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Does a Health Shock Modify Tobacco Consumption?

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Smoking caused almost 75,000 deaths in France in 2015, killing half of all regular smokers. It is also responsible for 90% of lung cancer cases, and increases the risk of developing a serious form of cardiovascular disease and of contracting chronic obstructive pneumopathy (Bonaldi et al., 2019).

To lower the incidence of these diseases, various anti-smoking campaigns have contributed to reducing average tobacco consumption over recent years. However, some parts of the population, in particular unemployed persons and low-income individuals, are still reluctant to change their smoking habits significantly and over the long term (Beck et al., 2015). This is partly due to tobacco's nicotine (a powerful alkaloid) content.

In this context, it is important to better understand the factors that foster reducing tobacco consumption. To that end, we explore whether the occurrence of a health shock requiring medical care would make individuals more aware of their risk of mortality. The health shock is assumed to induce a change in health risk behaviour. It might increase (in reaction to post-traumatic stress) or decrease (to avoid a further deterioration in health) in tobacco consumption. Using the longitudinal data from the Gazel cohort, our results indicate that smokers having such health shock reduce their tobacco consumption more than other smokers. Furthermore, this reduction is maintained up to five years after the health shock. We also show that heavy smokers reduce their tobacco consumption more than occasional smokers.

In 2019, the prevalence of smoking—including regular and occasional smokers—was estimated to be 30.4% in France (Pasquereau et al., 2020). This percentage is one of the highest in Europe: in Germany, Belgium, and the Netherlands, smokers account for a quarter of the population, in Italy one fifth, and in Great Britain one sixth. Given this high prevalence rate in France, smoking is aggravating the incidence of many chronic diseases in the popula-

tion (one out of every three cancers, certain cardiovascular diseases, and chronic obstructive broncho-pneumopathy). Hence, it is estimated that 20% of the 346,000 new cases of cancer diagnosed in 2015 among individuals aged 30 or over were associated with tobacco consumption and 13% of all deaths, and 12% of deaths due to cardiovascular diseases, can be attributed to smoking (Bonaldi et al., 2020). In addition, other associated diseases or those aggra-

vated by smoking have been identified: type II diabetes, gastro-duodenal ulcers, otorhinolaryngologic (ORL) and dental infections, and hypercholesterolemia (Pasquereau et al., 2016). Furthermore, smoking results in significant expenses: in 2012, they reached 26.6 billion euros and included direct costs associated with healthcare (hospital stays and treatments) and indirect expenses associated with workplace absenteeism (Kopp, 2015).

To limit the propagation and consequences of these diseases, several measures have been implemented in France, such as the prohibition of smoking in public spaces, regular tax increases of tobacco products, and the launch of several media campaigns. The various assessments of these measures have produced mixed results to date. While the introduction of taxes has significantly reduced tobacco sales, it has contrasting effects on tobacco consumption. Some smokers do not decrease their tobacco consumption, because they rely on other products that are less taxed (such as rolling tobacco) or have bought their cigarettes abroad or on the black market. Furthermore, taxation is unfair as it has a greater impact on the budgets of low-income individuals (Peretti-Watel and Seror, 2009). The various media campaigns are only effective if they are complemented by other more positive information, such as personalised advice about the importance of tobacco cessation or encouragement to do so (Gallope-Morvan, 2008). Furthermore, the media campaigns had unpredictable indirect effects; they have stigmatised smokers: they are depicted as selfish individuals who place a financial burden on the healthcare system (Chapman and Freeman, 2008).

In this context, it is important to identify factors that participate to modify undesirable individual lifestyles. How likely is it that a serious health shock will induce a change in individual tobacco consumption? If so, does such an event increase or reduce the individual's tobacco consumption? For how long?

Analysing the impact of a health shock on smoking behaviour, its scale, and duration

In this study, the event used is a health shock. It may, a priori, have a positive or negative impact on tobacco consumption. A positive impact would mean a reduction in tobacco consumption, because the health shock has made the individual more aware of his/her mortality, encouraging him/her to adopt

better health behaviours to avoid the possibility of a future hospitalisation or a deterioration in his/her quality of life; a negative impact would mean that the individual increases his/her tobacco consumption, if the individual is anxious about the occurrence of this health shock. Determining the direction and the magnitude of such effects is thus an empirical issue.

Empirical literature has shown that individuals suffering from a health shock change their subjective life expectancy, and even their health-related behaviours. Smith et al. (2001) pointed out that American smokers who suffered from lung cancers or a cardiovascular disease significantly reduced their subjective life expectancy (their self-reported life expectancy). Nonetheless, the continuity of this impact may be questioned because the study only spanned two years. By extending the analysis period to six years, Baji and Biro (2018) showed that the individuals believed that their subjective life expectancy was the same as prior to the onset of these diseases three years after being informed of the diagnosis of these diseases. Hence, it seems while the two health shocks certainly had a negative impact on the subjective life expectancy of American, the effect was transitory. Clark and Etilé (2002) and Sundmacher (2012) showed, using English and German longitudinal data, that the smokers who suffered either from angina pectoris (angor pectoris), or if they report a self-reported health deterioration, reduced their

tobacco consumption to a greater extent than smokers who did not face these health shocks. Darden (2002) specified that the reduction in tobacco consumption also depended on the seriousness of the health shock: while smokers are prone to suffer from cancers and cardiovascular diseases, bio-marker changes, such as, for example, cholesterol levels or blood pressure, are not readily observed in smokers. Lastly, these results have also been confirmed on the macroeconomic level in 11 European countries: the smokers who had suffered from a cardiovascular disease had a greater probability of stopping smoking than those who did not (Richards and Marti, 2014)¹. Additionally, other life events, which had no direct link with health (such as marriage, divorce, or the birth of a child) had a significant impact on tobacco consumption (Nystedt, 2006; Bricard, Legleye, and Khlal, 2017).

We contributed to this literature in four ways. First, by testing a new health shock: those requiring medical care. Until the present day, the health shocks considered (specifically lung cancer and cardiovascular diseases) were a direct consequence of tobacco consumption. By studying a health shock that has no direct link with smoking, we tested the hypothesis according to which the nature of the health shock has little impact on changing smoking

¹ The countries were Austria, Belgium, Denmark, France, Germany, Greece, Italy, the Netherlands, Spain, Sweden, and Switzerland.

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The hypothesis of identification

The study is based on the response to the following question, which was asked to the participants of the Gazel Cohort each year: "Have you suffered from an incident that has required medical care over the last twelve months?" The identification of a potential causal effect is based on the hypotheses that the health shock is exogenous (i) and perceived as serious enough (ii) to induce a tobacco consumption reduction.

(i) To be exogenous, the health shock must be as sudden and unexpected as possible for the individual who faced it. In this case, we hypothesise that the individual's tobacco consumption was not modified by the anticipation of the occurrence of this shock. Hence, the measurement of shock in this study seems to be more exogenous than the shocks used in previous studies (lung cancers or cardiovascular diseases).

(ii) To be perceived as serious enough, the shock has to induce consequences on the individual's quality of life. The term "requiring medical care" is in this case very important because, although it is impossible to specify the medical care in question. A minor health shock or one without consequences would be less likely to bring any tobacco consumption changes.

consumption. Furthermore, the choice of such shock was also motivated by their exogenous and unexpected nature, which is indispensable for establishing the causality between a health shock and a consumption change (see Inset 1, p. 2). Second, by using a sample of French workers, we studied the impacts of a health shock on tobacco consumption for a population that had not been previously studied. Third, we extended the analysis period to five years after the shock. This period highlights the duration of the impact over an unexplored time period. Lastly, given the correlation between tobacco consumption and alcohol consumption, and that the risks generated and the resulting damage augment, we also studied the variations in tobacco consumption in relation to the variations in alcohol consumption, which enabled us to discount any eventual link with the latter.

The data and method used

We obtained our analysis by using longitudinal data (same individuals observed periodically over a given period) drawn from the Gazel Cohort (see Context, p.5).

To measure smoking consumption, we added up the total number of tobacco units (cigarettes, cigars, cigarillos, and pipes) smoked per day². Based on this variable, we defined a binary indicator that characterised tobacco consumption. This indicator was equal to 1 if the individual was a heavy smoker (if he/she consumed at least 10 units of tobacco per day) and 0 if not. This distinctive threshold between light and heavy smokers has also been used in several epidemiological studies (Underner and Peiffer, 2010). Indeed, it also represents stable tobacco consumption: smoking at least ten cigarettes per day only corresponds very rarely with a period of initiation or reduction (Hennrikus, Jeffery, and Lando, 1996). Furthermore, having a daily threshold makes it possible to distinguish light smokers who smoke every day from occasional smokers (or intermittent or social smokers), who

smoke the same quantity of tobacco, but over longer periods (Underner and Peiffer, 2010).

The question used to measure the health shock was: "Have you suffered from an incident requiring medical care over the last twelve months?". As the same question was repeated every year for almost the entire length of the survey (twenty-five years), it provided information about the total number of incidents that occurred over this period. Before the individual's entry into the cohort, we were not aware if he/she had already had any health problem. Therefore, we hypothesised that the only health events experienced by the individual were those observed after his/her entry into Gazel. In addition, we only retained respondents who declared that they had had a single shock over the entire period. This enabled us to exclude certain individuals who may have had a higher tolerance to risk or greater resilience (a selection effect that would counter the notion of the shock unexpected nature).

We also included the following control variables: age, gender, the net household income, the father's socio-professional category, the respondents' educational level, if he/she was currently working, living in a couple, and the level of his/her alcohol consumption, the latter being measured by the total number of standard glasses of alcoholic beverage consumed (glasses of cider/beer, wine, or stronger drinks, such as aperitifs or digestifs) per day³.

To identify a causal association, and therefore establish whether the health shock had an impact on tobacco consumption, two groups were required: one in which such a shock occurred (the treatment group), and the other having no shock (the control group). To carry out the best possible analysis, the treatment group and the control group had to be statistically identical. They had to be as similar as possible in terms of the distribution of their observable and unobservable characteristics⁴. If these conditions were met, any difference in tobacco consumption observed between these two groups could reasonably be

attributed to the occurrence of the health shock, as all the other characteristics were identical. Nonetheless, the individuals in the treatment group did have characteristics that were not shared with those of the control group. They were older, had lower income, and were less often employed than the persons in the control group⁵.

To account for these initial differences between the two groups, we used a fixed effects model. This model has several advantages. First, it takes into account the effects of various unobserved variables (that is, those not available in the database), which are constant over time on an individual level. This is the case, for example, for the individual's genetic characteristics. Then, because it takes into account the effects of the unobserved variables that are the same for all the individuals, but which change over time. This particularly applies to the price of tobacco: the price increase is the same for each individual, but it may change from one year to the next. Hence, controlling for the effects of different unobserved variables, the fixed effects models minimise the bias due to omitted variables.

New findings on the impacts of a health shock on tobacco consumption: a long-lasting reduction in tobacco consumption is more likely to occur for more severe health shocks

The results of the analysis show that the health shock generates a long-lasting reduction in tobacco consumption. The individuals facing the shock smoke, on average, one to two cigarettes per week

² The following question was used: 'How many cigarettes, pipes, cigarillos, or cigars do you smoke on average every day?'

³ The following questions related to alcohol consumption: 'How many glasses of beer, cider, wine, or aperitif do you drink each day?'

⁴ For example, the individuals in the treatment group should have, on average, the same age as the individuals in the control group. They must also have the same dispersion around this average (a similar standard deviation).

⁵ The reader can consult Marsaudon and Rochaix (2019) for further details about the composition of the two groups.

less than those who do not face such an event. Although this is a low magnitude reduction, it lasts for 5 years after the occurrence of the health shock.

The graph shows the evolution in tobacco consumption for a period ranging from 2 years before the event to 8 years after. We normalised the year of the occurrence of the shock at 0 for all the individuals. Hence, the negatively indexed periods are the years prior to the shock and those indexed positively are the years after the shock. By using the pre-year shock as the reference (t-1), we observed that the individuals who faced a health shock reduced, everything else being equal, their tobacco consumption for five years.

Additionally, we wanted to find out if the tobacco consumption reduction was different according to the number of cigarettes initially smoked. The heavy smokers reduced their consumption to a greater extent while there was no significant effect among light smokers. This result appears to indicate that light smokers also need to be taken into account in preventive policies. Indeed, being a light smoker does not imply that the risks are lower (Oelsner et al., 2020).

The study concluded that in comparison with a non-smoker, a light smoker is twice as likely to die from a respiratory disease and eight times more likely to die from lung cancers. In fact, the number of years during which the individual smoked daily had more of an impact on health than the number of cigarettes smoked (Hackshaw et al., 2018) [other results are presented in Inset 2, p. 5].

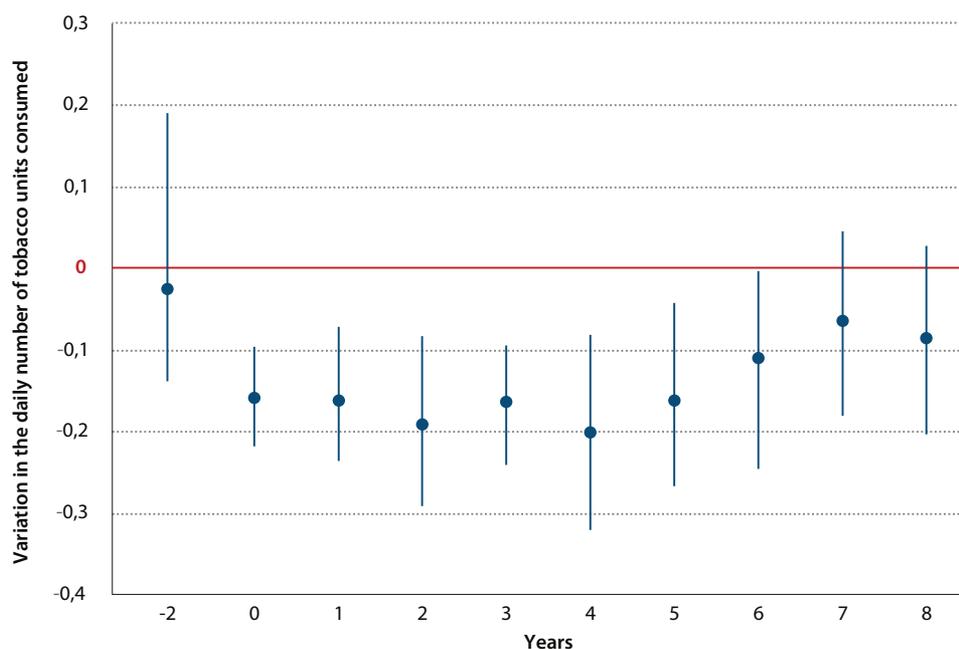
To better identify the severity of the health shock, we then assessed the impact of the shock on the sub-sample, which did not take sick leave over the period in question. In this case, we documented any change in tobacco consumption for individuals who had probably suffered from a severe shock. In other words, by distinguishing shock that required medical care followed by a sick-leave period, compared to those without sick-leave, we measured the severity of the shock, not in relation to the healthcare provided, but rather in terms of work incapacity. The results indicated that the smokers who face a health shock without sick-leave, did not change their tobacco consumption. We concluded from this that for individuals to significantly reduce their tobacco consumption, a rather severe shock is needed.

... a finding on which behavioural economics and personality psychology shed light

To gain a better understanding of the results of this study, we cross-referenced them with those in the literature in behavioural economics and personality psychology. An initial explanation as to why smokers reduce their tobacco consumption after the occurrence of a health shock was provided by Schurer (2015) and Decker and Schmitz (2016). The authors showed that certain health-related events increase the risk aversion of the individuals facing them. As risk aversion is correlated with tobacco consumption, its change may lead to a tobacco consumption change. A second explanation was provided by what Tedeschi and Calhoun (2004) called "post-traumatic growth", based on the observation of their patients. This notion describes the process through which a person who faced a traumatic event experiences positive changes in his/her life. Traumatic experience inducing unhealthy behaviours has been found empirically (Shen et al., 2015). Lastly, socialisation at work may encourage tobacco consump-

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The tobacco consumption change (before and after the health shock)



Note: The year 0 corresponds with the year of the health shock; the year t-1 is used as a reference and therefore does not appear on the graph. The points show the values of the regression coefficients and the dispersions around these points are the confidence intervals of the coefficients. When the confidence intervals do not include 0 (represented by the red horizontal line), the results are significant.

Reading: Tobacco consumption was not significantly different between the control group and the treatment group two years before the occurrence of the health shock compared to one year before the occurrence of the event. One year after the health shock, their consumption significantly different. This effect lasted almost six years.

Source: The Gazel Cohort, 1989–2014.

Score: The entire sample, including heavy smokers (≥ 10 cigarettes per day) and light smokers.

[Download the data](#)

tion (Evans, Farrelly, and Montgomery, 1999), and sick leave taken after the health shock may also lead to a reduction in tobacco consumption, although it does not explain the duration of this reduction over several years.

Two main limitations ...

Our study has two main limitations. First, the non-representativity of the sample: although our study documents behaviours that represent a health risk in a population that has not really been studied up until now, it does not reach any conclusions about the external validity of the results obtained. Indeed, the population studied is not representative of the French general population in at least two aspects: the male-female ratio and the educational level. Women are 27% in the studied sample, but they

represent 51% of the general French population (in 1989, the year of inclusion); persons without a "baccalaureate" (i.e., high school degree) degree accounted for most of our sample, although they represented a minority in the general population. And in the cohort's construction, all the persons included worked or had worked in the gas and electricity sector. And the data do not enable the nature of the health shock or its level of severity to be precisely documented. Indeed, the respondents were free to interpret the terms of the question on the health shock in accordance with what they perceived as a shock. In some cases, domestic incidents or those related to everyday life (such as a sport-related incident) could be interpreted as a shock requiring medical care. The same applied to the measurement of the shock's severity, as the term "medical care" could cover highly heterogeneous situations depending on the individual concerned. We were unable to distinguish whether medical care concerned a GP or a specialist consultation, or another health-care professional, or even whether it meant buying drugs. Nevertheless, our results show that there was no change in tobacco consumption among individuals who did not take sick leave, which attenuated this last limitation.

... but there are lessons for the design of prevention interventions

The results of this study highlight the importance of choosing the right moment to deliver a prevention message. Indeed, it is possible that smokers are more receptive to prevention campaigns during the period after the health shock. Furthermore, we show that there is a long-lasting tobacco consumption reduction (5 years), a duration that is higher than the average duration (2.4 months) of attempts to stop or reduce smoking (Segan, Borland, and Greenwood, 2006; Herd, Borland, and Hyland, 2009). Hence, future analyses could test if "storytelling" interventions (where a patient tells his/her story to other patients) could have any impact

CONTEXT

In 1989, EDF-GDF and the French National Institute for Health and Medical Research (INSERM, *Institut national de la santé et de la recherche médicale*) collaborated to monitor several thousand volunteers on an annual basis by creating the Gazel Cohort. This very-large-scale cohort—both in terms of the number of individuals monitored and the duration of the information gathering—sets out to document the frequency of various health problems according to different criteria (age, gender, socio-professional category, etc.) and their evolution over time. The volunteers, all of whom worked at the EDF-GDF, were monitored over a period of twenty-five years (from 1989 to 2014). The age category for inclusion in the cohort was 40–50 for men and 35–50 for women and all of them continued to receive the questionnaire when they retired. As this questionnaire was sent every year to the volunteers, the Gazel database provides annual panel data. The attrition rate was very low, with 201 participants lost over the first eighteen years (about 0.9% of the sample), and only 3.1% of the participants never sent back their questionnaire after taking part in 1989. The final sample established by Gazel included 20,000 persons, of which 15,000 were men and 5,000 women (Goldberg et al., 2006).

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on tobacco consumption. The experience and perception of the trauma recounted with the patients' words would possibly have a greater effect—because they are more personal—than general information campaigns. Lastly, complementary analyses could be conducted in the current context of the Covid-19 pandemic. Its health and economic consequences might, in fact, lead to an increase in tobacco consumption, as has already been demonstrated by other economic and social crises (Gallus, Ghislandi, Muttarak, 2015). ♦

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Additional results

This *Issues in Health Economics* has focused on the main result of the study conducted by Marsaudon and Rochaix, 2019. Nevertheless, other results have been found for other health behaviours: alcohol consumption and the Body Mass Index (BMI).

Alcohol consumption was measured by using the total number of glasses of alcoholic beverage (beer, cider, wine, and after-dinner liqueur) consumed per day, and the BMI was calculated using the ratio of weight to height squared.

The results indicate that the health shock had a significant and negative impact on alcohol consumption for three years. Conversely, there was no significant effect on the BMI. The differences in result between tobacco, alcohol, and the BMI may be explained in two ways. Firstly, the global harmfulness of the addictions, measured by an average of three scores (physical harm, the intensity of the dependency, and social prejudice), is different: the harmfulness of alcohol is stronger than that of tobacco (Nutt et al., 2007). Hence, alcohol cessation probably more difficult than tobacco cessation. In addition, GPs stated that they found it easier to give advice about tobacco than alcohol and diet (Dolor et al., 2010).

And the results on BMI may be explained by the fact that the food consumption choices were mostly made on the household level, not on individual level. (Cardon, Depecker, and Plessz, 2019).

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