The association between level of education and snus use in Norway: Analysis of repeated cross section surveys, 2008-2015

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A cross sectional study on whether there is an association between level of education and snus use - Based on national surveys from Statistics Norway between 2008-2015

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Abstract

The level of education has been negatively associated with tobacco use in the past literatures. However, most of these studies were associated with only smoking. Little research has been done to investigate the association between snus use and level of education. In the ones that included snus use in their studies, the two were not looked at separately. This thesis investigates snus users and smokers separately and whether and how the level of education is associated with snus use and how different the association is for different demographic groups. The thesis investigates in other words, the proportion who use snus within the different levels of education and other background variables. In the same way, the thesis investigates whether civil status, field of education, if the respondents think snus is harmful and observation period has something to say about snus use. In addition, the thesis compares the results with that of smokers and those who use snus as an aid to quit smoking. The observations used are taken from Statistics Norway's Smoking Habits Survey and Travel and Holiday Survey between 2008 and 2015, and consists of cross-sectional observations for a total of 8 years.

I find that individuals with high school degree have a significantly higher likelihood of using snus than those with only primary education or lower. Similarly, for individuals with university education, this likelihood was slightly higher than for those with a high school degree and significant at 5% significance level.

Furthermore, I find that younger people have a higher likelihood of using snus than older people. The younger one is, the greater is the effect on snus use. This can be observed in the form of a decrease in the proportion of snus users with age. For gender, I found that women have a lower likelihood of using snus than men. I also find that this effect is weaker for married people and registered partners i.e. they have a lower likelihood of using snus than the other groups. Within the observation period, there is a significantly higher likelihood of snus use with the year.

I believe that this study will be helpful to future scholars and researchers who wish to conduct further research on this particular topic as the findings from this study have increased the understanding of the core snus users and smokers separately. The thesis also discusses the practical implications of the findings from this research.

Acknowledgment

This master thesis marks the end of two years as a student at University of Oslo. It has been very exciting to work on this task, and I found it very interesting to work on the topic of snus use and education.

I would first of all like to thank my supervisor Knut Reidar Wangen. Thank you so much your valuable feedback and inputs. This thesis would not have been possible without your great help. I would also like to thank all my friends and family who have directly or indirectly helped me during this time.

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1 Introduction

Tobacco kills more than 7 million people worldwide (WHO, 2019). In Norway, smoking alone kills 6000 people annually (Norwegian Institute of Public Health, 2019). There are other forms of tobacco available in Norway for example 'snus'. Snus is an oral moist tobacco product, which is either sold as a loose snuff or, in a portion-bag packet (Andersson, Axell and Curvall, 1995). Norway has had a long tradition for use of non-combustible tobacco. Until 1930, 'plug tobacco' or chewing tobacco was the most popular product with 60% of the market share (Lund and McNeill, 2012). After WWII, moist snuff, a product similar to the modern day snus started gaining popularity and became the most popular smokeless tobacco product in Norway. For the first time in 2017, snus became more popular than cigarettes. This could be due to a number of factors. Lund and Lund (2014) suggested that snus contributes to lessened cigarette consumption in three ways- a) as a method of smoking cessation, b) as an alternative to smoking for the new generation and c) as an alternative to smoking for those that are unable and/or unwilling to quit. Another important reason why people use snus could be because past research shows that it is much less harmful than cigarettes. The health authorities have reportedly not found any deaths associated with snus (Gakidou et. al, 2017). Hence, it is a form of tobacco that is becoming more and more popular, especially with the younger population.

Furthermore, many use snus as an aid for quitting smoking also. Statistics Norway found that 1 out of 3 persons who quit smoking used snus as an aid for them to help quit smoking. For these very reasons, there has been constant debate for whether snus should be taxed less compared to cigarettes. But the goal of the Ministry of Health and Care Services in Norway is a tobacco free future and not just cigarette free. Hence, snus is taxed and treated in the same manner as cigarettes.

What I am most interested in is the relationship between educational level and snus use. There have been a number of past researches which have found that highly educated people tend to smoke less. Norberg et al. (2011) looked at the time trends in tobacco use among the middle aged population for the period 1990-2007 and found increasing differences between the educational groups. They found both a higher smoking and snus use prevalence among those with only basic education, and this was most noticeable in the younger age group of this population. But why is this? Is it because the highly educated have a better understanding of

the harmful effects of tobacco and they value their health more? If so, is it then the same with snus? What about those who use snus in order to quit smoking? What does the past research show? I will be aiming to answer all these questions in my thesis. With snus, we also need to take into account that it is mostly young people who use snus. So age is a very important factor. And if highly educated people smoke less and snus is the number one means of quitting smoking, does it mean that high snus users on average will have higher education also? I will aim to answer all these questions in this thesis.

The thesis aims to investigate whether and how variables for education, age, gender, civil status, year, and field of education have an impact on snus use. The most important relationship for the scope of the thesis is the level of education and snus use. It could be interesting to investigate if the level of education has affected snus use in different groups in society to varying degrees. For this, I have categorized the educational levels into primary, secondary and tertiary levels. Since age is an important factor in determining whether they use snus or not, I categorize age into four age groups (15-25), (26-45), (46-60) and (above 60) and see how differently they behave when it comes to snus use. Since women considerably use less snus than men, I will be looking at male and female snus users separately.

The sample is limited to just one overall sample with three models having endogenous variables based on the question do you smoke, do you use snus and do you use snus to quit smoking respectively.

a. Do you smoke? – The endogenous variable is a dichotomous variable depending on the question do you smoke and those who answered yes got the value of 1; others got the value 0.
b. Do you use snus? – The endogenous variable here depends on the question do you use snus and those who answered yes got the value of 1; others got the value 0.
   I wanted to compare the results with that in a. smokers and see if I get the similar results.
c. Do you use snus to quit smoking? – Similarly, the endogenous variable here depends on the question do you use snus to quit smoking and those who answered yes got the value of 1; others got the value 0. It would be interesting to look at this because one would expect the ones who use snus to quit smoking to behave in a different way than just snus users.

Two regression models are used to carry out the analyses – Linear Probability Model and Logistic Regression Model. In both the regression models, the left side variable is a dummy for whether the individual is a smoker or not in model 1, is a snus user or not in model 2 and whether the individual uses snus to quit or not in model 3. First, I look at the four most important variables i.e. age, gender, educational level and year. Later, I have carried out robustness checks by adding other variables like, marital status, and field of education. Since the thesis aims to look at the relationship between snus and educational level, I have separated the snus users and smokers and analyzed them individually i.e. I have looked at a group who only use snus and does not smoke, a group who only smokes and not use snus. I have also briefly looked at the group who does both i.e. dual users of snus and smoke (see Appendix 1 and 3).

The thesis begins with a discussion of the tobacco's place in the Norwegian society over the past years. To understand Norwegians' attitudes to tobacco today, it is important to know how attitudes have changed over time. Chapter 2 presents short health hazards associated with tobacco use and changes in tobacco legislation in Norway over time. Some past research done on the subject matter education and tobacco use is also presented in Chapter 2. Chapter 3 presents the research question or the problem statement at hand. Chapter 4 then presents the data used in the analysis in detail. The methods used in the analysis are explained in Chapter 5. Most of the analysis in the thesis is carried out with the help of the linear probability model. I have also briefly presented the logistic regression model and justified my choice of model. Chapter 6 presents the results of the study. Finally, Chapter 7 involves some discussion and some limitations of the study followed by the conclusion in Chapter 8.

2 Background

The consequences of tobacco use have been a hot topic within many fields of research. Over the past fifty years, many research projects have been carried out in connection with health, illness and tobacco use but mostly for smoking. The fact that such diseases and deaths related to tobacco use can totally be avoided gives the reasoning behind the strict tobacco control acts all around the world. Hence, tobacco control mechanisms are being implemented increasingly all over the world. In Norway, the Ministry of Health and Care Services launched a national strategy for tobacco control in 2013 which aimed for a tobacco free future in which the population is no longer affected by the damaging effects of tobacco and live longer and healthier lives (The Norwegian Directorate of Health, 2019). The three main goals of the tobacco strategy of 2013 were –

a. Prevent young people from starting to smoke or taking snus
b. Motivate and assist in quitting snus and smoking
c. Protecting the population from the damaging effects of tobacco

The smoking prevalence in Norway has reduced remarkably over the past years. A number of statutory measures have been implemented in Norway over the last 45 years. In 1975, the Tobacco Act was passed which required health warnings on tobacco packaging, and a ban on advertisements of tobacco products. This ban was further enhanced in 2010 by another ban of retail display of tobacco products in supermarkets (The Norwegian Directorate of Health, 2019). In 1988, protection from exposure to smoke in workplaces was passed. Since 2004, there has been a complete ban on smoking in bars and restaurants. Moreover, a ban on designated smoking rooms was implemented in 2014. Similarly, in 2011, there was a law passed which required all cigarette packages to be equipped with pictorial health warnings. More recently, there was a regulation passed requiring standardized tobacco packaging which came into effect on July 1st, 2017. The interest in tobacco or smoking reduction strategies has led to a comparison between smoking and other tobacco related products such as snus. For the first time in history, the number of people taking snus on a daily basis in Norway outweighed the number of daily smokers in 2017 (Statistics Norway, 2019). In 2018, the number of people daily snus takers equaled the number of daily smokers.

2.1 Clinical effects of snus

In addition to all these regulations, the availability of snus could also be one of the major factors in reducing the smoking prevalence in Norway. Moreover, there seems to be an overall impression that using snus has fewer health risks than smoking cigarettes. Daniel Roth and Liu (2005) carried out a systematic literature review on whether cigarettes were more harmful than snus. They found quantitative evidence that, for certain health outcomes, the health risks associated with snus are lower than those associated with smoking, specifically, for lung cancer, oral cancer, gastric cancer, cardiovascular diseases and for all-cause mortality.

On the other hand, the Swedish Institute of Public Health 2005; IARC 2012 has concluded that snus is carcinogenic (Norwegian Institute of Public Health, 2019). It has also been proved that a high consumption of snus is linked to an increased risk for diabetes mellitus type 2. There is some confirmation that snus consumption may lead to an increased risk of weight gain and lipid metabolism disorders. It is also a fact that the oral cavity changes post snus use- white and/or red mucosal lesions can be seen in the oral cavity. Most of these snus-induced lesions however disappear when snus consumption is stopped (Norwegian Institute of Public Health, 2019).

Rostron et al. (2018) however found that the US smokeless tobacco users had an increased risk of heart diseases as compared to the non-users. However in case of snus (Swedish smokeless tobacco) users, they did not observe an increased risk. In addition, the Swedish snus is subject to stricter tobacco control and higher quality requirements for its content (Rostron et al., 2018). It also contains less nicotine than the American ones. The results of this study are highly relevant because all snus sold in Norway is produced in Sweden.

2.2 Some relevant previous literatures

Lund and Lund (2014) suggested that snus contributes to lessened cigarette consumption in three ways- a) as a method of smoking cessation, b) as an alternative to smoking for the new generation and c) as an alternative to smoking unable and/or unwilling to quit. However, he concluded that tobacco control measures still outweighed the availability of snus in reducing the smoking prevalence.

With more knowledge about the dangers of tobacco use, it is important to look at which groups in society react in what way to it. For example, if highly educated people tend to use lesser tobacco products and, because tobacco use increases the risk of several diseases, it can lead to increased health differences between lower and higher educated people. This can be useful for the authorities to plan their course of action since it can potentially lead to an observable difference in the quality of life between the different socioeconomic groups in society. The authorities are implementing measures to reduce tobacco use, and therefore it is important to investigate whether this will increase, decrease or keep the socioeconomic differences constant.

There have been a number of previous literatures which tests whether education affects smoking behaviour. Not as much research has been carried out for the same with snus however. Grossman (1972) found that more educated individuals are better able to access and process health related information and make better health related decisions. Similarly, de Walque (2007) found that educated individuals are less likely to start smoking, and among those who initiated smoking, they are more likely to have stopped.

Giskes (2005) examined the trends in smoking behaviour across nine western European countries by education and found that men and women with tertiary level of education had a lower smoking and tobacco consumption than their less educated counterparts.

Pederson and von Soest (2014) found that both snus users and smokers came from more adverse socio-economic backgrounds, and were less adjusted to school. However, snus users were better adjusted to school than smokers.

In the recent years, there has been some research related to snus use and education. Norberg et al., (2011) evaluated the time trends in patterns of tobacco use among middle-aged population in Northern Sweden for the period 1990-2007 and found increasing differences in tobacco use between the educational groups. They found both a higher smoking and snus use prevalence among those with only basic education, and this was most noticeable in the younger age group of this population. However, they did not study the younger age groups that are most

vulnerable to snus use. They could have found very different results if they included the younger age group into their analysis.

When it comes to the Norwegian population, there has not been much research done on the context between snus use and educational levels. However, I did find one particular study from Norway which dealt with finding association between adolescent socioeducational status (SES) and use of snus and smoking. Øverland et.al (2010) found that adolescents with a lower SES had a much higher likelihood of smoking than those with a higher SES. However, they did not find any similar association between SES and snus use. Also, their focus was only on adolescent group aged 16-20 and they did not compare how the older age groups might have different results. Another difference is that they divided education according to academic, vocational and other category. In my thesis, I have categorized education based on level of education instead (primary referring to basic education, secondary referring to high school and tertiary referring to a university degree). This would give a more precise categorization in order to test the hypothesis that highly educated people tend to use snus less often.

3 Research Question

My aim is to test whether higher level of education is associated with lower snus use. Hence, the proposed research question is as follows:

> *'Is there an association between level of education and snus use in Norway? – An analysis of cross-sectional surveys from 2008 to 2015.*

In addition, I test for whether there is a visible time trend. Moreover, are men and women affected in the same manner? Are people of all ages affected in the same manner? Or are there specific age groups that are affected more than the others. For all this, I have analysed three groups mainly–a. only smokers, b. only snus users c. those who use snus to quit smoking. I analysed smokers mainly to compare it with the snus users, to see whether and how do they differ. I then aim to explain if and why they differ. Since snus is the one of the major aids in quitting smoking, I also looked at snus users who use it as an aid to quit smoking. This I believed would help shed light on the true effect of education on snus use.

Sub-questions:

The first demographic variable to investigate is education. I look into whether the proportion of snus users is less among those with low education than for those with high education in the 8 year period and if it's a significant one. The educational level variable will be divided into three levels primary education (less than a high school degree), secondary education (high school graduates) and tertiary education (university degree and above).

It could be interesting to see whether what field of education one undertakes affects the level of snus use. The field 'health, social sciences and sport' in particular seemed interesting. I investigate whether people within this field of education use snus less than people within other fields.

In the same manner, whether and how age affects the snus use is interesting to investigate. It is a known fact that younger people use snus more than older people. Previous research seems to be to have addressed the effects for young people, but there is little research for other age groups. Previous research also suggests that smoking control measures have an increased effect on young people (Siegel et al., 2008).

The next demographic variable I investigate in the thesis is gender. It also seems to be little research carried out on the significance of gender for snus use. It is a fact that women use snus less often than men. It could be interesting to see if this fact has something to do with education.

Next, I look at the civil status variable and examined whether married people and registered partners tend to use snus less often than those who are not.

I will also check if there is a time trend when looking at this relationship between snus use and education.

4 Data

In this section I describe the datasets that have been used in the analysis. I begin this chapter by presenting the dataset used and also mention what considerations must be taken into account. The sub-chapter provides a descriptive statistics of both the exogenous and endogenous variables that are used in the analysis. The data for this thesis was taken from Statistics Norways' Smoking Habits Survey and Travel and Holiday Survey and the dataset was then ordered from NSD (Norwegian Center for Research Data). The sample was drawn as a nationwide, representative sample in which all municipalities could be drawn. The survey is a result of telephone based interviews. The questions in the survey were both of quantitative and qualitative measures; but mostly quantitative because the questions were not so in depth in nature. However, there are some limitations with such type of interviews. For example, it is not guaranteed that the respondent is telling the truth.

For the endogenous variables (or the left-side variable), a dummy variable has been used which takes the value of 1 if the individual is a snus user and 0 if the individual is not a snus user. Similarly, in the other models, if the individual is a smoker, and if the individual uses snus to quit smoking, the dummy variable takes the value of 1 and 0 if the individual is not a smoker and the individual does not use snus to quit smoking. The exogenous variables (or the right-hand side variables) used in the analysis are level of education, age, gender, civil status, year, field of education and region(only for the smoker model).

The Smoking Habits Survey is available from 1973-2011, but questions regarding snus were only added from the year 2008. Hence, I have only used the data from 2008-2011. After 2011, the Smoking Habits Survey was incorporated into Travel and Holiday Survey. The Travel and Holiday Survey is available from 2012-2015. For each year, a random sample of people has been drawn. The same individual is not followed up over time over the years. In total, the data set that I used consists of 9495 individuals divided over the 8 years. For each year, there were on average 1186 respondents. The highest number of respondents was for the year 2015 with a total of 1941 respondents whereas the lowest number was for the year 2012 with only 923 respondents.

Table 1. – Number of respondents by year

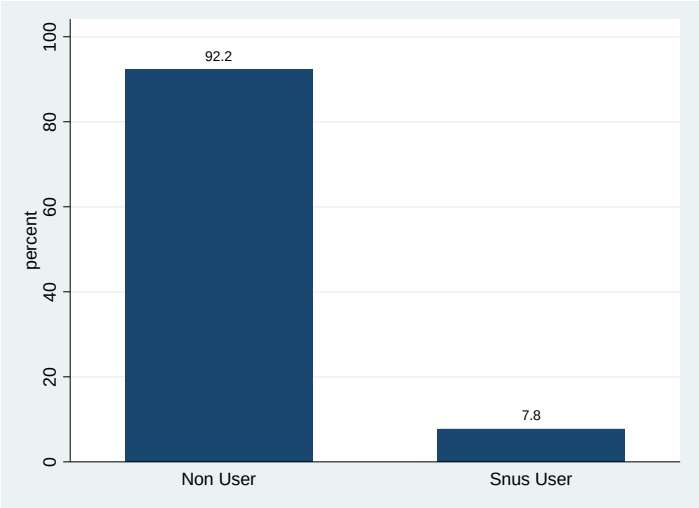
Year	Number of participants
2008	1136
2009	1206
2010	1072
2011	1158
2012	923
2013	1123
2014	936
2015	1941
Total	**9495**

Also, not all variables I inspected had all the observations. Only the three variables age, gender and region had all the observations. There are some missing observations in most of the variables. The variable that is the most important for the scope of the thesis i.e. the level of education has 333 observations missing. However, since this amounts to such a small number (0.037% of the total sample size), I simply removed them from the dataset regarding them as missing observations. I believe it would not make a significant difference since it is very few. Since the variable 'level of education' is the most important variable for this thesis, it is justified to remove observations of variables that do not have observations for the level of education variable.

4.1 Endogenous variables

The left hand side variable "snus user" in this analysis was derived from the question in the survey 'How often do you use snus'? Those who answered daily and occasionally were put into one category as snus users and got the value 1, whereas the ones who answered never got the value 0. The ones who answered 'I don't know' or 'I will not answer' were discarded from the study which corresponded to 35 respondents out of the 9495. Since this is such a small number, it would not make a significant difference if you disregard them from the final dataset. There were some missing observations (29 to be precise) that were also disregarded for the reason mentioned above. It is important to note that the variable 'snus user' refers exclusively to snus users who only use snus and do not smoke.

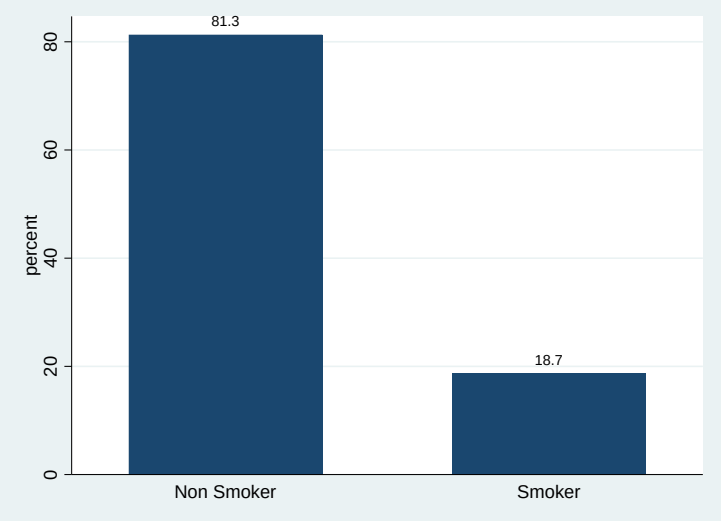
Figure 1. – Proportion of snus users compared to non-users (n=9431)



On average, a total of 7.8% of the respondents were exclusive snus users. However, if we only looked at the last couple of years(2014 and 2015), the percentage was higher (9.4%).

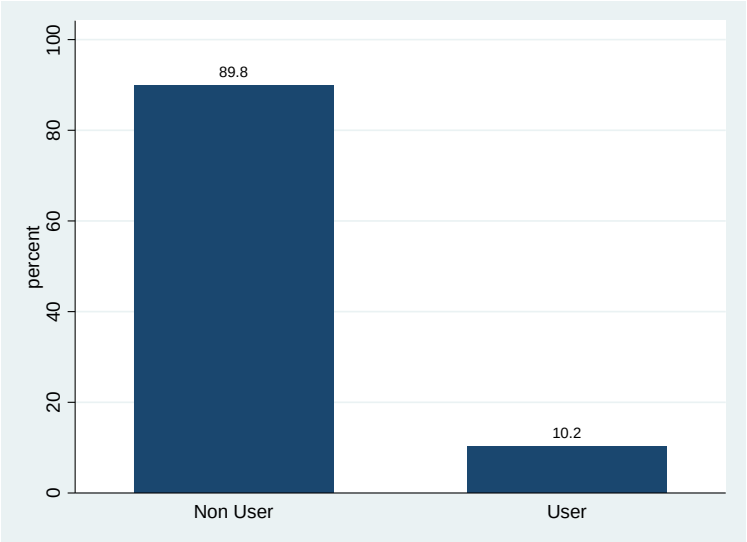
Similarly, for Model 1., the left hand side endogenous variable was those who smoke. This variable has been derived from the question ‘Do you happen to smoke?’ in the survey. Those who answered ‘yes’ got the value of 1 and the others got a value of 0. There were a few respondents who answered ‘Don’t know (3 respondents)’ and ‘I will not answer (12 respondents)’. Since this is such a small number, I simply choose to regard them as non-smokers. Similar to the ‘snus user’ model, the endogenous variable ‘smoker’ consists of only the smokers and not the snus users. If they happen to be both, they were not included in the variable.

Figure 2. – Proportion of smokers and non-smokers (n=9488)



Similarly, for Model 3., the endogenous variable will be those who use snus in order to quit smoking. Those who answered 'yes' got the value of 1 and the others got a value of 0.

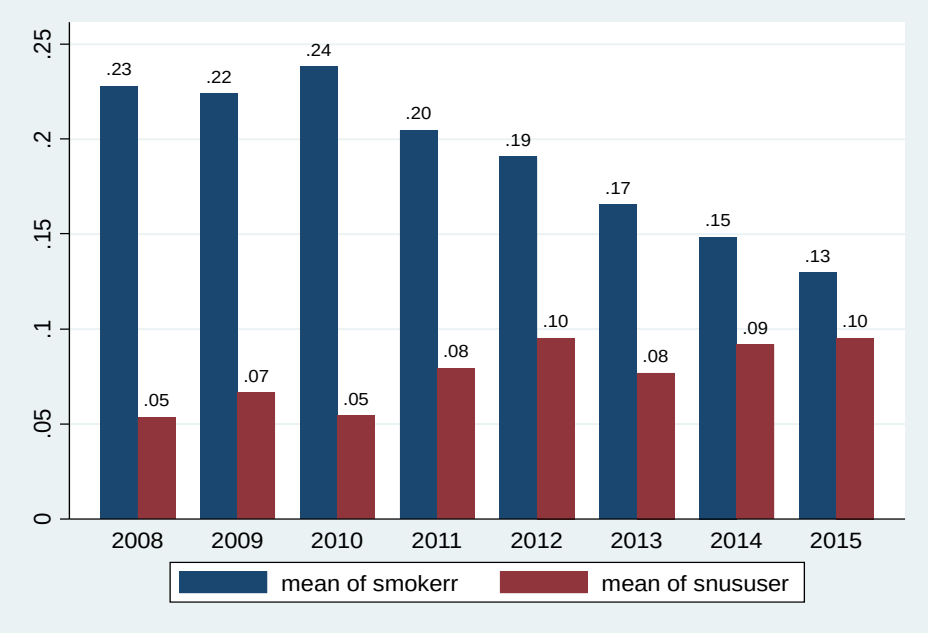
Figure 3. – Proportion of snus users who use it to quit smoking and who do not (n=1512)



Smokers compared to snus users

Figure 4. shows the trend in the proportion of snus users compared to smokers over the 8 year sample period.

Figure 4. - Smoking vs. Snus use by observation years[1]



[1] Refer to Appendix 4.

In the year 2015, approximately 10% of the sample were snus users and 13% were smokers whereas in 2008, only 5% of the sample was snus users and 23% were smokers. So we can see that smoking is becoming more and more unpopular and snus is slowly gaining popularity.

4.2 Exogenous variables

The exogenous variables used in the analysis are mostly background variables such as age, gender, region, level of education, civil status, field of education and year. The descriptive statistics of all the variables used are shown in the following table:

Table 2. - Descriptive Statistics

Variables	Observations	Mean	Std. Dev	Min	Max
Endogenous:					
Snus user	9431	0.08	0.27	0	1
Smoker	9488	0.20	0.39	0	1
Snus to quit	1512	0.10	0.30	0	1
Exogenous:					
Level of education	8786	2.11	0.74	1	3
Age	9495	2.56	0.99	1	4
Gender	9495	0.51	0.49	0	1
Married	6125	0.49	0.50	0	1
Field of Education	6129	2.86	2.55	0	9
Year	9495	2011.72	2.43	2008	2015
Region	9494	3.59	1.96	1	7

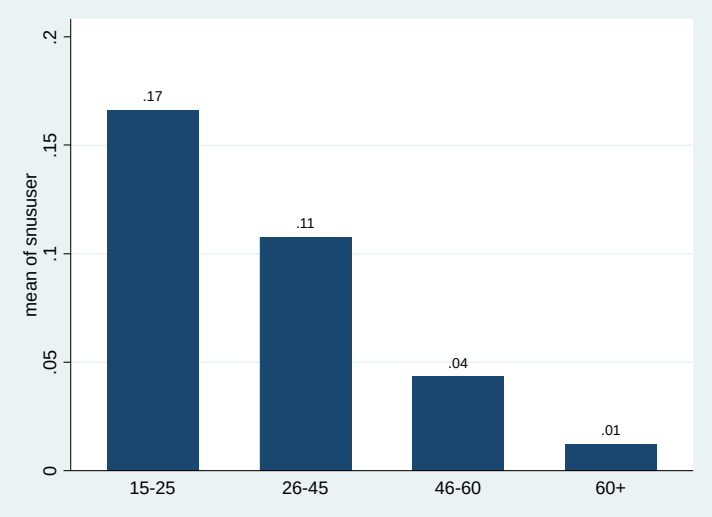
The observations are taken from the full sample. The total number of observations in the sample was 9495. The variables 'Married' and 'Field of education' were only available in the Travel and Holiday Survey. Hence, they have a lower number of observations than the other variables.

Age

The dataset consists of respondents of the age between 15 and 79. The average age was 45.38 with a standard deviation of 16.68. I have divided the ages into 4 groups- group 1 consists of respondents aged 15-25; group 2 of respondents aged 26-45; group 3 of respondents aged 46-60; and finally group 4 of respondents aged 61-79.

Group 2 had the most number of respondents comprising 34.2% of the respondents, followed by group 3 (28.6%), group 4 (21.7%) and group 1 (15.5%). From Figure 5., we see that out of the 4 age groups, the most popular snus using age group was the Group 1 (15-25).

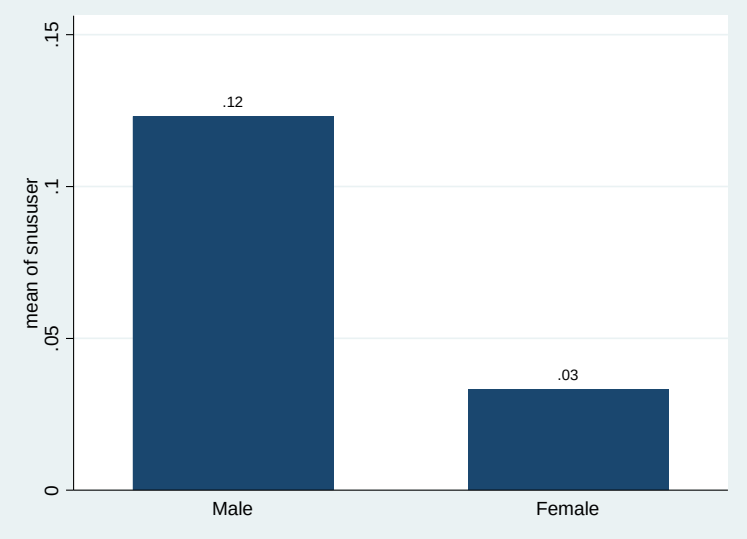
Figure 5. – Proportion of snus users by age group (n=732)



Gender

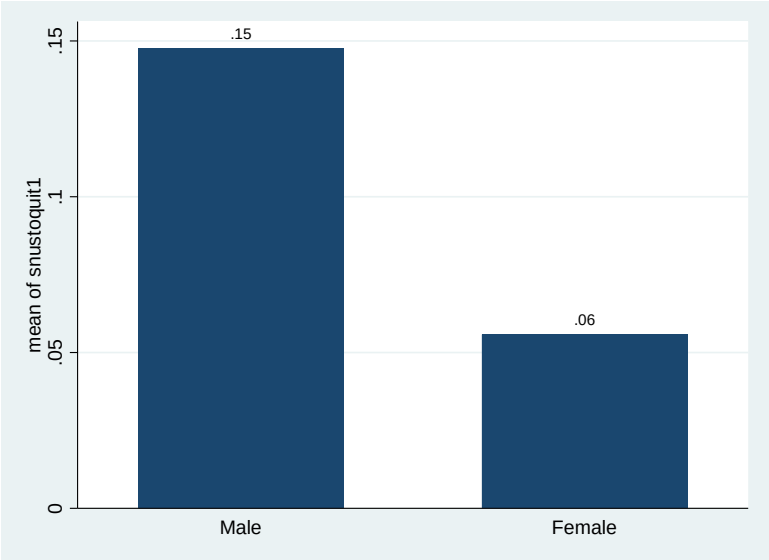
The sample was fairly distributed by gender. 49.4% of the respondents were male whereas 50.6% were females. Generally, men tend to use snus more often than females. Out of the 4663 males in the survey, 574 used snus whereas out of 4768 females, only 158 were found to be using snus.

Figure 6. – Snus use by gender (n=732)



It followed the same pattern i.e. males using it more than females among those who use snus to quit smoking.

Figure 7. – Snus use to quit smoking by gender (n=1512)



Level of education

This exogenous variable is of high interest for the thesis. It measures the degree of education in the respondents of the survey.

Table 3.- Education level (years of education)

Level of education	Frequency	Percentage	Cumulative
No education or pre-school (0)	14	0.15	0.15
Primary school (1-7)	15	0.16	0.32
Lower secondary school (8-10)	1944	21.22	21.53
Upper Secondary school 1(11-12)	1221	13.33	34.86
Upper Secondary school 2 (13+)	2351	25.66	60.52
Upper Secondary school 3 (14+)	260	2.84	63.36
University / College 1 (15-17)	2159	23.56	86.92
University/College 2 (18-19)	805	8.79	95.71
Research (20+)	17	0.19	95.9
Unspecified	376	4.1	100
Total	**9162**	**100**	**100**

Firstly, I have divided the 9 groups into 3 educational levels- primary education comprising of 10 years of education and under (1), secondary education comprising of 11-14 years of education (2) and tertiary education comprising of 15 years and above (3). There are a few missing observations, 333 to be precise which I have taken out of the dataset before calculating the other results. In addition to this, there are 376 observations which were categorized as unspecified education. I have chosen to regard this as missing observations and have taken this out of the dataset. As a result, the final number of observations for level of education was 8786, which is also shown in Table 2.

Figure 8. shows the proportion of respondents that belong to each of the three educational levels.

Figure 8. – Level of education composition (n=8786)

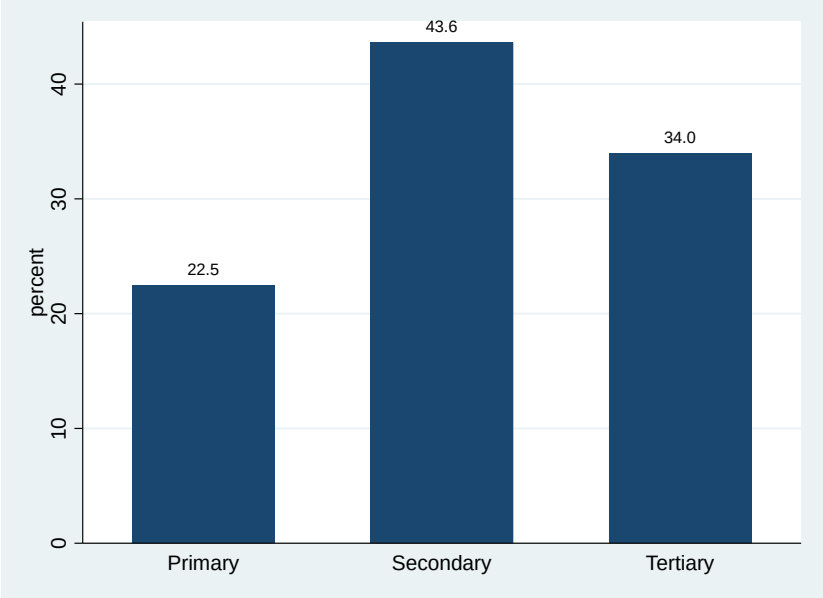
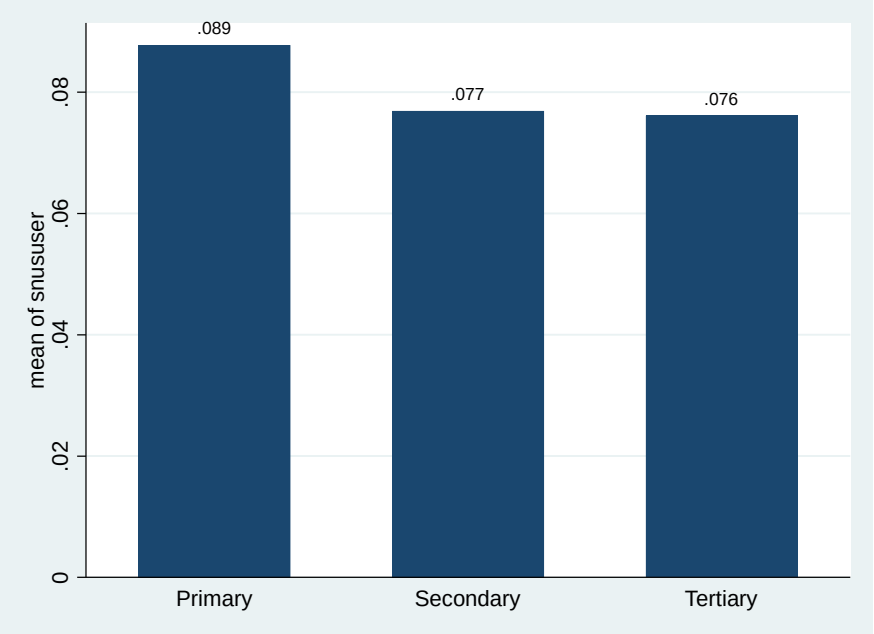


Figure 9., shows that 8.9 % of primary education level respondents are snus users, whereas 7.69% in secondary education level used snus and 7.61% in tertiary level use snus. So at first look, it does look like the higher the education, the lesser the snus use. I investigated this in closer detail later in the thesis.

Figure 9. – Snus use by level of education



Civil status

This variable civil status shows whether the respondent is unmarried, married/registered partner, widower, separated or divorced. What I test in this thesis is whether married and registered partners tend to use snus less often than others.

The Smoking Habits Survey is missing this variable 'civil status', which has been included only in the Travel and Holiday Survey. Hence, this variable is missing for the three years 2008, 2010 and 2011 and as a result I only had a total of 6125 observations for this variable. Out of these, the number of married people or people with registered partners and the unmarried are fairly distributed with 49.4% and 50.6% respectively.

Then, when I compared the proportion of 'married and registered partners' snus users with 'unmarried' ones, I find that 11.98% of the unmarried respondents were snus users whereas only 5.12%% of the married or registered partners were using snus.

Field of education

Finally, the discipline or the field of study is also one of the variables that I inspect. In particular, I look at whether those who study heath, social sciences and sport discipline tend to value their health more and use snus less. Once again, this variable was not available for

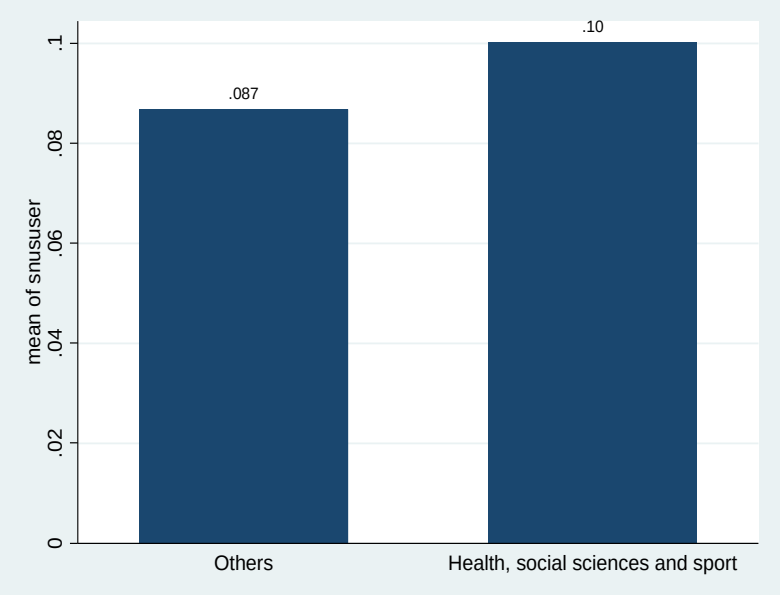
the years 2008, 2010 and 2011 which resulted in limiting the numbers of observations to 6129.

Table 4.- Field of education composition

Field of education	Frequency	Percentage	Cumulative
General	1899	30.98	30.98
Humanistic/Aesthetic subjects	471	7.68	38.66
Pedagogics	402	6.56	45.22
Social sciences and law	638	10.41	55.63
Economics and Administration	1064	17.36	72.99
Natural sciences and technical subjects	925	15.09	88.08
Health, social sciences and sport	350	5.71	93.79
Primary industries subject	21	0.34	94.13
Transport, security and service	49	0.8	94.93
Unspecified	310	5.06	100
Total	**6129**	**100**	**100**

Figure 10., shows the average snus use for the two groups – those who took health, social sciences and sport and others.

Figure 10. – Proportion of snus users by health, social sciences and sport field and others



5 Methods

In this chapter, I discuss the methods used in the analysis. I start this chapter by describing the linear probability model and then the logit model. I present the results from both the models but I use only the linear probability model in my analysis and I also justify my choice of model for the analysis. The regressions are run using the computer program STATA.

5.1 Linear Probability Model

Model in matrix form

$$Y = X\beta + \varepsilon \qquad (1)$$

Equation 1 can be broken down into the following.

$$Y = \begin{pmatrix} Y_1 \\ . \\ . \\ . \\ Y_n \end{pmatrix}, X = \begin{pmatrix} 1 & x_1 \\ 1 & x_2 \\ . & . \\ . & . \\ 1 & x_k \end{pmatrix}, \beta = \begin{pmatrix} \beta_0 \\ \beta_1 \\ . \\ . \\ \beta_k \end{pmatrix}, \varepsilon = \begin{pmatrix} \varepsilon_1 \\ . \\ . \\ . \\ \varepsilon_k \end{pmatrix} \qquad (2)$$

The variable ‘Y’ refers to the endogenous variables ‘smoker, ‘snus use’ and ‘snus use to quit smoking’ in Model 1, 2 and 3 respectively. The exogenous variables are set up on a matrix form so that X illustrates an n * k-matrix of all explanatory variables. The variable β is a k*1 vector with coefficients (β1..βk) which is shown in equation (2).

The residual value has the expected value equal to zero conditional on X.

$$E\ (\varepsilon|X) = 0 \qquad (3)$$

The endogenous variable snus use, smoker and snus use to quit can only have a value of 0 or 1, and are all dichotomous variables. However, this is only an assumption. This assumption is not always realistic for the linear probability model (Confer Figure 11, when x=0 for example). The Linear Probability Model can be estimated using the ordinary least squares

method. This is a simple method which is relatively easy to interpret. In LPM, you interpret the marginal effects. Instead of looking at the unit change in endogenous variable given one unit change in the exogenous variable, we look at the change in probability of an outcome given change in the exogenous variable. It makes more sense to look at the likelihood or the probability of an outcome since we have a binary variable with a dummy assigned to it. The probabilities must always add up to 1.

Problems with the linear probability model (LPM):

1. Heteroskedasticity: This can be fixed by using the "robust" option in Stata.
2. In the LPM, it is possible to get a predicted probability < 0 or > 1. This does not make sense as you can't have a probability below 0 or above 1. This is a fundamental problem with the LPM. This is why, we consider non-linear models such as logit and probit.

5.2 Logistic regression

Model in matrix form

$$L = X\beta + \varepsilon \qquad (4)$$

$$\beta = \begin{pmatrix} \beta_1 \\ . \\ . \\ . \\ \beta_n \end{pmatrix}, \; X = \begin{pmatrix} 1 & x_1 \\ 1 & x_2 \\ . & . \\ . & . \\ 1 & x_k \end{pmatrix} \qquad (5)$$

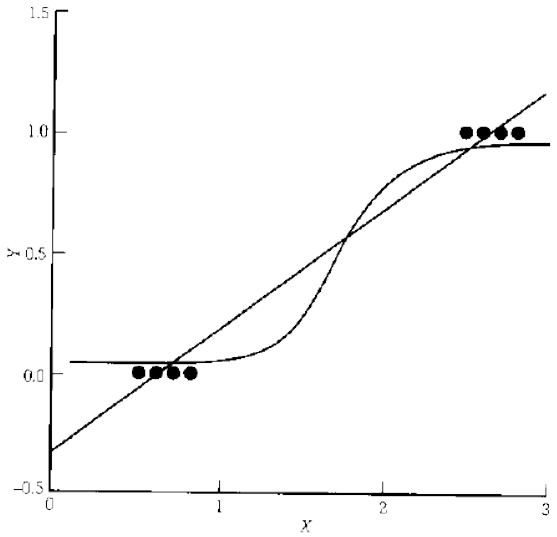
The basic dichotomous logistic regression equation for K exogenous variables is as follows:

$$L_i = \alpha + \beta_{1i}X_{1i} + \beta_{2i}X_{2i} + \cdots + \beta_K X_{Ki} \qquad (6)$$

$$where\ L_i = \ln(\frac{p_i}{1-p_i})$$

Logistic regression parameters can be estimated using the maximum likelihood estimation (MLE) technique. In the logit model, the marginal effects are not constant as in OLS, but vary with the size of the exogenous variables. The relationship between the exogenous variables and the endogenous variable will therefore be an S shaped curve.

Figure 11. - Linear Probability Compared to Logistic Regression (Figure copied from : Knoke and Bohrnstedt, 2002)



The logit model is therefore more cumbersome to use than the LPM for this reason. Therefore, I will be presenting the results from both LPM and logit model but for carrying out the analyses, I use the LPM despite some of its limitations.

5.3 Model Specification

I present three models, Model 1 with smoker as the endogenous variable, Model 2 with snus user as the endogenous variable and Model 3 snus use to quit smoking as the endogenous variable. The regression I end up with is shown in equation (7), (8) and (9) respectively.[2]

Model 1 specification

$$smoker = \alpha_0 + \alpha_1 levelofeducation + \alpha_2 age + \alpha_3 female + \alpha_4 year + \alpha_5 fieldofeducation + \alpha_6 married + \alpha_7 region + \varepsilon_{i0} \quad (7)$$

[2] Before running these, I also run regressions for all three models with what I believe to be are the important background variables like age, gender, level of education and year as exogenous variables. The model specification for this is shown in Appendix 2.

The endogenous variable smoker says something about the probability that the individual smokes, given the exogenous variables. The likelihood of success, that is, the probability for an individual to smoke is a linear function of the exogenous variables. The variable region is added into this model.

α_1 gives the effect of the variable 'level of education' on smoking. A negative value of α_1 indicates that smoking decreases with the level of education. Similarly, $\alpha_2$gives the effect of the variable age of the interviewer on smoking and so on.

Model 2 specification

$$snususe = \alpha_0 + \alpha_1 levelofeducation + \alpha_2 age + \alpha_3 female + \alpha_4 year + \alpha_5 fieldofeducation + \alpha_6 married + \varepsilon_{i0} \quad (8)$$

The endogenous variable snus use says something about the probability that the individual uses snus, given the exogenous variables. The likelihood of success, that is, the probability for an individual to use snus is a linear function of the exogenous variables.

α_1 gives the effect of the variable level of education on snus use. A negative value of alpha1 indicates that snus use decreases with the level of education. Similarly, α_2 gives the effect of the variable age of the respondent on snus use and so on. The residual is expected to have a value of zero.

Model 3 specification

$$snustoquit = \alpha_0 + \alpha_1 levelofeducation + \alpha_2 age + \alpha_3 female + \alpha_4 year + \alpha_5 snusharm + \varepsilon_{i0} \quad (9)$$

The endogenous variable 'snus to quit' says something about the probability that the individual uses snus to quit smoking, given the exogenous variables. The likelihood of success, that is, the probability for an individual to use snus to quit smoking is a linear function of the given exogenous variables. The variable 'snus harm' is added into this model to see if the respondents use snus less if they think that it is harmful.

6 Results

In this chapter, I discuss the results from the regressions carried out in this analysis. As described in Chapter 5, I first start with a model with only the most important variables for my study - level of education, age and gender before I add more variables.

In Model 1, I had smoker as the endogenous variable and age, gender, level of education and year as the exogenous variables. Furthermore, I continued in the same model where I included variables- civil status, region and the field of education. I looked at region for the model with smokers because I wanted to check if northern Norway has significantly higher likelihood of smokers compared to the other regions in Norway. The results are shown below:

Table 5.- Smoking status, coefficients in linear probability model and logit model (n=8,781)

Variable	LPM Coefficient	Std. Error	Logit Coefficient	Std. Error
Level of education-				
Secondary education	-0.089 ***	0.012	-0.529 ***	0.069
Tertiary education	-0.186 ***	0.012	-1.234 ***	0.082
Age-				
26-45 year old	0.133 ***	0.013	0.964 ***	0.111
46-60 year old	0.199 ***	0.013	1.355 ***	0.108
61 and above	0.094 ***	0.013	0.684 ***	0.114
Female	0.034 ***	0.008	0.232 ***	0.056
Year	-0.015 ***	0.001	-0.103 ***	0.011
Observations		8781		
R2		0.055		

LPM – Linear Probability Model; *** p-value <1%, ** p-value< 5% , * p-value < 10%

Table 5. shows the results of the regression from a linear probability model and the logit probability model and shows the effect of the exogenous variables on smoking. It shows the relationship between smoking and the various dummies for educational level, age and gender. Under the column LPM coefficient, we have the coefficients of the variables from the Linear Probability Model which tells us the effect of the variable to the left. The - sign means that there is a negative relationship between the variable and smoking. We see that there is significantly higher likelihood of smoking among women than men. The positive coefficient 0.034 tells us that for every 1 unit increase in female smokers, the expected likelihood of smoking increases by 3.4 percentage points on average, holding all other variables constant. This is highly significant at 1% significance level.

For age, the reference category is 15-25 year olds. From the table, we see that the likelihood of smoking increases with age for the first 2 age groups. The effect is greater when moving from the 15-25 year olds to 26-45 year olds than when moving from 26-45 to 46-60 year olds. This effect is also highly significant. However, for the oldest age group, this likelihood is decreasing when compared with their younger age groups. This can be explained by the age effect i.e. as you reach old age, you are more prone to diseases. Hence, this may result in lessened smoking or an additional motivation to quit smoking altogether.

Furthermore, one can read from Table 5. that the higher the level of education, the lesser the likelihood of smoking. In fact, with every 1 unit increase in secondary education level, the expected probability of smoking decreases by 8.9 percentage points, holding all other variables constant. This effect is significant at a 1% level of significance for all educational groups. For the tertiary educational level, this effect is twice as much, meaning with every 1 unit increase in tertiary education level, the expected probability of smoking decreases by 18.6 percentage points, holding all other variables constant.
This fits well with the previous studies on the relationships between education and proportion of smokers presented in chapter 2 - Background.

Also, with the observation period, there is a significantly lower likelihood of smoking. This is understandable as we see in Figure 4., smoking is becoming unpopular by the years and snus is gradually gaining popularity.

Next, I add more exogenous variables into the same model. The variables civil status, region, and the field of education are added. The results are shown below.

Table 6.- Smoking status, coefficients in linear probability model and logit model (Extended model) n=5,864

Variable	LPM Coefficient	Std. Error	Logit Coefficient	Std. Error
Level of education -				
Secondary education	-0.061 ***	0.018	-0.402 ***	0.125
Tertiary education	-0.162 ***	0.022	-1.262 ***	0.164
Age -				
26-45 year old	0.154 ***	0.016	1.204 ***	0.146
46-60 year old	0.236 ***	0.017	1.750 ***	0.148
61 and above	0.149 ***	0.017	1.148 ***	0.156
Female	0.027 ***	0.010	0.204 ***	0.076
Year	-0.015 ***	0.002	-0.108 ***	0.016
Married	-0.067 ***	0.011	-0.483 ***	0.079
Field of education-				
Humanities	0.028	0.024	0.280	0.184
Pedagogics	0.028	0.025	0.358 *	0.205
Sociology	-0.023	0.021	-0.157	0.162
Economics	-0.014	0.019	-0.085	0.143
Natural sciences	-0.028	0.020	-0.186	0.148
Health and sport	-0.015	0.025	-0.073	0.182
Nutrition	0.096	0.097	0.484	0.465
Transport	0.003	0.063	0.001	0.369
Unspecified	-0.016	0.052	-0.065	0.44
Region-				
Hedmark and Oppland	0.000	0.020	-0.01	0.151
Ostlandet	0.004	0.014	0.031	0.112
Agder og Rogaland	0.040 **	0.016	0.291 **	0.118
Vestlandet	-0.001	0.015	-0.014	0.118
Trondelag	-0.021	0.017	-0.193	0.149
North Norway	0.016	0.019	0.107	0.136
Observations		5864		
R2		0.060		

The number of observations is lesser here than the previous table because the variable 'Field of education' and 'Marital status' is missing in Smoking Habits Survey. The reference category is an unmarried 15-25 year old male with primary education from Akershus/Oslo from general field of study.

Once again, we see that there is a significantly higher probability of smoking among women. Moreover, the likelihood of smoking within the age group of 26-45 year olds increases by 15.4 percentage points as compared to 15-25 year olds, holding all other variables constant. Hence, the older you are, the more likely it is that you smoke, and this effect is also significant. But for the final age group i.e. 60+ year olds, the likelihood of smoking is lower compared to the other two age groups.

Furthermore, you can see in the table that the higher the level of education, the lower the probability of smoking. This effect is significant at a 1% significance level for all education groups. For secondary education level, the probability of smoking is 6.1 percentage points lower than for primary education level. Similarly, for the tertiary education level, the probability of smoking is 16.2 percentage points lower than the primary education level. Married and registered partners have a 6.7 percentage points lower likelihood of smoking than their non married counterparts. This effect is significant at 1% significance level.

With field of education, the effect was not found to be significant. Even though the effect was not significant, the likelihood of smoking was found to be lower for health and sport field of study compared to the general field of study which is the reference category here. With smoking, I was interested in the region of North-Norway. Once again, I did not find a significant effect but people in the north of Norway had a higher probability of smoking than people from Oslo and Akershus.

Preliminary Summary for smoking -

The major findings from Model 1 were as follows. Women had a significantly higher likelihood of smoking than men. This effect was robust even when additional variables were added into the regression equation. With age, 26-45 year olds had a significantly higher probability of smoking than 15-25 year olds and 46-60 year olds had an even higher probability of smoking. However for the age group 60 and above, the probability was lower than the previous two age groups. An explanation for this could be that older people are more prone to diseases and as a result are more likely to quit. As for education, the results were quite robust. The higher the level of education is, the lower is the likelihood of smoking. This effect is stronger in tertiary level of education.

The logit probability model coefficients signs and size were similar when compared to the linear probability model.

Model 2 Snus use, education, age and gender

Next, in model 2, I run the same regression as in model 1, but here I have snus users as the endogenous variable. I do not include region in this model as I believe there to be no significant correlation between region and snus use. The results are shown below.

Table 7.- Snus use status, coefficients in linear probability model and logit model (n=8,726)

Variable	LPM Coefficient	Std. Error	Logit Coefficient	Std. Error
Level of education -				
Secondary education	0.016 **	0.007	0.289 **	0.116
Tertiary education	0.013 *	0.008	0.313 **	0.129
Age -				
26-45 year old	-0.071 ***	0.013	-0.674 ***	0.114
46-60 year old	-0.142 ***	0.012	-1.740 ***	0.136
61 and above	-0.172 ***	0.011	-3.062 ***	0.226
Female	-0.090 ***	0.005	-1.476 ***	0.095
Year	0.005 ***	0.001	0.087 ***	0.017
Observations		8726		
R2		0.0754		

LPM = Linear Probability Model; *** significant at 1%, **significant at 5% and *significant at 10%

The R2 denotes the coefficient of determination. It explains how much variability of one factor can be explained by its relationship to another factor. The R2 here is 0.0754 meaning that together age, gender and level of education explain 7.54% of the variation in snus use. We see that the results are more or less opposite when compared to smoking. There is a significantly lower likelihood of snus use among women. This is highly significant at 1% significance level. For age, the reference category is once again 15-25 year olds. From Table 7., we can see that the proportion of snus users is likely to decrease with age for all age groups. For 46-60 year olds, this effect is twice as much compared to 26-45 year olds. This effect is also highly significant.

Furthermore, one can see that secondary level of education has a higher likelihood of using snus than primary level of education. This effect is significant at a 5% level of significance. However, as one moves from secondary to tertiary level of education, this likelihood of using snus slightly decreases by 0.3 percentage points.

Also, with the observation years, there is a higher likelihood of using snus. This is because snus is becoming more and more popular as the years go by and especially within the 8 year period (2008-2015).

Next, I added more exogenous variables into the same model. The variables civil status and the field of education were added. The results are shown below.

Table 8.- Snus use status, coefficients in linear probability model and logit model (Extended model) n=5,810

Variable	LPM Coefficient	Std. Error	Logit Coefficient	Std. Error
Level of education -				
Secondary education	0.039 ***	0.014	0.539 ***	0.177
Tertiary education	0.045 ***	0.016	0.685 ***	0.225
Age -				
26-45 year old	-0.056 ***	0.016	-0.442 ***	0.142
46-60 year old	-0.124 ***	0.015	-1.366 ***	0.168
61 and above	-0.157 ***	0.015	-2.552 ***	0.258
Female	-0.102 ***	0.007	-1.471 ***	0.111
Year	0.004 **	0.001	0.052 **	0.024
Married	-0.03 ***	0.007	-0.413 ***	0.116
Field of education-				
Humanities	-0.034 *	0.018	-0.401	0.258
Pedagogics	-0.023	0.018	-0.333	0.289
Sociology	-0.018	0.015	-0.250	0.227
Economics	-0.038 **	0.015	-0.443 **	0.190
Natural sciences	-0.033 **	0.014	-0.495 **	0.220
Health and sport	-0.007	0.019	-0.067	0.240
Nutrition	-0.003	0.058	0.073	0.723
Transport	-0.072 **	0.029	-1.159	0.714
Unspecified	-0.085 ***	0.024	-1.816 *	1.055
Observations		5810		
R2		0.080		

LPM = Linear Probability Model; *** significant at 1%, **significant at 5% and *significant at 10%

Here the reference category is an unmarried 15-25 year old male with primary education from general field of study. From the table, we can see that there is a significantly lower probability of snus use among women. Moreover, the proportion of snus use within the age group of 26-45 year olds decreases by 5.6 percentage points as compared to 15-25 year olds, holding all other variables constant. Hence, the older you are, the less likely you use snus, and this effect is also highly significant. Furthermore, you can see in Table 8. that the higher the level of education, the higher the probability of snus use. This effect is significant at a 1% significance level for all education groups. For secondary education level, the probability of snus use is 3.9 percentage points higher than for primary education level.

Similarly, married and registered partners have a 3 percentage points lower likelihood of using snus than their non married counterparts. This effect is highly significant at 1% significance level.

With the field of education, there is a lower likelihood of snus use if you are in the health and sport field than general field which is the reference category here. However, this effect was not found to be significant. However, within the field economics, there was a significantly lower likelihood of snus use as compared to the reference category i.e. general studies.

Preliminary summary for snus users

The major findings from Model 2 were as follows. Women had a significantly lower likelihood of smoking than men. This effect was robust even when additional variables were added into the regression equation. With age, 25-40 year olds had a significantly lower probability of using snus than 15-25 year olds. This likelihood is twice as less for 45-60 year olds. The 60 and above age group had an even lower probability of using snus. This is expected because the snus is mostly popular among the younger population. As for education, the higher the level of education, the higher was the likelihood of snus use. This was found to be significant at a 1% significance level. For field of education, there we no clear effects of the fact that the health and sport field has a negative relationship with snus use.

Now, since a majority of people use snus as an aid to quit smoking, in model 3, I run the regression with snus users who use snus to quit smoking as the endogenous variable and the exogenous variables age, gender, level of education, year and snus harm as the exogenous variables.

Model 3 Snus to quit and level of education, age and gender

Next, in model 3 I run the same regression as in the previous models, but here I have snus users who use snus as an aid to quit smoking as the endogenous variable. The results are shown below.

Table 9.- Snus use to quit smoking status, coefficients in linear probability model and logit model (n=1,003)

Variable	LPM Coefficient	Std. Error	Logit Coefficient	Std. Error
Level of education-				
Secondary education	-0.028	0.020	-0.298	0.245
Tertiary education	-0.036	0.026	-0.347	0.337
Age-				
26-45 year old	-0.059 *	0.040	-0.294	0.296
46-60 year old	-0.130 ***	0.038	-1.179 ***	0.320
61 and above	-0.138 ***	0.039	-1.477 ***	0.451
Female	-0.066 ***	0.019	-0.821 ***	0.250
Snus harm	-0.028 ***	0.005	-0.318 ***	0.062
Year	-0.001	0.009	0.000	0.113
Observations		1003		
R2		0.085		

From Table 9., we see that females have a lower likelihood of using snus to quit smoking. Similarly, the likelihood is decreasing with age. However, the magnitude by which it is likely to decrease is different. 26-45 year olds have a 5.9 percentage points lower likelihood of using snus to quit smoking than 15-25 year olds. Whereas 46-60 year olds have an even lower likelihood of using snus to quit smoking compared to 26-45 year olds. One interesting variable here is ‘snus harm’. It refers to how harmful the respondents think snus is. So, from the table we see that the more they think that snus is harmful, the less likely it is for them to use snus to quit smoking.

7 Discussion

We clearly see a tobacco use pattern when it comes to the three educational groups. The difference between the educational levels is important to be aware of for planning future legislative changes accordingly, especially among the lower educated group with smoking. On the other hand, for snus, we see that the higher educated people tend to use snus more than their lower educated counterparts. An explanation for this could be that since snus is not considered to be as dangerous, the more educated people know this and so they prefer snus over smoking.

7.1 Results compared to previous research

In this sub-chapter, I compare my results with previous research. The results in chapter 6 show that there are significant effects of level of education, age, gender in both snus use and smoking. The results were however roughly opposite in case of smoking and snus use.

Norberg et. al (2011) in their research found increasing differences in tobacco use between the educational groups. They found both a higher smoking and snus use prevalence among those with only basic education. My results had similar findings for smoking within the primary education level. However, for snus use, my findings were the opposite i.e. people with basic education had a lower snus use prevalence and this prevalence increased with level of education. This could be because the highly educated people are more knowledgeable about the clinical studies that show that snus is not harmful and hence, they prefer snus more over smoking. This is in support to Grossman (1972).

Øverland et.al (2010) found that adolescents aged 16-20 with a lower socio educational status (SES) had a much higher likelihood of smoking than those with a higher SES. However, they did not find any similar association between SES and snus use. My findings do support their findings in case of smoking i.e. the higher the education level, the lower the likelihood of smoking. On the other hand, for snus, I found that the higher the education level, the higher the likelihood of smoking. However, the size of the effect was marginal as we move from the secondary to tertiary level.

For age, it seems to be a significant negative effect. It implies that the older one is, the lesser is the likelihood of snus use. Similar results were found for snus as an aid to quit smoking.

This makes sense because firstly snus is popular among the younger population and secondly if you are quitting at an older age, it might be because of some tobacco related health problems. Hence, you would not use snus which is also a form of tobacco to quit smoking. For smoking, the results were vice versa. There were more smokers among older people than among younger people.

With gender, women had a higher likelihood of smoking than men. On the other hand, with snus, women had a lower likelihood of using snus than men. An interesting explanation for this could be 'trendiness' quotient associated with tobacco use. Hetland, Wiium and Aarø (2009) in their research found that snus use was perceived as trendier than smoking. Moreover, males thought that snus use was trendier than females. Hence, this could explain the gender differences in snus use.

7.2 Limitations

Linear probability model

In the thesis, I present results from two models- the linear probability model and logistic regression model. However, I analyze only the linear probability model despite some limitations mentioned in Chapter 5. I justify my choice of model because the sign of effects was the same in both logit model and the linear probability model. The logit model is however, more difficult to interpret.

Low value of R2

Another weakness with the model is a relatively low R2 value. The main model presented in Table 8 has an R2 value of 0.08. In other words, the model only explains 8% of the variation in snus use. However, this does not mean that the model should be rejected or is invalid. Because there are of course many others things that help determine whether an individual use snus or not, for example their income, their parents, relatives and friends using snus, psychological factors, etc. If these variables were included in the model, R2 could have a higher value.

In my analysis, I do not have many variables relatively. It is also not possible to include all the relevant variables into the model given the dataset. Because the dataset is so big, I conclude that the findings would not be much different with a higher R2.

Follow-up

The observations do not include the same person over the 8 years. The results would be clearer if we could observe the change in snus use behavior of the same person both pre and post education.

Missing observations

Because I combined two surveys into my analyses and there were some questions that were only added into the later survey, this resulted in a lower number of observations for some of the variables such as civil status and field of education. This, in turn, removed all the observations which had these two variables missing.

7.3 Further Research

Due to limitations in the data set, I could not have some variables like income in the analyses. In future research, it would be interesting to include the variable 'income' as it is an important variable in determining whether people use snus or use cigarettes for that matter.

I would also like to suggest researchers to classify snus users into daily and occasional snus users and carry out the research. This could show us different results. There were variables in the data set in order to do this, but I omitted this because it was beyond the scope of my thesis.

7.4 Practical implications

We know that education and health outcomes can be correlated. Past research has established that highly educated people in general have better health and live longer than people with lesser education (Cutler and Lleras-muney, 2006; Lager and Torssander, 2012; Clark and Royer, 2013) . This thesis found that the highly educated people have a higher likelihood of using snus. But the important thing to have in mind is that clinical studies show that snus is not as harmful as cigarettes. Hence, it may be that the highly educated prefer snus over more

harmful forms of tobacco such as cigarettes. However, the correlation could go the opposite way as well. The health of an individual could tell us about the level of education of the person. For instance, poor health can put education at risk. This could also then affect the snus use. However, my thesis does not examine which way the effect goes. More research into this is needed to better understand the determinants of snus use and health outcomes. This is also crucial in the effective implementation of tobacco control policies especially for targeted groups such as low education groups.

In addition, many people do not know the risks associated with the different forms of tobacco products. Coming up with a way to make the users aware about the risk continuum of the different tobacco products could pave way to interesting results. If we treat low risk tobacco products and high risk traditional tobacco products the same, rather than recognizing them as low-risk alternatives to smoking, this can be a problem more than a solution (Lund et.al, 2014). In the same manner, taxing all tobacco products in the same manner discourages smokers from switching to lesser harmful alternatives.

Also, the results in Table 9 show that the more the respondents thought that snus was harmful, the less likely it was for them to use it as an aid to quit smoking. This makes sense because they maybe would rather use other lesser harmful aids of quitting such as nicotine patches. But of course these are all just assumptions. Further research into this is suggested.

8 Conclusion

Research has shown that highly educated people in general are less likely to suffer from poor health and more likely to live longer. Past research also shows that highly educated people have a lower likelihood of smoking. However, most of these studies were only aimed at finding correlation between education and smoking. Not much research has been carried out to investigate the association between snus use and level of education. In some studies that looked at both snus use and smoking, they were not looked at separately.

This thesis investigates snus users and smokers separately and examines whether and how the level of education is associated with snus use and compares the results with that of smoking. In other words, the thesis explores how different the association is for the different demographic groups in society. This is important in the effective implementation of tobacco control policies or health related policies especially for disadvantaged groups such as low education groups (since low education groups in general have poorer health).

My findings show that there are differences in the effects for the different groups in the society. The older you are, the less likely you use snus. Women had a lower likelihood of using snus than men. Furthermore, non-married and respondents without registered partners had a higher likelihood of using snus than their married counterparts. There may be several reasons for this, but I have not had the opportunity to analyze more closely. One possible reason may be that married people value their health more and hence use less tobacco, but these are only conjectures. With year, the likelihood of smoking was lesser and lesser but for snus, the users were increasing with year. One possible reason for this could be the stricter smoking related laws and comparatively higher health risks of cigarettes. Also, it is very convenient and discreet to use snus.

As for the most important variable for the scope of this thesis, level of education, highly educated people were found to have a higher likelihood of using snus. This effect was however marginal. An explanation for this could be that the highly educated people are more aware of the health risks associated with the different forms of tobacco and hence take the lesser harmful form of tobacco ‘snus’. With smoking, the results were opposite and in line with the previous literatures.

I believe that this study will be helpful to future scholars and researchers who wish to conduct further research on this particular topic as the findings from this study have increased the understanding of the snus users and smokers separately. One of the main findings of the thesis was that the highly educated have a higher likelihood of using snus. In the same manner, previous research has shown that people with higher education level have better health. By this logic, there could be some association between snus use and health outcome. I have not investigated this in my thesis. But it could be interesting to closely examine this and find out which way the effect goes. Hence, further research into this is suggested.

References

Andersson, G., Axell, T. and Curvall, M. (1995). Reduction in nicotine intake and oral mucosal changes among users of Swedish oral moist snuff after switching to a low-nicotine product. Journal of Oral Pathology and Medicine, 24(6), pp.244-250.

Clark, D. and Royer, H. (2013). The Effect of Education on Adult Mortality and Health: Evidence from Britain. American Economic Review, 103(6), pp.2087-2120.

Cutler, D. and Lleras-Muney, A. (2006). Education and Health: Evaluating Theories and Evidence. National Bureau of Economic Research.

Daniel Roth, H., Roth, A. and Liu, X. (2005). Health Risks of Smoking Compared to Swedish Snus. Inhalation Toxicology, 17(13), pp.741-748.

de Walque, D. (2007). Does education affect smoking behaviors?. Journal of Health Economics, 26(5), pp.877-895.

Gakidou, E., Afshin, A., Abajobir, A., Abate, K., Abbafati, C., Abbas, K., Abd-Allah, F., Abdulle, A., Abera, S., Aboyans, V., et.al. (2017). Global, regional, and national comparative risk assessment of 84 behavioural, environmental and occupational, and metabolic risks or clusters of risks, 1990–2016: a systematic analysis for the Global Burden of Disease Study (2016). The Lancet, 390(10100), pp.1345-1422.

Giskes, K. (2005). Trends in smoking behaviour between 1985 and 2000 in nine European countries by education. Journal of Epidemiology & Community Health, 59(5), pp.395-401.

Grossman, M., (1972). The demand for health : a theoretical and empirical investigation, New York: Columbia University Press.

Knoke, D., Borhnstedt, G.W. & Mee, A.P., (2002). Statistics for social data analysis 4th ed., Itasca, Ill: Peacock.

Lager, A. and Torssander, J. (2012). Causal effect of education on mortality in a quasi-experiment on 1.2 million Swedes. Proceedings of the National Academy of Sciences, 109(22), pp.8461-8466.

Lund, K. and McNeill, A. (2012). Patterns of Dual Use of Snus and Cigarettes in a Mature Snus Market. Nicotine & Tobacco Research, 15(3), pp.678-684.

Lund, I. and Lund, K. (2014). How Has the Availability of Snus Influenced Cigarette Smoking in Norway?. International Journal of Environmental Research and Public Health, 11(11), pp.11705-11717.

Norberg, M., Lundqvist, G., Nilsson, M., Gilljam, H. and Weinehall, L. (2011). Changing patterns of tobacco use in a middle-aged population – the role of snus, gender, age, and education. Global Health Action, 4(1), p.5613.

Norwegian Institute of Public Health. (2019). [Internet] Available at: https://www.fhi.no/globalassets/dokumenterfiler/rapporter/2014/health-risks-of-scandinavian-snus-consumption-english-summary-pdf.pdf [Accessed 19 Apr. 2019].

Norwegian Institute of Public Health. (2019). Smoking and snus use. [Internet] Available at: https://www.fhi.no/en/op/hin/lifestyle/royking-og-snusbruk-i-noreg/ [Accessed 19 Apr. 2019].

The Norwegian Directorate of Health (2019). Tobacco Control. [Internet] Available at: https://helsedirektoratet.no/english/tobacco-control#norway's-tobacco-control-strategy [Accessed 19 Apr. 2019].

Pederson, W. and von Soest, T. (2014). Tobacco use among Norwegian adolescents: from cigarettes to snus. Addiction, 109(7), pp.1154–1162.

Rostron, B., Chang, J., Anic, G., Tanwar, M., Chang, C. and Corey, C. (2018). Smokeless tobacco use and circulatory disease risk: a systematic review and meta-analysis. Open Heart, 5(2), p.e000846.

Siegel, M., Albers, AB., Cheng, DM., Hamilton, WL., and Biener, L. (2008). Local Restaurant Smoking Regulations and the Adolescent Smoking Initiation Process: Results of a Multilevel Contextual Analysis Among Massachusetts Youth. Arch Pediatr Adolesc Med, 162(5), pp.477–483.

Statistics Norway (2019). Snus more used than cigarettes. [Internet] Available at: https://www.ssb.no/en/helse/artikler-og-publikasjoner/snus-more-used-than-cigarettes [Accessed 19 Apr. 2019].

Wiium, N., Aarø, L.E. and Hetland, J., (2009). Subjective attractiveness and perceived trendiness in smoking and snus use: a study among young Norwegians. Health Education Research, 24(1), pp.162–172.

World Health Organisation (2019). Tobacco. [Internet] Available from: https://www.who.int/news-room/fact-sheets/detail/tobacco [Accessed 19 Apr. 2019].

Øverland, S., Tjora, T., Hetland, J., and Aarø, L.E. (2010). Associations between adolescent socioeducational status and use of snus and smoking. Tobacco Control, 19(4), pp.291-296.

Appendices

Appendix 1

In Model 4, I include both snus users and smokers together and test for the same variables as in Model 1. I included both snus and cigarette users (tobacco users) as the endogenous variable in order to check if the effect is even more profound here as one would expect. Those who both smoke and use snus get a value of 1 and the others get a value of 0.

Model 4 Dual users

Variable	LPM Coefficient	Std. Error	Logit Coefficient	Std. Error
Level of education -				
Secondary education	-0.018 ***	0.005	-0.390 ***	0.141
Tertiary education	-0.031 ***	0.005	-0.954 ***	0.186
Age -				
26-45 year old	-0.047 ***	0.006	-0.605 ***	0.149
46-60 year old	-0.075 ***	0.006	-1.613 ***	0.186
61 and above	-0.089 ***	0.006	-2.904 ***	0.335
Female	-0.038 ***	0.003	-1.318 ***	0.143
Year	0.000	0.001	-0.016	0.024
Observations		8726		
R2		0.043		

For dual users of snus and cigarettes, there was a negative relationship between level of education and use. Similarly, there was a lower likelihood of using both, with age. Females also had a lower likelihood of using both than males. All these effects were highly significant at 1% significance level. The results were similar when we look at the coefficients from the logit probability model.

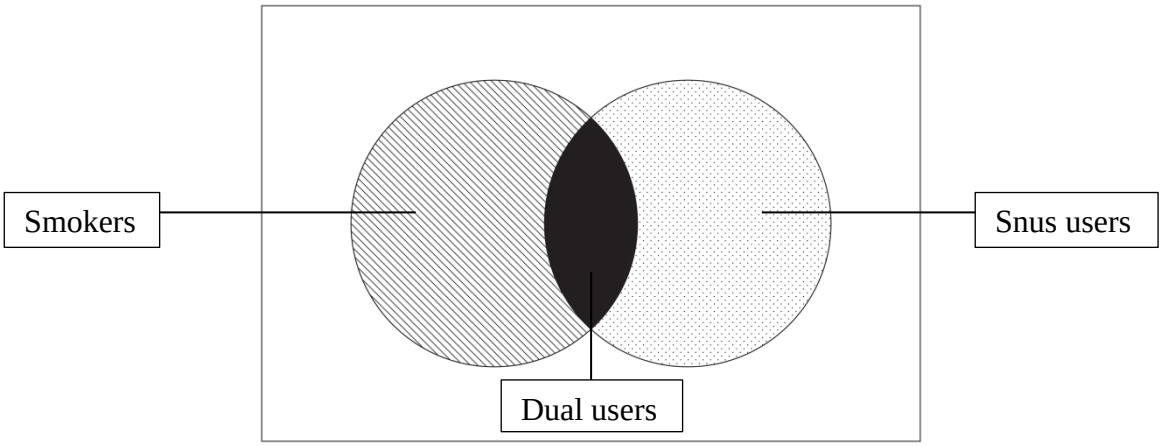
Appendix 2

Simplified model specification used in the analysis:

$$snususe = \alpha_0 + \alpha_1 levelofeducation + \alpha_2 age + \alpha_3 female + \alpha_4 year + \varepsilon_{i0}$$

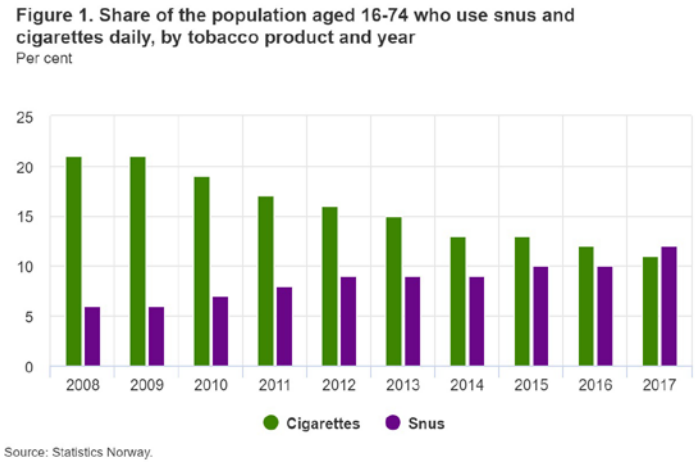
$$smoker = \alpha_0 + \alpha_1 levelofeducation + \alpha_2 age + \alpha_3 female + \alpha_4 year + \varepsilon_{i0}$$

Appendix 3



Appendix 4

Source: Statistics Norway (2019)



This is different from Figure 4. even though it is based on the same dataset because the above graph in Appendix 4 also includes dual users whereas in Figure 4, I looked at smokers and snus users separately.