



# Sweden's proposed excise tax on plastic bags

Using a stated preference method to evaluate outcomes

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## **Abstract:**

The 1<sup>st</sup> of May 2020, the Swedish government will implement an excise tax on plastic bags. Using a stated preference method, this paper explores the effects the excise tax will have on plastic bag consumption. The vast majority of plastic bags that are sold in Sweden are grocery store bags. Therefore, this study focuses on the consumption effects on grocery store bags, as opposed to plastic bags that are sold in other types of stores. Intercept surveys were conducted outside of four different grocery stores. Using the data gathered during the surveys, we calculate the average consumption decrease given three different price scenarios. Further, data on consumption habits in regard to the so called "fruit bags" was also collected. Using this data, we were able to calculate the consumption decrease at two different price levels for fruit bags. This study finds that, given a price increase of 3 SEK, plastic bag consumption will decrease by almost 36%. The consumption of plastic bags decreased by 11% between 2017 and 2018, and if this trend continues after the excise is implemented, we believe that it is possible to reach the EU consumption target of 40 plastic bags per person per year in 2025, but it is unsure if any further action is needed.

**Keywords:** Excise, environmental tax, plastic bags, stated preference, price elasticity of demand

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# 1. Introduction

It is commonly believed that the usage of plastic must decrease, and several countries have already discussed or actually banned single-use plastic items, because of the harmful effects plastic has on the environment. As of writing this paper, Sweden has proposed a law that will be implemented the first of May 2020, this law will put an excise tax on light weight plastic bags in order to reduce consumption (Finansdepartementet 2019).

Swedes consumed, approximately 1020 million thin lightweight plastic bags throughout 2018. It is an 11% decrease, in thin plastic bags, compared to the previous year. To decode the data to an individual level: 114 thin plastic bags were consumed per person in 2017 and 102 thin plastic bags per person in 2018 (Naturvårdsverket 2019).

This data is available because of a Swedish regulation (SFS 2016:1041) adopted at the end of 2016, and during that time period several other European countries started to reduce their consumption of plastic too, because of an EU directive. This EU directive (2015/720/EU) set a target for all member states: 90 bags per person per year in 2019 and/or 40 bags per person per year in 2025.

Sweden has proposed a policy change in order to reach the EU fixed target. This proposal includes an economic instrument, a specific tax on plastic bags, the tax will yield an extra cost of 3 SEK for thin lightweight plastic bags. The excise will also yield an extra cost of 0.3 SEK for very thin lightweight plastic bags (e.g. fruit bags in grocery stores). The goal of this taxation is to reduce the consumption of plastic carriers, and reducing plastic carriers will further decrease the negative impact on the environment whilst reaching the fixed target consumption goal (Finansdepartementet 2019).

Similar economic instruments have been implemented by other European countries, for example UK, Portugal, Ireland and Denmark. In the UK, Wales had the lowest reduction on grocery bags consumption, 74% in 2015 and England had the largest reduction on grocery bag consumption, 85% in 2016 (BBC 2015, Guardian 2016). What is noteworthy is that this effect was for grocery bags going from being free of charge to costing something, whereas in Sweden plastic bags are not currently free of charge. Going from being free of charge to having a cost is possibly a larger step than just an increase in price.

This paper contributes to the research on environmental taxes by focusing on the effects of an economic instrument levied on grocery plastic bags in Sweden. Previous papers have mainly focused on cases where plastic bags went from being free to actually having a cost. This paper, on the other hand, examines a case where plastic bags already have a cost and their price is increased by the implementation of an excise. Furthermore, this paper also examines the price increase for the so-called fruit bags which were free of charge before the implementation of the tax. This allows for a comparison between the two different cases, which further contributes to the research on excise taxes.

The tax on plastic bags will affect not just grocery stores, but also other stores where plastic bags are sold (e.g. bookstores, clothing stores). However, this paper focuses on grocery store consumption, since the majority of plastic bags in Sweden are sold in grocery stores. This paper will denote light weight grocery store plastic bags as “plastic bags”, “grocery store bags” or “bags”, while the thin very light weight plastic bags will always be denominated as “fruit bags”.

In this paper we will focus on the proposed tax and conduct a survey with a sample from grocery stores. Our main research questions are (1) will grocery store customers reduce their plastic bag consumption after the 3 SEK tax gets implemented, if so – by how much, and (2) will it be plausible to reach the EU fixed consumption target by 2025. Moreover, by presenting the survey participants with three different price scenarios, we will be able to derive the price elasticity of demand for plastic bags at different price levels.

We found, using data from a stated preference survey, that almost 86% uses plastic bags today and that after an implementation of the tax that plastic bag consumption will decrease. If the price increase is 3 SEK then the decrease of consumption will be approximately 36%. Additionally, people who only use plastic bags bought in grocery store as their garbage bags are less price sensitive compared to others.

This paper is organized as follows. Chapter 2 discusses the plastic bag regulations and also discusses the literary review. Chapter 3 presents the relevant theoretical framework used in this paper. Chapter 4 describes our method for gathering data and expected outcome. Chapter 5 presents estimates of the tax policy in the Gothenburg Metropolitan Area. Section 6 discusses possible explanations for the result of the three different price scenarios, as well as limitations. Section 7 concludes the paper.

## 2. Background and literary review

### 2.1 Background

In 2015, the EU directive 2015/720/EU amending directive 94/62/EC, was adopted to reduce the negative impact on the environment caused by the consumption of lightweight plastic bags. The directive set the fixed target goal for the consumption of plastic bags, additionally, the directive specifies that plastic bags with wall thickness less than 15  $\mu\text{m}$  (e.g. fruit bags in grocery stores) can be exempted from the consumption targets.

The Swedish proposal suggests an excise tax on the producer/import side. As declared above, plastic bags will be charged with a tax of 3 SEK and 0.30 SEK for “fruit bags”. Fruit bags are defined as plastic carriers with a thinner wall thickness, less than 15  $\mu\text{m}$ , and less volume, no more than 7 litres. This means that fruit bags are not part of the fixed target goal set by EU but Sweden still wants to decrease consumption of all plastic carriers.

Swedish business is in general opposed to the implementation of the excise tax. A slew of arguments in favour of abolishing the proposed tax have been presented. The food retail industry association “Livsmedelshandlarna” states that the new tax is inefficient. Paper bags will be cheaper than the plastic bags and as a result consumed more. This is inefficient because paper bags have a greater strain on the environment according to Livsmedelshandlarna (Karin Sörbring 2019). Svensk Handel, also a Swedish organization, argues that the consumer will pay the full tax of 3 SEK (Sveriges radio 2019) even though the tax is levied on the producers. The producers offset the tax by increasing the price of plastic bags, thereby letting the consumers pay the full tax burden. However, according to economic theory, the tax burden depends on the price sensitivity (Perloff 2013). This is further explained in Chapter 3.1.

### 2.2 Literary review

A number of papers have evaluated the effect of tax or levy on light weight plastic bags such as He (2010) and Martinho, Balaia, Pires (2017) and Convery et al. (2007). These studies suggest that higher cost decreases consumption. The study by He (2010) compares stated and revealed consumption. Using stated preference techniques, the study investigates if consumer

reactions to the Chinese levy on grocery plastic bags, can be predicted. The results show a 49% reduction in consumption and it is predicted well.

Martinho, Balaia, Pires (2017) evaluated how consumers react to the tax on plastic carriers implemented in Portugal. They found that the tax decreased consumption of grocery store bags and that reusable and garbage bag consumption increased.

A study by Tatiana A. Homonoff (2018) found that a small financial incentive aimed to reduce the consumption on grocery bags has a big effect. Over half of the demand was reduced. This result is similar to what happened in Ireland where consumption dropped by 90% when they introduced a levy on grocery bags in 2002 (Convery et al 2007). Later on, the levy was later increased, in 2007, when consumption increased a little bit, but it has had a low stable consumption over time (IEEP 2016, Irish Times 2018).

Another study evaluates how effective the legislative changes in Botswana affected the consumption of plastic bag usage. In Botswana a higher cost of bags led to a significant decline in consumption of said bags (Dikgang, Visser 2012).

There are several other countries that already implemented a fee or tax on plastic bags. Denmark and Luxemburg taxes bag usage in different ways, but both has a low average consumption per year compared to other European countries. More recently The Netherlands has successfully reduced consumption by charging minimum €0.25/bag (Kish 2018). In Sweden the average bag cost in grocery stores is usually between 2-3 SEK (DI 2019). As mentioned earlier our study will therefore contribute by examining the changes in consumption when the bags already have a relatively high cost. As stated previously, the other studies, on the other hand, focus on scenarios where the bags initially are free of charge.

## 3. Theoretical framework

### 3.1 Price elasticity of demand

Price elasticity of demand (denoted by  $\epsilon$ ) is used to measure the change in demanded quantity of a product in relation to that product's price change. The mathematical formula for price elasticity of demand is;

$$\text{Price Elasticity of Demand} = \frac{\% \text{ Change in Quantity Demanded}}{\% \text{ Change in Price}}$$

The price elasticity of demand for ordinary products is negative. This means that as the price increases, the demand decreases. However, for some products, generally luxury goods, the demand and price are positively correlated. As the price increases, so does the demand. These products are known as Veblen goods and the price elasticity for demand for these goods is positive (Veblen 1899).

Plastic bags should be considered an ordinary good. The consumption of them should be expected to decrease as price increases. For instance, as mentioned earlier England experienced an 85% decrease in demanded quantity for plastic bags when they increased the price of plastic bags by introducing an excise tax in 2016 (The Guardian 2016).

The price elasticity of demand is closely related to the demand curve. A vertical demand curve means that the price elasticity is zero. This implies that demand does not depend on price. A horizontal demand curve means that price elasticity is infinite. In this case, a slight increase in price leads to a 100% reduction in consumption. Ordinary goods have a downward sloping demand curve (Perloff 2013).

Price elasticities usually vary along the demand curve. Figure 1 illustrates how the price elasticity of demand (PED) varies along a linear demand curve. The elasticity is equal to 1 at the midpoint of the demand curve. This is called unitary elasticity. On the left-hand side, the elasticity is more than 1. Price elasticity above 1 is known as elastic demand. On the right-hand side the price elasticity is between 1 and 0. This is known as inelastic demand (Perloff 2013).

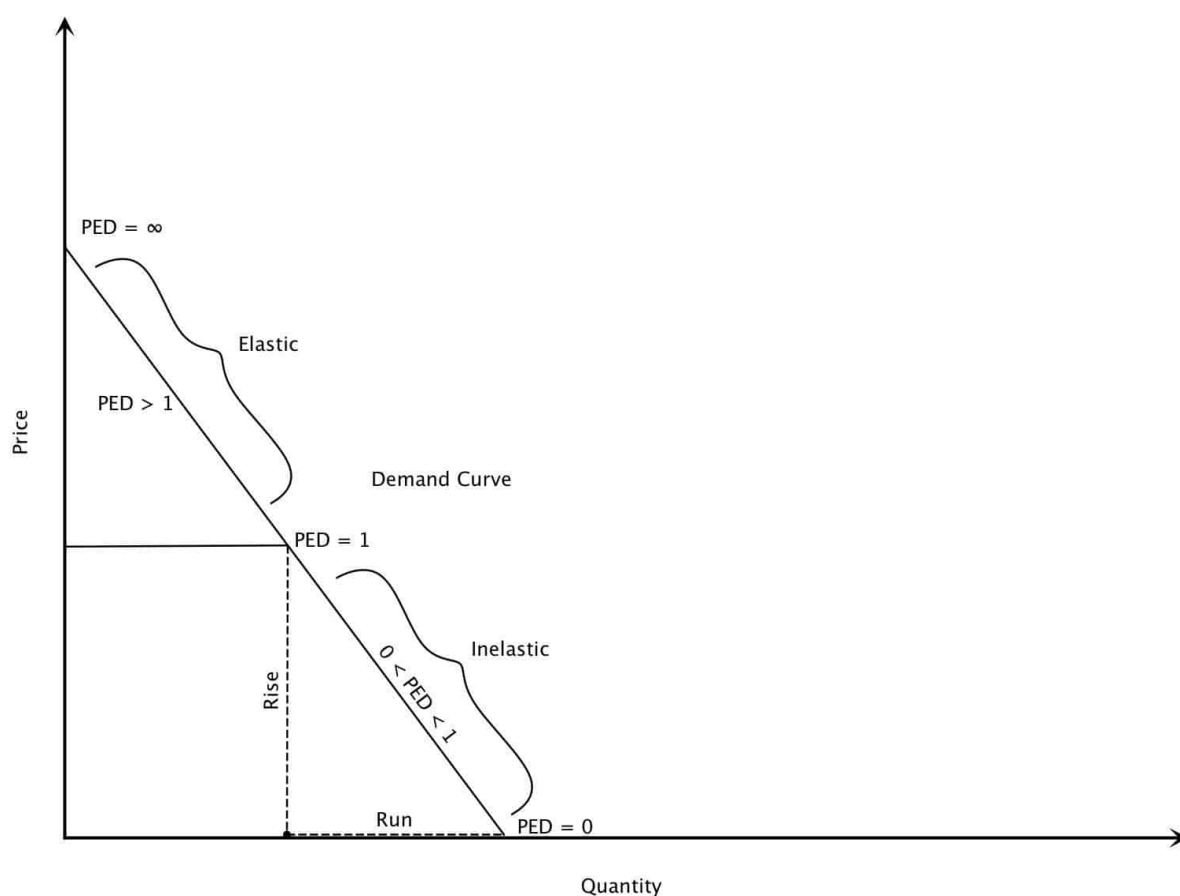


FIGURE 1. PED ON A DEMAND CURVE (INTELLIGENT ECONOMIST 2019)

Further, according to economic theory, the price elasticity of demand of a good determines the tax burden or tax incidence when a tax initially gets levied on the producers. The price elasticity limits by how much the producers can raise their prices to offset the tax. For instance, if an excise was to get implemented on a perfectly elastic good (i.e. a slight price increase results in a 100% decrease in demand), on the producer side, the producers would not be able to raise the prices whatsoever. This implies that the producers would have to pay the full tax burden. On the other hand, if the good was perfectly inelastic (i.e. demand stays the same no matter the price), producers would be able to raise the prices by the same amount as the excise tax and the full tax burden would be levied on the consumers instead. Very few goods are perfectly elastic or inelastic and as such the tax burden is often shared between consumers and producers (Perloff, 2013).



A phenomenon that is closely related to price elasticity of demand is known as the substitution effect. It occurs when a good increases in price and consumers choose to consume cheaper alternatives instead (Black et al., 2012). For instance, if the price of apples increases, consumers may choose to consume more pears. Further, if the price of plastic bags increases, as is the case with this study, consumers might decrease their plastic bag consumption in favor of consuming more paper bags, which are also sold in grocery stores.

### 3.2 Environmental taxes

Environmental taxes have been used in literature since Pigou (1932) wrote about externality problems. Externality problems, problems which have a negative impact on another party, have a proposed solution. The firm or party causing the problem should pay whatever the marginal cost of the negative externality is. The tax should then be incorporated in the price of the firm or party's product so that the outcome is socially efficient (Pigou, 1932).

In our case the main negative externality would be the damage light weight plastic bags have on the environment. The proposed tax, the excise tax, would not be fully Pigouvian because the grocery bag tax will not incorporate the damage caused by the externalities, and thus according to Nellor (1995) it is an indirect environmental tax. The law proposal suggests that the excise tax will probably discourage consumption of plastic bags, and by lowering consumption the negative impact on environment will diminish. The excise tax will also be levied as a source of revenue for the government.

### 3.3 Stated preference methods

Stated preference methods rely on surveys to measure the willingness to pay for goods and services in hypothetical or constructed markets. These methods are often used to assign value to goods that have no observable market price, e.g. impact of contamination (Brown T.C. 2003). Stated preference methods differ from revealed preference methods in that they study choices made by individuals before a proposed change has been implemented. A revealed preference method instead studies the actual choices made by individuals after said change has been implemented. Contingent valuation and choice modelling are two of the main stated preference models (Centre for International Economics, 2001). Contingent valuation is outlined below.

Contingent valuation (CVM) is the most widely used stated preference method. A CVM questionnaire generally contains detailed information on the proposed change and an elicitation question. Further, it contains a number of debrief questions that relate to attitudes and socio-economic background (i.e. education, age etc.) (Centre for International Economics, 2001). This paper utilises the contingent valuation technique to assess the impact of a proposed excise tax.

## 4. Method

### 4.1 Research design:

Intercept surveys were conducted outside of grocery stores in Gothenburg in November 2019 before the tax went into effect. The survey was made with Google Surveys and the interviewees were asked to answer the survey on a tablet that we brought. It was also possible for the respondent to answer our survey by using their own personal device because we created a QR-code connected to the survey. All answers were anonymous.

The survey is a structured survey addressed to grocery store customers utilising a contingent valuation technique. We tried to use phrasing and language as to not influence the participants and also avoiding leading questions. Not doing this could result in receiving answers affected by our opinions and/or hypothesis.

The survey is divided into five sections. The respondents will be taken to different sections depending on the answers that they give, following the design by He (2010).

Section 1 begins with a few control questions and ends with the first main question. The control questions include buys plastic bags today, age, gender, “climate awareness” and prior knowledge of the tax (if the respondent does not buy plastic bags today, then he/she will only be asked questions about fruit bag consumption).

Figure 2 shows how the respondent will be asked questions depending on their first answer regarding the consumption when it is a 3 SEK price increase. What they answer will determine which questions will follow. Answering “the same” leads to Section 2, and the respondent will be asked questions concerning the 5 SEK price increase. Answering “stop” leads to Section 3, whereas the respondent will face the price increase of 1.5 SEK and answering “reduce” leads to Section 4. Section 4 will ask the questions for both 1.5 SEK and 5 SEK.

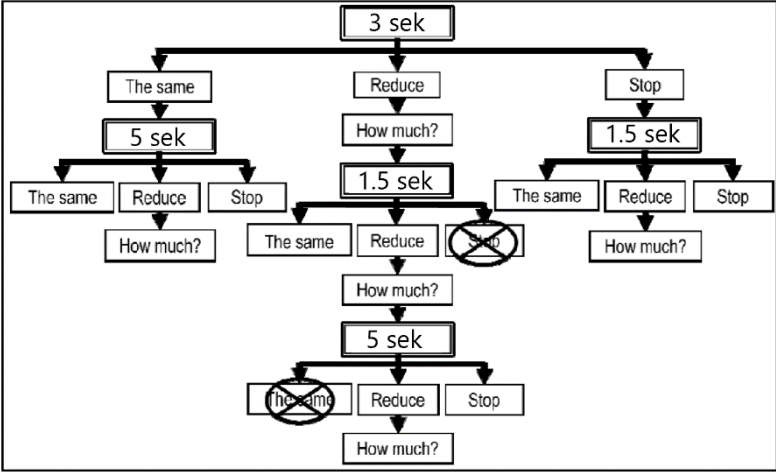


FIGURE 2. QUESTION STRUCTURE IN THE SURVEY QUESTIONNAIRE USED BY US. (HE 2010)

Section 5 discusses “fruit bags” which all respondents regardless of previous answers answer. This is because we assume that almost everyone still uses “fruit bags”. These questions follow a similar outline as the previous sections. Price levels for fruit bags were 0.5 SEK and 1 SEK. Fruit bags are free of charge with no tax and with the tax of 0.3 SEK there is no information on what the potential final price will be.

We include controls to evaluate the validity and to see if there are differences between different groups.

<b>Control</b>	<b>Why included?</b>
Age group	Evaluate differences between age groups
Sex	Evaluate differences between genders
Brings reusable bag (usually)	“Climate awareness”, evaluate how different groups of consumers are affected
Knowledge about the tax	Might bias our result
How many plastic bags bought per shopping trip	Calculate consumption
How many shopping trips per week	Calculate consumption

We choose three price increase scenarios around the tax of 3 SEK; 1.5 SEK, 3 SEK and 5 SEK. Depending on what the respondent answers, he/she will be introduced to the other price category/categories. 1.5 SEK and 5 SEK increases are chosen because first of all, we want to identify the consumer price sensitivity. Secondly, we do not know what the de facto price increase will be. Thirdly, there will probably be price differences between regions and individual stores. The price categories for fruit bags were 0.5 SEK and 1 SEK, there is no information on how grocery store will handle this tax, and therefore we choose only two prices.

To establish a systematic and objective way of choosing interviewees, and to maximize the randomness, sampling rules were decided on. Every third person leaving the store was asked if they wanted to participate in a short survey. If the person declined, the third person after them would be approached. Similarly, if the person did take part in the survey, the third person after them would also be asked if they wanted to participate (similar to He 2010).

Four grocery stores of similar size were chosen. Two stores were chosen in an area with a relatively high average income and the other two stores were chosen in an area with a relatively low average income (i.e. the stores were located in areas with different socioeconomic profiles) (Göteborgs Stad, 2019). This selection was done in order to increase the probability of capturing the consumption behaviour of the population as a whole.

The interviews were conducted in the morning between 8:00 – 9:00 and in the afternoon between 17:00 – 18:00 during weekdays. The interviews were conducted at two different

times because we assume that the clientele at these times are different. We conducted the interviews at four stores and only on weekdays because of time limitation, but we followed the same procedure at every store. Because of time limitation the intended sample size for this study was 150-200 answers.

#### 4.2 Expected outcome

We expect a higher price to decrease consumption. This is in line with the general demand theory. The law proposal argues that plastic bag consumption will decrease by 30% as a result of the tax. However, we think that the tax will yield a consumption decrease that is larger than 30%. The fruit bag consumption will probably decrease but relative to the grocery bags the decrease will be smaller, due to a lack of substitutes.

## 5. Results

We collected 161 responses. 91 of them are from the area with lower average income and the remaining 69 are from the higher average income area. We assume that 22 more answers from one group should not bias our result.

### 5.1 Summary statistics

Summary statistics are presented in Table 1. The Sex variable is a dummy variable that takes on the value 1 when the respondent is male and 0 when the respondent is female. A mean of 0.522 indicates that slightly more men took part in the survey. The variables *15-25* through *65+* are dummy variables for the age groups. The mean for these variables (e.g. 0.317 for *15-25*) indicates how big that age group is compared to the entire sample. For instance, *15-25* is 31.7% of the sample. The age distribution is outlined in Figure 3.

Our largest age group is the youngest one, as Figure 3 shows, and our second largest group is the *65+* category. Young people seemed to be more willing to answer the questionnaire. A possible explanation is that they were prone to use their own device to answer the survey by scanning the QR-code.

The *grocfrec* variable indicates how often the respondents go grocery shopping every week. The minimum value of 0.5 means one shopping trip every other week. The average respondent goes to the grocery store 1.89 times a week. *Numbags* shows how many bags the respondents buy every time they visit the grocery store. *Knowledge*, *awareness* and *garbagebag* are dummy variables. *Knowledge* takes the value 1 if the respondent knew about

the proposed tax before the survey, otherwise it takes the value 0. *Awareness* equals to 1 if the respondent brings their own bag (or similar) to the grocery store, and 0 otherwise. Whether the respondents use the grocery store bags as garbage bags is shown in the *garbagebag* variable. It takes the value 1 if the respondent uses only grocery bags as garbage bags and 0 otherwise. The *yearconsump* variable is constructed using data from *grocfrec* and *numbags*. It shows how many grocery store bags the respondents buy every year. The mean, 121.4, is considerably higher than the Swedish mean of 102 bags per person per year in 2018 (Naturvårdsverket 2019). This disparity is discussed in greater detail in chapter 5.

**TABLE 1 – DESCRIPTIVE STATISTICS FOR CONTROL VARIABLES**

Variable	Obs	Mean	Std.Dev.	Min	Max
Sex	161	.522	.501	0	1
15-25	161	.317	.467	0	1
26-35	161	.161	.369	0	1
36-45	161	.137	.345	0	1
46-55	161	.112	.316	0	1
56-65	161	.093	.292	0	1
65+	161	.18	.385	0	1
grocfrec	161	1.891	.985	.5	5
numbags	161	1.391	1.091	0	5
knowledge	138	.652	.48	0	1
awareness	161	.422	.495	0	1
garbagebag	161	.36	.482	0	1
yearconsump	161	121.441	89.962	0	520

**NOTES: TABLE REPORTS NUMBER OF OBSERVATIONS FOR EACH VARIABLE, DATA ON AGE GROUP, SEX, CONSUMPTION HABITS AND KNOWLEDGE OF THE TAX, AND THE MEAN VALUES.**

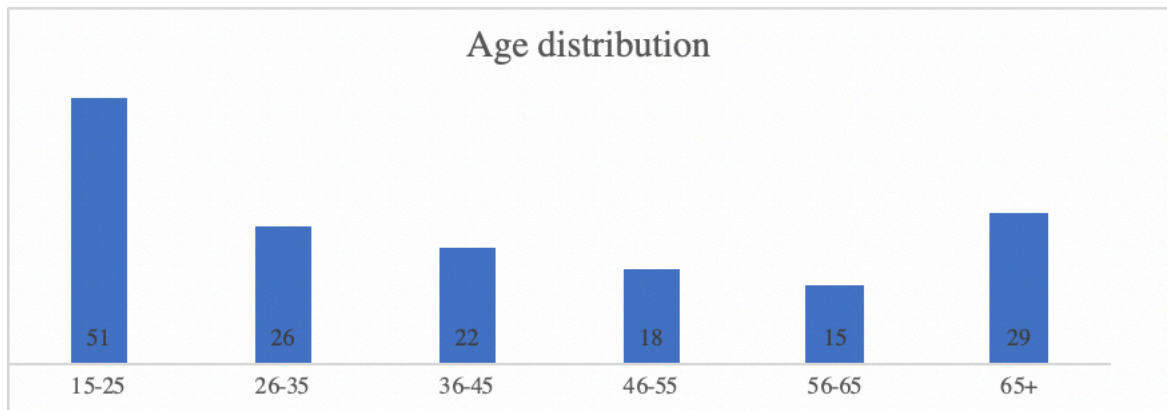


FIGURE 3. AGE DISTRIBUTION OF SAMPLE

## 5.2 Price elasticity of demand

Depending on what the respondents answer in our survey they are either people who answered “the same”, “stop” or “reduce” as discussed and shown in chapter 3. People who answer “the same” state that they will not change their consumption habits when the price increase is 3 SEK, i.e. they have a 0% decrease in consumption at that price level. The second group, those who answered “stop”, would decrease their consumption by 100%, i.e. they would stop buying plastic bags completely. The third group answered “reduce”, they would decrease their consumption somewhere between 0-100% if the price rose by 3 SEK. The first group is not as price sensitive as the other two groups, and the second group is the most sensitive to a sudden price increase.

In total 138 people were asked questions about the three different price scenarios. 23 people did not consume any plastic bags and as such, they did not answer further questions about plastic bags. For the 3 SEK price scenario, 38 people answered “the same”, 21 people answered “stop” and 79 people answered “reduce”. The first group answers “the same” (0% decrease) regarding the 3 SEK increase. Therefore, they automatically answer 0% decrease for the 1.5 SEK price increase, too. The second group answers “stop” (100% decrease) regarding the 3 SEK increase, and automatically answer 100% decrease for the 5 SEK price increase. The last group answered “reduce” and therefore had to manually answer the questions for the other price scenarios.

To calculate the price elasticity of demand we use the formula presented in our theoretical framework:

$$\text{Price Elasticity of Demand} = \frac{\% \text{ Change in Quantity Demanded}}{\% \text{ Change in Price}}$$

The percentage change in quantity demanded is calculated by weighing the mean calculation of the average reduction using bag consumption for each individual. This is because different people use different amounts of plastic bags. In practice this is done by using the stated reduction for each individual multiplied by the stated yearly consumption. Then next step is to sum the decrease for each individual and divide it by the total number of bags consumed in our sample.

The percentage change in price is calculated by using the average plastic bag cost. The typical plastic bag cost was between 2-3 SEK during our survey period, therefore we use a cost of 2.5 SEK.

When the price increase is 3 SEK the stated average decrease in plastic bag consumption is estimated to 35.8%. The change in price is then a 120% increase.

Consumption decrease:  $\frac{6993}{19522} = 0.358 = 35.8\%$  with a standard error of 0.029.

Price increase calculation:  $\frac{3}{2.5} = 1.2 = 120\%$ .

Now we can calculate the price elasticity of demand:  $\frac{-0.358}{1.2} = -0.298$

The value -0,298 indicates that a 1% increase in price will only give a decrease of about 0,3% in demand. Hence the respondents consider plastic bags as an inelastic good and the consumers are not especially price sensitive.

Stated consumption decrease for the 5 SEK scenario is estimated to be 65,8%. The change in price is then a 200% increase.

Consumption decrease calculation:  $\frac{12865}{19522} = 0,658 = 65,8\%$  with a standard error of 0.027.

Price increase calculation:  $\frac{5}{2.5} = 2 = 200\%$ .

Price elasticity of demand:  $\frac{-0.658}{2} = -0.329$



For the 5 SEK price increase it would be a large reduction in usage of plastic bags but compared to the large price increase the elasticity is still low and therefore the respondents are not especially price sensitive. In this scenario a 1% increase in price will give a decrease of about 0.33%.

Stated consumption decrease for the 1.5 SEK scenario is 18.3%, and the change in price is a 60% increase.

Consumption decrease calculation:  $\frac{3579}{19522} = 0.183 = 18.3\%$  with a standard error of 0.0002.

Price increase calculation:  $\frac{1.5}{2.5} = 0.6 = 60\%$

Price elasticity of demand:  $\frac{-0.183}{0.6} = -0.305$

A similar price elasticity as for the other price scenarios, also in this case consumers are not price sensitive. A 1% increase in price will give a 0.3% decrease in demand.

Table 2 illustrates the total decrease of bag consumption for the three different price scenarios. The reduction for the 1.5 SEK price scenario is 18.30%, for the 3 SEK scenario it is almost a 36% decrease and for the 5 SEK it is almost a 66% decrease. It also shows that the price elasticity of demand is inelastic for all of the different scenarios.

**TABLE 2 – SUMMARY OF PRICE ELASTICITIES FOR THREE PRICE SCENARIOS**

Price increase	Consumption decrease in number of bags	Consumption decrease in %	Price elasticity of demand
1.5 SEK	3579	18.30%	-0.305
3 SEK	6993	35.80%	-0.298
5 SEK	12865	65.80%	-0.329

**NOTES: THIS TABLE REPORTS CONSUMPTION DECREASE AND PRICE ELASTICITY OF DEMAND FOR THREE DIFFERENT PRICE SCENARIOS. PRICE TODAY IS 2.5 SEK AND THE TOTAL NUMBER OF BAGS CONSUMED IS 19522 PER YEAR.**

For fruit bags we calculated the mean consumption decrease by the adding stated individual consumption reduction divided by full number of respondents (161 people). The result was that consumption would decrease by approximately 35.5% if they cost 0.5 SEK. 71 people stated that they would not decrease consumption of fruit bags if they went from costing 0 to

0.5 SEK. Furthermore, 50 people still answered that they would not decrease consumption if the cost was 1 SEK.

$$\frac{50}{161} = 0.311$$

This results in 31% of our sample not being price sensitive at in regard to fruit bags.

### 5.3 Regression analysis

We try to examine if our control variables affect the price sensitivity. The regression uses the stated decrease for the different price scenarios as the dependent variable. The age groups are denominated as the variables *age1-age6*, *age1* is the first age group of ages 15-25 and so on. If the coefficient is negative it will lower the overall decrease and the opposite if the coefficient is positive.

Table 3 shows the regression outputs for the three different price scenarios, 1.5 SEK, 3 SEK and 5 SEK. For the 3 SEK scenario, only the variable *garbagebag* is significant. The variable *garbagebag* has a negative coefficient and will therefore lower the overall decrease by 17.6%. In other words: using only plastic bags from grocery stores as garbage bags has a fairly large impact on the willingness to reduce the usage.

For both the 1.5 SEK scenario and 5 SEK scenarios, the variable *garbagebag* is still significant meaning that using only grocery store bags as garbage bags, you would not be as price sensitive. For 5 SEK the variables *awareness* and *sex* are significant.

Table 3 also shows the regression output for fruit bags (4). For fruit bags we used the full sample of 161 observations. The regression uses the consumption decrease, stated for the 0.5 SEK scenario, as the dependent variable and we try to examine if our controls affect the price sensitivity. We have omitted the *knowledge* variable because only 138 answers were received for this variable. What is noticeable is that the dummy variable *awareness* is significant and largely positive, 25.9%. This tells us that if you bring your own bags to the store today you will decrease fruit bag consumption more than others.

**TABLE 3 – REGRESSION OUTPUT FOR DIFFERENT PRICE SCENARIOS**

VARIABLES	1.5 SEK (1)	3 SEK (2)	5 SEK (3)	Fruit bags (4)
age1	0.074 (0.079)	-0.045 (0.090)	-0.091 (0.082)	-0.048 (0.092)
age2	-0.043 (0.088)	-0.055 (0.101)	-0.134 (0.092)	0.114 (0.109)
age3	0.008 (0.091)	0.006 (0.103)	0.013 (0.094)	0.096 (0.113)
age4	-0.030 (0.097)	0.021 (0.110)	-0.040 (0.101)	0.068 (0.119)
age5	-0.145 (0.102)	-0.066 (0.116)	-0.050 (0.106)	0.194 (0.128)
garbagebag	-0.135** (0.052)	-0.176*** (0.060)	-0.126** (0.054)	0.001 (0.071)
awareness	0.033 (0.055)	0.010 (0.063)	0.109* (0.057)	0.290*** (0.069)
knowledge	0.014 (0.054)	-0.011 (0.061)	0.010 (0.056)	- -
Sex	-0.073 (0.052)	-0.069 (0.059)	-0.099* (0.054)	-0.102 (0.064)
yearconsump	-0.000 (0.000)	-0.001 (0.000)	-0.000 (0.000)	0.001* (0.000)
Constant	0.302*** (0.095)	0.607*** (0.109)	0.854*** (0.099)	0.159 (0.119)
Observations	138	138	138	161
R-squared	0.125	0.112	0.141	0.152

NOTES: STANDARD ERRORS IN PARENTHESES \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

COLUMN 1 REPORTS CONTROLS FOR 1.5 SEK PRICE SCENARIO. COLUMN 2 REPORTS CONTROLS FOR 3 SEK PRICE SCENARIO. COLUMN 3 REPORTS CONTROLS FOR 5 SEK PRICE SCENARIO. COLUMN 4 REPORTS CONTROLS FOR FRUIT BAGS AT 0.5 SEK SCENARIO.

## 6. Discussion

### 6.1 Analysing the results

The national age distribution differs from our sample, young people are relatively over-represented in our sample. Young people could have different consumption habits compared to other age groups. This means our sample could under- or overestimate the average decrease of consumption. If for example young people consume less bags than middle aged people, in the population, our result would be underestimated. We did not find any correlation between age and consumption in our sample. Therefore, this might not be a problem.

As mentioned in Chapter 3.1, the price elasticity of demand determines the tax incidence or tax burden. If the demand for plastic bags was completely inelastic, the tax burden would rest completely on the consumers, i.e. the price increase would be as large as the tax (3 SEK in this case). However, this study finds that the price elasticity of demand for plastic bags is roughly -0.3. As such, the tax burden would be shared between consumers and producers, although it would still be biased towards consumers, according to the theory. Therefore, it is likely the actual price increase will fall short of 3 SEK, however it will probably be larger than 1.5 SEK. This translates to a consumption decrease of somewhere between 18,3% and 36%.

Additionally, a low price elasticity causes a larger negative outcome for the consumers compared to the producers/importers. The consumers will carry most of the tax burden, as mentioned above, and when this is the case the consumers face larger negative welfare consequences than the producers.

Prior studies have noted the effect that an economic instrument generates when increasing the price of plastic bags. For instance, Martinho, Balaia and Pires (2017) shows that both reusable bags and garbage bags consumption increased when Portugal implemented a tax on plastic bags. Grocery store plastic bags are often used as garbage bags, and that we observed a correlation between garbage bag usage and plastic bag consumption might therefore not be surprising. For the 3 SEK scenario, the correlation is negative and has a large effect, meaning that if the respondent uses only grocery store bags as garbage bags, they will not decrease their consumption as much. Because some people only use grocery store plastic bags as

garbage bags, one could argue that garbage bag consumption will increase in Sweden as well. This is because of the large price difference between garbage bags and plastic carriers.

As mentioned in Chapter 2.2, Homonoff (2018) finds that small financial incentives aimed to reduce the consumption on grocery bags have a large effect on the reduction of plastic bags. The result in our study showed that a small tax on fruit bags caused a stated consumption reduction of 35,5%, a very similar decrease relative to that of the plastic bags (3 SEK scenario). This finding is also not what we anticipated, we expected that the consumption reduction of fruit bags would be smaller relative to the reduction of plastic bags. This result is more in line with what Homanoff (2018) found. A note of caution is due here since we are uncertain on how generalizable our result is.

For fruit bags the only significant variable was awareness. This had a strong positive relationship with the fruit bag price sensitivity. Being aware, i.e. bringing your own carriers, implies that you are more sensitive to the price change compared to those who are not aware. Our variable *awareness* could be biased since it might not only be people who care about the environmental consequences of consuming plastic bags that bring their own carriers to the store.

For the price scenarios 5 SEK and 1.5 SEK, the consumption decrease would be 65,8% (5 SEK) and 18,3% (1.5 SEK). What is notable is that the garbage bag variable is also significant for these price scenarios. This gives a slight robustness to our 3 SEK data, which is important for the validity of our study. For the 5 SEK scenario two additional variables were significant, sex and awareness. The variable sex implies that being male would lessen the reduction, and the variable awareness (bringing your own bag) would give a greater reduction. However, since they are not significant for the other scenarios we cannot conclude very much from that.

In 2018, Swedes' average consumption were 102 plastic bags per person per year and in our sample it was 121. The Environmental Protection Agency divided the total plastic bag usage with the entire Swedish population. This study instead calculates the average consumption by dividing the entire sample's consumption by the sample size. All of the respondents actually went to a grocery store as opposed the entire Swedish population (some people do not visit grocery stores, e.g. small children). A parent with a family of 4 probably buys more plastic bags than a single person household but in our data they are valued equally, this could be an explanation to why our mean is higher.

If the price of plastic bags increases by 3 SEK, then it is our estimation that consumption will decrease with almost 36%. From 2017 to 2018 there was an 11% decrease and assuming that we also have reduced consumption by 11% in 2019, Swedes will consume about 91 bags per person per year in 2019 (not reaching EU's fixed target for 2019). Our stated reduction of 36% would yield an average consumption of 58 plastic bags per person per year once the tax is introduced, using the data from the Swedish Environmental Protection Agency. If so, Sweden would be much closer to be able to reach the fixed target goal of 40 plastic bags per person per year by 2025.

Considering that Ireland increased their levy on plastic bags when plastic bag consumption increased after the levy was first introduced, something similar might be needed in Sweden, depending on and if the tax eventuates in a permanent effect or if consumption will increase after a while. We think it is plausible to reach the fixed target in 2025, set by the EU directive, and that the tax will be able to change consumer behaviour.

## 6.2 Limitations

The findings of this study have to be seen in the light of some limitations. Firstly, our survey was conducted in only two areas of Gothenburg. The two areas were chosen in order to capture the consumption habits of the population of Gothenburg. This was done by selecting areas with different socioeconomic profiles. However, it is unclear if our results are generalizable to the entire Swedish population. Since this paper aims to examine the effect of an excise tax that affects the whole of Sweden, the aforementioned point might be a concern worth taking note of. Data from Statistics Sweden (2017) suggests that the average income in Gothenburg in 2017 was just 0,97% higher than the national average. This fact might indicate that the socioeconomic profile of Gothenburg is roughly equal to that of Sweden overall. Further, this possibly means that the consumption behaviour of people in Gothenburg is a good predictor of the consumption behaviour of the entire Swedish population. Whether our results are generalizable is still a valid concern, though.

Secondly, another concern is the sample size. In total there were 161 respondents. 23 people did not answer the questions related to plastic bag consumption. These 23 people only answered questions regarding fruit bags. 161 answers were used to analyse the consumption of fruit bags. For both kind of bags, a bigger sample would provide more precise results.

Further, another limitation is that the interviewees might have given wrong answers to our questionnaire. This could have been done in two different ways; purposefully lying or failing to estimate how their consumption habits will change given the three different price scenarios. The latter is the most likely option. The respondents were asked to select by how many percent they would decrease their consumption given a price scenario. This was done by presenting the respondents with a number of options that contained intervals of consumption reduction outcomes (i.e. 0-10%, 10-20%, 20-30% etc.). Choosing the “correct” option can be difficult and this might be a source of bias in our results. However, if He (2010) is to be believed, this is not a big problem.

There may be some issues with the distribution of our dependent variables (i.e. the consumption decrease), especially at the 1.5 and 5 SEK price scenarios. Several interviewees answered either 0% or 100% in regard to what their consumption decrease would be at these price levels. This may cause a situation similar to that of censored data, which could result in inconsistent estimations of coefficients. A tobit regression could potentially solve this problem.

## 7. Conclusion

The main goal of the study was to determine if the proposed tax of 3 SEK on grocery store plastic bags in Sweden will decrease consumption of said bags, moreover if it is plausible to reach the fixed target consumption goal set by the EU. Compared to earlier research, this study examines the (stated) change in consumption in Sweden, where all plastic bags already had a cost. Furthermore, this study also investigates how consumers react to a cost for the very light weight plastic bags, i.e. the fruit bags.

The plastic bag tax in Sweden will reduce the consumption of plastic bags and no matter what price increase the price elasticity of demand will be approximately -0.3, meaning that grocery store plastic bags are not elastic in regard to demand. Only using the plastic bags as garbage bags has a strong negative relationship with the reduction of plastic bags. The tax also affects the consumption of fruit bags, though 44% of the respondents in our sample stated that they will not change their behaviour if the cost for the consumer will be 0.5 SEK.

These findings contribute in some ways to our understanding of environmental taxes in the form of an excise tax. Further, the findings provide understanding on how consumers behave when introduced to higher costs for environmental reasons. It is unfortunate that this study cannot compare our findings to what will actually occur. Further research could include a more thorough questionnaire, larger sample, and other variables such as income, family size, and means of transport to the grocery store.

If our research is correct the tax will reduce consumption of plastic bags (36% at 3 SEK increase) and fruit bags (35.5% at 1 SEK increase), but it is unsure if any further actions is needed to reach the 40 plastic bags per person per year goal by 2025. If the trend of decreasing consumption continues it will increase the likelihood of reaching the goal.



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## 9. Appendix

### 9.1 Appendix 1- Chosen questions from questionnaire (in Swedish)

#### Din könstillhörighet

*Markera endast en oval.*

 Man Kvinna Annat

#### Din ålder

*Markera endast en oval.*

 15-25 26-35 36-45 46-55 56-65 65+

### Hur ofta handlar du?

Markera endast en oval.

Varannan vecka

1 gång per vecka

2 gånger per vecka

3 gånger per vecka

4 gånger per vecka

5+ gånger per vecka

### Hur många plastpåsar köper du varje gång du handlar?

Markera endast en oval.

0 Fortsätt till frågan 18.

1

2

3

4

5+

# Sektion 1

**Visste du om att punktskatten kan införas?**

*Markera endast en oval.*

 Ja Nej

**Använder du OFTAST medtagen kasse eller liknande?**

*Markera endast en oval.*

 Ja Nej

**Använder du plastbärkassarna köpta här som soppåsar?**

*Markera endast en oval.*

 Ja, använder inte något annat Ja, när jag har hemma Nej (återanvänder, använder annat)

**Om punktskatten ökar priset med 3 kronor; \***

*Markera endast en oval.*

 Kommer inte min användning av plastpåsar ändras *Fortsätt till frågan 9.* Kommer jag sluta köpa plastpåsar *Fortsätt till frågan 11.* Kommer jag köpa färre plastpåsar *Fortsätt till frågan 13.*