Appendix A

Table A1: Sub-national and national tobacco control policy implementation and coverage

Province	Year	Law Description	Level
Córdoba	2003	Law 9113: Prohibited smoking in all enclosed public places, excluding open-air smoking areas, private workplaces, and designated tobacco clubs; restrictions on advertising and cigarette composition	Partial
Santa Fe	2005	Law 12432: Prohibited smoking in all enclosed public places, excluding open-air designated smoking areas in public government buildings; implemented educational programs to discourage smoking	Partial
Tucumán	2005	Law 7575: Prohibited smoking in all enclosed public places	Full
San Juan	2005	Law 7595: Prohibited smoking in all enclosed public places, excluding open-air smoking areas and private workplaces; required warning signs about dangers of smoking in public places	Partial
Buenos Aires City	2005	Law 1799: Prohibited smoking in all enclosed public places, excluding designated open-air smoking areas, mental health facilities, and criminal detention centers	Partial
Mendoza	2007	Law 7790: Prohibited smoking in all public places, excluding open-air smoking areas, mental health facilities, criminal detention centers, private parties, and casinos	Partial
Catamarca	2007	Law 5223: Prohibited smoking in all enclosed public places, excluding open-air smoking areas, tobacco clubs, mental health facilities, criminal detention centers, and private parties	Partial
Neuquén	2007	Law 2572: Prohibited smoking in all enclosed public places; implemented educational programs to discourage smoking	Full
Entre Ríos	2008	Law 9862: Prohibited smoking in all enclosed public places, excluding casinos, patios, open spaces, private parties, mental health facilities, and jails	Partial
Buenos Aires Province	2008	Law 13894: Prohibited smoking in all enclosed public places, but allowed smoking in casinos and designated smoking areas	Partial
Santiago del Estero	2009	Law 6962: Prohibited smoking in all enclosed public places, excluding casinos, patios, open spaces, private parties, mental health facilities, and jails	Partial
San Luis	2010	Law 0723-2010: Prohibited smoking in all enclosed public places, excluding prisons, detention sites, and private workplaces	Full

Pampa	2010	Law 2563: Prohibited smoking in all enclosed public places, but allowed smoking in open-air smoking areas outside of health and educational establishments	Partial
Salta	2010	Law 7631: Prohibited smoking in all enclosed public places, excluding open-air spaces and designated smoking areas	Partial
Río Negro	2011	Law 4714: Prohibited smoking in all enclosed public places; implemented educational programs to discourage smoking	Full
Chaco	2012	Law 7055: Prohibited smoking in all enclosed public places, excluding open-air smoking areas	Partial
Santa Cruz	2013	Law 3329: Prohibited smoking in all enclosed public places	Full
National Law and Ratification			
National Legislation	2011	Law 26.687: Prohibited smoking in all enclosed public places, excluding open-air spaces with public access (outside of educational and healthcare establishments), private indoor workplaces, and designated tobacco clubs; placed comprehensive advertising and distribution restrictions; required larger warning labels on all cigarette packs	Full
Chubut	2011	Law 452: Ratified National Law 26.687	Full
Mendoza	2011	Law 8382: Ratified National Law 26.687	Full
Formosa	2011	Law 1574: Ratified National Law 26.687	Full
San Juan	2013	Law 8406: Ratified National Law 26.687	Full

Note: Information retrieved from ALIAR Argentina website.[1]

[1] Legislación argentina [Argentinian legislation]. (n.d.). Retrieved October 17, 2015, from ALIAR Argentina website: http://www.aliarargentina.org/index.php?option=com_content&view=category&id=15&Itemid=19&lang=es

Table A2: Proportion of Sample, by Province and Year

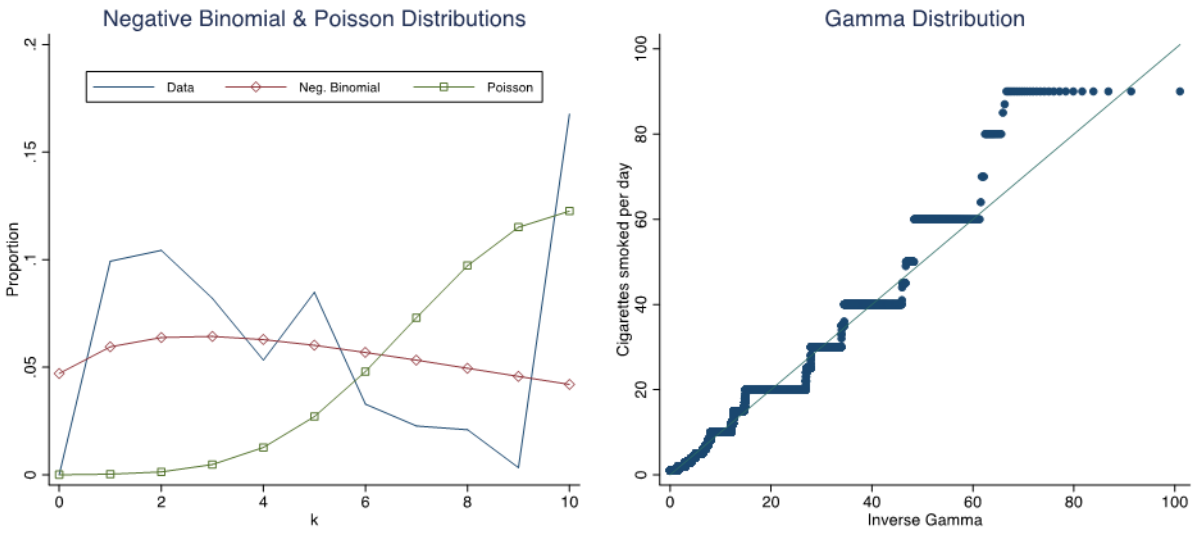
Province	2005	2009	2013	Total
Ciudad de Buenos Aire	3.65	3.29	2.33	3.14
Buenos Aires	8.33	14.93	16.05	12.75
Catamarca	3.77	3.66	2.65	3.40
Cordoba	4.06	6.02	6.29	5.35
Corrientes	4.16	3.30	3.41	3.66
Chaco	4.37	3.64	2.76	3.66
Chubut	3.82	3.25	4.27	3.77
Entre Rios	4.01	3.83	4.27	4.03
Formosa	4.01	3.66	3.37	3.71
Jujuy	4.28	4.29	3.11	3.93
La Pampa	3.70	3.41	3.17	3.45
La Rioja	4.22	3.75	3.24	3.78
Mendoza	3.98	3.18	4.05	3.75
Misiones	4.22	3.40	2.86	3.55
Neuquen	4.28	2.93	2.83	3.41
Rio Negro	3.83	3.80	5.17	4.22
Salta	4.37	3.84	3.86	4.05
San Juan	4.09	3.15	3.04	3.47
San Luis	3.99	3.73	3.22	3.68
Santa Cruz	3.45	3.67	3.00	3.38
Santa Fe	4.22	5.55	6.45	5.31
Santiago del Estero	4.34	2.79	3.25	3.52
Tucuman	3.88	3.97	4.23	4.02
Tierra del Fuego	2.97	2.96	3.11	3.01
Total	41,392	34,732	32,365	108,489

Table A3: Estimation Results: Policy Implementation by Province

Variable	Adopt Full Ban		Adopt Partial Ban	
2005 Smoking Rate	40.268	(29.134)	-15.795	(27.523)
2005 ETS Exposure	-4.883	(15.622)	17.556	(19.604)
Average Age	-0.066	(0.379)	1.300	(0.612)**
Proportion Male	-16.268	(32.671)	-12.427	(32.741)
Average Income Variation	-2.539	(2.782)	-5.026	(4.271)
Constant	-0.655	(30.559)	-55.999	(36.040)

Note: Logit regression of adoption of full or partial ban by province (N=24). Explanatory variables are aggregated to the province level using individual survey responses from ENFR data. Table reports coefficient estimates, standard errors (in parentheses), and significance at *** 1%, ** 5%, and * 10% levels.

Figure A1: Non-continuous distributions of smoking intensity count data



Appendix B

The theoretical model that motivates the empirical model specifications in Section 3 is described below. Because our data consists of repeated cross sections of individuals, we are limited in the extent to which we can capture lagged smoking behaviors. Likewise, we are unable to include peer effects explicitly. Nonetheless, we present the individual's decision-making problem in order to derive the structural demand equations that we estimate.

Each period *t*, it is assumed that an individual receives utility, $u(C_t, G_t; S_t, X_t, \varepsilon_t)$, from consuming cigarettes (C_t) and other consumption goods (G_t). Because cigarettes are addictive goods, it is important to take into account the effects of reinforcement, tolerance, and withdrawal; that is, the individual's utility from smoking today depends on past smoking behavior up to the current period (S_t), or the addictive stock (Becker and Murphy, 1988; Matsumoto, 2014). The utility of smoking, or marginal utility from smoking an additional cigarette, may also differ by exogenous individual demographic and health characteristics (X_t), including age, gender, education, household size, and BMI which may explain smoking decisions of different individuals. The error term (ε_t) represents unobserved preferences or preference shifters that affect the utility of smoking.

Although this model ignores an individual's decisions regarding location and time of smoking (because such detailed data are not available), our theoretical framework captures the disutility of a smoking ban generally by allowing the utility of smoking to depend on the presence of a ban and, in particular, the type of smoking ban (i.e., full or partial). To capture the essence of the different smoking bans used in Argentinian provinces, we specify a utility preference-ordering conditional on the type of ban as

$$u(C_t, G_t \mid B_t^f = 1, B_t^p = 0) \leq u(C_t, G_t \mid B_t^f = 0, B_t^p = 1) \leq u(C_t, G_t \mid B_t^f = 0, B_t^p = 0) \quad \text{(B1)}$$

where the indicator for a full, comprehensive public smoking ban is B_t^f, and the indicator for a partial ban (meaning that smoking is allowed in certain types of places or in designated smoking rooms) is B_t^p.[2] While bans impose these time and discomfort costs on smokers that result in lower indirect utility, the social utility of smoking may be positively influenced by or reinforced in designated smoking areas where the ratio of smokers to nonsmokers is larger. Peer effects have been most extensively explored in classroom settings between students but have recently become an area of inquiry in the field of health economics. For example, Fowler and Christakis (2008) explored peer effects and obesity using data from the Framingham Heart Study. They found that not only do obese individuals form social clusters, but also an individual's risk of becoming obese actually increases if he or she has a friend who becomes obese. Nakajima (2007) and Powell et al. (2005) investigated peer effects in youth smoking, and both studies found the existence of large and significant positive effects on smoking initiation. Based on this information, we assume that peer effects may play a role in smoking behavior in the presence of partial smoking bans; if smokers congregate in designated areas or rooms, they may actually smoke more than if they are in the main room of the bar with nonsmokers. In the designated areas, their behavior may be more socially acceptable and reinforced.[3]

An individual allocates income to cigarettes and all other goods. Consumption is constrained by household income and the prices of cigarettes and the composite good (P_t^C and P_t^G, respectively) in each time period. Thus, his budget constraint is

[2] Note that this particular utility preference ordering applies to a smoker. Among nonsmokers who frequent bars, restaurants, and other public venues, exposure to secondhand smoke would likely present disutility and the utility preference ordering would be the opposite of that shown here. Odermatt and Stutzer (2015) suggest that bans may increase the lifetime utility of smokers who wish to quit smoking but suffer from poor self-control.

[3] Based on this reasoning, positive peer effects (i.e., conformity among smokers) that encourage smoking behavior will be reduced in the presence of full smoking bans. Eventually, there may be more pressure to not smoke as the percentage of nonsmokers increases.

$$I_t E_t + N_t = P_t^C C_t + P_t^G G_t \quad \text{(B2)}$$

where household income is comprised of the individual's employment status (E_t), his earned income (I_t) if he works (i.e., $E_t = 1$), and non-earned income (N_t).

The individual's utility from smoking depends on his addictive stock, which evolves as

$$S_{t+1} = \delta_t S_t + \gamma_t C_t \quad s.t. \;\; 0 < \delta_t \leq 1 \;\; \& \;\; 0 < \gamma_t \leq 1 \quad \text{(B3)}$$

where δ_t and γ_t represent the depreciation of current addictive stock and the effect of current smoking levels on next period's addictive stock, respectively. As mentioned previously, addictive goods, which differ from non-addictive economic goods, are characterized by reinforcement, tolerance, and withdrawal. Reinforcement suggests that a history of consumption of cigarettes increases the marginal utility of smoking (i.e., $\frac{\partial^2 u}{\partial s \partial c} > 0$) and causes the desire for present consumption to increase. Simultaneously, the body becomes accustomed to increasing levels of consumption, and a physical process known as tolerance occurs, during which the individual must consume a greater quantity of cigarettes to achieve the same effect (i.e., a greater level of past consumption lowers current utility, or $\frac{\partial u}{\partial s} < 0$). Finally, as the individual continues to consume cigarettes and his addictive stock grows, a physical dependence is generated. Dependence makes reduction in smoking difficult as the individual faces disutility when decreasing consumption (i.e., $\frac{\partial u}{\partial c} > 0$). This withdrawal effect may explain why smokers are often insensitive to price increases. Differences in withdrawal effects may also explain variation in speed of quitting (i.e., gradual reduction in consumption or quitting "cold turkey").

A forward-looking individual makes cigarette consumption decisions to maximize lifetime utility, $\sum_{t=1}^{T} \beta^t u(C_t, G_t;\, S_t, X_t, \varepsilon_t)$, where β represents a discount factor and $t = T$ is the end of life. Given one's preferences (including the impact of various levels of smoking policy on utility), his budget constraint, and evolution of the addictive stock, the discounted present value of lifetime

utility of each smoking alternative $C_t = c$ (i.e., level of smoking) in period *t* can be represented by the recursive function

$$V_c(S_t, \varepsilon_t) = u(C_t = c, G_t\,;\, S_t, X_t, \varepsilon_t \mid B_t^f, B_t^p) + \beta E_t \left[\max_{c'} V_{c'}(S_{t+1}, \varepsilon_{t+1}) \quad C_t = c \right]$$

$$\forall t, c = 0, 1, \ldots, C \tag{B4}$$

The alternative-specific error term (ε_t^c) captures an individual's idiosyncratic utility of each smoking alternative.[4] The Bellman equation (B4) defines the lifetime value of smoking level $C_t = c$ at time *t* as contemporaneous utility plus the discounted expected value of future optimal utility. It exemplifies well the roles of adjacent complementarity in addictive goods analyses. On one hand, past consumption increases the marginal utility of current consumption through reinforcement (i.e., behavior is dynamic), which is captured by the specification of the utility function. On the other hand, a forward-looking individual recognizes that his level of current consumption alters the marginal utility of future consumption (Gordon and Sun, 2015) through evolution of the smoking stock.[5] The Bellman formulation also allows for the uncertainty of future policy enactments or removals.[6]

[4] An example of time-varying preference heterogeneity is an unexpected diagnosis of bronchitis in time *t*, which lowers the current utility of smoking.
[5] Additionally, an individual may wish to reduce his current levels of consumption in order to increase expected future utility, if the future benefit offsets the disutility of a reduction in consumption today (i.e., withdrawal effects).
[6] Empirical solution of the dynamic decision-making problem often relies on the assumption that individuals believe current smoking policy in their province will exist in the future. As such, changes in policy are surprises to individuals.