The Effect of Taxes and Bans on Passive Smoking

Jérôme Adda *and* **Francesca Cornaglia**

discuss a more precise way of measuring the impact of smoking bans on passive smoking, and report some surprising conclusions.

IN THE US, 15% of the population smokes regularly. Yet, detectable levels of tobacco-related chemicals can be found in body fluids in 84% of non-smokers of all ages. A large medical and epidemiological literature has stressed the dangers of exposure to environmental tobacco smoke. Passive smoking has been linked to serious illnesses such as lung cancer and heart disease in the adult population. In young children and babies, it causes asthma, bronchitis and sudden infant death syndrome.

Figure 1: *Not all cigarettes are smoked with the same intensity. A more accurate measure of smoke inhalation is needed than simply the number of cigarettes smoked.*

Exposure to smoke causes about 200,000 lower respiratory tract infections in young children each year, resulting in 10,000 hospitalizations (Environmental Protection Agency, 1992). Medical studies consistently find that smokers' behaviour damages the health of non-smokers. As a result, governments have come under pressure from the general public and from anti-tobacco groups to limit the exposure of non-smokers and generally to discourage smoking. Public intervention mainly uses two instruments to discourage smoking: directly by limiting or banning smoking in public places, and indirectly by raising taxes on cigarettes. Since the mid Eighties, support for smoking bans in public places has steadily risen: the proportion of individuals supporting a total ban in the US in restaurants has increased from 20% in 1985 to 54% in 2005.

The economic literature has focused on the effect of prices or taxes on *smokers*. Following the work of Becker and Murphy (1988), most papers estimate a measure of the responsiveness of the number of cigarettes consumed to their price both in the short and the long run. The evidence in these papers suggests that prices do have an effect on cigarette consumption. However, some recent papers dispute this: DeCicca *et al.* (2002) show that cigarette prices do not affect initiation at young ages; Adda and Cornaglia (2006) show that although taxes affect the number of cigarettes smoked, smokers compensate by smoking each cigarette more intensively. Few papers analyse the effect of bans on smoking. Among these, Evans *et al.* (1999) show that workplace bans decrease the prevalence of smoking in those who work.

While the research literature on the effect of taxes or prices on smokers is quite large, there is less evidence on the effectiveness of these measures and on the extent to which restricting smoking reduces smoking exposure for non-smokers. Yet the debate in public circles and in the media on the effectiveness of different measures has recently intensified, and policies to ban smoking are often justified by the protection of non-smokers rather than smokers. One of the main reasons why there is little work in the economic literature on the exposure of non-smokers to environmental smoke is the apparent difficulty of measuring passive smoking directly.

Cotinine as a measure for passive smoking

In a recent paper we analysed the effect of state interventions on non-smokers using a measure of the amount of tobacco smoke inhaled by non-smokers. Cotinine is a metabolite of nicotine. While nicotine is unstable and is degraded within a few hours of absorption, cotinine has a half-life in the body of about 20 hours and is therefore a biological marker often used as an indicator of passive smoking. It can be measured in body fluids (e.g. saliva or serum). The use of cotinine as a measure of exposure to tobacco smoke has several advantages. First, cotinine is directly associated with the exposure to cigarette smoke: there is a direct relationship between the number of cigarettes smoked in the household and the cotinine level in non-smokers living with smokers. Second, cotinine – and nicotine from which it is derived – is a good proxy for the intake of health-threatening substances in cigarettes. The nicotine yield of a cigarette is highly correlated with the level of tar and carbon monoxide, which causes cancer and asphyxiation: cotinine is therefore a good indicator of health hazards from passive smoking. Third, cotinine levels reveal variations in exposure caused by changes in policy more effectively than markers such as tobacco-related diseases, which take time to develop. Finally, there is minimal measurement error, compared with self-declared exposure to cigarettes, which is sometimes used as a measure of passive smoking. Cotinine is therefore a straightforward and precise measure of passive smoking, and one particularly

Figure 2: *Preparation for the smoking ban in the UK in July 2007. (Getty Images)*

suited to the evaluation of policies aimed at reducing smoking.

In our analysis we have used data from the National Health and Nutrition Examination Survey (NHANES), a nationwide representative sample of the US civilian population. It provides information, from 1988 to 1994 and from 1999 to 2002, for around 52,000 individuals from birth onwards. The data includes information on the age, sex, race, health, education and occupation of the individual, as well as information at the household level such as family composition, income or geographical location. In addition, the cotinine concentration in both smokers and non-smokers (aged four and above), and the number of cigarettes smoked in the household are reported. This last information allows one to distinguish between non-smokers that are exposed to passive smoke at home and non-smokers that live in smoke-free households. From the available sample we have selected non-smoking individuals – in total, around 30,000 non-smokers with a valid measure of cotinine concentration.

Taxes

We have merged the NHANES datasets with information on US excise taxes at state level. The data on excise taxes are from the Tax Burden on Tobacco. On average, taxes have increased by 2 cents per year.

Taxes have for a long time been used as a policy measure to reduce tobacco exposure. We find evidence of the fact that taxes do reduce the exposure of non-smokers. Cigarettes smoked in the presence of non-smokers seem to be the first to be cut as a result of a change in taxes. But the effect of taxes decreases with age: young children are the most sensitive to a change in taxes; for older individuals, taxes have no significant effect on exposure to tobacco smoke. This suggests that smoking is partly a social activity, and that smokers get more out of smoking in the presence of other adults. An alternative explanation could be that adults with children are poorer and are able less easily to borrow against future income, which would make them more sensitive to a change in tobacco prices.

Smoking bans

The other policy measure used to reduce tobacco exposure that we have considered is smoking bans in public places. We have merged the NHANES datasets with information on smoke-free laws in the different US states. Regulations on smoking bans in the US are obtained from the ImpacTeen website, based on state clean-air acts. This dataset reports the regulation in place, by year and by state, in different locations. Eleven different locations where regulations were enacted were identified: government worksites, private worksites, childcare centres, healthcare facilities, restaurants, recreational facilities, cultural facilities, public transport, shopping malls, public schools, and private schools. And for each of these locations the degree of restriction enforced has been measured. We have recoded the severity of the restriction into four categories: zero if no restrictions; one if smoking is restricted to designated areas; two if smoking is restricted to separate areas; three if there is a total ban on smoking.

Over the nineties, regulations became more stringent. Moreover, the proportion of states with no restriction in any places fell from 50% in 1991 to 36% in 2001. Similarly, in 1991 only 27% of the states had at least a total ban on smoking in one public space, whereas the figure was 51% in 2001.

Simple correlation analysis shows that states with more stringent restrictions on smoking also have lower exposure to passive smoking. This could be due to the causal effect of bans, or because more health-conscious states with lower smoking rates are more prone to ban smoking. We have therefore pursued the analysis by looking at differences across states *and* across time. This allows us to control for fixed states characteristics, which affects the attitude towards smoking and implemented policies.

When we consider the impact of smoking regulations on non-smokers' exposure in the whole sample of non-smokers, we obtain the striking result that smoking bans appear to have no role in preventing exposure. However, not to distinguish among the different locations where bans are enforced may be misleading. Smoking bans can apply to very different places and their effect may differ according to the location. We have therefore considered separately different places where regulation may be enforced. In particular we have distinguished between places where individuals spend their leisure time, and called them 'going out' (i.e. restaurants, recreational and cultural facilities), and public transport, shopping malls, workplaces, and schools. When we do this, we find evidence of the fact that tighter regulations have different effects on the cotinine concentration depending on where they are enforced. Tighter regulations in public transportation do not seem to have an effect on reducing the exposure of non-smokers. But tighter regulations do have an impact on the cotinine levels in non-smokers in schools and in shopping malls.

Displacement effects

Most interesting is what we observe as the impact of tighter regulations in 'going out' places. We observe a significant *increase* in the cotinine level in non-smokers when bans are enforced in public recreational places. The direct effect of the ban on non-smokers would be a *reduction* in exposure for individuals who spend time in such places, so why is there increased exposure? A plausible explanation is indirect contamination: the ban causes smokers to change their smoking habits and makes them more likely to smoke in the presence of non-smokers. We call this a 'displacement' effect.

To uncover displacement effects caused by tougher smoking regulations in places where people go out, we focus on non-smokers who would not be directly affected by such regulations: children. There are several reasons for doing this. First, it is likely that children are less prone than adults to go to bars, restaurants and, perhaps, recreational public places. Second, the displacement effect should be larger for children whose parents are smokers. Third, the displacement effect should also be larger when people are more likely to be indoors, such as in winter, especially at a young age.

When we distinguish by age, we find that in places like restaurants, bars and other recreational places ('going out'), a change in regulations *increases* the exposure of children. It can be interpreted that there is a displacement effect: leisure activities shift from public places, where regulation can be enforced, to private places, where no restriction on smoking can be enforced – leading to a displacement of smoking towards places where adults and children interact. To put it another way, when smokers cannot smoke in their 'going out' places, they smoke more at home instead.

On the other hand, tighter regulations in non-recreational public places do seem to reduce tobacco exposure in non-smokers, especially for young children. The effect of a ban in schools, for example, has a significant impact on children aged 8 to 12.

In general, smoking regulations have a larger impact, either beneficial or detrimental, on young children. For adults, we cannot find evidence of an effect of smoking regulations, wherever they are enforced. This is consistent with a displacement of smoking, with adult non-smokers accompanying smokers to places where smoking is allowed.

To substantiate further the displacement effect that results from tougher regulations in bars, restaurants and recreational places, we have investigated the differential impact of these measures during winter and summer: in colder months it is more likely that smokers will smoke indoors, exposing non-smokers to a higher level of environmental tobacco smoke than in the summer when they have the option to be outdoors. We find no seasonal effects for children living in non-smoking households. But when we look at children in smoking families, we find strong seasonal effects: the displacement effect of smoking restrictions in 'going out' places is more pronounced in winter than in summer; however, restrictions in non-recreational places are more efficient.

Conclusion

There seems to be evidence that children form the group of individuals most affected by changes in taxes and regulations. The observed effects of changes in regulations are considerably larger for children living in smoking households than for children living in non-smoking households. The effect of tighter regulations on children in smoking households differs according to where the regulations are enforced: restriction in bars, restaurants and other recreational places leads to significant increased exposure. These results are in accordance with the hypothesis of a displacement effect of adult smokers towards home.

Our results question the usefulness of bans in reducing smoking exposure for non-smokers. More precisely, we show that policies aimed at reducing exposure to tobacco smoke induce changes in behaviour which can offset these policies. It is therefore of crucial importance to understand how smoking behaviours are affected by regulations. So far, the research literature has not gone far enough in studying smoking behaviour to be able to evaluate its effect on non-smokers. It is not enough to show that smokers react to prices or taxes. Information on which particular cigarette is cut down during the day, where smokers smoke and with whom are also relevant. There are complex interactions at play and considerable variation in their effects across socio-demographic groups. Using a biomarker such as cotinine concentrations is a very direct way of evaluating the overall effect of interventions and the induced changes in behaviours.

It seems important when designing public policies aimed at reducing tobacco exposure of non-smokers to distinguish between the different public places where bans are introduced. Displacing smoking towards places where non-smokers live is particularly inefficient. It may also increase health disparities across socio-economic groups and in particular in children. Therefore total bans may not be the optimal policy. A better policy may be to allow for alternative places for smokers to turn to. There are several reasons why one may want to protect children. They constitute a vulnerable group with few options for avoiding contamination. The age group is particularly prone to tobacco-related diseases, and poor health in childhood has lasting consequences not only for future health but also for the accumulation of human capital (Case *et al.* 2005). Governments in many countries are under pressure to limit passive smoking. But a successful way of limiting second-hand smoke may need to take into account the possibility that public policies can generate perverse incentives and effects.

Dr Francesca Cornaglia is currently a British Academy Postdoctoral Fellow at the Department of Economics, Queen Mary University of London. Dr Jérôme Adda is reader at the Department of Economics, University College London.

Dr Cornaglia gave a presentation on this topic at the British Academy Postdoctoral Fellowship Symposium in April 2008. Summaries of other presentations given on that day may be found via www.britac.ac.uk/events/2008/pdf-symp/abstracts.html