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SMOKING & FINANCIAL STRESS

The role of tax increases on financial stress of smoking households

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Table of contents

Abstract

In this paper the effect of tobacco tax increases on the association between smoking behavior and financial stress in the Netherlands was studied. Data of the LISS panel, which is a representative sample of Duch individuals participating in monthly internet surveys, was used. The data consisted of 77,389 observations of 15,337 individuals obtained over a span of 15 years, from 2007 till 2022 with no observations in 2014. The results of a fixed effects regression substantiated the acceptance of the first hypothesis positing a positive association between smoking and the experiencing of financial stress. However, it's crucial to acknowledge the model had limited explanatory capacity, indicated by their relatively low R-squared values. While the regression outcomes for specific time periods showed some significant results, it is premature to conclude that tobacco tax hikes automatically elevate financial stress. To further explore the role of tax increases on tobacco among different socioeconomic groups, two regression models have been constructed for differences in education and income. The results suggested adopting both the third hypothesis and fourth hypothesis, together pointing towards the trend that individuals with lower socioeconomic status experience more financial stress after tax increases on tobacco.

1. Introduction

Smoking has been a prevalent and persistent behavior throughout human history, with evidence of tobacco use dating back to ancient civilizations. The cultural and social significance of smoking has varied across different societies and time periods, with smoking being used for medicinal, spiritual, and recreational purposes (Musk & De Klerk, 2003). The prevalence of tobacco usage in modern times can be attributed to the introduction of tobacco to Europe during the early 16th century, which occurred after Christopher Columbus's exploration of the Americas. (Burns, 2006). Over time, smoking became increasingly popular among European aristocracy and spread to other social classes. Cigarettes, introduced in England in the 1850s, quickly gained popularity due to their convenience. They became the most popular nicotine delivery devices ever since, especially with advancements such as filters and manipulable contents by manufacturers (Musk & De Klerk, 2003). By the 20th century, smoking had become a global phenomenon, with tobacco use being common in many parts of the world.

Despite the cultural significance of smoking in different societies, the negative health effects of smoking have been known for decades. The link between smoking and lung cancer was first established in the 1930s, and since then, tobacco use has been linked to a wide range of health problems, including various forms of cancer, heart diseases, respiratory illnesses such as chronic bronchitis and emphysema (Courtney, 2015). Smoking has a major influence on the life expectancy of people. With a dataset resulting from an survey of Statistics Netherlands of 40,000 participants the researchers found for heavy smokers, i.e. individuals smoking more than 20 cigarettes per day, life expectancy was on average 13 years shorter than for never-smokers. Moderate smokers, i.e. individuals smoking fewer than 20 cigarettes a day, were predicted to live an estimated 9 life years shorter. Light smokers, i.e. individuals smoking not on a daily basis, had a life expectancy that was on average 5 years shorter (Bergh et al., 2017).

Smoking persists despite its known detrimental effects to a large extent due to the highly addictive nature of nicotine, a component found in tobacco products. Nicotine stimulates the brain and releases neurotransmitters, particularly dopamine, which produces pleasurable sensations and reinforces the smoking behavior (Benowitz, 2010). As of 2020, the World Health Organization reported that approximately 22.3% of the world's population still smoked. Therefore, smoking remains a major public health challenge, with smoking being one of the leading causes of preventable deaths worldwide (World Health Organization: WHO, 2022). Public health campaigns and tobacco control policies have contributed over the past few decades to a decline in smoking rates in many countries. While progress has been made in reducing smoking rates, still approximately 19% of the Dutch population smokes according to the Health Monitor 2020 by the Netherlands' National Institute for Public Health and the Environment (RIVM).

Numerous studies consistently highlight socioeconomic disparities in smoking. Pierce et al. (1989) showed that from 1974 to 1985, smoking prevalence in the US decreased across all education levels, with a decline occurring five times faster among the higher educated. Giskes et al. (2005) demonstrated greater smoking declines among tertiary-educated individuals in nine European countries. Heymans et al. (2005) found education and income correlated with smoking in the EU, with education affecting both genders, while income only affected men. Dutch studies yield similar outcomes. Stronks et al. (1997) attribute elevated smoking rates in lower socioeconomic groups to cultural and material factors. Nagelhout et al. (2012) identify lower-educated individuals as more likely to smoke, with higher initiation and lower quit ratios. Benson et al. (2015) note that young adults with low income showed less improvement in smoking cessation during the Global Financial Crisis compared to higher-income peers.

The Dutch Government is aiming at a smoke free generation in 2040 with new tobacco restricting policies (Ministerie van Volksgezondheid, Welzijn en Sport, 2023). Efforts to reduce smoking rates have included policies restricting tobacco advertising and sales, and implementing smoke-free public spaces. However, the most used policy measure is increasing taxes on tobacco products (Willemsen, 2017). In the last two decades, the price of a pack of cigarettes in the Netherlands increased by more than 200 percent, when corrected for inflation(Centraal Bureau voor de Statistiek, 2020). The latest tax increase in April 2023 brings the average price of a pack of 20 cigarettes to 9 euros (Ministerie van Algemene Zaken, 2022), while in 2000 Dutch citizens paid €3.21 on average for a pack of cigarettes of this size.

Considering that smoking is more common among the lower socioeconomic classes, these tax increases may raise the question if these measures do not create a disproportional burden on lower socioeconomic classes. The analysis by Remler (2004) of horizontal equity, which pertains to fairness within specific income brackets, demonstrates that cigarette taxes disproportionately impact less affluent smokers who continue smoking, regardless of the method used to assess the tax burden. In their study, Franks et al. (2007) investigated the correlation between smoking engagement and cigarette pack prices within distinct income categories and time periods. Their aim was to elucidate the influence of cigarette costs on the income-associated discrepancies in smoking prevalence within the United States. Despite cigarette price increases after an intervention by the US government, income-related smoking disparities have increased. Hence, increasing cigarette prices impose a disproportionate burden on poor smokers.

Results by Siahpush, Borland & Scollo (2003) revealed that low income households in Australia experience more financial stress than high income households. Nevertheless, they also found that smoking households in Australia face an increased chance of experiencing financial stress, regardless of income level. In their research, Widome et al. (2015) established a link between greater

nicotine dependence and higher daily cigarette consumption with difficulties in adhering to household income limits. Additionally, these factors were associated with heightened concerns about affording essential expenses such as food and housing. Therefore, smoking may affect the income restraints of households and especially those of low income households.

Still, little is known of the association between smoking behavior and financial stress in the Netherlands. Moreover, while certain studies from England, Australia and the United States have indicated the significant impact of smoking on financial stress, these studies often rely on single-year data, which might not capture the broader trends accurately. This underscores the need for longitudinal analyses that encompass multiple years to provide a more comprehensive understanding of this relationship. Furthermore, the specific role of tobacco tax increases on the financial stress of smokers has not been examined. Given the evolving nature of taxation policies and their potential repercussions on individual behaviors, examining the role of tax increases on financial stress among smokers is crucial. This research can contribute to a better comprehension of the interplay between tobacco taxation, smoking behavior and individuals' financial well-being, thus informing potential policy interventions. Therefore, the following research question has been formed:

To what extent do tax increases on tobacco products play a role in experienced financial stress on smoking individuals among different socioeconomic groups in the Netherlands?

To formulate a better answer to the research question, it will be divided into three parts.

What is the association between smoking behavior and financial stress?

What is the role of tax increases on tobacco products on experienced financial stress by smoking individuals?

What is the role of tax increases on tobacco products on experienced financial stress by smoking individuals among different socioeconomic groups?

The rest of the paper will be structured as follows. First, a literature review and other background information is given, which results in the hypotheses. Second, the dataset used will be presented and its merits discussed and in addition the variables that are used are discussed separately. Next, in the methodology section the statistical methods will be discussed and after this the results will be provided. In the last section the results are discussed in more detail, the limitations and strengths of this study will be outlined and recommendations for further research and policy implications will be provided.

2. Theoretical Framework

The next section will be structured in the following way: First, the relation between smoking and financial stress will be discussed. Secondly, this study will explore the tax increases on tobacco in the Netherlands within the last two decades, ending with the relation between financial stress and these tax increases. Finally, two socioeconomic differences will be outlined, education and income, which will be taken into account in the future analysis.

Smoking behavior and financial stress

While limited material resources can restrict opportunities to engage in certain healthy behaviors, this does not appear to be the case for smoking, as not smoking is consistently the most affordable option. During wartime in Sarajevo, Bosnia, a fascinating observational study discovered that despite the rising cost of cigarettes and the necessity to allocate limited funds to essential goods for themselves and their families, healthcare workers experienced a notable increase in smoking. The authors of the study interpreted these findings through a framework of smoking as a coping mechanism, as the healthcare workers attributed their heightened smoking to stress-related factors (Creson et al., 1996). The psychological effect of experiencing stress is strongly associated with an initiation to smoke (Kassel et al., 2003), however smoking can lead to experiencing more financial stress (Siahpush et al., 2003), creating a cyclic relationship between smoking and stress.

Davis and Mantler (2004) define financial stress as 'the unpleasant feeling that one is unable to meet financial demands, afford the necessities of life, and have sufficient funds to make ends meet. The feeling normally includes the emotions of dread, anxiety, and fear, but may also include anger and frustration.' Experienced financial stress is a factor included in the aforementioned studies on smoking, however, the relationship is often not examined in isolation. The existing literature exploring this relationship will be presented in the following section.

Graham (1994), who did research on the smoking status of women in the United Kingdom, was one of the first to find that smoking status was strongly linked to financial circumstances. She used data following a survey focused on examining the smoking patterns and situations of women with young children in households led by individuals engaged in manual work, unemployed, or economically inactive, she conducted her analysis. She found that smokers had higher levels of debt and struggled more to afford basic necessities compared to non-smokers. The financial disadvantage increased as smoking intensity rose. She suggests that spending on cigarettes directly impacted the mothers' ability to meet their financial needs.

The research findings of Siahpush et al. (2003) show a strong association between financial stress and smoking behavior, regardless of income level. They used data from the 1998-99 Household Expenditure Survey collected by the Australian Bureau of Statistics, in which multiple financial stress

items were included such as cash flow problems or held back activities due to financial resources. The researchers developed three measures to assess financial stress: a financial stress index, an indicator for any financial stress, and an indicator specifically for severe financial stress. In contrast to households without smoking habits, smoking households are 1.5 times more prone to encounter general financial stress and twice as likely to face severe financial stress. Furthermore, households allocating 5% or more of their total expenditure on tobacco face a 1.7 times higher probability of experiencing any form of stress and more than twice the likelihood of severe financial stress, when compared to those dedicating 2% or less to tobacco expenses. Widome et al. (2015) did a similar study, collected adult smokers between the ages of 18 and 64 from the administrative databases of the Minnesota Health Care Programs. The study found that nicotine dependence, as measured by time to first cigarette and daily cigarette consumption, was associated with worries about housing and food costs. An increase of 10 cigarettes per day raised the likelihood of frequent concern about housing and food by 22.1% and 19.0% respectively. However, the frequency of smoking in the past 30 days did not predict financial stress in specific domains, although it was linked to overall financial strain related to household income.

In a study conducted by Laaksonen et al. (2005) using data from a survey among City of Helsinki employees, smoking was more prevalent among individuals reporting economic difficulties and dissatisfaction. However, the connection between economic difficulties and smoking diminished when the model incorporated indicators like education and occupational status. Similarly, in the Dutch study by Stronks et al. (1997), smokers exhibited a higher likelihood of lower income, financial issues, deprivation, and unemployment. Approximately 40% of the heightened risk of smoking, compared to former smoking, was attributed to unfavorable material conditions. It is important to note that this relationship between smoking and financial stress has not been exclusively examined in the Netherlands. Therefore, further investigation is warranted to determine whether this association remains significant after accounting for socioeconomic indicators. And in response to this findings the following hypothesis is constructed: *Smoking individuals have an increased chance of experiencing financial stress*.

Tobacco tax increases and financial stress

Cigarette price fluctuations

As mentioned before in the introduction there are several tobacco controlling policies, nevertheless, the single most used and most effective policy is tobacco taxation (Chaloupka et al., 2011). Increasing prices incentivizes smokers to quit smoking, decrease their tobacco consumption, and dissuades potential smokers from starting the habit. Research by Mirza (2019) has shown that increases in excise taxes that significantly reduce the affordability of tobacco products are the most effective

policy to reduce tobacco use. Also it is important to take in consideration that the big tobacco companies have smart pricing strategies of their range of products. Gilmore et al. (2013) their findings suggest that initiated price changes by the tobacco industry are timed to calm price-conscious smokers and accentuate the price gap, while also attempting to hide the price increases on more expensive brands behind the excise increases. The main increases in tax on tobacco products in the Netherlands will be analyzed in this section.

The first significant legislation on tobacco control in the Netherlands was the Tobacco Act of 2002 (Tabakswet). The act aims to protect public health by implementing measures to reduce smoking prevalence, protect non-smokers from secondhand smoke, and regulate tobacco advertising, promotion, and sponsorship. In 2004, a tax increase of €0.55 (including value-added tax [VAT]) per pack of cigarettes, or a 14% increase, was enacted in conjunction with the smoking act. Smokers faced an effective price increase of about €0.80 as a result of the tobacco manufacturers' decision to also raise the price by €0.25. (Willemsen, 2018). This brought the price of an average cigarette packet of 25 cigarettes, the most popular package, to €4.60 (Centraal Bureau voor de Statistiek, 2006). From then on more policies were introduced by the government.

The next big government measure was in July 2008, when the smoking ban was implemented in the hospitality sector: only in designated smoking areas it was permitted to smoke. This measure was coupled with an increase in taxes of €0.29 per pack of cigarettes, translating to an increase in consumer prices of €0.35 per pack, including an increase in prices by the industry. (Willemsen, 2018). Also the packaging of cigarettes changed with a common packet now containing 20 cigarettes, costing €4.50 at the end of 2008.

The subsequent tax increase was in 2013, bringing the average price of a pack of 20 cigarettes to 6 euros, of which €3.38 consisted of excise duties (Centraal Bureau voor de Statistiek, 2013). These tax increases were followed by the disappearance of smoking areas in 2014 after years of multiple lawsuits, making the whole hospitality sector smoke free. Furthermore, since 2014, the sale of tobacco products and related products has been only allowed to persons over 18 years of age. Six years later was the next big increase in 2020, when the price of an average packet of cigarettes became €1.14 more expensive, bringing the price to 7 euros (Centraal Bureau voor de Statistiek, 2020).

Tax increases and financial stress

Further research on smoking and financial stress by Siahpush and Carlin (2006) showed substantial evidence linking income and financial strain to smoking cessation. With data from the first two waves of the Household Income and Labour Dynamics in Australia, they found a 1-unit increase in financial stress being correlated with a 13% decrease in the odds of quitting. They also examined the relationship of relapsing to smoking and financial stress, and their findings revealed that an increase

of 1 unit in financial stress was linked to an 18% increase in the odds of relapse. They also noted the rather unique positive relation of smoking and financial stress, while financial stress is negatively associated with spending on almost all other items.

Considering that people in financial stress find it harder to quit and tend to relapse, are the implemented tax increases on tobacco an effective way to reduce the amount of smokers? And do these tax increases not create a disproportionate burden, on the lowest socioeconomic groups? Marsh and McKay (1994) were one of the first to raise this question, with their study on the prevalence of smoking and the consumption of cigarettes among Britain's low income families. They found almost no reduction in smoking prevalence among these low income families and increasing financial hardship. They also found that families on income support spend a significant amount of their disposable income on cigarettes, resulting in a vicious cycle of hardship increasing the risk of smoking and smoking increasing the risk of hardship.

Franks et al. (2007) conducted an analysis in the United States of nationally representative data collected before and after the 1998 tobacco Master Settlement Agreement (MSA), an American anti-tobacco law. Their study unveiled that an increased real cigarette-pack price over time was associated with a substantial decline in smoking among higher-income individuals, while this effect was not observed among those with lower incomes. Consequently, these growing income-related disparities in smoking suggest that cigarette excise taxation may no longer be an effective strategy for tobacco control in the post-MSA era. Similar research has been done in the Netherlands by Verdonk-Kleinjan et al. (2011), where they examined the effect of a workplace ban on smoking and two tax increases. Among those with paid work, the measures resulted in fewer cigarettes smoked per day and a decrease in daily smoking prevalence. The number of cigarettes per smoker per day was not significantly affected by the tax increases among respondents without paid employment. Also there were no interaction effects with gender, age, education level, or working hours.

The research on the role of tax increases on financial stress of smoking individuals can aid policymakers and healthcare professionals in devising targeted interventions to reduce smoking rates. Additionally, investigating this relationship can contribute to a more comprehensive understanding of the social determinants of health and guide efforts to create more equitable health and economic policy outcomes for different population groups. Following the aforementioned studies, the subsequent hypothesis is formulated: *A significant increase in experienced financial stress can be found among smoking individuals after tax increases on tobacco products.*

Socioeconomic differences in smoking behavior

Educational differences

As mentioned in the introduction Pierce et al. (1989) were among the first to reveal that smoking prevalence in the US decreased across all educational groups, however with a fivefold faster decline among higher-educated individuals. Using National Center for Health Statistics data from 1974 to 1985, they found that by 1985, college graduates had over 15% fewer smokers compared to high school dropouts. Higher quit rates among college graduates contributed to this difference, explaining the gap in smoking prevalence across education levels. In the European Union, Giskes et al. (2005) explored smoking trends from 1985 to 2000 in Western Europe. Their study, based on national surveys, highlighted that smoking was most prevalent among elementary educated individuals. Across nine European countries, smoking declined less among lower-educated individuals compared to those with higher education (8.58% to 11.97%). This trend persisted even when analyzing individual countries, with smoking being most common among lower-educated groups.

Similar findings emerged in the Netherlands. Stronks et al. (1997) analyzed data from the Longitudinal Study on Socio-Economic Health Differences, showing that as education decreased, current smoking rates increased(20% to 50%). Lower educational groups had higher smoking rates, while higher education correlated with more never smokers. Droomers et al. (2002) did research on the same dataset and the follow-up data collected in 1997. They found that while the overall smoking prevalence in the adult Dutch population decreased, educational differences in smoking increased. The increased educational gaps were brought on by lower education groups continuing to smoke more frequently (81%) than higher education groups (67%). With the lower educated groups having a higher likelihood to start smoking before the age of 18.

Nagelhout et al. (2012) examined smoking behavior among varying educational levels. They discovered notable differences in smoking prevalence between higher and lower educated individuals, for both men and women. Lower educated respondents exhibited higher smoking consumption in 2001 and 2008. The study also found significant distinctions in smoking initiation ratios and higher quit ratios among better-educated individuals in both genders. Educational inequalities widened for smoking prevalence, initiation, and cessation among women, and for smoking consumption among men.

Researching the role of smoking on financial stress among different socioeconomic groups is important to uncover potential inequalities, assess policy effectiveness, and tailor interventions. Understanding how smoking impacts diverse economic backgrounds can guide targeted measures to address specific needs and inform policy decisions that enhance overall well-being. Therefore, the following hypothesis is constructed based on the aforementioned findings: *Smoking individuals with lower levels of education experience more financial stress from tax increases.*

Income differences

Both education and income are correlated with each other, this has been found by Houthakker (1959), a longer school attendance is positively correlated with a higher mean income. Therefore, if differences in smoking prevalence and education level exist, the same could be found for differences in income level.

In a comprehensive analysis of 93 studies, Casetta et al. (2016) revealed a consistent global connection between lower income and higher cigarette smoking rates, particularly in countries with low mortality rates. Dube et al. (2009) found income-related smoking disparities in the US; below the poverty line, smoking rates exceeded 30%, contrasting with below 20% above. In Britain, Amos et al. (2011) found the lowest income tertile had higher smoking rates, alongside elevated rates among unemployed individuals. Leinsalu et al. (2007) explored the link between income and smoking cessation using Estonian Adult Population data. High-income men showed higher quit rates than their low-income counterparts, while education impacted initiation, not cessation. Occupation and income significantly influenced cessation for both genders. Heymans et al. (2005) explored the EU context, showing men with lower income had higher smoking prevalence across ages. Income's influence on smoking in adult EU men was relatively minor. Among women, income's association with smoking was weak, mainly noticeable in ages 25-34. In contrast, education exhibited a stronger smoking correlation than income in most EU countries.

De Vries (1995) compared Dutch adolescents' smoking beliefs based on their fathers' professions. Lower socioeconomic status (LSES) adolescents had higher smoking rates than higher socioeconomic status (HSES) counterparts. HSES adolescents held a more negative view of smoking, while LSES adolescents saw it as a means of social connection. LSES youth faced greater social pressure to smoke from peers. Nagelhout et al. (2012) using Dutch Continuous Survey of Smoking Habits (DCSSH) data found higher smoking prevalence among lower-income respondents. Differences in smoking consumption between income groups were smaller, notable for women in 2001 and 2008. Lower socioeconomic status respondents had higher initiation ratios. Quit ratios were higher among higher-income individuals, except for some male respondents in 2001.

Benson et al. (2015) examined Dutch socioeconomic smoking disparities pre- and during the Global Financial Crisis (GFC) using Health Survey data (2004–2011). They found higher smoking rates in the lowest income tertile both before and during the GFC. Higher household income was linked to greater cessation rates, even during the crisis. Among 18-30-year-olds, GFC-related disparities in cessation linked to income were somewhat more pronounced.

The following hypothesis has been drawn up based on the findings mentioned above: *Smoking individuals from a lower income category experience more financial stress from tax increases.*

3. Data

Datasets

In this essay, I draw on data from the Centerdata (Tilburg University, Netherlands) LISS (Longitudinal Internet Studies for the Social Sciences) panel. A representative sample of Dutch people who take part in monthly online polls makes up the LISS panel. A true probability sample of households taken from the population register forms the basis of the panel. A computer and Internet connection are made available to households who would not otherwise be able to participate. Every year since 2007, a longitudinal survey has been conducted in the panel, covering a wide range of topics such as personality, political views, time use, health, work, and education.

To ensure that the most important general characteristics of LISS panel households remain up-to-date, these are measured every month using a separate questionnaire, known as the 'household box'. One contact person from each LISS panel household answers this questionnaire. Prior to beginning the other questionnaires, the household must first fill out the household box when joining the panel. Following that, the contact person is given the household box each month to record any alterations that may have happened. Some of the questions in the household box concern the household, and others concern the individual household members. All questions of the questionnaire are completed by the household contact person only.

From 2007, the questionnaire "Gezondheid" (Health) is fielded every year in the LISS panel as part of the LISS Core Study, except for 2014 when the questionnaire was not conducted. The questionnaire focuses on health, health perception and health related to job situation and is held in the last two months of the year. On average the questionnaire was presented each year to 7,086.33 panel members, and 5,659.53 respondents fully completed the questionnaire, which results in an average response percentage of 80.46%. All the participation and response statistics per year can be found in Table A.1 in the Appendix.

While absolute certainty regarding the accuracy of all reported values is not attainable, it is feasible to identify and eliminate observations that exhibit unrealistic values. To improve data quality, participants who reported having Alzheimer's disease or dementia were excluded from the survey analysis due to their increased challenges in managing financial matters (Earnst et al., 2001). The individuals with Alzheimer's disease or dementia faced significant more difficulties in managing their financial obligations independently, while their smoking behavior was similar to that of the remaining sample.

Included variables

Financial stress: to measure the extent of financial stress of the respondents, the survey presents the following statement, which ties in with the study of Davis and Mantler (2004): "*taking care of financial affairs, such as paying bills and keeping track of expenditure".* Respondents are asked to

indicate to what extent they agree with this statement on a scale from ‘without any trouble’ to ‘with some trouble’ to ‘with a lot of trouble’ to ‘only with an aid or the help of others’ to ‘not’. These responses translate to a scale ranging from 1, without any trouble, to 2, with some trouble, to 3, with a lot of trouble, to 4, only with an aid or the help of others, to 5, not.

Smoking: The smoking variable consists of two parts, first respondents are asked if they ever smoked after that the respondents who indicated that they smoked are asked if they still smoke. Next, a dummy variable will be generated of people who have smoked in the past. This gives three groups of smokers, ex-smokers and non-smokers.

Gender: The gender variable in the dataset is initially coded with values 1 for male and 2 for female. In order to facilitate analysis and interpretation, it is necessary to transform this variable into a binary variable that takes the value 1 for males and 0 for females.

Education*:* The level of education is measured in three categories using the same scale as the CBS (Statistics Netherlands) (Centraal Bureau voor de Statistiek, n.d.-b): 1 primary school and vmbo (intermediate secondary education, US: junior high school), 2 havo/vwo (higher secondary education/preparatory university education, US: senior high school) and mbo (intermediate vocational education, US: junior college) 3 hbo (higher vocational education, US: college) and wo (university).

Income*:* The income level in the study was determined by the household net monthly income, which has been reported since 2008. To account for the amount of household members, the income level is calculated by the household net monthly income divided by the square root of the number of household members (Klijs et al., 2016). To account for inflation and facilitate comparisons across multiple years, the inflation rate specific to each year was applied. The inflation rates were obtained from the Central Bureau of Statistics (Centraal Bureau voor de Statistiek, 2023) for the respective years. To establish a consistent reference point, the year 2015 was selected as the base year for inflation adjustments. This choice was motivated by the fact that 2015 represented a relatively stable economic period with moderate inflation rates, providing a suitable baseline for analyzing income changes over time. Hereafter the level of income was divided into three categories: 1 low, 2 moderate, 3 high.

The household income is considered low if the for inflation corrected standardized net income was equal to or below €1,027 per month (Centraal Bureau voor de Statistiek, n.d.). There is no exact number given by authorities for a household income to be considered high. In the absence of a definitive threshold provided by authorities to classify a household income as "high," a common approach employed in this study, consistent with previous research, was to define high income as the

top 20 percent of household incomes based on the data from the base year. In this study, high income was operationally defined as a net income higher than 2,500 euros, representing the threshold for the top quintile of household incomes. This approach ensures consistency and comparability with other studies that have adopted a similar income criterion for identifying high-income individuals.

Age: Age is defined as age in years at the moment of the interview, captured in integers. To capture non-linear relationships between age and financial stress and in line with previous research, (Nagelhout et al., 2012), the age of individuals was separated into four groups: 1 young adults (18–30 years), 2 start working age (31-44 years), 3 late working age (45–64 years), and 4 pensioners (>64 years).

Heavy smokers: Heavy smokers is a binary variable which takes a value of 1 if individuals report that they smoke more than 20 cigarettes per day.

Data clean-up

Given the extensive amount of data collected in these surveys, it is inevitable that the dataset may contain some inaccurate values. Therefore, unrealistic values and missing values are excluded from the sample. This means that individuals who did not report their financial stress, educational level, smoking status or net income were also excluded from the analysis. The subset of individuals who did not report their financial stress, educational level, or smoking status constitutes a relatively small group(N=204), and it was found that they did not exhibit significant differences in terms of smoking behavior ($\chi^2(1)= 0.762$, $p > 0{,}1$) or the level of financial stress experienced ($\chi^2(4)= 7.692$, $p > 0{,}1$).

However, a notable proportion of individuals did not report their household income, and this group showed distinct variations in financial stress, educational attainment, and smoking behavior compared to the remaining sample. The analysis revealed that individuals who chose not to report their income exhibited lower levels of educational attainment compared to those who provided income information. This finding suggests that there may be a relationship between non-disclosure of income and lower educational backgrounds ($\chi^2(2)= 10.194$, $p < 0{,}01$), which is similar to results found by Nagelhout et al. (2012). Furthermore, significant differences in financial stress were observed in specific years, namely 2017, 2019, 2021, and 2022. Specifically, individuals who did not report their income exhibited higher levels of financial stress compared to those who provided income information. An overview of this analysis results are shown in Table A.2 of the Appendix.

Descriptive Statistics

Table 3.1 shows the demographic characteristics of the LISS Panel sample per year. The sample tends to have overall more women than men (53.5% against 46.5%). Also remarkable is the rise of educational level of the panel, given a decrease of 12.8 percent points of the low educational level towards an increase of 11.6 percent points of the high educational level. An observable trend is the gradual increase in the percentage of individuals within the low-income level until 2015, followed by a subsequent decrease. This phenomenon could potentially be elucidated by considering the impact of the global financial crisis during that period.

Table 3.1 Descriptive statistics of the LISS Panel per year

		Gender	Education			Income		
Year	**N**	**Men, %**	**Low, %**	**Middle, %**	**High, %**	**Low, %**	**Middle, %**	**High, %**
2007	6,158	46.1	36.8	33.6	29.7	.	.	.
2008	5,931	45.9	36.6	34.1	29.3	9.1	65.9	25.0
2009	6,048	46.4	36.9	33.3	29.8	9.4	66.1	24.5
2010	5,660	46.4	36.4	33.2	30.3	8.9	67.2	23.9
2011	5,029	46.6	35.5	33.9	30.6	9.0	68.2	22.8
2012	5,734	46.2	34.5	34.2	31.3	9.6	68.6	21.8
2013	5,341	46.3	34.0	34.2	31.8	12.1	67.9	20.0
2015	5,958	46.4	30.0	36.2	33.8	12.5	67.0	20.4
2016	5,354	46.9	29.7	35.4	34.8	11.5	66.0	22.5
2017	5,912	45.6	28.0	35.0	37.0	10.8	65.1	24.1
2018	5,447	45.8	28.3	34.4	37.3	10.7	64.6	24.7
2019	5,123	46.7	27.8	34.1	38.1	9.7	64.5	25.7
2020	5,676	46.1	25.4	34.9	39.7	9.8	62.5	27.8
2021	5,065	46.3	25.9	34.4	39.7	9.3	63.0	27.7
2022	5,771	46.2	24.0	34.7	41.3	10.0	64.2	25.8
ALL	77,398	46.5	31.2	34.1	34.7	10.2	65.8	24.0

Note. Values in columns % represent percentages of the group that fall within a certain category; N represents the number of observations per year.

Table 3.2 shows the characteristics of smoking individuals. It exhibits that a higher percentage of men smoke. Compared to the table of the whole sample, smokers are more likely to be in the low educated and low income tertile, and they are less likely to be in the high educated and high income tertile. At last it shows that the percentage of smoking individuals, i.e. the smoking prevalence, is declining. To show this decline in smoking prevalence and the corresponding quit ratios per year, Figure 3.1 has been constructed.

Table 3.2 Descriptive statistics of smoking individuals of the LISS Panel per year

		Gender	Education			Income		
Year	**N**	**Men, %**	**Low, %**	**Middle, %**	**High, %**	**Low, %**	**Middle, %**	**High,%**
2007	1,420	49.4	44.9	35.4	19.7	.	.	.
2008	1,312	50.6	44.4	35.1	20.5	10.9	67.4	21.8
2009	1,285	50.3	43.4	34.7	22.0	12.3	67.1	20.5
2010	1,189	51.3	44.7	34.1	21.2	13.0	68.3	18.7
2011	1,008	50.2	44.0	34.5	21.5	12.9	68.7	18.4
2012	1,083	50.1	41.0	36.9	22.1	13.5	69.3	17.2
2013	899	50.2	39.6	36.9	23.5	15.8	69.3	14.9
2015	1,048	50.7	36.2	40.3	23.6	18.1	66.8	15.1
2016	820	51.7	36.7	41.3	22.0	17.1	67.3	15.6
2017	874	49.3	37.3	38.7	24.0	15.0	67.0	18.0
2018	753	49.8	37.1	40.5	22.4	17.7	65.3	17.0
2019	641	50.6	36.4	39.0	24.7	14.9	66.8	18.3
2020	695	50.1	33.5	41.4	25.0	15.1	64.9	20.0
2021	587	52.6	33.7	41.1	25.2	14.6	64.3	21.1
2022	657	50.7	32.0	42.3	25.7	16.7	65.0	18.4
ALL	13,113	50.7	39.3	37.6	23.2	14.5	67.2	18.3

Note. Values in columns % represent percentages of the group that fall within a certain category; N represents the number of observations per year.

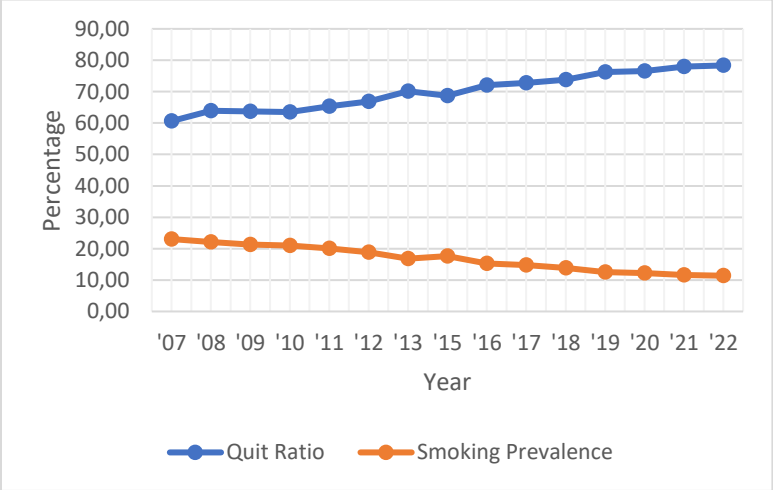

Figure 3.1 The smoking prevalence rate and quit ratio of the LISS Panel from 2007 to 2022

To show the annual rates of financial stress Table 3.4 is constructed. It shows that smokers tend to have a higher mean of financial stress compared to non- smokers, ex-smokers and the whole sample. Striking is the lower rate of ex-smokers compared to non-smokers. It also shows that the mean rates of smokers tend to be increasing over the years contrary to the rest, which could be the effect of the tax increases.

Table 3.4 Annual mean rates of financial stress for smokers, ex-smokers and non-smokers

Year	Smokers	Ex-smokers	Non-smokers	Total
2007	1.180	1.102	1.116	1.126
2008	1.178	1.119	1.129	1.136
2009	1.211	1.168	1.153	1.171
2010	1.219	1.146	1.158	1.167
2011	1.229	1.134	1.142	1.159
2012	1.189	1.145	1.158	1.159
2013	1.214	1.131	1.139	1.148
2015	1.214	1.130	1.131	1.145
2016	1.215	1.127	1.144	1.148
2017	1.245	1.116	1.135	1.143
2018	1.257	1.115	1.134	1.143
2019	1.223	1.116	1.136	1.139
2020	1.239	1.120	1.148	1.148
2021	1.232	1.117	1.143	1.143
2022	1.241	1.122	1.149	1.148
Average	**1.219**	**1.127**	**1.141**	**1.148**

4. Methodology

To test the hypotheses, I use a dataset consisting of observations obtained from multiple individuals over several years, also known as a panel data set. To be specific the panel consists of 77,389 observations of 15,337 individuals obtained over a span of 15 years, from 2007 until 2022 with no observations in 2014. It is important to note that the panel data is characterized as short, as the total number of observations per individual is relatively limited. Additionally, the panel is considered unbalanced due to the uneven participation of individuals across the years. This dynamic composition is further influenced by the entry and exit of individuals at different time points, making it a rotating panel. Notably, Stata (17.0, StataCorp LLC, College Station, TX) takes into account these characteristics, allowing for regression analysis and result interpretation that accommodates the unbalanced and rotating nature of the panel data.

The dependent variable, financial stress, is an ordinal response variable that captures the perceived level of financial stress reported by respondents. In order to perform quantitative analysis, the financial stress' data is transformed into a Likert scale, with values ranging from 1 to 5 (Likert, 1932). This transformation allows for the numerical representation and statistical modeling of the ordinal nature of the financial stress variable. The outcomes of financial stress reveal a pronounced right-skewness in the data. Nearly 70,000 out of the total 77,000 observations report no financial stress, resulting in limited variability in the dependent variable and potentially impacting the accuracy of regression analysis. Given that the last three categories, namely "with a lot of trouble", "only with an aid or the help of others" and "not" each got very few observations, all less than 750, it becomes challenging to draw meaningful distinctions among them. As a result, these three categories are consolidated into a single category denoting the experience of financial stress. Despite this consolidation, the data continues to exhibit a significant right-skewness. In order to mitigate this skewness and facilitate the examination of the relationship between smoking and financial stress, a log transformation is employed. Specifically, the natural logarithm is applied to the remaining three categories, allowing for the analysis of the role of smoking on the transformed financial stress variable.

The most commonly used regression models for panel data analysis are a Pooled Ordinary Least Squares (OLS) Model, Fixed Effects Model and Random Effects Model. A Pooled OLS Model assumes that there are no individual-specific effects or time effects. It treats all observations as coming from a single large group and estimates one set of coefficients for all individuals and time periods. Therefore, this model is appropriate if there is no concern about unobserved individual-specific heterogeneity or time-varying factors, otherwise a pooled regression may lead to biased and inconsistent estimates. Also the model assumes that the relationships between the variables are constant across all individuals and time periods, which may not hold in panel data.

To test whether there is heterogeneity across individuals in the data, two different tests: the Breusch-Pagan Lagrange multiplier (LM) test and the Pesaran's cross-sectional dependance (CD) test. The Breusch-Pagan LM test is employed to assess whether the residuals from a pooled ordinary least squares (OLS) regression exhibit significant heteroskedasticity (Breusch & Pagan, 1980). Heteroskedasticity indicates varying levels of dispersion in the error terms across different individuals, which may result from unobserved individual-specific characteristics. The Pesaran's CD test examines whether there is cross-sectional dependence (correlation) among the individual units (panels) in the panel data (Pesaran, 2014). Cross-sectional dependence occurs when the behavior or outcomes of individual units are influenced by common unobserved factors or interdependencies among the panels. The results of the Breusch-Pagan LM test ($\chi^2(1) = 1313.61$, $p<0.001$) indicates that the residuals from the pooled ordinary least squares (OLS) regression exhibit significant heteroskedasticity. The results of the Pesaran's CD test (CD = 444.434, $p<0.001$) show that there is significant cross-sectional dependence among the individual units (panels) in your panel data. The significant findings from both tests highlight the need to consider and account for the presence of heterogeneity and cross-sectional dependence in the panel data analysis.

Both fixed and random effects model are designed to address individual-specific heterogeneity, while making different assumptions about the nature of individual-specific effects. The fixed effects model accounts for all of the individuals' time-invariant differences, so the estimated coefficients of the fixed-effects models cannot be skewed by time-invariant characteristics that are not included, such as gender. This is because time-invariant characteristics of individuals are perfectly collinear with the person-specific dummy variables included in the model, therefore it becomes impossible to separate the effect of these time-invariant characteristics from the individual-specific fixed effects. A fixed effect is tested by F-test, which compares a fixed effect model and OLS to see how much the fixed effect model can improve the goodness-of-fit. The null hypothesis states that all dummy parameters, except for the one representing the dropped category, are equal to zero. The F test statistic is $F(15339, 62057) = 11.54$, and the p-value is smaller than 0.001. Therefore the alternative hypothesis holds that at least one dummy parameter is not zero and I can conclude that there is a significant fixed effect. The random effects model assumes that individual-specific effects are random and uncorrelated with the independent variable. It treats individual-specific effects as random variables and estimates their variances. A random effect is examined by Breusch and Pagan's (1980) Lagrange multiplier (LM) test, which contrasts a random effect model with OLS. With the test result of the Breusch and Pagan test for random effects (χ^2 = 1.1e^5, $p<0.001$), the null hypothesis is rejected. I can infer that the panel data exhibit a sizable random effect, and that the random effect model handles heterogeneity better than the pooled OLS.

To determine which effect (fixed or random) is more relevant and significant in panel data analysis, the Hausman specification test can be used. This test compares the fixed and random effects models under the assumption that individual effects are not correlated with any regressor in the model (Hausman, 1978). The test results show that the null hypothesis of no correlation is rejected ($\chi^2(1) = 74.97$, $p < 0.001$), it suggests that the individual effects are significantly correlated with at least one of the regressors in the model. Therefore it is advisable in this panel data analysis to favor the fixed effects model over the random effects model, otherwise it would lead to biased or inconsistent estimates.

Hence, I need to run a fixed effects regression, to specify if time fixed effects need to be included, the joint significance of time dummy variables are tested. The outcome of the test ($F(14, 15339) = 2.72$, $p<0.001$) show it is impossible to accept the null hypothesis that the coefficients for the years are jointly equal to zero, therefore time fixed effects are needed. Hereafter a modified Wald test for groupwise heteroskedasticity (Baum, 2001) is conducted, the test results suggest that the assumption of constant error variance across individuals is violated ($\chi^2(13889)$= 8.3e^39, p< 0.001). Next the Wooldridge test for autocorrelation (Drukker, 2003) will be used, the test results indicate the presence of first-order autocorrelation ($F(1, 8218) = 1168.948$, $p< 0.001$). This suggests that the error terms may be correlated across time periods for the same individual. By including the robust term and clustering per individual, the impact of heteroskedasticity and autocorrelation on the parameter estimates can be mitigated and enhance the reliability of our fixed effects regression.

After specifying the entity and time fixed effects model as our correct model, the following equation is constructed:

$$Y_{it} = \alpha_i + \beta X_{it} + \delta_t + u_i + e_{it}$$

Where:

- Y_{it} is the dependent variable and represents the level of financial stress for entity i at time t
- α_i captures individual-specific fixed effects, accounting for unobserved characteristics that are constant over time, also known as the unknown intercept
- β for a given entity, when a predictor changes one unit over time, the outcome will increase or decrease by β units, here representing the relationship between smoking behavior and financial stress. β signifies a consistent impact across entities, while controlling for individual and time heterogeneity
- X_{it} is the independent variable, in this case it signifies the smoking behavior of person i at time t
- δ_t the unknow coefficient for the time regressors (t), captures the time-specific fixed effects

- u_i also known as the within-entity error term, represents individual-specific disturbances that are constant across time
- e_{it} is the overall error term, which captures the random disturbances of individual i at time t

To enhance the accuracy and validity of the model, some control variables are added to the equation. Control variables help to isolate and examine the specific effect of the independent variable (smoking behavior) on the dependent variable (financial stress), while holding other relevant factors constant. First *education* and *income category* are incorporated. These variables reflect the socioeconomic status of individuals and can affect both smoking behavior and financial stress. Including these variables helps to disentangle the direct role of smoking from the potential influence of socioeconomic factors. Also the variable *heavysmokers* is included, by including this control variable, you can explore whether heavy smokers experience different levels of financial stress compared to other smokers. At last the variable age will be added to the model. Although age is time-invariant, it can still be an important control variable. Age might be correlated with both smoking behavior and financial stress. People of different ages may have different risk perceptions, health concerns, and financial responsibilities, which can influence their smoking habits and financial stress levels (Siahpush et al., 2003).

The analysis followed a three-step approach. First, a basic fixed effects regression was run without control variables or time fixed effects. Then, control variables were included to refine the analysis. Finally, time fixed effects were added to capture any time-related variations that might affect the results.

To address the second hypothesis, four separate fixed effects regressions were conducted, corresponding to the tax increases in 2009, 2013, and 2020. The time periods were categorized as pre-2009, 2009-2013, 2013-2019, and post-2020. The dependent variable is financial stress, and smoking behavior served as the independent variable. Additionally, the variable *ex-smoker* was introduced as a control variable. In the former regression because of the time period of 15 years, ex-smokers was highly correlated with the "smoking" variable, leading to multicollinearity issues. This can cause instability in the coefficients and inflate standard errors, which resulted in loss of significance. However, with this smaller year clusters it strengthens the significance of smoking.

In response to the third hypothesis, a parallel regression methodology was applied. To stratify the dataset according to specific socioeconomic groups, an adapted method of conditional filtering was employed. This segmentation hinged on categorizing individuals into discrete tiers defined by their education and income levels, covering high, middle, and low categories. Through the application of this technique, the objective was to ascertain potential variations in the interplay between smoking behavior and financial stress across these distinct socioeconomic layers.

5. Results

This section reports the main results of the analysis using the identification strategy presented in the methods section. First in section 5.1 the role of smoking on financial stress will be discussed, then in section 5.2 the role of tobacco tax increases on financial stress will be handled and lastly in section 5.3 the role of these tax increases across different socioeconomic groups will be reviewed.

5.1 Role of smoking behavior on financial stress

To test the first hypothesis, that smokers have an increased chance of experiencing financial stress, a fixed effects regression is constructed with financial stress as the dependent variable and smoking as the independent variable. Table 5.1 shows the results of this fixed effects regression. Column 1 is the regression with only smoking as an independent variable, Column 2 is the regression with the control variables included and Column 3 is the regression with both control variables and time fixed effects incorporated.

In all the three regression models the estimated effect of smoking on financial stress is statistically significant at the 10% significance level. The effect of smoking on financial stress is also significant at the 5% significance level in the most simple model. The coefficient of 0.009 signifies that individuals who engage in smoking, relative to their non-smoking counterparts, exhibit a slight increase in the natural logarithm of the financial stress level by approximately 0.009 points. This suggests a positive relationship between smoking behavior and the logarithmic transformation of financial stress. To put it in perspective, when calculating these logarithmic values of smokers and non-smokers in model 3, smokers encounter 0.9 percentage points more financial stress.

Regarding control variables, heavy smoking significantly impacts both models 2 and 3. The coefficient for heavy smoking indicates a positive link in both models, resulting in a rise of 0.009 units, maintaining significance at a 5% level in the model with time fixed effects. Education emerges also as a significant factor in both models. Individuals with a middle education level show negative correlations, leading to reductions of 0.043 and 0.044 units ($p<0.01$). Similarly, those with higher educational attainment display negative associations, resulting in declines of 0.068 and 0.070 units ($p<0.01$). These findings suggest that middle or high education is associated with lower financial stress compared to lower educational attainment. In contrast, the coefficients of the other socioeconomic control variable *income category* show no significant effect on financial stress. Regarding age, the results indicate a progressive reduction in financial stress as individuals age, but no statistically significant relationships are established across the models for different age categories. The coefficients for each year demonstrate changes in financial stress relative to the reference year, 2008. For example, in 2009, there's a statistically significant increase of 0.015 ($p<0.01$), with similar patterns observed for subsequent years up to 2022.

Table 5.1 Fixed effects regression results for the relationship between smoking and financial stress, supplemented by control variables and time fixed effects

Variable		Financial stress		
		1	2	3
	Smoking	0.009**	0.009*	0.009*
		(0.042)	(0.067)	(0.058)
	Heavy smoker		0.009**	0.008**
			(0.010)	(0.030)
Education	**Middle**		-0.043***	-0.044***
			(0.000)	(0.000)
	High		-0.068***	-0.070***
			(0.000)	(0.000)
Income	**Middle**		0.001	0.001
			(0.885)	(0.879)
	High		-0.002	-0.002
			(0.730)	(0.741)
Age	**30-44**		-0.004	-0.005
			(0.506)	(0.405)
	45-64		-0.011	-0.013
			(0.135)	(0.106)
	>64		-0.013	-0.016
			(0.118)	(0.100)
Years	**2009**			0.015***
				(0.001)
	2010			0.011***
				(0.007)
	2011			0.010**
				(0.016)
	2012			0.012***
				(0.005)
	2013			0.010**
				(0.024)
	2015			0.010**
				(0.032)
	2016			0.011**
				(0.021)
	2017			0.011**
				(0.016)
	2018			0.009*
				(0.067)
	2019			0.010**
				(0.049)
	2020			0.011**
				(0.041)
	2021			0.010*
				(0.062)
	2022			0.012**
				(0.031)
	Constant	0.079***	0.126***	0.119***
		(0.000)	(0.000)	(0.000)
	Observations	77,398	71,240	71,240
	Individuals	15,340	13,889	13,889
	R^2	0.005	0.020	0.021

Note. Standard errors are in parentheses; *p<0.1 **p<0.05 ***p<0.01

The table is based on a large sample size with substantial observations and individuals. Variation in observation counts between Model 1 and Models 2 and 3 arises from the inclusion of the income category control variable. The increase in R-squared values indicates the proportion of variability in financial stress explained by included independent variables, rising from around 0.5% in the simple model to about 2% in Models 2 and 3. However, the majority of financial stress variance remains unexplained, potentially due to other factors or complexities influencing individuals' stress levels.

In conclusion, the analysis supports the adoption of the first hypothesis that smoking is associated with an increase in experiencing financial stress, as demonstrated by the positive coefficients observed in the regression models. However, it is important to acknowledge that the explanatory power of the models remains limited, indicated by the relatively low R-squared values. This implies that while smoking appears to have a observable influence on financial stress, a substantial portion of the variability in financial stress remains unexplained by the included variables. Therefore, the impact of other potentially influential factors should not be overlooked in shaping individuals' experiences of financial stress.

5.2 The role of tax increases on tobacco on financial stress

The second hypothesis reads: a significant increase in experienced financial stress can be found among smoking individuals after tax increases on tobacco products. To examine this hypothesis, four fixed effects regressions are established with financial stress as the dependent variable and smoking as the independent variable. In particular, these regressions are constructed in response to three significant tax hikes occurring in 2009, 2013, and 2020. Each model corresponds to a distinct time period, contributing to a comprehensive exploration of the potential role of tax increases on smoking-associated financial stress. The results of these fixed effects regressions are presented in Table 5.2.

Table 5.2 Fixed effects regression results for the relationship between smoking and financial stress for time periods before and after tax increases

	Financial stress			
	Pre 2009	**2009-2012**	**2013-2019**	**Post 2020**
Smoker	-0.004	-0.026***	0.006	0.052**
	(0.595)	(0.009)	(0.431)	(0.046)
Ex-smoker	-0.002	-0.018**	0.001	0.038
	(0.717)	(0.031)	(0.866)	(0.166)
Constant	0.078***	0.105***	0.076***	0.052***
	(0.000)	(0.000)	(0.000)	(0.000)
Observations	11,639	20,713	30,056	14,990
Individuals	7,308	7,535	8,217	6,654
R^2	0.002	0.002	0.005	0.001

Note. Standard errors are in parentheses; *p<0.1 **p<0.05 ***p<0.01

When examining the years prior to the first tax increase, no statistically significant effect can be found of individuals being a smoker or ex-smoker on the natural logarithm of financial stress in those years. After the first tax increase we see smoking and ex-smokers establish a significant relationship with financial stress. The coefficient for smokers exhibits statistical significance at a significance level of $p < 0.01$, this suggests a robust link between smoking and the experience of financial stress in the specified timeframe. The coefficient of ex-smokers is statistically significant at $p<0.05$, indicating that there is a moderate association between being an ex-smoker and experiencing financial stress during this time period. Furthermore, an increase of the constant can be discovered, which indicates that individuals in general experienced more financial stress after the tax increase in 2009. This increase could be the result of the Global Financial Crisis in 2008. In contrast to both the aforementioned literature and hypothesis, the negative coefficients imply that smokers and ex-smokers, on average, encountered a reduction in financial stress during this specific period relative to non-smokers.

Digging deeper into the next tax increase period reveals notable shifts in the coefficients of both smoking and ex-smokers. Both smoking and ex-smoking coefficients transform into positive values, indicating a positive association with financial stress. However, this shift does not achieve statistical significance. Meanwhile, the constant displays a reduction, indicating individuals experienced less financial stress after the tax increase in 2013 than the period before. In the final time span, a statistically significant connection between smoking and financial stress resurfaces, although this pertains solely to smoking and not to ex-smokers. The coefficient of smokers (0.052) exhibits its most substantial alteration between time periods and is statistically significant at $p<0.05$. This indicates a moderate positive association between being a smoker and experiencing financial stress during this time period. Simultaneously, the constant term reaches its lowest value among all four time periods, indicating a reduced level of experienced financial stress in this time period.

When looking at the effect sizes, a trend can be observed. Over the last three analyzed periods, smokers exhibit an increasing trend in financial stress, with a notable rise in the two most recent periods. Concurrently, the overall financial stress level of smokers experiences a consistent upward trajectory across all time intervals, reflecting a growing trend. However, the R^2 values in this models are very low (0.002 to 0.005), suggesting that the models explain only a small fraction of the variation in financial stress. This indicates that other factors beyond those included in the model influence financial stress levels.

In conclusion, while smoking is found to have a statistically significant negative association with financial stress after the tax increase in 2009, the opposite holds for the period after the last tax increase. Notably, a discernible trend indicates that smokers experience a significant increase in financial stress during the last three periods, paralleling the observable rising trend in their overall financial stress levels. However, it is important to emphasize that while this trend is evident, a

hypothesis of a direct causal relationship between tax increases and financial stress can not be accepted.

5.3 The role of tobacco tax increases on financial stress across different socioeconomic groups

The third and fourth hypotheses are linked to distinct socioeconomic groups. The third hypothesis postulates that individuals with lower levels of education who smoke may encounter heightened financial stress as a result of tax increases. This examination involves the segmentation of observations by education levels and the consideration of periods before and after tax adjustments. Shifting focus to the fourth hypothesis, it asserts that individuals from lower income categories who smoke might undergo amplified financial stress due to tax increases. Notably, this analysis shifts its perspective from education levels to income categories, specifically low, middle, and high.

Educational differences

The results, which can be found in Table 5.3, suggest that the role of smoking on financial stress varies across educational groups and time periods. In the low education group, smoking's effect on financial stress varies over time. While it's non-significant before 2009, from 2009 to 2012, smoking significantly ($p<0.05$) reduces stress. The period 2013-2019 sees a slight, insignificant increase, while post-2020 shows a significant ($p<0.05$) rise in stress due to smoking. This suggests that smokers from the lower educational group experience more financial stress from the last two tax increases. When looking at the effect sizes, the same trend can be observed as mentioned in the last section, nevertheless this effects are larger for the low educated group. Ex-smokers show less consistent patterns, which are also insignificant.

The middle and high education groups exhibit mixed outcomes in the relationship between smoking and financial stress over different time spans. Upon closer examination of the multiple constant terms, a trend emerges, indicating an inverse relationship between the level of educational attainment and the magnitude of reported financial stress. In other words, individuals with higher educational levels tend to exhibit comparatively lower levels of financial stress, which could be seen at the first hypothesis. The low R^2 values indicate that the included variables do not explain a large portion of the variability in financial stress.

In summary, for the less educated group, smoking's role on stress fluctuates over time, with a significant reduction in stress observed from 2009 to 2012. This is followed by a significant more pronounced increase post-2020, suggesting heightened stress for lower-educated smokers after recent tax hikes. For the middle and high education groups the same trend can be observed, however the relationship is less definitive. Therefore, these results provide enough evidence to accept the third hypothesis, that lower educated smokers experience more financial stress.

Table 5.3 Fixed effects regression results for the relationship between smoking and financial stress for time periods before and after tax increases by educational group

Education		Financial stress			
		Pre 2009	2009-2012	2013-2019	Post 2020
Low					
	Smoker	-0.022	-0.043**	0.009	0.113**
		(0.173)	(0.033)	(0.541)	(0.047)
	Ex-smoker	-0.010	-0.030*	0.005	0.087
		(0.505)	(0.060)	(0.708)	(0.134)
	Constant	0.128***	0.153***	0.121***	0.072***
		(0.000)	(0.000)	(0.000)	(0.000)
	Observations	4,253	7,385	8,848	3,662
	Individuals	2,744	2,815	2,643	1,636
	R^2	0.000	0.001	0.001	0.000
Middle					
	Smoker	0.013	-0.006	0.016	0.033
		(0.171)	(0.653)	(0.148)	(0.138)
	Ex-smoker	0.005	-0.009	0.014	0.007
		(0.349)	(0.196)	(0.207)	(0.716)
	Constant	0.062***	0.089***	0.060***	0.061***
		(0.000)	(0.000)	(0.000)	(0.000)
	Observations	3,938	6,905	10,394	5,170
	Individuals	2,555	2,689	3,062	2,333
	R^2	0.011	0.001	0.001	0.003
High					
	Smoker	0.000	-0.038**	0.000	0.055
		(1.000)	(0.035)	(0.948)	(0.308)
	Ex-smoker	0.000	-0.014	-0.004	0.057
		(1.000)	(0.385)	(0.745)	(0.307)
	Constant	0.037***	0.069***	0.050***	0.019***
		(0.000)	(0.000)	(0.000)	(0.000)
	Observations	3,448	6,423	10,814	6,158
	Individuals	2,148	2,358	3,015	2,815
	R^2	.	0.000	0.001	0.000

Note. Standard errors are in parentheses; *p<0.1 **p<0.05 ***p<0.01

Income differences

The results of the fixed effects regression used to test the fourth hypothesis are demonstrated in Table 5.4. Overall, the results indicate that the relationships between smoking behavior and financial stress vary across different income groups and time periods. While some patterns emerge, the statistically significant effects are limited, and the explanatory power of the model remains modest. This suggests that other factors beyond smoking contribute significantly to the variability in financial stress for individuals in these income groups.

Table 5.4 Fixed effects regression results for the relationship between smoking and financial stress for time periods before and after tax increases by income group

Income		Financial stress		
		2009-2012	2013-2019	Post 2020
Low				
	Smoker	-0.008	0.004	0.077
		(0.810)	(0.885)	(0.187)
	Ex-smoker	-0.026	-0.020	0.049
		(0.145)	(0.404)	(0.409)
	Constant	0.164***	0.154***	0.132***
		(0.000)	(0.000)	(0.000)
	Observations	1,913	3,384	1,453
	Individuals	934	1,439	818
	R^2	0.007	0.000	0.006
Middle				
	Smoker	-0.035***	0.007	0.062
		(0.009)	(0.509)	(0.130)
	Ex-smoker	-0.021*	0.007	0.040
		(0.066)	(0.463)	(0.334)
	Constant	0.114***	0.074***	0.051**
		(0.000)	(0.000)	(0.024)
	Observations	13,976	19,797	9,481
	Individuals	5,512	6,150	4,577
	R^2	0.001	0.000	0.001
High				
	Smoker	-0.024	0.020	0.053
		(0.202)	(0.261)	(0.309)
	Ex-smoker	-0.007	0.002	0.060
		(0.577)	(0.85)	(0.305)
	Constant	0.057***	0.037***	0.008
		(0.000)	(0.000)	(0.790)
	Observations	4,824	6,875	4,056
	Individuals	2,068	2,405	2,102
	R^2	0.001	0.003	0.000

Note. Standard errors are in parentheses; *p<0.1 **p<0.05 ***p<0.01

However, the same aforementioned trend becomes visible in these results, especially in the low income group. In this group, the effect sizes indicate that smokers experience an increase in financial stress during the periods following the tax increases. This trend is evident as the effect size shifts from negative values after the first tax increase to positive values after the last two tax increases, suggesting a notable rise in financial stress levels among smokers during these later periods. In conclusion, this leads to the adoption of the fourth hypothesis: smoking individuals from a lower income category experience more financial stress from tax increases.

6. Discussion

6.1 Interpreting the results

In summary, my analysis substantiates the acceptance of the first hypothesis positing a positive association between smoking and the experiencing of financial stress. These findings are in line with the studies of Siahpush et al. (2003) and Widome et al. (2015). In addition to this results, middle and high education levels are associated with notable significant reductions in financial stress, while income category does not show a significant role. This is in line with the results of Pierce et al. (1989), Stronks et al. and Nagelhout et al. (2012). However, it's crucial to acknowledge the models' limited explanatory capacity, indicated by their relatively low R-squared values.

Conversely, the outcomes of the regression models of specific time periods neither accept nor reject the second hypothesis. Although a statistically significant positive connection is established between smoking and financial stress following the tax increase of 2020, the converse holds true for the periods subsequent to the 2009 tax increase, affecting smokers. However, the overall financial stress level of smokers experiences a consistent upward trajectory across all time intervals, reflecting a growing trend. Consequently, it is premature to conclude that a tax increase on tobacco automatically translates into an elevated experience of financial stress among smoking individuals. However, it's crucial to note that the global financial crisis of 2008 has not been factored into the analysis, potentially influencing the results subsequent to the initial tax increase of 2009. Furthermore, the observed trend raises the question whether smokers might indeed experience heightened financial stress over time as cigarette prices continue to rise. Therefore, more research is necessary to investigate this observed trend.

To further explore the role of tax increases on tobacco among different socioeconomic groups, two regression models have been constructed for differences in education and income. The results suggest adopting both the third hypothesis and fourth hypothesis, together pointing towards the trend that individuals with lower socioeconomic status experience more financial stress after tax increases on tobacco. While socioeconomic differences have been found by multiple studies (Heymans et al. (2005), Nagelhout et al. (2012), Stronks et al. (1997)), the result that individuals with lower socioeconomic status experience more financial stress after tax increases on tobacco has not been found elsewhere.

6.2 Limitations

It is important to mention that this study also got some limitations. An important limitation of this study stems from the availability of data. The absence of data for the year 2014, a crucial period following the tax increase in 2013, presents a gap in the chronological sequence. This omission restricts the analysis of the potential effects of the tax policy change on smoking behavior and financial stress during this interval. Additionally, it's important to acknowledge the inherent survey

nature of the data, which can introduce measurement bias due to self-reported responses. Respondents' perceptions and interpretations of smoking behavior and financial stress could lead to variations in reporting, potentially influencing the accuracy and consistency of the collected information.

While the analysis can highlight associations, the nature of cross-sectional data and fixed effects models limits the ability to establish causality (Brooks, 2019b). The observed link between smoking and financial stress could potentially be subject to bidirectional causation, implying that not only can smoking contribute to heightened financial stress, also financial stress might influence individuals' smoking behavior. As such, a more comprehensive understanding of the interplay between these variables necessitates longitudinal studies that can unravel the temporal dynamics and potential causal pathways between smoking and financial stress.

Another limitation of this study may lie in unobserved heterogeneity (Brooks, 2019b). Fixed effects models help control for time-invariant unobserved factors at the individual level. Nevertheless, it's important to acknowledge that the presence of unobserved time-varying elements or omitted variables could potentially introduce bias into the analysis. These factors, not accounted for in the model, have the potential to simultaneously affect both smoking patterns and financial stress levels, thereby leading to the emergence of omitted variable bias. This underscores the importance of acknowledging the limitations of the fixed effects approach and considering alternative methodologies or data sources that could potentially address this concern and provide a more nuanced understanding of the association between smoking behavior and financial stress.

There might be variables that affect both smoking behavior and financial stress, introducing endogeneity issues (Brooks, 2019b). A good example is the potential influence of mental health status, a variable that might exert a role in both smoking behavior and financial stress, yet has not been incorporated into the analysis. The presence of such unobserved common causes could undermine the integrity of the estimated relationships, potentially leading to biased and inaccurate results.

Another limitation lies in the pricing strategy of tobacco companies. Gilmore et al. (2013) their findings suggest that price changes initiated by the tobacco industry are timed to appease smokers who are concerned about price and accentuate the price gap while also concealing the price increases on the more expensive brands behind the tax increases. This price maneuvering by tobacco corporations implies a potential delay in the manifestation of the impact of tax increases on smoking behavior, possibly requiring a span of several years for its substantive realization. Therefore the role of tax increases on financial stress by smoking individuals could be postponed for a few years.

6.3 Strengths

Unlike previous research on financial stress by Siahpush et al. (2003) and Widome et al. (2015) that made use of cross-sectional data, this study employs a longitudinal approach by using data collected over multiple time periods. This approach allows to track changes in variables of interest over time, which is a powerful method for establishing trends and exploring causal relationships. By observing how financial stress and smoking behaviors evolve across different time periods, not only correlations but also potential cause-and-effect dynamics can be better understood. By making use of the data provided by the LISS panel, the study benefits from a substantial number of participants over multiple years, providing a comprehensive representation of the population. This extensive sample size enhances the generalizability of the findings, allowing for meaningful insights into broader trends and patterns.

The study presents statistically significant findings, underscoring that the observed outcomes regarding the relationship between financial stress and smoking are unlikely to be random occurrences. Additionally, the overall financial stress level of smokers, especially those from low socioeconomic classes, experiences a consistent upward trajectory across the various time periods, reflecting a growing trend. By shedding light on the complex dynamics between tax increases, financial stress and smoking, the study equips policymakers and stakeholders with empirically grounded insights that can effectively inform the process of decision-making. This, in turn, holds the potential to drive the formulation of targeted interventions and policies aimed at reducing the smoking prevalence.

6.4 Recommendations for future research

Given the Netherlands' ambitious goal of establishing a smoke-free generation by 2040 and the implementation of new anti-tobacco measures (Ministerie van Volksgezondheid, Welzijn en Sport, 2023b), future research should focus on assessing the long-term effects of these initiatives on financial stress. This research is especially crucial in anticipation of larger tax increases that are planned for the nearby future. Investigating how changes in smoking behavior resulting from tax increases and other measures influence individuals' financial stress levels is essential for understanding the broader socio-economic effects of anti-tobacco policies.

On the other hand, it is important to acknowledge that tobacco industries have not remained inert in response. In recent years, multiple alternative forms of tobacco smoking have emerged, including vapes and e-cigarettes. Particularly noteworthy is a study conducted in Denmark by Kjeld et al. (2022). In this study, adolescents from various socioeconomic backgrounds are examined to determine the efficacy of an intervention in preventing the use of cigarettes and other tobacco products (ATPs). According to their findings, social disparities in ATP use grew over time, while social

disparities in current smoking decreased. Therefore, for future research also this alternative tobacco products must be taken into account.

6.5 Policy implications

The observed significant association between smoking and financial stress has not been studied earlier in the Netherlands and are in line with the aforementioned study by Siahpush et al. (2003). The results underscore the need for targeted interventions aimed at reducing smoking prevalence. Policy makers should consider incorporating financial literacy programs into smoking cessation initiatives, as addressing financial stress could enhance the effectiveness of anti-smoking campaigns.

The substantial rise in the positive effect of smoking on financial stress following the tax increase in 2020 highlights the complicated interplay between taxation policies and smoking behavior. Policymakers should carefully evaluate the potential repercussions of tax adjustments on various demographic groups, especially considering their financial vulnerability. The findings emphasize the importance of continuous monitoring of smoking behavior in response to tax alterations to inform timely policy adjustments.

Appendix

Table A.1 Participation and response statistics for the Health Questionnaire in the LISS Panel

Year	Panel Members	Fully completed	Response Percentage
2007	8,487	6,625	78.06
2008	8,280	5,933	71.65
2009	9,170	6,070	66.19
2010	7,364	5,665	76.93
2011	6,533	5,044	77.21
2012	6,769	5,735	84.72
2013	6,217	5,343	85.94
2014	no data	no data	no data
2015	7,126	5,975	83.85
2016	6,336	5,366	84.69
2017	7,487	5,927	79.16
2018	6,466	5,455	84.36
2019	5,954	5,145	86.41
2020	6,832	5,714	83.64
2021	6,274	5,094	81.19
2022	7,000	5,802	82.89
Average	7,086.33	5,659.53	80.46

Table A.2 Pearsons chi-squared test of independence between individuals without reported income and three variables

		Smoking		Education		Financial stress	
Year	**N**	**Pearson chi2(1)**	**Sig.**	**Pearson chi2(2)**	**Sig.**	**Pearson chi2(4)**	**Sig.**
2008	450	0.033	0.855	4.241	0.120	3.261	0.515
2009	434	0.572	0.449	11.125***	0.004	2.244	0.691
2010	438	0.015	0.902	7.892**	0.019	8.162*	0.086
2011	402	0.042	0.838	7.406**	0.025	4.3016	0.367
2012	484	0.460	0.498	6.600**	0.037	0.277	0.991
2013	487	0.015	0.902	10.551***	0.005	4.273	0.370
2015	549	0.984	0.321	9.847***	0.007	2.114	0.715
2016	492	1.290	0.256	1.567	0.457	1.015	0.908
2017	551	0.448	0.485	8.9725**	0.011	10.647**	0.031
2018	487	1.116	0.291	10.430***	0.005	7.692	0.104
2019	513	1.208	0.272	8.995**	0.011	10.565**	0.032
2020	519	0.249	0.618	16.324***	0.000	8.762*	0.067
2021	471	0.940	0.332	13.297***	0.001	19.251***	0.001
2022	532	4.276**	0.039	25.467***	0.000	14.580***	0.006

Note. Standard errors are next to the Pearson chi2 score; *p<0.1 **p<0.05 ***p<0.01

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