate of the 'peer smoke' coefficient is 1.57. This means that on average individuals with more friends who smoke are 57 percent more likely to become regular smoker than someone who has fewer friends who smoke[5].

Overall, under all the distributional assumption prices remain to be insignificant where as peer and parents continue to be significant. This confirms our hypothesis of friends and family exerting a greater influence on peoples smoking status than prices. State policy index and easy access to cigarettes all lend support to our claim that restricting access to cigarettes among adolescents coupled with creating more awareness about the adverse consequences of smoking will have a more lasting impact that an increase in prices. Prices and state policies may however be collinear, i.e. states with higher tax rates (which translates into higher prices) may be the states with the strictest anti-smoking polices and this could lead to an underestimation of the price effect. To check for whether the policy index is picking up the price effects, we estimated the model without the policy index. Prices continue to remain insignificant even without the policy index. This reflects that the price effect are not an underestimation[6].

Even though almost all the coefficients under the five distributional assumptions have given us the same estimates in terms of the sign and statistical significance, we must select the most appropriate model to identify the most accurate estimates of the covariates. Table 7 presents the AIC index of each model. From there we can see that the modle estimated under the Log-Normal distribution has the least AIC index and therefore is our preferred model.

4. Conclusion & Policy Implication

Our purpose in this study was to determine whether prices that individuals face during their adolescent affect their propensities of addiction, i.e. does an increase in price during adolescent (the period during which the hazard of initiation is the highest) reduce the lifetime probability of becoming a smoker. Utilizing an ordered probit model we found that prices have an impact that is expected to last in the short run but is not likely to persist till adulthood. Thus even if prices delay initiation, it cannot prevent eventual addiction. Whereas peer effects instigates an affect that lasts till adulthood and individuals who have more friends who are smokers are more likely to progress into higher stages of smoking. The same holds true for parental smoking status, while a better parent-child relationship is more likely to prevent someone from making a transition into a higher stage of smoking. State policies that limits the availability of cigarettes

[5] The hazard rates under the Weibull and Exponential distributional assumptions are provided in Appendix 1.

[6] The estimation result without the policy index is provided in Appendix 2 for the best fitted model under the AIC index.

among adolescents and discourages its usage exhibits an effect that persists into adulthood. Thus an increase in prices will not have a significant effect in reducing smoking rates and attain its policy objective of reducing smoking among those who has a higher propensity of addiction.

From our hazard estimates we learned that price effect will eventually decline as transition into adulthood is made, thus having a negligible impact on propensity of becoming a regular smoker. Where as, the peer and parental smoking status exerts an effect that has more persistent long run impact. Therefore, a policy of price increase to reduce smoking rates is not target efficient since it fails to alter the risk of addiction among those who has the highest propensity of addiction, i.e. the regular smokers. Adolescents who have easier access to cigarettes are also likely to exhibit higher propensity of becoming a regular smoker.

Our results indicates that price increase as a policy to reduce smoking rates will not achieve its target objective, where as policies that are designed to create more awareness about the adverse consequences of smoking especially aimed towards the more at risk groups will attain the goal of achieving an overall reduction in smoking rates. Significant effects of peer and parental smoking along with parent-child relationship on lifetime smoking rates are evidence of that. A better parent-child relationship is an indicator that information regarding the adverse effects of smoking passed on through parents will be more receptive among adolescents. Thus an adolescent who enjoys a good relationship with his or her parents is more likely to not make a transition in being a regular smoker.

These findings raise concern that prices alone may not be enough to reduce adolescent smoking. In our study we find that state policy variables that are designed to restrict adolescent access to cigarettes and discourage its consumption exerts an influence that persist till adulthood. Thus more rigorous state policies aimed at restricting access and discourage usage might yield more dividends in terms of lower long term addiction rates. However, such policy has to be target specific, i.e., designed to target various smokers at various stages of addiction.

In short, our findings suggest that given the long-term policy objective is to reduce adverse health consequences related to cigarette consumption, reliance on increased prices via taxation may not yield the desired results. This is especially true, given the recent decline in smoking rates in the United States has been because of more people quitting after experiencing dire smoking related health consequences. Adolescent experimentation with cigarette is still widely prevalent and this makes them one of the most important demographic groups for policy focus. A target specific smoking awareness policy may have a more lasting impact on adolescents.

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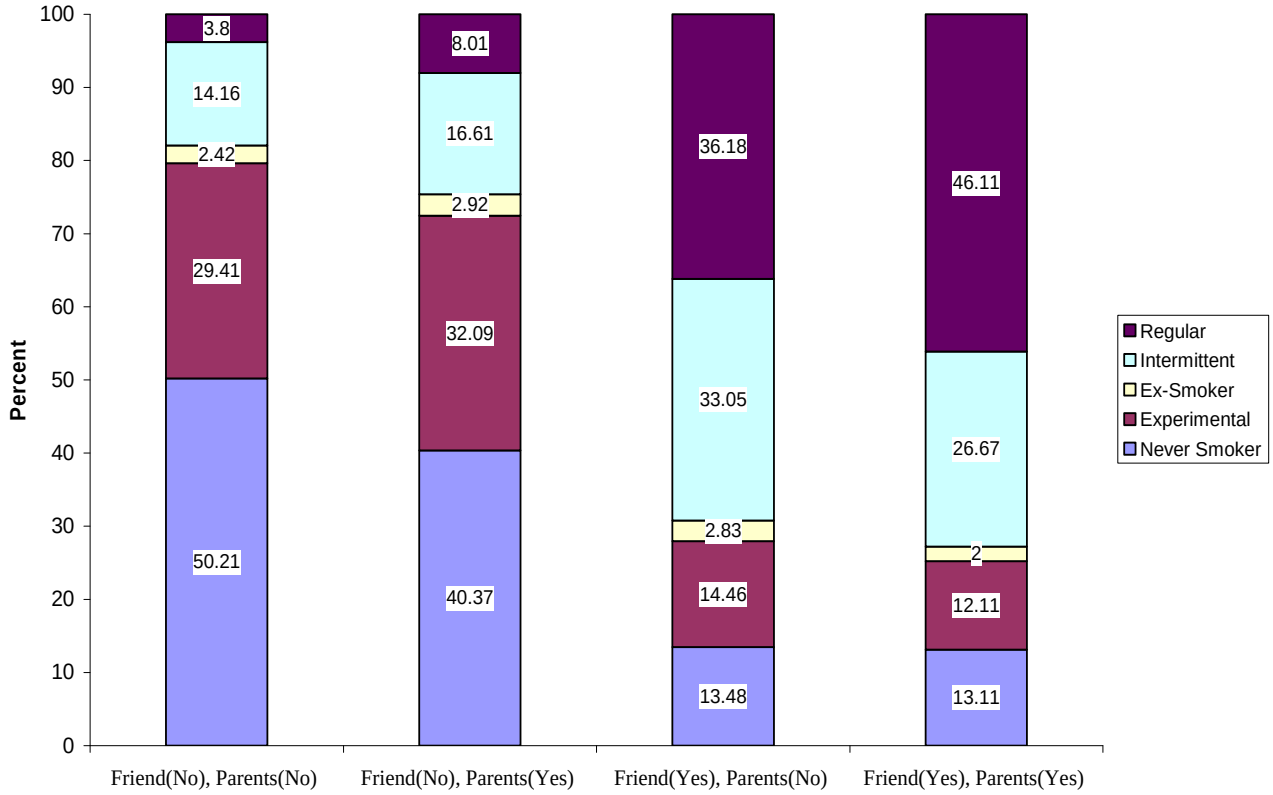
Table 1: Stage Conceptualized Smoking vs. Conventional Smoking

	Never Smoker	Experimental	Intermittent	Regular	Ex-Smoker
Conventional Smoker: No (%)	59.07	37.52	-	-	3.41
Conventional Smoker: Yes (%)	-	-	65.22	34.78	-

From AddHealth Wave I (1994) Sample.

Figure 1: Peer and Family Effects by Smoking Stage



From AddHealth Wave I (1994) Sample.
Friend: Does the respondent have 3 or more friends who smoke daily (no = 0 – 2 friends who smokes daily).
Parent: Does at least one of the parents of the respondent smoke.

Table 2: Factor Analysis Results - Eigenvalues

	Eigenvalue							
	Factor 1	**Factor 2**	**Factor 3**	**Factor 4**	**Factor 5**	**Factor 6**	**Factor 7**	**Factor 8**
State Policy	3.47424	0.98259	0.34966	0.13239	-0.05573	-0.10363	-0.16013	-0.21682
Parent-Child Relationship	2.25837	0.85097	-0.00106	-0.06302	-0.08920	-0.11075	-0.15053	-0.22606

Table 3: Factor Loadings and Scoring Coefficients – State Policies

	Factor Loadings	**Scoring Coefficients**
	Factor 1	**Factor 1**
Vending Machines Banned in location accessible to youths	0.5769	0.07586
Billboard Prohibited within 500 feet of school	0.7056	0.12497
Free Sample Prohibited	0.0363	-0.01104
Marketing Restrictions	0.8654	0.36874
Local Enforcement of Youth Access	-0.7305	-0.16956
Dissemination of Information	0.8028	0.26638
Education Measurement for Compliance	-0.4308	-0.05026
Schools Required to Offer Tobacco use Prevention Programs	-0.7277	-0.13654

Table 4: Factor Loadings and Scoring Coefficients – Parent-Child Relationship

	Factor Loadings	**Scoring Coefficients**
	Factor 1	**Factor 1**
Respondents Survey:		
Parents Care	0.2117	0.05434
Parents Understand	0.2168	0.06921
Parents Pay Attention	0.2747	0.09283
Communicate	0.2728	0.06833
Parents Survey:		
Get Along	0.7941	0.36525
Understand	0.6504	0.19047
Trust	0.7360	0.26783
Decision	0.6491	0.18838

Table 5.1a: Ordered Probit Estimates: 1996 Smoking Status

Variables	Model I: Prices & State Policies LR Chi2: 808.58 Log Likelihood: - 15,264.95 N: 11,620				
	Never Smoker	**Ex-Smoker**	**Experimental Smoker**	**Intermittent Smoker**	**Regular Smoker**
Price	0.038**	0.000**	- 0.003**	- 0.017**	- 0.018**
	(0.015)	(0.000)	(0.001)	(0.007)	(0.007)
Policy Measures:					
Policy Index	0.011**	0.000**	- 0.001**	- 0.005**	- 0.005**
	(0.004)	(0.000)	(0.000)	(0.002)	(0.002)
Parent Measures:					
Parent Smoke	-	-	-	-	-
Relationship Index	-	-	-	-	-
Easy Access	-	-	-	-	-
Peer Measures:					
Peer Smoke	-	-	-	-	-
Demography:					
Age	- 0.051*	- 0.001*	0.004*	0.024*	0.024*
	(0.003)	(0.000)	(0.000)	(0.001)	(0.001)
Education	0.081*	0.001*	- 0.010*	- 0.037*	- 0.035*
	(0.011)	(0.000)	(0.002)	(0.005)	(0.004)
Male	0.004	0.000	- 0.000	- 0.002	- 0.002
	(0.008)	(0.000)	(0.001)	(0.004)	(0.004)
White	- 0.109*	- 0.001*	0.011*	0.050*	0.049*
	(0.012)	(0.000)	(0.002)	(0.006)	(0.005)
Black	0.099*	0.001*	- 0.012*	- 0.045*	- 0.042*
	(0.015)	(0.000)	(0.003)	(0.007)	(0.006)
Hispanic	0.026**	0.000**	- 0.002**	- 0.012**	- 0.012**
	(0.012)	(0.000)	(0.001)	(0.005)	(0.005)
Other	- 0.103*	- 0.001**	- 0.004	0.047*	0.061*
	(0.029)	(0.001)	(0.005)	(0.013)	(0.022)

- all variables except demographies are for 1994.
* - sig at the 1% level; ** - sig. at the 5% level; *** - sig. at the 10% level.

Table 5.1b: Ordered Probit Estimates: 1996 Smoking Status

Variables	Model II: Prices, State Policies, Peer & Parents LR Chi2: 3,378.57 Log Likelihood: - 13,979.95 N: 11,620				
	Never Smoker	**Ex-Smoker**	**Experimental Smoker**	**Intermittent Smoker**	**Regular Smoker**
Price	0.023	0.000	- 0.002	- 0.013	- 0.009
	(0.015)	(0.000)	(0.001)	(0.008)	(0.006)
Policy Measures:					
Policy Index	0.002	0.000	- 0.000	- 0.001	- 0.001
	(0.004)	(0.000)	(0.000)	(0.002)	(0.002)
Parent Measures:					
Parent Smoke	- 0.074*	- 0.001*	0.007*	0.041*	0.027*
	(0.009)	(0.000)	(0.001)	(0.005)	(0.003)
Relationship Index	0.054*	0.001*	- 0.004*	- 0.030*	- 0.020*
	(0.005)	(0.000)	(0.001)	(0.003)	(0.002)
Easy Access	- 0.093*	- 0.001*	0.003*	0.053*	0.039*
	(0.008)	(0.000)	(0.001)	(0.005)	(0.004)
Peer Measures:					
Peer Smoke	- 0.166*	- 0.002*	0.012*	0.093*	0.062*
	(0.004)	(0.000)	(0.002)	(0.003)	(0.002)
Demography:					
Age	- 0.002*	- 0.000*	0.002*	0.012*	0.008*
	(0.003)	(0.000)	(0.000)	(0.002)	(0.001)
Education	0.038*	0.000*	- 0.004*	- 0.021*	- 0.014*
	(0.011)	(0.000)	(0.001)	(0.006)	(0.004)
Male	- 0.004	- 0.000	0.000	0.002	0.002
	(0.008)	(0.000)	(0.001)	(0.004)	(0.003)
White	- 0.098*	- 0.001*	0.010*	0.054*	0.035*
	(0.012)	(0.000)	(0.002)	(0.007)	(0.004)
Black	0.053*	0.001*	- 0.006*	- 0.030*	- 0.019
	(0.014)	(0.000)	(0.002)	(0.008)	(0.005)*
Hispanic	0.008	0.000	- 0.001	- 0.004	- 0.003
	(0.012)	(0.000)	(0.001)	(0.007)	(0.004)
Other	- 0.091*	- 0.001**	- 0.004	0.053*	0.043**
	(0.029)	(0.001)	(0.005)	(0.017)	(0.018)

- all variables except demographies are for 1994.
* - sig at the 1% level; ** - sig. at the 5% level; *** - sig. at the 10% level.

Table 5.2a: Ordered Probit Estimates: 2002 Smoking Status

Variables	Model I: Prices & State Policies LR Chi2: 1,000.93 Log Likelihood: - 16,358.31 N: 11,620				
	Never Smoker	**Ex-Smoker**	**Experimental Smoker**	**Intermittent Smoker**	**Regular Smoker**
Price	0.015	0.003	0.001	- 0.004	- 0.014
	(0.011)	(0.002)	(0.001)	(0.003)	(0.011)
Policy Measures:					
Policy Index	0.015*	0.003*	0.001*	- 0.004*	- 0.015*
	(0.003)	(0.006)	(0.000)	(0.001)	(0.003)
Parent Measures:					
Parent Smoke	-	-	-	-	-
Relationship Index	-	-	-	-	-
Easy Access	-	-	-	-	-
Peer Measures:					
Peer Smoke	-	-	-	-	-
Demography:					
Age	- 0.005*	- 0.001*	- 0.000**	0.001*	0.005*
	(0.002)	(0.000)	(0.000)	(0.001)	(0.002)
Education	0.019*	0.003*	0.001*	- 0.005*	- 0.019*
	(0.001)	(0.000)	(0.000)	(0.000)	(0.001)
Male	- 0.031*	- 0.006*	- 0.002*	0.008*	0.031*
	(0.006)	(0.001)	(0.001)	(0.002)	(0.006)
White	- 0.070*	- 0.012*	- 0.001	0.018*	0.065*
	(0.009)	(0.002)	(0.001)	(0.002)	(0.008)
Black	0.113*	0.017*	- 0.008*	- 0.029*	- 0.093*
	(0.012)	(0.002)	(0.003)	(0.003)	(0.008)
Hispanic	0.072*	0.011*	- 0.003**	- 0.019*	- 0.062*
	(0.010)	(0.001)	(0.002)	(0.003)	(0.007)
Other	- 0.024	- 0.005	- 0.003	0.006	0.025
	(0.023)	(0.005)	(0.004)	(0.006)	(0.026)

- all variables except demographies are for 1994.
* - sig at the 1% level; ** - sig. at the 5% level; *** - sig. at the 10% level.

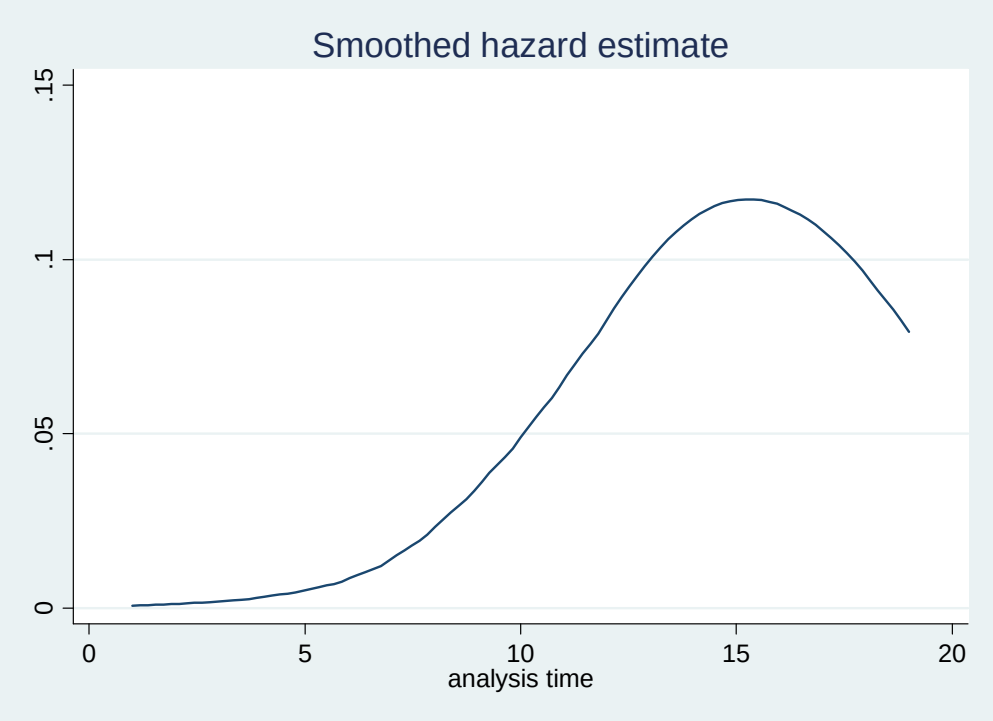
Table 5.2b: Ordered Probit Estimates: 2002 Smoking Status

Model II: Prices, State Policies, Peer & Parents
LR Chi2: 2,131.97
Log Likelihood: - 15,792.79
N: 11,620

	Never Smoker	Ex-Smoker	Experimental Smoker	Intermittent Smoker	Regular Smoker
Price	0.007	0.001	0.001	- 0.002	- 0.007
	(0.011)	(0.002)	(0.001)	(0.003)	(0.011)
Policy Measures:					
Policy Index	0.010*	0.002*	0.001*	- 0.003*	- 0.010*
	(0.003)	(0.001)	(0.000)	(0.001)	(0.003)
Parent Measures:					
Parent Smoke	- 0.052*	- 0.010*	- 0.002*	0.015*	0.049*
	(0.006)	(0.001)	(0.001)	(0.002)	(.006)
Relationship Index	0.025*	0.005*	0.002*	- 0.008*	- 0.025*
	(0.004)	(0.001)	(0.000)	(0.001)	(0.003)
Easy Access	- 0.041*	- 0.009*	- 0.005*	0.012*	0.042*
	(0.006)	(0.001)	(0.001)	(0.002)	(0.007)
Peer Measures:					
Peer Smoke	- 0.079*	- 0.016*	- 0.006*	0.024*	0.078*
	(0.003)	(0.001)	(0.001)	(0.001)	(0.003)
Demography:					
Age	0.009*	0.002*	0.001*	- 0.003*	- 0.009*
	(0.002)	(0.000)	(0.000)	(0.001)	(0.002)
Education	0.012*	0.002*	0.001*	- 0.003*	- 0.011*
	(0.001)	(0.000)	(0.000)	(0.000)	(0.001)
Male	- 0.037*	- 0.007*	- 0.003*	0.011*	0.036*
	(0.006)	(0.001)	(0.001)	(0.002)	(0.005)
White	- 0.059*	- 0.011*	- 0.002**	0.018*	0.055*
	(0.009)	(0.002)	(0.001)	(0.003)	(0.008)
Black	0.083*	0.015*	- 0.003	- 0.024*	- 0.071*
	(0.011)	(0.002)	(0.002)	(0.003)	(0.008)
Hispanic	0.057*	0.010*	- 0.001	- 0.017*	- 0.049*
	(0.009)	(0.002)	(0.002)	(0.003)	(0.007)
Other	- 0.017	- 0.004	- 0.002	0.005	0.018
	(0.023)	(0.005)	(0.004)	(0.007)	(0.025)

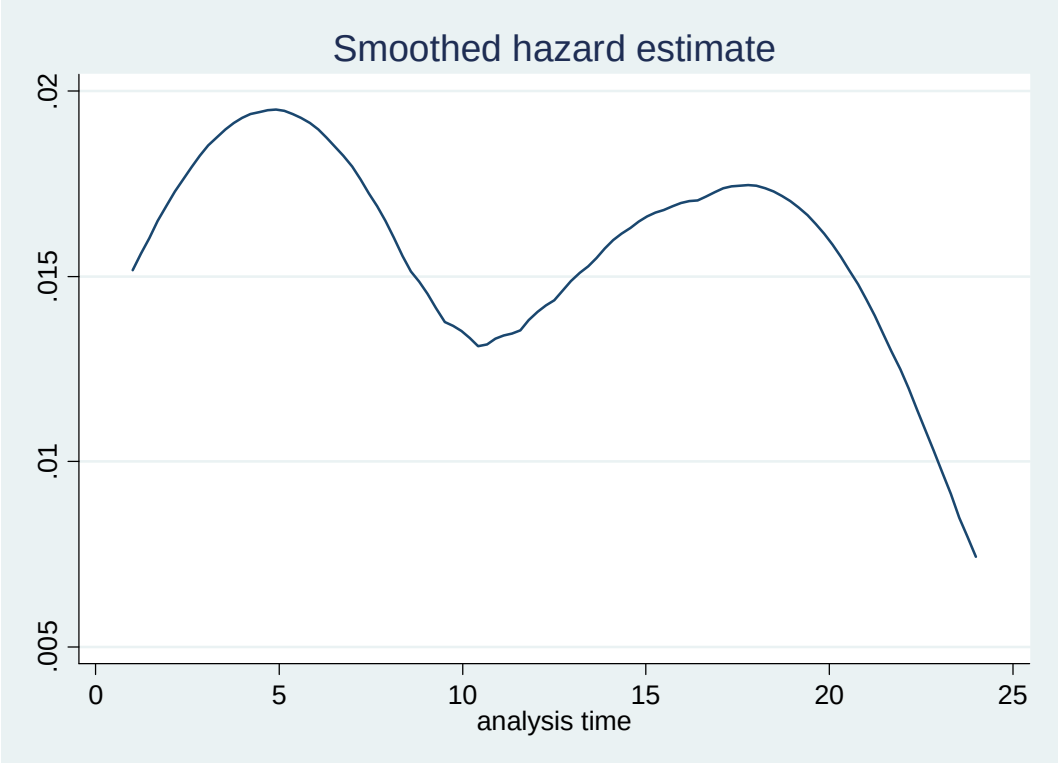
- all variables except demographies are for 1994.
* - sig at the 1% level; ** - sig. at the 5% level; *** - sig. at the 10% level.

Figure 2: Hazard of Smoking Initiation



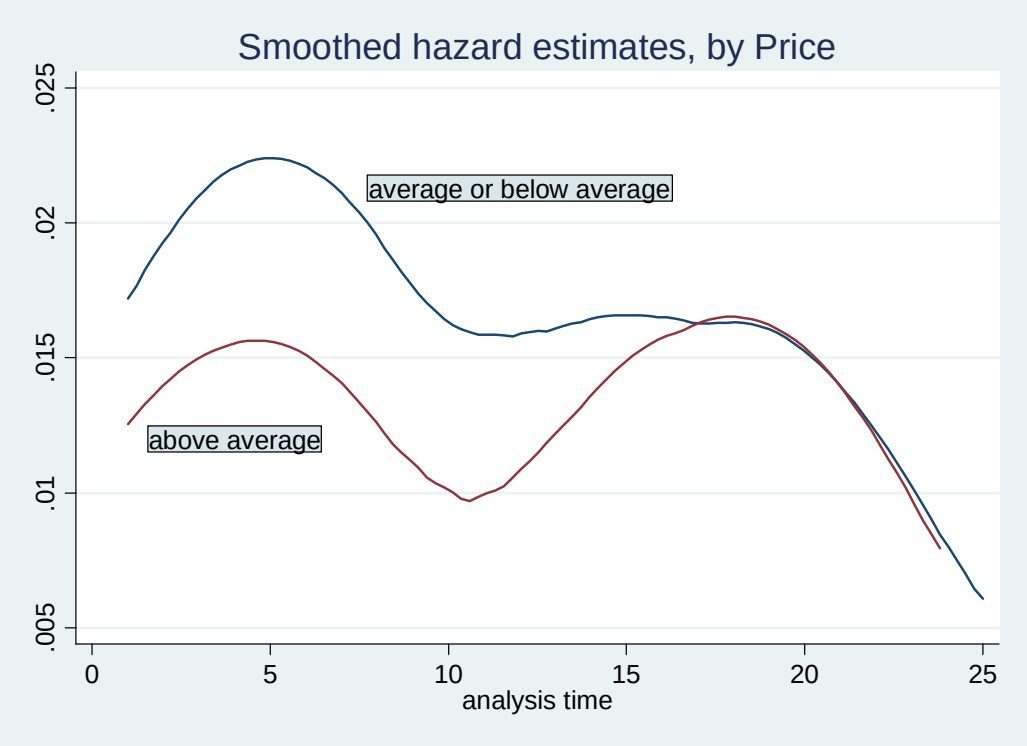
Analysis Time: Age of Initiation

Figure 3: Hazard of Being Regular Smoker



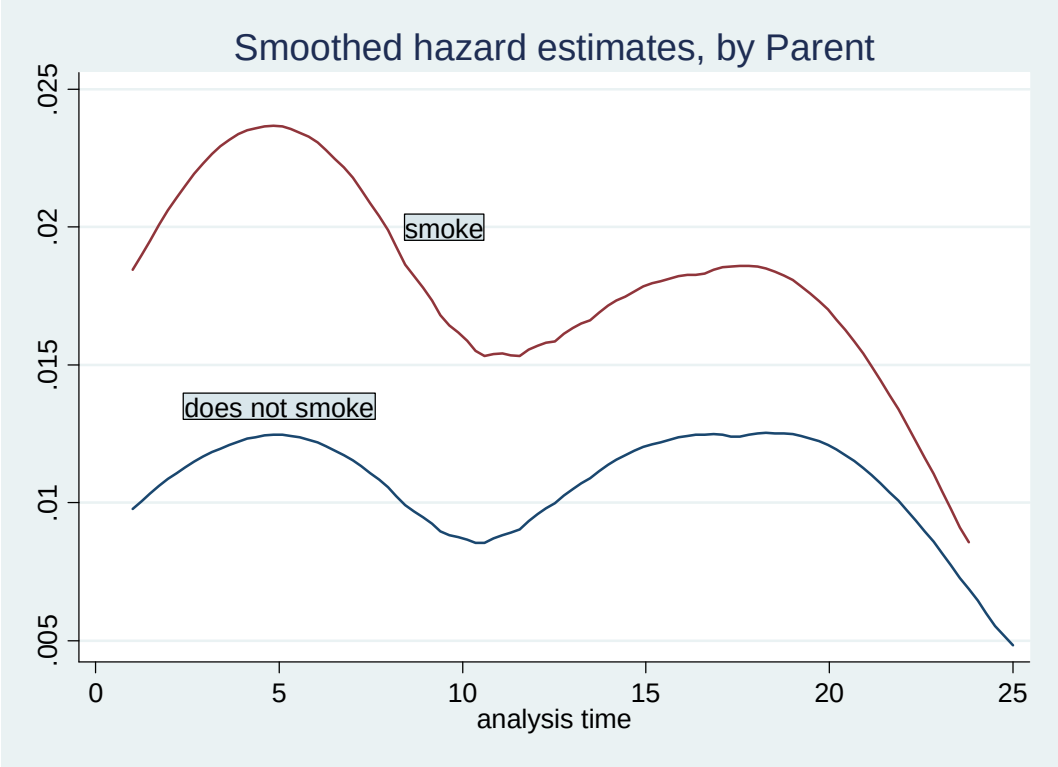
Analysis Time: Years before becoming a regular smoker; Onset of Risk: Age of Initiation

Figure 4: Hazard of Being Regular Smoker by Price



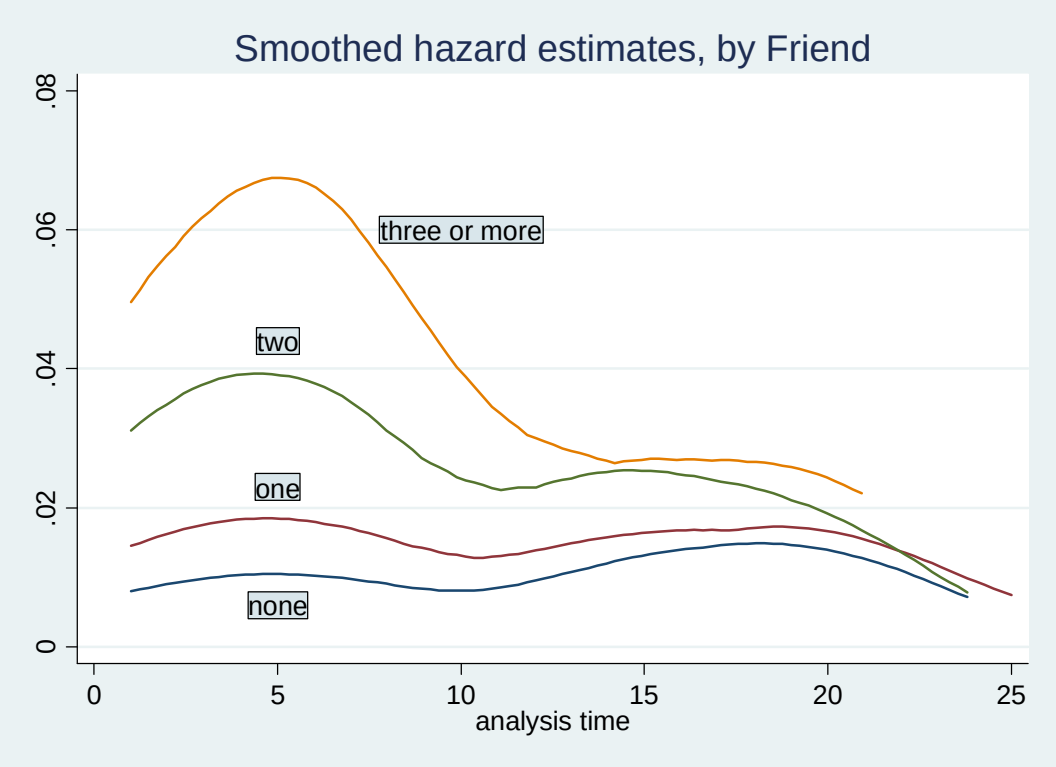
Analysis Time: Years before becoming a regular smoker; Onset of Risk: Age of Initiation

Figure 5: Hazard of Being Regular Smoker by Parent Smoking Status



Analysis Time: Years before becoming a regular smoker; Onset of Risk: Age of Initiation

Figure 6: Hazard of Being Regular Smoker by Peer Smoking Staus



Analysis Time: Years before becoming a regular smoker; Onset of Risk: Age of Initiation

Table 6: Estimation Results for Predicted Log of Years before becoming Regular Smoker (Weibull, Log-Logistic, Exponential, Log-Normal & Gamma Distribution)

Variables	Weibull	Log-Logistic	Exponential	Log Normal	Gamma
Price	0.044	0.060	0.049	0.046	0.048
	(0.068)	(0.071)	(0.076)	(0.072)	(0.071)
Policy Measures:					
Policy Index	0.104*	0.115*	0.114*	0.121*	0.118*
	(0.023)	(0.023)	(0.026)	(0.023)	(0.023)
Parent Measures:					
Parent Smoke	- 0.225*	- 0.207*	- 0.249*	- 0.223*	- 0.218*
	(0.043)	(0.042)	(0.0467)	(0.041)	(0.042)
Relationship Index	0.100*	0.100*	0.109*	0.106*	0.102*
	(0.021)	(0.022)	(0.023)	(0.022)	(0.022)
Easy Access	- 0.143*	- 0.175*	- 0.163*	- 0.186*	- 0.178*
	(0.038)	(0.039)	(0.042)	(0.040)	(0.039)
Peer Measures:					
Peer Smoke	- 0.409*	- 0.431*	- 0.440*	- 0.441*	- 0.435*
	(0.017)	(0.017)	(0.018)	(0.017)	(0.017)
Demography:					
Age	0.083*	0.073*	0.087*	0.069*	0.069*
	(0.010)	(0.011)	(0.011)	(0.011)	(0.011)
Education	0.158*	0.163*	0.173*	0.124*	0.144*
	(0.010)	(0.011)	(0.011)	(0.009)	(0.011)
Male	- 0.138*	- 0.143*	- 0.156*	- 0.159*	- 0.151*
	(0.035)	(0.036)	(0.039)	(0.036)	(0.036)
White	- 0.400*	- 0.375*	- 0.432*	- 0.356*	- 0.362*
	(0.067)	(0.065)	(0.073)	(0.062)	(0.063)
Black	0.660*	0.675*	0.717*	0.618*	0.640*
	(0.082)	(0.079)	(0.090)	(0.074)	(0.076)
Hispanic	0.703*	0.712*	0.765*	0.654*	0.677*
	(0.067)	(0.065)	(0.073)	(0.061)	(0.063)
Other	- 0.112	- 0.069	- 0.121	- 0.064	- 0.066
	(0.154)	(0.156)	(0.170)	(0.156)	(0.156)
Log Likelihood	- 6,326.63	- 6,263.03	-6,345.76	- 6,230.41	- 6,230.49
N	11,095	11,095	11,095	11,095	11,095

- all variables except demographies are for 1994.
* - sig at the 1% level; ** - sig. at the 5% level; *** - sig. at the 10% level.

Table 7: Hypothesis Testing of Function Form Assumption: Akaike Information Criterion

	Log Likelihood	AIC
Weibull	- 6,326.63	12,685.26
Log-Logistic	- 6,263.03	12,558.06
Exponential	- 6,345.76	12,721.52
Log-Normal	- 6, 230.41	12,492.82
Gamma	- 6, 230.39	12,494.78

Appendix 1: Hazard Ratio under Weibull and Exponential Distribution

Variables	Weibull	Exponential
Price	0.990	0.991
	(0.068)	(0.069)
Policy Measures:		
Policy Index	0.894*	0.894*
	(0.023)	(0.023)
Parent Measures:		
Parent Smoke	1.284*	1.286*
	(0.060)	(0.060)
Relationship Index	0.894*	0.896*
	(0.020)	(0.020)
Easy Access	1.175*	1.180*
	(0.049)	(0.049)
Peer Measures:		
Peer Smoke	1.574*	1.555*
	(0.028)	(0.027)
Demography:		
Age	0.912*	0.916*
	(0.011)	(0.011)
Education	0.840*	0.841*
	(0.009)	(0.009)
Male	1.165*	1.170*
	(0.045)	(0.045)
White	1.563*	1.547*
	(0.115)	(0.113)
Black	0.483*	0.488*
	(0.044)	(0.044)
Hispanic	0.454*	0.460*
	(0.033)	(0.033)
Other	1.150	1.147
	(0.195)	(0.195)
Log Likelihood	- 8,252.39	- 8,271.39
N	11,095	11,095

Appendix 4: Estimates without Policy Index

Variables	Log Normal
Price	0.0509
	(0.066)
Policy Measures:	
Policy Index	-
Parent Measures:	
Parent Smoke	- 0.227*
	(0.041)
Relationship Index	0.103*
	(0.022)
Easy Access	- 0.195*
	(0.040)
Peer Measures:	
Peer Smoke	- 0.449*
	(0.017)
Demography:	
Age	0.073*
	(0.011)
Education	0.125*
	(0.009)
Male	- 0.158*
	(0.036)
White	- 0.426*
	(0.061)
Black	0.560*
	(0.073)
Hispanic	0.688*
	(0.061)
Other	- 0.088
	(0.156)
Log Likelihood	- 8,169.12
N	11,095