國立政治大學應用經濟與社會發展
英語碩士學位學程

International Master's Program of Applied Economics
and Social Development
College of Social Sciences
National Chengchi University

碩士論文
Master's Thesis

吸煙行爲: 排列路徑方法
Smoking Behaviors: A Permutation Approach

Student: Tim Stahl
Advisor: 連賢明

中華民國　2016 年　6 月
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研究生：司亭牧　　Student: Stahl, Timothy

指導教授：連賢明　　Advisor: Lien, Hsienming

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Abstract

Using data from the 2009-2010 National Adult Tobacco Survey, this study investigates how the heterogeneity of individual behaviors affects demand for different types of cessation supports. Previous studies have demonstrated that smokers with a desire to quit have a demand for external cessation controls, however, there is limited research into how those same smokers demand individual disutility decreasing supports like nicotine replacement or counseling. We find that high addiction and consumption levels increase the demand for nicotine replacement or other medication. We also find support linking naïf hyperbolic discounters to lower demand for external cessation supports like smoking bans or cigarette taxes.

Keywords: rational addiction, time-inconsistent, hyperbolic discounting, heterogeneity, smoking taxes, pre-commitment, self-control, self-awareness, cigarette consumption

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1 Introduction

The World Health Organization warns that tobacco is one of the world's greatest health epidemics – killing 6 million per year. [1] The harms to individual health are well-established: increased rates of morbidity, cancer, cardiovascular disease, respiratory disease, and harm to nearly every organ in the body. [2] Smoking also imposes societal costs upon populations because of the externalities created by secondhand smoke. Estimates of gross healthcare costs imposed from smoking in high-income countries range from .10-1% of GDP. Additionally, smoking kills productive workers and reduces human capital through mortality. [3]

Consequently, governments have a strong imperative to curb smoking and therefore reduce the costs imposed upon individuals and society. An example from the USA was the Master Settlement Agreement of 1998, where the five largest tobacco companies paid a settlement, and established regulations for advertising, promoting, and regulating cigarette taxes. [4] In addition to taxing cigarettes and regulating advertising, smoking bans at work and public places are increasingly commonplace. Additionally, at an individual level, cessation supports like counseling, quit-lines, and nicotine replacement medications may be covered by social insurance. [1]

Still, the effectiveness of each policy depends on the causal factors driving smoking behaviors throughout the consumption lifecycle: initiation, consumption, and perhaps cessation. While a restriction of advertising may prevent initiation of smoking, it probably has less relevance regarding cessation.

Furthermore, cessation is a particularly interesting time in the smoking lifecycle because the majority of current smokers express a desire to quit, however, quitting has an 85% failure rate. [5] There is a barrier preventing intentions from materializing into action. Although chemical dependence on nicotine is an easy explanation, it fails to capture the entirety of the story behind why people cannot quit. For example, relapses often occur long after the period of physical withdrawal. Others start smoking, but have no problem quitting. Theories of addiction and self-control aim to complete the story about intentions failing to materialize into action.

Addiction and self-control are not physical objects, but rather social constructs. As such, definitions vary. Addiction and self-control are not purely the domain of consumption goods – alcohol, tobacco, or drugs – but also may include compulsive behaviors like gambling or procrastination. Addiction is usually presumed to be negative, but that may not always be the case, for example, addictions to exercise or compulsive healthy eating. However, in the context of smoking, the following definitions provide a working definition of the characteristics associated with cigarettes.

The American Society of Addiction Medicine frames addiction as mostly a biological, "chronic disease of brain reward, motivation, memory and related circuitry." Where a person's neurobiology, executive functioning, and genetics are causal factors. The addict is highly susceptible to behavioral cues, and craving states, so consequently relapse is a persistent possibility. [6]

The World Health Organization has stopped using the term addiction, and instead prefers dependence. Dependence, then, is explained in the context of consumption where dependence is created because of the need for repeated doses of the addictive substance, often manifesting in strong desires to consume the substance, difficulty abstaining, and sometimes physical withdrawal symptoms. [7]

While a precise descriptive definition is particularly important in the scope of a clinical diagnosis, it is not required for the scope of this paper. Instead, a working definition as inspired by US Supreme Court Justice Potter Stewart's famous line, "I know it when I see it," will suffice. The aim of this, then, is to allow flexibility later for model-precise specification.

Because of the incredible societal costs imposed by smoking, several theoretical economic models exist to explain smoking behavior. Then, empirical models have attempted to validate or invalidate the various models and ultimately pick a winner. However, the empirical results have, to this day, still not produced a clear winner amongst the theoretical models.

This suggests that there are bounds to when models are appropriate. Smoking populations are likely heterogeneous. Probably an individual slides through different

models during different stages of the addiction lifecycle. A permutation approach, then, to modelling addiction and self-control will require the marginal contributions of numerous empirical evaluations to piece together the theoretical underpinnings. To that, this paper will happily oblige.

This paper's unique contribution is the analysis of revealed preferences for different types of cessation strategies, building upon previously established characteristics of heterogeneous smoking populations. Our findings suggest that higher consumption and addiction levels decrease demand for taxes and bans, but increase demand for individual nicotine replacement therapy or medication during the cessation period.

2 Background

Addiction, self-control, and self-awareness are an enduring part of the human condition.

Already, in 805 B.C. Homer's epic The Odyssey describes the commands from a ship captain, Odysseus, as he and his shipmates are approach the area where the Sirens inhabit:

> …if thou myself art minded to hear, let them bind thee in the swift ship hand and foot, upright in the mast-stead, and from the mast let rope-ends be tied, that with delight thou mayest hear the voice of the Sirens. And if thou shalt beseech thy company and bid them to loose thee, then let bind thee with yet more bonds. *[8]*

The Sirens sing so beautifully and persuasively that the crews of ships are unable to resist their influence and end by crashing into nearby rocks. Odysseus, after consulting an advisor, had the foresight to do two things: (1) Command his crew to tie him to the mast until out of earshot. (2) Command the crew to wax their own ears so they cannot hear the Sirens. Ultimately, the plan went accordingly with Odysseus tied to the mast and his crewmates unwilling to let him free and unable to hear the Sirens because of their waxed ears. However, this begs more than a few questions. Why didn't Odysseus also put wax in his ears? Why didn't more of the crew forego the waxed ears and opt for being tied down? Why didn't any of crew rip the wax out of their ears after seeing the excitement of Odysseus?

In modern times, social researchers continue to explain these Odysseus-like situations involving, most notoriously, cigarettes, alcohol, drugs, gambling, food, and procrastination. While these are all different scenarios, they still overlap to various degrees, under the general theme of addiction and self-control.

There is an extensive, multi-disciplinary body of literature explaining these themes under the framework of biology, psychology, and economics. The earliest theories of addiction were pioneered by psychologists and are often used as the causal underpinnings behind the tractable economic theories. Recently, neurobiological explanations are gaining traction as technology allows researchers to visually map the brain.

The following literature review was constructed using the VOSviewer network analysis tool [9] for mapping citation impact for various keywords related to addiction, self-control, and self-awareness.

The literature review goals are two-fold, then: firstly, to provide a brief explanation of the relevant theories, terms, and models so to develop a foundation that, secondly, allows even an unfamiliar reader to understand the rational for the research questions this paper aims to address.

2.1 Discounted Utility

Intertemporal choices, tradeoffs between costs and benefits that occur in a sequence of time periods, were neatly mathematically modeled by Paul Samuelson in 1937 [10] when he published the Discounted Utility (DU) model, with functional form:

$$U^t(c_t,\ldots,c_T) = \sum_{k=0}^{T-t} D(k)\, u(c_{t+k}) \qquad \text{where } D(k) = \left(\frac{1}{1+\rho}\right)^k.$$

Where,

And U^t = total period utility

$U(C_{t+k})$= per period (period t+k) utility

$D(k)= (1/1+p)^k$ = the discounting component

Note that consumption preferences are independent across periods – one period's consumption does not affect the marginal rate of substitution for different periods. Secondly, per period utility is independent – knowledge about future periods wouldn't influence present period utility. Samuelson himself disavowed the models realism [10].

Becker and Murphy's rational addiction model modifies the assumption of consumption independence throughout periods [11]. Formally:

$$u(t) = u[y(t), c(t), S(t)].$$

Where u(t) = the utility at any moment as a function of goods y and c, and S is the stock of "consumption capital" of previous c, which removes the consumption independence in the Samuelson DU model.

Then, the investment function is expressed by:

$$\dot{S}(t) = c(t) - \delta S(t) - h[D(t)],$$

Where $\dot{S}(t)$ is the rate of change over time in S, c is learning by doing, δ is the depreciation of consumption capital, and D(t) are the endogenous expenses on appreciation or depreciation.

Finally, lifetime utility, with a lifetime of T, and constant discount rate of α is given by:

$$U(0) = \int_0^T e^{-\alpha t} u[y(t), c(t), S(t)]dt.$$

Where utility over time is not separable in y and c alone. This captures the changing inter-period marginal rate of substitution between goods.

Finally, Consumers are aware that consumption in addictive goods may have detrimental effects in the future and even account for it in their utility maximizations. Consumption decisions are based on a lifetime cost-benefit maximization, and "…present and future consumption of addictive goods are complements, and a person becomes more addicted at present when he expects events to raise his future consumption. That is, in our model, both present and future behavior are part of a consistent maximizing plan. [11]"

The exponential discounting form, then, is time-consistent: lifetime utility would be indifferent between a two week delay in utility a week from present, or a year. A person who plans to quit smoking next week would do it absolutely. People wouldn't procrastinate if they previously planned not to. Yet, while these examples are unexplained under the above models, they are a common occurrence in the real world.

Lifetime utility maximization, then, depends on intertemporal choices. Utility maximization in the present will also plan future optimal consumption decisions. The problem, then, is that each time period presents a new consumption choice, and therefore a chance to re-evaluate the previously established consumption plans. In this sense, plans in the present need to consider whether the future plans will be carried out obediently. In a sense, the present self needs to consider whether the future self will be obedient or disobedient. Strotz [12] has considered this problem of self-control, coined "intertemporal tussle," which occurs when future utility is not discounted time consistently or when preferences change.

Secondly, he specifies whether people are even aware of self-control problems. If people are aware of their self-control problems, they are sophisticates while those unaware of their self-control problems are coined naïfs. He further explains some options the sophisticates have for making sure the future plans are carried out obediently. One option is pre-commitment: taking away or changing the terms, by increasing costs of undesired consumptions choices, of the future decision to ensure they agree with the previously laid out consumption path. The second, and less desirable, plan is carefully choosing future consumption decisions to ensure obedience.

Animal behaviorists also noticed that time-consistent behavior poorly described experimental results. A more useful model for the real world, then, was hyperbolic discounting [13]. True hyperbolic discounting takes a form similar to:

$$U_0 = C_0 + \left(\frac{1}{1+k}\right) C_1 + \left(\frac{1}{1+2k}\right) C_2 + \ldots$$

Where the discount rate is relativistic with time from present (τ), then f(τ)=1/1+kτ

However, most economic models actually use a slightly different form, commonly called quasi-hyperbolic preferences.

The quasi-hyperbolic model was first developed by Phelps and Pollack [14] to explain intergenerational time preferences for savings. Later, Laibson, applied this model to individuals to explain under-saving for retirement [15].

Formally, the model follows this form:

$$U_t = E_t\left[u(c_t) + \beta\sum_{\tau=1}^{T-t}\delta^{\tau}u(c_{t+\tau})\right].$$

Where,

Ut= lifetime utility

Et= expected instantaneous utility

u(ct)=utility at period t

B= present bias

S^{τ}=discount rate at time in relativistic years from present(τ)

$u(c_{t+\tau})$ = utility at period t+τ

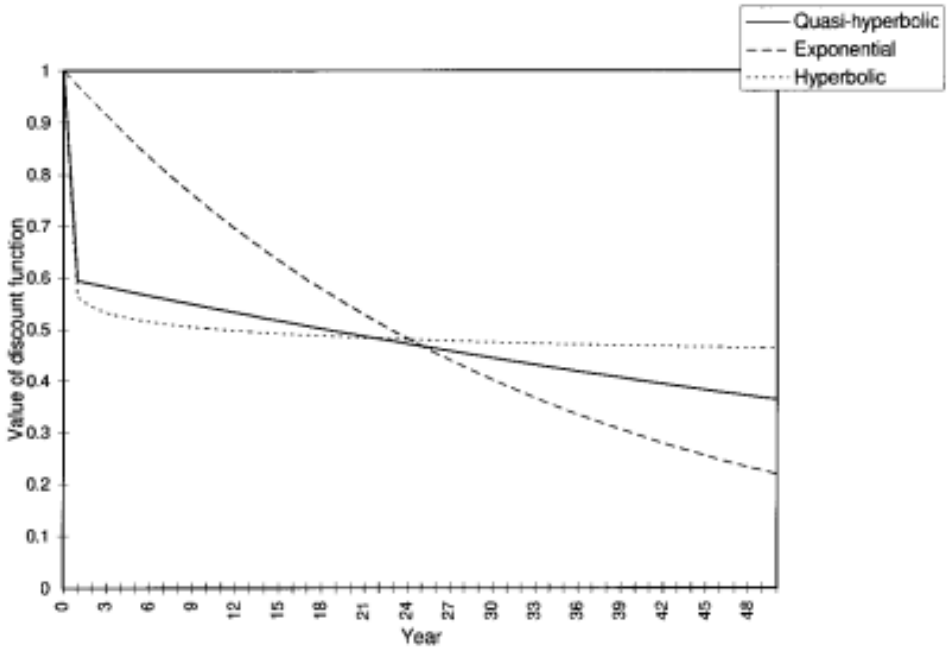
By adding a B that takes the value 0>B>1, it's clear from the model that inconsistent time preferences arise. B=1 implies time consistent preferences.

This model is often called the Beta-Delta model as it can be modelled accordingly:

$$U_0 = C_0 + \beta\delta C_1 + \beta\delta^2 C_2 + \beta\delta^3 C_3 + \ldots$$

Again, where 0>B>1. Notice that from relativistic time=0 to time=1, the change in discount rate is sharply B*S, while after that, the change in S is decreasing as a function of relativistic time from t=0.

Graphically, we can see the differences in the functional forms. Exponential model with S=.99, and quasi-hyperbolic with B=.6 and S=.97



[15]

Lastly, from Laibson [15], hyperbolic discounters are willing to give up income to create incentives to fight against present bias. Under quasi-hyperbolic discounting conditions, a desired behavior can be perpetually procrastinated.

The possibility of perpetual procrastination, then, explains why a sophisticated, present-biased, quasi-hyperbolic discounter would need costly commitment devices to force obedience upon the future decision maker in order to maximize lifetime utility.

The idea is empirically explored as it relates to cigarette smoking. Kan 2006, offers evidence against the Becker rational addiction model. Specifically, by developing an empirical model and showing that smokers with an intention to quit have a demand for pre-commitment devices: cigarette taxes and smoking bans. These pre-commitment devices increase the cost of future period smoking, enough to stop current period smoking. Because rational addicts with time consistent preferences shouldn't do anything to minimize their utility, this casts doubt upon the time consistent preferences in the rational addiction model [16].

The hyperbolic discount model used in the Kan paper follows the hyperbolic discounting form, developed by Phelps and Pollack [14]:

$$U_t = \delta^t u(c_t) + \beta \sum_{\tau=t+1}^{T} \delta^\tau u(c_\tau),$$

Where, Ut=is lifetime utility at time, t

S and B are discount factors

ct = consumption at time t

u(ct) = utility at time t

Then, per period options are Q for quit smoking, S for continue smoking, and N, for non-smoking. Ordinal per-period utilities are Q<S<N

Precisely, the individual will be a perpetual procrastinator if the following conditions holds:

$$\frac{\beta\delta}{1-\delta}(N - S) < S - Q < \frac{\delta}{1-\delta}(N - S),$$ [16]

So, in order to quit smoking, the smoker may choose to impose a cost, C, upon themselves in future periods to swing the lifetime utility of smoking in their favor. C must be large enough for the following inequality to hold:

$$C > S - Q - \frac{\beta\delta}{1-\delta}(N - S),$$ [16]

Finally, empirical support indicated that a desire to quit increased the demand for controls – a demand for C. Under the Becker Rational Addiction model, this shouldn't happen because time consistent smokers wouldn't give up utility.

However, Gruber and Köszegi [17] empirically test the assumptions of the BRM and find support for the forward thinking utility maximizers. However, in line with psychological research, they modify the model to allow time inconsistent preferences. Importantly, they specify different types of cessation support that those who plan to stop smoking may

employ: (1) costly commitment (self-control) devices, like the Kan paper provides support for, or (2) quitting aids, for example counseling or nicotine replacement therapy. This has important implications: the commitment devices decrease utility from smoking while the quitting aids decrease disutility associated with cessation. Then, time consistent decision makers could use a quitting aid, but would never opt for a costly commitment device. Also, time-inconsistent decision makers would only use commitment devices if they are sophisticated.

Rabin and O'Donoghue further specify present biased decisions by differentiating between immediate costs couples with delayed rewards and immediate rewards coupled with delayed costs, highlighting the different game theoretic outcomes under sophistication or naivety. Present biased, sophisticated agents fare better than naïfs when facing immediate cost situations because naïfs can fall into the perpetual procrastination loop. Given immediate rewards, however, the sophisticated agent is worse off because they fall into a sort of repeated prisoner's dilemma: they simply consume now the immediate cost now, knowing they lack self-control in the future. [18]

2.2 Cue Triggered Response

For behaviors that create physical dependence, like smoking, the highest costs of quitting, in terms of disutility, are in the early stages of quitting because there are physical and mental withdrawals. However, recidivism often happens long after initial abstention. Drawing upon psychological and biological models, Bernheim develops a model to explain self-control and addiction in terms of cue-avoidance. [19] The model also explains the idea of a "hot" or "cold" preference state, independent of present-bias, where cravings can be induced by the environment. In this case, avoiding cues doesn't necessarily involve adding costly pre-commitment devices. The idea of craving states are supported in biological foundations.

In the context of pathological gambling, Potenza [20] summarizes the neurobiological foundations of addiction. Several neurotransmitters have physiological functions linked to attributes of impulsivity, addiction, and self-control. Noradrenaline is linked to higher measures of extroversion, arousal, and excitement, and prefrontal cortical functions.

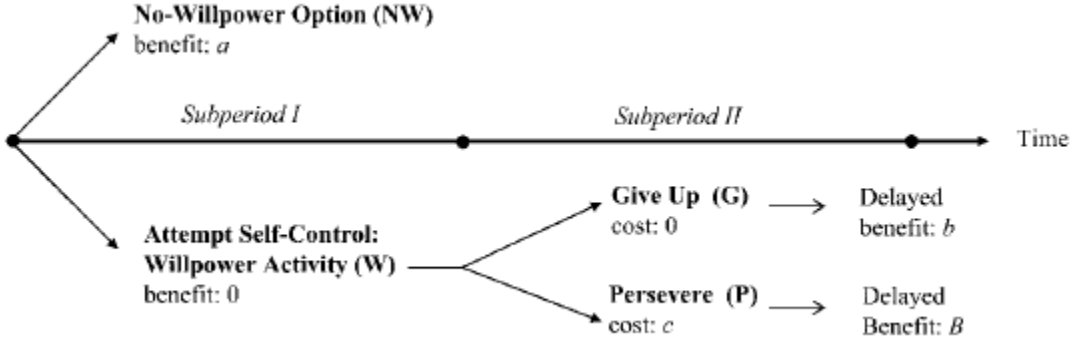
Furthermore, those with pathological gambling were found to have higher levels of Noradrenalin than those without. Serotonin has also been linked with impulse control, with those suffering from diagnosed control disorders having lower serotonin metabolites. Dopamine is linked to rewarding and reinforcing addictive behaviors. Secondly, the neural networks of pathological gamblers, those dependent on alcohol or cocaine, and children are different compared to adults. In the addicted populations, the ventral striatum, responsible for reward anticipation in the short term, appears to have less activation. The dorsal striatum, responsible or long term planning, are also less active when compared to non-addicted adults. The authors conclude that more research is needed to investigate whether neural circuitry changes throughout different phases in addiction – for example, initiation of the behavior and escalation into addiction.

2.3 Internal Controls

The above models are focused on possible behavioral controls via external forces. However, this is a de-facto concession of internal, individual self-control. Consequently, Tirole [21] has proposed a behavioral model where individuals make personal rules, or internal commitments, in order to build their stock of self-confidence. Mechanically, because people have imperfect awareness of their willpower, their previous choices may affect their self-image. Then, the fear of creating a precedent that would harm an individual's self-image works as a type of internal control mechanism.

The driving themes of the paper are (1) imperfect willpower – present bias. (2) Imperfect memory recall.

Then, the decision tree takes this form:



Where c>0, and B>b, however the ranking of a to b is ambiguous.

Psychologically, there the theory of planned behavior explains the causal mechanism involved with the self-identity creation as a function of past lapses. The theory of planned behavior models attitude toward the behavior, subjective norms, intentions, and perceived behavioral control as predictors of behavioral outcomes. The causal pathway traces all the predictors through intention. Perceptions of behavioral control is the individual's confidence in their ability to achieve a behavioral outcome. [22] Just as addictive stock in behaviors can be learned by doing, so can an exasperated, all hope is lost type of attitude may be learned by failing.

2.4 Imperfect Awareness

Through an experiment, Ariely 2002, [23] finds that those who self-identify as procrastinators are willing to impose costs upon themselves in the form of deadlines, these imposed costs do improve performance, however not at an optimal level. The reasons behind the sub-optimality were not investigated in the research, but speculatively included biased rationality, cognitive limitations in setting deadlines, or a mixed strategy of wanting both control and flexibility.

As applied to smoking cessation, however, Hersch [24] uses panel data to show increased support for cigarette taxes if the smoker has tried to quit and failed once. The implication suggests that smokers may have a learning curve and can slide on the scale of self-awareness that differentiates sophisticates and naivety.

2.5 Smoking Populations are Heterogeneous

Grignon (2009) posits that smoking populations are likely heterogeneous in time preferences – some may in fact be exponential discounters while others are hyperbolic. He investigates, then, how an individual's time preference affects their decisions regarding smoking. Using cross-sectional data, he finds no relationship between discounting behavior and the decision to start smoking. However, those with present-biased time preferences quit smoking later in life, are not price sensitive in their attempts

to quit, and have more failed quit attempts [25]. Ida 2014 [26] uses the Fagerström Test for Cigarette Dependence to create a latent variable of addiction levels and finds a correlation between present-biased utility and high addiction levels.

However, the Grignon and Ida papers didn't disaggregate naïve and sophisticated individuals. Ikeda 2014 [27] disaggregates sophisticates and naïfs using panel data. Under Cragg's two part model, the results indicate that discounting rates affect the probability of initiating smoking and secondly, the number of cigarettes consumed among smokers. Furthermore, naïve hyperbolic discounters are more likely to start smoking than sophisticated hyperbolic discounters. Lastly, the study noted that an individual's time preferences were not stable throughout time, casting doubt on an assumption implicit to many models.

2.6 Summary and Motivation

In summary, the previous models describe populations, often but not exclusively in the context of smoking, who discount utility across time. Under the rational addiction model, the discounting factor is exponential, time consistent, and agents are forward-looking. Quasi-hyperbolic discounting, however, adds a Beta that accounts for time inconsistent behavior. The Laibson framework explains how under the quasi-hyperbolic framework, strong biases for the present can create a perpetual procrastination loop.

Then, secondly, whether individual agents are aware of the type of their behavior - sophisticates or naïfs. Naturally, following the model assumptions outlined above, this further distinction only applies to quasi-hyperbolic discounters. Naïve agents have a Beta with a value between 0 and 1, but think they have a Beta equal to one. In the context of smoking, the group of naïve smokers would not choose to impose costly external pre-commitments upon themselves because they are not aware they could benefit from them. The sophisticates are the self-aware quasi-hyperbolic discounters. They solve a backwards induction problem at t=0 to align their future decision tree with the current optimal. One way for them to align their future decisions with the current optimal is to increase the costs in future utility streams. This is why empirical studies have looked for evidence of smokers imposing external costs upon themselves in the form of smoking

taxes or smoking ban - only the sophisticated quasi-hyperbolic discounters would exhibit a behavior like this.

However, smokers are a likely heterogeneous population – a mix of exponential discounters, quasi-hyperbolic sophisticates and naïfs. Furthermore, ex-ante and ex-post preferences and behavior are likely not stable throughout time at the individual level.

While other studies have linked certain behaviors like higher addiction levels, and more failed quit attempts to naïf hyperbolic discounters, as far as we are aware, few studies have linked the behaviors to demands for cessation support. Only Hersch, [24] has explained increased demand for public smoking bans as a function of failed quit attempts and consumption. However, as far as we are aware, no papers have done similar studies for the individual cessation supports that are aimed at decreasing disutility – nicotine replacement and counseling.

This paper's unique contribution, then, is investigating whether characteristics linked to particular types of smokers will translate to revealed preferences that are consistent with their type, and secondly, whether these same behaviors affect demand for supports that decrease disutility from cessation.

A more thorough understanding of the mechanics of cessation are important because smoking is costly. The US Surgeon general estimates that the economic costs to the US are in excess of USD150billion per year. This captures the productivity loss from mortality, but not morbidity. Healthcare costs attributed to smoking are estimated to be around 7% of total healthcare expenditures. [28] At individual level, smokers also internalize increased healthcare costs compared to lifetime nonsmokers. If healthcare premiums on account of smoking were incorporated into the price of cigarettes, each pack would have an additional USD35 on top of the purchase price. [29]

However, health is not a completely sunk cost after smoking initiation. Starting and quitting would still be preferable to starting and continuing to perpetuity, but research finds recent quitters increased healthcare utilization in the first year after quitting smoking. Then, in the following years, healthcare utilization converges to non-smoker levels. [30] Because quit attempts are a window of opportunity for behavioral change,

information about how different types of smokers experience the cessation period is valuable.

3 Data

The statistical findings of this study are based on the 2009-2010 National Adult Tobacco Survey Questionnaire (NATS). The goal of this survey was to provide a framework to evaluate national and state tobacco control policies and characterize adult tobacco user behaviors while controlling for sociodemographic factors. [31]

The NATS was a national, cross-sectional study conducted from October 2009-February 2010. The survey uses a two-stage (house, then individual respondent), weighted sampling procedure divided into two frames – landlines and cell phones – respectively divided into three strata: a listed landline stratum, a not-listed landline stratum, and a cellphone stratum. The listed stratum was oversampled relative to the not-listed stratum. The target landline was equally distributed among the states, while the cell phone strata was proportional to population. Accordingly, three sets of weights were created: national estimates, state estimates, and landline estimates. [32]

The final sample size is 118,581 adults 18 or over. 67,272 have never smoked. 34,327 are ex-smokers. 16,542 are current smokers. Of the current smokers, 10467 want to quit, 5185 do not. 2846 individuals were currently quitting during the interview.

This paper will focus on the group of current smokers who have expressed a desire to quit. The descriptive statistics for the sociodemographic variables, sorted by different groups from the study are summarized in table 1.

Table 1. Descriptive Statistics from the NAT

# obs Mean SD	**Total Sample N=118581**	**Current Smoker N=16,542**	**Lifetime Non-Smoker N=67272**	**Former Smoker N=34327**	**Current Smokers With Plans to Quit N=10467**	**Current Smokers Without Plans to Quit N=5185**	**Currently Quitting For Good N=2846**
Age	115741 53.92 16.75	16275 48.21 15.16	65450 52.38 17.20	33601 59.59 14.89	10307 47.61 14.29	5099 49.05 16.53	2796 45.32 16.30

Sex (Binary. Male=1)	118408 0.39 0.49	16513 .44 .5	67158 .35 .48	34302 .46 .5	10451 .43 .5	5173 .46 .5	2839 .48 .5
Education[1]	117784 3.76 1.61	16443 3.04 1.46	66788 3.97 1.6	34128 3.72 1.59	10409 3.02 1.45	5155 3.04 1.46	2827 3.31 1.51
Income[2]	103254 4.56 2.12	15007 3.63 2.07	57878 4.8 2.09	30061 4.56 2.08	9612 3.62 2.07	4648 3.66 2.06	2586 4.15 2.11
Marriage (Binary. Married=1)	117666 .56 .50	16459 .39 .49	66709 .59 .49	34068 .58 .49	10419 .39 .49	5159 .38 .48	2831 .45 .5

* observation numbers differ b/c I drop non-responses and "don't know" responses

(1) Education is an ordinal variable with the following assignments: 1=Less Than High School Diploma, GED, or Equivalent 2=High School Diploma, GED, or Equivalent 3=Some College, no degree 4=Post High School Certificate or Diploma, or Associate degree 5=Bachelor's Degree 6=Master's, Professional, or Doctoral degree

(2) Income is an ordinal variable with the following assignments: 1= less than $20,000 2=$20,000 to less than $30,000 3= $30,000 to less than $40,000 4=$40,000 to less than $50,000 5=$50,000 to less than $70,000 6=$70,000 to less than $100,000 7= $100,000 to less than $150,000 8= $150,000 or more

3.1 Variable Settings

In the following section, we will present our variables of interest and corresponding questions used in their construction.

The NATS has several questions about smoking policies. Particularly, we are interested in demand for different types of smoking cessation methods. Cigarette taxes and smoking bans are externally imposed, costly controls - they would increase the cost thereby reducing the net benefit of future cigarette consumption. On the contrary, counseling or nicotine replacement therapy are aimed at reducing the disutility associated with smoking cessation during the withdrawal period.

This study is interested in these different supports because the theoretical models specify which type of support a particular type of individual would likely use. The rational, time consistent addicts would never use any costly external control that reduces the net benefits in the future stream of utility from cigarette consumption. Naïve hyperbolic discounters are also not aware they even need this type of external control, so they would not opt for anything costly. Then, the only group opting for this type of costly, external control is the sophisticated hyperbolic discounters – they know they may not be time

consistent with future choices, but are willing to pay with future utility in order to coerce compliance with the present plans. Lastly, disutility minimizing supports like nicotine replacement therapy, quit lines, or counseling could be utilized by any type of individual.

3.1.1 Dependent Variables

1. Cigarette Tax (bincigtax) captures support for cigarette taxes. It is a binary variable created from the question, "Would you be in favor of an increase in the tax on a pack of cigarettes if the money were used to improve the public's health?"

2. Restaurant Smoking Bans (binrestban) is a binary variable created from the question, "Should smoking indoors in restaurants [always/sometimes/never] be allowed?" Never was assigned 1 as it is a position against smoking.

3. Bar Smoking Bans (binbarban) is a binary variable created from the question, "Should smoking indoors in bars, casinos, or clubs [always/sometimes/never] be allowed?"

4. Park Smoking Bans (binparkban) is a binary variable created from the question, "Should smoking at parks [always/sometimes/never] be allowed?"

5. Cessation Assistance (binfutasst) regards whether people who want to quit smoking will seek cessations supports. It is created from the question, "When you try to quit smoking, do you plan to use a telephone quit line, a class or program or one-on-one counseling from a health professional to help you quit?"

6. Medication Usage (binfutmed) measures whether people plan to use medication to quit smoking. It is created from the question, "When you try to quit smoking, do you plan to use a nicotine patch, nicotine gum, lozenges, nasal spray, an inhaler, or pills such as Wellbutrin, Zyban, buproprion, Chantix, or varenicline to help you quit?"

All of the dependent variables are binary. For variables 1-4, a preference in favor of a tax or ban is coded as 1. For variables 5 and 6, a preference for seeking out cessation assistance or medication is coded as 1.

3.1.2 Independent Variables

The main research focus of this paper is to examine how heterogeneity in the smoking population with a desire to quit affects demand for different types of smoking cessation support. For example, naïve hyperbolic discounters smoke more cigarettes, have more failed quit attempts, and have a higher likelihood of initiating smoking. [33] Those with a present bias also have a higher level of addiction. [26]

Under predictions of the empirical models, only the sophisticated hyperbolic discounters have a preference for costly "penalties" for future smoking: taxes, bans. Kan has found a link between a desire to quit smoking and a support for costly pre-commitment, however was not able to disaggregate the population according to sophistication or naivety, or smoking behaviors. [16] The NATS does not have questions about time preferences, discounts, or sophistication or naivety. However, it does have questions about behaviors that have a demonstrated association with the differently modeled individuals:

1. Addiction levels (binaddicthigh) was constructed from the question, "How soon after you wake up do you usually have your first cigarette?" This was coded as a binary variable signifying high addiction levels if a cigarette was smoked within five minutes of waking up.

2. Daily consumption (SMOKPERDAY) is an ordinal variable constructed from the question, "On average, about how many cigarettes a day do you now smoke?"

3. Previous quit attempts (QT12MOS) is an ordinal variable constructed from the question, "During the past 12 months, how many times have you tried to quit smoking for good?"

4. Gender (bingender) is a control variable which is specified as 1 if gender is male.
5. Age (AGE) is a control variable that is ordinal and takes the range of 18-113.
6. Education (Educa2_r) is an ordinal control variable. The original answers were recoded with the following assignments: 1=Less Than High School Diploma, GED, or Equivalent 2=High School Diploma, GED, or Equivalent 3=Some College, no degree

4=Post High School Certificate or Diploma, or Associate degree 5=Bachelor's Degree 6=Master's, Professional, or Doctoral degree.

7. Marriage (binmarriage) is a binary control variable. Those responding as married were coded as 1.

8. Household income (INCOME2) was coded as an ordinal variable. Income is an ordinal variable with the following assignments: 1= less than $20,000 2=$20,000 to less than $30,000 3= $30,000 to less than $40,000 4=$40,000 to less than $50,000 5=$50,000 to less than $70,000 6=$70,000 to less than $100,000 7= $100,000 to less than $150,000 8= $150,000 or more.

9. Health insurance coverage (hccpayqs) that pays for individual cessation supports like counseling or medication is included in the regressions about healthcare utilization. If an individual's insurance payed for counseling, quitlines, or medication being used as an aid in cessation, then it was coded as 1.

3.2 Data Processing

The NATS is an excellent opportunity for research because it has a large sample size that allows us to separate the sample into different groups of smokers. Furthermore, it asks about many different types of smoking cessation supports: those that would decrease future streams of utility, or those that would decrease disutility during a quit attempt. This is particularly important because the theoretical models explain different types of utilization patterns for these supports.

However, there are some caveats and cautions with this survey. Firstly, the demographics seem skewed towards an older sample. According to the US census, the median age in 2009 was 36.9, while our samples have a mean age around 50. The sex ratio also skews towards women. Lastly, the survey did not ask any questions to reveal time preferences or discounting rates, so we are not able to disaggregate before running regressions, but instead rely on revealed preferences to draw inferences about whether those preferences are consistent with the expected behavior under the theoretical models. The data is also

cross-sectional data, so the study must think carefully about how to avoid introducing a bias from omitted variables.

Another problem with the data was dealing with refusal to answer questions. Many questions had a high refusal rate, particularly those related to income, insurance, and preferences for smoking bans in the home. The survey also had ambiguous responses like "maybe" or "sometimes." These didn't serve to strongly identify a cessation strategy, so they were also dropped. The combination of these refusals and ambiguous answers resulted in a high rate of attrition, particularly for the healthcare related questions. Consequently, the regressions regarding the individual supports (binfutasst and binfutmed) were ran separately to prevent such large amounts of sample attrition.

4 Research Design

4.1 Hypotheses

4.1.1 Demand for Costly External Cessation Supports

The first type of cessation support we analyze is costly, external commitment supports that aim to decrease future utility if smoking is continued. Conditional upon current smoker with a desire to quit, this paper will test whether different predictors: addiction level, consumption, and past quit attempts affect demand for costly external commitment devices like taxes and bans.

The relationship between demands for different types of cessation support can be analyzed by assigning the individual smoker's consumption patterns to a predicted type of smoking model they fall under. From the theoretical models, there are various types of individuals, then:

Type 1. Rational addicts who would not demand any costly support if it reduced their utility.

Type 2. Naïve hyperbolic discounters who would not demand any type of costly support because they do not recognize that they need it.

Type 3. Sophisticated hyperbolic discounters who would demand costly supports because they are aware their plans are not time consistent.

Certain expressed behaviors, like high cigarette consumption, high addiction levels, and high quit attempts, have been linked to Type 2, the naïve hyperbolic discounter. [33] Then, if we assume a positive relationship between higher expressed behavior and higher proportions of the Type 2 individuals, we should also see decreased demand for costly cessation supports like cigarette taxes and bans as the proportion of Type 2 individuals increases because the naïfs or time consistent individuals either don't need them or don't think they need them.

Formally, we can test the following hypothesis:

Ho: Addiction levels, failed quit attempts, and daily consumption have no effect on the demand for costly external supports
Ha: Addiction levels, failed quit attempts, and daily consumption have an effect on the demand for costly external supports

4.1.2 Demand for Disutility Decreasing Cessation Supports

The second type of cessation support are the individual options like quit lines, counseling, or nicotine replacement therapy. All three types of smokers could have a demand for counseling, quit lines or nicotine replacement because these act to decrease disutility during the cessation period without affecting future streams of utility – this isn't running contrary to any of the posits of any model.

These supports, however, still do have a consumption price. If the smoker believes that the price of the cessation support will adequately compensate them by sufficiently alleviating the disutility from cessation, then they will be positively demanded. If the contrary is true, and the smoker believes the support price to be higher than the corresponding decrease in disutility, then they will be negatively demanded.

This sets up a basic cessation utility maximization problem. We'll assume a one-shot quitting period. Then, we will assume a choice between two products: quitting support and no-quitting support. Then, the quitting support will be demanded if the following condition is met: Expected utility gain – support price>0.

The important consideration is the perception of disutility associated with smoking cessation. Again, the smoker needs to make a forecast into the future and predict their disutility during the cessation period. If smokers expect to experience very little disutility from smoking, then the supports may be a loss in utility. Smoking withdrawal is linked to the physical dependence created by nicotine. Consequently, higher addiction, consumption, and smoking quits are all signals of a difficult cessation period. Therefore, they could predictably increase demand for the supports.

However, this is an interesting distinction, then, if smokers with a desire to quit exercise foresight about disutility mitigation, but are aloof about their time inconsistency.

Formally, we can test the hypothesis:

Ho: Addiction, quit attempts, and consumption have no effect on the demand for individual supports
Ha: Addiction, quit attempts, and consumption have an effect on the demand for individual supports

Our statistical model, then, will test the effect of addiction, quit attempts, and daily consumption as a predictor of demand for different supports.

4.2 Statistical Model

This statistical research tool used in this paper is the M-estimation linear model, an extension of the Least Absolute Deviation method, which was proposed by Huber in 1968 [34] as a method of robust regression.

We use a robust regression to account for leverage points in the independent variables as well as heteroscedasticity in the error terms. The regression results are presented in chapter 5.

5 Empirical Results

5.1 Descriptive Statistics

The descriptive statistics are useful because the regressions were conducted separately to avoid such high rates of sample attrition. A graphical display of sample statistics for each post-data processing allows a benchmark of comparison across the samples. The summary statistics for the individual supports are numbered and correspond to the regressions in subsection 5.2

Table 2. Sample Statistics of Variables in the External Supports

Dependent Variables	n	Mean	Std. Dev.	Min	Max
bincigtax	3440	0.40	0.49	0	1
binrestban	3440	0.56	0.50	0	1
binbarban	3440	0.22	0.41	0	1
binparkban	3440	0.20	0.40	0	1
Independent Variables					
binaddicthigh	3440	0.23	0.42	0	1
SMOKPERDAY	3440	15.67	8.87	1	100
QT12MOS	3440	2.77	5.13	1	76
binmarriage	3440	0.40	0.49	0	1
bingender	3440	0.41	0.49	0	1
educa2_r	3440	3.01	1.41	1	6
AGE	3440	45.94	13.91	18	99
INCOME2	3440	3.59	2.04	1	8

The sample n=3440 for the external support regressions. Here, much sample attrition was avoided by leaving out the question about health insurance, which many people refused to answer. The sample means differ across the several dependent variables tested, with restaurant bans having the highest overall support, cigarette taxes coming second, while bar and park bans have relatively low support. As for sociodemographic controls, the

sample is representative of the larger NATS population. For the variables SMOKPERDAY and QT12MOS, the max is very high compared to the mean. When plotted, they produced leverage points, so this influenced the decision to process the data with robust regression methods.

Table 3. Sample Statistics for Individual Support Regression 1

Dependent Variables	n	Mean	Std. Dev.	Min	Max
binfutasst	1948	0.34	0.47	0	1
Independent Variables					
binaddicthigh	1948	0.18	0.39	0	1
binmarriage	1948	0.44	0.50	0	1
bingender	1948	0.41	0.49	0	1
educa2_r	1948	3.29	1.44	1	6
AGE	1948	47.66	13.49	18	86
INCOME2	1948	4.06	2.10	1	8
binhccpayqs	1948	0.57	0.49	0	1

Here, the sample size (n=1948) is smaller than the external supports samples. Again, this is because of the refusals to answer the health insurance question. The mean healthcare utilization is .34, which is well below 50%. The sociodemographic controls are consistent with the larger population and other sample groups.

Table 4. Sample Statistics for Individual Support Regression 2

Dependent Variables	n	Mean	Std. Dev.	Min	Max
binfutasst	1419	0.37	0.48	0	1
Independent Variables					
SMOKPERDAY	1419	15.86	8.58	1	75
binmarriage	1419	0.44	0.50	0	1
bingender	1419	0.40	0.49	0	1
educa2_r	1419	3.22	1.41	1	6
AGE	1419	47.64	13.18	18	86
INCOME2	1419	4.00	2.08	1	8
binhccpayqs	1419	0.57	0.50	0	1

The difference in sample n is because of different refusal rates for the different independent variable questions. Here, we see more drops for the SMOKPERDAY

variable. The mean demand for future assistance is similar throughout all three regression groups.

Table 5. Sample Statistics for Individual Support Regression 3

Dependent Variables	n	Mean	Std. Dev.	Min	Max
binfutasst	1288	0.33	0.47	0	1
Independent Variables					
QT12MOS	1288	3.78	7.28	1	76
binmarriage	1288	0.46	0.50	0	1
bingender	1288	0.39	0.49	0	1
educa2_r	1288	3.32	1.44	1	6
AGE	1288	47.44	13.44	18	86
INCOME2	1288	4.05	2.11	1	8
binhccpayqs	1288	0.56	0.50	0	1

Again, we observe different levels of data attrition with different dependent variables. SMOKPERDAY exhibits the same mean as other samples, but again, has outliers in this group as well.

Table 6. Sample Statistics for Individual Support Regression 4

Dependent Variables	n	Mean	Std. Dev.	Min	Max
binfutmed	1979	0.63	0.48	0	1
Independent Variables					
binaddicth~h	1979	0.18	0.39	0	1
binmarriage	1979	0.44	0.50	0	1
bingender	1979	0.40	0.49	0	1
educa2_r	1979	3.30	1.44	1	6
AGE	1979	47.55	13.47	18	86
INCOME2	1979	4.06	2.11	1	8
binhccpayqs	1979	0.58	0.49	0	1

The descriptive statistics for regression 4, healthcare utilization of medications that ease cessation, have a much higher utilization rate than the previous questions about individual supports. Here, we see a mean of .63, which is above 50%. There is no significant difference in the mean for health insurance coverage, which would be an explanatory factor for a higher demand for this type of individual support.

Table 7. Sample Statistics for Individual Support Regression 5

Dependent Variables	n	Mean	Std. Dev.	Min	Max
binfutmed	1439	0.68	0.47	0	1
Independent Variables					
SMOKPERDAY	1439	15.88	8.62	1	75
binmarriage	1439	0.44	0.50	0	1
bingender	1439	0.39	0.49	0	1
educa2_r	1439	3.23	1.41	1	6
AGE	1439	47.52	13.15	18	86
INCOME2	1439	4.00	2.08	1	8
binhccpayqs	1439	0.57	0.49	0	1

This sample group has utilization of cessation medication predicted by daily cigarette consumption. The means and standard deviations are consistent with the other groups. Notice that the maximum age has been truncated, however the standard deviance remains relatively robust. In this sample, as well as the population, women were represented above the expected 50%.

Table 8. Sample Statistics for Individual Support Regression 6

Dependent Variables	n	Mean	Std. Dev.	Min	Max
binfutmed	1320	0.63	0.48	0	1
Independent Variables					
QT12MOS	1320	3.81	7.44	1	76
binmarriage	1320	0.46	0.50	0	1
bingender	1320	0.38	0.49	0	1
educa2_r	1320	3.34	1.44	1	6
AGE	1320	47.29	13.41	18	86
INCOME2	1320	4.06	2.13	1	8
binhccpayqs	1320	0.56	0.50	0	1

The descriptive statistics are similar throughout all of the regression samples. It is worth noting that the age across these groups is lower than the NATS population age. However, across these groups, it is consistent with the smoker who wants to quit. Also, the education amongst the external support is slightly lower than the individual support samples.

There is a large difference in the mean utilization between different dependent variables. Cessation medication, for example, has the highest mean acceptance of all the supports at roughly 60%. This is followed by restaurant bans, then cigarette taxes. The lowest mean supports were for individual assistance in the form of quit lines or counseling, but also public supports like bar bans and park bans.

5.2 Regression Results

The regression tables are organized according to the dependent variables.

5.2.1 External Support Regressions

The first set of regressions presented below in Table 9 are the external supports: cigarette taxes, restaurant bans, bar bans, and park bans. They are presented in the same table because attrition rates were lower than healthcare related questions.

Table 9. External Support Regression

	CigTax b/se	BanRest b/se	BanBar b/se	BanPark b/se
binaddicth~h	-0.032	-0.103***	-0.000	-0.000
	(0.03)	(0.03)	(0.00)	(0.00)
SMOKPERDAY	-0.007***	-0.009***	-0.000***	-0.000***
	(0.00)	(0.00)	(0.00)	(0.00)
QT12MOS	0.006**	-0.003	0.000	0.000
	(0.00)	(0.00)	(0.00)	(0.00)
binmarriage	-0.022	-0.008	0.000*	-0.000*
	(0.03)	(0.03)	(0.00)	(0.00)
bingender	-0.020	-0.058**	-0.000**	-0.000*
	(0.03)	(0.03)	(0.00)	(0.00)
educa2_r	-0.022**	-0.026***	-0.000***	-0.000***
	(0.01)	(0.01)	(0.00)	(0.00)
AGE	-0.006***	0.001	0.000**	-0.000***
	(0.00)	(0.00)	(0.00)	(0.00)
INCOME2	-0.015**	0.016**	0.000	-0.000
	(0.01)	(0.01)	(0.00)	(0.00)
_cons	0.828***	0.748***	0.000***	0.000***
	(0.06)	(0.06)	(0.00)	(0.00)

* p<0.10, ** p<0.05, *** p<0.010

From Table 9, the dependent variables of interest were addiction levels, daily consumption, and number of quit attempts in the past 12 months. Here, many of the results were significant, and exhibiting the same negative effect on support for the dependent variables. The largest beta was the 10% reduction in support for restaurant bans for those with high levels of addiction. This is consistent with the Ikeda finding [33] that naïf hyperbolic discounters show higher rates of addiction and consumption because this group doesn't foresee their future self control problem, and therefor doesn't demand costly self-imposed external controls. The exception is the positive demand, albeit relatively small, for cigarette taxes as the number of failed quit attempts in the last 12 month increases. The literature review suggested a causal mechanism for this as self-awareness increases, thus suggesting people are transient between naïve and sophisticated in their forecasting.

5.2.2 Individual Support Regressions

The second and third sets of regressions are about this paper's most important contribution: testing for utilization of individual cessation supports like counseling, quit lines, and medication. Because of data attrition, the independent variables that we were most interested in, addiction levels, daily consumption, and number of failed quit attempts in the past 12 months, were included in different regressions. Consequently, the reporting tables look different than the previous results.

Table 10. Individual Support Regression 1-3 (from left to right)

	FutAsst b/se
binaddicth~h	0.006***
	(0.00)
binmarriage	0.001
	(0.00)
bingender	-0.001
	(0.00)
educa2_r	-0.000
	(0.00)
AGE	0.000
	(0.00)
INCOME2	-0.001***
	(0.00)
binhccpayqs	0.004***
	(0.00)
_cons	0.007***
	(0.00)

* p<0.10, ** p<0.05, *** p<0.010

	FutAsst b/se
SMOKPERDAY	0.000
	(0.00)
binmarriage	0.001
	(0.00)
bingender	-0.004*
	(0.00)
educa2_r	-0.000
	(0.00)
AGE	-0.000
	(0.00)
INCOME2	-0.001**
	(0.00)
binhccpayqs	0.006***
	(0.00)
_cons	0.015***
	(0.00)

* p<0.10, ** p<0.05, *** p<0.010

	FutAsst b/se
QT12MOS	-0.000
	(0.00)
binmarriage	0.001
	(0.00)
bingender	-0.001
	(0.00)
educa2_r	0.000
	(0.00)
AGE	0.000
	(0.00)
INCOME2	-0.001***
	(0.00)
binhccpayqs	0.004***
	(0.00)
_cons	0.007***
	(0.00)

* p<0.10, ** p<0.05, *** p<0.010

Table 11. Individual Support Regression 4-6 (from left to right)

	FutMed b/se
binaddicth~h	0.006***
	(0.00)
binmarriage	0.002
	(0.00)
bingender	-0.005***
	(0.00)
educa2_r	0.001
	(0.00)
AGE	0.000
	(0.00)
INCOME2	0.001**
	(0.00)
binhccpayqs	0.004**
	(0.00)
_cons	0.978***
	(0.00)

* p<0.10, ** p<0.05, *** p<0.010

	FutMed b/se
SMOKPERDAY	0.000***
	(0.00)
binmarriage	0.000
	(0.00)
bingender	-0.002***
	(0.00)
educa2_r	0.000
	(0.00)
AGE	-0.000
	(0.00)
INCOME2	0.000***
	(0.00)
binhccpayqs	0.001**
	(0.00)
_cons	0.993***
	(0.00)

* p<0.10, ** p<0.05, *** p<0.010

	FutMed b/se
QT12MOS	-0.012***
	(0.00)
binmarriage	0.015*
	(0.01)
bingender	-0.025***
	(0.01)
educa2_r	0.002
	(0.00)
AGE	0.000
	(0.00)
INCOME2	0.003
	(0.00)
binhccpayqs	0.015*
	(0.01)
_cons	0.922***
	(0.02)

* p<0.10, ** p<0.05, *** p<0.010

From table 10, the only significant predictor of cessation support (quit lines or counseling) utilization was a high addiction level. Those who reported smoking a cigarette within five minutes of waking up demanded higher levels of counseling or quit-lines. Because these types of support serve to make quitting less awful, the difference is noteworthy.

From table 11, the results are slightly ambiguous. High addiction levels and consumption increase demand for these supports, however a high number of failed quit attempts decreases demand for medication. It is definitely worth investigating the causal mechanism behind this observation, and opens the door to future research.

Comparing table 10 and 11, an increase in income reduces demand for time intensive supports like quit lines and counseling, but increases demand for the less time intensive medication. Logically, this is because of increased opportunity cost of lost time. Health care coverage had significance across the board and increases demand for all types of cessation supports: counseling, quit lines, and medication. This has important policy implications.

6 Discussion

The first set of hypotheses concerned the demand for costly external cessation supports as predicted by observed smoking behavior, which was argued to be a causal pathway for manifestations of consequences per theoretical model.

For the high addiction level predictor, there are somewhat inconsistent results based on the type of ban. Only the restaurant ban has explanatory power from this variable. The high addiction level decreases demand for smoking bans at restaurants. This is consistent with the Ikeda correlation. [27]

The model with cigarette taxes was the only regression that yielded any significant results for quit attempts. Hersch [24] had shown that previous quit attempts increased the demand for smoking bans using panel data. We were not able to replicate his results for smoking bans, however the result for taxes is similar. We can speculate that the possible

reason could be that as smokers increase in quit attempts, their self-awareness changes them from naïf to sophisticated.

For consumption levels, our model yielded the most consistent results. For each of the external cessation support categories, higher levels of cigarette consumption decreased the demand. This is consistent with the Ikeda [27] analysis linking the naïve hyperbolic type to higher rates of consumption. However, it runs contrary to the Hersch findings. Both this study and the Hersch study did not have information about time preferences and discounting, so we were not able to disaggregate the types. The Ikeda study, on the other hand, didn't answer questions about support for external cessation supports. Because the models remain indeterminate in these questions, future research would be invaluable in trying to explain the links between types, behaviors, and preferences throughout a smoking lifecycle.

The second set of hypotheses were about the previously un-researched questions about smoking behaviors and support for individual cessation supports.

The first type of support was assistance like quit lines, counseling, or therapy. Of the predictor variables only level of addiction had a significant p-value. Here, there was a modest increase in demand for these types of cessation support. Although fuzzy, being a male did decreases the demand in one sample. In all the regressions, demand was also decreased with higher income, which could be explained by the higher opportunity cost of these therapies. Across the groups, however, having healthcare coverage that paid for these supports increased demand. Here, there is a salient policy implication: the government could subsidize these types of treatments to increase utilization levels.

For nicotine replacement therapy or medicine support categories, higher levels of addiction increased the demand. This is consistent under all of the models, given that the expected reward in utility is greater than price. An important policy implication is that, regardless of likely heterogeneity amongst smoking groups, this type of support remains attractive.

Higher daily consumption levels also, albeit modestly, increased the demand for nicotine replacement therapy or medicine. Logically, this makes sense because higher levels of consumption will likely translate to higher disutility in the withdrawal phase. A similar rationale is behind the addiction proxy. Therefore, regardless of type, reducing disutility from smoking cessation is demanded.

A high number of quit attempts decreased the demand for nicotine replacement therapy or medication. This is an important finding because it is a different type of predictor than addiction levels and consumption, in that it is actualized failure to carry out the desired task. The mental process that differs between addiction levels, daily consumption, and failed quit attempts could be further investigated.

Lastly, amongst these types of support, healthcare coverage increased demand as did a higher income. Here, income moves demand in the opposite direction compared to the time-intensive quit lines or counseling.

Comparing the regressions between the external supports like taxes and bans compared to individual supports like counseling or medication, this also introduces an inconsistency because it implies awareness and forecasting about disutility in the withdrawal period, but not about time inconsistencies. Further research would benefit by asking questions to obtain information about time preferences, discounting, and sophistication or naivety.

7 Conclusion

Lastly, models of smoking are largely used for prescriptive reasons: policy aimed at reducing smoking. Therefore this paper takes a special interest in explaining the heterogeneity of preferences amongst the group that is currently smoking, but expresses a desire to quit. While it may be more difficult for policymakers to collect information about time preferences and discounting, a link between certain observed behaviors from our survey – quit attempts, addiction levels, and consumption – may be more readily observable.

Finally, also recognizing that different supports will be utilized differently, this paper was the first to explore how quit attempts, addiction levels, and consumption influence the

utilization of individual cessation supports. High addiction levels and high consumption levels increased demand for nicotine replacement therapy and medication.

Future research is still required to sort out the heterogeneity in observed behavior as it relates to time preferences and support for different types of cessation supports. Like this, public policy can have different approaches available given different observed characteristics of smoking groups.

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