The Effect of an Increased Excise Tax on Alcohol Consumption

A study on the price elasticity of demand for alcoholic beverages

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Abstract:

In September 2020, the Swedish government announced the ambition to further raise the tax on alcohol and tobacco products. The new policy, planned to be enacted in January 2023, aims to adjust for inflationary measures while promoting public health and increasing government revenue. The generated tax funds will partly be used for military expenditures. This thesis investigates the impact of the aforementioned proposed alcohol tax increase on the consumption of alcohol, as well as the tax revenue generated. In order to provide an answer to the effectiveness of the new legislation, the price elasticities of demand for alcohol need to be obtained. We focused on three different alcoholic products; spirits, wine and beer. Through the use of OLS regressions of different complexities, we find that the demand for beer and wine have a negative, yet overall inelastic demand. The results for spirits, however, are not as definitive due to ambiguous estimates caused by the limitations of the empirical framework. If we have managed to correctly estimate the price elasticities of demand, then the consumption of beer and wine will not be affected to a great extent when a hypothetical tax increase is imposed, but it does however raise important questions regarding the fiscal impact and the role of the government.

Bachelor's thesis in Economics, 15 credits

Fall Semester 2020

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Acknowledgements

We would like to express our deepest gratitude and appreciation to our supervisor Arnaldur Stefansson for his immeasurable assistance during our writing process. This thesis would not have been possible without his guidance, expertise and patience. We thank the members and faculty at the Department of Economics for all the invaluable lectures, labs and seminars that have inspired us and aided us in writing this thesis. We would also like to thank our friends and family for all their support and encouragement.

Table of Contents

1. Introduction

1.1 Background

The effects of alcohol consumption are a substantial societal problem. Excessive drinking is commonly associated with violence, accidents, and other types of unintended injuries. Alcohol-related incidents can result in fatal consequences, as well as social and economic burdens. In Sweden approximately 3000 fatal accidents occur annually (IQ, n.d.). Among those, alcohol abuse is the most common factor in cause of death for young people. Alcohol related traffic accidents occur most frequently, followed by drownings, falls and fires. Furthermore, physical abuse due to alcohol mostly takes place in public spaces, followed by work and school properties. In a study conducted by Ramboll (2019), a consultancy company in community counselling, it was concluded that the societal cost of alcohol in Sweden 2017 amounted up to 103 billion SEK. All things considered, it is in the interest of the government to regulate the alcohol supply, in order to prevent any potential outcomes of intoxication.

A potential way in achieving a limited alcohol consumption is through high alcohol taxes. The Swedish government recently announced in their budget proposition for 2021, the intention to increase taxes on alcohol and tobacco (Finansdepartementet, 2020). This proposal was justified as a strategy to promote the wellbeing of the public, while simultaneously increasing government revenue. The generated tax revenue will partly be used to finance military expenditures, but more detailed information has yet to be released. The Swedish Minister of Finance, Magdalena Andersson, argued that this new legislation was necessary following a long period of not having the alcohol tax indexed. Consequently, it has been automatically eroded when higher inflation and wages have increased the purchasing power nationally.

While the alcohol tax rate is set by the Swedish Government, it has to fall within the European Union's common procedural rules for taxation. Despite a partially restrictive legal framework where the member states have agreed on a minimum alcohol tax rate, each EU country implements quite different final taxation rate policies. Compared with other countries, Sweden has set generally higher tax rates for all beverage types (Angus et al. 2019). Since the abolition of the annual CPI indexation in 1998, the excise duty on all types of alcoholic goods has been raised on a total of four occasions; 2008, 2014, 2015, and 2017. An increase of the excise tax has mainly been executed in order to promote improved public health. According to most economic models, everything else being equal, as the prices of alcohol rise, a reduced demand

for alcohol products is to be expected. Notwithstanding a lower demand for domestic alcoholic products, previous tax raises have managed to increase government revenue by hundreds of millions of SEK (2015/16:RFR8). The current and previous alcohol taxes in Sweden can be viewed in Appendix A. Moreover, the change in real alcohol taxes for each product can be seen in the graphs found in Appendix B.

In a motion put forward by Kristina Nilsson, a member of Swedish Parliament, it is stated that the real price of alcohol has decreased in recent decades due to the inflation rate exceeding the nominal increase in alcohol prices (Motion 2018/19:1795). However, the term alcohol is used rather loosely, and does not specify whether or not the fall in real prices pertains to all categories of alcoholic beverages. With everything else held constant, as the real price of alcohol falls, while real incomes increase, an increased purchasing power tends to increase alcohol consumption. For public health purposes, it should therefore be important to ensure that the real price of alcohol does not fall. The information that has been currently provided by the government is limited; while the government provides concise motivations for their proposal, they still have not yet accounted for how it would potentially affect the consumption of alcohol specifically. If the sales of alcohol prove to be highly price inelastic then the goal to reduce alcohol consumption will in the end not be met. Conversely, if domestic sales are notably impacted negatively as a result of increased taxes, and imports instead increase, then the proposal would ultimately prove itself to be ineffective to increase tax funds (Finansdepartementet, 2020).

1.2 Purpose

The aim of this study is to predict the effectiveness of a proposed alcohol tax increase in reducing consumer demand. In addition, it seeks to measure the fiscal impact of the tax raise. This will be achieved by estimating the price elasticity of demand for different categories of alcoholic beverages (beer, wine and spirits) through the use of different OLS regressions.

1.3 Institutional settings within the Swedish alcohol market

Sweden has an alcohol monopoly called Systembolaget, a state-owned chain of liquor stores which strictly prohibits other entities to sell alcoholic beverages above the 3.5% level (Häkkinen, 2019).

The origins of Systembolaget dates back to several centuries. Prior to its existence, Sweden was commonly known as a 'Country of Spirits', due to the widespread introduction of Scandinavian Brännvin. The Swedish society was exposed to the negative externalities of an intoxicated population as early as the 15th century. While attempts to halt the excessive consumption were made by authorities, meaningful progress was not achieved until 1850 in Falun, when a popular movement of miners formed the precursor of what would today be known as Systembolaget. This concept was later developed into the Gothenburg Public House System in 1865, which in turn was adopted by other cities such as Lund and Stockholm. In 1870 the Swedish Parliament finally decided that all profits obtained from alcohol should be submitted to the government. Despite a couple of setbacks, with prominent advocacy for abolishing alcohol consumption altogether due to health concerns, by 1955 all regional liquor stores merged into a single nation-wide state-owned enterprise, formally known as Systembolaget (Systembolaget, n.d.).

As of today Systembolaget brands itself as a responsible single-seller with exclusive rights to the distribution of alcoholic beverages containing more than 3.5% alcohol by volume. In order to have access to the retail trade of Systembolaget, one has to be above the age of 20 years old. However, the age limit for consuming alcohol in restaurants and bars is 18. In accordance with the agreement between Systembolaget and the Swedish state (SFS 2019:552), Systembolaget aims to promote public health by informing the general public on its harmful effects. Based on their compiled statistics, alcohol consumption has fallen for almost 2 consecutive decades, and teenagers have historically low consumption levels (Systembolaget, n.d.).

A regular monopoly selects higher prices and lesser quantity of output, in contrast to any price-taking firm. The prices are set above the marginal cost and the positive profits constitute governmental earnings in terms of taxes (Perloff, 2014). However, Systembolaget claims to be a non-profit monopoly, with regard to improving the wellbeing of the public. As they aim to promote public health, they do not maximize profits like a regular standard monopoly would according to microeconomic theory. Systembolaget has further declared that "We are not profit-maximized and do not work to achieve excess sales". For example, they do not offer any volume or quantity discounts, which go against the Swedish Alcohol Act that states a special moderation must be taken into account (Public Health Agency of Sweden, 2015). Among other things, this essentially means that marketing cannot be intrusive nor encourage the use of alcohol. In addition, Systembolaget has made several executive decisions in the past to

temporarily cease the sales of popular products such as “Fireball” and “Band of Roses Rosé, 2019”, due to potential health concerns. Fireball was recalled in 2014 due to findings of high amounts of propylene glycol (SVT, 2014), while Band of Roses Rosé was recalled in 2020 due to the content of pesticide, in accordance with EU regulations (SVT, 2020).

As Systembolaget constitutes a unique monopoly, the slope of their supply curve will inevitably differ from one of a typical monopoly. A profit maximizing firm produces at the point where the marginal cost and the marginal revenue curve intersect. Due to the lack of information provided by Systembolaget, the slope of the supply curve cannot be ascertained. In an interview conducted with Systembolaget via email, they emphasized that they aim to provide good service for their consumers, which includes offering a large range of different products to satisfy the demands of the consumers (Brännborn, 2020). They don’t want to “sell as much as possible”, thus they don’t promote their alcoholic products through commercials or printed advertisements. Marketing strategies like these go against their social mission (Sytembolaget’s Customer Service, 2017)

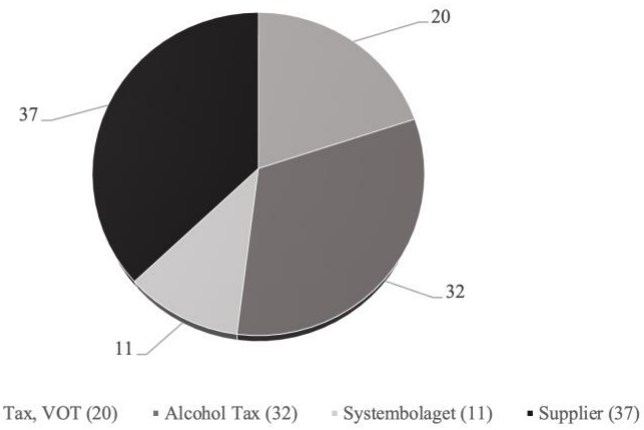


Figure 1- Pie chart showing the average share of value of total sales (%) (Systembolaget, n.d.)

As illustrated above, Systembolaget receives the smallest share of value from their sales, as a cumulative percentage of 52% goes to the Swedish Government and 37% is attributed to suppliers. However, it’s important to note that the chart merely shows the average share of sales. When dissecting sales per category of alcoholic beverages, the distribution looks slightly different, due to Systembolaget’s different alcohol taxes and mark-ups between the different products. A more accurate representation of how the sales revenues are distributed for all products can be viewed in Appendix C. Following the requirements of the European Union, Systembolaget does not under any circumstances negotiate on prices with suppliers, regardless of different suppliers and brands. Final price to the consumer is ultimately set by suppliers.

However, Systembolaget will often specify a price ceiling or price range when purchasing their standard products, for example SEK 90-99. To begin with, suppliers provide Systembolaget with a purchase price that covers their costs, which in addition makes themselves a profit. Systembolaget then places a 17% markup on the purchase price. It should cover all costs attributable to the product, as well as a required rate of return provided by the government. The surcharges allow Systembolaget to bear all their own costs. Another markup is placed for packaging, for example, 4.92 SEK is added for a box of wine. Further along the process of setting the price, an alcohol tax and any potential container-deposits are added. Finally, the value added tax is included and the price is rounded up for sale (Systembolaget, n.d.).

1.4 Litreature review- previous research

Multiple studies have attempted to estimate the price elasticity of demand for alcohol in Sweden, including Norström (2005), Assarsson (1991), and Asplund et al (2006). However, these research papers estimate the price elasticity in the time period between 1970 and 2003. Consumer preferences and demand for alcohol may have since changed and the consumption patterns may look quite different today. Therefore, it is important to estimate a more modern price elasticity of demand to predict the outcome of the increased alcohol tax that will take place in 2023. According to a study by Manthey et al. (2019), alcohol consumption per capita has increased from 5.9 litres in 1990 to 6.5 litres in 2017, and is expected to rise to 7.6 litres in 2030. This projection is to a great extent possible due to broader possibilities to obtain alcohol. For instance, just in the last five years, internet shopping for alcohol has increased notably. In addition, since 2004, the formal quantitative restrictions on cross border purchase of alcohol within the EU were eased. Individual consumers have since had free admission to bring alcohol, purchased in the EU, into Sweden. Furthermore, a broad range of alternative channels for foreign imports has made alcohol from abroad more accessible, for example through duty free shopping on ferries. Subsequently, the assumption of increased price elasticities in recent years is quite plausible. This should affect the fiscal impact of tax changes on alcoholic beverages (Hortlund & Mihaescu, 2017).

Johansson et al. (2014) examine the more specific implications of cross border shopping of alcohol. Approximately 12% of the entire EU population lives close to the border of another member state. Thus, the capacity for tax avoidance can be of substantial importance. As a result of the previously mentioned transitional restrictions being removed in 2004, many high

tax countries have reconsidered their excise tax rates to emulate the lower levels of neighbouring countries' in order to avert lowered tax revenues. Peculiarly, Sweden seeks to increase their alcohol tax rates seemingly doing the opposite of other high tax countries. Johansson et al. (2014) argues that there may still be a scope to maintain higher tax rates despite revenue losses caused by cross border shopping, due to the harmful externalities.

Johansson et al. (2014) further compares the alcohol policies between the neighbouring EU members; Finland and Sweden, which they assert "provide an exceptionally promising setting for analysing the cross-border health and productivity effects of national alcohol policies". This claim is supported by the fact that both countries have traditionally pursued similar policies regarding alcohol, with especially high excise taxes. Strict regulation of alcohol sales has been possible through their respective government monopolies; Systembolaget of Sweden and Alko of Finland that set homogenous prices within each country. The alcohol policies of both countries have common features, which implies that their prices or the supply of alcohol don't vary endogenously within countries. After 2004, Finland chose to reduce their excise taxes which led to an average 19% decrease in the retail prices of all alcoholic beverages as well as to an average cut of 36% in the price of spirits. Concurrently, Sweden maintained the same alcohol policies. As a result, there were considerable sales declines in Swedish outlets near the Finnish border. In regions further away, the alcohol consumption remained unchanged. Furthermore, Johansson et al (2014) establishes that an increase in cross-border shopping in areas near Finland coincided with health effects in said areas. However, there wasn't any significant effect on mortality or alcohol-related hospitalisations.

In a research conducted by Norström (2005), an estimation of the price elasticity for spirits, beer and wine was established, between the time periods of 1984 to 1994 and 1995 to 2003. Instead of simply analysing the raw relationship between the independent and dependent variable, Norström looked at the relationship between changes in the independent variable and the dependent variable using the Box and Jenkins method or also known as ARIMA modelling. The price data is based on weighted baskets deflated by the cost of living indexes. He used both quarterly sales data and monthly sales data to obtain his final results.

In another study, Assarsson (1991) estimated the price elasticity of demand for beer, wine and spirits between the years 1970-1988. Included in the time frame is the 'mellanölsperioden', which illustrated a change in the alcohol consumption patterns. Thus, Assarsson included a

dummy variable for the ‘mellanölsperioden’ to observe the effect of this time period on the price elasticities. The estimates were found to be -0.9 for spirits, -1.3 for beer and -0.9 for wine when using quarterly data (SOU 1991:52).

In a similar study, Asplund et al (2006) researched the responsiveness of alcohol sales to domestic and foreign prices to investigate the engagement in cross-border arbitrage. The authors also looked at how sales are affected by the distance to the Swedish international borders, ultimately focusing on the Law of One Price in an international setting. They estimated the price elasticity of demand for spirits, wine and beer using both domestic prices and foreign prices based on the Harmonized Consumer Price Index (HICP).

In contrast to previously mentioned studies, Kumar (2017) conducted a research set in India, a country whose alcohol consumption has rapidly increased in recent years. To contribute to the dearth range of existing studies for low-income countries, Kumar used a survey of unrecorded alcohol in India. Although he did not conduct his research on wine, he estimated the price elasticity for ‘country liquor’, also known as desi daru, which is another category of alcohol produced in India (Dhamija, 2020). By using OLS regression he managed to establish rather inelastic results for all alcoholic beverages, with spirits being the least elastic and country liquor being the most elastic.

Research focusing on estimating the price elasticity for different alcoholic beverages is fairly extensive in high-income countries. However, the elasticity estimates differ in their magnitudes; some find positive elasticities while others find negative estimates. Some studies that focused on the price elasticity within the UK borders conclude that beer tends to be less elastic in comparison to wine and spirits. Gallet (2007) and Wagenaar et al. (2009) estimated the average price elasticity of alcohol to be −0.5, while a study conducted by Meng et al. (2014) found the price elasticity estimates to range from −0.08 to −1.27.

The following Table summarizes the price elasticities obtained by each study.

	Time period	**Spirits**	**Wine**	**Beer**	**Country liquor**	**Method**
Assarsson (1991)	1970-1988	-0.9	-1.3	-0.9		Linear regression with 'mellanölsperioden' as a dummy
Norström (2005)	1984-1994 (Quarterly data)	-1.16**	-0.62**	-1.36***		Box and Jenkins (ARIMA modelling)
	1995-2004 (Quarterly data)	-0.34	-0.81	-0.55*		
	1984-2004 (Quarterly data)	-0.96***	-0.57**	-0.79***		
	1984-2004 (Monthly data)	-0.81***	-0.63**	-0.90***		
Asplund et al (2006)	1995-2004 (Monthly data)	-1.29***	-0.91***	-0.24***		Linear regression focusing on domestic and foreign prices
Kumar (2017)	2014 (Individual data on population aged > 15)	-0.14		-0.33*	-0.46*	Linear regression focusing on socio-economic differences in rural and urban areas using individual consumption data.

**p<0.1 **p<0.05 ***p<0.01*

Table 1- Compilation of price elasticities for spirits, wine and beer obtained in each study and the research method used

Note: Assarsson's study lacks information about significance and type of data used. Kumar did not study the price elasticity of wine but of country liquor.

The results from all studies mentioned above, clearly show the prevalence of negative coefficient estimates. This illustrates that higher prices lead to lower consumption. The Swedish price elasticities vary between -0.96 and -1.3 for spirits, -0.2 and -0.9 for wine, and between -0.9 and -1.3 for beer. The findings in the three research papers will be compared to our results in the discussion section of this study by looking at whether there has been a change in consumer demand for different alcoholic beverages in terms of their respective price elasticities over the years.

2. Theoretical framework

Identifying both the price elasticity of demand and of supply at the same time is a difficult task, if even possible. Therefore, based on institutional knowledge, we make assumptions about the price elasticity of supply. Based on this we discuss theories of externalities, the effect of tax and how to identify the price elasticity of demand. The purpose of this is to understand the effects of alcohol consumption on the individual and society, and how these can be eliminated using taxes. The effect of the tax on alcohol consumption is determined by its price elasticity of demand.

2.1 The slope of Systembolaget's supply curve

As aforementioned, identifying both the price elasticity of demand and of supply at the same time is a difficult task, if even possible. Therefore, based on institutional knowledge, assumptions and simplifications will be made. It is assumed that the supply curve is horizontal, also known as the supply being perfectly elastic. Based on our conversations with Systembolaget, we make the assumption that Systembolaget does not adjust their price in response to changes in demand. As described above, suppliers set a price and Systembolaget then implements mark-ups and taxes. Therefore, in each period, the supply curve from suppliers to Systembolaget is perfectly elastic. It may be the case that suppliers adjust their price dynamically in response to changes in demand. However, we make the assumption that these are negligible in comparison to other adjustments due to mark-ups and taxes. Therefore, the annual price of alcoholic beverages changes due to modifications in costs, taxes or supplier prices, and not in response to demand. This causes the flat supply curve to shift up or down.

2.2 Negative externality of consumption

Alcohol is not viewed as a regular product, it is a highly addictive demerit good that can, when consumed, be damaging to the consumer and harmful to others. When choosing to drink alcohol, an individual usually only considers his or her own marginal private costs (MPC) and marginal private benefits (MPB) but fails to consider the marginal costs to society (MSC) and the effect on the marginal social benefits (MSB). The consumption of alcohol can lead to negative externalities that affect a third party (Tragakes, 2012, p. 103). Greenfield et al (2009) highlight six types of externalities that result from an individual's drinking; assaults, family problems, motor accidents, vandalization of property, financial problems and accompanying

intoxicated drivers. Due to these, it is in the interest of the government to mitigate the problems associated with alcohol consumption.

Figure 2 below illustrates how an overconsumption of alcohol occurs at the intersection of MPC and D, at the quantity Q with the price of P. The divergence between the MPC and MSC curves represents the external cost to society when consuming alcohol. The social optimum level is where MSC and the demand curve intersect. This equilibrium quantity takes into account the external costs (Pettinger, n.d.)

2.3 Pigouvian tax on alcohol

A Pigouvian tax is a tax implemented on goods that create negative externalities. It internalizes the extensionality by increasing the price to achieve consumption at the optimal level (Pettinger, n.d.). Greenfield et al (2009) discuss in their paper that increasing prices through taxes or limiting the availability of alcohol have been the most effective measures in reducing the consumption of alcohol and the negative externalities associated with drinking. In agreement, the World Health Organization states that taxes on alcoholic beverages have proven to be an effective method in preventing the harmful effects of alcohol, in addition to financing the economic costs of alcohol to society through raised government revenue (WHO, n.d.).

Normally, consumers are sensitive to price changes of goods and services, and thus pricing policies can be used to alter consumers' behaviour. According to Pettinger (n.d.), the introduction of taxes should lead to a reduction in the quantity demanded, which is shown in the figure below.

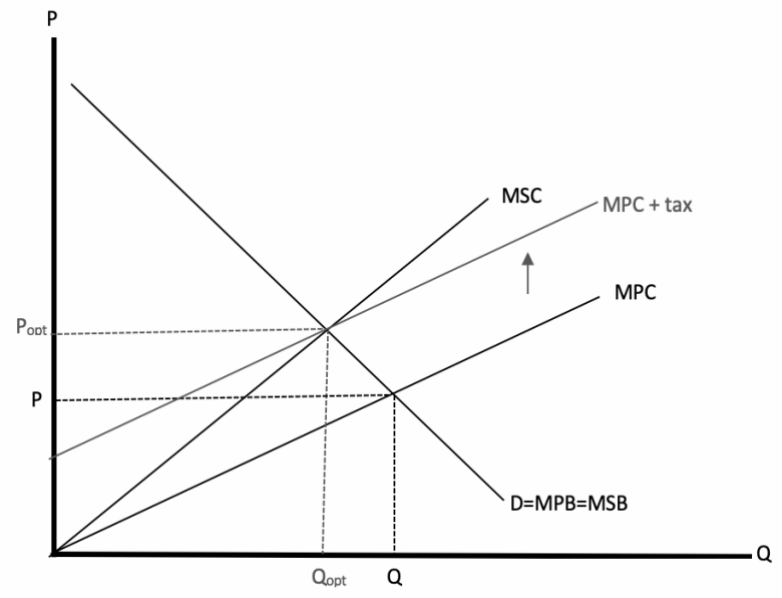


Figure 2 - Diagram showing the negative externalities of alcohol and the impact of implementing a Pigouvian tax (Pettinger, n.d.)

By implementing a tax that is equal to the cost to society, the MPC curve shifts upwards to MPC+tax. Consumption has decreased to the optimum level, Q_{opt}, and the price has increased to P_{opt}.

2.4 Elasticities

2.4.1 Price elasticity of demand

When implementing a tax on a good, it is vital to take into account the price elasticity of the demand. The price elasticity of demand (ε) is a measure of how responsive the quantity demanded is to a change in price. The mathematical formula for the price elasticity is given by:

$$\varepsilon = \frac{(percentage\ change\ in\ quantity\ demanded)}{(percentage\ change\ in\ price)} = \frac{\Delta Q/Q}{\Delta p/p} = \frac{\partial Q}{\partial p}\ \frac{p}{Q}$$

If the percentage change in the quantity demanded is larger than the percentage change in price, the demand for the good is elastic $|\varepsilon| > 1$. We have an inelastic demand if the percentage change in price is larger than the percentage change in quantity demanded $|\varepsilon| < 1$. (Perloff, 2014, p.50)

The degree of elasticity is determined by several factors such as the number of substitutes and whether the good is a luxury or necessity good. A good with high substitutability translates into the demand for the good being more elastic (Tragakes, 2012, p.52). An ordinary good faces a negative demand curve, meaning that if the price of the good increases then the quantity

demanded for the good decreases. For example, if the price elasticity for a good is -0.4, this means that an increase in price by 10% will cause the quantity demanded for the good to fall by 4%. These have a downward sloping demand curve, adhering to the Law of Demand, which states that as the price of a good increases, the quantity demanded will decrease, vice versa, ceteris paribus (Tragakes, 2012, p.47). Goods known as veblen and giffen goods face an upward sloping demand curve, which is not in accord with the Law of Demand. Some luxury goods such as designer handbags or sports cars are known to be veblen goods, which means that the quantity demanded increases as the price increases. In contrast to veblen goods, a giffen good is a low income, non-luxury inferior product whose demand increases as the price of the product increases (Chen, 2020).

As mentioned above, it is important to know the price elasticity of demand when implementing a tax. This is because the responsiveness of demand will determine the effect of the tax.

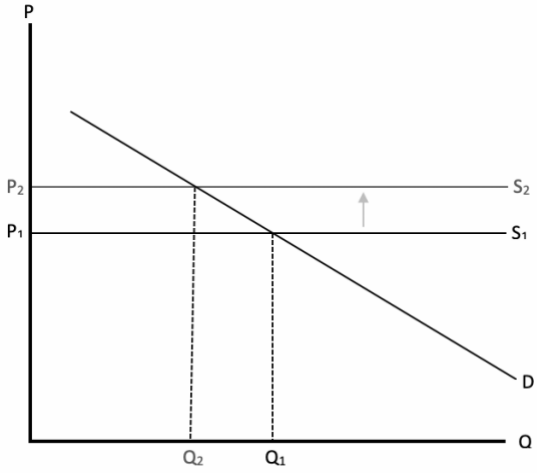


Figure 3- Impact of tax on an elastic demand (Tragakes, 2012, p.57)

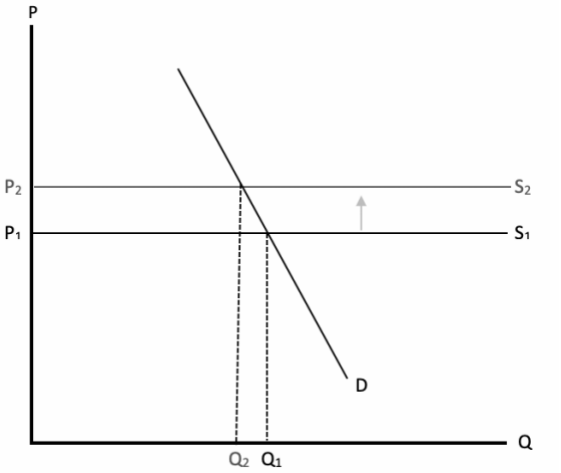


Figure 4- Impact of tax on an inelastic demand (Tragakes, 2012, p.57)

With an elastic demand curve, increasing prices through taxes will cause a larger decrease in the quantity demanded. This will generate lower tax revenues for the government in comparison to a good with an inelastic demand. With an inelastic demand curve, on the other hand, implementing a tax will raise prices and cause the quantity demanded to fall less than the increase in prices.

2.4.2 Income elasticity of demand

The income for consumers is a factor that influences demand for a good, as well as the position for its demand curve. Income elasticity of demand is a measure of how responsive the demand

of a good or service is to a change in income. An income elasticity involves shifts in the demand curve, and provides information on the direction and size of the change for demand, in the case of a change in income (Tragakes, 2012, p.62). The formula below is used to calculate the income elasticity:

$$\xi = \frac{(percentage\ change\ in\ quantity\ demanded)}{(percentage\ change\ in\ income)} = \frac{\Delta Q/Q}{\Delta Y/Y} = \frac{\partial Q}{\partial Y}\frac{Y}{Q}$$

If the percentage change in the quantity demanded and the percentage change in income moves in the same direction, the income elasticity for the good is positive, $\xi > 0$. This means the good is a normal good, as the income increases, the demand for the good increases as well. The good is income elastic if $\xi > 1$, meaning that a percentage change in the quantity demanded is larger than a percentage change in income. An income inelasticity of $0 < \xi < 1$ means that a percentage change in income yields a smaller percentage change in the quantity demanded. A good is classified as inferior if the demand for the good decreases when incomes rise, which means that the income elasticity is negative $\xi < 0$ (Perloff, 2014, p.132).

3. Method and data

This section of the paper describes the method that will be implemented in order to fulfil the purpose of the thesis. The type of data that will be used and the choice of regression equations, as well as controlled variables will be presented and explained below. In the following section we will also account for the method of calculating the effects on consumption and government revenue that stem from a potential tax raise.

3.1 Data sources

To estimate the price elasticities of demand, data primarily from Systembolaget's own statistics website, Eurostat and SCB was used. Systembolaget's quarterly sales data in litres per Swedish region for the period 2010-2018 were obtained from Systembolaget's own statistics website. The quarterly sales in litres per region were divided by the population in each region for the corresponding year to obtain sales per capita in litres. Since the legal drinking age in Sweden is 18, the chosen age category was 18 years and older. Due to the lack of quarterly pricing information on Systembolaget's website, the Harmonized Consumer Price Index (HICP) for each product category was used as the products' prices and was gathered from Eurostat's statistics database. The HICP produces an indicator of inflation by measuring how the prices of consumer goods and services have changed over time, which can be used to measure the development of the Swedish price levels. Currently, the year of 2015 is used as the main index reference period, meaning that in 2015, prices were equal to 100. The classifications of individual consumption by purpose (COICPO) that were used were CP0211 for spirits, CP0212 for wine and CP0213 for beer (Eurostat, 2020). The income per capita per region is the nominal disposable income gathered from SCB. The Consumer Price Index (CPI), extracted from Statistiska Central Byrån (SCB, 2020), has been used to adjust income per capita and prices in year t for inflation by converting them into 2019 prices using the following formula:

$$\frac{Price_t \; x \; CPI_{2019}}{CPI_t}$$

3.2 Ordinary Least Squares regressions

A type of regression analysis known as the Ordinary Least Squares (OLS) regression will be implemented to analyse the gathered data using the statistical software program Stata 16. This method is the best unbiased estimator for a linear regression by minimizing the sum of the

squared errors. It provides a simple relationship between the dependent variable or the outcome variable (Y) and the independent variable or regressor (X) (Dzemski, 2020).

Two types of OLS regressions will be used to estimate the price elasticities:

1. An individual regression for each of the three products
   $lsales\_per\_capita_{prq} = \beta_0 + \beta_1 lprice_{pq} + \beta_2\, lincome\_per\_capita_{rq} + \gamma_r + \alpha_q + \varepsilon$,
2. A compiled regression combining all three estimates into one single regression
   $lsales\_per\_capita_{prq} = \beta_0 + \beta_1 lprice_{pq} + \beta_2\, lincome\_per\_capita_{rq} + \Omega_p + \gamma_r + \alpha_q + \mu_y + \varepsilon$,

where r is a subscript for region, p is a subscript for product category, q is a subscript for quarter, and y is a subscript for year. ε represents the error term and β_0 is the intercept. The regions that are used in the regressions are weighted based on the population density. This is done because the larger regions, such as the Stockholm region, represent a larger share of total sales in comparison to smaller regions.

Variable	**Description**
lsales_per_capita	Sales for each alcoholic category in litres per capita (18 years old and above), per region, per quarter, logged. Extracted from Systembolaget's statistics website (2020).
lprice	HIPC for each alcoholic category; spirits (CP0211), wine (CP0212) and beer (CP0213), per quarter, logged. Taken from Eurostat (2020), converted into 2019 prices.
lincome_per_capita	Real income per capita, per region, logged. Extracted from SCB (2020).

By compiling all products in order to produce one single estimate, it gives room for including time trends of one product compared to the others. In one regression it is possible to test the differences in elasticities between the three products. By including time trends for the product, it allows for a linear decrease in consumption irrespective of price. For example, even if there was no change in price, the sales of the product have decreased by 0.5%. There is a correlation between changes in preferences and changes in price, and the time trends capture the trend increase of consumption.

The regressions take the form of a log-log regression to find the effect of a percentage change in price on the percentage change in quantity demanded, which is known as the price elasticity of demand. This means that both the independent variable, sales per capita in litres, and the dependent variable, the inflation adjusted price in SEK, will be logged. In other words, a 1% change in X_1 will result in a β_1% change in Y. Ultimately, the parameter of interest that will be analysed is β_1. This is the price elasticity of demand for each alcoholic beverage. This value represents the slope of the demand curves of each product. Another type of elasticity that can be analysed is the income elasticity for each product category. This is similar to the price elasticity of demand; however, it measures the responsiveness of demand to a change in income. This will be observed by including a control for the logged real income per capita in each region.

Since time series data is being used, fixed effects, such as product (Ω_p), region (γ_r), year (μ_y), and quarterly fixed effects (α_q), are included. Product fixed effects help adjust for product-specific heterogeneity; they show the difference in consumption levels between the three product categories in the compiled regression. Region fixed effects control for any region-specific differences between the regions. Year fixed effects adjust for heterogeneity that varies with time, which could be the result of economic trends or cycles, and other domestic trends.

When working with an OLS regression, it is important to ensure that certain assumptions are met. One of the most important assumptions is that the information subsumed in the error term, ε, cannot be used to predict the regressors ($E = [U \mid X_1, \ldots, X_k]$). The regressors are exogenous if this equation is satisfied. In other words, there is zero covariance between the regressors and the error term (Dzemski, 2020). For instance, this is the reason for including income as another control, as different income levels could potentially affect the alcohol consumption.

3.3 Calculating the effect of a tax increase on consumption and tax revenues

Based on the estimates provided by the OLS regressions, the effect of a tax increase can be predicted. Since the government has not provided detailed information on how much the tax will increase, the calculations will be purely hypothetical.

Different tax percentage increases will be applied to the price of spirits, wine and beer due to the different amounts of alcohol per volume. The nominal tax rate increased by 7% for both wine and beer, and 1% for spirits in 2014. In the following year, the tax increased by 9% for beer and wine, and 1% for spirits. The latest tax increase that took place in 2017 raised the tax for beer and wine by 4% and 1% for spirits (Appendix A). Based on these previous tax increases, an appropriate hypothetical tax increase could be anywhere between 4%-9% for wine and beer, and 1% for spirits. For the sake of simplicity, we'll set the tax increase at 5% (for beer and wine) in our following calculations.

To better grasp the effect of a tax increase, the two different elasticities (individual and compiled), produced by our given regressions, on actual existing products. In order to give a more concrete and realistic view on how the tax increase will affect the consumption of alcohol, the most popular brands in each product category are used in the calculations. According to Appendix D, the most sold brand of spirit was Explorer Vodka. Castillo de Gredos was the most sold bottle of wine and Norrlands Guld Export 5.3% was the most popular beer. The prices were gathered from Systembolaget's own online store. While it's not possible to forecast alcohol sales 2023 with definite certainty, we can facilitate the calculations and comparisons by setting the sales volume to 100 litres before the tax increase. This is helpful in determining whether or not a tax increase, with the price elasticities taken into account, will increase or decrease government tax revenues.

In addition, compared to the most sold product in each category, a hypothetical product for each alcoholic category was generated by using the average of total litres sold and the average price for the 100 most popular brands for spirits, beer and wine (Systembolaget, n.d.). This is done in an attempt to estimate the aggregated effect of a tax increase on consumption levels and government revenue.

4. Results

This section begins with describing the consumption and price patterns of spirits, wine and beer between the time frame of 2010-2018. It is then followed by presenting the elasticities obtained from the different OLS regressions and how these will potentially impact consumption and tax revenues.

4.1 Initial graphs

The graphs below, Figures 5-7, show how the price and sales of each beverage have changed over the years. The price for spirits has gradually decreased over the years, while beer and wine prices have increased. Spirits sales per capita have dropped, while wine sales have remained relatively stable over the years. Beer consumption has steadily increased over the years. There appears to be a large spike in the real prices for all three products in 2015-Q1 due to the tax increase of alcohol. The year before also introduced a tax increase, which is shown by a similar price rise in all three graphs but smaller compared to the increase in 2015. The price declines in 2011 and 2018 could be explained by the high inflation the economy experienced that year.

By looking at the sales per capita of each product between 2010 and 2018, it is apparent that there exists a consumption trend between the quarters. Festivities, celebrations and holidays affect the consumption of alcohol; we see a larger consumption of alcohol during the summer and winter holidays. Consumption of all three different alcoholic beverages tend to be much lower in the first quarter of every year.

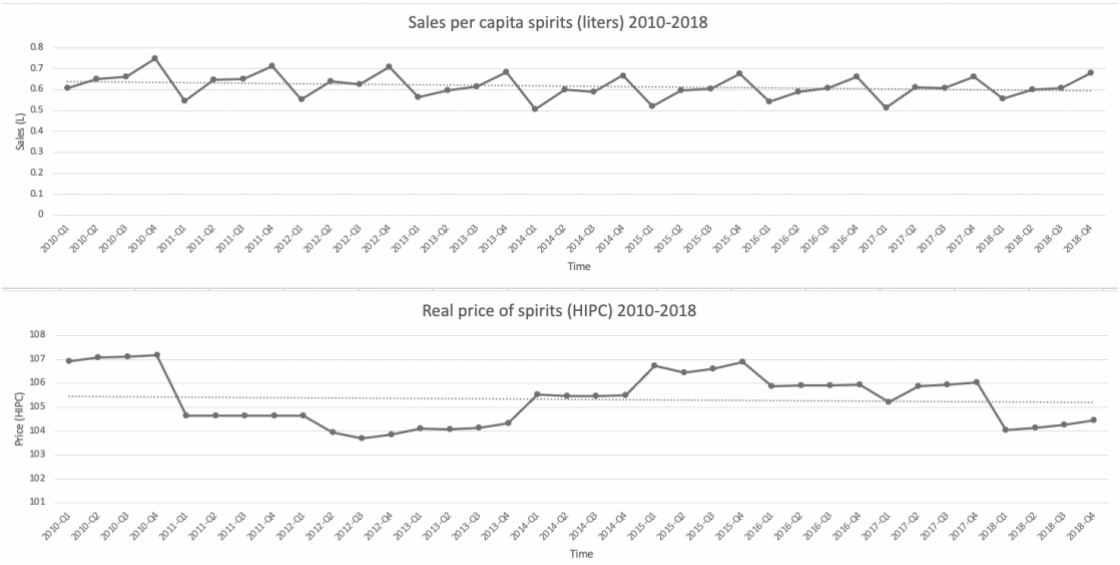


Figure 5- Graphs depicting the change of price and change of sales between 2010 and 2018 for spirits (Eurostat & Systembolaget, 2020)

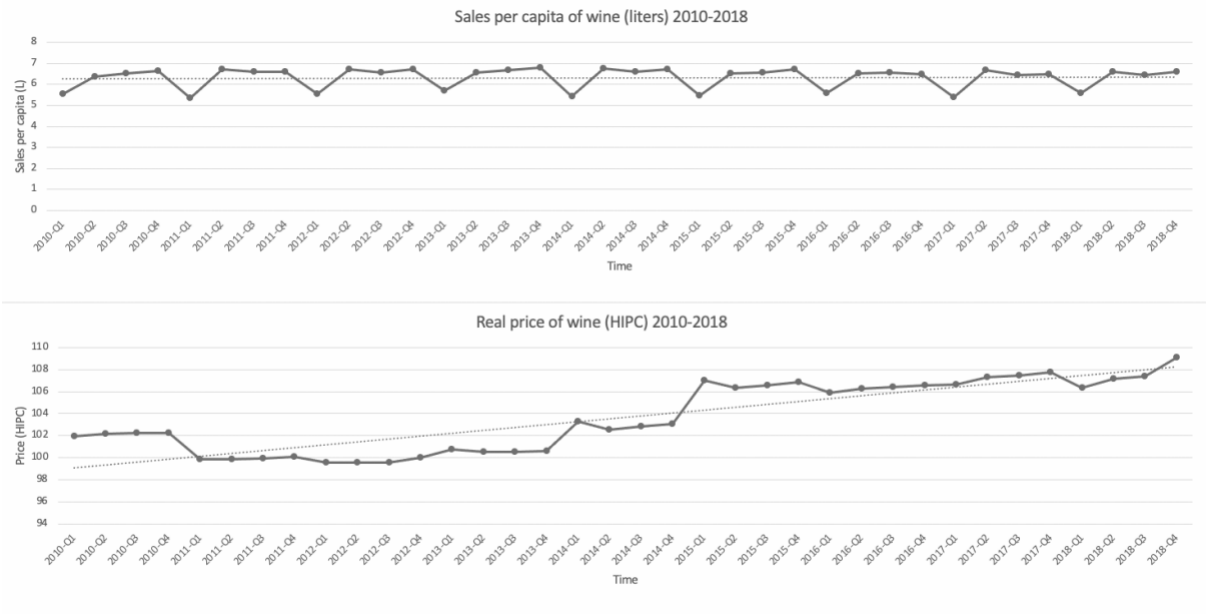


Figure 6- Graphs depicting the change of price and change of sales between 2010 and 2018 for wine (Eurostat & Systembolaget, 2020)

Figure 7- Graphs depicting the change price and change of sales between 2010 and 2018 for beer (Eurostat & Systembolaget, 2020)

4.2 Regression analysis

When estimating the elasticities for each product, three regressions of different complexities were run in Stata. The first model, Model 1, simply estimates the relationship between the logged price and the logged sales per capita. Model 2 includes a coefficient for income per capita per region. The final and most complex model, Model 3, controls for region, income per capita per region, and annual quarter.

4.2.1 Spirits

None of the estimated price elasticities proved to be statistically significant for spirits, meaning that no statistical conclusions can be drawn. To interpret the results, despite the insignificance, the price elasticity of demand for spirits is positive when looking at all three models. Model 1 produced an elasticity of 0.536; a decrease in the price by 1 percent will result in a decrease in sales by 0.536%. The elasticity slightly increases when controlling for income per capita in Model 2. In the final model, the elasticity is 0.132, which indicates an upward sloping, however relatively flat, demand curve.

The regressor, lincome_per_capita, found in Model 2 and 3 estimates the income elasticity of spirits. The income elasticity estimated by Model 2 is negative with a value of -0.449, meaning that as income increases by 1%, demand for spirits falls by 0.449%. Furthermore, by adding a control for annual quarters in Model 3, the income elasticity becomes even more negative at -0.562. Both the income elasticities in model 2 and 3 are statistically significant at the 1% level.

	Model 1	Model 2	Model 3
	lsales_per_capita	lsales_per_capita	lsales_per_capita
lprice	0.536	0.552	0.132
	(0.365)	(0.355)	(0.172)
lincome_per_capita		-0.449***	-0.562***
		(0.0696)	(0.0336)
2.q			0.119***
			(0.00506)
3.q			0.111***
			(0.00506)
4.q			0.232***
			(0.00507)
_cons	-3.115*	2.366	5.609***
	(1.700)	(1.861)	(0.899)
N	756	756	756

Standard errors in parentheses

* p<0.1, ** p<0.05, *** p<0.01

Table 2- Regression results for spirits using three different models, where Model 2 controls for region fixed effects, and Model 3 adds quarterly fixed effects.

4.2.2 Wine

Model 1 produced a positive elasticity of 0.144. This yields the following interpretation; a decrease in price by 1% will result in a decrease in sales by 0.144%. But in the more complex models, Model 2 and Model 3, negative elasticities; -0.534 and -0,725 were produced, due to the inclusion of more controls. For instance, according to Model 3, a decrease in the price by 1% will result in an increase in sales by 0.725%. The produced result for Model 3 proved to be statistically significant at the 1% level. This produces a relatively flat demand curve with a negative slope.

The income elasticity is 0.434 under Model 2 and decreases to 0.297, when adding more controls in Model 3. This means that an increase in income by 1% will result in an increase of

wine consumption by 0.297%. Both the income elasticities estimated are statistically significant for Model 2 and 3.

	Model 1 lsales_per_capita	Model 2 lsales_per_capita	Model 3 lsales_per_capita
lprice	0.144	-0.534*	-0.725***
	(0.151)	(0.313)	(0.179)
lincome_per_capita		0.434**	0.297***
		(0.176)	(0.101)
2.q			0.185***
			(0.00719)
3.q			0.163***
			(0.00719)
4.q			0.184***
			(0.00725)
_cons	1.337*	-0.886	1.560**
	(0.703)	(1.141)	(0.651)
N	756	756	756

Standard errors in parentheses
* p<0.1, ** p<0.05, *** p<0.01
Table 3- Regression results for wine using three different models, where Model 2 controls for region fixed effects, and Model 3 adds quarterly fixed effects.

4.2.3 Beer

The price elasticity of demand for beer turned out to be negative for all models, which is consistent with what was previously predicted regarding elasticities. Model 1 produced the value of -0.0129. Model 2 estimated an elasticity of -1.060, which is shown to be statistically significant at the 1% level. Model 3 being the most complex estimated an elasticity of -0.552 and has a p-value lower than 0.05, meaning that the result is significant at the 5% level. The demand curve is expected to be downward sloping but flatter than the demand curve for wine. The income elasticity for beer decreases from 0.649 in Model 2 to 0.312 in Model 3. Like the previous income elasticities for wine and spirits, the estimates are significant at the 1% level.

	Model 1	Model 2	Model 3
	lsales_per_capita	lsales_per_capita	lsales_per_capita
lprice	-0.0129	-1.060***	-0.552**
	(0.293)	(0.400)	(0.218)
lincome_per_capita		0.649***	0.312***
		(0.171)	(0.0936)
2.q			0.276***
			(0.0103)
3.q			0.288***
			(0.0102)
4.q			0.160***
			(0.0102)
_cons	2.076	-1.110	0.524
	(1.356)	(1.585)	(0.870)
N	756	756	756

Standard errors in parentheses
* p<0.1, ** p<0.05, *** p<0.01

Table 4- Regression results for beer using three different models, where Model 2 controls for region fixed effects, and Model 3 adds quarterly fixed effects.

Model 3 in each individual regression has been chosen to conduct the in-depth main analysis in the discussion section. Through the inclusion of many controls and fixed effects, it attempts to model reality with the highest accuracy. However, the estimate for spirits is imprecise. The demand for wine appears to be more elastic than beer. Sales for all three products are lower in the first quarter of the year. For spirits and wine, the sales increase the most during the fourth quarter, where there is a 0.232% increase in sales of spirits and 0.184% increase in the sales of wine. There is a similar increase of wine sales during the first quarter as well. Beer sales tend to be higher during the second and third quarters with approximately 0.28% higher sales than in quarter 1. All these differences are statistically significant at the 1% level. The following Table summarizes the results estimated by Model 3 for each product.

	Spirits	Wine	Beer
	lsales_per_capita	lsales_per_capita	lsales_per_capita
lprice	0.132	-0.725***	-0.552**
	(0.172)	(0.179)	(0.218)
lincome_per_capita	-0.562***	0.297***	0.312***
	(0.0336)	(0.101)	(0.0936)
2.q	0.119***	0.185***	0.276***
	(0.00506)	(0.00719)	(0.0103)
3.q	0.111***	0.163***	0.288***
	(0.00506)	(0.00719)	(0.0102)
4.q	0.232***	0.184***	0.160***
	(0.00507)	(0.00725)	(0.0102)
_cons	5.609***	1.560**	0.524
	(0.899)	(0.651)	(0.870)
N	756	756	756

Standard errors in parentheses
* p<0.1, ** p<0.05, *** p<0.01

Table 5- Summary of model 3, for each product category, where all three regressions control for region and quarterly fixed effects.

4.2.4 Compiled estimate

The compiled estimate allows for the inclusion of a time trend. A time trend for spirits is included in Models 2 and 3 due to the fact that consumption of spirits has on average steadily decreased over the years, which can be viewed in Figure 5. We see a decrease in the consumption that might not necessarily be correlated with the fall in prices. This could not be executed in the individual estimates done above.

Model 1 simply estimates the price elasticity of demand by taking into account the different consumption levels for each product. The model also considers the differences in consumption patterns during the 4 quarters of the year. In the second model, a control for income was added since it is expected, according to microeconomic theory, that an increase in income will result in higher consumption. This model assumes that income elasticity is the same for all products.

With the region fixed effect, a region consumes 0.674% more alcohol when the income per capita increases by 1%. In Model 2, a time trend for spirits was added. In these two models, we have assumed that the elasticity is the same for all products, however, that may not be the case. The elasticities for beer and wine could be different from spirits. Therefore, the terms 2.p#c.lprice and 3.p#c.lprice are added in Model 3, which leads to the significance of the price elasticities vanishing. As seen in Table 6, the regression shows an elasticity for spirits at -0.238, -0.947 for wine (-0.238-0.709) and -0.812 (-0.238-0.574) for beer.

	Model 1	Model 2	Model 3
	lsales_per_capita	lsales_per_capita	lsales_per_capita
lprice	0.616**	-1.093**	-0.238
	(0.249)	(0.428)	(0.931)
2.p#c.lprice			-0.709
			(0.685)
3.p#c.lprice			-0.574
			(0.633)
lincome_per_capita	0.674	0.674	0.674
	(0.595)	(0.592)	(0.592)
1.Spirit#c.time		-0.00515***	-0.00474***
		(0.00105)	(0.00115)
_cons	-11.75	-2.703	-6.780
	(7.409)	(7.598)	(8.561)
N	2268	2268	2268

Standard errors in parentheses
* p<0.1, ** p<0.05, *** p<0.01
Table 6- Regression results for compiling every product into one estimate, where all three regressions control for region, yearly and quarterly fixed effects. Models 2 and 3 include a time trend for spirits, in addition, Model 3 takes into account differences in elasticities between the alcoholic categories.

4.3 Calculations of a hypothetical tax increase

With the elasticities estimated above, the aim of predicting how a tax increase will affect the consumption of alcohol can be satisfied. Since the government has not provided detailed information on how much the tax will increase, this following section is purely hypothetical. The tax on spirits is increased by 1% and the tax on wine and beer by 5%.

Spirits

Hypothesized nominal tax increase: 1%

	ε = 0.132				**ε = -0.238**			
	Explorer Vodka 37.5%		***Hypothetical average product***		***Explorer Vodka 37.5%***		***Hypothetical average product***	
	Before tax increase	After tax increase	Before tax increase	After tax increase	Before tax increase	After tax increase	Before tax increase	After tax increase
Excise duty rate (SEK/ litre pure 100% ABV alcohol)	516.59	521.76	516.59	521.76	516.59	521.76	516.59	521.76
Price (SEK/ litre)	288.57	290.51	357.55	359.49	288.57	290.51	357.55	359.49
Excise duty (SEK) *tax rate* x *litre pure alcohol*	193.72	195.66	193.72	195.66	193.72	195.66	193.72	195.66
Tax rate (% of price)	67.13	67.35	54.18	54.43	67.13	67.35	54.18	54.42
Price△ (%)		0.67		0.54		0.67		0.54
Consumption △(%) ***ε* x *Price change***		**0.089**		**0.072**		**-0.16**		**-0.129**
Sales volume (litre)	100.00	100.09	144596.04	144699.45	100.00	99.84	144596.04	144409.59
Sales volume (SEK)	28857	29076.46	51700314.10	52017602.64	28857	29004	51700314.10	51913399.20
Government revenue (SEK) *Sales volume* x *tax rate (% of price)*	19372.125	19583.18	28011325.61	28311672.30	19372.125	19535	28011325.61	28254957.39
Government revenue △ (SEK)		211.06		300346.68		162		243631.77
Government revenue △(%)		**1.089**		**1.072**		**0.840**		**0.870**

Table 7- Effect of a tax increase on the consumption of the most popular brand of spirits and a hypothetical average product. The hypothetical average product is based on the average sales volume and price for the 100 most sold brands. The elasticity in the first two columns is generated from the individual regression for Spirits (Table 2), and the second elasticity for columns 3 and 4 is from the compiled regression (Table 6).

Wine

Hypothesized nominal tax increase: 5%

	ε = -0.725				**ε = -0.947**			
	Castillo de Gredos Blanco, 12%		***Hypothetical average product***		***Castillo de Gredos Blanco, 12%***		***Hypothetical average product***	
	Before tax increase	After tax increase	Before tax increase	After tax increase	Before tax increase	After tax increase	Before tax increase	After tax increase
Excise duty rate (SEK/ litre)	26.18	27.49	26.18	27.49	26.18	27.49	26.18	27.49
Price (SEK/ litre)	63	64.31	76.69	77.99	63	64.31	76.69	77.99
Excise duty (SEK) *tax rate* x *litre*	26.18	27.49	26.18	27.489	26.18	27.49	26.18	27.489
Tax rate (% of price)	41.56	42.75	34.14	35.24	41.56	42.75	34.14	35.24
Price △ (%)		2.01		1.71		2.08		1.71
Consumption △(%) ***ε* x *Price change***		**-1.51**		**-1.24**		**-1.97**		**-1.61**
Sales volume (litre)	100	98.49	952501.46	940714.42	100	98.03	952501.46	937105.15
Sales volume (SEK)	6300	6334.03	73047336.97	73374784.45	6300	6304.36	73047336.97	73093264.90
Government revenue (SEK) *Sales volume* x *tax rate (% of price)*	2618	89.49	24936488.22	25859298.83	2618	2694.81	24936488.22	25760083.57
Government revenue △ (SEK)		89.49		922810.61		76.81		823595.35
Government revenue △(%)		**3.42**		**3.70**		**2.93**		**3.30**

Table 8- Effect of a tax increase on the consumption of the most popular brand of wine and a hypothetical average product. The hypothetical average product is based on the average sales volume and price for the 100 most sold brands. The elasticity in the first two columns are generated from the individual regression for Wine (Table 3), and the second elasticity for columns 3 and 4 is from the compiled regression (Table 6).

Beer

Hypothesized nominal tax increase: 5%

	ε = -0.552				**ε = -0.812**			
	Norrlands Guld Export 5.3%		***Hypothetical average product***		***Norrlands Guld Export 5.3%***		***Hypothetical average product***	
	Before tax increase	After tax increase	Before tax increase	After tax increase	Before tax increase	After tax increase	Before tax increase	After tax increase
Tax rate (per litre and volume percentage)	2.02	2.12	2.02	2.12	2.02	2.12	2.02	2.12
Price (SEK/ litre)	32.42	32.96	36.51	37.04	32.42	32.96	36.51	37.04
Excise duty (SEK) *tax rate* x *volume %* x *litre*	10.71	11.24	10.71	11.24	10.71	11.24	10.71	11.24
Tax rate (% of price)	33.02	34.11	29.33	30.35	33.02	34.11	29.33	30.35
Price △ (%)		1.65		1.47		1.65		1.47
Consumption △(%) ***ε* x *Price change***		**-0.91**		**-0.81**		**-1.34**		**-1.19**
Sales volume (litre)	100	99.09	2196998.75	2179216.81	100	98.66	2196998.75	21720841.26
Sales volume (SEK)	3242	3265.49	80207826.04	80725179.31	3242	3251	80207826.04	80414922
Government revenue (SEK) *Sales volume* x *tax rate (% of price)*	1070.60	1113.88	23521068.62	24497229.90	1070.60	1109	23521068.62	24403078
Government revenue △ (SEK)		43.28		976161.28		38		882009
Government revenue △(%)		**4.04**		**4.15**		**3.59**		**3.75**

Table 9- Effect of a tax increase on the consumption of the most popular brand of beer and a hypothetical average product. The hypothetical average product is based on the average sales volume and price for the 100 most sold brands. The elasticity in the first two columns are generated from the individual regression for Beer (Table 4), and the second elasticity for columns 3 and 4 is from the compiled regression (Table 6).

As shown in all tables above, a hypothetical tax increase by each product group will indeed generate a positive change in government revenue for all product categories. The percentage change in consumption for beer and wine are all negative, which was expected due to the negative elasticities that were estimated. For instance, when looking at the aggregated effect, a 5% tax raise for a wine bottle will reduce consumption by 1.24% and increase tax revenues by 3.70% (ε=-0.725). For beer we observe a similar pattern where a 5% tax increase will result in a 0.81% reduction in consumption, and a 4.15% increase in government revenue (ε=-0.552). With a positive price elasticity for spirits, the change in consumer consumption is positive when a tax increase is implemented. It is apparent that the change in consumption and government revenue for the top brands are similar to the results estimating the aggregated effects.

5. Discussion and conclusion

5.1 Discussion of results

The results obtained by our research have been rather anticipated, as they proved to be consistent with preconceived notions, microeconomic theory and previous research. As expected, the overall demand for alcoholic beverages turned out to be quite price inelastic, despite a wider range of ways to obtain alcohol. Moreover, research on price elasticities of demand conducted beyond the borders of Sweden finds that the elasticities are inelastic, due to the lack of substitutes for alcoholic beverages.

While Systembolaget has reported a decrease of sales of alcohol per volume, the overall sales of alcoholic beverages have increased. Hence, the actual alcohol consumption has in fact fallen over the years, as purchasing preferences have changed. As demonstrated by Figure 5, the overall sales per capita of spirits have dropped. The sales of wine have remained fairly stable throughout the years, as seen by Figure 6. In contrast, sales of beer have increased, which can be viewed in Figure 7.

5.1.1 Spirits results

In the case of spirits, the individual estimates in each of the three models are not statistically significant, which makes it difficult to draw any definite conclusions. Despite the insignificance of the estimates, we can still observe a fall in consumption. This can be seen in Figure 6, where the consumption of spirits has steadily decreased over the years while prices have simultaneously dropped. As shown in Table 2, all models produced positive estimates of 0.536, 0.552 and 0.132. However, it is illogical to draw the conclusion that lower prices have caused lower sales. The positive price elasticity of demand for spirits can more likely be attributed to changed preferences of alcohol consumption, which is not reflected in price changes. Out of the three alcoholic categories in the compiled estimate, spirits proved to be the least elastic, which we did not expect since the incentive to obtain spirits from abroad is bigger than for wine and beer. For instance, it’s more convenient to buy spirits through duty-free shopping abroad, since the acquired alcohol contains a higher amount of alcohol per volume. This can possibly be explained by the consumption by domestic alcoholics, which is driven by their compulsive need to consume alcohol regardless of price.

Moreover, the income elasticity of demand appears to be negative, contrary to expectations for a normal good, with statistically significant estimates of -0.449 and - 0.562. Thus, spirits seem to be an inferior good according to microeconomic theory. This could largely be due to the differences in alcohol consumption between the different regions. Stockholm region has the highest income per capita, however, spirits are not consumed to a large extent. Jämtland and Värmland region consume the most spirits, though the income per capita is low compared to other regions. On the other hand, the region fixed effects eliminate this assumption. With these fixed effects, when the incomes increase within the individual regions, the consumption of spirits decreases. These can be viewed in Figure 5, where the consumption of spirits has decreased over the years while real income per capita has increased, indicating the decrease in the popularity of spirits. The model captures the spurious correlation between these two factors, rather than the income effect. There exists a coincidental correlation between the two variables because of these stochastic trends. By compiling the estimates into one large regression, we take into account this decreased consumption trend of spirits. The final estimate that was produced in Table 6 for spirits was -0.238, which means that spirits is in fact an ordinary good.

As previous research states, the price elasticity of spirits have formerly varied between -0.96 and -1.3. Despite the insignificance, the compiled regression estimated a much more inelastic demand for spirits at -0.238. This is quite ambiguous since the consumption of spirits has fallen over the years, yet the demand has become more inelastic, meaning that the consumption should've stayed relatively unchanged according to its elasticity. With the individual regression, the price elasticity was positive, which is a big contrast to previous research. An explanation for this could be that preferences for alcohol have changed compared to the time period for when previous research was conducted. However, this cannot be proven due to the high p-values and thus we don't know the true effect of price on the consumption of spirits.

5.1.2 Wine results

While consumption of wine has remained stable, prices have moved in an upward direction, as illustrated by Figure 8. In the individual regression analysis, the more complex regressions for wine, seen in Table 3, with more added controls produced expected estimates, which were also significant. The negative price elasticities essentially explain that an increase in prices have caused sales to ultimately go down. Due to the estimate of -0.725 being statistically significant at the 1 % level, a conclusion of causation can be drawn. Wine had the most elastic demand out of all three products. One reason could possibly be explained by a bigger incentive to obtain

wine elsewhere than at Systembolaget, due to accessible channels of imports. It is easier to import one standard unit of wine in terms of volume and weight compared to one standard unit of beer. Table 3 also shows positive income elasticities of demand for model 2 and 3, with 0.434 being significant at the 5% level, and 0.297 being significant at the 1% level, indicating that wine is an ordinary good. According to the compiled regression, the elasticity was higher in absolute value, showing a more elastic, yet still overall inelastic, demand. However, this estimate was insignificant.

Our findings in this paper are somewhat in line with previous research. The price elasticity for wine was -0.725 based on the individual regression and -0.947 based on the compiled regression, whereas both estimates are similar to prior research. The consumption patterns seem to have remained stable compared to a little over two decades ago.

5.1.3 Beer results

The findings for beer also confirmed initial expectations of a negative relationship between prices and sales. As displayed in Table 4, Stata produced negative elasticities for all models, with the estimates -1.060, significant at the 1% level for Model 2 and -0.552, significant at the 5% level for Model 3. At first glance, Figure 7 visualizes how sales of beer have increased concurrently with raised prices through the years. It is possible that higher sales have occurred, despite higher prices, due to higher quality breweries and a wider range of options for beer. However, upon further inspection, it is visible to see that spikes in prices have caused drops in sale during the same time frame. Thus, the point of causation still remains, as higher prices have caused lower sales in the past. The findings confirm the negative relationship between prices and consumption. The income elasticity for beer proved to be positive as well, with estimates of 0.649 and 0.312, both statistically significant at the 1% level. On the contrary, the compiled estimate of -0.812, with time trends taken into account, was statistically insignificant.

The elasticity for beer has previously been between -0.9 and -1.3. Our estimates of -0.552 and -0.812 appear to be lower compared to previous research; the demand for beer nowadays has become more inelastic. This illustrates that the consumption patterns for beer have changed since the last attempt to measure price elasticities of alcohol that was made in 2006. Figures 6-8 illustrate that the beer sales have steadily increased over the years, while consumption of spirits has fallen, and wine remained fairly stable. This suggests that beer is the more preferred alcoholic beverage, and that consumers will more or less continue to purchase beer despite the

price increases. The lowered price elasticity could also mean that beer has become more of an everyday commodity in Swedish households.

5.2 Effect of taxes

By using the results in our study, and comparing them with previous research, it is possible to finally prognosticate the outcome of the tax proposal, set to take effect in 2023. As previously stated, according to Greenfield et al (2009), there are numerous negative externalities that result from the consumption of alcohol including assaults and vehicle accidents. To prevent these societal costs, the government attempts to control consumer behaviour through raising prices by using taxes.

By applying the obtained price elasticities for each group in the context of raised taxes, and therefore higher prices, we managed to acquire effects on consumption and the fiscal effects. Based on our calculations in section 4.3, it is apparent that the change in consumption is negative for all products, except for spirits (based on the individual regression). This is because spirits had a positive, but insignificant, price elasticity. The consumption of spirits is expected to increase by 0.09% ($\varepsilon = 0.132$) and fall by 0.13% ($\varepsilon = -0.238$). When analysing the results for beer and wine, it indicates that the intention of an alcohol tax increase will ultimately fulfil its purpose in lowering consumption, but not to a great extent. With wine being the most elastic, it yielded the largest decrease in consumption, with a drop of 1.24% ($\varepsilon = -0.725$) and 1.6% ($\varepsilon = -0.947$). Beer consumption will decrease by 0.8% ($\varepsilon = -0.552$) and 1.19% ($\varepsilon = -0.812$) when a 5% tax increase is implemented.

Furthermore, it will satisfy the goal of increasing tax funds to a certain extent. We have estimated that there will be a 3.7% ($\varepsilon = -0.725$) or a 3.3% ($\varepsilon = -0.947$) increase in tax revenue from selling wine, and a 4.2% ($\varepsilon = -0.552$) or 3.75% ($\varepsilon = -0.812$) increase from selling beer due to its more inelastic nature. Due to the lack of statistical significance for the price elasticity of spirits, the calculated change in tax revenue by percentage is rather uncertain, however, the result we obtained was a 1.1% ($\varepsilon = 0.132$) or a 0.87% ($\varepsilon = -0.238$) increase. Nonetheless, it still helps to imply that a tax increase will result in a positive change in government revenues.

Based on these results, it is evident that the decrease in consumption of alcohol is much lower than the increase in government revenue. For instance, a 5% increase in the tax of wine will

result in the consumption of wine falling by 1.24% but this will generate a positive fiscal effect of 3.7%. This is due to the large percentage share that constitutes the alcohol tax, around 34% of the price of a wine bottle is just the tax. We see similar effects with the other two beverages; the increased taxes have a minimal effect on the alcohol consumption. Since the overall consumption is inelastic and therefore remains more or less the same, a tax raise should not affect the prices that suppliers set. Systembolaget can therefore operate similarly to before any tax raise is implemented, with the exception of adapting to menu costs. This raises questions regarding the effectiveness of the alcohol tax in reducing and controlling the consumption of alcohol, which according to the Swedish government, is the main purpose of establishing the alcohol monopoly and implementing high alcohol taxes. Systembolaget claims that they are not profit maximizing, however, it can be viewed that the high alcohol taxes take advantage of the inelastic demands for alcoholic products.

5.3 Limitations

The main limitation with this study is the threat to identification. Since our analysis is not based on an experiment or a reform, but rather incremental changes in prices between the time period of 2010 to 2018, these prices could potentially be endogenous, which violates the exogeneity assumption of the OLS model. We may have simply found a correlation between the consumption and prices of alcohol, but not the desired causation. Since Systembolaget's sales data was used and not consumption data, it is difficult to distinguish the price elasticity of demand from the price elasticity of supply. This could potentially mean that the elasticities that have been estimated in this study reflect how sensitive Systembolaget is to a change in price. This is why it is important to understand the nature of Systembolaget's supply curve. However, we failed to establish the true relationship between prices and quantity supplied through the lens of Systembolaget, despite numerous attempts to reach out for more detailed information. Therefore, we made assumptions that simplified the slope of the supply curve.

Another limitation with our findings is that the alcoholic category of cider and other alcoholic beverages besides spirits, wine and beer have not been accounted for in this study due to the lack of price data on them. The increased alcohol tax will also have an effect on these categories and therefore it is important to estimate their respective price elasticities to approximate this effect.

Furthermore, we used sales statistics from Systembolaget, which does not take into account unregistered sales. The total consumption of alcohol comprises registered and unregistered sales. The data does not cover unregistered cross border sales, which could have been impacted by changes in domestic prices. While higher taxes won't have an effect on the total consumption in the short run, they will distort the consumption patterns in terms of channels used to obtain the alcohol. The domestic change in taxes can result in a substitution effect where the distribution between registered and unregistered sales won't remain the same. If consumers are discouraged by higher domestic prices, they will feel compelled to procure alcohol by other means. Regions close to neighbouring countries have the possibility of importing cheaper alcoholic beverages, however, this is not reflected in our analysis. In addition, alternative means of obtaining alcohol such as home brewing has also not been taken into consideration.

Throughout the report, the terms 'consumption' and 'sales' have been used interchangeably even though the true meaning of these are not the same. A drop in sales at Systembolaget does not directly translate into a similar drop in consumption of alcohol. As mentioned above, consumers could've simply switched to alternative means of obtaining alcoholic beverages, however, this is not recorded.

5.4 Conclusion

The aim of this paper was to, with some certainty, predict the effect of a tax increase on consumer demand as well as its fiscal impact through estimating the price elasticities of demand for alcohol. Since research on the price elasticities of demand for alcoholic beverages dates back to over two decades ago, it was necessary to update them in order to estimate the potential effect of the proposed tax increase. Therefore, our findings contribute to the already existing research on this topic by taking into account the changes in consumer behaviour.

The elasticities that were estimated were partially consistent with previous research, but with some differences. Our estimated elasticity of wine corroborates the findings of previous studies. On the contrary, beer has become more inelastic. Due to this change in demand for beer, a price increase will result in a smaller change in consumption and a larger fiscal change compared to previous price elasticities. Higher tax funds can in turn be used for increased government expenditure. Moreover, spirits seem to have a positive elasticity, but this cannot be determined for certain due to the imprecise results. If the overall achieved results are correct

or at the very least somewhat accurate, we will see a slight decrease in demand for alcohol, but an even larger increase in the government revenue. This begs the ethical question: Is the Swedish government acting in the interest of its people's health or is it aiming to maximize government revenues? To complement our study, it would be interesting to research where the tax revenues are allocated to understand the societal importance of Systembolaget. In addition, cross price elasticities is another concept that would be useful to explore in further research.

6. References

2015/16:RFR8 (2016). Punktskattehöjningar På Alkohol- Och Tobaksprodukter – Skatteeffekter Och Påverkan På Den Oregistrerade Anskaffningen Av Dessa Produkter .data.riksdagen.se/fil/9ACF001D-C07A-4CCB-825B-A01F7A96F3F9.

Angus, C., Holmes, J., & Meier, P. (2019). Comparing Alcohol Taxation throughout the European Union. *Wiley Online Library*, John Wiley & Sons, Ltd, 30 May 2019, onlinelibrary.wiley.com/doi/full/10.1111/add.14631.

Asplund, M., Friberg, R., & Wilander, F. (2007). Demand and Distance: Evidence On cross-Border Shopping. *Journal of Public Economics*, vol. 91, no. 1-2, pp. 141–157., doi:https://doi.org/10.1016/j.jpubeco.2006.05.006.

Brännborn, S. (2020, December 10). Systembolagets prissättning [E-mail interview].

Chen, J. (2020, December 01). Veblen Good. Retrieved December 10, 2020, from https://www.investopedia.com/terms/v/veblen-good.asp#:~:text=Veblen goods are fairly commonplace,be classified as Veblen goods.

Dhamija, S. (2020). It's time to go #VocalforLocal with your Daaru choices! Do you know about Desi Liquor of India? Retrieved from https://www.localsamosa.com/2020/07/22/desi-liquor-of-india/

Dzemski, A (2020). Basic Econometrics- Lecture Notes. The OLS Estimator. The OLS Estimator.

Eurostat (2020). Harmonised index of consumer prices (HICP) (prc_hicp). Retrieved December 4, 2020, from https://ec.europa.eu/eurostat/cache/metadata/en/prc_hicp_esms.htm

Finansdepartementet (2020). Skatten På Alkohol Och Tobak Höjs Från 2023. *Regeringskansliet*, www.regeringen.se/pressmeddelanden/2020/09/skatten-pa-alkohol-och-tobak-hojs-fran-2023/

Gallet CA. (2007) The demand for alcohol: a meta-analysis of elasticities. *Aust J Agricult Resource Econ* 51:121–35.

Greenfield, T. K., Ye, Y., Kerr, W., Bond, J., Rehm, J., & Giesbrecht, N. (2009). Externalities from alcohol consumption in the 2005 US National Alcohol Survey: implications for policy. *International journal of environmental research and public health*, *6*(12), 3205–3224. https://doi.org/10.3390/ijerph6123205

Historien om Systembolaget. Från Bergsmän till Bratt. *Systembolagets Historia* , www.systembolagethistoria.se/Teman/Ursprunget/.

Hortlund, P. & Mihaescu, O. (2017). The Impact of Price Changes on Volume Sales of Alcoholic Beverages in Sweden, 2006–2013,

Häkkinen, E (2019). Alko Inc . *Information On The Nordic Alcohol Market 2019*, www.alko.fi/INTERSHOP/static/WFS/Alko-OnlineShop-Site/-/Alko-OnlineShop/fi_FI/pdf_t/Uutishuoneen%20pdf_t/Information%20on%20the%20Nordic%20Alcohol%20Market%202019.pdf.

IQ (n.d.). Alkoholens skador i samhället. Retrieved December 2, 2020, from https://www.iq.se/fakta-om-alkohol/alkoholens-skador-i-samhallet/

Johansson, P., Pekkarinen, T., & Verho, J. (2014). Cross-border health and productivity effects of alcohol policies. *Journal of Health Economics, 36*, 125-136. doi:10.1016/j.jhealeco.2014.04.002

Kumar, S. (2017). Price Elasticity of Alcohol Demand in India. *Alcohol and Alcoholism, 52*(3), 390-395. doi:10.1093/alcalc/agx001

Manthey, J., Hasan, O., Probst, C., Rehm, J., Rylett, M., & Shield, K. (2019). *The Lancet*, vol. 393, no. 10190, doi:10.1016/S0140-6736(18)32744-2.

Meng, Y., Brennan, A., & Purshouse, R. (2014) Estimation of own and cross price elasticities of alcohol demand in the UK—a pseudo-panel approach using the Living Costs and Food Survey 2001 2009. *J Health Econ* 34:96–103.

Motion 2018/19:1795. Återför indexeringen av alkoholskatten. https://www.riksdagen.se/sv/dokument-lagar/dokument/motion/aterinfor-indexering-av-alkoholskatten_H6021795

Norström, T (2005). The Price Elasticity for Alcohol in Sweden 1984–2003. *Nordic Studies on Alcohol and Drugs*, vol. 22, no. 1, pp. 87–101., doi:10.1177/145507250502201s21.

Perloff, J (2014). *Microeconomics with Calculus*. 3rd ed., Pearson Education Limited.

Pettinger, T. (n.d.). Pigovian Tax. from https://www.economicshelp.org/blog/glossary/pigovian-tax/

Ramboll. (2019, June). Alkoholen Samhällsekonomiska Konsekvenser. Retrieved December 9, 2020, from: https://www.omsystembolaget.se/globalassets/pdf/alkoholproblematik/ramboll---resultatrapport----alkoholens-samhallskonsekvenser---uppdaterad-oktober-2020.pdf

SFS 2019:552. *Avtal mellan Systembolaget Aktiebolag och staten.* https://www.riksdagen.se/sv/dokument-lagar/dokument/svensk-forfattningssamling/tillkannagivande-2019552-av-avtal-mellan_sfs-2019-552.

Skatteverket (2020). Skattesatser på alkohol. Retrieved October 16, 2020, from https://www.skatteverket.se/foretagochorganisationer/skatter/punktskatter/alkoholskatt/skattesatser.4.4a47257e143e26725aecb5.html

SOU 1991:52. Alkoholbeskattningen, slutbetänkande av alkoholskatteutredningen. Stockholm: Allmänna förlaget. https://data.kb.se/datasets/2015/02/sou/1991/1991_52%28librisid_16918224%29.pdf

SCB (2020). Priserna i Sverige – Konsumentprisindex (KPI). www.scb.se/hitta-statistik/sverige-i-siffror/samhallets-ekonomi/kpi/#:~:text=KPI%20visar%20att%20priserna%20nu,tre%20g%C3%A5nger%20s%C3%A5%20mycket%20idag.

SCB (2020). Befolkning Efter 18-95+ år efter region, ålder, kön och år. https://www.statistikdatabasen.scb.se/pxweb/sv/ssd/START__UF__UF0506/UtbBefRegionR/Table/TableViewLayout1/.

SVT. (2014, October 26). Systembolaget stoppar försäljningen av Fireball. *SVT Nyheter*. Retrieved from https://www.svt.se/nyheter/inrikes/systembolaget-stoppar-forsaljningen-av-fireball

SVT. (2020, November 25). Systembolaget återkallar rosévin. *SVT Nyheter*. Retrieved from https://www.svt.se/nyheter/inrikes/systembolaget-aterkallar-rosevin

Systembolaget (n.d.). Alkoholkonsumtion i Sverige. (n.d.). Retrieved December 7, 2020, from https://www.omsystembolaget.se/kropp-halsa/livsstil/sa-dricker-vi-i-sverige/

Systembolaget (n.d.). Systembolaget's online shop. Retrieved November 26, 2020, from https://www.systembolaget.se/

Systembolaget (n.d.). Systembolagets prismodell. Retrieved November 26, 2020, from https://www.omsystembolaget.se/om-systembolaget/inkop-kvalitet/prismodell/

Systembolaget (n.d.). Systembolagets försäljningsstatistik. Retrieved November 26, 2020 www.omsystembolaget.se/om-systembolaget/foretagsfakta/forsaljningsstatistik/ .

Systembolaget's Customer Service. (2017, November 09). Varför gör Systembolaget reklam? https://vanligafragor.systembolaget.se/org/systembolaget/d/varfor-gor-systembolaget-reklam/

The Public Health Agency of Sweden. (2015). Responsible alcohol service. https://www.folkhalsomyndigheten.se/contentassets/4c3f1cdf4b19469ea79bbd1915c01f58/responsible-alcohol-service-15039-webb.pdf

Tragakes, E (2012). *Economics for the IB Diploma*. Cambridge: Cambridge UP. Print.

Wagenaar AC, Salois MJ, Komro KA. (2009) Effects of beverage alcohol price and tax levels on drinking: a meta-analysis of 1003 estimates from 112 studies. *Addiction* 104:179–90.

World Health Organization (2020). Harmful Use of Alcohol. Retrieved November 20, 2020, from Https://Www.who.int/substance_abuse/Safer/r/En/#:~:Text=An%20increase%20in%20excise%20taxes,in%20the%20price%20of%20drinks.

7. Appendices

Appendix A

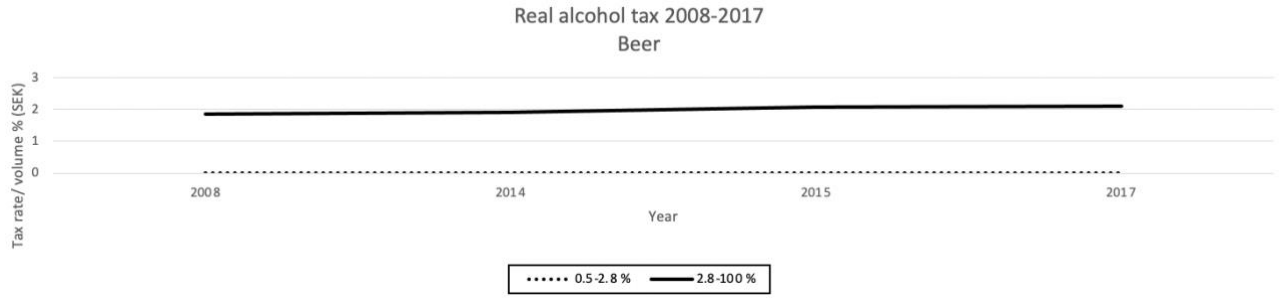
Tax rate increases for each alcoholic beverage category between 2008 and 2017 (Skatteverket, 2020)

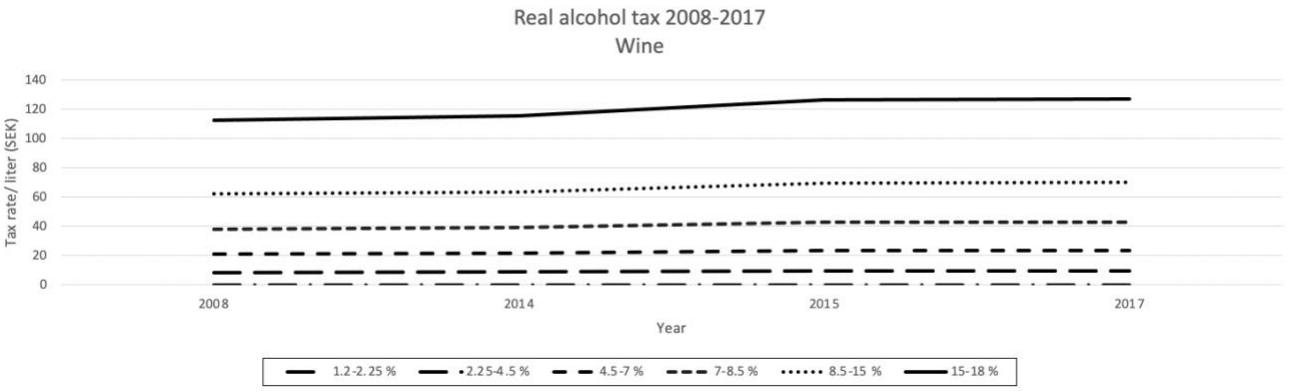
Year	Product	Volume % min	Volume % max	Tax rate/volume % (SEK)	Tax rate/litre	Tax rate/litre pure alcohol
2017	Beer	0.5	2.8	0		
2017	Beer	2.8	100	2.02		
2017	Wine and other fermented beverages than wine and Beer	1.2	2.25		0	
2017	Wine and other fermented beverages than wine and Beer	2.25	4.5		9.19	
2017	Wine and other fermented beverages than wine and Beer	4.5	7		13.58	
2017	Wine and other fermented beverages than wine and Beer	7	8.5		18.69	
2017	Wine and other fermented beverages than wine and Beer	8.5	15		26.18	
2017	Wine and other fermented beverages than wine and Beer	15	18		54.79	
2017	Middle class products	1.2	15		32.99	
2017	Middle class products	15	22		54.79	
2017	Etylalkohol	1.2	100			516.59
2015	Beer	0.5	2.8	0		
2015	Beer	2.8	100	1.94		
2015	Wine and other fermented beverages than wine and Beer	1.2	2.25		0	
2015	Wine and other fermented beverages than wine and Beer	2.25	4.5		8.84	
2015	Wine and other fermented beverages than wine and Beer	4.5	7		13.06	
2015	Wine and other fermented beverages than wine and Beer	7	8.5		17.97	
2015	Wine and other fermented beverages than wine and Beer	8.5	15		25.17	
2015	Wine and other fermented beverages than wine and Beer	15	18		52.68	
2015	Middle class products	1.2	15		31.72	

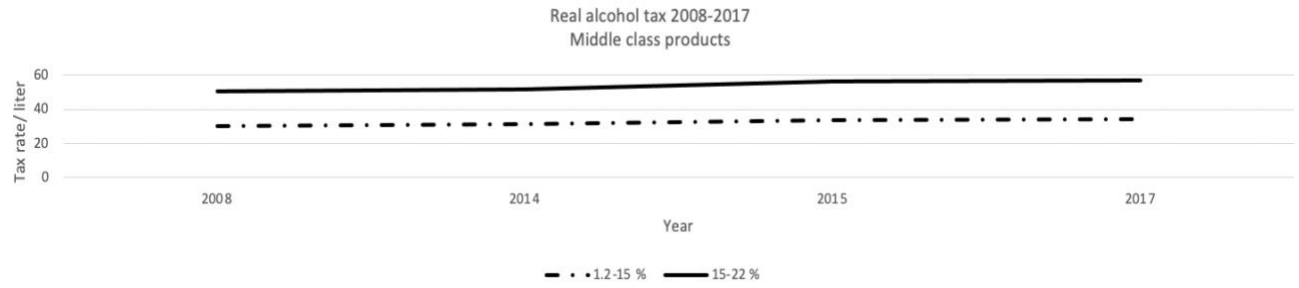
2015	Middle class products	15	22		52.68	
2015	Etylalkohol	1.2	100			511.48
2014	Beer	0.5	2.8	0		
2014	Beer	2.8	100	1.78		
2014	Wine and other fermented beverages than wine and Beer	1.2	2.25		0	
2014	Wine and other fermented beverages than wine and Beer	2.25	4.5		8.11	
2014	Wine and other fermented beverages than wine and Beer	4.5	7		11.98	
2014	Wine and other fermented beverages than wine and Beer	7	8.5		16.49	
2014	Wine and other fermented beverages than wine and Beer	8.5	15		23.09	
2014	Wine and other fermented beverages than wine and Beer	15	18		48.33	
2014	Middle class products	1.2	15		29.1	
2014	Middle class products	15	22		48.33	
2014	Etylalkohol	1.2	100			506.42
2008	Beer	0.5	2.8	0		
2008	Beer	2.8	100	1.66		
2008	Wine and other fermented beverages than wine and Beer	1.2	2.25		0	
2008	Wine and other fermented beverages than wine and Beer	2.25	4.5		7.58	
2008	Wine and other fermented beverages than wine and Beer	4.5	7		11.2	
2008	Wine and other fermented beverages than wine and Beer	7	8.5		15.41	
2008	Wine and other fermented beverages than wine and Beer	8.5	15		21.58	
2008	Wine and other fermented beverages than wine and Beer	15	18		45.17	
2008	Middle class products	1.2	15		27.2	
2008	Middle class products	15	22		45.17	
2008	Etylalkohol	1.2	100			501.41

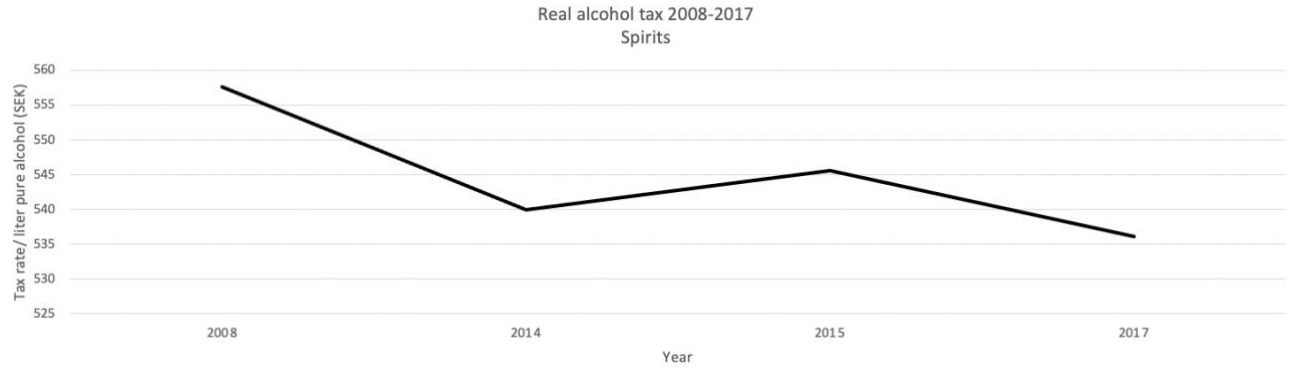
Appendix B

Graphs showing real tax rate increases for each alcoholic beverage category between 2008 and 2017, based on the Table in Appendix A and adjusted for inflation (Skatteverket, 2020).



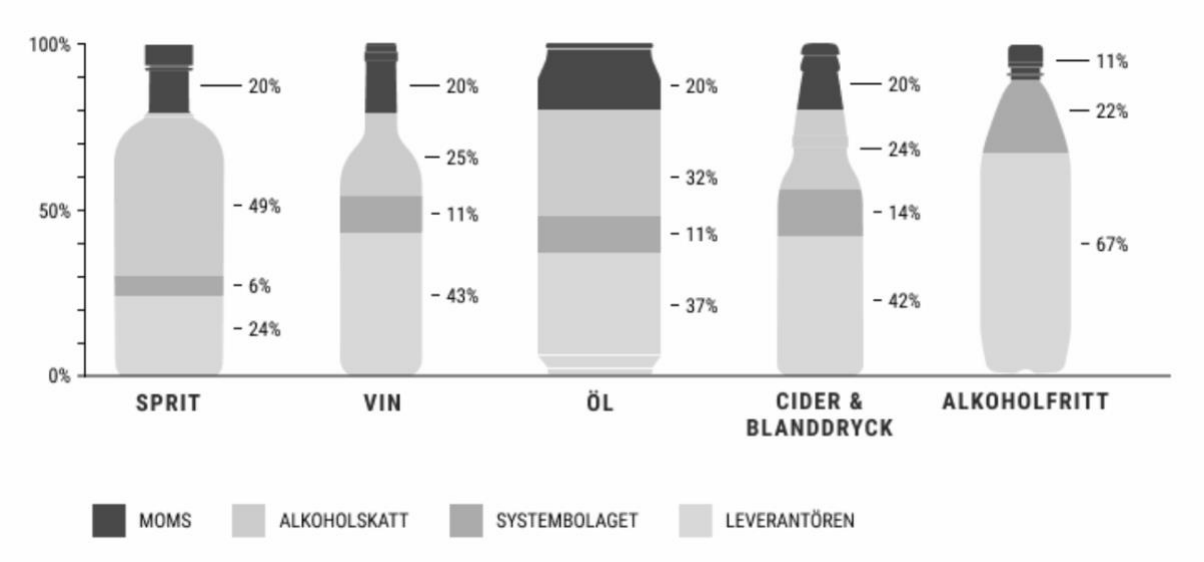






Appendix C

The share of total sales per product category (Systembolaget, n.d.)



Appendix D

Top 5 most sold brands in the year of 2019 per product category, sorted by popularity (Systembolaget, n.d.).

Most sold (litres)	Spirits	Wine	Beer
1.	Explorer Vodka, 37.5%	Castillo de Gredos Blanco, 12%	Norrlands Guld Export, 5.3%
2.	Absolut Vodka, 40%	Les Fumées Blanches Sauvignon Blanc, 11.5%	Mariestads Export, 5.3%
3.	The Famous Grouse, 40%	Il Barone Rosso, 12%	Sofiero Original, 5.2%
4.	Dworek Vodka, 37.5%	Leva Chardonnay Dimiat & Muscat, 13%	Falcon Export, 5.2%
5.	Lord Calvert, 40%	Zumbali Chenin Blanc, 13%	Kung, 5.2%