

# Economics of Smoking

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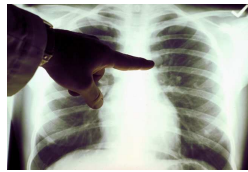
## Plan

- Why smoking is a problem.
- Why should governments intervene?
- Economic analysis of smoking.
- Policy responses.
  
- Taxes, cigarettes and smoking intensity
- The effect of taxes and bans on passive smoking

## Why smoking is a problem

### Diseases caused by tobacco use:

- Lung cancer
- Emphysema, bronchitis, etc
- Stroke (bleeding in the brain)
- Heart attack and heart disease
- Narrowing and clogging of arteries
- Cancers of mouth, throat, larynx, esophagus
- Other cancers – bladder, kidneys, pancreas
- Peptic ulcers (stomach bleeding)
- Respiratory infections and compromise (cough, wheezing etc)
- Gum disease and tooth loss
- Low birth weight and SIDS
- Asthma
- Ear infections
- Compromised sexual performance



## Why smoking is a problem

### Why does tobacco kill?

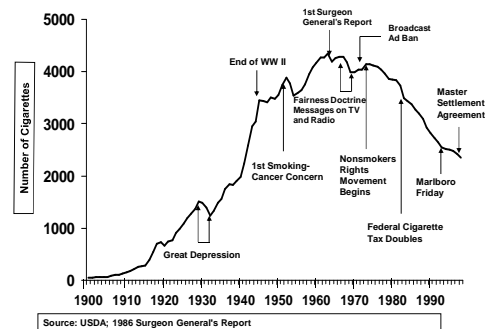
- Cig smoke has > 4,000 chemicals, 43 known carcinogens/harmful substances (tar, cadmium, lead, cyanide, nitrogen oxides, benzo(a)pyrene, carbon monoxide, vinyl chloride, acetaldehyde...)
  
- Damages tissues throughout the body, clogs arteries, causes blood clots/bleeding

## Why smoking is a problem

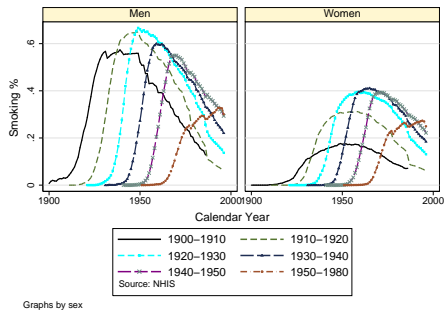
### Are some cigarettes better?

- **No** such thing as a safe cigarette
- “light”, “low tar” cigarettes are deceptive –
  - Manipulation by maker
  - Compensation by smokers so actual yields not = machine yield

## Adult Per Capita Cigarette Consumption and Major Smoking-and-Health Events -- United States, 1900-1998



## Smoking Prevalence by Gender and Birth Cohort, US



## Why smoking is a problem

### Global Trends in tobacco use

- 1.1 billion smokers, 80% in low- and middle income countries (1 in 3 adults)
  - 1.6 billion by 2025
  - 85% of all tobacco used is smoked (cigarettes, bidis, kreteks)
- Centers for Disease Control and Prevention (<http://www.cdc.gov/tobacco>)

## Why smoking is a problem

### United Kingdom: Current Risks

- On average, among 1000 20-year-olds who smoke cigarettes regularly:
  - about 1 will die from homicide
  - about 6 will die from motor vehicles
  - about 250 will be killed by smoking in MIDDLE age alone (+ 250 more in OLD age)

## Why smoking is a problem

### Smoking is increasing in the developing world

#### Male adult prevalence, 1995

US	28 % (was 61% in 1939)
East Asia	61 %
Europe, Central Asia	57 %
Latin America, Caribb	40 %
South Asia	41 % (cigs + bidis)
Sub-Saharan Africa	29 %

## Why smoking is a problem

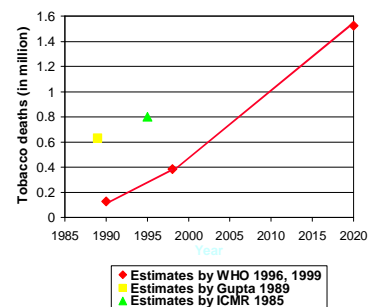
### Burden of Tobacco Deaths Shifting

#### World: Annual Tobacco deaths (in millions)

	2000	2030
Developed	2	~3
Developing	~2	~7
<b>World Total</b>	<b>4</b>	<b>~10</b>

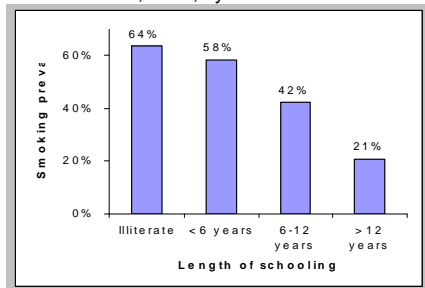
- ◆ 1 in 2 long-term smokers killed by their addiction
- ◆ 1/2 of deaths in middle age (35-69)

## Tobacco deaths are on the increase in India



## Smoking is more common among the less educated

Smoking prevalence among men in Chennai, India, by education levels



Source: Gajalakshmi and others, background paper

## Road Map

- Why smoking is a problem
- **Why should governments intervene?**
- Economic analysis of smoking
- Policy responses

## Why should governments intervene?

Economic rationale – “market failures”

- People do not know the risks of tobacco use (imperfect info)
- Most smokers start young (not fully rational)
- Nicotine is very addictive
- Tobacco users impose costs on others
  - second hand smoke harms non-smokers
  - children and infants need protection
  - health care costs (families and government)
  - opportunity cost for families

## Why should governments intervene?

Role of economics:

Provide empirically based work to guide the formulation of tobacco control policy

Particularly regarding:

1. How prices influence the demand for tobacco products;  
– *effects of addiction on consumer demand*
2. How taxation affects price
3. Effect of media counter-advertising
4. Introduction of restrictions on smoking in public places

## Road Map

- Why smoking is a problem
- Why should governments intervene?
- **Economic analysis of smoking**
- Policy responses

## The impact of price on the demand for tobacco products

1. Conventional studies on cigarette demand
- 2. Addiction models**
  1. Imperfectly rational models of addictive behaviour
  2. Models of myopic addictive behaviour
  3. Models of rational addictive behaviour
3. Behavioural economic analyses

## Addiction Models and Cigarette Demand

First discussion by an economist of the effects of addiction on demand

*“Whether a commodity conforms to the law of diminishing or increasing return, the increase in consumption arising from a fall in price is gradual; and, further, habits which have once grown up around the use of a commodity while its price is low are not so quickly abandoned when its price rises again”.*  
(*Marshall, Principles of Economics*)

## Addiction Models and Cigarette Demand

Three basic dimensions of addiction:

1. Gradual adaptation (tolerance)
2. Irreversibility (withdrawal)
3. Positive effects of habits (reinforcement)

## Addiction Models and Cigarette Demand

Economic Models of Addiction:

1. Models of myopic addictive behaviour
2. Models of rational addictive behaviour
3. Imperfectly rational models of addictive behaviour

## 1. Models of myopic addictive behaviour

Behaviour is naïve in the sense that

... an individual recognizes the dependence of current addictive consumption decisions on past consumption, but then ignores the impact of current and past choices on future consumption decision when making current choices (Pollak, 1975)

- Studied by many (Farrel (1952), Houthakker & Taylor (1966)).

## 1. Models of myopic addictive behaviour

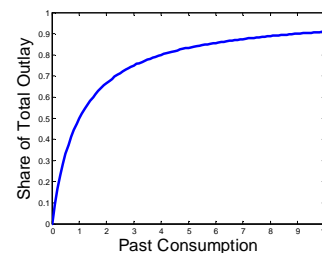
- Example: Model with two goods, one of these is addictive:

$$U(c_1, c_2, c_{1,t-1}) = c_1^{\alpha_1(c_{1,t-1})} c_2^{\alpha_2} \quad \text{subject to } y = pc_1 + c_2$$

$$c_1^* = \frac{1}{p} \frac{\alpha_1(c_{1,t-1})}{\alpha_1(c_{1,t-1}) + \alpha_2} y$$

## 1. Models of myopic addictive behaviour

Example:  $a_1=1, a_2=1, p=1$



## 1. Models of myopic addictive behaviour

Other implications (of more sophisticated models):

- Notion of asymmetric response to price and income as evidence of addiction (e.g. Young, 1983)
- Smokers respond more to a decrease in price than to an increase.

## 2. Models of rational addictive behaviour

Rationality implies that individuals incorporate the interdependence between past, current and future consumption into their utility maximization process.

...future implications are considered when making current decisions (high discount rate are not ruled out)

## 2. Models of rational addictive behaviour

Individuals recognize the addictive nature of choices they make but may still make them because the gains from the activity exceeds any cost through future addiction. (Becker and Murphy, 1988)

Key normative implication: the optimal regulatory role for government related to smoking is solely a function of the **societal costs** induced by smoking.

## 2. Models of rational addictive behaviour

...the fact that smokers impose enormous costs on themselves is irrelevant; only the costs they impose on others provide the rationale for a mandate for government action.

## 2. Models of rational addictive behaviour

How do we measure the **societal costs** associated with smoking?

...low estimates, but what about:

- Second hand smoke?
- Pregnant women? Low birth weight babies
- Loss in workplace productivity from smoking

## 2. Rational Addiction Model

- Three periods.
- Program of the agent:

$$\max_{c_1, c_2, c_3} u(c_0, c_1) + \beta u(c_1, c_2) + \beta^2 u(c_2, c_3)$$
$$y = c_1 + c_2 + c_3$$

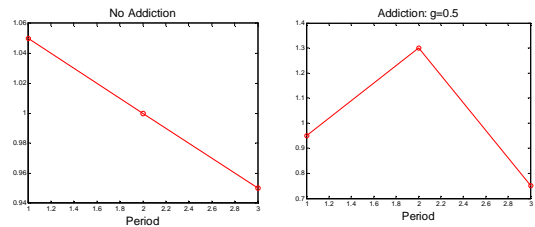
## 2. Rational Addictive Model Numerical Example

- Discount factor:  $\beta=0.95$
- Utility function:

$$u(c_0, c_1) = a_1 c_1 + \frac{a_2}{2} c_1 \cdot c_1 + g c_0 c_1$$

$$a_1 = 1, a_2 = -0.5, g \geq 0$$

## Optimal Consumption



## 3. Criticisms of rational addictive models

Reasons to question whether the assumptions of the rational addiction model apply to smoking decisions:

**Time inconsistency** – individuals are more impatient when evaluating trade-offs between today and tomorrow than when evaluating trade-offs in the future.

**Naïve:** “I’ll start my diet tomorrow”;

**Sophisticated:** “I wish I could quit but I can’t”.

## 3. Imperfectly rational models of addictive behaviour

- These models assume stable but inconsistent short-run and long-run preferences.
  - far-sighted vs short-sighted personality (Schelling, 1978)
  - far-sighted planner vs myopic doer (Thaler and Shefrin, 1981)

## Hyperbolic Discounting

- Time inconsistent behavior.
- Future discounted at rate  $\beta$  between period  $t+s$  and  $t+s+1$ ,  $s>0$ .
- Future discounted at rate  $\delta\beta<\beta$  between period  $t$  and  $t+1$ .
- Choices made in period 1 are not optimal anymore in period 2 or 3.

## Hyperbolic Discounting

- Program of the agent in period 1:

$$\max_{c_1, c_2, c_3} u(c_0, c_1) + \delta(\beta u(c_1, c_2) + \beta^2 u(c_2, c_3))$$

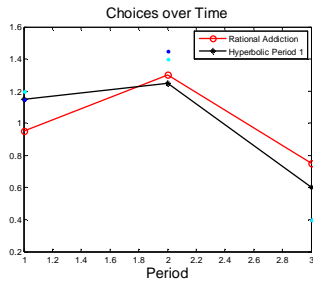
$$y = c_1 + c_2 + c_3$$

- Program of the agent in period 2:

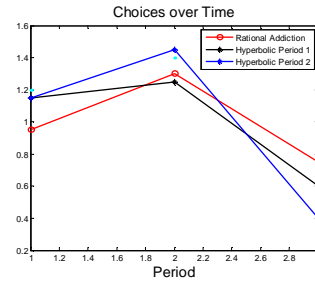
$$\max_{c_2, c_3} u(c_1, c_2) + \delta\beta u(c_2, c_3)$$

$$y = c_1 + c_2 + c_3$$

## Numerical Example



## Numerical Example



## Hyperbolic Discounting

- Optimal program is to solve the program **backward** to find the best response  $c_2^*(c_1)$ :

$$\max_{c_2, c_3} u(c_1, c_2) + \delta \beta u(c_2, c_3)$$

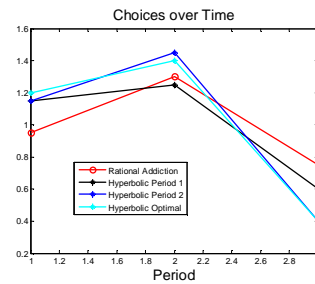
$$y = c_1 + c_2 + c_3$$

- Then, solve for  $c_1$ , taking into account the optimal behavior in period 2:

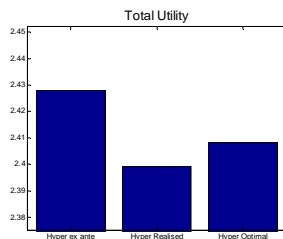
$$\max_{c_1} u(c_0, c_1) + \delta (\beta u(c_1, c_2^*(c_1)) + \beta^2 u(c_2^*(c_1), y - c_1 - c_2^*(c_1)))$$

$$c_3 = y - (c_1 + c_2^*(c_1))$$

## Numerical Example



## Numerical Example



- The agent knows that future plans will be sub-optimal.
- The agent is willing to pay to constrain future consumption.

## 3. Models of rational addictive behaviour

Self control devices (betting with friends, telling other about the decision,...)

Government regulatory policy acts as the self-control device that time-inconsistent agents desire to help in controlling their habits.

Cigarette taxes control the “internalities” (the effects on one’s own health), as well as the externalities of smoking.

## Do taxes make smokers **happier**?

- Rational addiction models vs time inconsistent models
- Do taxes serve as a self control device? (Gruber and Koszegi, 2001; Gruber, 2002)

## Road Map

- Why smoking is a problem
- Why should governments intervene?
- Economic analysis of smoking
- **Policy responses**

## Policy responses

1. **Taxation**
2. Restrictions on cigarette smoking, **Smoking bans**
3. Bans on **advertising** and promotion
4. Dissemination of **information** on the health consequences of smoking
5. Limits on **youth access** to tobacco products

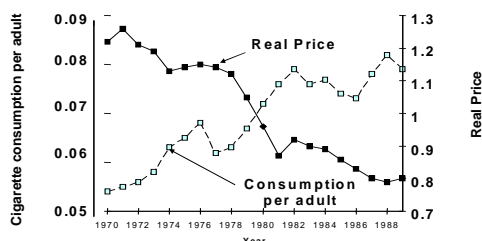
## Policy responses: (1) Taxation

### Taxation is the most effective measure

- Higher taxes induce quitting and prevent starting
- A 10% price increase reduces demand by:
  - 4% in high-income countries
  - 8% in low or middle-income countries
- Young people and the poor are the most price responsive

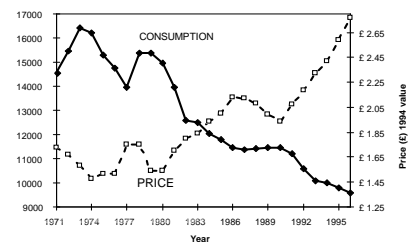
## Price Elasticity Evidence

As real price decreases, consumption increases  
Evidence from South Africa



## Evidence from the UK

### Real Price and Consumption of Cigarettes in the UK, 1971-96





### Policy responses: (1) Taxation

#### Questions:

- What is the “right” level of cigarette taxation?
- Are cigarette taxes fair? Distributional issue.
- What are the proper trade-offs between the interests of the individuals and the social interests in the public’s health?
- How will a tax increase influence smoking?
- And, consequently, what impact will it have on public health?
- Smuggling?

### Policy responses: (1) Taxation

#### 1. Purpose of Taxation

- A. Revenue
- B. Reduce consumption

#### 2. Cons of tax increases?

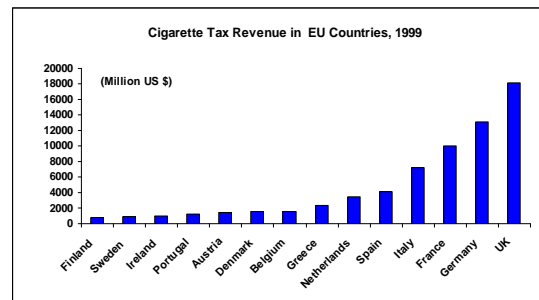
- employment effect
- smuggling
- impact of taxes on poor smokers

### A. Tobacco Taxes generate Revenues

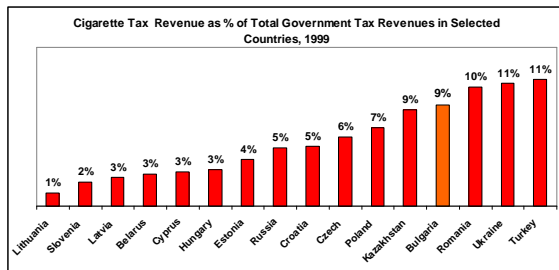
#### Revenue Generating Potential of Tobacco Taxes:

- As price rises, consumption falls, but by less than the percentage rise in price (demand is price-inelastic).
- As incomes rise, so does consumption - and total revenue (the income elasticity of demand is greater than one).
- Production can be closely supervised by the government – easy to collect taxes.

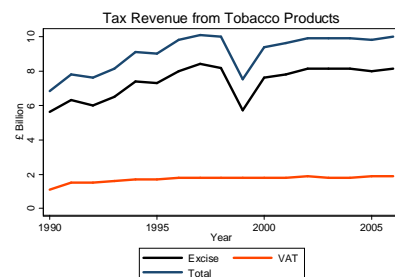
### A. Tobacco Taxes generate Revenues



### A. Tobacco Taxes generate Revenues



### Tax Revenue in the UK



### B. Cigarette consumption reduction

- Raison d'être underlying desire to see smoking decline: to reduce morbidity and premature mortality associated with smoking.
- Economists have taken the demand elasticity evidence and combined it with data on the health consequences of quitting smoking and not starting to project the **health gains** that would be achieved with tax increases of various magnitudes.  
eg Moore (1996); Chaloupka (1998)

### B. Cigarette consumption reduction

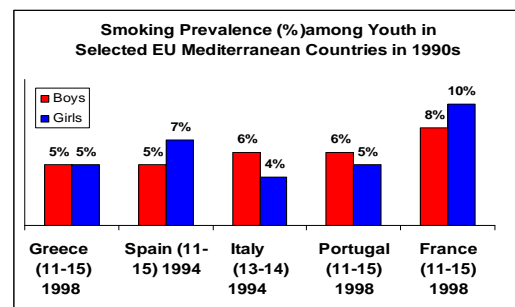
- What is the "right" level of cigarette taxation, if any?
- An economically optimal tax on cigarettes would equate the revenues generated with the net social costs produced by smoking (Pigou, 1962).
- What has to be included in the social costs?  
Hay, 1991; Manning et al, 1989 (did not include passive smoking); Viscusi, 1995

### B. Cigarette consumption reduction

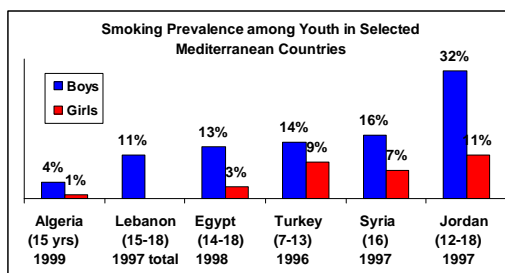
Other factors to be considered when trying to define an optimal cigarette tax:

1. Smoking is a behaviour initiated almost exclusively at **young age**;
2. It is **addictive**;
3. Many smokers are not truly well **informed** about the hazard of smoking.

### Protect Youth Smoking and Addiction Starts Young



### Protect Youth: Smoking and Addiction Starts Young



### Policy responses: (1) Taxation

#### 2. Cons of tax increases?

- A. Cause job losses?
- B. Reduce government revenues?
- C. Increase smuggling ?
- D. Hurt poor smokers ?

### Policy responses: (1) Taxation

A. *If demand for tobacco falls, will there be massive job losses?*

- This argument is often used by the tobacco industry
- BUT is it such a big effect?
  - Tobacco production is a small part of most economies
  - Even tobacco-dependent economies will have a market big enough to ensure their jobs for many years to come, even in the face of gradually declining demand.

### Policy responses: (1) Taxation

- The tobacco industry estimates that 33 million people are engaged in tobacco farming worldwide.
- Of the total, some 15 million are in **China**, and another 3.5 million in **India**. **Zimbabwe** has some 100,000 tobacco farm workers.
- the **United States** has 120,000 tobacco farms, and the **European Union** has 135,000-mostly small-farms in Greece, Italy, Spain, and France.
- The manufacturing side is only a small source of jobs, as it is highly mechanized. In most countries tobacco manufacturing jobs account for well below 1% of total manufacturing employment.

### Policy responses: (1) Taxation

The impact on economies of a global fall in tobacco consumption will vary, depending on the type of economy.

Countries can be grouped into three categories:

1. countries that produce more raw tobacco than they consume, that is, **net exporters**.
2. countries that consume about as much as they produce, that is, so-called "balanced" tobacco economies.
3. countries that consume more than they produce, meaning **net and full importers**.

### Studies on the employment effects of dramatically reduced or eliminated tobacco consumption

Type of Country	Name and year	Net change as % of employment in base year
Net Exporters	US (1993)	0%
	UK (1990)	0.5%
	Zimbabwe (1980)	-12.4%
Balanced Tobacco Economies	South Africa (1995)	0.4%
	Scotland (1989)	0.3%
Net Importers	Bangladesh (1994)	18.7%

Source: Buck and others, 1995; Irvine and Sims, 1997; McNicoll and Boyle 1992, van der Merwe and others, background paper; Warner and others 1996

### Policy responses: (1) Taxation

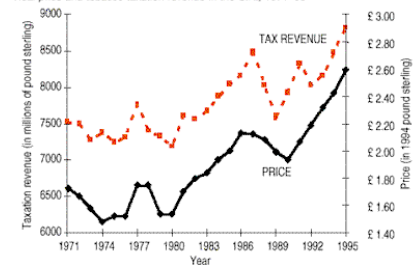
B. *Will higher tobacco taxes reduce government revenues?*

- Policymakers argue against raising tobacco taxes on the basis that the resulting reduction in demand will cost governments vital revenue.
- In fact, the reverse is true in the short to medium term, even though the situation in the very long term is less certain.

### Policy responses: (1) Taxation

FIGURE 6.1 AS TOBACCO TAX RISES, REVENUE RISES TOO

Real price and tobacco taxation revenue in the U.K., 1971-95



Source: Townsend, Joy, "The Role of Taxation Policy in Tobacco Control." In Albedian, I., and others, eds. *The Economics of Tobacco Control*. Cape Town, South Africa: Applied Fiscal Research Centre, University of Cape Town.

### Policy responses: (1) Taxation

C. Will higher tobacco taxes cause massive increases in smuggling?

- Cigarette consumption will remain high and tax revenues will fall and criminal activity increases
- However the experience of a large number of high-income countries show that, even in the face of high rates of smuggling, tax increases bring increased revenues and reduce cigarette consumption.
- Crack down on crime.
- Harmonization in cigarette tax rates between neighboring countries will help to reduce the incentives to smuggle.

### Policy responses: (1) Taxation

- More smuggling if :
  - Tax differential is high
  - Public is tolerant
  - Controls are weak
  - corruption in the country is high
  - tobacco industry is complicit
  - organized crime plays a big role

### Policy responses: (1) Taxation

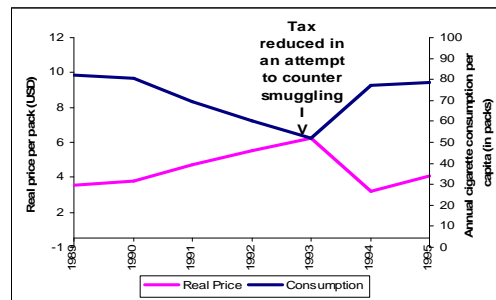
- **Canada's** experience:

In the early 1980s and 1990s, Canada increased its cigarette taxes sharply: real price rose significantly.

Between 1979 and 1991 teenage smoking fell by nearly two-thirds, adult smoking declined, and cigarette tax revenues rose substantially.

However, because of concerns about greatly increased **smuggling**, the government cut cigarette taxes sharply.

Smuggling: What is the Solution?  
Canadian Government reduced tobacco tax rates dramatically in February 1993



### Policy responses: (1) Taxation

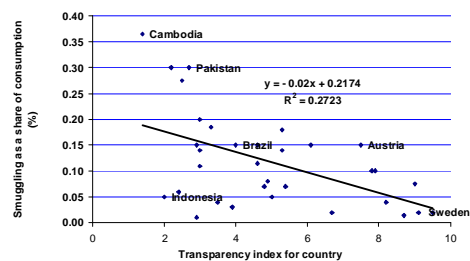
- The experience of **South Africa** is also illuminating.

During the 1990s: excise taxes on cigarettes increased sharply (by more than 450 percent). As a percentage of sale price, **taxation rose** from 38 to 50 percent.

**Smuggling rose** too.

**Sales fell** by more than 20%, implying a significant net fall in consumption even with increased smuggling. Meanwhile, total **tax revenues more than doubled** in real terms.

Tobacco smuggling tends to rise in line with the degree of corruption  
Smuggling as a function of transparency index



### Policy responses: (1) Taxation

D. What about the impact of taxes on poor smokers?  
Will poor consumers bear the heaviest financial burden?

- Consensus that tax systems should be progressive, where the marginal rates of tax rise as incomes rise.
- Tobacco taxes are regressive: they place a disproportionately heavy financial burden on people with low incomes.
- This regressivity is further increased due to the fact that smoking is more common in poor households than rich households, so that **poor smokers spend a larger share of their income on cigarette tax** than do rich smokers.

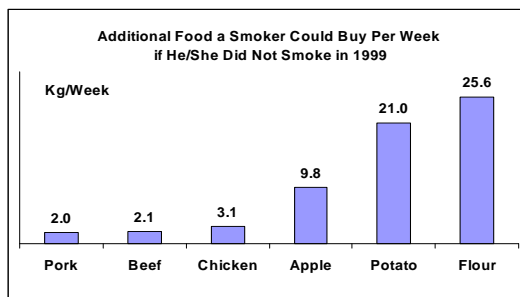
### Policy responses: (1) Taxation

Concern: as taxes are raised, poor consumers will spend more and more of their income on cigarettes, resulting in significant family hard-ship.

Even with contracted demand, it is true that if poor consumers continue to consume more tobacco than the rich, they will also pay more tax.

However, people on lower incomes are more responsive to price changes than people on high incomes. As their consumption falls more steeply, their relative tax burden will fall compared with that of the richer consumer, even though their absolute payments will still be greater.

### Allocating Tobacco Expenditure to Other Goods and Services Better Nutrition, Better Health: Evidence from Hungary



### Policy responses

1. Taxation
2. **Restrictions on cigarette smoking, Smoking bans**
3. Bans on **advertising** and promotion
4. Dissemination of **information** on the health consequences of smoking
5. Limits on **youth access** to tobacco products

### Policy responses: (2) Smoking Restrictions

- Starting in 1973 US states started adopting “clean indoor air” laws.

Prime Objective: limit non-smokers exposure to environmental tobacco smoke (ETS)

...but they can also lead to significant reductions in cigarette smoking

### Policy responses: (2) Smoking Restrictions

- Where most nonsmokers' exposure to others' smoke occur? in public places or in the home?
- Econometric evidence:
  - Adda and Cornaglia (2006)

### Policy responses

1. Taxation
2. Restrictions on cigarette smoking, Smoking bans
3. **Ban on advertising and promotion**
4. Dissemination of **information** on the health consequences of smoking
5. Limits on **youth access** to tobacco products

### Policy responses: (3) Advertising ban

- Cigarettes are one of the most heavily advertised products in the world:
  - television, radio, newspapers, magazines, internet,...
  - multiple pack promotions, sponsorship of cultural, sporting, and other entertainment events,...

- Several mechanisms through which cigarette advertising could affect cigarette consumption:

#### Direct mechanisms:

1. initiate regular smoking
2. reduce willingness to quit
3. increase daily consumption
4. induce relapse

#### Indirect mechanisms:

1. discourage media coverage of health risks
2. perception of smoking as socially acceptable

- Impact of cigarette advertising on cigarette demand? mixed econometric evidence. Experiments?

### Policy responses: (3) Advertising ban

- Substitution between media
- studies that have examined the effect of partial cigarette advertising bans have found little or no effect on smoking.
- multiple restrictions on advertising in all media mean there are relatively few alternative outlets for the industry.
- Modeling suggests that the European Union's ban on advertising could reduce cigarette consumption within the European Union by nearly 7 percent.

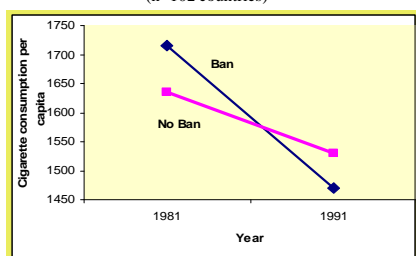
### Policy responses: (3) Advertising ban

- A study of 100 countries compared consumption trends over time in those with relatively complete bans on advertising and promotion and those with no such bans (Saffer, "The control of Tobacco Advertising and Promotion ")

### Policy responses: (3) Advertising ban

#### Comprehensive advertising bans reduce cigarette consumption

Consumption trends in countries with such bans v. those with no bans (n=102 countries)



Source: Saffer, "The control of Tobacco Advertising and Promotion "

### Policy responses

1. Taxation
2. Restrictions on cigarette smoking, Smoking bans
3. Ban on advertising and promotion
4. **Dissemination of information** on the health consequences of smoking
5. Limits on **youth access** to tobacco products

### Policy responses: (4) Dissemination of info on health consequences of smoking

- Extensive econometric analysis on the **smoking related “health scares”** (1950s and 1960s in the US): cigarette smoking fell significantly in response to the new information on its health consequences (eg. Warner, 1981).
- Limited econometric evidence on **health warning labels** on cigarette packaging: small but significant reduction in cigarette smoking (eg. Bardsley and Olekans, 1998).
- Mixed econometric evidence on the effect of “**counter advertising” campaigns**.

### Policy responses: (4) Dissemination of info

#### health warning labels

- Tobacco industry rebrands cigarettes as “healthy”: “low tar” and “low nicotine.”
- are these brands safer than other cigarettes?
- Since the early 1960s a growing number of governments have required cigarette manufacturers to print health warnings on their products.
- One weakness of warning labels: they do not reach some poorer individuals, particularly children and adolescents, in low-income countries (cigarettes bought singly rather than in packs).

### Policy responses

1. Taxation
2. Restrictions on cigarette smoking, Smoking bans
3. Ban on advertising and promotion
4. Dissemination of information on the health consequences of smoking
5. Limits on **youth access to tobacco products**

### Policy responses: (5) Limits on youth access to tobacco products

- In the US, 43 states ban the sale of cigarettes to minors.
- Mixed evidence on the effectiveness of these youth access limits (eg. Forster et al, 1998; Rigotti et al, 1998)
- Few recent econometric analyses: little or no impact was found on young cigarette smoking (eg. Chaloupka et al, 1997).

**Reason: weak enforcement of the laws?**  
(Chaloupka and Grossman, 1996)

### Policy responses: (5) Limits on youth access to tobacco products

- The issue of retailers’ compliance with limits on cigarette sales to youth has received much attention (Jason *et al.* 1991,1996; Lynch and Bonnie 1994; USDHHS 1994; Rigotti *et al.* 1997; Forster *et al.* 1998).
- In general, the evidence suggests that retailer compliance is relatively low.
- Youth-restriction policies are relatively inexpensive to legislate, but costly to enforce.

### Policy responses: (5) Limits on youth access to tobacco products

- Even in situations where the laws exist and are enforced, if the risk of prosecution is minimal or the fines are substantially less than the benefits from breaking the law, retailers will not comply with the law (Carruthers and McDonald 1995).
- Where high levels of retailer compliance are achieved, youth rely more heavily on social sources of tobacco.
- the actual accessibility of tobacco to youth did not decline despite a significant decline in availability from retail

### Broader purpose of the Economics of Smoking

Not only enlightens debate on tobacco policy, but economic research on smoking informs both research and policy debates on **other addictive substances** (e.g. Warner, 1991)

e.g alcohol, fatty food, illicit drugs (marijuana, cocaine) for which the availability of reliable data is scarce.

### What Next?

- Measure of smoking:
  1. compensatory behaviour of smokers  
When taxes go up, smokers compensate by extracting more nicotine per cigarette
  2. displacement of smoking from public to private places  
Smoking bans