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Navn:	Hanna Løchen

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Hanna Løchen

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Excise Duties and Cross-border Trade

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Espen R. Moen

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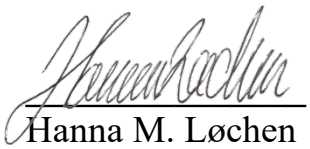
Abstract

In this thesis I study the influence Norwegian excise have on the Norwegian/Swedish cross-border trade. I highlight relevant literatue and construct models to explain the consumer behavior mechanisms. I then run an OLS linear regression in order to study the interplay between taxes and weekly cross-border traffic. I find that Norwegian taxes have a significant impact on cross-border trade, but I also discover that so does several other economic variables. My conclusion becomes that it is hard to measure the exact influence caused by excise duties alone, since there is so many other factors involved. As taxes affect the Norwegian prices, poor and/or addicted people, in addition to the marginal consumers, tend to be the most responsive to tax changes.

Acknowledgements

I would like to express my gratitude to my supervisor Espen Rasmus Moen for clear and structural feedback, kind support, understanding and guidance. As he did not have much background from cross-border trade research, together we have managed to get a solid grip on the topic. Due to the effort he put into getting a broad understanding of the theme, his feedback has been extremely helpful.



Hanna M. Løchen

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Chapter 1: Introduction and Background

1st of December 2020, the Norwegian government agreed on the final 2021 state budget, after hours of discussing certain elements. One of the most shocking decisions made that day, was the tax cuts of alcohol, tobacco and sugary goods, which several of the parties at the parliament have been working to further increase for many years. The tax on beer and wine went down 10%, alcohol free drinks went down 50%, the Norwegian tobacco product "snus" went down 25%, and chocolate and sugar became free of tax (Regjeringen, 2020).

Frp, the party that fronted this case, argued that these changes needed to be done in order to try and reduce the current trade leakage the Norwegian economy is experiencing due to cross-border shopping in Sweden. Siv Jensen (Frp) stated that this matter is solely about whether Norwegians should leave their money with Swedish merchants, or if they should leave it in the Norwegian treasury (NRK, 2020).

Due to this current case, I became interested in investigating the relationship between the Norwegian tax level and the volume of cross-border shopping in Sweden. As I figured out that it does not, to my knowledge, exist any research on this particular topic, and little on Norwegian/Swedish cross-border trade in general, I considered this topic as perfect for my master thesis. As these taxes is a part of the price faced by the consumers on these goods, it is perhaps obvious that changes in the taxes would change the Norwegian consumer behavior – and thereby the amount of cross-border shopping. Yet I am curious for evidences, and also of how the consumer behavior adapts.

Since the Swedish border is currently closed due to the coronavirus, it is hard to measure the direct and instantaneous effects of the tax changes that was decided last December. My thesis will try and establish some answers on the responses to tax changes before 2020, thus, my thesis will mainly deal with the years 2000-2019.

In this thesis I will highlight relevant historical data and previous publications on the subject, as well as economic models and intuition. I also display a linear regression based on what I considered as the most crucial factors for my topic. Based on the literature and the analysis, I will try to answer the research question of this thesis, which is the following

"*Do Excise Duties affect Cross-border Trade?*"

Mainly Norwegian tax rates and Norwegian-Swedish border trade will be in focus. The goods in focus are snus, cigarettes, alcoholic beverages, non-alcoholic beverages and chocolate and candy, as these are goods that are highly taxed in Norway, and, as it turns out, the goods Norwegians tend shop in Sweden. Norwegians also do buy large amounts of groceries across the border, but as the taxation of all the different food categories would be many, as well as it already exist several publishments on groceries and cross-border shopping, I decided not to include this in my thesis.

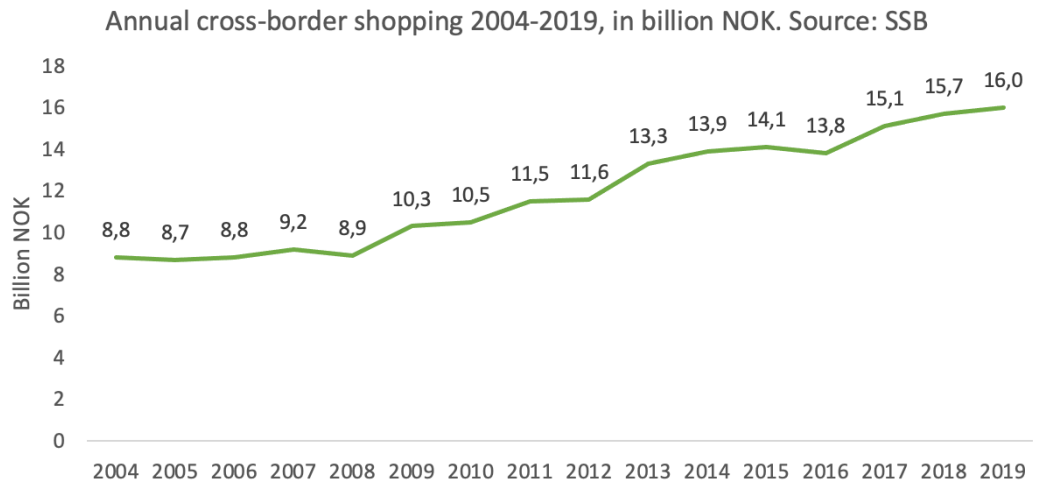
Chapter 2: Literature Review

The theoretical foundation of this master thesis will be previous publications and historical data that is relevant to excise duties and cross-border shopping. I will mainly focus on data from Statistics Norway (SSB.no) and the Norwegian government (Regjeringen.no). There are not too many publications within this research area, but the ones I present is mainly the ones published by Menon Economics (2017), Friberg et al. (2019) and various authors via Statistics Norway.

2.1 The Norwegian cross-border trade

We see an increasing trend in how much money, in current prices, Norwegians leave with foreign merchants. In 2019 Norwegians used 336 million NOK more on cross-border shopping than in 2018. One must also assume that there exists many dark numbers in the cross-border trade, as many of the transactions made by Norwegians abroad are difficult to trace. One can therefore imagine that these numbers are even higher in reality. Parts of the increase in shopping across the border can be explained by economic growth, but the most important reason is that Norwegians cross-border trade in larger volume and more often (Menon Economics, 2017). 92% of the Norwegian cross-border trade is happening in Sweden, mainly in Strömstad (48%) and Charlottenberg (23%) (Henriksen, 2020; SSB, 2020).

Graph 2.1.1 Annual Cross-border Shopping, 2004-2019

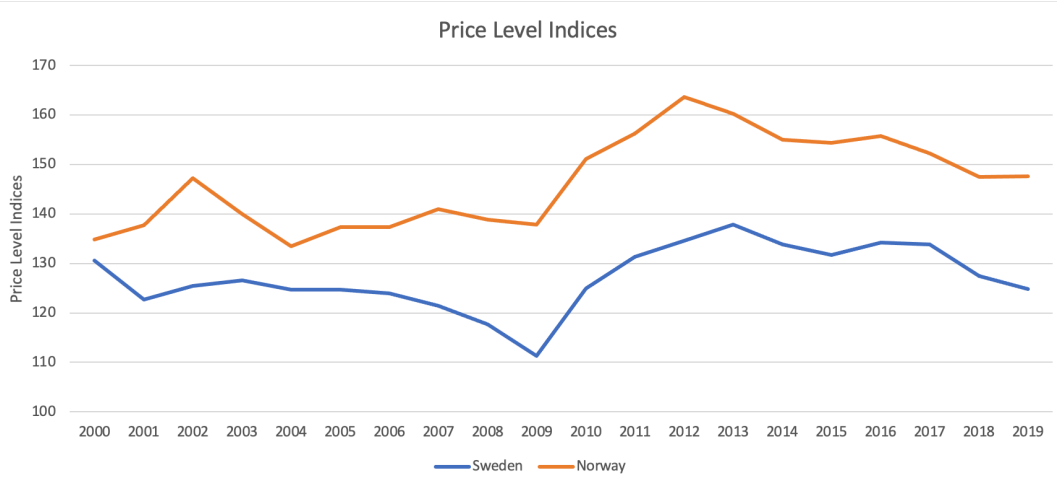


Source: Henriksen (2020)

Various studies show that over half of what Norwegians shop across the border was spent on goods such as alcohol, soda and mineral water, snus and tobacco, and chocolate and sweets. These are all goods that, throughout the last decades, have had large price differences in Norway compared to neighboring countries – much due to high taxation of these goods in Norway. These are goods Norwegians can save the most by shopping abroad to a lower price, so many people take advantage of that opportunity (Henriksen & Kvile, 2020 (a)).

2.2 Price differences and travel distances

Graph 2.2.1 Price Level Indices, Norway and Sweden



Source: Eurostat (n. d.)

In this graph, we can see that the price level indices in Norway and Sweden are quite different. A price level index is a measurement for the price level in a country, compared to one or more other countries. These indices are based on the gross domestic product in each country. The price level index is defined as purchasing power parity divided by the exchange rate (SSB, n.d. (a)). The updated, relevant price levels that are currently used are the ones normalized so that the price level in EU27 (EU members prior to 2020) equals 100 in each year (Eurostat, n. d.). We see from the graph that Sweden is above EU27 in all the years, but Norwegian prices are strikingly in comparison. Based on the price level indices, one can imply that Norwegian prices are relatively high compared to Sweden.

Price level indices can also be expressed through various product groups, including alcoholic beverages, non-alcoholic beverages and tobacco. These goods tend to almost be twice as expensive in Norway compared to Sweden, according to the indices (Eurostat, n. d.). These price differences is due to many differences in

economic factors between the two countries. The Norwegian excise duties on the mentioned goods is likely to be one of these factors.

Restrictive policies such as tariffs and taxes on food and the mentioned goods and, high incomes, a retail structure characterized by high internal competition and a dispersed population across a large mountainous country are other possible factors that contribute to high price levels in Norway (Friberg et al., 2019). As the price level indices depend on the exchange rates, fluctuations to these rates will cause the price level differences between Norway and Sweden to vary over time. Although the curves have flattened out somewhat the past years, there is still enormous price differences – making it overall beneficial for Norwegians to cross-border trade (Henriksen & Kvile, 2020 (a)).

The baseline price of products sold are determined by the sellers, and the tax added, as the ones handled in this thesis, is added to the total price faced by the consumer. The consumer pays these taxes. In this way, the suppliers have some power of what share the tax will constitute out of the total price. This share will, to some degree, affect the price sensitivity by the demanders concerning a change in the taxes (Grønn, 2016). The market structure of Norwegian and Swedish merchants for these products are a little different. In Norwegian grocery stores, you are able to buy drinks with alcohol content up to and including 4.7%, while stronger drinks have to be bought at Vinmonopolet. In Sweden this limit is a little less, with a maximum of 3.5%, and everything stronger has to be bought at Systembolaget (Stokke, 2016). So, medium beer (4.5%) is sold in Norwegian grocery stores, whom may set their own prices, while in Sweden these are sold to a fixed price at the state alcohol company. Tobacco merchants and grocery stores can to a greater extent also in Sweden set their own prices.

Not only are price differences large, but Swedish stores are also relatively accessible since Sweden and Norway share an elongated border. The majority of the Norwegian population live in the southeast and the Oslo-region, and the distance to the border for these consumers is 30-200 minutes – making these the ones that shop the most across the border (70% of the total). This explains why Strömstad and Charlottenberg is the most visited destinations across the border (Menon Economics, 2017).

2.3 An overview of taxes and the mechanisms they may bring

Excise duties on various goods and services are mainly based on providing the state with revenue, that is, that they are fiscally justified. In addition, these taxes can be used as a tool to price socio-economic costs of using products that are harmful to health and climate and to influence the consumer behavior into a desired direction (Finansdepartementet, 2020). Excise duties also exist to preserve producers and suppliers, in Norway in particular the agricultural sector (Friberg et al., 2019). Altogether, these taxes are made to please national profit-based self-interests and to better the public health.

Due to the many factors mentioned of why Norwegians shop across the border, these fees work somewhat against their purpose – creating a costly trade leakage. Menon Economics (2017) estimated the repercussions of cross-border shopping, both direct and indirect, to cost the Norwegian economy 11.750 jobs, 7,8 billion in value creation and at least 4,9 billion in public revenues annually. These numbers are calculated based on what Norway could have alternatively gained if it were not for imports by travelers, affecting both the industry and raw material sector. As the Norwegian consumers easily have access to shop cheaper substitutes across the border, it is difficult for the governments to steer the population away from these harmful goods – making the public health worse off.

What should be the government's best approach then, since the consumer behavior is hard to control? The consumers seem to find a way to buy the goods they want, and as the government sets high taxes, Norwegians find a way to buy them somewhere else. What would happen if the government cut their taxes? Perhaps the results would not turn out to be that bad, but just instead increase Norwegian profits? Some interesting findings was discovered in the article by Mäkelä & Österberg (2009) on the tax cuts on alcoholic beverages in Finland in 2004. This was done to try and reduce cross-border shopping to Estonia. What turned out to be the result was that the cross-border trade remained practically unchanged, while the total Finnish alcohol consumption increased by 10% the following year, and alcohol-related harms and deaths increased as well.

Consumer behavior is not always rational, and it can be difficult to predict possible outcomes. What happened in Finland can likely be explained by the fact that even though alcoholic beverages got cheaper in their own country, it was still profitable for many to travel to Estonia and buy it there instead. And for those who lived farther from the border, who did not shop abroad before the cuts, suddenly

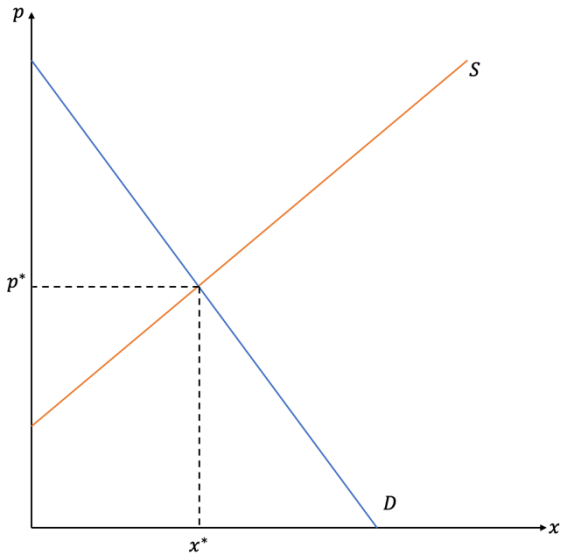
got access to cheaper alcohol. Mäkelä & Österberg (2009) concluded that alcohol taxation and alcohol prices *do* affect consumption and relation harms, and heavy drinkers and poor people are the most responsive to price.

Chapter 3: An Economic Interpretation

To examine how the market respond to changes in price, due to for instance a change in taxes, I dig into some microeconomic theory in this chapter to try and explain some of the mechanisms in the market. The models in chapter 3.1 is based on basic microeconomic models of market equilibria, mainly inspired by the theories in the books Moderne Mikroøkonomi by Riis & Moen (2017) and Anvendt Mikroøkonomi by Grønn (2016). In chapter 3.2 I design an appropriate Hotelling model inspired by the article by Friberg et al. (2019).

3.1 Market equilibria

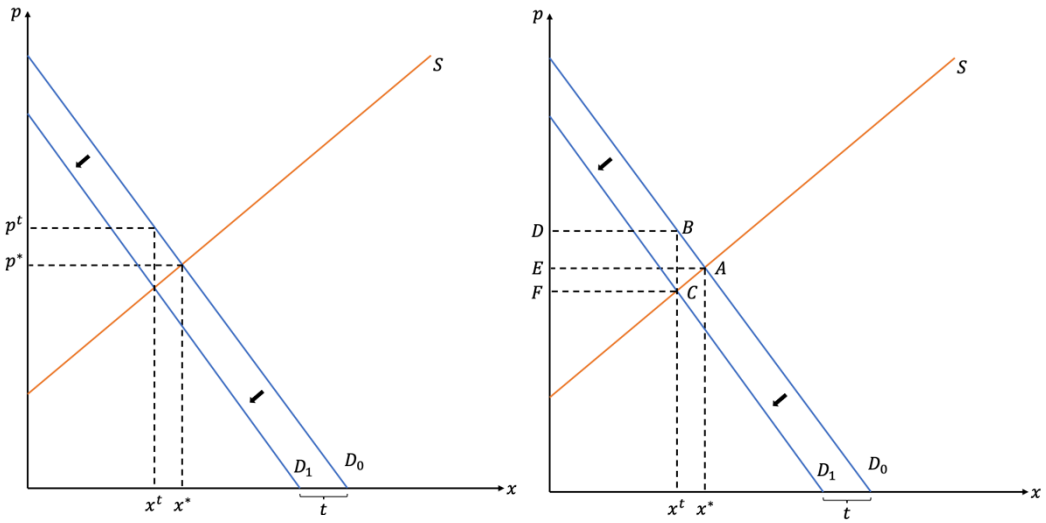
Figure 3.1.1 Overview Norwegian Supply and Demand



This model describes the relationship between Norwegian potential sellers and buyers of alcoholic beverages, tobacco, non-alcoholic beverages, chocolate and candy in a market with perfect competition – no taxes involved. In a perfect market, the price and quantity would be set at the intersection between the two curves, shown by (p^*, x^*).

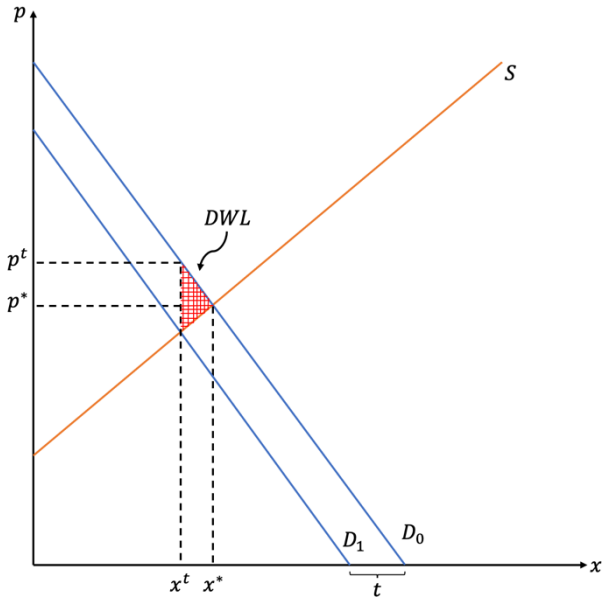
But then the government introduce a tax on these goods, increasing the price and reducing the quantity. This tax is implemented as the government *wants* the population to consume less of these goods, as they are considered harmful to health. The price facing the consumer is now the price set by the supplier plus the tax set by the government. A higher total price causes the Norwegian demand for these goods to shift inwards. The new equilibrium (p^t, x^t) creates a dead weight loss to the economy.

Figure 3.1.2 Mechanisms by Taxation



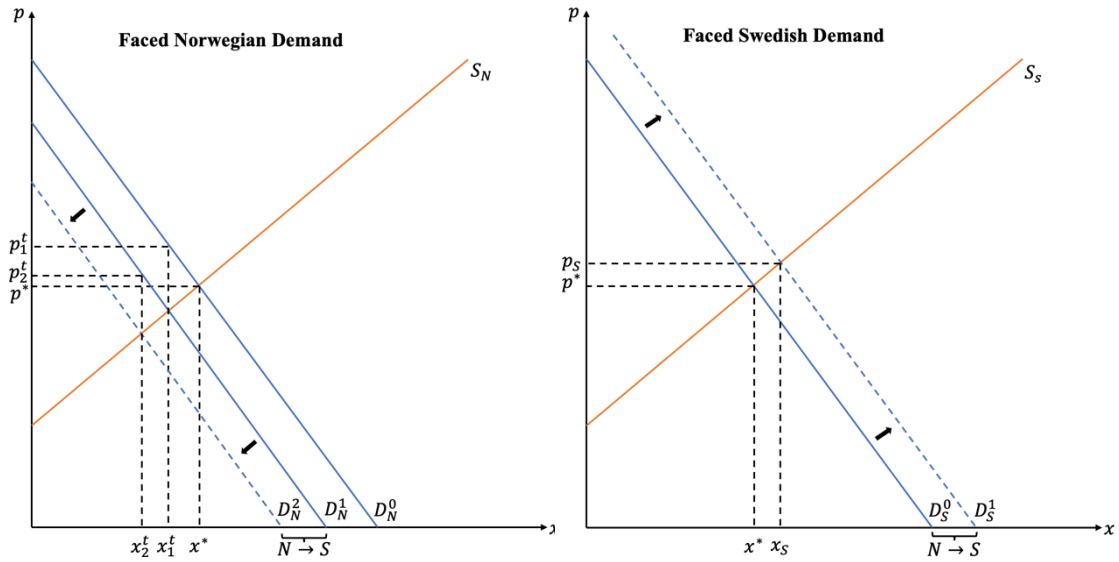
The tax is paid by the consumer, so this affects him poorly. He now gets less beer and tobacco for his money, as some of the transaction goes to pay the tax. The consumer would prefer to pay price p^* and buy quantity x^*. The consumers lose the area $ABDE$. The producer also suffers a loss, because they now sell less quantity. The loss to producer surplus is the area $ACFE$. The government, who gets the profits from these taxes, gains a surplus of the area $BCFD$. The dead weight loss from taxation is the area that no one gains, and simply represent the value creation that goes lost due to the decrease in quantity sold. The socio-economic loss to the Norwegian economy equals the area ABC.

Figure 3.1.3 Dead Weight Loss from Taxation



Assume that the Swedish suppliers and demanders have the same base model as Norway has. Sweden has no tax, so their price is equal to p^*. Some of the Norwegian consumers have the ability to buy these goods in Sweden to price p^*, so that is what they do. Thus, a part of the Norwegian demand moves from the Norwegian market and over to the Swedish one. Sweden is thus experiencing an increased demand for these goods at the expense of a lowering of this demand in Norway. The demand faced by Norwegian suppliers has now shrunk even more.

Figure 3.1.4 Transfer Norwegian demand from Norway to Sweden



As the demand now is smaller in Norway, the suppliers lower their price to meet the new demand – the price goes from p_1^t to p_2^t. This is a loss to Norwegian suppliers. Even though the prices go down, the quantity sold decreases as the demand goes down. The Norwegian equilibrium, considering both taxes and cross-border shopping, is (p_2^t, x_2^t). The tax rate is the same as before, but due to decreased demand, they gain less revenue from these excise duties, as their revenue is $x * t$. The Norwegian consumers on the other hand, do not suffer from this shift, as they get their difference in quantity in Sweden instead – note that $x_1^t - x_2^t = x_S - x^*$.

In reality, p^* in Norway and p^* in Sweden are not equal, due to many economic differences. From my illustration, p_2^t seems like a lower price than p_S, which is not the case – because then it would not be profitable for Norwegians to go to Sweden. Alternatively I could have set different base prices for the two countries in order to make my model more correct, but as the differences in demand, supply and economic factors are hard to express correctly in such models, I chose

this approach. The illustration demonstrate the shifts in demand that both Norway and Sweden experiences, and thus I believe it is sufficient for its purpose.

The interpretation of the two shifts in Norwegian faced demand is the following: (i) The first shift harms both the consumers and the suppliers, which causes a dead weight loss in the economy. Even though the government gains revenues on behalf of the market, there will still be some value lost. (ii) The second shift makes the government and the supplies lose profits due to cross-border shopping. The consumers does not suffer from this, in fact, they even may experience a surplus, because in total they still get their demanded quantity. As explained, p_S will in reality turn out to be a lower price than p_2^t, so the consumers would in that case experience a surplus based on what they gain from shopping a part of their demanded quantity in Sweden. Additional to this, the price on these goods in Norway goes down from p_1^t to p_2^t, making the consumers access cheaper goods in their own country as well – creating a surplus.

It is hard to tell whether the second mechanism will zero out or not, as it is difficult to calculate the exact size of the total Norwegian consumer surplus, because of the surplus created by the cross-border shopping. This is because the Swedish equilibria model may be, as mentioned, somewhat misrepresented. If the Norwegian consumer surplus and the losses to suppliers and government revenues would even each other out, the economy may not experience markable socio-economic costs because of cross-border shopping. Nevertheless, it would be preferrable to Norway that the supply and total demand were to intersect in the Norwegian model, as both the sellers, the consumers and the authorities would benefit from it.

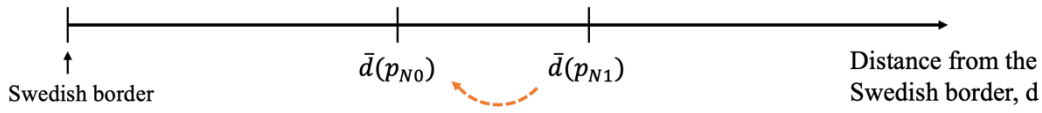
As the goods I am focusing on in this thesis are considered harmful to health, the ripple effects from the given Norwegian equilibrium would perhaps make the socio-economy worse off than assumed above. The consumers will end up buying these goods cheaper than what they would do in figure 3.1.2. Chances are that there will be further dynamics to this model, creating new equilibriums, as the consumers always hunt down the cheapest price. This is the opposite of what the government wants, in regards to the tax they set. If one count the repercussions of lower price in Norway and cross-border shopping, the socio-economic computation will most likely *not* even out – considering other factors than just pure profits.

3.2 Responses to demand

How sensitive the consumers are to relative price changes between two countries, when it comes to cross-border shopping, depends on their travel distance to the closest border. The people within a given radius from the border will be the ones affected the most by potential relative price shifts (Gopinath et al., 2009). Friberg et al. (2019) reveals that the estimated response to a relative price change when it comes to cross-border shopping is the strongest at the intermediate travel times from the border – it is hump shaped.

Friberg et al. (2019) use exchange rates, and they look at possible effects from a weakened Norwegian currency – making goods relative more expensive in Sweden than before the decline. Looking at the same case from a tax perspective, if the taxes of some goods go down in Norway, these goods will be relative cheaper in Norway than before the change. Thus, we look at two sides of the same coin. They explain the hump shaped effects of relative price changes by distance-related travel costs, and how the trip across the border should be profitable for the consumer. The marginal consumer is the one who is indifferent between traveling to Sweden to shop and purchase the good in Norway. A decrease in the price from p_{N1} to p_{N0} on the given goods in Norway, for instance due to a tax decrease of these goods in Norway, would shift the location of the indifferent consumer (denoted by $\bar{d}$) closer to the border.

Figure 3.2.1 A Norwegian Price decrease in a Hotelling model



For example, the indifferent consumer would for instance live in Sandvika before the price change, while after the change this consumer would might live in Oslo – a little closer to the Swedish border. This coordinate reveals the point where the calculation of a trip to Sweden equals zero.

Chapter 4: Regression Analysis

To provide some independent evidence that cross-border shopping is affected by changes in excise duties, I made analyses based on five data sets: i) border crossings from the Norwegian Public Roads Administration, ii) historic excise duties from the Norwegian Ministry of Finance, iii) price level indices from Eurostat, iv) exchange rates between Swedish and Norwegian currency (SEK/NOK) from the Norwegian Central Bank, and v) Norwegian GDP from Statistics Norway.

4.1 Methodology and Research Hypotheses

The main objective of this thesis is to create an analysis of the impact Norwegian excise duties have on Norwegian/Swedish cross-border trade. To do this, I use a linear OLS multiple regression with three independent variables. The usage of the least-squares estimator rather than any other competing estimator, is justified by the Gauss-Markov theorem, which satisfies assumptions of linearity, independence and constant variance, but does not assume that the distribution is normal. The multiple regression model allows me to examine the effects of a particular independent variable on the dependent variable, holding other factors fixed. To my mission in this thesis, I decided that the OLS linear regression was sufficient for my analysis.

The hypothesis I am testing is the following

H_A: Do Norwegian excise duties have a significant impact on cross border trade?

In this chapter, I will determine whether it exists statistical proof to confirm this hypothesis or not.

4.2 Data

In order to comment on the relationship between excise duties and cross-border trade, I decided to run a linear OLS regression including also the price level indices and exchange rates in Norway and Sweden, and quarterly GDP in Norway – this to control for some of the economic differences between the two countries. I

also add a dummy variable term to separate the time periods before and after the opening of the new bridge at Svinesund. In my regression, I use the following terms

Table 4.2.1 List of Variables

Name of variable	Explanation	Measure
$WeeklyTraffic_{ij}$	Weekly traffic from Norway to Sweden	Cross-border trade
$TaxYearly_{ij}$	Yearly weighted excise duties in Norway	Excise duties
$ExChSEKNOK_{ij}$	Exchange rates SEK divided by NOK	Exchange level in the two countries
$PriceLvlSENO_{ij}$	Price level indices based on GDP normalized to EU27_2020 = 100. The Swedish divided by the Norwegian.	Price level/Purchasing power in the two countries
$GDPmillNOK_{ij}$	Norwegian total quarterly GDP. Market value, mill NOK.	Reflects the Norwegian economic growth and the population growth.
$D_{Bridge\_Existence}$	Dummy variable that controls for the years pre and post 2005.	

To represent cross-border shopping as the output variable, I chose to use weekly private car-crossings to Sweden at Svinesund due to many reasons. I could alternatively looked at total profits of the biggest shopping centers along the border, but then I would have included all the Swedish customers that also shop at these stores. Also, most of the alcohol is sold by the wine monopoly in Sweden which is not included in all the shopping centers at the border, the same applies for many independent tobacco merchants. I therefore decided that the changes in border traffic would be a better reflection of the changes in cross-border trade. I chose to only examine the border traffic of cars with a maximum length of 5,6 meters, as this limit will include most of the private cars crossing the border and exclude all commercial vehicles which travels independent of cross-border trade.

The Norwegian Public Roads Administration experienced lack of resources due to the corona-crisis, and were not at any time able to find the data that I needed. Simen Ulsaker on the other hand, one of the authors of a paper on cross-border shopping and exchange rates (Friberg et al., 2019), had the numbers that I needed for the years 2000-2017. The only border-crossing that was documented all the way

back to 2000 was the one at Svinesund (both the old and the new bridge) related to Strömstad. As the majority of the Norwegian/Swedish cross-border trade, almost 54%, takes place in this area, I considered this data to be sufficient for my analysis (Henriksen & Kvile, 2020 (b)). The crossings for the remaining two years (2018-2019) that I needed was found at the website of the Norwegian Public Roads Administration (Statens Vegvesen, n. d.).

The Norwegian excise duties on tobacco, alcoholic beverages, non-alcoholic beverages and chocolate and candy are only published once a year. I used total Norwegian consumption in a random year, 2018, to weight the different taxes based on how "important" the goods are for Norwegian consumers – reflecting how important an associated tax on these products would be (SSB, n. d. (b)). All calculations and assumptions associated with the weights of all taxes are explained in the Appendix. The sum of all of these taxes, weighted appropriately, establishes the variable TaxYearly. I decided to adjust the taxes for inflation, to just focus on the real value of these taxes, and not capture any tax change caused by inflation. The inflation is set by 2015 as a baseline of 100. The inflation is measured from the Norwegian consumer price index and is obtained from SSB.no (SSB, n. d. (c)). The inflation is however important to include into my regression, but as this is covered in the GDP variable, I believe this is sufficient.

The exchange rate is the average weekly exchange rate between the Swedish and the Norwegian currency, and are obtained from the Norwegian Central Bank (Norges Bank, n. d.). The dataset reflects how strong the Swedish currency is compared to the Norwegian one. The price level indices reflect how much you get for your money in the two countries, given an universal currency. If one can buy more for a given amount of money in Sweden rather than at home, one is more likely to go to Sweden and buy goods there instead.

The Norwegian gross domestic product expresses the economic development, and by doing so, it also expresses the population growth to some extent. Alternatively, I could have used GDP per capita and population growth as two separate variables, but as the total Norwegian GDP capture both in some way, I considered that as a sufficient variable alone. The dataset on GDP is obtained from Norwegian national accounts from Statistics Norway (SSB, n. d. (b)). As the Norwegian population both grows in size and overall gets richer, I hope that the volume of Norwegian/Swedish cross-border trade will be proven to be a variable of interest.

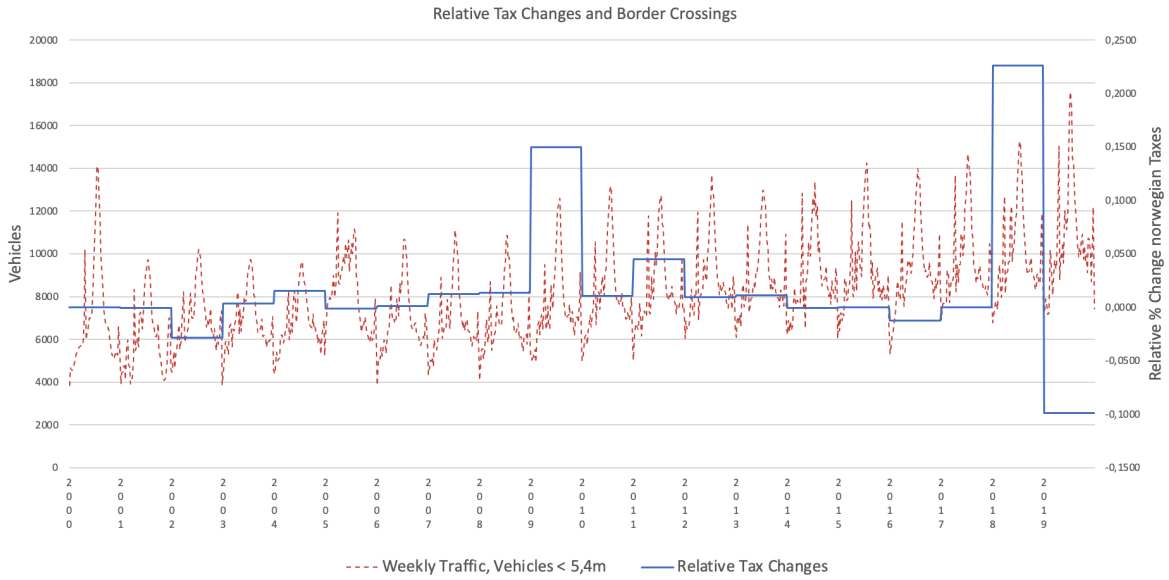
As both the taxes and the price level indices are published yearly, these are constant for all weeks in a year. The dataset on GDP is quarterly, published every third month, so each of these values are set constant for thirteen weeks at a time – which equals three months roughly. These manipulations are done in order to match these datasets with the ones on weekly traffic and exchange rates, which is given weekly. With the same time perspective on all datasets, it gets easier to perform the analysis on all variables. Alternatively I could have changed the weekly datasets to yearly or quarterly, but then I would end up with little data. I wanted to include as much data as possible, and the approach I ended up using allowed just that.

The dummy variable implemented intends to separate the years before and after the opening of the new bridge at Svinesund in 2005. Pre 2005, the weekly traffic only include the crossings at the old bridge, while after 2005, both bridges are included. This will make the linear regression as a whole and the estimated model more accurate, since the traffic increased considerably after the opening. The dummy was created by adding a column to the dataset with the observation number, from 1 to 1040. 1-260 is the observations from the years 2000-2004, while 261-1040 is for 2005-2019. Then I let the dummy equal 0, but defined its value to 1 if the observation was after 260. Thus, the dummy coefficient I would get out of the regression should be added in the estimates for the years after 2005, but not for the years pre 2005.

4.3 Excise Duties and Cross-border Shopping

First in my analysis, I made a graph showing the relative tax changes and the weekly traffic for the past twenty years, in order to see if there were any immediate connections between those two variables that stood out. In this graph, I manipulated the tax dataset so it expresses relative percentage changes adjusted for inflation. I let the changes be constant of each year to highlight the changes.

Graph 4.3.1 Correlation Taxes and Weekly Traffic



There are some happenings in this graph worth commenting.
(i) In 2002, the taxes on both alcoholic and non-alcoholic beverages went down by 6,07% and 6,37%, respectively, compared to the year before. As can be seen from the graph, the peak in traffic that year was a little higher than both the previous and the following year. (ii) In 2005, there was no remarkable tax changes, but in this year the new Svinesund bridge opened, which opened up a motorway crossing across the border. This clearly increased the traffic. (iii) In 2009, the taxes on non-alcoholic drinks increased a lot, and also the taxes of snus increased some. The traffic increased within the same year and kept increasing the next year. (iv) The tax on cigarettes, snus and alcoholic beverages went up yet again in 2011, and the car-crossings maintained the level from 2009 up high. In the following years, the traffic keeps a stable development, with the exception of a small tax cut in 2016. (v) In 2018, the taxes on both non-alcoholic beverages and chocolate and candy went up way high, and the traffic increased as well that year and in 2019.

One cannot tell the precise correlation on these two variables based on this graph, as there are many other factors affecting the traffic across the border.

Nevertheless, if one is to comment on the relationship based on this illustration, it would be reasonable to think that Norwegian excise duties have a positive impact on Norwegian/Swedish cross-border shopping.

4.4 Regression and Results

The linear OLS regression used is the following

$$\begin{aligned} WeeklyTraffic_{ij} = {} & \beta_0 + \beta_1 D_{Bridge\_Exictense} \\ & + \beta_2 (TaxYearly_{ij}) + \beta_3 (ExChSEKNOK_{ij}) \\ & + \beta_4 (PriceLvlSENO_{ij}) + \beta_5 (GDPmillNOK_{ij}) \\ & + \varepsilon_{ij} \end{aligned}$$

with WeeklyTraffic as the endogenous variable, β_0 as a constant, TaxYearly, ExChSEKNOK, PriceLvlSENO and GDPmillNOK as exogenous variables, β_1-β_5 as coefficients for the right-hand side variables, and ε as the error term. $D_{Bridge\_Existence}$ is the dummy variable controlling for the opening of the new Svinesund bridge. i expresses the different years, and j expresses the different weeks, with

$i = 0,1, \dots ,19$ where year 0 equals 2000 and year 19 equals 2019
$j = 1,2, \dots ,52$ for the different weeks of each year

The output of the linear regression then becomes

Table 4.4.1 Linear Regression Output

Weekly Traffic	**Coefficient**	**Std.Err**	**t**	**P > |t|**
Bridge_Existence	1842.04	245.47	7.50	0.000
TaxYearly	442.26	36.16	12.23	0.000
ExChSEKNOK	-26.73	18.15	-1.47	0.141
PriceLvlSENO	7444.45	2608.05	2.85	0.004
GDPmillNOK	-0.01	0.001	-7.24	0.000
Constant	-3586.60	1870.01	-1.92	0.055

With the belonging statistical values

n	F(5, 1034)	Prob > F	R-squared	Root MSE
1040	82.03	0.0000	0.3285	1795.8

The estimated model then becomes

$$\widehat{WeeklyTraffic_{ij}} = -\underbrace{3586.60}_{(1870.01)} + \underbrace{1842.04}_{(245.47)} D_{Bridge\_Existence} + \underbrace{442.26}_{(36.16)}\left(TaxYearly_{ij}\right) - \underbrace{26.73}_{(18.15)}\left(ExChSEKNOK_{ij}\right) + \underbrace{7444.45}_{(2608.05)}\left(PriceLvlSENO_{ij}\right) - \underbrace{0.01}_{(0.0001)}\left(GDPmillNOK_{ij}\right)$$

where the betas now are replaced with the calculated coefficients, and the numbers in the parentheses show the standard error of the coefficients.

According to the linear regression, excise duties *do have* a significant impact on cross-border trade, as the p-value of that variable is below 5%, and I am testing on a 5% level. In fact, the regression tells me that if the taxes go up by 1 unit (1 NOK), given that everything else remains unchanged, the weekly traffic will increase by 443 cars (rounding the number up as the coefficient implies slightly more than 442 cars). Vice versa this happens with the opposite sign in the case of a tax reduction. The fact that an increase in taxes have a positive impact on cross-border trade makes sense, as the relative price differences between Norway and Sweden are increasing and it gets even more profitable to spend your money in Sweden rather than home.

Both the price levels and GDP also seem to have a significant effect on the cross-border trade, which implies that it is appropriate to control for these variables. In chapter two, I highlighted that there are many economic differences between the two countries, and that all of them together is the reason why Norwegians shop certain goods in Sweden. This regression proves the theory right, showing that the weekly traffic do depend on these variables. As the price level fraction SE/NO increases, it means that you get more for your money in Sweden versus in Norway, which would naturally increase the cross-border trade. The coefficient is positive, which confirms this reasoning. The development in the Norwegian GDP seem to almost nothing affect the border shopping at all. This can be explained by the following intuition; on the one hand, Norwegians are getting wealthier and have more money to leave with Swedish merchants, while on the other hand, as

Norwegians become wealthier, the importance of saving some of their money through cross-border shopping becomes smaller. These factors may equal each other out, making the cross-border trade almost unaffected by an increased Norwegian GDP.

Exchange rates do not seem to have a significant impact on weekly traffic, as the p-value of 14,1% exceeds the 5% test level. It is likely that in real life, the exchange rate would in fact matter to some degree, because it determines the value of Norwegian and Swedish currencies, and thereby also a part of their prices. Based on this analysis, one can argue that the exchange rates do not matter too much when it comes to cross-border shopping, because the other economic factors captures the main reasons of the price-differences that makes Norwegians go to Sweden. Nevertheless, the negative sign of the coefficient makes sense. If the exchange rate would have a significant impact, it would be negative, as an increase in the fraction SEK/NOK would imply that Norwegian money will weaken against Swedish.

The dummy variable, $D_{Bridge\_Existence}$, implies that for all years after 2005, when the new bridge opened, 1843 cars should be added to the weekly traffic estimate. From the dataset, one can see that the true value of the weekly traffic increases after year 2005, thus, to add 1843 units for each estimate for these years would give a more accurate value. The dummy is significant.

The R-squared is the determination coefficient, which reflect the explanatory power of the model and how good the model fits the data. It varies between 0 and 1, and a high value implies that there are few and minor deviations between the observations and the predicted values. Nevertheless, small R-squared values are not always a problem, and high R-squared values are not necessarily good (Wooldridge, 2012). Our model has an R-squared of 32,85%, which can be considered low, but can also be defended by several reasons. The weekly traffic data set is weekly values and not adjusted for seasonable factors such as holidays and seasons. This data set varies a lot from week to week due to this. The data sets for taxes and price level indices are only published or changed yearly, so these numbers are constant for all the 52 weeks of each year. As these static data sets are to predict a very dynamic output variable, it is natural that the true values will vary from the estimated model. It is also reasonable to assume, as with most other analyses, that the R-squared would be higher, and thereby also the model more fitted for the data, if I were to have a better model specification and adjust for even more variables.

The intercept, the constant, turned out to be a negative number of -3587. This implies that if all the other variables were set to zero, the cross-border traffic would be minus 3587 cars weekly. This does not make sense, since there cannot be negative cars crossing the border – this number would either be zero or positive. The intercept is insignificant, as the p-value is 0,055 and therefore higher than 0,05. An insignificant constant implies that the average effect of all omitted variables may not be important, but it does not mean that one should remove the constant from the regression. It works as a "garbage" term and forces the residuals to have a zero mean, and it should in fact be included in the model. If it were to be removed, the "garbage" would likely be captured through some of the other variables, making the regression worse off (Wooldridge, 2012; Sucarrat, 2017).

I would like to comment that a regression with the given variables is a challenging task, mainly because of the difficulties of comparing the data sets. If I were to make my analysis with yearly numbers, I would not have been able to capture the variation in the different months and weeks throughout the years, which I think is essential to do in this type of study. Also, it would be a quite small data set and my results would likely be poorer. All over, I think it was interesting to perform this analysis, especially because including Norwegian excise duties into this kind of model has, for all I know, not been done in previous research.

Chapter 5: Discussion and Conclusion

Throughout this thesis, I have highlighted different arguments and perspectives on cross-border shopping and excise duties. In this concluding section I will try to gather all loose threads and answer the research question of interest – whether or not excise duties affect cross-border shopping.

As the price faced by the consumer is affected by a potential tax, and prices often make consumer behavior to change, one can easily assume right away that taxes do affect Norwegian/Swedish cross-border shopping. But, there do not exist, based on my knowledge, any proof that taxes alone make people cross the border to buy cheaper goods.

Seen from the perspective of the history in Finland, tax cuts did not cause their trade-leakage to Estonia to decrease – which was the intention of lowering the taxes. Instead the total Finnish alcohol consumption increased, and alcohol-related harms and diseases increased (Mäkelä & Österberg, 2009). Based on this situation, one can argue that taxes do in fact affect *consumer behavior*, but not in the direction the government intended to. Consumer behavior seems to be difficult to steer into a desired direction, and that it is therefore a difficult job to create the ideal tax rates. Norwegian authorities try to set the perfect tax, so that they both affect the consumer behavior in the "right" way, while also shielding Norwegian suppliers. This is clearly a difficult dilemma.

Another key finding from the paper on Finland (Mäkelä & Österberg, 2009), is the fact that worst part of the population, addicted and poor people, tend to be the most responsive to price changes. If one draws this assumption to cross-border trade and excise duties, the same consumer group are likely to be the ones most sensitive to tax changes. If the taxes in Norway increase, they are the people most likely to track down cheaper prices, through for instance cross-border shopping. Even though it would be just a slight change of taxes, as long as the trip to Sweden is anything profitable, these are the ones most likely to go.

The marginal consumers are also a group of people that are likely to respond to tax changes. If a tax cut were to happen, and the calculation of going to Sweden now goes to zero, one will perhaps decide not to go – because it is no longer profitable. The marginal consumer are placed some distance away from the border, and it is likely that we would see the biggest respond to tax changes here.

According to the economic interpretation in this thesis, the Norwegian faced demand for alcohol, tobacco, soft drinks and candy decreases twice; first because of a tax and then because of a part of the demand moves to the Swedish market. The model indicates that the second shift happens as a response to the tax, but as underlined, also due to other economic factors. It is not clear by the model what part of the second shift is due to taxes and what is due to other elements, but it is clear that the price differences in Norway and Sweden creates the cross-border shopping. As long as the tax is a part of the price faced by the consumer, it is reasonable, based on the model, that the taxes, among other things, do affect some consumers to shop in Sweden.

Based on the regression analysis, one can assume that excise duties do in fact have a significant impact on cross-border shopping, but so does some of the other independent variables as well. Even though my regression has its weaknesses, I do believe it presents a quite realistic illustration of the factors that affect cross-border shopping. The analysis, combined with all the other theories reviewed in this thesis, illustrates that it is the sum, and the interplay, between the various economic differences that determines the Norwegian/Swedish cross-border trade – which is consistent with my own perception of the topic.

Excise duties do seem to affect cross-border shopping, but as long as there exist other economic differences between Norway and Sweden that makes it profitable to cross-border trade, the findings in this thesis indicates that consumers are likely to keep on traveling to Sweden even if the taxes were set to zero.

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Appendix

Weights Excise Duties

The dataset I received from the Ministry of Finance on historical Norwegian taxes, was somewhat difficult to work with. The duties are expressed in different units of measurement, and there were many subcategories. As I wanted taxes as one independent variable in my analysis, some manipulations needed to be done.

The first thing I did was to remove categories that was not of interest in this thesis, such as cigars, cigarette paper and alcohol under 3,7%. These taxes would create unnecessary fluctuations to my data, so as these are not the goods Norwegians mainly buy in Sweden, I decided to remove them.

And then the assumptions for the weighting began. The weightings are supposed to express how important each good is, and thereby how important a tax on that product is for Norwegian consumers. From the national accounts at SSB, I found the 2018 Norwegian detailed consumption of alcoholic beverages, non-alcoholic beverages and tobacco, which equaled 29.763, 19.474 and 24.310 million NOK respectively, equivalent a sum of 73.547 million NOK (SSB, n. d. (b)). I wanted to split the tobacco sum into cigarettes and snus, and did so by statistics on how many people smoke and uses snus in Norway. Out of the total tobacco use in Norway, 41% is smoke and 59% is snus, and thereby the calculated consumption of each of these was 9.945 and 14.365 million NOK, respectively (SSB, 2021).

To make alcohol into one variable, I found the consumption of beer and cider (3,7-4,7%), wine (4,7%-22%) and liquor (over 22%), as this data was public. I then found the correct weighting of each of these, making beer and cider, wine and liquor 75,57%, 21,41% and 3,02% of the total Norwegian alcohol consumption, respectively (SSB, n. d. (d)).

It does not exist data on consumption of chocolate and candy, as this falls under groceries. I therefore needed to estimate the Norwegian importance of taxes on those goods myself. By the categories of snus, cigarettes, alcoholic beverages, non-alcoholic beverages and chocolate and candy, I have five categories. I then tried to set the category of non-alcoholic beverages as 20%, 1/5, since this category is one fifth of the total five consumption categories. This equals 18.387 million NOK. I needed to control that this assumption was close to correct. I tried to imagine how much candy Norwegians buy in Sweden, and how important that is of the total cross-border shopping. Out of own intuition, I think candy is as important

as soda and other non-alcoholic drinks, which had a consumption of 19.474. I also tried to calculate how much an average Norwegian spends on candy each year. I multiplied the average Norwegian price of self-picking candy, 14,90 NOK per hectogram (Lorvik & Ripegutu, 2020), with the average yearly Norwegian consumption of sugar, 240 hectogram (Helsedirektoratet, 2020), and the population in Norway, 5,398 million (SSB, n. d. (e)). This equaled 19.303 million NOK. As some of the consumption of sugar goes falls outside chocolate and candy, I believe that the estimated weighting of 20% and the value of 18.387 million NOK is sufficient for this category in my analysis.

Then the shares for each of the five categories become the following

	CONSUMPTION	WEIGHT
CIGARETTES	9.945	10,82%
SNUS	14.365	15,63%
ALCOHOL	29.763	32,37%
NON-ALCOHOLIC	19.474	21,18%
CHOCOLATE AND CANDY	18.387	20,00%
TOTAL	91.934	100%

Since the units of measurement for the different categories was very different, I needed to make further assumptions in order to end up with one total tax. I then estimated portion-wise, for example, cigarettes and snus are highly taxed and done so by 100 grams or 100 pieces. I divided these so that they corresponded to the content per package.

After manipulating the data, I summed up all the different taxes according to the different weights, and got out one variable for each year. This variable ended up expressing weighted average tax per demanded good. I figured out that the number that I got out was not the most important, but rather the correct weighting, such that the variable express the most important tax changes according to Norwegian consumers.