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2019 **Tomáš Mitro**

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Impact of the smoking ban on food and beverages services sector sales in the Czech Republic

Bachelor thesis

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Abstract

The aim of this thesis is to determine whether the smoking ban implemented in May 2017 has had any impact on sales in Czech Republic's food and beverages services sector. This is done by constructing three different regression models on two outcome measures in order to examine the statistical significance of the smoking ban in these models. In two of the three models, the smoking ban shows no significant effect, while in one model it shows a positive effect. The positive effect, however, is argued to be partly due to the implementation of EET half a year prior to implementation of the smoking ban. This thesis can therefore definitely conclude no adverse effect of the smoking ban on sales in food and beverages services sector.

Keywords

smoking ban, sales, restaurant, impact, smoke-free ordinance, EET

Abstrakt

Cílem této práce je určit, jestli zákaz kouření zaveden v květnu 2017 měl dopad na tržby sektoru stravování a pohostinství v České republice. Na tento účel jsou sestrojeny tři regresní modely na dvě kritéria výsledků, kde je pozorována statistická signifikance zákazu kouření. Ve dvou ze tří modelech není nalezen žádný signifikantní efekt, zatímco v jednom modelu je nalezen kladný efekt. Tento kladný efekt je ale možné považovat za součást efektu EET, které bylo zavedeno půl roky před zavedením zákazu kouření. Tato práce proto dokáže jednoznačně říct, že zákaz kouření neměl negativní efekt na tržby sektoru stravování a pohostinství.

Klíčová slova

zákaz kouření, tržby, restaurace, důsledek, vyhláška proti kouření, EET

Range of thesis: 64 852

Declaration of Authorship

1. The author hereby declares that he compiled this thesis independently, using only the listed resources and literature.

2. The author hereby declares that all the sources and literature used have been properly cited.

3. The author hereby declares that the thesis has not been used to obtain a different or the same degree.

Prague 26.07.2019 Tomáš Mitro

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Proposed topic

Impact of the Czech smoking ban on sales in pubs.

Research topic and motivation

Before the smoking ban had been enacted in the Czech Republic, predictions about its impacts on Czech pubs have differed across all the parties involved. Economists, politicians and businessmen haven't had a clear idea on the effect of this ban on sales. Some have opposed this ban saying that smokers will leave these premises, resulting in a decrease in sales, while others claimed that it will attract non-smokers who wouldn't have otherwise enjoyed these services. Now, a year after the ban had been enacted, it is still not clear whether this ban had a significant effect on the sales. In this thesis, I will be studying what is the effect of the ban on sales of Czech pubs and determine the long term and short-term effects of this ban. Doing this, I will be trying to answer whether sales in pubs have been impacted by this policy, and perhaps I will help determine if changes in sales should be considered before enacting such policies in other countries. Although no study has been done concerning this topic in the Czech Republic, many studies on the effect of smoking ban on sales in bars and restaurants have been conducted worldwide. According to Dearlove JV, Bialous SA, Glantz SA (2002), the tobacco industry claims that smoking bans reduce profitability of bars and restaurants and continues to lobby against smoke free policies, while other studies, such as Alamar B, Glantz S. (2004), claim that these policies increase profits and value of restaurants. Other study conducted by Centers for Disease Control and Prevention (2004) that studied the effect of smoking ban in restaurants and bars in Texas has concluded that no statistically significant changes in restaurant and bar revenues occurred after the smoking ban took effect. Such conclusion has also been reached by Cornelsen L, Normand C (2014). Their study on the effect of smoking ban in Irish bars has shown that the impact on sales appears to be very small, insignificant. Conclusions of studies conducted on this topic vary greatly. The reason why working on this topic is important is that more studies conducted would help legislators make better, more objective decisions on passing similar, smoking-restricting laws in the future.

Methodology

I will be using a linear regression model where I will be running a regression of sales on the following variables: Household disposable income to account for economic growth, as increases in disposable income might be used by households to enjoy more leisure, which might be time and money spent in pubs. The data on household disposable income is obtained from the OECD public database of economic indicators in Czech Republic. To account for economic growth, I will also introduce variables for GDP growth rate and unemployment rate. I will be regressing on both of these variables instead of just one of them to avoid possible bias in estimators of their parameters, as these variables are probably highly correlated. Data on GDP growth rate are obtained from a public CZSO (Czech statistical office) database of national accounts. Data on unemployment rate are obtained from a public CZSO database of employment, unemployment. Finally, a dummy variable is introduced to account for the smoking ban enactment in time t, i.e. this dummy variable will be equal to 0 until 27.05.2017 (enactment of smoking ban) and equal to 1 after 27.05.2017. To control for changes in prices, I will adjust sales to national CPI for food and beverages from a public CZSO database Consumer price index according to The Classification of individual consumption by purpose (COICOP). This regression will be similar to the one used by Alamar B, Glantz S. (2007) in the way economic growth is accounted for and I will be using sales adjusted to national CPI as used by Cornelsen L, Normand C (2014) in their demand model. It is expected that estimated coefficients of household disposable income and GDP growth rate are going to be positive. This would mean that higher household disposable income would make households spend more money in pubs and that higher economic growth would result in higher sales in pubs. The estimated coefficient of unemployment rate is expected to be negative, as unemployment tends to fall with economic growth, which, as mentioned, results in higher sales. The coefficient of the dummy variable is what I will be interested in. If the coefficient turns out to be statistically significant and positive, it would show that enacting a nation-wide smoking ban in pubs had resulted in increased sales in pubs. If the coefficient turns out to be significant and negative, then it would show that enacting a nation-wide smoking ban in pubs decreased sales in pubs in Czech Republic, and that this decrease should be considered before enacting such policies in other countries. One more possible estimate of the coefficient can be a statistically insignificant coefficient, meaning that the

dummy variable plays no significant role in sales in pubs and that sales are, and have been, mostly affected by economic conditions unrelated to this smoking ban.

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Contents

1 Introduction

On May 27th 2017, Czech Republic has implemented a country-wide smoking ban. Before its enactment, this law has been called controversial as noted by Krajské listy, arguing that it would take away the right to choose and that a person should be able to make his own mind whether he wants to visit establishments that allow smoking or ones that prohibit it. According to some, the same argument can be used regarding employees in these restaurants or bars as stated on iDnes. If they do not want to experience the negative effects of second-hand smoking, they should choose not to get employed there. The possible flaw of this, of course, is that the right to choose might only be applicable in larger cities. In many small villages, there's only few eating and drinking places, so the pool of available jobs to choose from for people in need of employment is small and being picky might not be viable. For example, K. Riseley (2003) examinated how voluntary smoking ban in Australian workplaces affected employees' and patron's exposure to environmental tobacco smoke. Riseley states that voluntary ban fails to protect these persons and that a comprehensive smoke-free legislation is necessary to ensure that workers and patrons are protected from exposure to tobacco smoke. The results of this study may imply that owners generally do not have to take their employees health into consideration, and therefore the government should intervene.

Another argument against this law came from a member of parliament of the Czech Republic, as informed by Aktuálně.cz, Ondřej Veselý (ČSSD), who argued that it could hurt business in villages, where, he says, "men go to have a beer, cigarette and play cards" and that after the smoking ban, these men turn from publicly available establishments in the village and instead carry on with these activities in their private garages.

Indeed it appears that lawmakers have to consider different points of view when enacting such controversial policies, since the road to proper smoking policies is riddled with many arguments and studies supporting both sides that apply their influence and pressure on politicians.

This thesis aims to help settle the argument whether the Czech smoking ban did indeed hurt sales in the hospitability sector and add to the literature that may help lawmakers in their public policy decision making process.

2 Literature review

2.1 Consumers' and owners' choice

Some studies that argue against smoking bans state that such government intervention prevents consumers and owners from choosing the types of establishments they prefer.

One proponent of the free choice for consumer, Michael R. Pakko (2006), argues that before any smoking ban is implemented, consumers are free to choose whether they want to visit establishments that are smoke-free or ones that are not. By choosing the establishments without any non-smoking areas or restrictions, they reveal their preferences and would likely be worse-off if the option to choose was taken away from them via a smoking ban. The same principle is stated by Dunham and Marlow (2003), who cite Coase (1960) for the argument that owners should be able to decide on smoking restrictions themselves, and that government should no regulate smoking in bars and restaurants. The argument Dunham and Marlow provide is that owners essentially rent out the space of their establishments to people, customers, who value the space the most. When customers are divided to smokers and non-smokers, these two groups in a sense compete for the space, allowing owners to allocate smoke-free seating in accordance for demand of smoke-free areas. Owners seeking the highest profits would therefore allocate their resources, that being space in restaurants, in accordance to customers preferences. If it was most profitable for owners to establish 100% smoking restriction in their establishments, they would do so without government regulations. Therefore, when the option to keep areas of bars or restaurants available to smokers is taken away, the allocation of resources is not efficient. This argument has been met with opposition, for example Hyland and Tuk (2001), who note that tobacco industry often claims non-smoking areas in pubs are vastly unpopular and commercially unviable, decided to find evidence for such claims by asking pubs to establish non-smoking areas and then conducting a survey. Out of the eleven pubs surveyed by Hyland and Tuk that established non-smoking areas for at least 2 months, only one pub dropped out of the study, claiming that the policy was unpopular with its, mostly young, customers. The results of the survey, suggest that non-smoking areas in pubs do have support of majority of customers.

Other argument for the necessity of comprehensive smoking legislation could be that owners of eating and drinking establishments are flawed in their decision making. Chapman (1996) in his article argues that self regulation, i.e. dividing the establishments by an arbitrary "magic line" is not optimal, as Chapman notes that owners of restaurants grossly underestimate public's demand for smoke-free areas.

2.2 Health effects

Other studies do not consider this free choice arguments, but rather focus on the health effects such legislation could possibly have on agents such as customers or employees of these establishments. One of such studies is Allwright et al. (2005). This study looks into exposure of bar staff in Ireland to second hand smoking, using a method of baseline survey, conducted in such a way that four different areas of Ireland were represented in the sample to control for different types of "pubs environments". Exposure to second-hand smoke was measured in three different ways, by measuring cotinine levels in saliva of participating bar staff, exposure to second-hand smoke that participants reported themselves over one week and inspecting participants respiratory and sensory systems, focusing on symptoms of irritation. The study concludes that non-smokers have seen up to 80% reduction of cotinine levels in their saliva samples, suggesting that their involuntary exposure to second-hand smoke has decreased significantly. In addition, self reported work related second-hand smoke exposure has dropped across both smokers and non-smokers, and respiratory problems declined in the Republic of Ireland areas, while increasing in the Northern Ireland area. The study then concludes that smoking ban laws might be a useful instrument to protect bar staff that do not smoke from smoking exposure. It is also important to note that while some studies may not conclude negative effect of second hand smoking, Barnes and Bero (1998) examine various articles on health effects of passive smoking, studying how conclusions of said articles is related to their quality, affiliations of their authors et cetera. The study concludes that 94% of the articles whose authors where affiliated with the tobacco industry conclude that passive smoking is not harmful to health, where only 13% of authors without tobacco industry affiliation conclude so.

Another study, Alpert et al. (2007), aims to also quantify the environmental effect of smoke free ordinance in workplaces. While the sample used for measuring air quality changes in workplaces was quite small (n=27), respirable suspended particles, i.e. particles that can be breathed deep into lungs and cause various respiratory problems, in said workplaces decrease by as much as 93%. Alpert et al. therefore state that it indeed appears smoking is the main contributor in respirable suspended particles in the air, and that banning smoking in workplaces could have substantial effect on workers' and patrons' health. The study shows that tobacco industry affiliation has a significant effect on article's authors' conclusion on health effects of second-hand smoking.

2.3 Tobacco industry's influence

The tobacco industry has a lengthy history of trying to influence politics and decision making process, both around the world and even in Czech Republic. In 1999, tobacco giant Philip Morris tried persuading Czech government that smoking population actually saves money of the state, since smokers tend to die younger and therefore the country does not have to spend money on their pensions and elderly healthcare, as reported by Los Angeles Times.The reason why tobacco industry tries to influence decision making process could be that with enactment of anti-smoking policies, such as smoking bans in public places or increasing taxes on tobacco products, could cause tobacco firms a lot in revenues lost. Fichtenberg and Glantz (2002), in their systematic review of smoke free policies in workplaces, aimed to quantify such losses, as they examined the effect of such smoking bans on tobacco companies' revenues in the United States and the United Kingdom. Their findings conclude that such laws would reduce tobacco companies total annual revenue by $1,7 billion in the United States and £310 million in the United Kingdom. It is therefore not surprising that tobacco industry tries to influence politics, media and conduct it's own studies. Magzamen and Glantz (2001) have conducted a study that examines how politicians and media are influenced by tobacco industry's lobbying practices and tactics in order to possibly prevent or at least delay enactment of smoking bans in California. This analysis was done through many interviews of "representatives from representatives from voluntary health organizations, legislative offices, advocacy groups, state agencies, state contractors, interest groups, trade groups, and media observers" and also obtaining information from various other sources, such as news, memoranda and other related documents. Magzamen and Glantz were able to conclude that tobacco industry uses aggressive lobbying and other practices in order to persuade law makers not to implement smoking ban laws and persuade persons not to comply with the law once it is in effect. On the other hand, Magzamen and Glantz claim that health groups that aim to encourage implementation of such laws can and already have been successful in doing so by focusing on the health improvement effects of smoke-free places. Another analysis done by by Bero and Schotland (2002) evaluates adverse effects of tobacco products and shows how tobacco industry influences public policies decision making process. This analysis has shown that 83% of the critics of risk assessments on tobacco products were associated with the tobacco industry.

The criticism done by tobacco industry, however, appears to be based on poor quality of studies. Scollo et al. (2003) reviews how quality of studies analysing economic effect of smoking bans is related to their conclusions. In order to asses the quality of study, Scollo et al. utilise Siegel's (2002) criteria, i.e. use of objective data, use of regression or other method that control for time trend and fluctuations in the data, and control for other economic trends. In addition to that, Scollo et al. take into consideration whether given study was published in a peer reviewed journal and whether or not study's authors were independent of tobacco industry funding. The results of the study were that studies who scored low quality were more likely to conclude a negative effect of smoking bans and that there studies were also more likely to be funded by the tobacco industry. Thirty five studies reviewed by Scollo et al. concluded that smoking bans have negative economic effect on the hospitability industry, and none of these studies were found to be funded by sources "clearly" independent of tobacco industry. Traynor, Begay and Glantz (1993) cite how the tobacco industry claims that 100% smoke free ordinances could potentially decrease restaurant sales by as much as 30% and state that these some claims made by the are to be challenged.

Ritch and Begay (2001) provide an insight how Massachusetts Restaurant Association collaborates with the tobacco industry in order to combat state and local smoking restriction policies. Among other things, Ritch and Begay highlight tobacco industry's claims that smoke-free policies would burden bar owners financially. This claim is for one supported by Dunham and Marlow (2000), which is a study that can be considered affiliated with the tobacco industry, since John Dunham was at the time of the study a Manager of fiscal issues for Philip Morris Managements Corp. Dunham and Marlow criticize the methods used by other researchers, such as Goldstein and Sobel (1998), Sciacca and Ratliff (1998), noting some flaws in the approach these studies have chosen. For example, Dunham and Marlow state that previous studies conducted are not able to uncover differential effect of smoking laws, as they tend to aggregate all the data on firms in communities. Next, they state that some studies, such as Glantz and Smith (1994), suffer from selectivity bias in the way they select their states of interest. The study Dunham and Marlow conduct is in the form of a survey of 650 bars and 650 restaurants across the United States. They note that this survey approach may be flawed since owners' predictions may not reflect the reality of future events. The study confirms that predictions of owners on the effect of smoking ban do show smoking laws might have differential effects, where one of the main factors is seating allocation to non-smokers of restaurants/bars. An estimated logit model showed that owners whose facilities had higher share of seats allocated to non-smokers were less likely to expect revenue losses with a smoking ban.

The tobacco industry's media influence can be seen in Champion and Chapman (2005), who have conducted a study analysing methods the Australian Hotels Association (AHA) and tobacco control groups utilized in order to either resist or support smoke free laws in bars in Australia. They focused on statements made by the AHA and tobacco groups spokespeople in print media, covering a lengthy period of 8 years, from March 1996 to March 2003. Their study suggests that opposition of smoking bans, in this case AHA, mainly emphasised the economic issues related to this kind of legislature as well as arguing the importance of cultural identity related to smoking and framing smoking ban laws "unAustralian". On the other hand, the proponents of strict tobacco products bans, in the case of Australia various tobacco control groups, have chosen a different approach, considering health issues related to smoking as the main area the lawmakers should focus on. Champion and Chapman have also called the economic predictions made by the AHA "wildly exaggerated" and concluded that the success in implementing smoking bans in bars was greatly aided by the endurance of health groups and their media advocacy.

With such influence from the industry in place, it's clear that it is important to conduct studies independent of tobacco industry's funding, as those studies tend to criticize anti-smoking laws heavily and are shown to be of mostly low quality, as noted by Scollo et al.

2.4 Economic impact

2.4.1 Sales effect

The main concern of owners of drinking and eating establishment with the coming implementation of a smoking ban seems to be the possible adverse economic effect on their sales. Many studies have focused on this topic.

Cornelsen and Normand (2013) conducted a study that aimed to determine the effect of Irish smoking ban, implemented in 2004, on sales of Irish bars using business-level data. The study used data from 2 Irish regions and then estimated four models, one for each size-group of bars, ranging from small, to medium-small, medium-large and finally large, using fixed-effects regression model. Cornelsen and Normand were able to find differential effect of the smoking ban, noting that with a few exceptions, there was no detectable effect of the ban. However, the study found that for large bars, i.e. ones with 20+ persons engaged within the business, the ban was associated with reduction in bar sales in the South-East region. On

the other hand, for the Border-Midland-West region, smoking ban was associated with an increase in bar sales for medium sized bars, i.e. ones with 5-19 persons engaged in the business.

Cowling and Bond (2005) study the effect of California's smoking ban on revenues in bars and restaurants. The method used is a fixed effect regression with both entity fixed effects and time fixed effects. The study shows that not only did the smoking ban not have an adverse effect, it actually had a significant ($p < 0.05$) positive effect on both restaurant and bar revenues.

Walbeek, Blecher and Graan (2007) have conducted a survey of 1011 South African restaurants in order to determine the effect of a smoking ban on restaurant sales. The study concludes that when restaurant owners were asked how the smoking ban affected their business, 59% said it had no substantial impact, 22% of owners reported an increase in revenues and 19% reported a decrease.

Hayslett and Huang (2000) studied the impact of clean indoor air ordinances in Texas' restaurants. Specifically, the study examines the impact on 2 outcome measures, restaurant revenues and the ratio of restaurant revenues to total retail sales. For restaurant sales, the study shows positive impact of clean indoor air policy, with a significant impact in 2 of the 4 cities studied. For the ratio of restaurant sales to total retail sales, only one city saw a significant positive impact for the smoking ordinance, while other did not see significant effect at all.

Huang, De and McCusker (2004) studied the impact of a smoking ban on restaurant and bar revenues in El Paso, Texas. The study is consistent with other study conducted in Texas, Hayslett and Huang (2000), and states no negative effect of smoking ban on sales in restaurants and bars.

Bartosch and Pope (2002) studied how restrictive smoking policies affected restaurants in Massachusetts, comparing meals tax receipts across 239 towns before and after the implementation of restrictive smoking laws. The effect of these laws was estimated using a fixed effects model, where variables indicating time that has passed since respective towns have passed either highly restrictive or not highly restrictive smoking laws were of main interest. The study has found that restrictive policies had no significant effect on restaurant business, noting that levels of meal receipts, with respect to local smoking restrictions implementation, did not deviate from the strong positive trend that Massachusetts restaurant business has been experiencing during the timeline of the study.

A study done by Biener and Siegel (1997) was the first study to examine changes in patronage in restaurants and bars in the US that would potentially occur with enactment of smoking bans in these establishments. The study conducts a telephone survey on households in Massachusetts, assessing the use of tobacco products by the respondents, their frequency of visiting food services establishments, and their own predictions on how will their patronage change, had a smoking ban been implemented in their establishments of interest. The study concluded that a majority, or "approximately two thirds" of households surveyed responded that if the various food and beverages services facilities were to become smoke-free, their patronage would not change. In addition to that, they state that frequency of use of restaurants would also be affected, with already frequent patrons being more likely to respond they would increase their use of restaurants with an active smoking prohibition. Since in this survey there were as much as four times as many frequent non-smoking restaurants visitors than frequent smokers visiting restaurants, an increase in frequency of visits with no change on patronage could prove to be profitable to surveyed foods and drinks facilities.

Another study that examines how patronage behaviours have changed after smoke-free bars law was implemented was done by Tang et al. (2003). The study conducts 3 surveys, the first immediately after the law was implemented, the second one 5 months later and the third one 2 years after the law had become effective. Tang et al. show that the ban was met with increasingly higher approval in the period of 2 years, indicating that more and more patrons in California preferred their bars to prohibit smoking.

Hyland, Cummings and Nauenberg (1999) have analysed the effect New York City's Smoke-Free Air Act had on taxable sales for various establishments affected by this act. This study is unique in a way that it considers five outcome measures. They are total taxable sales from drinking and eating establishments, hotels, ratio of sales from eating a drinking facilities to total retail sales, ratio of sales from eating and drinking facilities in New York City to facilities outside New York City and finally the ratio of hotel sales in NYC to ratio of hotel sales outside NYC. The advantages of the ratio measures is that the way it is constructed, it allows controls for underlying economic trends. In addition to that, Hyland, Cummings and Nauenberg (1999) control for economic activities by including time, seasonal and unemployment variables. The resulting multivariate linear regression for every one of the five outcome measures have shown that the effect of the smoke-free act was not significant, suggesting that smoke-free laws do not affect neither hospitability nor accommodation industries.

Glantz and Smith (1994) studied effect of smoking ban on restaurant revenues in California and Colorado, USA. Glantz and Smith were the first to introduce a method of estimating the effect of smoking ban not on restaurant revenues directly, but rather on the ratio of restaurant sales to total retail sales. In addition to that, Glantz and Smith also studied the effect on smoking ban on a ratio of restaurant sales in city with smoking ordinance to restaurant sales in city without the ordinance. The argument is that if smoking bans had an adverse effect on restaurant sales, both these ratios should drop. Glantz and Smith then estimated a multivariable regression model and concluded that the smoking ban had no significant negative effect on both the ratios and thus no significant negative effect on restaurant sales in neither of the 15 cities examined.

In their follow up study, Glantz and Smith (1997) also analysed how smoking bans affected revenues of bars in the United States. Glantz and Smith have again chosen a method similar to the one used in previous study, estimating the effect of smoking ban on the ratio of bar sales to total eating and drinking places sales and also the effect of smoking ban on the ratio of bar sales to total retail sales. The resulting estimates showed that the smoking ban had no significant effect on either of these ratios, and thus Glantz and Smith concluded that smoke-free ordinances had no adverse impact on restaurant and bar sales.

Goldstein and Sobel (1998) have followed the methods used by Glantz and Smith (1994) and examined the effect of smoke-free ordinance in North Carolina on the ratio of restaurant sales to total retail sales. Their results were consistent with those of Glantz and Smith, noting that even in the number one tobacco-producing state in the United States, smoke free laws did not have significant negative effect on restaurant sales.

Wakefield et al (2002) have also followed methods introduced by Glantz and Smith (1994) in their study of smoking ban's effect on restaurant business in South Australia. Wakefield et al. computed a ratio of restaurant and café sales to total retail sales in South Australia, and a second ratio of restaurant and café sales in South Australia to restaurant and café sales to whole Australia. The results are consistent with those of Glantz and Smith, and that the introduction of smoke-free laws did not have a significant negative effect on restaurant business in South Australia.

Evans and Hyland (2005) studied the impact of smoke free ordinance on restaurant sales and employment in the Montgomery county. This study uses the log form of every continuous variable in the panel data regression. In addition to that, Evans and Hyland also use county specific fixed effect variable and year specific time fixed effect variable. The

results of this study are that both employment and sales in restaurants were not affected by the smoking ban.

Parker and Chiang (2007) in their study of smoke free ordinances on bar and restaurant revenues employ a model that considers sales in city's establishments divided by the city's population as the dependent variable, taking a unique approach from previous studies. The results show an insignificant positive effect of smoking ban on restaurant sales and a significant ($p<0,01$) positive effect on bar sales.

Kayani et al. (2012) have conducted a log linear regression analysis in 11 Missouri cities, finding that the smoke-free ordinance in 8 out of the 11 cities was found to have had a significant positive effect on eating and drinking establishments sales.

It could be argued that most studies conducted on this topic have been done almost exclusively in the anglosphere, which could imply that the studies have been done in culturally mostly homogenous environments, therefore mostly consistent results are to be expected. Luk, Ferrence and Gmel (2006) signify the importance of a study in bilingual communities, implying different cultures and behaviours compared to the studies done in Australia and USA and thus conduct their study in the City of Ottawa. However, the estimated ARIMA model employed by Luk, Ferrence and Gmel shows, consistently with many studies, that the smoking ban had no significant negative impact on restaurant and bar sales. Ahlfeldt and Maennig (2009) show another study estimating effect of smoke-free ordinances using multivariate regression across German Federal States. The fixed effects regression estimated in this study is yet another one that shows smoking bans do not carry significant negative effect on bar and restaurant revenues. Ahlfeldt and Maennig noted that the effect, while not significant, is in fact positive. This study also constructs a difference in differences model in order to estimate immediate impact smoking bans had on revenues. The DD model shows a limited, short run impact of such ordinances on bar revenues. Ahlfeldt and Maennig conclude that while there might be some reduced spending of smokers in the short run, this decrease is compensated for by increase in spending by non-smokers.

Crémieux and Ouellette (2001) have designed a study that examines what Québec restaurants and firms predictions on smoking ban's effect, specifically the perceived costs that would incur with such ban. From this study, it became clear that majority of restaurant owners would prefer to build areas designated to smoking in their restaurants, such as ventilated areas, rather than embrace an outright smoking ban. However, they managed to

find that costs that expected by restaurant owners to build these smokers-only ventilated or wall closed areas were significantly higher that the actuals costs that would incur. In addition to surveying predicted costs of constructions, Crémieux and Ouellette (2001) also surveyed expected revenues, specifically whether restaurant owners expected revenues to grow, reduce or stay approximately the same with a smoking ban law implemented. The result was that sixty percent of restaurant owners without any smoking restrictions already in place expected their revenues to fall, while eighty percent of owners whose establishments already had some sort of smoking control in place expected their revenues not to decrease with an upcoming government smoking regulation.

2.4.2 Employment effect

Of course, sales of establishments is not the only variable that shows the economic effect of policies. Alamar and Glantz (2007) studied how smoke-free laws affect bars' profitability and value. The study shows how the relation of prices the bars were sold for with sales of bars changed with the implementation of a smoking ban. Alamar and Glantz note that this measure of transaction price to gross revenue is a standard valuation method as the division of price by revenues allows for control of bar size. The resulting estimates show that smoke free laws had no "detectable" effect on bars' values.

The other possible variable showing the economic effect of anti-smoking policies can be employment in establishments affected by these policies.

Adams and Cotti (2007) study the effect of introduction of smoke-free laws on employment of bars and restaurants in the United States. Adams and Cotti use a fixed effects regression model with both entity fixed effect, in this case counties in the US, and time fixed effects, in this case the different quarters. The study shows that smoking laws do negatively affect employment in US bars, especially in bars located in areas with a high prevalence of smokers. Only restaurants in counties with few smokers saw the effect of smoking ban on employment to be positive.

Another study done by Hyland and Cummings (1999) examines the effect of New York City's Smoke-free Air Act on employment in NYC's restaurants. They used mandatory quarterly business report from the New York State Department of Labor in order to compare employment levels before and after the act has been passed, specifically they looked on employment changes between the years 1993 and 1997. The study concludes that while the

whole state of New York experienced growth in the restaurant business, NYC far outpaced the rest of the state, meaning that the smoke ban did not cause employment to drop.

2.5 Employees' reaction and cigarette consumption

Hilton et al. (2007) have studied how bar staff react to a comprehensive smoking ban in enclosed public places in Scotland. The study aimed to provide insight on how those arguably most affected by such law perceive the effects it will have on their health and jobs. Unsurprisingly, majority of workers, 80% before the ban, 81% after, agreed that smoking prohibition in their workplace is necessary to protect workers' health. On the other hand, almost half of the workers said they believe that the ban would hurt the bar business and 27% of workers feared they would lose their jobs, while 40% disagreed that their jobs would be in jeopardy. The changes in this attitude after the implementation of the ban were significant, and only 20% of workers thought the legislation hurt their bar's business and 61% of respondents disagreed that they could lose jobs as a consequence of the smoking ban.

In addition to all these economic effects, it is also possible to quantify the effect of smoke-free policies on cigarette consumption. A systematic review done by Fichtenberg and Glantz (2002) aimed to quantify the effect of a smoke free workplace on employees' smoking habits in various workplaces across Germany, United States, United Kingdom, Australia and Canada. The discovery is that such practices in workplaces decreased overall cigarette usage by 3,1 daily cigarettes per active smoker. In addition to smokers' reduced consumption of cigarettes, the total number of smokers also decrease, by 3,8%, meaning that the smoking ban in surveyed entities had a "double effect" on the total amount of cigarettes consumed per employee by 29%. Fichtenberg and Glantz (2002) also discussed the difference between smoking prohibitions and increase in taxes on tobacco products, noting that a similar per employee cigarette consumption would require up to 47% increase in taxes on cigarettes in the United States and 24% increase in the United Kingdom.

3 Legal background

3.1 Smoking ban

The Act on Protection from the Harmful Effects of Addictive Substances has been approved by the senate of Czech Republic on 19.01.2017. This bill aims to limit sale of addictive substances like alcohol and tobacco products. It also includes a smoking ban law, which prohibits smoking in certain public and publicly accessible premises. The smoking ban law, specified in "zákon č. 65/2017 Sb., o ochraně zdraví před škodlivými účinky návykových látek" forbids use of tobacco products in interior premises of establishments providing food and catering services, which includes restaurants, bars, wineries, cafés, teahouses, clubs, pubs and discos. This ban does not include the use of hookahs and e-cigarettes.

3.2 EET

Online registration of sales, also known in Czech Republic as EET, is an online system of communication of various businesses and entrepreneurs with a financial authority, in this case the Financial Administration. EET requires businesses to register every cash payment, including payments made by tokens and vouchers, car payments and other payments made by electronic means, and payments made using vouchers and cheques. The registration is done online, however, if internet connection fails, it also requires a temporary offline registration that has to be made online within the following 24 hours. So far, this registration is mandatory for providers of food, beverages and accommodation services as well as retail and wholesale traders. Registration for other areas of businesses such as selected crafts and manufacturing, transport services, agriculture and freelancing is not yet mandatory. This is due to the fact that on 12th December 2017 the Constitutional Court of Czech Republic has made a decision that resulted in implementation of online registration of sales to be postponed for these areas.

4 Data description

The main data of interest, which concerns the sales in the hospitability industry in Czech Republic is obtained from the Czech Statistical Office (CZSO) and collected under the CZ-NACE 56 classification, which is defined as activities connected to serving food and beverages, with waitstaff, meant and fit for immediate consumption. We have obtained monthly and quarterly indexed data which took average of the year 2015 as basis, ranging from January 2000 up to April 2019. Afterwards, data expressed in czech crowns (CZK) is obtained ranging from the year 2008 up to year 2019 and this data is used to recalculate indexed data into monetary values.

Average gross monthly wage for given quarters is also obtained from the CZSO, where wages also include bonuses and other wage components paid to employees in a given period, not including compensation for temporary inability to perform work tasks, such as sickness leave. These values are expressed in CZK and range from the first quarter of 2000 up until first quarter of 2019

Monthly and quarterly unemployment rate data have been obtained from the CZSO, which collects these data continually using a random household samples, focusing on the economic standing of households across the whole country. According to CZSO, the scope and indicators of employment and unemployment used by CZSO in data collection is in line with standards and definitions of the International Labour Organization (ILO) and methodical recommendations of Eurostat. Time range of the data used is identical to the one used in sales data.

The data on Czech Republic's gross domestic product per capita is obtained from Eurostat. This aggregate is expressed in current prices and is seasonally unadjusted, collected quarterly.

Employee numbers for the four sectors (accommodation, hospitability, retail, wholesale) obtained from the CZSO measures average permanent and temporary employees for given quarter, where an employee is in either employment, service or membership contract with the employer.

Sales data for the four sectors is expressed without VAT or excise tax.

Wages for employees of the four sectors represent total amount of remuneration provided by the employer to emplyoees.

5 Empirical model

The studies examining the economic impact of a smoking ban in various countries, states or cities mainly focus on examining the impact of this ban on either total sales in affected entities, be it bars, restaurants, pubs or the hospitability industry as a whole, such as Cornelsen and Normand (2013), Cowling and Bond (2005) and Huang, De and McCusker (2004) or they examine the impact on the sales of these entities as a percentage of total retail sales, such as Hyland, Cummings and Nauenberg (1999), Glantz and Smith (1994), Goldstein and Sobel (1998) and Wakefield et al (2002). Some studies employ both these methods, such as Hayslett et al. (2000).

In this analysis we will construct two multivariate regression models in order to conclude whether the smoking ban law had a significant effect on the food and beverages industry sales. The two models aim to capture the effect on the two outcome measures mainly employed by reviewed literature. First measure would be the ratio of food and beverages services sales to total retail sales in Czech Republic. The second measure would be total food and beverages services sales.

5.1 Ratio of hospitability sales to total retail sales

This approach for evaluating the effect of a smoking ban was first introduced by Glantz and Smith (1994), then also utilised by Wakefield et al. (2002) and Goldstein and Sobel (1998). It aims to capture the possible changes in the ratio of total restaurant sales and total retail sales with the introduction of a smoking ban. The argument is that the ratio inherently captures underlying economic conditions, inflation as well as population growth. The same method is utilized by Hyland (1999) with the difference of directly controlling for unemployment by including unemployment rate as a regressor.

Using the data on monthly sales in both the hospitability and retail industries, the ratio M is defined as:

$$M = \frac{food\ and\ beverage\ services\ sales}{total\ retail\ sales}$$

where total retail sales consists of retail sales including food and beverages services sales.

Figure 1 depicts this ratio M from January 2000 until April 2019. The ratio has consistently stayed in the range of 7%-14% through the entire analysed period with a

downwards sloping trend. Also, there is seemingly a seasonal trend in the ratio *M*. The regression model to be estimated using OLS is constructed as follows:

$$M_t = \beta_0 + \beta_1 unemp_t + \beta_2 time_t + \beta_3 Q2_t + \beta_4 Q3_t + \beta_5 Q4_t + \beta_6 EET_t + \beta_7 law_t + u_t \quad (1)$$

Following Wooldridge (2016), to correct for possible underlying time trend in the development of ratio *M* , a count variable $time_t$ is utilised, where *time* equals to 1 at *t = Jan 2000* and equals 232 at *t = April 2019.* Quarterly dummy variables *Q2, Q3* and *Q4* are introduced to the model in order to treat seasonality, with *Q1* being part of the intercept β_0. The independent variable $unemp_t$ represents Czech Republics unemployment rate at time *t.* Furthermore, variable EET_t is included. On 01.12.2016, Czech Republic has enacted a law requiring all individual entrepreneurs and legal entities with business activities in the accommodation and food services area to participate in registration of sales. This registration has, according to the Ministry of finance of Czech Republic, raised 5.2 billion CZK. It can be argued that many businesses did not record their sales truthfully in order to decrease their taxes payable, and therefore the introduction of EET could have a substantial impact on sales data collected by CZSO. This variable is equal to 0 from the beginning of the time period, January 2000, until November 2016. The law was implemented in December 2016, and therefore the *EET* variable is set to 1 for this month up until April 2019. The main variable of interest, law_t is a dummy variable indicating presence of the smoking ban in Czech republic. Since the smoking ban has been enacted on 27th of May 2017, the author has deemed it reasonable to set the law_t variable equal to 0 up until May 2017 and set as 1 from June 2017 onwards. Finally, u_t is the disturbance term. The OLS estimates of parameters $\beta_0, \ldots, \beta_7$ are listed in Table 1 below.

Figure 1

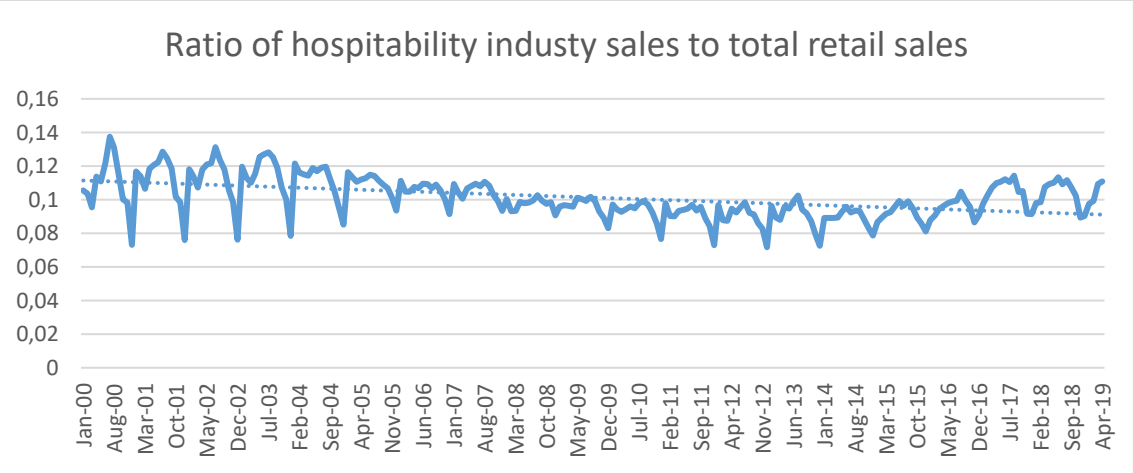


Table 1: resulting estimation of equation (1)

Predictor	Estimate	(Standard Error)
intercept	0.12464508	(0.00427716)***
unemp	-0.00118185	(0.00048229)*
time	-0.00016051	(0.00001115)***
Q2	0.00516714	(0.00126586)***
Q3	0.00704723	(0.00127893)***
Q4	-0.00946389	(0.00127483)***
EET	0.01547141	(0.00312414)***
law	0.00173684	(0.00318825)
n=232	$R^2 = 0.6968$	Adjusted $R^2 = 0.6874$
p-value:	(<0.001)***	(<0.01)** (<0.05)*

The resulting estimation shows that both time trend and seasonality appear to have had a significant effect on ratio *M,* with time trend showing a downward slope. Since variable Q_1 is included in the intercept term, estimates $\hat{\beta}_3$, $\hat{\beta}_4$ and $\hat{\beta}_5$ can be interpreted as how the ratio *M* differs, on average, in quarters 2, 3 and 4 respectively, from quarter 1. Our estimates of coefficient on *unemp* variable show that the variable has a significant (p<0,05) negative effect on ratio *M.* The *EET* variable had even more significant (p<0,001) positive effect, which can be interpreted such that the introduction of *EET* has increase sales, or perhaps reported sales, in the food and beverages services industry. Finally, the main variable of interest *law* appears to have no significant effect on the ratio *M,* meaning that the implementation of a smoking ban did not have effect on the hospitability industry sales.

However, it is possible that our data might be subject to serial correlation or heteroskedasticity. With the presence of serial correlation, it is not very precise to infer statistical significance of our variables, as standard errors, and consequently test statistics, are no longer valid. Therefore, it is important to test for serial correlation in our disturbance term. The test is conducted based on the one specified by Wooldridge (2016).

First, the OLS regression specified in equation (1) and obtain the residuals $\hat{u}_t$. Then, the following regression is to be run:

$$\hat{u}_t = \alpha_0 + \alpha_1 unemp_t + \alpha_2 time_t + \alpha_3 Q2_t + \alpha_4 Q3_t + \alpha_5 Q4_t + \alpha_6 EET_t + \alpha_8 law_t + \rho\hat{u}_{t-1} + \epsilon_t \quad (2)$$

where ϵ_t is assumed to be an i.i.d sequence and t = 2, … ,232. Then, the estimate $\hat{\rho}$ as well as the t-statistic $t_{\hat{\rho}}$ are obtained. In order for the t-statistic to be valid, Wooldridge (2016) recommends using heteroskedasticity-robust t-statistic on $\hat{u}_{t-1}$, and therefore White's standard errors are also obtained. The results of the regression (2) are listed in Table 2, together with heteroskedasticity-robust standard errors.

Table 2: resulting estimation of equation (2)

Predictor	Estimate	(Heteroskedasticity robust standard error)
intercept	0.0010496656	(0.00412276287)
$\hat{u}_{t-1}$	0.3007949001	(0.08589533839)***
unemp	-0.0000097665	(0.00047858269)
time	-0.0000005959	(0.00001097440)
Q2	-0.0005858706	(0.00103081783)
Q3	-0.0013937983	(0.00103774790)
Q4	-0.0014950938	(0.00164431831)
EET	-0.0007362109	(0.00211986485)
law	0.0007362177	(0.00184638672)
n=231		
p-value:	(<0.001)*** (<0.01)** (<0.05)*	

The obtained t-statistic $t_{\hat{\rho}}$ is now used to test the hypothesis of first order serial correlation in disturbances,

$$H_0: \rho = 0 \qquad H_1: \rho \neq 0 \quad (3)$$

With the $\hat{u}_{t-1}$'s coefficient's p-value < 0.001, there is very strong evidence for rejecting the null hypothesis stated above, showing the statistically significant effect the lagged residuals $\hat{u}_{t-1}$ have on the residuals $\hat{u}_t$. This shows the present of serial correlation in the disturbance terms of equation (1).

Since we have detected first order serial correlation of disturbance term, it is not unreasonable to test for higher order serial correlation. The test is conducted in similar fashion as to the one used before.

First, equation (1) is estimated by OLS and residuals $\hat{u}_t$ are obtained. Then, the regression specified below is run

$$\hat{u}_t = \alpha_0 + \alpha_1 unemp_t + \alpha_2 time_t + \alpha_3 Q2_t + \alpha_4 Q3_t + \alpha_5 Q4_t + \alpha_6 EET_t + \alpha_8 law_t + \rho_1 \hat{u}_{t-1} + \rho_2 \hat{u}_{t-2} + \epsilon_t \quad (4)$$

where ϵ_t is assumed to be an i.i.d sequence and t = 3, … ,232. Then, the estimate $\hat{\rho}_2$ as well as the t-statistic $t_{\hat{\rho}_2}$ are obtained. Just as before, the regression (4) is estimated by OLS and heteroskedasticity robust standard errors are also obtained. The results are listed in Table 3

Table 3: resulting estimation of equation (4)

Predictor	Estimate	(Heteroskedasticity robust standard error)
intercept	0.001244751	(0.0037713525)
$\hat{u}_{t-1}$	0.277462614	(0.0924134998)**
$\hat{u}_{t-2}$	0.081252817	(0.0590178472)
unemp	0.000008591	(0.0004338590)
time	-0.000001230	(0.0000109041)
Q2	-0.000737007	(0.0009506791)
Q3	-0.001704480	(0.0009982109)
Q4	-0.001839285	(0.0015559526)
EET	-0.001023278	(0.0020679146)
law	0.001149693	(0.0019471528)
n=230		
p-value	(<0.001)***	(<0.01)** (<0.05)*

Now the hypothesis for the serial correlation of second order is tested using the obtained t-statistics:

$$H_0: \rho_2 = 0 \qquad H_1: \rho_2 \neq 0 \quad (5)$$

With the p-value of $\hat{\rho}_2$ being below above 0.1, we can conclude that the $\hat{u}_{t-2}$ in equation (4) is statistically insignificant, and therefore the null hypothesis in (5) can not be rejected. This shows that in equation (1), there is no serial correlation in disturbances of higher order than 1.

In order to correct for the first order serial correlation found above, we follow the model specified by Wooldridge (2016) and use quasi-differenced data as follows:

$$\widetilde{M_t} = (1-\rho)\beta_0 + \beta_1 \widetilde{unemp}_t + \beta_2 \widetilde{time}_t + \beta_3 \widetilde{Q2}_t + \beta_4 \widetilde{Q3}_t + \beta_5 \widetilde{Q4}_t + \beta_6 \widetilde{EET}_t + \beta_7 \widetilde{law}_t + e_t \quad (6)$$

where $\widetilde{M_t} = M_t - \rho M_{t-1}$; $\widetilde{unemp}_t = unemp_t - \rho\, unemp_{t-1}$; … ; $\widetilde{law_t} = law_t - -\rho law_{t-1}$, $e_t = u_t - \rho u_{t-1}$ and t = 2, … , 232.

For t = 1, $\widetilde{M_1} = (1-\rho^2)^{1/2} M_1$; $\widetilde{unemp}_1 = (1-\rho^2)^{1/2} unemp_1$; … ; $\widetilde{law_1} = (1 - -\rho^2)^{1/2} law_1$.

A consistent estimate of ρ, as described by Wooldridge, is obtained from the following regression using OLS:

$$\hat{u}_t = \alpha + \rho \hat{u}_{t-1} + \epsilon_t \quad (7)$$

The Prais-Winsten estimation of (6) as described above is listed in Table 4

For the statistical inference of equation (6) to be valid, Wooldridge also recommends testing it for possible heteroskedasticity presence. This is done using the Breusch-Pagan test as follows:

$$e_t^2 = \gamma_0 + \gamma_1 \widetilde{unemp}_t + \gamma_2 \widetilde{time}_t + \gamma_3 \widetilde{Q2}_t + \gamma_4 \widetilde{Q3}_t + \gamma_5 \widetilde{Q4}_t + \gamma_6 \widetilde{EET}_t + \gamma_7 \widetilde{law}_t + \nu_t \quad (8)$$

where t = 2, ... , 232

The Breusch-Pagan test has yielded a p-value of under 0.001, thus the null hypothesis of joint significance $H_0: \gamma_1 = \gamma_2 = \gamma_3 = \gamma_4 = \gamma_5 = \gamma_6 = \gamma_7 = 0$ is rejected, therefore there is a strong evidence for heteroskedasticity in the FGLS model (6) and heteroskedasticity-robust standard errors are to be obtained. The results are listed in Table 4

Table 4: resulting estimation of equation (6)

Predictor	Estimate	(Standard error)	(Heteroskedasticity robust standard error)
intercept	0.127960097	(0.00633829)***	(0.005920051)***
unemp	-0.001351040	(0.00071851)	(0.000660650)*
time	-0.000160125	(0.00001685)***	(0.000017097)***
Q2	0.002968861	(0.00138692)*	(0.001171195) *
Q3	0.002828281	(0.00151272)	(0.001576686)
Q4	-0.011796685	(0.00140413)***	(0.001834609)***
EET	0.012726473	(0.00413549)**	(0.002719378)***
law	0.003675589	(0.00421026)	(0.002573132)
n=232	$R^2 = 0.5737$	Adjusted $R^2 = 0.5604$	
p-value:	(<0.001)***	(<0.01)**	(<0.05)*

Now that both serial correlation in disturbance term and heteroskedasticity have been corrected form, it is valid to infer statistical significance of our variables. Comparing tables Table 1 and Table 4, we can see that some changes have occurred. The variable *unemp* is no longer significant at the 0,1% level, yet it remains significant at the 5% level. The variable *Q3* is also no longer significant at the 0,1% level but remains significant at the 5% level. However, and most importantly, the variable *law* still remains statistically insignificant even at the 10% level (p>0.1), meaning that the implementation of a nation-wide smoking law did not significantly affect the ratio M, which, as suggested by Glantz and Smith (1994), is evidence that the Czech smoking ban did not harm sales in the food and beverages services.

5.2 Total hospitability sales

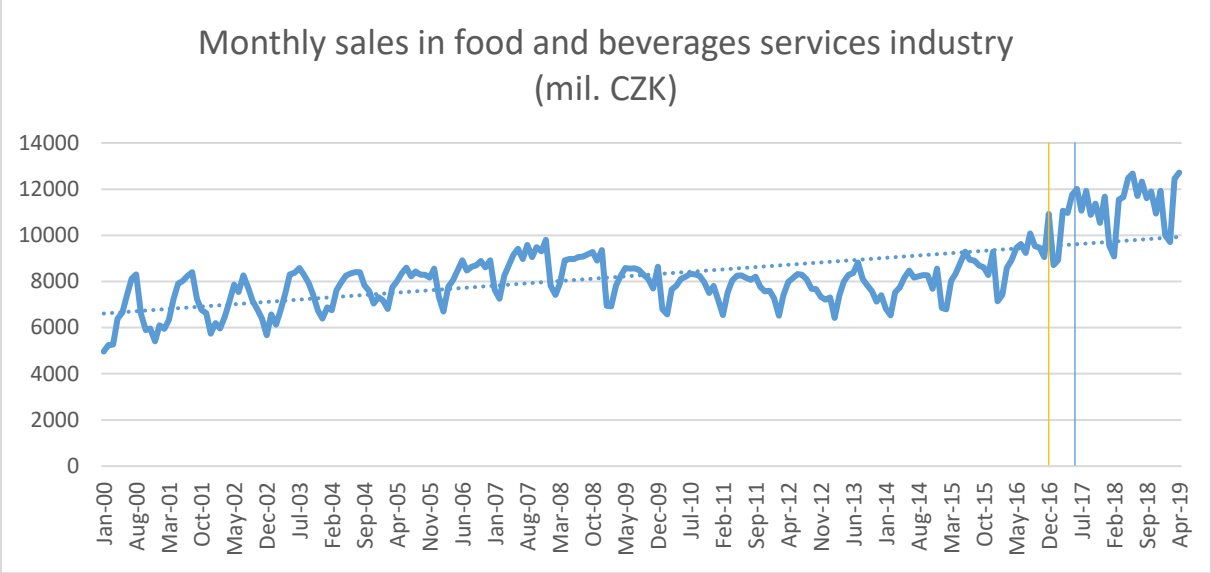
Following the methodology of Parker and Chiang (2007), Hayslett et al. (2000), Huang et al. (2004), Evans and Hyland (2005), Cornelsen (2013), Ahlfeld and Maennig (2009), we will now build an econometric model that sets sales in the hospitability industry as the dependent variable. Our regression model is constructed as follows:

$$sales_t = \beta_0 + \beta_1 income_t + \beta_2 unemp_t + \beta_3 time + \beta_4 Q2_t + \beta_5 Q3_t + \beta_6 Q4_t + \beta_7 pcgdp_t + \beta_8 EET_t + \beta_9 law_t + u_t \quad (9)$$

where $sales_t$ represents quarterly sales for the hospitability industry at time *t*. Following Parker and Chiang (2007), who used household income at a city level, we have included an independent variable $income_t$ which represents Czech Republic's nationwide average gross

monthly wage at quarter *t*. The variable *unemp*, included from the regression conducted by Ahlfeldt and Maennig (2009) and Parker and Chiang (2007), represents unemployment rate in Czech Republic in quarter *t.* As there appears to be a time trend in our *sales* variable, following Wooldridge (2016) in order to correct for it, a time trend count variable *time* is included, with the value of 1 at the beginning of our time period, first quarter of 2000, up to 77 at the end, first quarter 2019. Sales in the food and beverages industry might often be subject to seasonal trends, which can also be seen in Figure 2, and therefore to correct for it, author uses the correction done by Bartosch and Pope (2002), and includes quarterly dummy variables, Q_2, Q_3 and Q_4 which equal to 1 in their respective quarters and 0 otherwise. The first quarter, Q_1 is omitted from this regression and the effect of this quarter on the *sales* variable can be found in the intercept term β_0. Another variable to control for changes in economic activity, $pcgdp_t$ represents per capita GDP in Czech Republic. The dummy variable EET_t has been included in our regression, where EET_t equals 0 until the third quarter of 2016 and equals 1 from the fourth quarter of 2016 onward. Finally, a dummy variable law_t, indicating a presence of smoking ban in quarter t is included, such that it is equal to 0 until the first quarter of 2017 and is equal to 1 from second quarter of 2017 onward, which means that an estimate of β_9 will be of our main interest. The component u_t is a random error term and parameters $\beta_1;\ldots;\beta_9$ are to be estimated. All variables expressed in monetary units, in this case czech crowns, have been CPI adjusted and expressed in 2015 real crowns. The results of this regression and estimates of regression parameters can be found in Table 5 below.

Figure 2



Note: the yellow and blue vertical lines depict introduction of EET and smoking ban, respectively.

Table 5: resulting estimation of equation (9)

Predictor	Estimate	(Standard Error)	(Heteroskedasticity robust standard error)
intercept	4295.55212	(4301.10276)	(4419.04948)
income	-0.34900	(0.27948)	(0.28074)
unemp	-50.93737	(212.37202)	(228.94276)
time	-166.41521	(26.94907)***	(26.62014)***
Q2	2222.72050	(464.95784)***	(375.55977)***
Q3	2141.82639	(516.96093)***	(516.36246)***
Q4	-524.53053	(615.78217)	(616.96136)
pcgdp	0.36550	(0.05623)***	(0.05392)***
EET	5223.73489	(1036.63160)***	(664.68525)***
law	1508.48435	(1066.56165)	(578.78804)*
n=77	$R^2 = 0.8842$	Adjusted $R^2 = 0.8686$	
p-value:	(<0.001)***	(<0.01)**	(<0.05)*

Now before the results of this regression are to be interpreted, it is again important to test for possible serial correlation and heteroskedasticity. First, a test for first order serial correlation in disturbances is performed in similar fashion to equation (2):

$$\widehat{u_t} = \alpha_0 + \alpha_1 income_t + \alpha_2 unemp_t + \alpha_3 time_t + \alpha_4 Q2_t + \alpha_5 Q3_t + \alpha_6 Q4_t + \alpha_7 pcgdp_t + \alpha_8 EET_t + \alpha_9 law_t + \rho\hat{u}_{t-1} + \epsilon_t \quad (10)$$

where $\widehat{u_t}$ are residuals saved from the OLS regression (9), t = 2, … ,77 and $\{\epsilon_t\}$ is assumed to be an i.i.d. sequence. Now regression (10) is to be estimated and the statistical significance of coefficient ρ will show whether there is evidence for serial correlation in the disturbance term. Just as in Section 5.1 we have also obtained heteroskedasticity-robust standard errors in order for the t-statistic $t_{\hat{\rho}}$ to be valid. The estimates of equation (10) are listed in Table 6 below

Table 6: resulting estimation of equation (10)

Predictor	Estimate	(Heteroskedasticity robust standard error)
intercept	1422.05758	(4570.132709)
$\hat{u}_{t-1}$	-0.06180	(0.129483)
income	-0.15281	(0.260418)
unemp	59.88924	(228.912552)
time	12.57369	(25.367757)
Q2	-129.60617	(356.728176)
Q3	-196.43932	(469.028736)
Q4	85.97041	(617.750652)
pcgdp	0.01501	(0.053026)
EET	133.35781	(641.071387)
law	223.44084	(556.040827)
n=76		
p-value:	(<0.001)***	(<0.01)** (<0.05)*

Now with valid t-statistic $t_{\hat{\rho}}$, we can set a hypothesis:

$$H_0: \rho = 0 \qquad H_1: \rho \neq 0 \tag{11}$$

Considering the high p-value on coefficient ρ shows there is not enough evidence to reject the null hypothesis stated in (11), therefore we can conclude there is no serial correlation in our errors.

Secondly, we can still test our regression (9) for possible heteroskedasticity, just as in Section 5.1. Following Wooldridge (2016), we perform Breusch-Pagan test:

$$\begin{aligned} u_t^2 = {} & \gamma_0 + \gamma_1 income_t + \gamma_2 unemp_t + \gamma_3 time_t + \gamma_4 Q2_t + \gamma_5 Q3_t + \gamma_6 Q4_t \\ & + \gamma_7 pcgdp_t + \gamma_8 EET_t + \gamma_9 law_t + \nu_t \end{aligned} \tag{12}$$

where under the null hypothesis $H_0: \gamma_1 = \gamma_2 = \gamma_3 = \gamma_4 = \gamma_5 = \gamma_6 = \gamma_7 = \gamma_8 = \gamma_9 = 0$.

The p-value on joint insignificance of the γ coefficients is 0.0019, and thus the null hypothesis (12) has to be rejected in favor of the alternative. Therefore, evidence for heteroskedasticity of the equation (9) has been found and thus heteroskedasticity-robust standard errors are included in Table 5.

As Table 5 shows, variables *income* and *unemp* did not have a statistically significant effect on hospitability industry sales, while variables *pcgdp*, *time* and quarterly dummy variables did. Our estimates of the variable *EET* have shown that the implementation of EET has had a statistically significant positive effect ($p<0.001$) on hospitability industry sales, increasing them by 5.223 billion CZK on average. The main variable of interest, *law*, shows a statistically significant positive effect as well, with significance at the 5% level, showing that the smoking ban did not adversely affect restaurants, pubs and bars business. On the contrary, our evidence shows an actual positive effect on the business.

However, in the case of the model (9), one could possibly argue that the implementation of the smoking ban happened not too long after EET has been enacted. Specifically, the smoking ban and EET have been enacted half a year apart and with quarterly data that shows as a 2 quarter difference in our model, therefore it is plausible that part of the positive effect of the smoking ban on sales that has been estimated in the model above could be a lagged effect of EET law.

For this reason, a second model concerning quarterly sales needs to be estimated. This new model shall be constructed in a way that allows control and treatment groups to exist, in order to differentiate the effect of the smoking ban. Some studies with similar approach, ones that takes

control groups that have not been deemed affected by a smoke-free ordinance into consideration, have been done, such as Cornelsen and Normand (2013), Cowling and Bond (2005), Bartosch and Pope (2002), Evans and Hyland (2005), Ahlfeldt and Maennig (2009) and Adams and Cotti (2007). However, these studies do differ from approach necessary in this thesis in a way of choosing control groups. For example, Cornelsen and Normand's control groups are chosen on the level of regions, Bartosch and Pope's on the level of cities and towns, Evans and Hyland's on the level of counties and Ahlfeldt and Maennig's on the level of federal states. Since the smoking ban in Czech Republic has been enacted nation-wide in an identical time manner, it is not possible to let treatment and control groups to differ by region. Smoking bans main feature is that it primarily affects the food and beverage services industry, and thus it is possible to consider this whole industry as a treatment group. Given the nature of the ban, it is not viable to identify more industries directly affected by it. Other industries, that will be treated as control groups, have to be chosen based on them being affected by EET implementation. Three industries have been identified: accommodation industry (CZ-NACE 55), wholesale industry, except of motor vehicles and motorcycles (CZ-NACE 46) and retail industry, except of motor vehicles and motorcycles (CZ-NACE 47).

Thus, considering the specifications described above, the following regression model is constructed:

$$log(sales_{it}) = \beta_0 + \beta_1 log(wage_{it}) + \beta_2 log(empl_{it}) + a_i + quarter_t + \beta_3 EET_{it} + \beta_4 law_{it} + u_{it} \quad (13)$$

where *i* indicates given industry, *t* captures quarter of our data and β_0 is the intercept term. The independent variable $empl_{it}$ represents number of employees, both permanent and temporary, employed in sector *i* at time *t.* This variable had been introduced into the model in order to control for the economic activity differences in the four sectors. Another variable $wage_{it}$ represents average monthly wages paid to the employees of sector *i* at time *t,* measured in CZK*,* where the main reasoning for introduction of the $wage_{it}$ variable is that it is potentially correlated with number of number of employees. The dependent variable, $sales_{it}$, captures total sales in sector *i* at time *t.* A log transformation is used for these three variables to capture percentage changes in their values rather than absolute changes, mainly due to the fact that values of variables $sales_{it}$ and $empl_{it}$ are of magnitude larger in some sectors than in others. The variables $wage_{it}$ and $sales_{it}$ have been CPI adjusted into real 2015 CZK. Variables a_i and $quarter_t$ capture the industry specific fixed effect and time fixed effect respectively. The EET_{it} stands for a dummy variable that captures the

implementation of EET for given sector. Since the EET has been introduced in two phases, the EET_{it} differs in the 4 sectors. For the accommodation and hospitability industries, EET variable is equal to 0 up until third quarter of 2016 and is equal to 1 from fourth quarter of 2016 all through until first quarter of 2019, which is the last quarter observed in this analysis. The second phase of EET introduction concerned the retail and wholesale sectors, and therefore the EET_{it} for these two sectors is equal to 0 up until the fourth quarter of 2016 and is equal to 1 from the first quarter 2017 onward. A second dummy variable law_{it} indicates presence of the smoking ban in industry i at time t. For every industry other than the hospitability industry, this dummy variable is equal to 0 at all times. For the hospitability industry, law_{it} equals 0 until the first quarter of 2017 and equals 1 from the second quarter of 2017 until first quarter 2019. The remaining u_{it} represents the disturbance term.

In order to estimate the above described regression model, the industry specific fixed effects and time fixed effects are treated as dummy variables as described in Watson (2006) therefore the model is to be estimated using the OLS method, which Watson describes as yielding identical estimates on the coefficients as using the time-demeaning method.

$$\begin{aligned} log(sales_{it}) = \beta_0 + \beta_1 log(wage_{it}) + \beta_2 log(empl_{it}) + \delta_1 hospitability_i + \delta_2 retail_i \\ + \delta_3 wholesale_i + \alpha_1 Q_2 2010_t + \cdots + \alpha_{36} Q_1 2019_t + \beta_3 EET_{it} + \beta_4 law_{it} \\ + u_{it} \end{aligned} \quad (14)$$

Where the $hospitability_i$ is a dummy variable indicating that observation i belongs to the hospitality sector. If it does, then the value of this dummy variable is equal to 1 and 0 otherwise. Accordingly, dummy variables $retail_i$ and $wholesale_i$ are introduced. Dummy variable for the accommodation sector is included in the intercept term β_0. These variables are introduced in order to estimate the fixed effects a_i, specified in equation (13) . This model also includes dummy variables indicating whether given data point is observed in given quarter. For example, dummy variable $Q_2 2010$ is equal to 1 if an observation has been measured in second quarter of year 2010 and is equal to 0 otherwise. Analogously, variables for all other quarters are introduced. These variables are used in order to estimate time-fixed effects, specified as $quarter_t$ in equation (13). The first quarter of 2010 is included in the intercept term. The estimates of equation (14) are listed in Table 7 below

Table 7: resulting estimation of equation (14)

Predictor	Estimate	(Standard error)
log(wage)	1.33346	(0.23351)***
log(empl)	1.30622	(0.28110)***
EET	0.04112	(0.06997)
law	0.01668	(0.04484)
hospitability	0.01655	(0.28628)
retail	0.38260	(0.60089)
wholesale	0.81034	(0.61297)
$Q_2$2010	0.1388663	(0.0489634)**
$Q_3$2015	0.1235759	(0.0523286)*
$Q_1$2019	-0.2314613	(0.1035522)*
n=148	$R^2 = 0.9875$	Adjusted $R^2 = 0.99823$
p-value:	(<0.001)***	(<0.01)** (<0.05)*

Note: Not all individual quarter dummies are included in this table, however majority of these dummies were found to be statistically significant which could explain the high values of R^2.

The results of this fixed and time-fixed effects regression show that variables $log(wage_{it})$and $log(empl_{it})$have a statistically significant ($p<0.001$) effect on the percentual change of sales in their respective industries. The variable *EET*, however, appears to be statistically insignificant in contrary to the previous models constructed in this study. This may suggest that while the introduction of EET may have raised reported sales in the hospitability sector, it did not have the same effect in the other 3 sectors included in this analysis. On the other hand, variable *law* remains consistently statistically insignificant ($p>0.1$). Since the variable *law* only affects sales in the hospitability sector, it is evidence that the implementation of the smoking ban did not adversely affect sales of food and beverages services, the insignificant effect it has is if anything positive.

6 Conclusion

This thesis follows established methods in order to evaluate the impact of Czech smoking ban on sales in the Czech food and beverages services sector. This is done on the basis of three regression models and two outcome variables.

Firstly, the thesis evaluates the impact of the ban on sales in the hospitability sector as a percentage of total retail sales, finding no evidence of any significant impact of the smoking ban.

Secondly, the thesis evaluates the impact of the smoking ban on total hospitability sector sales. This is done by first building a time series regression model, which suggest that the ban had a significant positive impact. This model, however, had certain drawbacks, as the quarterly data used did not allow much time to pass between implementation of EET and the smoking ban in Czech Republic, and thus the author acknowledges that it is possible part of the effect of EET has been also captured in the smoking ban variable. In order to correct for this drawback, another model is constructed that allows the existence of control and treatment groups, such that only EET affected the control groups, and both EET and smoking ban affected the treatment groups. For the treatment groups, only one sector, the hospitability sector, has been found and utilized. For the control groups, accommodation, retail and wholesale industries were deemed viable. The resulting fixed effects and time-fixed effects regression has shown statistically insignificant positive effect of the smoking ban, consistently with the first measure used.

Therefore, this thesis concludes that the Czech smoking ban did not adversely affect sales in Czech pubs, bars, restaurants and other establishments that belong to the food and beverages services classification. If there was any effect, however insignificant, it was positive in both outcome measures and all three models used. These results are consistent with those of most studies conducted on this topic across different countries. For example, a German study of Ahlfeldt and Maennig (2009) also concludes non-significant positive effect. A Canadian study of Luk, Ferrence and Gmel (2006) also sees no significant negative effect of the smoking ban, as does majority of studies conducted in the anglosphere countries.

This study suffers from some limitations, mainly from the data availability. The smoking ban has been enacted nation-wide, and while the Czech Republic aggregate sales data provide insight on how the hospitability industry was affected as a whole, it can be argued that in many small regions, the sales possibly did not follow the trend of the whole country. How small towns and villages' restaurants, pubs and bars were affected is not

addressed in this study. This study also does not address differential effects based on the proportion of smokers in the population, as establishments in locations with larger smoking populations could be affected in a different way that locations with fewer or no smokers. Thus, possible extensions of this research could provide an analysis on a level smaller than the nation-wide level one conducted in this study. Furthermore, these studies could conduct a study that takes the proportion of smokers in the population into consideration.

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