

Master's Thesis Economics

The Effect of Tobacco Taxation and Health Warning Labels on Tobacco Consumption

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Date: June 5, 2020

Abstract

This research studies the effect of tobacco taxation and size regulation of health warning labels of tobacco packages on tobacco consumption. Studies such as Chaloupka (1999) state that tobacco taxation is the most effective policy, but economists such as Callison and Kaestner (2012) argue that the effect is small, and insignificant. This study intends to find the true effect of tobacco taxation and the size of health warning label on tobacco consumption and fill the gap. This research has been conducted for 15 OECD countries from 2006 to 2016. The dependent variable is “Tobacco Consumption” and the independent variable is “Tobacco Taxation”. The control variables are “Income”, “Unemployment”, “Income Inequality”, “Size of the Warning Label on Tobacco Packages”, and the interaction effect of tobacco taxation and warning label. The results show that the association between tobacco consumption and tobacco taxation is small and insignificant, but when it is mixed with larger health warning label on tobacco packages, the association is significant, negative and large. Fixed effect regression shows that the differences in taxes, warning label size, unemployment rate, and average income explain the differences in tobacco consumption across countries, but not within countries.

Acknowledgment

First of all, I want to thank professor Knobben for supervising this Master thesis. I wouldn't be able to finish this work without his guidance. I have faced nothing, but helpful comments when I was struggling with the pressure of writing this thesis during these hard times of COVID-19 pandemic. I should also thank professor Visser, as his feedbacks at the start of my thesis helped me to start on the right track. I also want to thank all the great professors I met during my stay in the Netherlands at Radboud University. Their support through the master's program always took the pressure of studying off my shoulders.

Secondly, no words can describe how thankful of my family I am. I want to thank them for supporting me mentally, emotionally, and financially during my studies. Their warm words made it possible for me to push through all the difficult times I encountered for the past two years.

I also have to thank my friends, the ones who helped me grow in and outside of class by our discussions, and the ones far away who supported me in any way possible. Their support has always been one of the greatest assets I had in life.

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1) Introduction

Smoking is the biggest cause of death around the globe (Gruber and Koszegi. 2008). According to the World Health Organization (WHO) \$500 billion is the damage to the world economy, which smoking causes (Ekpu, Brown. 2015). Because of this, but also because smoking has negative external effect on the health of others, policy interventions to reduce smoking prevalence are commonplace. Examples of such policies include tobacco taxation, giving information and knowledge about the harms smoking can cause, etc. (WHO. 2003).

Previous studies have arrived at different conclusions on the effect of tobacco taxation on tobacco consumption. Many economists like Chaloupka (1999) and Barcat et al (2012) have stated that tobacco taxation is the single most effective way to decrease tobacco consumption. Fuchs et al (2019) too have stated in their paper that tobacco taxation is the most effective tool to decrease tobacco consumption. The authors state that tobacco taxation alone is responsible for half of the decrease in tobacco consumption rate. There are other economists such as Callison and Kaestner (2012) who indicate that the association between tobacco taxation and tobacco consumption is negative, but small (close to zero) and not significant. Townsend (1996) estimates that a 100% increase in tobacco tax would lead to around 50% decrease in tobacco consumption, but Callison and Kaestner state that a 100% increase in tobacco tax would lead to just a 5% decrease in tobacco consumption. Adoption of each view can lead to a different policy, so it is important to understand to which estimation the true price elasticity of demand is closer.

It has been proved by economists like Scollo et al (2018) that the price elasticity of demand for tobacco is lower than most other normal goods. Previous studies show the possibility of achieving lower rates of tobacco consumption by combining other factors with taxation. This can be due to the addictive nature of smoking, and that just a price incentive is not sufficient to reduce tobacco consumption, but combining it with other measures such as warning label on tobacco packages might overcome the addiction effect to some extent. It can be concluded that the effect of taxation could be conditional on other factors; as different researches had different countries included in their research with different tobacco control programs.

This study intends to fill the gap shown above about the true effect of tobacco taxation on reducing tobacco consumption and to help with better policy designs for tobacco control. For this matter, as mentioned before, the effect of the size regulation of health warning label on tobacco

packages is studied alongside tobacco taxation, on tobacco consumption. This research intends to help policy makers find the best policy design for tobacco taxation.

Since the nicotine inside tobacco is addictive the phenomenon of tobacco consumption is not purely an economic decision. As such, the effects of tobacco taxation should be studied from the perspectives of different disciplines. (Schwartz, Benowitz .2010). Considering disciplines such as, psychology, and public health alongside with economics would help understand the possible effects of tobacco taxation. It can be understood from these disciplines, why people keep smoking while the price increases. As Behavioral Economics lies between Psychology and Economics, in this research some parts of the behavioral economics which is related to tobacco taxation has been considered. Psychological effects of the health warning label on tobacco packages has been studied in this research as well.

The data has been collected for 15 OECD countries, over the years 2006-2016, using panel data. The dependent variable is “Tobacco Consumption” and the independent variable is “Tobacco Taxation”. The control variables are “Income”, “Income Inequality”, “Unemployment”, and “Warning Label Size on Tobacco Packages”. There is also one interaction effect variable which is the interaction between tobacco taxation and the warning label size, “Warning*Tax”. Cigarette excise on value has been used as a proxy variable for tobacco consumption. Gini Index has been used to address income inequality. Income has been collected as the average income of each country. The percentage of warning label of cigarette packages has been used for the “Warning Label Size”. This research has used regression analysis to find the associations between the dependent and independent variables. A fixed effect regression analysis has also been conducted to control for time invariant unobserved values.

1.1) Research Question

This study addresses the following research question: What is the effect of tobacco taxation on tobacco consumption? And how does the size requirement of the health warning label on tobacco packages affect tobacco consumption?

The results of this research are expected to show a negative association between tobacco taxation and tobacco consumption based on the previous studies. It is also expected that an increase in the size requirement for the health warning labels on tobacco packages leads to even

more decrease in tobacco consumption. The association is expected to be the most substantial, when tobacco taxation is combined with larger health warning labels on tobacco packages.

The answer to the abovementioned research question is expected to give a better understanding of the degree to which tobacco taxation affects tobacco consumption, as estimations about the degree of the effect have been different among different economists. This would help policy makers design better policies. The control variables that were mentioned in the introduction are expected to help give a better estimation about this phenomenon than have the previous studies.

1.2) Value of the research for science and policy

It has been estimated that tobacco taxation almost doesn't have an effect on tobacco consumption. Health warning labels on tobacco packages has found to have a minimal negative effect on tobacco consumption, but when tobacco taxation is mixed with larger health warning labels on tobacco packages, the decrease in tobacco consumption is more substantial. Other variables which has found to have effect on tobacco consumption are "Unemployment" and "Income". Increase in in a country's average income decreases tobacco consumption, but increase in unemployment rate in a country increases tobacco consumption. As some of the studies in existing literature state that tobacco taxation has a substantial negative effect on tobacco consumption and some other studies state that the effect is small and not significant, this research is able to fill this gap by showing that indeed the effect is not significant, but when it is mixed with larger health warning labels on tobacco packages the effect becomes significant and more substantial. This can be rather important for policy makers as they can combine both policies to reach better results. These results show the difference in tobacco consumption across countries, but not within countries.

1.3) Structure of Sections

The rest of this thesis is organized as follows. Section 2 presents the literature review, where the relationship between tobacco consumption and tobacco taxation uncovered in previous studies is discussed. Section 3 presents the research design, where the variables used in this research are introduced, how the data have been collected is explained, the role of each of the variables in this research is described, and the methods used to analyse the data are discussed.

Section 4 presents and interprets the results of the data analysis. Section 5 presents the conclusions of this research, the recommendations to the policy makers, and some suggestions for future research.

2) Literature Review

2.1) Brief History of Smoking Harms

Before 1953, tobacco companies had minimal problem with being known as an unhealthy production industry. Starting that year, the industry faced the problem of tobacco being linked to cancer (Brandt. 2012). The new scientific methods made it possible for scientists to figure out that smoking causes various lung diseases as well as cardiac diseases that lead to death. With the publication of these findings in peer-reviewed journals and also in media, many people started to realize how harmful tobacco use can be. As tobacco industry was one of the most successful industries in terms of marketing and public relations, they started to confuse people over the harms of smoking and told people that the new scientific results can be false. They used the scientists who believed that the relationship between tobacco use and cancer is not correct to clear the troublesome facts out of people's minds.

With all the efforts, by 1960 only one-third of all U.S doctors believed that smoking causes lung cancer (Proctor. 2012). The world has been through so much that today it is clear for almost everyone that tobacco use is harmful. Smoking rates have been falling since the educational efforts increased between 1970s to 1990s by governments and scientists (Reubi, Berridge.2016), but the decrease is still not enough. As it can be seen in Graph 1, the rates have been declining from 1980 to 2012 in both men and women, but at a slow rate. The decline has happened because of the work of scientists and the extra efforts governments put to decrease the rates.

Graph 1

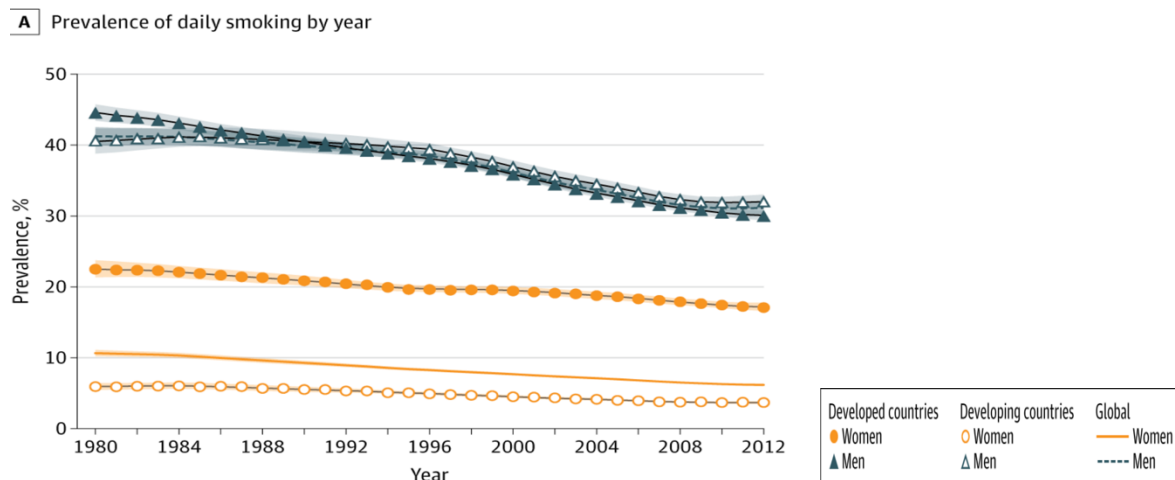


Figure 1

Source: <https://jamanetwork.com/journals/jama/fullarticle/1812960>

2.2) Brief History of Tobacco Control

The internationalisation of tobacco control started in the 1950s by informal contacts among researchers who were working on cancer. The contacts started to get more formal during the 1960s (Reubi, Berridge. 2016). From mid 1960s to the late 1970s, the awareness toward the negative health effects of tobacco use started to increase by the publication of reports on smoking and health by medical authorities such as US Surgeon General. In the 1970s WHO acknowledged the negative health effects of tobacco and called for action by member states. This could be considered as the start of the international movement on tobacco control. From the 1970s to the 1990s the efforts for tobacco control increased rapidly. During these years more countries other than European and North Americans, started to take tobacco consumption more seriously. In the 1980s, WHO established its first permanent program called “The Tobacco or Health”. Tobacco taxation has been in effect since the 1970s, but it was widely unpopular and misunderstood among health experts until the 1980s. During the 1980s, American and European economists started to design much better tax policies, which then entered the tobacco control programs through the World Bank. The international efforts on tobacco control increased even more rapidly from the 1990s to the 2000s with WHO’s new Framework Convention on Tobacco Control (FCTC) and Bloomberg Initiative to Reduce Tobacco Use in Developing Countries (BI). Later in 2005 the regulation for health warning labels on tobacco packages started take place in different countries as part of the WHO’s tobacco control program (Hiilamo et al. 2014). Tobacco

industry was against this regulation, but the effectiveness of the policy made governments believe that it is necessary to have it. The reason was that this policy is low-cost and effective way to decrease smoking.

2.3) Tobacco Taxation's Effectiveness

It has been found that 80% of smokers start smoking by the age of 18 (Chaloupka. 1999). Two thirds of the people above this age try smoking, but only 20%-25% of them become addicted. Nicotine is more likely to cause permanent changes on the brain, when the smoker is younger. These changes would lead to addiction, and that is why the risk of dependence is higher in younger people. By policies targeting people at this age, there are higher chances that the rate of smoking would fall. As it is less likely that older people become addicted even if they try smoking, it is best to at least postpone the time of trying tobacco. Chaloupka and Grossman (1996) indicates that people around the age of 18 are the most sensitive group to price changes. Previous studies show that by increasing the price through taxation youth are being targeted, but in the long run the whole population is being targeted. This shows that by targeting youth, the rate of smoking in the whole population can be lowered in future. The reason is if people don't start smoking at a young age, there is lower probability that they would get addicted later on and there would be a decrease in the smoking population.

As mentioned before, governments have used many different instruments to decrease the rate of tobacco consumption. But, as stated by Barcat et al (2012), a price increase is widely considered as the single most effective way to decrease tobacco consumption rate. Gallus et al (2006) estimates that a 10% increase in all 52 European countries in their research would lead to 40 million smokers quitting tobacco consumption. The authors state that a 10% increase in the real price of tobacco in Europe would lead to a 5-7% decrease in consumption. In another paper Chaloupka (1999) explains the reason for the effectiveness of tobacco taxation is that even in societies that are most difficult to reach with other tobacco control policies, increase in tobacco taxation is the only way to influence tobacco consumption. Chaloupka states that tobacco taxation targets everyone. The author indicates that to reach the best outcome in terms of the reduction in tobacco consumption, tobacco taxation should be mixed with other tobacco control efforts. It is also possible that the revenue generating part of tobacco taxation programs could backfire. As an example, in a study by Do and Park (2009) about the local government's dependence on tobacco

tax in revenue in the Republic of Korea, governments which derived higher percentage of their local tax revenue from tobacco taxes were less likely to participate in tobacco control programs. This example shows that a greater will and anticipation in a country is needed to tackle this problem.

2.4) Price Elasticity of Demand

To understand how substantial the effect of tobacco taxation on tobacco consumption is, it is important to know about the price elasticity of demand for tobacco. The basic economic theory suggests that an increase in the price reduces the quantity demanded. The price elasticity of demand refers to the degree of responsiveness of the change in the quantity demanded to the change in the price of that good. In a book by Scollo et al (2018), the authors suggest that the price elasticity of demand for tobacco products are not as elastic as for many other (normal) goods. A tax increase on tobacco might not have as strong an effect as would a tax increase on many other (normal) goods. A 1% increase in tobacco tax, on average decreases tobacco consumption by 0.5% according to Townsend (1996). The most important effect tobacco tax increase has, is that it discourages non-smokers from starting smoking (mostly youth), and as mentioned in previous paragraphs, that is the most important group to target. A tax increase would also encourage current smokers to quit, but at a smaller rate. A tobacco tax increase also discourages former smokers from starting again. Even the small percentage decrease in the rate of smoking can result in large numbers. The authors argue that regardless of the size of the effect, which can be substantial in the whole population, an increase in tobacco tax would increase the willingness to quit, quitting attempts, and successful quitting. It can be concluded from chapter 13 of this book that effective tax on tobacco is truly important for controlling tobacco consumption.

According to the existing literature, some economists oppose the view that taxation have a great effect on decreasing tobacco consumption. Callison and Kaestner (2012) state that the association between tobacco taxation and consumption is negative, but rather small and not usually statistically significant. They estimate that a large tax increase is needed to decrease tobacco consumption by small amounts. They state that a 100% increase in tobacco tax would lead to around 5% decrease in consumption. The authors indicate that the price elasticity of demand for cigarettes is between -0.02 to -0.05. It has been shown that smoking is either almost unaffected by increase in taxes or the rate would decrease minimally (close to 0%) at best. This is fairly different

from what has been stated in the previous studies by Gallus et al (2006) and Townsend (1996). This thesis intends to settle the disagreement in the literature on how big of an effect tobacco taxation has on tobacco consumption.

2.5) Taxation is Conditional on Other Factors

It is important to keep in mind the reason for which the tobacco taxation is in place. On one hand as the increase in the price of tobacco have the highest effect on youth , it can be used as an instrument to prevent people from starting to smoke (Chaloupka and Grossman.1996); on the other hand tobacco taxation has also been used to discourage people from continuing to smoke and quit (Townsend.1996). As youth are more sensitive to the change in the price of tobacco, and older population are less likely to become addicted, tobacco taxation works well to stop people from getting addicted.

Another way to tackle the tobacco consumption issue is by providing education and information about the harm tobacco can do to people. The most cost-effective education which can be given to smokers is the warning labels on tobacco packages (Fong et al. 2009). Many different interventions have been introduced to decrease tobacco consumption, but Chaloupka (1999) indicates that by combining effective tobacco taxation and education about the harms of smoking, the best outcome can be achieved. The reason can be that both groups of smokers and nonsmokers (mostly youth) are being targeted this way. As mentioned before, youth are being targeted by higher prices and smokers are being targeted by more information about the health effects of tobacco consumption. As smokers buy tobacco as a routine, they encounter the warning labels on the packages the most, and the effect can be substantial.

2.6) Psychological Effects of the Health Warning Labels

From the introduction of the text only warning on tobacco packages to improving to graphic warnings and increasing the size of the warnings, there has been debates over, whether text only warning is more effective or the graphic warning. In a paper by Erceg-Hurn and Steed (2011) this phenomenon has been studied. They have conducted a research to understand if the graphic warnings or text warnings are more affective Psychologically. The authors state that smokers whom were exposed to text only warning showed a little psychological reactance, but the smokers whom were exposed to graphic warning showed above 80% psychological

reactance. As recently the size of the requirement for graphic warning size is increasing in many countries, the previous sentence can show the importance of this. As nowadays, most of the warning labels is filled with graphic warnings, this section shows the importance of it. The authors indicate that large graphic health warnings which are required by WHO, make smokers to notice the health effects of tobacco consumption more. Around 10% of smokers reported to smoke less because of the graphic health warning labels. As an example, in Canada, the smoking rate decreased from 25% to 19% when this policy was introduced. In another study by Yong et al (2014), The authors indicate that the health warning label on tobacco packages helps to increase the number of future quitting by stimulating thoughts about the harms of tobacco consumption. This would lead to more health concerns for the smoker.

In a paper by Susanna and Raith (2018), the authors state that the graphic health warning labels are more successful because of the salience they have. It can also cause emotional effects and cognitive increase. As discussed before, more information about the harms of smoking could potentially lead to lower levels of tobacco consumption and as Hammond et al (2006) state, the health warning labels on tobacco are the main source of information about the harms of smoking. The authors indicate that in countries with the strongest health warning labels such as Canada, 84% of smokers announced these labels as a source of health information, but in countries such as United States, which has the weakest warning labels in their sample, only 47% of smokers announced these labels as information source. It can be concluded that as graphic health warnings become larger, they would inform smokers more about the health effects of tobacco consumption, and the information could lead to a decrease in consumption.

2.7) Behavioural Economics Perspective of Tobacco Taxation

After understanding the fact that the price elasticity of demand for tobacco is lower compared to that for many other (normal) goods (Scollo et al .2018), it is important to understand why people keep consuming tobacco when its price increases. Murphy and Becker (1988) mention a theory about this behavior in their paper called “Theory of Rational Addiction”. “Rational” means that consumers are trying to maximize their utility. In the case of addiction to a good, there would be an effect from previous consumption on current consumption. This would make current state unstable. This simply means that if the addicted person has consumed more in the past, then he/she needs to consume more today to maximize utility. This shows that if the price of tobacco

increases by not sufficient amount, the smoker keeps smoking, because as he/she increased smoking in the past, he/she captures the same amount of utility from more tobacco consumption today. The authors indicate that, not all tobacco or heroin users become addicted, but individuals who discount the future more heavily have a higher chance of getting addicted. The authors argue that an increase in the price of the addictive good has a short-run effect on demand. That is why people think an increase in price would not have enough effect on addicted people but anticipated future increase in the price would have more permeant effect on demand. The reason for this matter is that “rational” individuals would know that an increase in today’s consumption of addictive good would increase their consumption in the future, and that is why they tend to reduce consumption today.

According to Cherukupalli (2010), even if individuals are rational and they are aware of the tobacco hazards, they might still overconsume tobacco as they have tendency to prefer immediate satisfaction over future harm (present bias). The author indicates that as economic studies typically estimate external cost of tobacco consumption to be low, they don’t apply heavy taxation on it. But what they don’t consider is the present bias. As mentioned in the previous paragraph, smokers would increase consumption if they had consumed more in the past. The present bias can be a reason for that, as they prefer to satisfy immediate satisfaction. The author argues that, how high tobacco taxes should be dependent on how much smokers underrate smoking hazards and also on each country’s circumstances. Cherukupalli states that, economic theory suggests that taxes shouldn’t be such that restrict people’s choice while they are not harming others. Current behavioral economic research suggests that this is not correct and taxes higher than current rates might be beneficial. The rationale for increasing the tax is that the rise in tobacco price can counter some of the harm smoking causes to the society. As it is indicated in the previous sentence about the rise of the tax above current levels and it is stated in the previous section that larger warning results in better results, and also Cherukupalli (1999) indicated that the combination of both results in the best outcome, it can be understood that increase in each policy affects tobacco consumption, but the combination has the largest effect.

3) Research Design

The theories discussed in previous sections have been converted into measurable variables in this section. This section presents the variables used in this research and their meanings for this research, as well as the methods used to execute the research agenda.

The hypothesis of This research states that as well as the negative effect of tobacco taxation on tobacco consumption, combining health warning label with this policy would lead to even higher degrees of reduction in tobacco consumption. To test the hypothesis, other factors which affect tobacco consumption should also be taken into account. Tobacco consumption is affected by factors other than tobacco taxation as well. As mentioned before, the level of income plays an important role in the level of tobacco consumption. Ross and Al-Sadat (2005) argued that income is highly and positively correlated with tobacco consumption. It has also been found that income inequality is positively correlated with tobacco consumption (Li. Guindon. 2013; Pampel. 2007; Siahpoush et al. 2006). The existing literature shows that as a country becomes more unequal in terms of income, tobacco consumption increases. Unemployment is another factor which affects tobacco consumption. De Vogli and Santinello (2005) argued that smoking is highly correlated with unemployment. The authors have stated that, the odds of smoking among the unemployed are 2.78 times higher than managers and professionals. It is also important to note how strict are the rules of a country in tobacco control. Previous studies have found that bigger health warnings and images on tobacco packages makes smokers think more about the message, hence the bigger the warning label, the more effective it is (Kowitt et al. 2017; Senior. 2000; Hammond.2011).

3.1) Data

The data for this research has been collected for the period 2006-2016. The reason for choosing this period is that, the data are hardly available for the abovementioned variables for before 2006 and some data are not still fully available for after 2016. The countries chosen for this research are 15 of OECD member countries for which data are available; not enough data are available for the excluded countries. The reason for choosing OECD member countries is that, enough differences are available in this pool of countries, which makes it possible to study the effect of tobacco taxation on tobacco consumption. As the data are being extracted in multiple

points in time (11 years) for multiple variables, then panel data method of estimation has been chosen.

As the data for this research are not available in a single database, a database had to be made. Sources for making the database include OECD database, OECD consumption trend reports, governmental reports and websites, European Commission reports (CIRCABC), UN database, WHO database, tobacco labeling resource center (tobaccolabels.ca), and Canadian Cancer Society international status report on cigarette packages health warnings.

3.2) Measurements

3.2.1) Dependent Variable

As the change in tobacco consumption is the focus in this research, then the dependent variable is tobacco consumption. Tobacco consumption data have been collected as grams per person (15+) tobacco used in each country in each year. As the data for Tobacco consumption were highly skewed, a logarithmic transformation has been conducted to normalize the data and avoid outliers.

3.2.2) Independent Variable

Tobacco taxation is the independent variable in this research. As there are different types of taxation on different tobacco products, this research has used the cigarette excise on value rate as a proxy variable for tobacco taxation. The reason for choosing this type of tax is that it is the easiest to work with. For example, the excise tax (per cigarette) needed to be calculated as a percentage of each cigarette, which makes it difficult. The reason to choose cigarettes as the proxy variables is that, there is more information available about cigarette taxation compared to the other tobacco products. The data has been collected as the percentage of the excise on value on the retail price of the cigarettes in each country, for each year.

3.2.3) Control Variables

As the effects of tobacco taxation on tobacco consumption also depends on other factors, five control variables are being used in this research. The first control variable is unemployment. Unemployment rate is measured as harmonized unemployment rate, referring to working age

unemployed population, who are actively looking for a job. This variable is calculated by unemployed population as a percentage of the total labor force (OECD.org).

The second control variable is Income. Income is calculated as the annual average of the income of the total population in each country, for each year. All the income data for all of the countries have been converted to US dollars to have the same unit. As the data for the average income were highly skewed, a logarithmic transformation has been conducted to normalize them.

Another control variable is income inequality. The reason to choose this control variable is that, income alone can't show how the income is distributed in a country. A country with great number of high income and a great number of low-income populations might have the same average income as a country where most of the population earn around the mean. As there are different measures for this variable, the Gini index after tax and transfer has been chosen. "After tax Gini" works better than before tax, because it shows how much people are financially different with what they actually have to spend.

Another control variable in this research is the tobacco health side effects awareness. The data for this factor has been collected as the size of the health warning labels on tobacco packages. As the requirements for each type of tobacco product is different, the percentage of the warning label compared to the size of the surface of the cigarette packages in each country, for each year has been collected as a proxy variable for the tobacco side effect awareness.

As previously mentioned, when tobacco taxation is used with the awareness about the health side effects of the tobacco consumption, the best outcome can be achieved. As a result, this research uses the interaction effect of the health warning label size and tobacco taxation as another control variable.

3.3) Statistical Method

This study has used multivariate regression analysis to capture the impact of its independent and control variables on its dependent variable. The independent variable and control variables are added step by step, one at a time, to unveil how much each one changes the impact of tobacco taxation on tobacco consumption. The association between the dependent and independent variables is expected to become weaker as each control variable is added in each step. The reason for this is that, control variables are supposed to capture some parts of the association.

To control for the effect of time invariant variables, fixed effect regression would be conducted after non-fixed effect regression is conducted, and then the results would be compared.

3.4) Hausman Test

Hausman test has been conducted in this research to know whether random effect model is allowed or not. The null hypothesis indicates that the random effect is suitable for this research. The alternative hypothesis indicates that the random effect is not suitable for this research. The table presenting the results of this test is shown in table 1.

Table 1

	Fixed Effect	Random Effect	Difference	S.E
Tobacco Tax	0.235	0.228	0.007	0.052
Gini Index	0.359	0.442	-0.083	0.335
Log (Income)	-0.508	-0.528	0.019	0.170
Unemployment	-1.068	-1.007	-0.060	0.085
Warning	-0.644	-0.637	-0.008	0.019
Warning*Tax	0.265	0.204	0.614	0.038

$$\text{Chi2}(6) = 3.10$$

$$\text{Prob >Chi2} = 0.7957$$

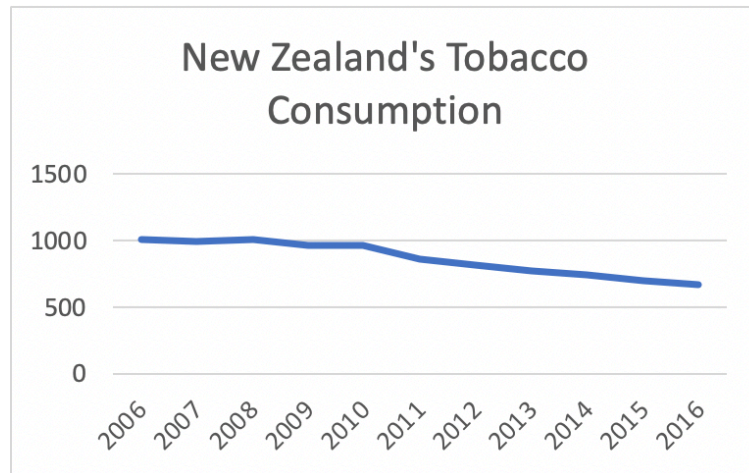
It can be observed from the results that the p value is 0.7957, which is larger than 0.05. This shows that the null hypothesis is accepted, and the alternative hypothesis is rejected. The results show that random effect regression is appropriate for this research.

4) Results

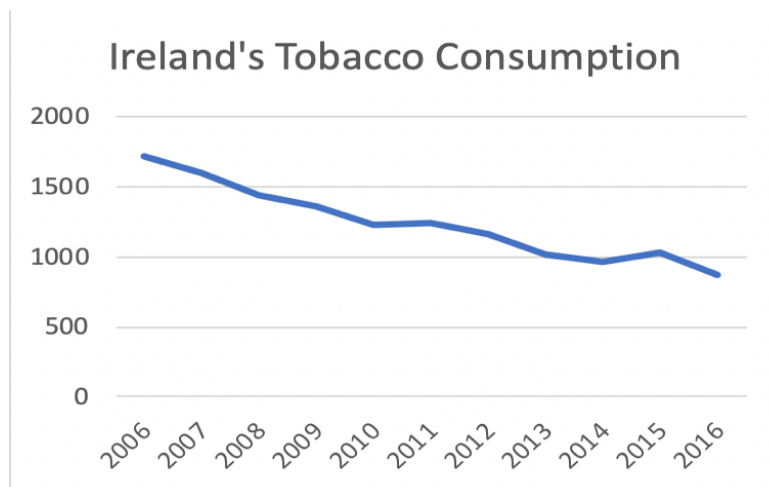
This section presents the results and interpret them. The main goal of most governments in tobacco control is to reduce tobacco consumption. Countries have used different methods and they have gotten different results. This section brings an example from the trends of tobacco consumption from two different countries. These countries are New Zealand and Ireland. Their trends of tobacco consumption are presented respectively in Graph 2 and Graph 3. New Zealand is known for having one of the best tobacco control programs in the world (Laugesen et al. 2000).

New Zealand is one of the countries with the lowest levels of tobacco consumption in this research. The list of the countries included in this research is provided in the appendix. Other than having low levels of tobacco consumption, New Zealand has been able to have a steady decrease in tobacco consumption over the years.

Graph 2



Graph 3



It is observable in the data that New Zealand had a reduction in tobacco consumption per capita in every single year from 2006 to 2016. In 11 years, tobacco consumption has decreased by 33.5%. It is observable in the graph that a higher degree of reduction in tobacco consumption started from 2010. The highest decrease in tobacco consumption rate in this research goes to

Ireland by 46% decrease in 11 years. The trend in tobacco consumption for Ireland is observable in the graph above. Ireland had a higher percentage decrease in tobacco consumption, but still higher level of consumption in 2016 compared to the New Zealand. Although Ireland had the highest percentage decrease in tobacco consumption among the countries included in this research, they still had medium-high levels of tobacco consumption in 2016 compared to other countries.

In another example it can be referred to Finland which didn't face a great reduction in their tobacco consumption. Graph 4 shows the level of tobacco consumption and tobacco taxation in Finland. It is observable that unlike Ireland and New Zealand, Finland didn't have a steady decrease in tobacco consumption and multiple maximums and minimums are observable. In the graph from 2006 to 2016 there is a 15% decrease in tobacco consumption, which is lower than other countries. The reason could be that Finland increased tobacco tax once and by a small amount of 2% in 2009.



4.1) Descriptive Statistics

Table 2 provides an overview of the descriptive statistics for variables presented in the previous section. As it is observable from the table, none of the variables have missing values. The reason for this is that, the few missing values have been estimated by taking the average values of one year before and one year after. As mentioned before, because of the skewness of the data for the variables tobacco consumption and income, logarithmic transformation has been conducted and it is observable in the table that the variation is not too large. The largest variation is for the log (Tobacco Consumption), which is from 6.30 to 8.44. Table 2 also presents the mean of each variable. The minimum and maximum values of each variable is also presented in the table.

Table 2

Variable	Observations	Mean	Standard Deviation	Minimum	Maximum
Log (Tobacco Consumption)	165	7.23	0.42	6.30	8.44
Tobacco Tax	165	0.34	0.18	0.01	0.75
Log (Income)	165	10.63	0.30	9.91	11.07
Gini Index	165	0.30	0.03	0.24	0.37
Unemployment	165	0.08	0.05	0.02	0.27
Warning Label	165	0.43	0.14	0	0.825
Warning*Tax	165	0.15	0.1	0	0.48

Table 3 shows the correlations between each two variables and their significance respectively from top to bottom in each cell. The correlation of all variables with Tobacco Consumption is highly significant except for Tobacco tax and the Gini coefficient. The largest correlation between a variable and Tobacco Consumption is for Income which is -0.45. The smallest significant correlation between a variable and Tobacco consumption is for

Warning*Tax variable which is -0.2820. These correlations show that to what extent each two variables move together.

Table 3

	Log (Tobacco Consumption)	Tobacco Tax	Gini Index	Log (Income)	Unemployment	Warning	Warning*Tax
Log (Tobacco Consumption)	1						
Tobacco Tax	-0.0460 0.5573	1					
Gini Index	-0.0621 0.4280	0.1981 0.0107	1				
Log (Income)	-0.4559 0.0000	-0.1085 0.1652	0.1428 0.0674	1			
Unemployment	0.3201 0.0000	0.1541 0.0481	0.2972 0.0001	-0.3044 0.0001	1		
Warning	-0.3933 0.0000	0.0665 0.3962	0.3240 0.0000	0.2143 0.0057	-0.0872 0.2655	1	
Warning*Tax	-0.2820 0.0002	0.7806 0.0000	0.3307 0.0000	0.0107 0.8917	0.0757 0.3339	0.6186 0.0000	1

4.2) Regression Analysis

Tobacco consumption as the dependent variable has been regressed over the independent variable and control variables. The results are presented and interpreted in this section. Table 4 shows the regression results in different steps as each variable is added step by step one at a time. The first step is only the regression between tobacco consumption and tobacco taxation. It can be observed that the association between them, when there is no control variable, is negative with the magnitude of 0.109, but not significant by having a p-value of 0.557. As each control variable is added one at a time, the negative association becomes larger in absolute value and in the end when all the control variables are added, it becomes positive and still insignificant.

It can be observed that the association between tobacco consumption and tobacco taxation is not significant. It can be concluded that tobacco taxation almost doesn't have an effect on tobacco consumption. It is more so for the Gini index. The relationship between tobacco consumption and the Gini index is not significant in any steps of the regression analysis. It can be concluded that the income inequality doesn't affect tobacco consumption. The association between income and tobacco consumption however is highly significant and negative. The association between these two variables is -0.511. As both variables are in log form, their association indicates that as the average income of a country rises by 1%, the tobacco consumption decreases by 0.5%. The result might sound different from what has been seen in the literature review part, but it can be interpreted differently. As in the literature review section "Income" has been studied from more of a microeconomics and individualistic point of view, it was estimated that as people have more income, they consume more tobacco. In this results section, we can see that income has a negative association with tobacco consumption, and the reason is that it is studied from a macroeconomics point of view and at a country level. It can be interpreted that as countries have higher average income and standard of living to some extent, the people of those countries smoke less comparing to countries with lower average income. This still doesn't rule out the estimation in the literature review section. In a country with lower average income, if a smoker's individual income increases, there is a chance that his/her tobacco consumption increases based on previous literature, but this research's results show that this is not the case at country level.

The association between tobacco consumption and unemployment rate is also significant. This association is positive and has a magnitude of 0.179 (log (1.509)). This association is rather substantial. It indicates that as the unemployment rate in a country increases by 1%, tobacco consumption increases by 0.179%. This can show that countries with higher unemployment rate face higher tobacco consumption rates compared to countries with lower unemployment rates.

Another association in this table is the one between tobacco consumption and the size of the warning label on tobacco packages. It can be seen that their association is negative and significant in step 5 but the opposite in the final step 6, where the interaction term between the warning label size and tobacco tax is included. It can be concluded that the size of the warning label has a negative effect on tobacco consumption and the magnitude is - 0.028 (log (0.937)). This association indicates that as the size of the warning label on tobacco packages increases by

1%, tobacco consumption decreases by 0.028%. The effect is rather small, but when it is combined with tobacco taxation in step 6, it can be observed that the effect becomes larger and equal to -0.365 (log (2.317)). When tobacco taxation and health warning regulations are combined the effect is 18.25 times larger than having the health warning alone. This result confirms a part of the hypothesis by showing that the effect increases as the variables are combined.

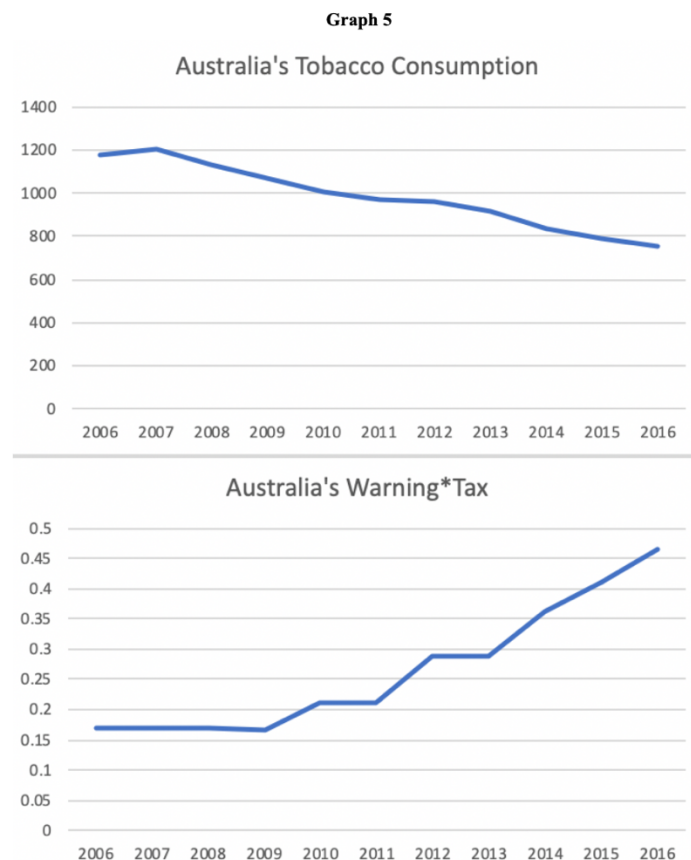
Table 4
(Random Effect Regression)

	(1) Log (Tobacco Consumption)	(2) Log (Tobacco Consumption)	(3) Log (Tobacco Consumption)	(4) Log (Tobacco Consumption)	(5) Log (Tobacco Consumption)	(6) Log (Tobacco Consumption)
Tobacco Tax	-0.109 (0.557)	-0.0832 (0.661)	-0.242 (0.157)	-0.270 (0.107)	-0.244 (0.123)	0.712 (0.120)
Gini Index		-0.666 (0.491)	0.306 (0.726)	-0.652 (0.472)	0.659 (0.467)	0.672 (0.453)
Log (Income)			-0.652*** (0.000)	-0.539*** (0.000)	-0.487*** (0.000)	-0.511*** (0.000)
Unemployment				1.905** (0.003)	1.502* (0.012)	1.509* (0.011)
Warning					-0.937*** (0.000)	0.00568 (0.990)
Warning*Tax						-2.317* 0.027
Constant	7.270*** (0.000)	7.460*** (0.000)	14.15*** (0.000)	13.09*** (0.000)	12.57*** (0.000)	12.44*** (0.000)

Australia is one of the countries in the dataset which has achieved one of the lowest levels of tobacco consumption at 756.4 grams per capita per year. The reason can be due to the effectiveness of combining tobacco taxation and health warning label regulations. In graph 5, it is observable that as the tobacco consumption decreases from 1180 grams per capita per year in 2006 to 756.4 grams per capita per year in 2016, “Warning*Tax” interaction effect is increasing from 0.163 in 2006 to 0.4653 in 2016. Australia requires the highest size of the warning label for

tobacco packages alongside New Zealand, and the rate of tobacco tax is also one of the highest in Australia compared to other countries. From 2009 until 2016, in most years both tobacco taxation and the size required for health warning labels on tobacco packages have been increasing. This example shows the effectiveness of the combination.

From the graph and the results from the regression it can be concluded that the best policy to achieve lower tobacco consumption levels and to save people from direct and indirect harms of tobacco is combining tobacco taxation and strict rules on the size of the health warning labels on tobacco packages which is made up of a picture and a message. As mentioned previously in the literature review section, this can be due to the fact that, tobacco taxation targets the youth and other people not to start smoking, and the health warning label targets the smokers, who encounter the pictures and messages on a daily basis. As by this intervention both groups are being targeted, there are higher chances that this policy would be more successful than any of the others individually.



It can be concluded from the regression table (Table 3) that the level of average income, unemployment rate, and the interaction effect of label warning size and tobacco taxation are the variables which have an effect on tobacco consumption. It can be observed that countries which are stricter on tobacco control policies and have a better welfare situation in terms of unemployment and income are experiencing lower levels of tobacco consumption. It is noticeable that tobacco consumption level is dependent on other factors than tobacco taxation.

It can also be concluded that as Townsend (1996) stated, tobacco taxation is useful to discourage people from starting to smoke. Tobacco taxation can also discourage people from continuing with smoking, but at a slower rate. As the number of current smokers are higher than the ones who might start smoking, the association might show that tobacco taxation is not effective, but it might discourage many people from starting to smoke and the presence of it might be important.

The adjusted R square becomes larger as each control variables are added. In the last step when all variables are added the adjusted R square is 0.340. This implies that 34% of the variation in the dependent variable is explained by the independent variables. There are also 165 observations in each step which shows there is no missing value for any independent variable. As the p-value for tobacco taxation is not smaller than 0.1, the null hypothesis can't be rejected. As the hypothesis of this research is that, increase in tobacco taxation results in a decrease in tobacco consumption, the results reject the hypothesis

4.3) Fixed Effect Regression Analysis

After running a random effect regression analysis and interpreting the results in the previous section, in this section the results from the fixed effect regression analysis are presented and interpreted. Fixed effect regression analysis is used in this panel data to control for time-invariant unobserved values, which could be correlated with the existing independent variables in this research. Table 4 presents the results from the fixed effect regression analysis.

The variables for which the regression is fixed have been added step by step, one at a time. The first step shows the regular regression analysis between the dependent variable, the independent variable, and control variables. The second step shows the regression fixed for "Nation" or the countries. The last step shows the regression fixed for "Nation" and "Time". Basically, the fixed effect regression is trying to show whether the estimated associations also

reflect the differences within the countries as well as across countries shown in the random effect regression.

It can be observed from the table that, when the regression is fixed for both “Nation” and “Time”, none of the variables are significant. All the p values are bigger than 0.1. It can be concluded from Table 4 in the previous section that, differences in tobacco taxation and the size of warning labels explain the differences in tobacco consumption across countries, but Table 5 shows that differences in tobacco consumption is not explained by differences in abovementioned variables within countries.

Table 5
(Fixed Effect Regression)

	(1) Log (Tobacco Consumption)	(2) Log (Tobacco Consumption)	(3) Log (Tobacco Consumption)
Tobacco Tax	0.712 (0.120)	0.235 (0.351)	0.207 (0.338)
Gini	0.672 (0.453)	0.359 (0.729)	1.244 (0.157)
Log (Income)	-0.511*** (0.000)	-0.508 (0.059)	-0.0612 (0.789)
Unemployment	1.509* (0.011)	-1.068 (0.009)	-0.148 (0.706)
Warning	0.00568 (0.990)	-0.644*** (0.003)	0.00284 (0.990)
Warning*Tax	-2.317* (0.027)	0.265 (0.573)	-0.216 (0.592)
Constant	12.44*** (0.000)	12.64*** (0.000)	7.225** (0.003)
Observations	165	165	165
Adjusted R squared	0.340	0.896	0.932

It can be concluded that changes in tobacco consumption level within a country are not significantly associated with changes in tobacco taxation and the size of the warning label on tobacco packages. It shows that cross-country association between tobacco consumption, tobacco taxation and warning labels on tobacco packages is not causal and is explained by other country differences.

The same logic holds for the average income and unemployment as well. It can be observed that the differences in income and unemployment doesn't explain the differences in tobacco consumption within countries, but it explains the differences across countries. This can show that countries differ in tobacco consumption levels partly because of the difference in their unemployment rate and average income, but these variables can't explain the difference in the levels of tobacco consumption in the same country in different years.

The tobacco consumption differences within a country couldn't be explained in this research because it is almost impossible to include all the variables influencing tobacco consumption as control variables. This research hopes to reignite the tobacco consumption discussion and motivate further research. Future research could focus on culture, institutions, etc. as variables that could possibly explain changes in tobacco consumption within countries over time.

5) Conclusion and Discussion

5.1) Discussion

The immediate results of this research can be concluded in three points. 1- Tobacco taxation doesn't affect tobacco consumption. 2- Size requirement of the health warning labels on tobacco packages is negatively correlated with tobacco consumption and it is significant, but the effect is small. 3- When tobacco taxation is combined with the size requirement of the health warning labels on tobacco packages, the effect is significant and more substantial. The main attempt of this research at first was to fill the gap between existing studies. There has been a difference in the findings as economists like Chaloupka (1999) stated that tobacco taxations effect on tobacco consumption is significant and substantial, but studies like Callison and Kaestner (2012) argued that the effect is small, and it is not significant. This paper proves that indeed the effect is insignificant, but if it is combined with health warning label the effect

becomes substantial and significant. The results of this paper also open up a path to investigate for even more combinations. The interaction effect of tobacco taxation, health warning labels, and more tobacco control policies can be studied to reach a better and more effective policy design to fight tobacco consumption.

This research faced some unexpected results. The first is the insignificance of tobacco taxation. The second one is that the income inequality doesn't affect tobacco consumption. Another unexpected result is that the differences in tobacco consumption levels within countries are not explained by the variables mentioned before. To make the policy design even more effective, studying this matter would be beneficial to know what variables cause the difference in tobacco consumption levels within countries.

The value of this research can be explained from different perspectives. The first view is from the economic point of view. Not only this research fills the gap in existing studies about the effect of tobacco taxation on tobacco consumption, but also it moves further to point out to a policy combination which will reduce tobacco consumption and therefore the healthcare costs associated with it. Another perspective is from individualistic point of view. Better policies designed by policy makers from the results of this paper, would improve smoker's quality of life. On top of that, by smoking less or quitting, smokers can spend the money on products which improves their welfare.

5.2) Conclusion

This research examines the effect of tobacco taxation on tobacco consumption. The hypothesis of this research indicates that there is a negative and significant association between tobacco taxation and tobacco consumption and the size requirement of the health warning label on tobacco packages is expected to be negatively correlated with tobacco consumption as well. The hypothesis can be concluded as, the combination of tobacco taxation and size requirement of the warning label leads to stronger effect on tobacco consumption. The results of the research show that tobacco taxation's association with tobacco consumption is not significant. It can be understood from the results that tobacco taxation almost doesn't have an effect on the level of tobacco consumption. The size requirement of the health warning label is negatively correlated with tobacco consumption and the association is significant. The most important result of this paper is that when increase in tobacco taxation is combined with increase in the size requirement of the health warning labels, the interaction effect is significant and more substantial comparing

to when only health warning label requirement is in place. Other factors which found to be affecting tobacco consumption are unemployment rate and average income of each country. Combining the results of the random effect and fixed effect regression analysis shows that the difference in tobacco consumption are explained by the differences between tobacco taxation and health warning labels, unemployment rate, and average income across countries, but not within countries. To find these results, this research used 15 OECD countries for a panel data regression analysis from 2006 to 2016.

This research and its data have some limitations. One of the first problems this research encountered was lack of data. Many previous studies had access to some data which is not published for the public. For this reason, some proxy variables had to be used instead of the original variables. One of these variables was tobacco taxation. Tobacco taxation data as the average of the retail price was not available on any of the major databases. As a result, the excise on value rate for cigarettes was chosen as a proxy variable. This proxy variable was also not available easily and it had to be extracted from many different European commission reports and several different databases and governmental websites. The data for the requirement of health warning labels also was lacking and many different databases, websites, and reports had to be searched for finding the data. The data which couldn't be extracted, was estimated.

Another limitation this research have is in its interpretation of some results. Some parts of the decrease in the tobacco consumption might be due to other types of tobacco control policies such as treatments and advertisement ban which have not been studied in this research. It is not possible for any research to include all relevant control variables, but it can be hoped that future research continues with what this research has started and include more control variables for better and more precise results.

This research can be improved by including more countries in the data. The aim of this research was to conduct the research with all 36 OECD countries for the period 1996-2016, but due to lack of data, the number of countries was limited to 15 countries, and the period also was limited to the period 2006-2016. As more data are being available, it would be possible in future to re-conduct this research with a greater number of countries for a longer period of time, which might give a better and more accurate result.

As this paper tackles the issue of tobacco consumption from more of a Macroeconomics perspective, it would be more difficult to connect it to the multidisciplinary nature of tobacco

consumption. It has been tried to capture some parts of the psychological effect of the warning labels on consumption in the literature review section, but for more comprehensive results in this area, future research can conduct Microeconomics research to understand this matter better.

One question that rise with increase in tobacco taxation is the burden on low income smoking population. Wilson and Thomson (2005) have researched this question before. It is observable that the low-income smoker population whom can't or don't want to stop smoking will face a burden when tobacco taxation increases. It can also be argued that the tobacco taxation is even contributing to autonomy by reducing exposure of non-smokers to second-hand smoke and freedom from nicotine dependence. Furthermore, it can be concluded that increase in tobacco tax would lead to a decrease in health inequality and increase in justice as the authors state. It is true that the tax burden on the smokers who want to keep smoking might be unjust, but the benefits to society is much higher than that, and this makes it ethically the right thing to do.

The overall significance of this research is that it's findings can contribute to a better policy design in fight for tobacco consumption. As it was discussed before, tobacco consumption is one of the main causes of death around the globe and finding an effective policy can be a contribution to save many lives. By finding that the combination of tobacco taxation and increasing in the size of the health warning labels of tobacco packages this paper made a good contribution.

One possible area which future research can study is the two effects which warning labels capture. In most countries included in this research, the requirement of warning label has been introduced before the time period chosen except New Zealand, Switzerland, and United Kingdom. These two effects which warning label captures can be the introduction of the warning label and the increase in the warning label size. It can be studied how the effect is different. Possibly even the future research can look for the threshold effect of the warning label.

The results from the fixed effect regression and the fact that the differences in tobacco consumption is not explained by the included variables in this research within countries, arise the question of why that is. The reason could be because of some omitted variables which could have been added to the control variables at the country level that explains both the introduction of higher taxes and larger warning labels and lower tobacco consumptions. One of these variables could be the attitude of the public towards tobacco consumption. Less acceptance of this behavior could potentially lead to more pressure on governments for stricter rules on tobacco

control policies. This would be a path which future research could follow and derive more effective tobacco control policies.

Future researchers who continue the path of this research, can either focus on the effect of other types of tobacco controls on tobacco consumption, such as advertisement bans, or/and try to study the factors which explain the changes in tobacco consumption within countries over time. This research can also be conducted on other groups of countries to see if the results are the same or not. The reason is that, as this research focused on 13 European OECD countries plus New Zealand and Australia, the results could be different from other groups of countries with different characteristics.

6) Sources

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7) Appendix

List of the countries

Australia	Germany	Netherlands
Czech Republic	Greece	New Zealand
Denmark	Hungary	Spain
Finland	Iceland	Switzerland
France	Ireland	United Kingdom