Economics of Smoking

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What Next?

- Measure of smoking:

  1. <u>compensatory behaviour of smokers</u>

  When taxes go up, smokers compensate by extracting more nicotine per cigarette

  2. <u>displacement of smoking from public to private places</u>

  Smoking bans

outline

1. **Taxes, Cigarette Consumption and Smoking Intensity** (Adda and Cornaglia, 2006)
2. **The Effects of Bans and Taxes on Passive Smoking** (Adda and Cornaglia, 2006)

1. Taxes, Cigarette Consumption and Smoking Intensity

This paper analyses the compensatory behavior of smokers.

Exploiting data on cotinine we show that smokers compensate tax hikes by extracting more nicotine per cigarette.

Two important contributions:

1. our results question the usefulness of tax increases.
2. we show that the previous empirical results suffer from severe estimation biases.

Plan of the talk

- Introduction.
- A simple model of smoking and smoking intensity. Empirical Strategy.
- Data and descriptive statistics.
- The effect of prices on quantities and intensity.
- Other determinants of smoking intensity.
- Bias in the economic literature.
- Conclusion.

1. Taxes, Cigarette Consumption and Smoking Intensity

Some Empirical Evidence…

Introduction. Smoking: How behaviour matters

- Other disciplines have shown that smoking topography matters:
  - Differences in **the way smokers smoke** a cigarette:
    - Cigarette size & yield.
    - Number of puffs.
    - Depth of inhalation, blocking of ventilation holes.
  - Smokers compensate low yield cigarettes and fewer cigarettes by smoking more **intensively**.

Results in Epidemiology Literature

- Cotinine is the best biological marker to study smoking behavior.
- Variation in cotinine levels, conditional on the number of cigarette smoked: behavioral adjustments.
  - Bridges et al (1990), Wagenknecht et al (1990), Kozlowski et al (1980).
- Smokers compensate light cigarettes with higher intensity.
  - Frost et al (1995), Withey et al (1992)
- Racial and SES differences in smoking behavior
  - Caraballo et al (1998), McCarthy et al (1992), Kozlowsky et al (1980), Wagenknecht et al (1990), Patterson et al (2003), Jarvis et al ().
- Misreporting of smoking status is very limited
  - Caraballo et al (2001), Clark et al (1996)

Introduction. Previous Economic Literature on Smoking

- Smoking is measured by the number of cigarettes smoked per day.
- Evaluate the effect of prices on smoking using the number of cigarettes:
  - significant (negative) price elasticity.
- Assumes that cigarettes are a homogenous consumption product :
  - all cigarettes are the same.
  - all cigarettes are consumed in the same way.

Contribution

- We introduce a new dimension: Intensity of smoking
- We consider the case where the agent can choose:
  - The number of cigarettes to smoke.
  - The effort, or smoking intensity, exerted to smoke a cigarette.
  - Therefore, SMOKING = N. OF CIGARETTES * INTENSITY
- As measure for smoking we use data on cotinine concentration in blood or saliva.
- Analysis of smoking intensity, using large data sets on smokers over time in the US .

What is cotinine?

- An individual exposed to smoke absorbs nicotine.
- Nicotine is transformed into cotinine (half life of 18 hours).
- Cotinine measured in saliva samples.

Advantage:

- Precise measure of exposure.
- Pick up changes in policy very quickly.
- Minimal measurement error.
- Nicotine is highly correlated:
  - with tar (0.96)
  - and carbon monoxide (0.85)

cotinine is a good marker of absorption of hazardous chemicals due to smoking.

- We define smoking as the level of cotinine in the body.

Key Points

- We document the extensive heterogeneity in smoking intensity.
- Smokers compensate higher prices by smoking more intensively.
- Prices have no effect on nicotine intakes.
- Smoking intensity varies with socio-economic position, gender, race, cohort and time.

Consequences of Analysis

- Conventional price elasticities are misleading.
- A priori, ambiguous price effects on health.
- The literature suffers from approximation bias and endogeneity (e.g. Addiction Literature).

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A Simple Model of Smoking:

- Agent derives utility from : $u(n, i, q)$ $(+, -, +)$
  - Nicotine, n
  - Intensity of smoking, i $n = c.i$
  - Other good, q $y = pc + q$
- Budget constraint:

A Simple Model of Smoking:

- Agent derives utility from : $u(n, i, q)$ $(+, -, +)$
  - Nicotine, n
  - Intensity of smoking, i
  - Other good, q $n = c.i$
- Budget constraint: $y = pc + q$
- Effect of Prices:

$$\frac{dc}{dp} \leq 0, \frac{di}{dp} \lesseqgtr 0$$

$$\text{If } n \text{ is large enough}: \frac{\mathrm{di}}{\mathrm{dp}} > 0 \text{ and } \frac{\mathrm{dc}}{\mathrm{dp}} < \frac{dn}{dp}$$

Empirical Strategy:

- Compare cigarette smoking and cotinine concentrations:

$$\log c_{ist} = \alpha_0 + \alpha_1 p_{st} + \alpha_2 X_{ist} + \alpha_s + \alpha_t + u_{ist}$$
$$\log n_{ist} = \beta_0 + \beta_1 p_{st} + \beta_2 X_{ist} + \beta_s + \beta_t + v_{ist}$$
$$\log i_{ist} = \log n_{ist} - \log c_{ist}$$

- Effect of prices: Compare α_1 and β_1.
- Effect of ind. char.: Compare α_2 and β_2.

Methods

- OLS. Intensity of smoking on prices (and control variables).
  - Problem: If low intensity smokers are more likely to quit: change in composition in the sample, OLS are biased.
- Selection model (Heckman (1979)).
  - Problem: Difficult to find an instrument.
- Worst case bounds (Manski (1994)).
  - Advantage: No exclusion restrictions to assume.
  - Problem: The bounds can sometimes be quite large.

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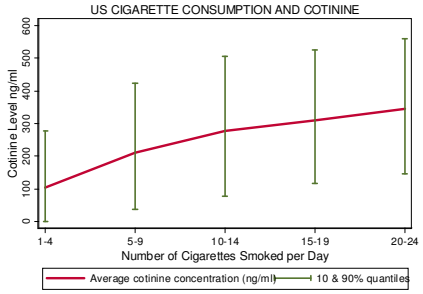
Data

- National Health and Nutrition Examination Study, NHANES 1988-1994, and 1999-2000 (about 20,000 individuals).
- Report:
  - Smoking habits, number of cigarettes per day.
  - Cotinine concentration in blood or saliva.
  - Individual and household characteristics.
- Tax Burden on Tobacco: Information on cigarette excise taxes.

Descriptive Statistics

	US		
	All	**Smokers**	**Non Smokers**
# of observations	20050	4641	13882
average # of cigarettes	10	**18.8**	0
average level of cotinine (ng/ml)	78	**230**	**0.44**
average age	44	39	45
sex (% male)	47.7	51	43
% white	84.1	84.0	84.6
% education high	40	27	47
% education medium	49	63	41
% education low	11	10	11

Cotinine Concentration and Cigarette Consumption.



Explained Variance in Cotinine Intakes

% Explained Variance of cotinine concentration	**US 1988-94**	26%	26%	-	-	-
		[4122]	[4122]	-	-	
	US 1999-00	22%	-	24%	35%	36%
		[840]		[776]	[776]	[776]
Number of cigarettes smoked		Yes	Yes	Yes	Yes	Yes
Time / Day of Examination		No	Yes	No	No	No
Nicotine yield of cigarette		No	No	Yes	Yes	Yes
Brand of Cigarette		No	No	No	Yes	Yes
Size, filter, menthol characteristics		No	No	No	No	Yes
Numbers in bracket indicate the number of observations.						

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Decomposing the change in intensity: cigarette types and smoking behaviour

	Baseline	Baseline + Excluding cotinine level<200 ng/ml(median value)	Baseline + Additional controls: height, day and time of examination	Baseline + Excluding those started after 1988	Baseline+ Excluding late starters
Elasticity Smoking Intensity	**0.47** (0.18)**	**0.55** (0.19)**	**0.46** (0.20)**	**0.43** (0.18)**	**0.34** (0.14)**
Elasticity Number of Cigarettes	**-0.20 (0.37)**	**-0.49** (0.21)**	**-0.19 (0.34)**	**-0.13 (0.38)**	**-0.73** (0.27)**
Elasticity Cotinine	**0.28 (0.25)**	**0.06 (0.05)**	**0.27 (0.26)**	**0.30 (0.27)**	**-0.39 (0.35)**

Baseline estimations use NHANES 1988-1994. All regressions control for age, sex, race, occupation, education, household size, passive smoking, year and region effect. Robust standard errors clustered at region and year level. ** significant at the 5% level.

Decomposing the change in intensity: cigarette types and smoking behaviour

	NHANES 1999-2000	NHANES 1999-2000 Additional Controls: Cigarette length and nicotine yield
Elasticity Smoking Intensity	**0.11** (0.04)**	**0.10** (0.04)**
Elasticity Number of Cigarettes	**-0.15** (0.04)**	**-0.15** (0.04)**
Elasticity Cotinine	**-0.03 (0.04)**	**-0.04 (0.07)**

All regressions control for age, sex, race, occupation, education, household size, passive smoking, year and region effect. Robust standard errors clustered at region and year level. ** significant at the 5% level.

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US: Individual Characteristics

	Log(Cig)	Log(Cot)	Log(Cot/Cig)
Men	-0.05 (0.040)	-0.11 (0.060)	-0.06 (0.040)
Age	0.05** (0.006)	0.05** (0.008)	-0.01 (0.007)
Age squared (*100)	-0.1** (0.001)	-0.04** (0.010)	0.01 (0.007)
Log Income	-0.02 (0.026)	-0.05 (0.035)	-0.03 (0.027)
Education (years)	-0.01 (0.007)	-0.03** (0.009)	-0.02** (0.007)
Size of house (number of bedrooms)	-0.04** (0.009)	-0.09** (0.010)	-0.05** (0.009)
White	0.39** (0.094)	0.36** (0.130)	-0.03 (0.100)
African-American	-0.05 (0.102)	0.51** (0.140)	0.56** (0.100)
Family size	0.01 (0.010)	0.05** (0.020)	0.04** (0.010)
Attending church	-0.17** (0.030)	-0.08** (0.040)	0.09** (0.030)
Living in urban area	-0.10** (0.030)	-0.04 (0.041)	0.06* (0.030)
Height (inches)	0.01* (0.005)	0.01 (0.007)	-0.00 (0.006)
Married	0.19** (0.060)	0.10 (0.090)	-0.09 (0.07)
Age started smoking	-0.02** (0.003)	-0.03** (0.004)	-0.00 (0.003)

US: Individual Characteristics

	Log(C60/Cig) NHANES 1999-2000
Men	**0.11 (0.120)**
Age	**0.00 (0.021)**
Age squared (*100)	**-0.00 (0.022)**
Log Income	**0.03 (0.020)**
Education (years)	**-0.04 (0.061)**
White	**0.16 (0.129)**
African-American	**0.64** (0.140)**
Height (inches)	**-0.01 (0.007)**
Married	**-0.02 (0.101)**
Age started smoking	**-0.00 (0.010)**
Filter	**0.40 (0.372)**
Nicotine Yield	**0.76** (0.190)**
Length of Cigarette (cm)	**0.06 (0.051)**
Mentholated	**0.09 (0.110)**

Health Consequences

- Differential smoking intensity may help to resolve puzzle in medical literature:
  - In the US, African-Americans smoke less but have higher incidence of lung cancer.
  - African-Americans and Hispanics are both economically deprived but Hispanics are healthier.

Incidence of Lung Cancer (US) per 100,000.		
White	African-Americans	Hispanics
79.4	120	46.1
Source: National Cancer Institute (2004)		

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Are estimates in the economic literature biased?

- Rational Addiction Models:
  - Becker and Murphy JPE (1988).
  - Becker, Grossman, Murphy AER (1994).
  - Chaloupka JPE (1991).
  - A number of subsequent papers.
- Only margin of adjustment is the number of cigarettes.
- Empirical results on cigarette consumption support the model.

Rational Addiction and Smoking Intensity

- Model of (rational) addiction with intensity of smoking:

$$\max_{i_t, n_t, q_t} E\sum_t \delta^t u(n_t, n_{t-1}, q_t, i_t)$$

  - n_t: nicotine.
  - n_{t-1}: past nicotine (addiction).
  - q_t : composite good.
  - i_t: intensity of smoking.
- Subject to budget constraint:

$$a_t = R\, a_{t-1} + y_t - p_t\, c_t - q_t$$

Rational Addiction and Smoking Intensity

- First Order Condition:

$$n_t = \theta_0 + \theta_1 n_{t-1} + \theta_2 n_{t+1} + \theta_3 \frac{p_t}{i_t} + u_t$$

- Theory imposes:

$$\theta_1 \geq 0,\ \theta_2 \geq 0, \theta_3 \leq 0$$

Bias

- Literature estimate:

$$c_t = \gamma_0 + \gamma_1 c_{t-1} + \gamma_2 c_{t+1} + \gamma_3 p_t + v_t$$

- When the real model would be more like:

$$n_t = \theta_0 + \theta_1 n_{t-1} + \theta_2 n_{t+1} + \theta_3 \frac{p_t}{i_t} + u_t$$

Evaluating the Bias

- Rewrite both specification in matrix notation:
  - Standard rational addiction model:

$$C = X\Gamma + V \qquad X = [1, p_t, c_{t-1}, c_{t+1}]$$

  - Rational addiction with smoking intensity:

$$N = Y\Theta + U \qquad Y = [1, p_t / i_t, n_{t-1}, n_{t+1}]$$

- Let Z be a matrix of instruments: Z=[1, p_t, p_{t-1},p_{t+1}]

$$\hat{\Gamma}_{IV} = (Z'X)^{-1} Z'C$$

Evaluating the Bias

$$\begin{aligned}\hat{\Gamma}_{IV} &= (Z'X)^{-1}Z'C \\ &= (Z'X)^{-1}Z'N/i \\ &= (Z'X)^{-1}Z'Y/i\Theta + (Z'X)^{-1}Z'u/i \\ &= (Z'X)^{-1}Z'\tilde{Y}\Theta + (Z'X)^{-1}Z'\tilde{u}\end{aligned}$$

- Two bias terms, multiplicative and additive.
- The first matrix is not necessarily the identity matrix.
- Z'ũ is not necessarily zero in expectation.

Evaluating the bias

$$Z'X = \begin{bmatrix} T & \sum p_t & \sum c_{t-1} & \sum c_{t+1} \\ \sum p_t & \sum p_t^2 & \sum c_{t-1}p_t & \sum c_{t+1}p_t \\ \sum p_{t-1} & \sum p_t p_{t-1} & \sum c_{t-1}p_{t-1} & \sum c_{t+1}p_{t-1} \\ \sum p_{t+1} & \sum p_t p_{t+1} & \sum c_{t-1}p_{t+1} & \sum c_{t+1}p_{t+1} \end{bmatrix}$$

$$Z'\tilde{Y} = \begin{bmatrix} \sum \frac{1}{i_t} & \sum \frac{p_t}{i_t^2} & \sum c_{t-1}\frac{i_{t+1}}{i_t} & \sum c_{t+1}\frac{i_{t+1}}{i_t} \\ \sum \frac{p_t}{i_t} & \sum \frac{p_t^2}{i_t^2} & \sum c_{t-1}p_t\frac{i_{t+1}}{i_t} & \sum c_{t+1}p_t\frac{i_{t+1}}{i_t} \\ \sum \frac{p_{t-1}}{i_t} & \sum \frac{p_t p_{t-1}}{i_t^2} & \sum c_{t-1}p_{t-1}\frac{i_{t+1}}{i_t} & \sum c_{t+1}p_{t-1}\frac{i_{t+1}}{i_t} \\ \sum \frac{p_{t+1}}{i_t} & \sum \frac{p_t p_{t+1}}{i_t^2} & \sum c_{t-1}p_{t+1}\frac{i_{t+1}}{i_t} & \sum c_{t+1}p_{t+1}\frac{i_{t+1}}{i_t} \end{bmatrix}$$

Bias when estimating addiction models

		$(Z'X)^{-1}Z'Y/i$	
-0.03	-0.35	-0.55	14.63
-0.00	0.01	-0.00	-0.07
-0.00	0.03	0.95	-1.64
-0.00	0.02	0.17	0.23

Notes: Model controls for age, sex, education level, race, a trend for the UK and for state and fixed effects for the US. A constant was included in the regression. Lags and leads of prices or taxes were used as instruments.

Bias when estimating addiction models

Implied Values for θ in Rational Addiction Model.

	Estimated parameters in rational addiction model	Implied parameters in full model with smoking intensity
Price Effect	$\gamma_1 = -1.5$	$\theta_1 = 0.16$
Past Smoking	$\gamma_2 = 0.5$	$\theta_2 = 42.90$
Future Smoking	$\gamma_3 = 0.5$	$\theta_3 = -0.91$

Conclusion

- Economic literature has overlooked an important margin of adjustment.
- First paper to characterize smoking intensity and its determinants.
- Question the real effect of prices.
- Question the estimation of models of smoking behavior.

Future Developments

- The economic literature on smoking has much to gain from exploiting information on cotinine concentration:
  - Better understand the process of addiction.
  - differences in quitting rates across ethnic or socio-economic groups
  - Effect of changes in taxes and regulations on non smokers?

The Effect of Taxes and Bans on Passive Smoking

Motivation

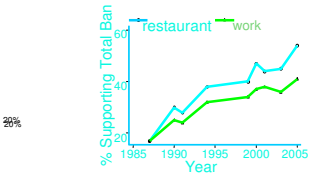
- Smokers impose a negative externality on non-smokers.
  - Link with lung cancer, cardio-vascular diseases, respiratory diseases, cot-death…
  - 35,000 deaths per year from heart diseases.
  - 3,000 lung cancer deaths.
  - 200,000 lower respiratory tracts infections in young children, resulting in 10,000 hospitalizations per year.

Motivation

- Smokers impose a negative externality on non-smokers.
- Passive smoking is widespread:
  - 15% of the US population is smoking,
  - 84% of the US *non smoking* population has detectable traces of tobacco related chemicals in body fluids.

Motivation

- Smokers impose a negative externality on non-smokers.
- Passive smoking is widespread.
- Public opinion has turned against passive smoking since the eighties.



Motivation

- Smokers impose a negative externality on non-smokers.
- Passive smoking is widespread.
- Public opinion has turned against passive smoking since the eighties.
- Increased limitation of smoking:
  - restrict or ban smoking in public places.
  - raising taxes on cigarettes.

Motivation

- Smokers impose a negative externality on non-smokers.
- Passive smoking is widespread.
- Public opinion has turned against passive smoking since the eighties.
- Increased limitation of smoking:
  - restrict or ban smoking in public places.
  - raising taxes on cigarettes.
- How effective are these measures on non-smokers?

Previous Economic Literature on Smoking *

- Effect on non-smokers: not much has been done
- The economic literature has focused on the effect of prices or taxes on *smokers:*
  - Prices/taxes have an effect on cigarette consumption. Becker et al., 1994; Chaloupka, 1991; Chaloupka and Warner, 1999
  - Workplace bans decrease smoking. Evans et al., 1999
  - Cigarette prices do not affect initiation at young ages. DeCicca et al (2002)
  - Smokers compensate by smoking more intensively a given cigarette. Adda and Cornaglia (2006)

Contribution *

- We use a novel measure for passive smoking: cotinine concentration in body fluids.
- Exploit time and state variations in excise taxes and in smoking regulations.
- This allows us to directly quantify the effect of cigarette taxes and smoking bans on non smokers.

Contribution *

- We show that:
  - On aggregate, bans have little effect on non-smokers.
  - Evidence of displacement of smoking: increase in exposure in children following bans in recreational public places.
  - Bans in recreational public places have no effects on adults.
  - Bans appears to be efficient in other places (eg public transport, shopping malls), especially to protect children.

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4. Effect of Taxes and Bans
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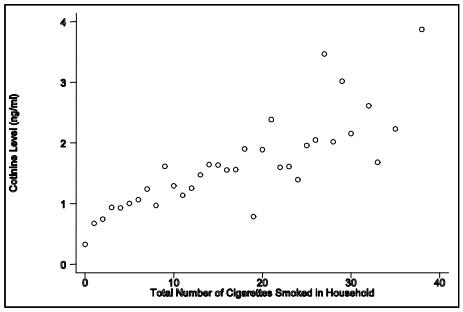
Cotinine and Passive Smoking



Empirical strategy *

- Basic model for individual *i* in year *t* and in state *s*:

$$\mathrm{Cot}_{ist} = \alpha_0 + \alpha_1 \log tax_{st} + \alpha_2 R_{st} + \alpha_3 X_{ist} + \delta_s + \lambda_t + u_{ist}$$

- *tax*: state excise tax
- *R*: state level of restriction on smoking
- *X*: vector of individual or state characteristics.
- δ and λ: state and year fixed effects.

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  - *tax*: state excise tax
  - *R*: state level of restriction on smoking
  - *X*: vector of individual or state characteristics.
  - δ and λ: state and year fixed effects.

- Estimation by OLS. Standard errors clustered at state level. Allow for serial correlation in error term.

Effect of Taxes and Bans

- Direct effect: smoking bans prevent exposure of non smokers to tobacco smoke.

Effect of Taxes and Bans

- Direct effect: smoking bans prevent exposure of non smokers to tobacco smoke.
- Indirect effect: (operates through the behaviour of smokers)
  - taxes decrease smoking.
  - bans change the behaviour of smokers: displacement, across time or places.

Endogeneity of anti-smoking policy

- Bans and taxes are correlated with anti-tobacco sentiments, which also determine smoking and exposure to tobacco smoke.
  - We deal with this problem by controlling for state fixed effects. Identification through changes within states.

Endogeneity of anti-smoking policy

- Bans and taxes are correlated with anti-tobacco sentiments, which also determine smoking and exposure to tobacco smoke.
  - We deal with this problem by controlling for state fixed effects. Identification through changes within states.
- Changes in exposure can lead to the introduction of anti-smoking policies:
  - Politically easier to ban smoking if smoking is on the decline.
  - Tougher health policies may be introduced in periods when smoking is on the increase.
  - We proxy for this by using lagged smoking prevalence at state level.

$$\mathrm{Cot}_{ist} = \alpha_0 + \alpha_1 \log tax_{st} + \alpha_2 GO_{st} + \alpha_3 PT_{st} + \alpha_4 SM_{st} + \alpha_5 WP_{st} + \alpha_6 S_{st} + \alpha_7 X_{ist} + \delta_s + \lambda_t + u_{ist}$$

Differential Effect of Smoking Bans across Locations

$$\mathrm{Cot}_{ist} = \alpha_0 + \alpha_1 \log tax_{st} + \alpha_2 GO_{st} + \alpha_3 PT_{st} + \alpha_4 SM_{st} + \alpha_5 WP_{st} + \alpha_6 S_{st} + \alpha_7 X_{ist} + \delta_s + \lambda_t + u_{ist}$$

- GO: "Going out" i.e. bars, restaurants, recreational places…
- PT: Public transportation.
- SM: Shopping malls.
- WP: Work place.
- S: Schools.

Measuring Displacement

- Some individuals do not go to some of these location: e.g. children & work place, or bars & restaurants.
- Smoking Bans will lead to more displacement if private alternatives exist:
  - Unlikely that workplace bans lead people to stay at home.
  - Home entertainment credible substitute for going out.
- Displacement should affect:
  - Children whose parents are smoking.
  - Not adults if they go out or stay in together.
  - More prevalent in winter as individuals more likely to stay indoors

⇒ Test effect of bans in different locations, by age and by family smoking status, by season.

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Data

- Our analysis uses the National Health and Nutrition Examination Study **(NHANES)**.
- Representative of the US civilian population.
- Reports the cotinine levels in saliva.
- Covers the years 1988-1994, 1999-2000 and 2001-2002.
- We merge information on state excise taxes (Tax Burden on Tobacco).
- Information on state level bans from ImpactTeen, based on Clean Air Acts.

Sample Selection

- All non-smoking individuals with a valid cotinine measure.
- Non-smoking status:
  - Self-declared non-smokers.
  - Self-declared non user of chewing tobacco or snuff.
  - Cotinine level < 10ng/ml.

Descriptive Statistics

	Whole sample	Individuals in smoking families	Individuals in non smoking families
# of observations	29687	5770	23897
average level of cotinine (ng/ml)	0.44 *(1.02)*	1.47 *(1.59)*	0.26 *(0.75)*
Proportion with detectable cotinine measure (>0.035ng/ml)	84%	99%	79%
average age	33.5	22.7	35.7
Age range	4-90	4-90	4-90
sex (% male)	46	46.8	45.8
% white	74	72	74
% black	12	18	11

Note: Standard deviations in parenthesis. The whole sample consists of all non-smoking individuals who have a valid cotinine measure lower than 10ng/ml.

Information on Smoking Bans

- Data collected and compiled by ImpacTeen.
- Based on Clean Air Acts.
- Reports regulation by year and by state.
- Identifies 11 different locations were regulations were enacted:

  Govt. worksites, Private worksites, Child care centers, Health care facilities, Restaurants, Recreational facilities, Cultural facilities, Public transit, Shopping malls, Public schools, and Private schools.
- For each of these locations, reports the severity of the restrictions enforced:

  0 = No restriction
  1 = Restrict smoking to designated areas
  2 = Restrict smoking to separate ventilated areas
  3 = Ban at all times

Information on Smoking Bans

- We construct an overall index of the severity of smoking regulation by state and by year.
  Simple average of levels of restrictions over all locations.
  Can take values from:
  - 0 = no restriction anywhere.
  - 3 = total ban in all 11 locations.
- Next, we group the location into five categories:
  - Going out (restaurants, bars, cultural and recreational public places).
  - Public transportation.
  - Shopping malls.
  - Workplace.
  - Schools.

Descriptive Statistics:

Excise taxes and Smoking Regulations

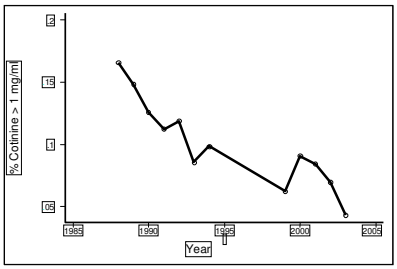
	Average Level	Range	Within State Standard dev.
Log tax	3.43	0.97-4.62	0.27
Average Regulation	0.79	0-2.63	0.22
Bans Going-out	0.76	0-2.67	0.25
Bans public transportation	1.24	0-3	0.31
Bans shopping mall	0.27	0-3	0.31
Bans workplace	0.70	0-3	0.28
Bans schools	0.85	0-2	0.27

Within State Correlation:

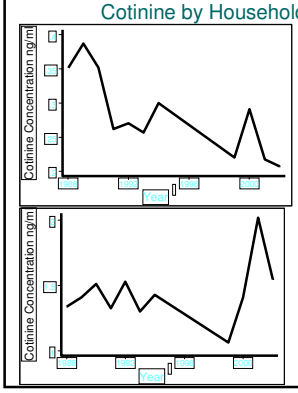
	School	Workplace	Going out	Shopping	Public Transport
School	1				
Workplace	0.47	1			
Going out	0.44	0.71	1		
Shopping	0.33	0.62	0.88	1	
Public Transport	0.22	0.35	0.73	0.53	1

Trends in passive smoking:
Cotinine Concentration in non-smokers

Trends in passive smoking:
Fraction of non smokers with cotinine>1ng/ml



Trends in passive smoking:
Cotinine by Household Smoking Status



Non-smokers in **non-smoking** household

Non-smokers in **smoking** household

Road Map

1. Introduction
2. Empirical Strategy
3. Data and Descriptives
4. Effect of Taxes and Bans
5. Conclusion

Effects of One Standard Deviation in Taxes and Regulations *

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Log Tax	**-0.02***	**-0.03****				**-0.04****	**-0.05****
	(0.012)	(0.012)				(0.015)	(0.019)
Regulations			**-0.032****	**-0.012****	-0.006	0.005	0.004
			(0.009)	(0.002)	(0.008)	(0.006)	(0.005)
Controls:							
Year Dummies		X			X	X	X
State Dummies		X		X	X	X	X
Age, sex, race, state GDP	X	X	X	X	X	X	X
State smoking prevalence							X

Robust standard errors adjusted for clustering at state level in parenthesis. ** significant at 5%, * significant at 10%

Average Cotinine Level = 0.44 ng/ml`

Taxes and Regulation Elasticity of Passive Smoking

- No evidence of a global effect of regulations.
- Effect difficult to evaluate over the whole population.
- Analysis requires more detailed examination:
  - by age group
  - family smoking status
  - season
  - different locations were regulations were enacted

Effects of One Standard Deviation of Taxes and Regulation, by Place of Enforcement *

	All ages
Average Cotinine Level (Standard Deviation)	0.44ng/ml (1.00)
Log Tax	**-0.04**** **(0.02)**
Regulation Going out	**0.21**** **(0.07)**
Regulation Public Transport	**0.05** **(0.04)**
Regulation Shopping Mall	**-0.28**** **(0.10)**
Regulation Workplace	**-0.001** **(0.01)**
Regulation Schools	**-0.04**** **(0.015)**
Controls:	
Year Dummies	X
State Dummies	X
Age, sex, race, state GDP	X
State smoking prevalence	X

Regressions controls for age, sex, race, state GDP, state of residence and year of survey. Robust standard errors adjusted for clustering at state level in

Characterizing Displacement Effect

To uncover displacement effects due to tougher smoking regulations in places where people go out, we focus on non smokers who would not be directly affected by such regulations: children

1. It is likely that children are less prone than adults to go to "going out" places
2. Displacement effect should be larger for children whose parents are smoking
3. Displacement effect should be larger in winter

Effect of One Standard Deviation of Taxes and Regulation by place of enforcement and age

	(1) All ages	(2) Age<8	(3) Age 8-12	(4) Age 13-20	(5) Age 20+
Average Cotinine Level (Standard Deviation)	0.44ng/ml (1.00)	0.94 ng/ml (1.47)	0.63 ng/ml (1.03)	0.74 ng/ml (1.26)	0.43 ng/ml (0.84)
Log Tax	**-0.04**** **(0.02)**	**-0.20**** **(0.06)**	**-0.12**** **(0.03)**	**-0.01** **(0.05)**	**-0.01** **(0.02)**
Regulation Going out	**0.21**** **(0.07)**	**0.65**** **(0.14)**	**0.46**** **(0.10)**	**0.07** **(0.11)**	**-0.03** **(0.14)**
Regulation Public Transport	**0.05** **(0.04)**	**-0.04** **(0.10)**	**-0.01** **(0.06)**	**-0.03** **(0.09)**	**0.04** **(0.04)**
Regulation Shopping Mall	**-0.28**** **(0.10)**	**-0.60**** **(0.22)**	**-0.45**** **(0.17)**	**-0.01** **(0.15)**	**-0.19** **(0.11)**
Regulation Workplace	**-0.001** **(0.01)**				**0.07** **(0.08)**
Regulation Schools	**-0.04**** **(0.015)**	**0.06** **(0.06)**	**-0.10**** **(0.05)**	**-0.04** **(0.03)**	

Regressions controls for age, sex, race, state GDP, state of residence and year of survey. Robust standard errors adjusted for clustering at state level in parenthesis. ** significant at 5%, * significant at 10%.

Effect of One Standard Deviation of Taxes and Regulation by place of enforcement and age *

	(1) All ages	(2) Age<8	(3) Age 8-12	(4) Age 13-20	(5) Age 20+
Average Cotinine Level (Standard Deviation)	0.44ng/ml (1.00)	0.94 ng/ml (1.47)	0.63 ng/ml (1.03)	0.74 ng/ml (1.26)	0.43 ng/ml (0.84)
Log Tax	**-0.04**** **(0.02)**	**-0.20**** **(0.06)**	**-0.12**** **(0.03)**	**-0.01** **(0.05)**	**-0.01** **(0.02)**
Regulation Going out	**0.21**** **(0.07)**	**0.65**** **(0.14)**	**0.46**** **(0.10)**	**0.07** **(0.11)**	**-0.03** **(0.14)**
Regulation Public Transport	**0.05** **(0.04)**	**-0.04** **(0.10)**	**-0.01** **(0.06)**	**-0.03** **(0.09)**	**0.04** **(0.04)**
Regulation Shopping Mall	**-0.28**** **(0.10)**	**-0.60**** **(0.22)**	**-0.45**** **(0.17)**	**-0.01** **(0.15)**	**-0.19** **(0.11)**
Regulation Workplace	**-0.001** **(0.01)**				**0.07** **(0.08)**
Regulation Schools	**-0.04**** **(0.015)**	**0.06** **(0.06)**	**-0.10**** **(0.05)**	**-0.04** **(0.03)**	

Regressions controls for age, sex, race, state GDP, state of residence and year of survey. Robust standard errors adjusted for clustering at state level in parenthesis. ** significant at 5%, * significant at 10%.

Introduction

Effect of One Standard Deviation in Taxes and Regulation on Children, by Place of Enforcement and Household Smoking Status *

	(1) Non Smoking Households	(2) Smoking Households
Average Cotinine Level (Standard Deviation)	0.27 ng/ml (0.44)	1.97 ng/ml (1.85)
Log Tax	0.012 (0.02)	-0.30** (0.06)
Regulation Going Out	0.03 (0.04)	1.08** (0.15)
Regulation Public Transport	0.03 (0.02)	-0.03 (0.13)
Regulation Shopping Mall	0.01 (0.07)	-1.05** (0.23)
Regulation Schools	0.008 (0.01)	-0.09 (0.07)
Controls:		
Year Dummies	X	X
State Dummies	X	X
Age, sex, race, state GDP	X	X
State smoking prevalence	X	X

Summary: Effect of Regulations

- Displacement effect of regulation in restaurants and cultural public places.
- Suggest that smoking adults go home and smoke
  → increase the exposure of young children.
- Bans in recreational public places have no effects on adults.
- Bans appears to be efficient in other places (eg public transport, shopping malls), especially to protect children.

Seasonality Effect in Children, by Household Smoking Status *

	Children Non Smoking Households	Children Smoking Households
Winter	0.001 (0.04)	0.59** (0.21)
Log Tax	-0.13 (0.09)	0.04 (0.08)
Tax*Winter	0.12 (0.09)	-0.27** (0.12)
Going Out	0.07 (0.05)	0.08 (0.11)
Going out*Winter	0.002 (0.16)	0.70** (0.32)
Other regulation	-0.05 (0.04)	-0.02 (0.13)
Other regulation*Winter	-0.02 (0.13)	-0.95** (0.31)
Controls:		
Year Dummies	X	X
Regional Dummies	X	X
Age, sex, race	X	X

Health and Economic Consequences of Anti-Smoking Policies (Children)

- Health effects of passive smoking (children):
  - Asthma (prevalence 10%)
  - An increase of 1ng/ml of cotinine is associated to an increase in prevalence of asthma of 0.8 percentage point.
- Cost of asthma: $ 791 per year. 2.48 days of school missed (Wang et al, 2005)

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  - An increase of 1ng/ml of cotinine is associated to an increase in prevalence of asthma of 0.8 percentage point.
- Cost of asthma: $ 791 per year. 2.48 days of school missed (Wang et al, 2005)
- 1 st dev increase in excise taxes nationally:
  - Saves 45,000 cases of asthma. $ 36 m and 116,000 school days not missed.
- 1 st dev increase in restriction in going out nationally:
  - 160000 new cases of asthma. $ 126 m and 396,000 school days missed.

Conclusions

- **The effect of anti smoking policy interventions on non-smokers is not straightforward:**
  - How do smokers and non smokers interact?
  - Where do smokers smoke?
  - With whom?
  - Which cigarettes are cut down?
  - Where do they smoke if bans are in place?
- **Induce changes in behaviours which can offset these polices.**
- **Although smoking bans appear to be a good way of limiting exposure, not everybody benefit from these policies (eg children)**
- **Rising trend of regulations (US, UK, Ireland...)**
- Consequences on non smokers? Importance of distinguishing between different public places when designing public policies aimed at reducing ETS
- Consequences on health inequalities.

Smoking bans (BBC, Oct.2006)

- **By 2008, the UK could be a largely smoke-free zone.**
- **The government has said it will introduce a smoking ban in almost all public places by then.**

  Anti-smoking and medical organisations have long been campaigning for a full ban on smoking in the workplace, pubs and restaurants.

- **What are the arguments?**

Arguments for:

- **For:** Supporters of a ban say that evidence about the risks of passive smoking is too compelling to ignore. Some of the arguments they put forward are listed below.

1. **Passive smoking is dangerous:** Second-hand smoking in the workplace causes a large number of deaths each year.
2. **A majority of people favour a smoking ban:** A smoking ban in workplaces including pubs and bars is supported by a majority of people.
3. **A ban would encourage more smokers to quit.**
4. **The "voluntary approach" has failed:** The Wanless report on public health said the voluntary approach to smoking in the workplace had only limited success - pubs and bars still allow smoking.
5. **People have a right to protect themselves from smoke inhalation:** The British Medical Association argues that 70% of the population are currently denied the freedom to go about their lives in a smoke-free environment.

Arguments against:

- **Against:** Opponents of a smoking ban say that freedom of choice would be affected. Some of the arguments they put forward are listed below.

1. **People want restrictions not a ban.**
2. **People should have freedom of choice.**
3. **Smoking bans damage business:** A smoking ban could lead to a significant fall in takings from bars, restaurants and casinos. Licensed Victuallers Wales says the ban could lead to the closure of more than a quarter of pubs in Wales.
4. **The link between passive smoking and ill health is unproven:** Forest maintains there is no clear link between exposure to passive smoke and illness in non-smokers.
5. **Self regulation is the solution:** Left to market forces, pubs, bars and restaurants will introduce smoke-free areas and better ventilation tailored to customers' needs.