



**CHALMERS**  
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# **Taxation of Hazardous Chemicals as a Substitution Measure**

An interview study on companies affected by the Swedish tax on chemicals in certain electronics

Master's thesis in Industrial Ecology & Management and Economics of Innovation

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### SUMMARY

Flame retardants have been widely applied in products due to their fire protective properties. Commonly used flame retardants contain; bromine, chlorine or phosphorus, and several of these have proven to cause hazardous health and environmental effects and have been found in indoor environments. As one measure taken to reduce the occurrence of hazardous flame retardants containing either bromine, chlorine or phosphorus, the Swedish Government implemented an excise tax on chemicals in certain electronics in 2017. The tax targets commonly used white goods and other electronics. Since the implementation, the tax has been criticized for not reaching its purpose. The study has investigated what effects Swedish companies perceive that the tax has generated. Based on 13 interviews, the authors have found that substitution of hazardous flame retardants have occurred, but only to a small extent. The main reason behind the substitution is the Swedish tax on chemicals in certain electronics. The tax is further expressed as a driver for substitution of hazardous flame retardants, together with EU directives. That only some substitution has been achieved might be explained by several factors. Firstly, the tax rate might not accurately reflect the damage costs caused by hazardous flame retardants, and therefore not create enough incentives to substitute. Other reasons seem to derive from the identified challenges companies face in relation to substitution; that the Swedish market is too small to be able to influence the global production, substitution cost and that some companies do not have their own production. Most companies have been able to do more tax deductions over time, although, the application of the highest level of tax deductions is still limited. The underlying reason for why not more deductions is made is lack of documentation. The tax has moreover added administration for most companies, however to a varying extent. Over time, the administrative cost has been constant, except from the initial phase. Main opinions about the tax is that the environmental aim is good, but the question regarding hazardous flame retardants ought to be addressed on a higher level than national to achieve substantial impact.

Keywords: Tax on Chemicals, Chemical Substitution, Flame retardants, Electronic products



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Ida Andersson



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# Abbreviations

FRs - Flame retardants

MB - Marginal benefit

MC - Marginal cost

MD - Marginal damage

PER - Perchloroethylene

POP - Persistent Organic Pollutant

PPP - Polluter pays principle

REACH - Registration, Evaluation, Authorisation and restriction of Chemicals

RoHS - Restriction of Hazardous Substances

SCCP - Short-chain chlorinated paraffines

WEEE - Directive on Waste Electrical and Electronic Equipment



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# 1. Introduction

Flame retardants (FRs) are chemical substances used by society for their vital protective function. FRs are added to combustible materials to reduce the risk of fire, by either prevent or delay fire (Swedish Chemicals Agency, 2019a). In this way, FRs plays a vital part in saving life and property in society. FRs are widely used in consumer products to maintain product safety and are in some products, such as electronic equipment, required by law (LVD 2014/35/EU). There exist several different types of FRs, containing different elements which work as the active substance (Guerra, Alae, Eljarrat & Barcélo, 2011). Some of the most commonly used FRs in Europe contains; bromine, chlorine, or phosphorus (Pinfa, 2017). According to the Swedish Chemicals Agency (n.d.), approximately 7 000 tonnes FRs are used in Swedish production and additionally FRs are brought into the country through imported products. Despite the flame retardancy advantage that comes with the use of FRs, there are several disadvantages present.

Both brominated and chlorinated FRs have due to their application variety been very popular to use (Hull, Law & Bergman, 2014). However, these FRs have proven to be bioaccumulative and persistent (van der Veen & de Boer, 2012). These FRs have additionally shown to exhibit a wide range of toxic effects, such as thyroid effects, toxicity for reproduction and development, and possible carcinogenic effects (EFSA, 2014). Therefore, several of these FRs have already been banned within the EU (Hull, Law & Berman, 2014; Stockholm convention, n.d.; European Commission, 2020). As focus has been on the health and environmental compatibility of FRs, the interest for halogen-free FRs have increased (Marosi, Szolnoki, Bocz & Toldy, 2014). Phosphorous-based FRs are considered to be a substitute for halogenated FRs. However, as mentioned by van der Veen & de Boer (2012), some negative effects do exist. Some phosphorus based FRs have in animal and cell testing shown to have carcinogenic effect and toxic effects on the nervous system (Environmental Protection Agency, 2017). Moreover, toxicity to aquatic organisms has additionally been found to be related to phosphorus FRs (SOU 2015:30). Besides the proven negative health and environmental effects, some FRs have additionally been found to leach out of products and enter the indoor environment. In this way, hazardous FRs come into direct contact with humans (Purser, 2014). FRs can additionally disperse in the outdoor environment and have been found to concentrate in remote areas such as the polar arctic (Hull, Law & Bergman, 2014).

The Swedish Government have for many years tried to limit the use of hazardous FRs, especially brominated FRs, as part of the national chemical policy (Prop. 1997:98:145). Replacing hazardous FRs is, despite existing regulations, still of high concern to reduce their negative effects on society. Replacing or eliminating chemicals in products or processes with less hazardous alternative substances is called chemical substitution. Additionally, the term can imply that chemicals are being replaced with non-chemical alternatives (Swedish Chemicals Agency, 2019e). The purpose of chemical substitution is to limit the use of hazardous substances in society but there is a potential risk of *regrettable substitution*. As the term implies, regrettable substitution occurs when a hazardous substance is replaced by a substance

possessing equally or potentially even worse toxicological properties (Swedish Chemicals Agency, 2019e; European Commission, 2017).

Chemical substitution may not be a voluntary act, due to e.g. high substitution costs or lack of knowledge about alternative substances. Policy makers may, therefore, try to incentivise substitution by implementing different policy instruments. Traditionally, chemical management has focused on reducing hazardous chemicals with high substitution costs by using policy instruments, such as bans and permits, that restrict quantities (Slunge & Alpizar, 2019). However, the interest for economic instruments is increasing (Söderholm & Christiernsson, 2008) and there is, according to Brännlund (2018), an upcoming trend in implementing excise taxes for environmental purposes. The use of environmental taxes commenced in Sweden in the late '80s, where several environmental tax proposals were submitted and adopted (Brännlund, 2018).

In 2017, Sweden implemented the tax on chemicals in certain electronics, as a measure to achieve the national non-toxic environmental goal. The tax aims to reduce the occurrence, spread and exposure of hazardous FRs in society (Swedish Tax Agency, n.d.c). According to SOU 2015:30, FRs are often found in commonly used electronic products such as white goods and other electronics. Hence, these products are subject for taxation. The tax has since its implementation affected Swedish companies and has been criticized for not reaching its environmental purpose as well as negatively affect Swedish trade (Lönn & Kruse, 2019; Svahn, 2019; HUI Research, 2018). The tax on chemicals in certain electronics is presently under investigation by the Swedish Chemicals Agency and the Swedish Tax Agency on behalf of the Government of Sweden. Their investigation aims to evaluate whether the tax has reached its purpose or not (Swedish Chemicals Agency, 2019b). To be able to comprehensively evaluate the effects of the tax, several aspects needs to be investigated. One aspect in such an evaluation is the company perspective and how they perceive the effects by the tax.

## 1.1 Purpose and research questions

This study aims to understand which effects companies perceive that the Swedish tax on chemicals in certain electronics has generated. To achieve this purpose, a case study on Swedish companies affected by the tax is conducted, where the following research questions are answered;

- Have substitution of bromide, chloride or phosphorus-based flame retardants been made? If so, what is the underlying reason behind the substitution?
- Which are the perceived drivers and challenges for substitution of flame retardants in electronic products?
- What are the underlying reasons for not making tax deductions?
- What administrative cost, measured in time and effort, have the affected companies experienced since the implementation of the tax, and how has this cost changed over time?
- What are the main opinions about the tax among the companies?

The study is conducted to inform the investigation of the tax on chemicals in certain electronics conducted by the Swedish Chemicals Agency and the Swedish Tax Agency. The study may further contribute to the academic field of taxation within the area of chemical management.

## 2. Background

The Swedish Government assigned in 2013 an investigation to evaluate the need for new economic policy instruments in the chemical field and if so, a suitable policy instrument. The investigation aimed to find ways to reduce the occurrence and risk for exposure and proliferation of environmental- and health hazardous substances from certain product groups in peoples' homes. The investigation pointed out that hazardous substances, such as FRs, in an indoor environment originate from electronic products. Hence, the inquiry concluded such products ought to be subject for taxation and proposed an excise tax on chemicals in certain electronics (SOU 2015:30).

### 2.1 The Swedish tax on chemicals in certain electronics

The tax on chemicals in certain electronics was implemented on the first of April 2017 and the tax obligation for Swedish companies was brought into force on the first of July the same year (SFS 2016:1067). Taxable products are identified by their customs number, i.e. CN number. Among these, there are commonly used white goods, such as refrigerators, washing machines and vacuum cleaners, and other electronics, such as computers, telephones and TVs (SFS 2016:1067). The tax rate for each product is based on the product's weight and the rate differs between the two sub-groups; white goods and other electronics. Current tax rate for white goods is 11 SEK per product kilo and 163 SEK for other electronics. There is a tax ceiling for all products which corresponds to 448 SEK per product (Swedish Tax Agency, 2019).

It is possible for companies to do tax deductions. The tax deductions differ between additive and reactive added substances containing either bromine, chlorine or phosphorus. Reactive added FRs binds to the polymers through a chemical reaction and is added into the product material in early stages of manufacturing. Additive substances are, on the other hand, solely mixed into the polymers, making the substance easier to leach and can thereby to a greater extent end up in people's home environment (United States Environmental Protection Agency, 2014). If a products' circuit boards and plastic parts (over 25 grams) is free from additively added bromine or chlorine, a tax deduction of 50% is possible. Free from, refers in the tax to less than 0.1% of the homogeneous material. If the product, in addition, is free from additive added phosphorus and reactive added bromine and chlorine substances, a tax deduction of 90% is possible (SFS 2016:1067). Hence, a tax rate of at least 10% is always applied for all products targeted by the tax. For white goods, 10% corresponds to a tax of 1.1 SEK per product kilo and for other electronics 16.3 SEK per product kilo.

The tax liability occurs for either an authorized stock keeper or a registered recipient. For a stock keeper, the tax is paid either if taxable products are sold to a non-authorized stock keeper, sold in their own stores, taken for other use than sale or when the authorisation is recalled. An authorized stock keeper is allowed to stock, import and sell products to another authorized stock keeper without paying tax. The tax is then displaced to the following stock keeper (Swedish Tax Agency, n.d.a). This means that a company who manufacture or sell products which are subject for the tax, is not necessarily the one who pays the tax to the Swedish Tax Agency. If a manufacturing company is an authorized stock keeper and sell their products to, for instance, a

retailer who also is an authorized stock keeper, the retailer becomes the company who pays the tax. For a registered recipient, the tax liability occurs directly when taxable products are imported to Sweden for professional use. A registered recipient is therefore not allowed to display the tax, as an authorized stock keeper (Swedish Tax Agency, n.d.c). Additionally, tax liability occurs directly if a non-authorized stock keeper or registered recipient produces or import taxable products for professional use (Swedish Tax Agency, n.d.a).

Since its implementation, the tax has changed three times. In 2017 a new paragraph was added, allowing the tax rate to be adjusted according to the general price level. This adjustment was brought into force in 2018 (SFS 2017:1222). Another few changes were made in 2018, including introducing the term registered recipient and some other minor changes in the law (SFS 2018:1891). Furthermore, the tax rate was in 2019 raised for both product groups, which was brought into force later the same year (SFS 2019:489).

## 2.2 Criticism against the tax

Even before the tax was implemented, it was widely debated how much substitution the tax would achieve. Opponents argued that the tax would rather lead to increased import of electronics instead of reducing hazardous FRs (Lönn & Kruse, 2019). Additionally, several stakeholders commented on the proposed tax before its implementation. TCO Development and Miljömärkning Sverige AB argued that the proposed tax will increase risk for regrettable substitution and a tax on Swedish products will not be incentives enough for the global manufacturers to substitute (TCO Development, 2016; TCO Development, 2015). The Swedish Tax Agency (2015) concluded that this type of tax ought not to be implemented since the administrative burden for companies, as well as the Swedish Tax Agency, were predicted to be high and controls for ensuring the accuracy in documentation were perceived as difficult.

After the tax on chemicals in certain electronics entered in force, further questioning and resistance have been present. An investigation from HUI Research (2018), at the request of Svensk Handel, Elektronikhandel & APPLiA (appliance industry), argue that an excise tax is not the right method to speed up substitution of FRs. The investigation argues further that the administrative burden is unreasonable and that the tax is neither easily designed nor comprehensible to businesses. Moreover, the tax on chemicals in certain electronics is criticized to create competitive disadvantages for Swedish trade (Svahn, 2019; HUI Research, 2019), since imports from e-commerce to private persons are currently not taxed and will, in the long run, lead to lost jobs in Sweden. It has further been argued that the tax lacks scientific support to quantify the health benefits caused by the tax (HUI Research, 2019).

## 2.3 Legislation governs the use of flame retardants in electronics

Several EU directives regulate the use of chemicals in electronics, which applies in parallel with each other. Firstly, safety in electronic equipment is regulated in the European Union by, for instance, the Low Voltage Directive (LVD 2014/35/EU). Secondly, the REACH regulation (registration, evaluation, authorization and restrictions) aims to protect human and environmental health from risks posed by chemicals, by reducing the use of proven hazardous



substances. Such substances are placed on a candidate list. If placed on the candidate list, actors, such as manufacturers, importers or retailers that handle a product containing the substance, may impose certain obligations. For example, the REACH regulation may require authorization to use the substance or that specific information needs to be provided to customers (Swedish Chemicals Agency, 2019d). Thirdly, the RoHS directive aims to reduce the impact on human health and the environment by replacing and limiting hazardous substances in electronic equipment. Substances regulated by RoHS are for example mercury, cadmium and the FRs PBB and PBDE (Council Directive 2011/65/EU). Further, the POP regulation aims to regulate persistent organic pollutants that can cause health effects such as cancer, reproductive disorders and behavioral changes. The POP regulation limits or prohibits the use of substances depending on the effect the use of a certain substance has. One example of such substance is SCCP, which is an FR and plasticizer, used in, for example, PVC plastic. Lastly, the WEEE regulation is a directive that regulates producer responsibility for waste (Swedish Chemicals Agency, 2019c).

### 3. Theory behind a tax on chemicals

The Swedish tax on chemicals in certain electronics was implemented based on an inquiry conducted on behalf of the Swedish government. The inquiry concluded that an excise tax is the preferably policy instrument to achieve the environmental goal of reducing the occurrence of hazardous FRs in indoor environments (SOU 2015:30).

#### 3.1 Motivation of a tax on hazardous chemicals

Environmental policies are often implemented when externalities related to environmental problems exist. Externalities are nonmarket side effects, caused by production or consumption, and result in a cost to an unrelated third party, where the cost is not borne by the causal agent (Stern & Coria, 2012). Both positive and negative externalities exist but related to environmental problems, the negative externalities are the ones often raised. The use of electronic products containing hazardous FRs causes negative externalities for consumers, as FRs can leach to the indoor environment (SOU 2015:30).

In an unregulated market with present negative externalities, the damage health and environment costs are not accurately reflected in the product price. Hence, the price mechanisms are not enough in order to achieve the social optimum level of production. In a regulated market, policy makers try to internalize the negative externality by implementing different policy instruments, for instance a tax (Stern & Coria, 2012). According to economic theory, implementation of environmental policies aims to achieve the point where the environmental damage caused by production equals the cost for reducing the damage (Brännlund, 2018). By implementing an environmental tax, the damage costs are included in the product price, enabling the price mechanisms to efficiently generate the social optimal level of production. As can be seen in figure 1, the level of production (Q) thereby shifts from the private optimum level ( $Q^P$ ,  $P^P$ ), to the social optimum level ( $Q^*$ ,  $P^*$ ) (Stern & Coria, 2012). Thus, the regulated market results in a lower

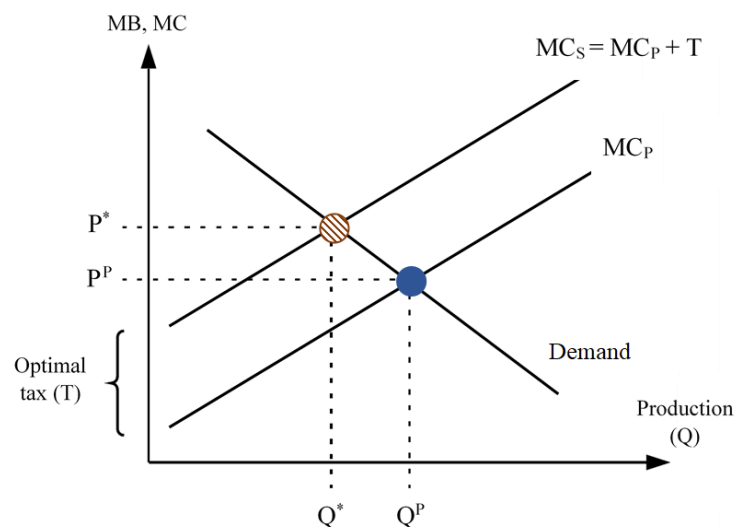


Figure 1. How a tax changes the social optimum level of production in a regulated market. Source: Re-designed from Stern & Coria (2012, p. 63).

optimal level of production. Therefore, an optimal environmental tax should be set so that the private marginal cost ( $MC_P$ ) equals the social marginal cost ( $MC_S$ ). Consequently, a firm will theoretically abate until the level when additional abatement costs more than using the taxed chemical (Stern & Coria, 2012). In this way, the use of a targeted chemical is reduced in a cost-effective way, which is one of the main advantages with a tax. By making the targeted

chemical more costly to use, a green tax additionally creates continuous incentives for abatement or substitution (Slunge & Alpizar, 2019). A tax may further be considered as a fair policy instrument since it builds on the polluter pays principle (PPP), i.e. the actor responsible for pollution bears the cost of it. This could however also be used as a contrary argument by firms. For the individual firm, a tax could be seen as costly, since firms pay twice for emission reduction, both for abatement and remaining emissions (Sterner & Coria, 2012).

### 3.2 Finding the optimal tax rate

A theoretical optimal tax - a Pigouvian tax - can be difficult to implement in practice. In order to find the optimal tax rate, knowledge about social damage cost and firms' abatement costs are required. Thus, an optimal green tax requires high level of information for the regulator (Sterner & Coria, 2012). In several cases, monitoring emissions can be very difficult and costly. Hence, the damage cost is not easily estimated. As raised by Slunge & Alpizar (2019), in the case when products contain FRs, the damage cost arises from diffuse sources when consumers using these products, making it difficult to monitor. The health and environmental damage caused by FRs are further difficult to estimate since there is almost no research done within this area (SOU 2015:30). Absence of economic value for health and environmental damage poses additional difficulties in estimating the damage cost (European Chemicals Agency, 2013).

Furthermore, there are often information asymmetries between regulators and firms. Asymmetric information refers to when one party to a transaction possess relevant information which the other party lacks (Perloff, 2015). One example of asymmetric information is when firms possess more knowledge about their costs related to substitution or reduction of a certain chemical, relative the regulator. As pointed out by Söderholm (2013), this is normally the case and firms have typically low incentives to reveal this information. Hence, the regulator needs to estimate firms' abatement costs. Due to these existing uncertainties, there is a risk that the estimated tax rate is insufficient. Hence, the underlying assumption that a green tax creates abatement may not necessarily be achieved (Söderholm & Christiernsson, 2008).

Due to large uncertainties about the damage cost caused by FRs (SOU 2015:30), alternative tax constructions may be preferable. Presumptive taxes target input or output to production. Such a tax is called presumptive since it is presumed that the agent using a certain input or produces a certain output, generates pollution (Sterner & Coria, 2012). An output tax on products may be used as a second-best instrument, in cases when products are a close complement to pollution and can be used as a good proxy. Since hazardous FRs in indoor environments originates from electronic products, a tax on such products was therefore considered to be appropriate (SOU 2015:30). A product tax has the same advantages as a theoretical tax, where the social damage caused by FRs is included in the product price. Further, a tax on products allows the demand side to give an "output" effect, by choosing products not subject for the tax (Sterner & Coria, 2012). The output effect was an argument for such a tax construction in the inquiry (SOU 2015:30).

### 3.3 Other potential policy instruments

Beside market-based instruments, such as a tax, several other different policy instruments exist and may be used in order to internalize negative externalities caused by hazardous chemicals. Traditionally, quantitative restrictions have been most commonly used in chemical management (Slunge & Alpizar, 2019). However, whether to use a price-type or a quantitative instrument is an ongoing discussion within this field. As illustrated in Sterner & Coria (2012), quantitative restrictions (ban or permits) is generally more efficient in cases when the marginal damage cost curve is steeper than the MC for abatement. In the opposite case, a price instrument (tax or fee) is a generally more efficient. A major potential disadvantage with market-based instruments is the previously mentioned information uncertainties, which makes it difficult to find an efficient tax rate. The great uncertainties together with the hazardous characteristics many chemicals possess may motivate quantitative restrictions in over price-type instruments (Söderholm & Christiernsson, 2008). However, as raised by Weitzman (1974), it is generally neither easier nor harder to specify optimal prices than optimal quantities, since it is in principle the same information required to specify either. Another alternative is to use a combination of price-type and quantitative instruments. In this way, the most hazardous substances may be restricted through a ban in order to ensure that these are not being used, while a tax could further steer away from less hazardous chemicals.

As mentioned in section 2.3, several EU regulations regulate the use of hazardous substances, either through bans or restricted use, and have the advantage that all countries in the European Union apply to the same regulation. A possible action to reduce the occurrence of hazardous FRs is therefore to lobby for inclusion of hazardous FRs in EU directives. However, as concluded in SOU 2015:30, even if large inquiry- and negotiation resources are invested by Sweden, there are 27 other member states (European Union, 2020) to convince and the outcome is therefore uncertain. A ban at EU level further requires extensive documentation as every substance is evaluated individually and due to the large number of existing FRs, this would involve comprehensive work. Another aspect is time, it takes several years before a substance may be included in RoHS and even more time before it is implemented. A national ban could be possible, if chemical politics were not harmonised at EU level, meaning that individual countries are not allowed to impose regulations, such as a ban. This applies especially for harmonised product areas such as electronics (SOU 2015:30).

Further alternative policy instruments are informative instruments, such as environmental labels and information disclosure. By informing consumers, there is a potential advantage of generating an output effect on the demand side by enabling consumers to actively choose more environmentally friendly products (Sterner & Coria, 2012). However, as explained in SOU 2015:30, this type of instrument requires high chemical knowledge about FRs among the consumers, which the majority do not possess. Furthermore, neither product content nor FRs are declared to consumers. Some environmental labels do however exist in electronic products, such as the Swedish label “Svanen” and TCO Certified. Even though informative instruments could be used to reduce the occurrence of hazardous FRs, they were considered not to generate enough effect (SOU 2015:30).

### 3.4 Effects from previously implemented taxes on chemicals

There have been some previous attempts to use market-based instruments for chemical management. One example is Denmark, where an excise tax on products containing phthalates and PVC was implemented in 2000 (Slunge & Alpizar, 2019). Examples of products that were covered by the tax were plastic floors, plastic pipes, gloves and tape. The tax was implemented in order to reduce the use of PVC and phthalates (SOU 2015:30). How much effect the tax had on the use of PVC and phthalates is uncertain, but according to the Government of Denmark (2006) did the use of phthalates decrease by 15% between the years 2002-2004. However, there is a possibility that the use of phthalates would decrease anyway, due to technical progress (Slunge & Alpizar, 2019). Another attempt to phase out hazardous chemicals was made by Norway in 2000. To reduce the use of trichloroethylene (TCE) and perchloroethylene (PER), a tax on these chemical inputs was introduced. The result was successful with a rapid reduction of the two substances in Norway. However, other countries with quantitative restrictions also achieved a similar reduction. Therefore, a ban is according to Slunge & Alpizar (2019) not necessarily more effective than a market-based instrument in order to reduce hazardous chemicals. Another example are taxes on fertilizers, which has been implemented in several European countries, including Austria and Sweden. In Austria, the tax achieved an annual decrease of 3% of fertilizer consumption, while implemented (ECOTEC, 2001). This tax generated, besides the price effect, also an increased awareness among the farmers regarding these chemicals (Söderholm & Christiernsson, 2008). In Sweden, the tax on nitrogen and phosphorus fertilizers was implemented in 1984. The tax did achieve a reducing effect on both fertilizers but the reduction of phosphorous was more apparent (Söderholm & Christiernsson, 2008).

## 4. Methodology

This paper was based on a qualitative approach, where an empirical analysis was supported by a literature study. The empirical analysis consisted of a case study where companies affected by the tax on chemicals in certain electronics were interviewed.

### 4.1 Literature study

Initially, a literature study was conducted to gain knowledge about the overall topic of chemical substitution and the Swedish tax on chemicals in certain electronics. In this phase, some additional overall areas of expertise were found which guided the further literature study. These areas were; tax as an environmental policy instrument, flame retardants, and interview methodology. Information was mainly searched for on Chalmers library and Google Scholar. Further articles and information were provided from the supervisor, the Swedish Chemicals Agency and The Swedish Tax Agency.

### 4.2 Case study

Empirical data was collected through semi-structured interviews. This form of interviews was chosen since it uses a preplanned interview template, which enabled comparable interviews and at the same time allowed the interviewees to speak freely (Bryman, 2011). Formulating interview questions was an iterative process and several modifications were made. Firstly, both the supervisor and the Swedish Chemicals Agency gave feedback on the interview questions. Secondly, the authors pilot tested the questions in the first interview conducted. This interviewee was later in the project interviewed again for complementary questions. Additionally, after each interview, the questions were evaluated. A few times some questions were changes or removed for not giving any valuable information. The interview questions are attached in Appendix.

#### 4.2.1 Interview objects and interviews

To find companies to interview over 100 companies were contacted. The authors did originally try to find equally many different types of actors such as manufacturers, reseller, importers and distributors. However, it was early noticed that Swedish manufacturers of components containing FRs, are not affected by the tax on chemicals in certain electronics and they were therefore excluded from this study. Furthermore, the authors conducted two interviews with companies who are resellers of taxable products but are not obligated to pay the tax. In their cases, tax is paid by another company in the distribution chain. Hence, these companies were also excluded from the study since their administrative burden were perceived as low.

Finding which companies that are obligated to pay the tax has been a challenge. According to the Swedish Tax Agency, 668 unique actors paid the tax on chemicals in certain electronics in 2019 (A. Gustafsson, personal communication, March 4, 2020). But due to the secrecy act, the Swedish Tax Agency is not authorised to reveal which actors the tax applies to. Instead the authors contacted different organizations in the white goods and other electronics industry to obtain their member lists. Further, the authors searched for companies based on certain industry

classifications. The search was focused on finding a variety of companies providing either white goods, other electronics or both product categories, in order to represent the industry as accurately as possible.

During this study, the spread of Covid-19 reached Sweden and several restriction actions were introduced. This affected the study in such a way that no physical interviews were conducted. Instead, interviews were mainly conducted by telephone and online meetings. Due to the prevailing situation, several companies were also affected with heavy workload and some companies were therefore three companies were only able to answer by email. Email interviews could be argued not to generate as deep and rich interviews like the ones conducted by telephone or online meeting. However, short and concise answers may not per se be disadvantageous because, as pointed out by Hawkins (2018), a short answer can be clearer and more precise compared to a long and dissolute answer. A potential risk with email interviews were that the interview questions were not being perceived as intended or that the given answers were very brief. To reduce this risk, follow up emails were sent to enable the researchers to ask questions for clarification.

During each interview, one of the researchers asked questions while the other one took notes. Every interview was directly revised afterwards in order to get as accurate and detailed notes as possible. When possible and consent expressed, the interview was recorded. Moreover, every interviewee was allowed to review their answers, enabling the authors to check whether the answers given were perceived as intended by the interviewee. In the review, the companies could add, change or remove information.

In summary, 13 companies have been interviewed within the white goods and other electronics industry. This number of interviews was considered to generate enough data for the purpose of the study. Since similarities in the interview answers were noticed quite early there was no necessity to keep gathering more data when no new information emerged, as described by Flick (2009). Nevertheless, the authors continued to conduct additional interviews after this notice, to further verify the data.

#### 4.2.2 Treatment of empirical data

The empirical data from the interviews was first roughly sorted aligned with the research questions. In this step, selection of which interview questions to include was decided. Since some questions have been necessary for understanding the subject but not directly refers to the research questions, these have been excluded from the result. The following step was coding and reduction of data. As explained by Lantz (2015), data reduction involves simplifying and to abstract raw data and is necessary in order to manage large amount of qualitative data. Based on the reduced data, different dimensions of each research question area were then identified. To illustrate the process, the first identified area aligned with the first research questions was *substitution of FRs*. Based on the reduced raw data, several dimensions of this area were identified, such as *have substitution been made* and *reason behind substitution* et cetera. By identifying certain dimensions, the reduced data can further be compressed in order to find summary key words and phrases, without losing its meaning. This process helped in retaining

the interviewees' responses as intact as possible while compressed into a clear compilation. After coding the answers into the different dimensions, a form of meta-coding was used to search for patterns in the responses given. One way to facilitate this work this is to compile the data in matrix form (Lantz, 2015). In order to easily get an overview of the result, the data has been kept in matrix form in this report. The process of compiling empirical data has been equal for all research areas. An illustration of the process is illustrated in figure 2, where the research area of substitution is used as an example.

Research area	Higher dimensions of the research area	Lower dimensions of the research area	Key words
Substitution of hazardous FRs	Knowledge about product content	How do you know which FRs your products contain?	Documentation from supplier
			Product documentation
			No knowledge
	Out phasing	Which FRs are mainly used in your company's taxable products?	Mainly ...
			No knowledge
Substitution of hazardous FRs	Out phasing	Have you changed any FRs or components or products containing FRs since 2017?	Yes
			Yes, small changes
			Probably
	Out phasing	What was the reason behind the change?	No
			Tax deductions
			Normal product development
Substitution of hazardous FRs	Out phasing	What was the reason behind the change?	Sustainability

Figure 2. Schematic illustration of the empirical data treatment process for the research area of substitution.

Confidentiality was thought of as a challenge and during each interview, the question was raised whether the authors can publish the answers. The authors informed the interviewees that the companies will be listed in the report, but all the opinions raised will be presented anonymously. However, most of the companies have not expressed that the given information is confidential and all of them have expressed an approval for publication. But, due to the nature of the paper, the researchers decided to keep the results anonymous since it is presumed that there are no benefits to point out certain companies or persons. The purpose of the study is merely to reflect the perspectives and experiences of the tax.



### 4.3 Limitations

The tax on chemicals in certain electronics is only implemented in Sweden, therefore the study included only companies operating in Sweden. Moreover, the study only included companies that are obligated to pay the tax. The presence and possibility of alternative FRs were not further evaluated. In order to know how available alternative FRs affects the companies' ability to substitute, knowledge about alternative FRs, costs and technical requirements for substitution was required. Since this has been a focus area, it was not included in the study. Nor have the authors investigated the competition disadvantages against foreign actors, since the Ministry of Finance proposed changes to impose tax liability on foreign actors. This amendment is proposed to enter in force on the first of October 2020 (SOU 2020:20), therefore was this rather a subject for research when the changes have been implemented. Furthermore, evaluation or proposal for an improved tax construction has been excluded from this study, since the study was more descriptive than prospective.

## 5. Results

The following results build on 13 interviews with companies within the white goods and other electronic industry. The interviewed companies and persons are listed in Table 1. As some of the information provided during the interviews was considered sensitive by some of the participating companies, the companies will be referred to as numbers instead of names in this section. Note that the order of the companies in Table 1 is not linked with the company numbers in the following subsections. Further note that references to company size are presented in bottom of the reference list, section 8.

Table 1. Interviewed companies.

Company	Person	Contact form & date	Type of actor	Type of products	Size, nr of employees
<b>Jula Sverige Ab</b>	Pia Björnberg	Video 2020-03-19	Retailer Manufacturer	White goods Other electronics	568 <sup>[1]</sup>
<b>NetOnNet AB</b>	Stefan Andersson Kristina Wärmare	Email 2020-04-07	Retailer Importer Manufacturer	White goods Other electronics	560 <sup>[2]</sup>
<b>Cylinda (Elektroskandia Sverige AB)</b>	Bengt Thaysen	Telephone 2020-04-01	Importer	White goods	827 <sup>[3]</sup> (Elektroskandia Sverige AB)
<b>Lenovo Sweden AB</b>	Thomas Hedin	Telephone 2020-04-15	Supplier	Other electronics	44 <sup>[4]</sup>
<b>Severin Svenska AB</b>	Leif Lindholm	Telephone 2020-04-14	Sales subsidiary	White goods	4 <sup>[5]</sup>
<b>Dometic Scandinavia AB</b>	Malin Ståhl	Email 2020-04-14	Importer	White goods	47 <sup>[6]</sup>
<b>LG Electronics Nordic AB</b>	Henrik Sondell	Telephone 2020-04-16	Importer	White goods Other electronics	96 <sup>[7]</sup>
<b>Kjell &amp; Co Elektronik AB</b>	Kristoffer Nettleingham	Telephone 2020-04-21	Importer Manufacturer	White goods Other electronics	654 <sup>[8]</sup>
<b>Philips AB</b>	Hampus Larsson	Telephone 2020-04-20	Importer Manufacturer	White goods Other electronics	288 <sup>[9]</sup>
<b>Miele AB</b>	Niklas Ödahl	Telephone 2020-04-23	Importer Manufacturer	White goods	109 <sup>[10]</sup>
<b>Atea Sverige AB</b>	Victoria Lindqvist Ann-Charlotte Klerstad	Video 2020-04-29	Retailer	Other electronics	2416 <sup>[11]</sup>
<b>Italian Brands AB</b>	Susanne Bogren	Email 2020-04-30	Distributor	White goods	2 <sup>[12]</sup>
<b>Electrolux AB</b>	Viktor Sundberg Giorgia Possamai	Video 2020-05-22	Manufacturer Importer	White goods	2016 <sup>[13]</sup>

## 5.1 Substitution of hazardous flame retardants

Table 2 describes whether substitution of hazardous FRs has been made or not, the underlying reason for why substitution has been made and companies' knowledge about FRs used in their products.

Table 2. Substitution of flame retardants in electronic products covered by the tax on chemicals in certain electronics.

	How do you know which FRs your products contain?	Which FRs are mainly used in your company's taxable products?	If you do not know which FRs the product contains, how is the tax paid?	Have you changed FRs or components or products containing FRs since 2017?	Reason behind change?
<b>Company 1</b>	Documentation from supplier	No knowledge	Do always know	Yes, small changes	Tax, although the tax had low impact
<b>Company 2</b>	Documentation from suppliers, about which deductions that are possible	No knowledge	Pay full tax	No	-
<b>Company 3</b>	Information from suppliers	Mainly Br or P based FRs	This case does not happen. You always know	It probably has	Normal product development
<b>Company 4</b>	Do not know	No knowledge	-	No knowledge	-
<b>Company 5</b>	Information from suppliers	Br, P, salts (aluminium) and some Cl based FRs	Pay full tax	Yes, small changes	Component or product exchange Tax deductions (low impact)
<b>Company 6</b>	Administrative system where suppliers sign self-declarations	Mainly Br and P based FRs	If no signed declarations - No deductions	Yes, small changes	Sustainability policy Tax
<b>Company 7</b>	Do not know, no complete material declarations exist	-	Pay full tax	No	-
<b>Company 8</b>	Information from manufacturers	No knowledge	Manufacturers do always know	Yes, small changes	Tax deductions
<b>Company 9</b>	Asking manufacturers Documentation from supplier	No knowledge	Do always know	It probably has	-
<b>Company 10</b>	Product documentation	No knowledge	Do always know	It probably has	Normal product development
<b>Company 11</b>	Product documentation about which deductions that are possible	No knowledge	Pay higher tax	No knowledge	-
<b>Company 12</b>	Documentation from suppliers, about which deductions that are possible	Several different substances are used	The manufacturer has this information	Yes, small changes	Environmental benefits Tax deductions
<b>Company 13</b>	Documentation from supplier	Mainly Br and Cl based FRs	Pay full tax	Yes	Tax Normal product development Cleaner and greener products

As can be seen in table 2, knowledge about what FRs a product contains varies between the interviewed companies. One company mentioned that - *“//...// it varies a lot whether you know or don’t, this depends on the long supply chain and that there are many different components in an electric product.”*. This view was further raised by another company who mentioned that the product contents are not known *“//...// at a substance level “*, but merely that suppliers provide product documentation of what tax deduction that is possible for that specific product. On the contrary, some other companies said that - *“This is common knowledge since documentation is today needed for every screw.”* and - *“We know exactly what all products contain, for each product, there is a descriptive product sheet with detailed information about its content”*. As can further be seen in table 2, seven companies mentioned that they do not possess any knowledge about what type of FRs that are mainly used in their products. Among the four companies that do know, all three chemical elements targeted by the tax was mentioned; bromine, chlorine and phosphorus.

In those cases where knowledge about product content is insufficient, six companies expressed that they then pay full or higher tax instead. As one company explained - *“If there are any doubts about what FRs are added, we don’t make any tax deductions but pays full tax for it”*. Six companies instead expressed that this scenario does not occur. According to these companies, they always have knowledge about the product content.

As can further be seen in table 2, six companies expressed that changes of FRs in products or components have been made since the implementation of the tax. Among these companies, five described the changes made as small or few. The expressed reason for the implemented changes varies between companies. Six companies specified the tax on chemicals in certain electronics to be one reason behind these changes. However, product development was in addition raised as one underlying reason. As one company explained, changes have been made - *“//...// not as a result of the tax, but rather from product improvements //...//”*. This is further why three companies answered that substitution has *probably* been made since it probably has been done during product development. Among the companies who have succeeded to substitute hazardous FRs, three companies mentioned that this has not been accomplished by the company itself, but by exerting pressure on suppliers. A fourth company mentioned that substitution has been achieved by choosing to acquire other products.

## 5.2 Drivers and challenges for substitution

Table 3 presents what drivers and challenges companies experience related to substitution of hazardous FRs.

Table 3. Drivers and challenges for substitution of flame retardants

	Active search for alternative FRs	Knowledge about alternative FRs	Drivers for substitution of FRs	Challenges for substitution of FRs?	Perceived possibility to influence product content?
<b>Company 1</b>	-	-	Eu regulations Proven hazardous FRs Technical performance	Sweden too small market share Substitution cost Risk for regrettable substitution	Yes, if alternatives exist
<b>Company 2</b>	No, do not seek alternatives	No knowledge	-	No manufacturing No knowledge about product content	No possibility
<b>Company 3</b>	Yes, part of product development	Yes, internal knowledge	EU regulations Eco labels Consumer demand Tax ( <i>but only for one product type</i> )	Substitution cost Sweden too small market share	Yes, to some extent
<b>Company 4</b>	-	-	-	-	No possibility
<b>Company 5</b>	Yes, where possible	Yes, moderate knowledge	Reduce hazardous FRs ( <i>bromine and chlorine</i> ) EU regulations	Difficult to get info about products' contents Sweden too small market share Substitution cost	Small, particular for electronics
<b>Company 6</b>	Yes, where it is possible	Yes, but not complete knowledge	Flammability & safety Sustainability Tax	Verification such as testing Substitution cost	Yes
<b>Company 7</b>	No, do not seek alternatives	-	If ban – possible global action	Sweden too small market share	No possibility
<b>Company 8</b>	No, do not seek alternatives. But try to exert pressure on suppliers	Yes, through suppliers	Tax deductions ( <i>indirect consumer price</i> )	Sweden too small market share	Yes, exert pressure on suppliers
<b>Company 9</b>	-	-	-	Sweden too small market share	No possibility
<b>Company 10</b>	No, do not seek alternatives	-	Retail & consumer demand	Substitution cost	No possibility, not at Nordic level
<b>Company 11</b>	-	Globally - internal knowledge	-	No manufacturing Sweden too small market share	No possibility, not from a Swedish level
<b>Company 12</b>	-	No detail knowledge	Existing alternative FRs Tax deductions EU regulations	Sweden too small market share	Small
<b>Company 13</b>	No, do not seek alternatives. But try to exert pressure on suppliers	Globally – internal knowledge	Cleaner and greener products ( <i>own products</i> )	No manufacturing	Yes, to some extent

Five companies mentioned that they do not seek substitutes actively, among these, two mentioned that they are trying to exert pressure on suppliers. To cite one of these companies - *“We tell them //...// that if you do not achieve this, we cannot sell your products to this customer. Then the suppliers have to work to replace components”*. One other company mentioned that seeking substitutes is something they do constantly but not because of the tax on chemicals in certain electronics but rather for product improvement. Among the companies who expressed that they do seek alternative FRs in some way, all additionally expressed that they have knowledge about alternative FRs. Among the remaining companies, who do not seek substitution alternatives, only two company mentioned that knowledge within the parent company exists. The rest answered that they do not seek alternatives or possess no knowledge about alternative FRs.

Four companies mentioned EU directives as a driver for substitution and believe that these have more impact in driving substitution than the tax on chemicals in certain electronics. To cite one of these companies - *“The biggest impact has undoubtedly the EU REACH regulation and the candidate list”*. In addition, four companies mentioned that the possibility of tax deductions drives substitution. To quote a company - *“If it is possible to substitute these for more environmentally friendly alternatives, then it is of course preferable and the opportunity for tax deductions is often an incentive to substitute”*. One of these four companies expressed that the tax on chemicals in certain electronics is only a substitution driver for one specific product type within the other electronics category since it constitutes a large share of the product price for this product. Moreover, some companies mentioned that substitution is handled by their respective parent company abroad and therefore have no or limited insight in the work with substitution.

Eight companies mentioned that one obstacle for substitution is that the Swedish market is too small to be able to influence global players. As one company said - *“you cannot adapt the factory for one small country, it can be very expensive to substitute, then it is obviously a trade-off if it is worth it or not”*. Five companies additionally mentioned the cost of substitution as a hinder for substitution. To cite one of these companies - *“if it would be cheaper than it is today, it would already have been done. And the point is that if it is a little price increase, we might have the benefit from the Swedish tax, but on the other hand if there is a slightest price increase multiplied with a huge volume that goes to the rest of Europe, the whole equation does not make sense. Because the volume is not in Sweden, it is elsewhere”*. Another challenge mentioned by three companies is - *“That we don’t have our own manufacturing...”*, which was experienced as a significant hinder. If production were located in Sweden, the tax is believed to have a greater impact on out phasing of hazardous FRs. One additional opinion brought up was that substitution of hazardous FRs is included in the company’s sustainability work and may therefore not be in focus per se - *“There is a continuous dialogue with suppliers in order to develop better products from an environmental perspective. Flame retardants constitutes of only one part of this work...”*.

Six companies expressed that they experience no possibility to substitute FRs in their products, whereas four companies experience a small possibility and can to some extent exert pressure on suppliers. As pointed out by one company - *“In this particular area, we experience that we have small possibility to substitute. There are areas where the possibility to substitute material is greater. But in this area, we experience that there is no components or material available”*, which implies that lack of available alternatives reduces the possibility to influence. Three companies experience that they can influence the content of FRs in their products. To quote one company - *“if you are a trading company who buys and sells products, it is quite easy to // ... // exchange products with another one. But if you are a producer, you have more control over what substances that are used”*.

### 5.3 Tax deductions

Table 4 describes which tax deductions the interviewed companies currently make and the underlying reason for why no deductions are made when paying full tax.

Table 4. Tax deductions and the tax influence on consumer price.

	For how large share of your company's taxable products do your company pay full tax, do 50% deductions and 90% deductions respectively?	In those cases where no deductions are made, what is the reason behind this?	Have any changes been noticed in how much and which tax deductions that are made since 2017?
<b>Company 1</b>	Confidential	-	Yes, increased share 50% deductions
<b>Company 2</b>	<b>Full tax:</b> 50% <b>50%:</b> 40% <b>90%:</b> 10%	Lack of documentation	Started with 100% tax. During the first year, big changes happened. Since then, stable
<b>Company 3</b>	<b>50%:</b> 100%	-	No
<b>Company 4</b>	-	Lack of documentation	-
<b>Company 5</b>	Majority full tax	Mainly lack of documentation	Yes, few changes
<b>Company 6</b>	-	Lack of documentation or the product contains hazardous FRs	Yes, but only due to more documentations now
<b>Company 7</b>	<b>Full tax:</b> 100%	Lack of documentation	-
<b>Company 8</b>	<b>Full tax:</b> 10% <b>50%:</b> 75% <b>90%:</b> 15%	The product contains hazardous FRs	Yes, increased share 50% deductions
<b>Company 9</b>	<b>Full tax:</b> 20% <b>50%:</b> 70% <b>90%:</b> 10%	Probably, costs for testing are greater than the profit from deductions	No
<b>Company 10</b>	<b>Full tax:</b> 80-85% <b>50%:</b> 10-15% <b>90%:</b> 5%	-	No
<b>Company 11</b>	<b>Full tax:</b> 75% <b>50%:</b> 25%	Lack of documentation	Yes, changes occur
<b>Company 12</b>	Confidential	Lack of liability agreement or lack of documentation	Yes, changes occur, but few
<b>Company 13</b>	Full tax: approx. 50% <i>No information about deduction split</i>	Does not meet the requirements or lack of documentation	No

Among the interviewed companies, the majority explained that tax deductions are made, even though they still pay full tax for some products. When asking about why no deductions are made, eight companies mentioned lack of documentation as one reason. The companies that mentioned this, described the problem in a similar way. To cite one of these companies - *“Mainly because it is difficult to find information, and above all, to get complete information about the components that influence an article’s tax rate”*. To cite a second company - *“It is not uncommon for us to pay full tax even though the supplier claims the possibility of deduction and this is because we are always fully obliged to pay the tax and if we do not then have a liability agreement or have not received the documentation we require to ensure that the product is valid for deductions. So, we choose not to make this deduction even though it may be correct”*. On the other hand, one company mentioned that it is because the product contains hazardous FRs. As they described it - *“Because they contain dangerous flame retardants. The supplier has not been able to simply switch to a more environmentally friendly production”*.

According to seven companies, the share of deductions has changed since the tax was implemented in 2017. To cite one company - *“So, in the middle of a product’s life cycle, there can suddenly be tax reliefs on certain products”*. However, the underlying reason for these changes is rarely substitution of FRs. As one company explained - *“Yes, there have been cases where the manufacturers have changed to enable tax deductions, but unfortunately, it seems to be the case for several products, that the product has initially been approved for deductions but the suppliers were not initially certain so they didn’t dare to ensure that deductions could be made”*. This is further strengthened by another company who said - *“Yeah, but only because we have more paper available now from the suppliers”*. Two companies expressed that they during the first year requested documentation for tax deductions, which resulted in that these companies could increase the number of tax deductions during this period.

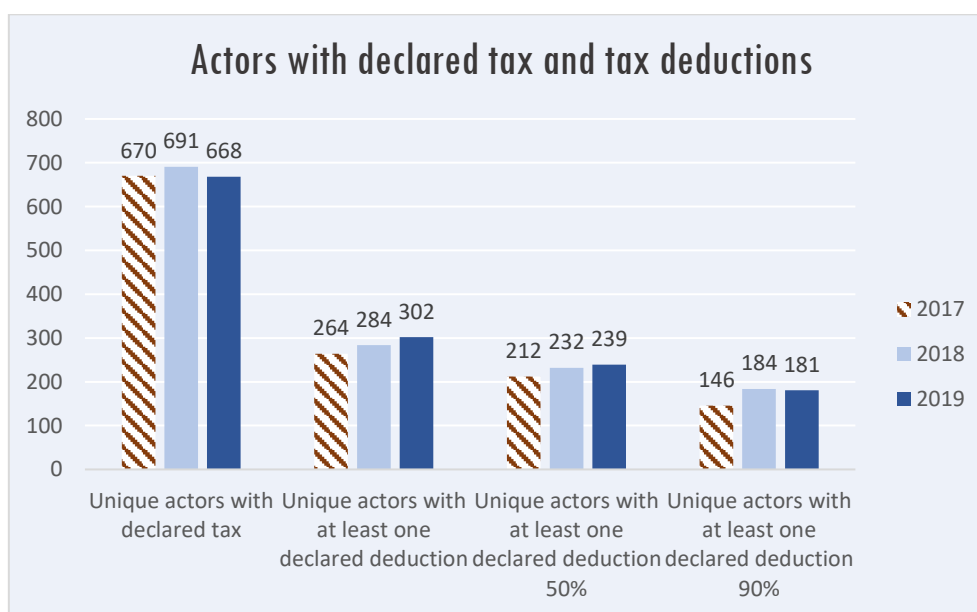
Another question that was asked during the interviews was whether controls are made or not to check that tax deductions are made correctly. Four companies answered that controls are made by the Swedish Tax Agency. However, how frequently these controls are made were experienced differently among the companies. One company said *“Yes, controls are made regularly”* while another company expressed that controls are made *“To a small extent”*. Four companies answered that they have no knowledge about whether controls are or have been made and five companies expressed that no controls occur. One company expressed that *“//...// they have not done a lot of controls and they have definitely not done any testing because they cannot do any testing”*. This concern about lacking possibility to test products was raised by three more companies. According to these companies, testing the product content is very difficult, especially to test how a substance has been added (additive versus reactive). As one company said - *“No, it is extremely hard. It seems like existing test methods are not reliable enough”*. Another aspect raised was the cost of testing, as one company explained - *“A test is very expensive, it is therefore not sustainable to test only one product”*. The lack of testing methods and the high cost of testing results in that the companies need to rely on self-declarations from their supplier to obtain information about product content. Lack of documentation and full knowledge could in addition stem from suppliers unwillingness to reveal such information. As explained by one company - *“//... // phosphorus-based flame*



*retardants, which are new on the market and are under patent, so suppliers do not want to disclose the CAS nr of the exact substance they use. This is another criticality, the fact that it is sometimes hard to ask to disclose the full formulation”.*

The interviewees expressed that the tax constitute a varied share of the consumer price, were the estimations made varies from 1% up to 20%. However, as one company explained - “//...// *this is roughly estimated, it depends on the product of course, since we have large price differences among our products*”. The tax share on the product price further depends on what tax deduction a product is entitled to. For certain products, the tax does however constitute of quite a large share, to quote one company - “*There is a tax ceiling, so it is not too bad for expensive products, but it becomes noticeable when the product price drops //...//*”. Another company pointed out that the most noticeable products are “//...// *smaller but compact products. When the weight is relatively large compared to the price*”.

Additional data related to tax deductions made by the companies, was received from the Swedish Tax Agency, which is illustrated in figure 3 and figure 4. Figure 3 illustrates the unique actors that have declared tax on chemicals in certain electronics since 2017 and figure 4 how many unique actors that have declared at least; one tax deduction, one 50% tax deduction, and one 90% deduction per year. As can further be seen in figure 3, the number of unique actors with at least one declared deduction has steadily increased since 2017. For each year, there is more actors which have declared 50% deductions than 90% deductions.



*Figure 3. Actors with declared tax and tax deductions*

The tax has since the implementation generated over 3.4 billion SEK in tax revenues, as can be seen in figure 4 (A. Gustafsson, personal communication, March 4, 2020).

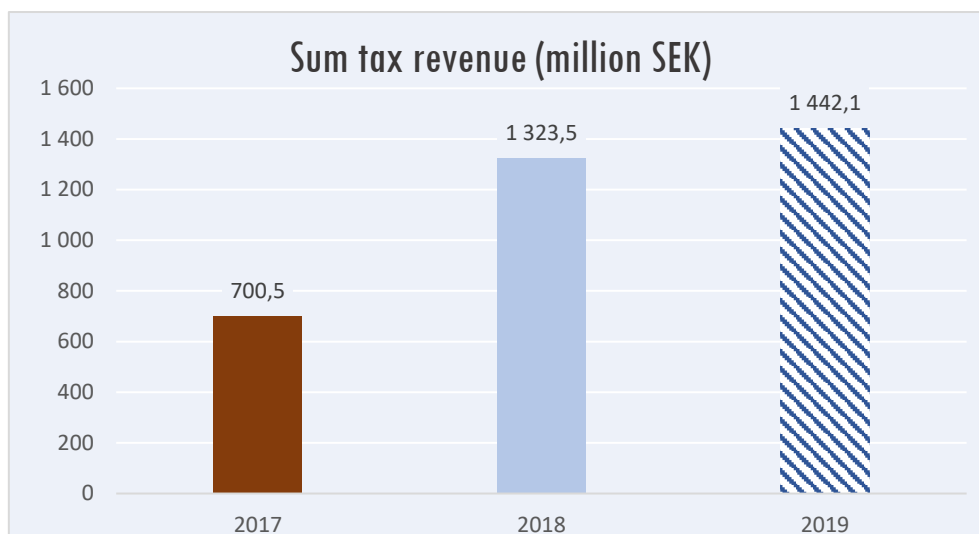


Figure 4. Sum tax revenues. Note that the tax entered in force on July 1, 2017, and therefore tax revenues in 2017 is not calculated for a full year.

## 5.4 Administrative cost related to the tax on chemicals in certain electronics

Table 5 displays how much time the interviewed companies estimate the tax on chemicals in certain electronics require and how it has changed over time since the tax was implemented.

Table 5. Administrative cost of the tax, measured in time.

	How much time do you estimate your company spend to administer the tax?	How has this time changed since 2017?
Company 1	80 h/month	-
Company 2	48 h/month	More workload in the initial phase. Today more standardized process so it takes less time today
Company 3	10–20 h/month	-
Company 4	-	More workload in the initial phase
Company 5	Hard to estimate, little time due to automated systems	More workload in the initial phase. Apart from that has the workload remained the same over time
Company 6	Do not know	More workload in the initial phase
Company 7	3 h/month	Requires more time now than before
Company 8	10 h/month	More workload in the initial phase. Apart from that has the workload remained the same over time
Company 9	6 h/month	More workload in the initial phase
Company 10	Extremely little	-
Company 11	Difficult to estimate	More workload in the initial phase
Company 12	-	More workload in the initial phase
Company 13	Estimating a couple of hours per product	Takes more time today for products that are not our own brand

As can be seen in table 5, the time companies spend on administration varies significantly. Two companies mentioned that little time is spent on administration, which is according to one of these companies due to automated systems. On the other hand, four companies expressed that ten hours per month or more are required to administer the tax. The required time stems from several factors. Two companies said that every time the company bring a new product into their assortment, they need to control they have all the information needed to declare everything. One of these companies mentioned that they have to include the right tax on all products in their enterprise system. This is nothing they handle in the same way as VAT, where VAT is based on percentage, whilst the tax on chemicals in certain electronics is a weight-based tax. Further, the company explained that they need to find all the products covered by the tax and then check if the product is included in any of the CN numbers. If the product is covered by the tax, the company have to check the weight of the product and then its chemical content. As they described it - *“this is not a net weight we use in other situations, but only in the case of the tax on chemicals in certain electronics. This increases the administrative burden.”*. Further, this company mentioned that this process is especially hard when producing custom made products where one product might have a hundred different variants. Another company explained that they spend a lot of time on dialogue with suppliers, updating article data, reporting to the Swedish Tax Agency et cetera. A third company mentioned that it takes some time to collect tax accounting documents. Three companies mentioned that they spend time on troubleshooting. One of these companies explained that they are partially troubleshooting for the wrong weight on products. The weight is based on the products’ net weight, so distributors need to obtain this information from manufacturers. Many product sheets are initially based on a paper product, but when the distributor gets the final product, they have to control the product weight to obtain the exact weight. Further, the companies can be uncertain about which tax deduction to apply and there may be errors that must be resolved through troubleshooting. Three companies mentioned that administration is needed to ensure the tax is included on the invoices when it should, otherwise not. One company explained further that in cases when an error occurs the order department have to credit the invoice and make a new one.

Moreover, several companies mentioned that in the initial phase, when the tax was implemented, the administrative burden was very high. One company said - *“I am not kidding if I said we were 100 people involved when we set this up in 2017”*. The initial work included; implement systems at parent company to handle the tax, explain to suppliers what information they need to share, how suppliers should report this information and inform customers about the tax. Moreover, another company mentioned that implementing the tax into their enterprise system required hundreds of hours. Further, this company said that - *“At midsummer 2019, there was a price increase, which was applied from July 1, it was almost impossible for us to handle this. So, to succeed we had to cancelled holidays for several employees”*.

## 5.5 Companies’ opinions about the tax on chemicals in certain electronics

Table 6 and 7 presents the perceived positive and negative effects of the tax as well as raised opinions about the tax.

Table 6. Perceived effects by the tax and opinions about the tax on chemicals in certain electronics, companies 1-7.

	Perceived positive effects of the tax?	Perceived negative effects of the tax?	Opinions about the tax?
Company 1	None, except substitution of FRs	More administration Higher product cost	PVC plastics contain chlorine but not used as an FR, becomes taxable but there exist no alternatives today  Local tax in a global world - small possibility to achieve impact  Risk for regrettable substitution
Company 2	None	More administration  Difficult to make sure that received information about FRs is correct  Limited time for the company to act upon changes in tax	Good environmental aim  Need to be addressed on a higher level, Sweden alone have no impact  Wrong chemicals that are taxed (more hazardous ones exist)  Repaired products are being double taxed when sold again after remanufacturing  Limited time to react upon changes in the tax
Company 3	None	More administration Competition disadvantages towards foreign actors Higher product cost	The tax should be removed. Should be conducted through existing EU directives → better achieving substitution of FRs No possibility for 100% deductions
Company 4	None	More administration Competition disadvantages towards foreign actors	Good that Sweden pursue environmental questions Need to be addressed on EU level Need to be addressed towards the manufacturers  Free competition within EU, this tax generates competition disadvantages for Swedish trade
Company 5	The question about FRs is raised  More knowledge now about what product contains	More administration Competitions disadvantages towards foreign actors Higher product cost	Initiatives like the tax is good, but maybe not the best way  Better if addressed on EU level
Company 6	Increased knowledge  Better documentation  System in place for documentation	More administration  Tax rely on self-declarations, but no possibility to test products for their content	Odd that there is no possibility for 100% deductions  PVC plastics contain chlorine but not used as an FR, no tax deductions are possible for the whole product then  Easier to ban the targeted chemicals instead (EU legislations)
Company 7	None	More administration  Competition disadvantages towards foreign actors	Need to be addresses on EU level, to achieve impact on substitution

Table 7. Perceived effects by the tax and opinions about the tax on chemicals in certain electronics, companies 8-13.

	Perceived positive effects of the tax?	Perceived negative effects of the tax?	Opinions about the tax?
Company 8	None	<p>More administration</p> <p>Frustration</p> <p>Updates in enterprise systems</p>	<p>Initiatives towards a sustainable future are good</p> <p>Odd that there is no possibility for 100% deductions</p> <p>Requires “following up” so that the tax actually gives results</p>
Company 9	None	<p>More administration</p> <p>Distortion of competition</p> <p>Higher product cost</p> <p>Reduced sale (especially e-commerce)</p> <p>Lost jobs</p>	<p>Good environmental aim, but not achieved by this tax</p> <p>Need to be addressed on EU level</p>
Company 10	None	More administration	Tax does not achieve impact on substitution
Company 11	Not so noticeable on the consumer price (due to premium products)	<p>Reduced sale (<i>when tax entered in force</i>)</p> <p>Limited time for the company to act upon changes in the tax</p> <p>Some competition disadvantages</p>	<p>Need to be addressed on a higher level, to achieve impact on substitution</p> <p>The tax has achieved something</p> <p>Limited time to react upon changes in the tax</p>
Company 12	None	<p>More administration</p> <p>Competition disadvantages towards foreign actors</p>	<p>To strive for improved and more environmentally friendly products is good</p> <p>Should be conducted through existing EU directives, to achieve impact → better achieving substitution of FRs</p>
Company 13	None	<p>More administration</p> <p>Lots of resources needed when the tax was implemented (developing new ERPs)</p> <p>Competition disadvantages towards foreign actors</p>	<p>Initiatives towards a sustainable future are good</p> <p>Need to be addressed on EU level, to achieve impact on substitution</p> <p>Odd that there is no possibility for 100% deductions</p>

As seen in table 6 and 7, experienced positive effects were mentioned by four companies, whereas nine companies expressed that no positive effects have been perceived since the implementation of the tax. On the contrary, all companies interviewed expressed negative effects, were commonly mentioned drawbacks are; more administration, competition

disadvantages, and higher product prices. As one company explained, are higher product prices not solely generated by the tax itself, but also by more administration - *“Above all, it requires more time for accounting et cetera, hence, the total product cost increases //...//”*. Additional negative effect experienced is reduced sale, which was mentioned by two companies. One of these companies experienced a drop in sale when the tax was brought into force, while the other experience a sustained reduction in sales, especially in e-commerce.

All interviewed companies have expressed opinions about the tax on chemicals in certain electronics as such. Opinions raised have referred to; the tax purpose, its application and its design. Six companies have in some way expressed that the environmental aim is good and that initiatives taken by Sweden towards a sustainable future are welcomed. However, equally many interviewees questioned whether this tax reaches its environmental purpose or not. One company said that *“It has had no effect on what type of chemicals we use //...//”*. Another company said - *“The purpose was to reduce chemicals in production, but that has not been noticeable at all”*. This view, that the tax has no impact on substitution of FRs, was additionally shared by other companies. Furthermore, several companies raised concerns about the tax being fiscal - *“Even if it is called the chemical tax, it is //...// a disguised fiscal tax covered in an environmental suit. This aims purely to raise revenues //...//”*.

Other opinions about the tax concerned the fact that it is only applied to the Swedish market - *“//...// a Swedish excise tax is not the right way, since Sweden has small possibility to impact and achieve a true change in the global manufacturing industry”*. This view was shared among other interviewees and the majority pointed out that the Swedish market share in the industry is too small to achieve any impact. The tax is believed to have a greater impact if it were applied on a higher level, which was mentioned by eight companies. *“To ban hazardous substances on EU level would have been better and would more certainly achieve the desired effect, if the purpose is to phase out certain flame retardants”*. A national tax was further discussed as not being beneficial for Swedish trade. Competition disadvantages were frequently mentioned, and one company additionally raised an opinion about the tax being unfair against Swedish companies since foreign companies are not included. - *“... it is not competition on equal terms”*. One company's opinions were summarized by the words - *“... we believe, the problem is that this is a local tax in a global world”*.

Additional opinions concerned the design of the tax. To cite one company - *“We have questioned why there is no possibility to do 100% deductions in cases where these flame retardants do not exist //...// we believe that if you have a complete environmentally friendly product you should get credit for it, but you do not, in this case”*. This opinion was raised by four companies who think that a case where you do not pay any tax ought to exist. On the other hand, one company expressed that the difference between 90 and 100% deduction is small, monetary wise, and might therefore not have made any difference on substitution anyway.

Further questions about the tax, which is not displayed in table 6 or 7, is whether it should be based on the product weight, as it is today, or not. Six companies expressed that it is not reasonable to base the tax on the product weight. As one company said - *“Completely irrelevant*

*//...// what has this got to do with this? It's the amount of FR in the product".* Among these six companies, five expressed the same opinion, that the tax would be more accurate if it were based on the amount of FRs in a product instead. Another company additionally suggested that the tax might be applied to the components including FRs and not the entire product - *"It is so many components that has nothing to do with flame retardants, which weighs a lot"*. This company further explained that there is a possibility that companies then sell their products without belonging gadgets, making the purchase more complicated for the consumer. Three companies further explained that the present solution is complex. One company described it as - *"it is not the ordinary net weight of the product, but a chemical tax net weight"* that is taxed. This taxable weight includes every gadget that follows a product, such as charging cables, which generates extra administration, since this "chemical tax net weight" needs to be calculated. However, two companies expressed that it is reasonable to base the tax on the product weight. As one of these companies explained, it is difficult to measure or know how much FRs a product contains. Hence there is, according to this company, no other way to apply the tax.

Additionally, one company raised concern for regrettable substitution - *"... but the question is whether the substances you change to is better or not"*. Regrettable substitution was described by this company as a big problem, not only for substitution of FRs but for all substitution made. Another company raised the problematic with recycled or remanufactured products which can be taxed twice. In their case, they offer to recycle and remanufacture products and some of these are later sold again. The problem arises since there is no way for the company to keep track of which product that has already been taxed when sold as new. This results in the possibility that the same product may be taxed twice. As further explained by this company, remanufacturing has already small margins and the benefits of recycling or remanufacture old products might vanish if products are taxed once more, which per se is a loss for the environment.

## 6. Discussion

In this section, the authors discuss the findings presented in the results and elaborates on which relations exist between certain areas. The discussion is divided similar as the result, where each research area is touched upon, in order to guide the reader. The section ends with a limitation discussion about the study and proposals for further research.

### 6.1 Substitution of flame retardants in electronics

According to half of the interviewed companies, some substitution of FRs has been made. The substitution made seems to be limited, since the companies have referred to these changes as small or few. In those cases where substitution has occurred, the superior reason behind this change is the Swedish tax on chemicals in certain electronics, which is further expressed as one of the drivers for substitution of hazardous FRs. Whether the tax has achieved its environmental purpose or not depends on the aim. If the aim of the tax is solely to *reduce* the occurrence of hazardous FRs, all substitution made could be argued to fulfil this aim, despite how little substitution that has been made. Hence, the purpose seems to some extent have been achieved. If substitution has occurred and the tax in fact is a driver, one might question why not more substitution has been achieved.

#### 6.1.1 Theoretical explanation for why not more substitution has been achieved

One underlying reason for why only some substitution has occurred may be due to the existing information uncertainties. As described in section 3.2, a green tax should preferably be set so that the marginal damage equals the marginal benefit of using a certain chemical. However, obtaining accurate information for such a tax rate is difficult. As presented in section 5.1, several companies do not possess knowledge about which exact FRs that are used in their products, as this is not specified by the supplier. Even if the companies have documentations stating which tax deduction the product is entitled to, knowledge on a substance level is still absent for several companies. Hence, there seems to exist information asymmetries, both between the interviewed companies and their suppliers, and the companies and the regulator. As the product content is not always known by the companies, one might question how the damage cost caused by FRs ought to be estimated. It seems to exist a present risk that estimations done by the regulator might not reflect reality. Hence, the Swedish tax on chemicals in certain electronics may not accurately reflect the damage caused by the targeted products.

If the tax rate is underestimated, there is a risk that the tax does not generate enough incentives for substitution for the companies and thus the theoretical assumption of a tax incentivize substitution is lost. The expected level of substitution of FRs may therefore not been achieved. However, the inquiry made before the implementation of the tax, proposed a strategy to initially implement a low tax, due to uncertainties concerning the effects caused by the tax and to reduce resistance to the tax among companies (SOU 2015:30). It could therefore be the case, that the optimal tax rate is not yet reached and that further tax increases will incentivise further substitution.



A further explanation to why only some substitution has occurred may be that the demand side output is lower than expected. Since a tax is implemented to steer consumption towards other alternatives, the tax rate needs to be high enough to be noticeable on the consumer price, in order to achieve such effect. However, as several companies mentioned, the tax share on the consumer price varies greatly. How large the tax share is, seems not to depend on what type of product it is (white goods or other electronics) but merely on the product's weight relative its price. For products with high prices, the tax constitutes of such a small share that it becomes neglectable. In these cases, one might suspect that the output effect is absent, and the tax could be argued to be more fiscal since the tax is too low to incentivise substitution. In other product cases, such as cheap and heavy products, the tax ceiling is often reached, and the tax constitutes of a much larger share of the consumer price. Hence, the output effect can be believed to be noticeable on such products. It seems therefore that the tax only generates a steering effect on certain products. Hence, substitution incentives can be seen as only target some of the products that are subject for taxation.

#### 6.1.2 Empirical explanation to why not more substitution has been achieved

One explanation for why only some substitution has occurred may lie in the companies' limited ability to influence product content. As described in section 5.2, the majority of the companies express that they possess little or no power to influence the product content. The reason behind this limited ability to influence seems to be related to challenges with substitution of FRs. Several companies do not have their own production but are solely middlemen in the supply chain and thus their influence on the use of FRs is limited. This is further strengthened by the fact that no company has expressed that substitution has been carried out by the company itself, but rather by exerting pressure on suppliers or choosing other products to purchase when possible. Several companies further mention that the Swedish electronics market constitutes only a small share (0.5%) of the global market. Hence, influencing global production is difficult. Further, one explanation could be that substitution is too expensive, which was mentioned by several companies. It can be very expensive to substitute for products sold in one individual country. Hence, savings made from deductions in Sweden will not have any major impact on substitution. Another explanation might be that no alternative substitutes exist.

## 6.2 Tax deductions

Whether substitution of FRs have been made or not, is also reflected in the interviewees' answers on the question whether any changes in tax deductions have been noticed since 2017. Among the companies who answered that substitution has been made, the majority of these companies have additionally noticed changes in tax deductions, which strengthens that substitution has occurred. However, as expressed by several companies, more deductions have mainly been possible due to increased available documentation and not necessarily due to actual substitution.

As can be seen in figure 3, section 5.3, not even half of the companies who have paid tax have declared at least one tax deduction. One logical reason behind this is that more substitution has not been possible and that products without deductions still contain hazardous FRs. Another underlying reason, that seems to have great influence, is lack of or insufficient documentation. As previously mentioned, knowledge about FRs in products is far from comprehensive for all companies. And even in cases where knowledge exists, lack of documentation may raise uncertainties that make it difficult for companies to declare tax deductions. This might seem strange, that equally many companies have expressed that they do not always have knowledge about their product contents as companies who have expressed that they always have full knowledge. Potential reasons for this difference could lie in the perception of what full knowledge is. For some companies, full knowledge may refer to what tax deduction that is possible, while to another company it may refer to what chemicals are included on a substance level. It may further be explained by a potential unwillingness among certain suppliers to disclose full information. It seems like the majority of the companies with expressed full knowledge manage their own brand. Other relations could not be identified, and more data is needed to validate these types of relations and to reach a conclusion of why the knowledge differs so widely.

Furthermore, according to the interviewed companies, the share of 90% tax deductions is small, and far from all companies make 90% deductions. This is further strengthened by the numbers from the Swedish Tax Agency, which illustrates that fewer unique actors had declared at least one 90% deduction compared to at least 50% deduction. However, the fact that at least one 90% deduction has been declared, does not say how many deductions per actor that have been made. One underlying reason to that seemingly few actors make 90% deductions, may be because it is difficult to substitute targeted FRs. Either because, as mentioned in section 6.1, it is too expensive or that no substitutes are available. Another reason might be that several products or components contain PVC plastics, which contains chlorine. Even though the chlorine is not used as an FR in PVC, taxable products containing PVC are still subject for taxation. According to the companies, there exist no suitable alternatives to PVC, thus there is no possibility for deductions for products containing PVC.

### **6.3 Administrative cost related to the tax on chemicals in certain electronics**

As can be seen in table 5, the tax adds administration for most companies, although the stated time required to administer the tax varies considerably. These estimations need to be put in context in order to be evaluated. The variations may be natural since it is believed that required time varies depending on several factors such as company size, number of products handled and number of persons administering the tax. It seems logical that larger companies with more products require more time to administer the tax compared to smaller companies. However, such a pattern cannot be seen by the authors and the time required seems therefore to depend on other factors as well. It may further be the case that the more tax deductions made; the more administration follows. However, the authors cannot see any pattern in estimated time required for administration versus how much deductions that are made. So, whether 3 or 80 hours per

month for a specific company, is “a lot” or not, is difficult to say. But the inquiry estimated that the administration the tax would require varies from 2 to 24 hours per month. For some of the interviewed companies, the time seems to match what the inquiry estimated, for others is the administrative burden significantly higher. One underlying reason for this could be, that the administrative burden is raised as a significant negative effect by the majority of companies. It could be the case that the negative view of the tax influences the perception of how much administrative burden the tax has generated. Another reason might be that the inquiry missed to include the work companies experienced in the initial phase when the tax was implemented. Moreover, administration spent on troubleshooting is mentioned by several companies during the interview, something that the inquiry does not take into account, which could explain why some estimated numbers differ.

Since the tax has resulted in only some substitution, one can question whether the costs caused by tax administration overweighs the positive effects. The authors of this thesis have only been investigating the companies’ perspectives, the social benefits generated by the tax is therefore not included. Hence, to evaluate whether the administrative cost outweighs the positive effects, the social benefits need to be evaluated and taken into account.

## **6.4 Companies’ opinions about the tax on chemicals in certain electronics**

According to the majority of the companies, an EU regulation is believed to have a greater impact on FRs substitution. This is additionally strengthened by EU regulations, such as RoHS and REACH, being expressed as a driver for substitution of hazardous FRs. Given that the Swedish tax only has resulted in small changes, there is reason to believe that regulation at EU level would have generated greater impact on the process of phasing out hazardous FRs. However, further inclusion of hazardous FRs in EU regulations requires, as mentioned in section 3.2, extensive work and even if Sweden pushes for it, there is no guarantee that these substances will be included. Therefore, it seems unlikely that relying on EU regulations only would achieve a reduction in hazardous FRs faster than the present tax. However, the authors believe that the present tax should not hinder Sweden to push for inclusion of hazardous FRs within the EU since a combination of price-type and quantity-type policy instruments may be preferable in order to reduce the use of hazardous FRs. Additionally, by leading the way in Sweden, there is a possibility that the tax could raise debate on a higher level, so an EU regulation is introduced faster.

As described in section 2.2, commonly raised criticism towards the tax are reduced sale and lost jobs. It is interesting to notice that reduced sale and lost jobs are solely mentioned by two and one company respectively. The reason behind this could be that the tax has not led to significant lost jobs or reduced sales. However, it should be mentioned that causal relationships are difficult for companies to evaluate, since reduced sales and lost jobs may occur as a result of a variety of reasons. It is therefore difficult to say whether the tax has led to either of these two consequences. This may further explain why not more companies have mentioned this as a negative effect.

Although several companies have mentioned that the environmental aim of the tax on chemicals in certain electronics is good, they experience the tax as unnecessary complex and questions whether it is a suitable measure to reach the environmental goal or not. However, one might keep in mind that there is a risk for lobbying among the interviewed companies. Since the majority of the companies have expressed a negative view of the tax, there is reason to believe that they might emphasise the perceived negative effects. Noticeable is that substitution of FRs seems not to be perceived as a positive effect caused by the tax. Only one company mentions both that substitution has been made and that substitution is a positive effect by the tax. It seems therefore to exist a common perception among the companies, that substitution is not a positive outcome from the tax. One might question why this is the case since several companies have expressed that the environmental purpose of the tax is good. One reason could be that the substitution made is yet too small to be perceived as something good or that the negative experienced effects overshadow the positive ones. This perception may have influenced the companies' expressed perspectives of the tax.

## 6.5 Study limitations

To be able to answer how successful the tax has been, there is a need to evaluate if the environmental aim is reached and if it was reached to the lowest possible cost for the society. In this study, only the company perspective was investigated, and this study can therefore not solely answer whether the tax has been a successful policy instrument or not for the purpose of reducing hazardous FRs. The results from this study additionally needs to be verified from other perspectives. Therefore, other studies are required such as more statistical analysis of how the tax has affected sales of taxable products.

This study interviewed 13 companies within the white goods and other electronic industry. The study has only included companies in wholesale trade, but other types of companies are also obligated to pay the tax. Since these companies have been difficult to find, the study cannot be said to represent all companies that are tax liable, but merely companies within wholesale trade. The number of interviews conducted might also impact the validity of data, since 668 actors declared the tax in 2019 a larger or different sample group could have resulted in different interview answers. However, the conducted interviews show similarity in the answers given so there are no indications that a different sample group in wholesale trade would lead to different results. Moreover, the companies who chose to participate, might be companies with an interest in the subject. Hence, the study might miss out of companies' perspectives that did not want to participate which could have influenced the result. In addition, there may be a risk of strategic answering by the interviewed companies as a way to influence Swedish tax policy.

There is a potential risk of the researchers not retaining strict to the interview questions, for various reasons, and thus prompt the interviewee to answer in a certain way. To reduce the risk, the researchers used a pre-planned interview template to ensure that the interview questions were asked similarly. There might also be a risk that the researchers start to expect certain answers, based on previously given answers. However, each interview summary was sent to

each interviewee afterwards, in order to reduce this risk. When giving the interview objects the possibility to review the answers, there is a present risk that the interviewee changes his or her initial statement and some valuable data may be lost. This risk was however perceived as low since the interviewees were experienced by the authors to be eager to raise their opinions. The benefits of obtaining accurate answers further outweighed the risk. A majority of the companies did not change any substantial information. Furthermore, all interviews were mainly held in Swedish and the empirical data was therefore translated for the study, which may have affected quotes.

## 6.6 Further research

One topic for further research is to look at whether recycled or remanufactured products are subject for double taxation or not. Even though the legislation implies that exemption from the tax applies if products have previously been taxed, this seems difficult to enforce in practice. Another interesting area for further research is to look at available substitutes and evaluate what impact the alternatives have on the possibility to substitute FRs. A further topic for research could be to evaluate whether the Swedish tax on chemicals in certain electronics have resulted in regrettable substitution or not. Since this concern was raised by a few companies, there seems to exist a risk that regrettable substitution is a possible outcome. Moreover, to investigate why some companies experience that they possess full knowledge about product contents whereas others do not may also be subject for further research. Due to the study's focus on companies within wholesale trade, subject for further research could be to investigate other types of companies that are obligated to pay the tax outside, to better reflect all the companies that pay the tax.

## 7. Conclusion

In this study, the authors performed qualitative interviews with 13 companies to analyse how the Swedish tax on certain electronics has influenced their work with substitution of FRs and how they perceive the effects of the tax. Based on the study the authors conclude that substitution of hazardous FRs has occurred, albeit to a small extent. The main reason behind the substitution is expressed to be the Swedish tax on chemicals in certain electronics. Thus, the authors further conclude that, if the aim of the tax is to reduce the occurrence of hazardous FRs in society, the tax has to some extent reached its environmental purpose. However, more substitution could have been expected, since the tax is expressed as a driver for substitution. Besides the tax, EU legislations are also expressed drivers, together with consumer demand, technical and safety performance and greener products. The authors believe that one reason behind why only some substitution has occurred, stems from asymmetric information between both the companies and their suppliers, but also between the companies and the regulator. Noticeable from the study is that there seems to be a knowledge gap regarding product content for some companies, but not for others. Due to the asymmetric information, the tax rate is believed to not accurately reflect the damage costs caused by hazardous FRs. Thus, the tax seems neither to create enough incentives for substitution nor generate an output effect from the demand side. Further reasons for why not more substitution have been made, stem from that the majority of the interviewed companies experience no or small possibility to influence their product's content. The low possibility to influence may be explained by the perceived challenges for substitution; that Sweden is a too small market to influence global production, high substitution cost and that some of the interviewed companies do not have their own production.

Furthermore, the authors conclude that even though declared tax deductions seems to have increased since the implementation of the tax, there is still few actors that make 90% tax deductions. The main underlying reason for why not more tax deductions can be made is lack of or insufficient documentation. Moreover, the administrative cost experienced by the interviewed companies is concluded to vary greatly. Among the companies that could estimate an approximate time, numbers vary from 3 hours to 80 hours per month. The administrative cost caused by the tax is additionally perceived as a very negative effect. The required time to administer the tax has according to the companies changed since its implementation. However, this is mainly because more time was required in the initial phase. Since then, most of the companies have not experienced any changes.

Based on the conducted interviews, the authors conclude that the main opinions about the tax on chemicals in certain electronics, is that the environmental aim of the tax is good, but this issue ought to be addressed on a higher level in order to achieve a substantial impact. Additionally, raised opinions regards the tax construction. Several companies expressed that the tax is unnecessary complex and that the current construction ought to be considered again. The authors further conclude that it seems to exist a common perception among the companies, that substitution is not a positive effect of the tax. One explanation to this is that the perceived negative effects overshadow the positive ones.

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# Appendix

Appendix lists the interview questions used in this study. The questions were formulated in Swedish but have here been translated into English.

## Opening questions

- Please describe your role in the company
- Which type of actor would you describe your company as? Importer, manufacturer, retailer or several of these?
- Do you operate solely in Sweden or in other countries as well? Within EU or globally?
- In what way are your company affected by the tax on chemicals in certain electronics?
- Does your company pay the tax for your taxable products to the Swedish Tax Agency or is the tax paid for by another company in the supply chain?
- What type of products do your company sell/manufacturer/import that are taxable?
- Where are the products, which are affected by the tax, manufactured or imported from?

## Questions related to the products and flame retardants

- Which flame retardants are mainly used in your products?
  - o Where in the product are the flame retardants being used?
  - o Are different flame retardants used in different products?
  - o Why are these specific flame retardants used?
- Is it your company who adds flame retardants in your products or is it included in parts you buy from suppliers?
- How do you know which flame retardants the product contains to make the right tax deduction?
- If you do not know which flame retardant the product contains, how is the tax paid?
- How is the information regarding the product content made available throughout the production chain?
- Do you label your products with which flame retardants they contain?
  - o Do consumers demand this type of labelling? Do you get questions from consumers regarding flame retardants in electronics?
- Have you changed flame retardants / components with flame retardants since 2017? If so, when?
  - o Why were these changes made?
  - o Has the tax on chemicals in certain electronics had any impact on the use of flame retardants? If so, in what way?

## Questions related to drivers and challenges of substitution

- Are you actively working to find substitution of the flame retardants that are currently used?
  - o If looking for substitutes, what is the main driver for you? What criteria do you have when looking for alternatives?

- In what way are you looking for substitute to your currently used flame retardants? Are you only looking flame retardants that are part of a lower tax category or other alternative solutions?
- If not, what hinder substitution?
- Do you consider that you have knowledge of alternative flame retardants?
- How do you search for information regarding alternative flame retardants and update your knowledge around the subject?
- What costs do you have if you want to substitute flame retardants / products / components? Can substitution be a cost saving measure?

#### **Questions related to administration of the tax**

- How much time would you estimate you are spending on the entire tax process and how has it changed during the period 2017-2020?
- Who is in charge of this process?
- For what percentage of your taxable products do you pay full tax? And what percentage of 50% deduction and 90% deduction?
  - When paying full tax, why is deduction not made?
  - Since there are different deductions that can be made, have you noticed that any deductions have changed since 2017? Please exemplify.
- What share of the consumer price constitutes of the tax? Please exemplify.
- Does the tax reduce the margin on some products, or is it only charged as a mark-up for the customer?
- What is your opinion about the tax being based on the product weight? Is this fair?
- Is there any follow up that the company have pay the correct tax?
- Do you experience that your company can influence the content in the products?

#### **Finishing questions about the tax**

- What is your opinion about the tax?
- Is taxation a good mean to phase out hazardous flame retardants or would you have preferred another way, if so, how?
- Have you experienced any positive effects since the tax was implemented?
- Have you experienced any negative effects since the tax was implemented?
- Would it be ok to contact you again?
- Is it ok to mention in our report that we have been in contact with you and your company?

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