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Taxes on fossil fuels

- an incentive for FDI within the biofuel industry?

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Titel: Skatter på fossila bränslen – ett incitament för ökad FDI inom biobränsleindustrin?

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Sammanfattning

Efterfrågan på biobränslen har ökat de 30 senaste åren och under samma tidsperiod har oljepriset stigit. I den här uppsatsen har vi undersökt i vilken utsträckning skatter på fossila bränslen har påverkat efterfrågan på biobränslen under tidsperioden 1970 till 2003. Vi har granskat de fem, i Sverige, mest frekvent förekommande fossila bränslena. En hög korrelation mellan höjda skatter och en ökad efterfrågan skulle leda till en större marknad för biobränslen och därmed göra Sverige mer attraktivt för utländska investerare inom denna bransch. Resultatet visar på trender som indikerar att höga skatter blir mer effektiva ju fler adekvata alternativ som finns tillgängliga. Dessvärre visar många av våra resultat ej signifikanta värden varpå inga säkra slutsatser kan dras.

Bachelor Thesis in Economics

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Abstract

The demand for biofuels has increased over the last 30 years and at the same time period the price of oil has risen. In this thesis we have investigated the impact that taxes on fossil fuels had on the demand for biofuels between 1970 and 2003. We have looked at five different fossil fuels; the chosen fuels are the most frequently used. A large impact would lead to an increase in the biofuel market in Sweden and therefore make Sweden a more attractive alternative for foreign investors. The result might indicate trends towards the conclusion that high taxes gets more effective the larger the biofuel market becomes, this since adequate substitutes for fossil fuels are required. Unfortunately, most of our results show insignificant results and therefore no strong conclusions can be drawn.

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1 Introduction

The purpose of this thesis is to analyse the impact of different taxes on fossil fuels on the demand for biofuels. Then if an increase in these tax rates can lead to an increase in Foreign Direct Investment, FDI within the sector of biofuels. All investigations will be made with focus on Sweden. The definition of demand for biofuels will throughout this thesis be biofuels consumed.

The price of oil is steadily increasing and has now reached a price level where alternatives to fossil fuels can no longer be ignored by economic agents. Together with the strong pressure from the environmental lobbyists to reduce carbon dioxide emissions, which has been a political issue for a long time, this provides strong incentives to develop substitutes for fossil-fuels such as bio fuels. Since the Swedish government now faces both economic and political stress to do so, they have started the process of transforming the Swedish energy industry towards more environmentally friendly energy production with renewable fuels. The pressure that they are facing is partly due to the Kyoto Protocol, which was approved in December 1997. The protocol is an important step in fighting global warming, especially since it includes quantifiable and cogent goals to combat the greenhouse effect. To accomplish this, significant steps towards the ambition of the Kyoto protocol need to be taken by both the government and by private investors.

A discussion of the implementation of green energy sources first requires a definition of what is meant by biofuels. Biofuels can be thought of as the fuel from the process of converting organic matter into combustible fuel. Examples are biogas where waste is used to produce energy and different products from the forest such as sawdust and bark.

The government plays an important role in this process since its policies will determine how successful the future transformation of the energy market will be. There are several strategies the government can choose in order to affect the way in which to create and further stimulate the demand for renewable fuels. It is of great importance that the government creates a single national policy that is applicable for the whole of Sweden. As an initial step in this national policy, the government has put pressure on the Swedish municipalities by implementing various tax subsidies and tax incentives to induce them to decrease carbon-dioxide pollution. According to the Swedish minister of the environmental department, Lena Sommestad - 'The green taxes are mostly about reducing the emissions of greenhouse gases. By taxing the discharge of carbon dioxide, firms and individuals have an incentive to choose renewable fuels (Regeringskansliet, 2005). This is crucial because if the change to renewable fuels is to be successful, the whole economy must operate as one market where it is possible for all consumers to choose between fossil fuels and biofuels throughout the entire country.

There are several tools that the government can use to create a demand for biofuels, one of these is carbon taxes. A carbon tax is a tax that is put on fuels that produce carbon-dioxide emissions, when they are combusted. Such taxes can have one of many purposes, for instance to substitute the consumption of fossil fuels to more environmentally-friendly alternatives such as biofuels. During the last 30 years Sweden has significantly increased carbon taxes on fossil fuels and as a result the fuel prices in Sweden are among the highest in the world. (International Energy Agency 2005) One of the aims of this policy has been to make people economise the use of these goods, in order to decrease the emissions of carbon dioxide. Another aim is to increase the investments in environmental technology. As a result of the increase in taxes and increases in the prices of fossil fuels the demand for

biofuels has now increased to a level where people are starting to be more indifferent in their consumption between fossil fuels and biofuels. More environmentally friendly substitutes are available which has led to a reduction in the price.

A problem that should be introduced to this discussion is the inconsistency of the environmental policy in Sweden. Different governments focus on different projects and the environment has got a low priority on the political agenda. This brings insecurity not only for the producers but also for the consumers. Without a single policy it will be difficult to create a sustainable and efficient market, which in turn will lead to insufficient investments from the private sector since they require a large market to make the investments.

The biofuel production sector is a capital intensive industry, so to be able to achieve effective production large scale economic investments must take place. So far the market in Sweden is too weak to be seen as an attractive target for investors, since the demand is insufficient. In this thesis FDI will be the option due to positive externalities that would not occur at the same level with domestic investors. The development of new technology seems to be one important positive externality that will occur among others. Different theories of the optimal host country and incentives to attract FDI will be examined: this is done to give a clearer view of Sweden's role as a host country and what should be done to increase the attractiveness to investors. Two countries that have been successful in creating markets for biofuels are Germany and France. They have large scale productions, competitive and efficient markets that drive the development of biofuels. Due to a report by the 'Invest in Sweden Agency', these countries are considered to be the best suited countries to make the necessary investments in Sweden (ISA 2004). The challenge is to create a market, or a demand for biofuels in Sweden that will make the investors in these countries willing to invest.

Earlier studies by Brännlund (1997) examine the impact that taxes have on fossil fuels. He argues that when the price of fossil fuels increases due to higher carbon dioxide or sulphur taxes, a decrease in the demand for fossil fuels will occur.

In this paper the same subject will be elucidated, here five different taxes are investigated to analyse which of them has the biggest impact on the demand for bio fuels, as opposite to fossil fuels. This increase in demand will lead to the possibility of a larger market for biofuels in Sweden, which in turn will raise the attractiveness for foreign investors. The analysis will be done by using regressions, and graphical analysis. Data received from the Swedish Energy Agency will be used. The data shows the tax rates from 1970 - 2003. A positive correlation between an increase in the taxation of fossil fuels and the demand for biofuels is expected.

The first section, 2.1 looks into different theories of FDI and tax policies to increase attractiveness of a certain host country. Other incentives that the government can use to increase foreign investments to their country is discussed in section 2.1.1. The second part of the theoretical section is concentrating on tax policies and the effect they have on consumers and producers. Green taxes are investigated and the policy in Sweden is in focus.

The policy in Germany will be briefly investigated and compared to the Swedish model in section 3.1.2. In section 3.2 the determinants of the oil price is briefly analysed, since changes in the oil price has a large influence on the demand for biofuels.

In section 4, the data is analysed. Regressions are used followed by a graphical analysis,

to give a clearer view. What will be examined is the influence that taxes on fossil fuels has on the demand for biofuels. The data section is followed by an analysis of the results in section 5. Section 6 concludes.

2 Theoretical Background

This section presents different theories about inflows of FDI and the different incentives that governments can use to attract investors. The key message of the section is the effects taxation has on investors.

2.1 Theory of optimal host country

FDI can be define as “...investment made to acquire a lasting interest in an enterprise operating in an economic environment other than that of the investor, the investor’s purpose being to have an effective voice in the management of the enterprise”. Measuring the effect of FDI in the host country is difficult, since it varies between industries and countries (UNCTC 1992).

A substantial literature on inward FDI and the effect on host countries have recently arisen. The results that can be seen are widely different from each other and no clear sign of convergence on a consensus can be seen. According to Lipsey (2003), it is “...safe to conclude that there is no universal relationship between the ratio of inward FDI flows to GDP and the rate of growth of a country” (p. 297). Despite this, most policy makers have come up with the result that inward FDI is profitable for their country. FDI and host country incentives

“The problem of whether and how to use incentives is among the most important but least heralded issues facing national and regional policymakers throughout the world” (Graham and Krugman 1995). Competition is taking place between countries and regions when it comes to attracting investments. A rapid growth in FDI has taken place during the last decades, with a peak of almost \$1.5 trillion in the year 2000 which implied an increase of nearly 18 per cent since the previous year. FDI investments can come in different forms, of which mergers and acquisitions (M&A) and Greenfield investments are two of the most common. Greenfield investments focus on creating new assets in the host country whereas M&A just shift the ownership of already existing assets (Easson 2004).

Why do countries try to attract foreign investment? The most important answer is to acquire modern technology. Product, process and distribution technology as well as marketing and management skills are included in this concept (Blomström et al. 2000). Normally FDI results in an overall increase in investments, due to the fact that they do not displace domestic investments but may even increase it (Easson 2001).

To attract these investments different kinds of fiscal measures exists such as “rule-based” and monetary incentives. The “rule-based” incentives include measures such as a relaxation in for example work permit rules, restrictions in capital transfers or in worker protection legalisation. Monetary incentives can be divided into two groups; they can be “direct” (financial) or “indirect” (fiscal). The direct incentives can be seen as when the host government is sharing the start-up costs with the firm, training workers or helping providing infra structure. These financial services can be compared to tax exemptions, since they will have the same impact. Normally when a large start-up is involved with large investments both financial and fiscal incentives will be discussed (Easson 2004).

Most of the developed countries want to attract inward FDI, but some sectors of the economy are reserved for domestic or state ownership. The attitude towards inward FDI

has turned to a much more positive attitude lately; since the beginning of the 1980s most countries have developed frameworks to attract investors and to found a positive investment climate. Due to a study from UNCTAD (2001) among 71 countries, 194 out of 208 changes in the legislation of FDI resulted in a more favourable environment for investments. That equals 93 per cent.

Within the European Union most of the countries still offer incentives to increase the attractiveness to investors, despite the rules on state aid¹ and a Code of Conduct on business taxation². In 2000 ECOFIN³ council presented a report where 66 names of tax regimes involved in “harmful taxation” were declared. Out of these 66, 40 countries/regions belonged to the European Union. The only two countries that are members and still escaped the list were Sweden and United Kingdom (Easson 2004).

Financial incentives, like national grants and loans are very limited in Sweden. Different institutions can offer incentives to specified companies that establish in specific areas. For example a transport grant is established for transporting goods longer than 400 kilometres, but to receive this, the company has to have its location in the northern parts of Sweden. A conditional loan on the other hand can be given to firms who are investing in new products or new markets, this is given when they face a big risk. For foreign investors not many special incentives exist, they might receive a subsidy for employing people that is unemployed. Three different kinds of subsidies within employment can be given. The first one is general employment subsidy and can be granted for the employment of an individual that has been registered as unemployed at least 12 months. Half of the wage will be paid with a maximum amount of 350 Swedish kronor per day, for a time period of 6 – 12 months. The second subsidy is reinforced employment subsidy and can apply to a person that has been unemployed or participated in a special program from the employment agency in 24 or 48 months. 75 percent of the wage costs can be granted the first six months and the following 18 months, 25 percent will be paid for. A maximum payment per day exists, also in this subsidy, but differs depending on the period of unemployment. Special employment subsidy is the last one. To be able to receive this one the employer has to meet the requirements for the reinforced subsidy, together with this the employee must be at least 57 years. The payment can continue for 24 months with a subsidy equal to 75 percent of the wage cost (ISA 2003).

What causes foreign firms to invest in one country but not in another? First aspect to look at is why firms invest abroad instead of the domestic market. The most common answer will be to maximise profit. Sometimes differences in the exchange rate might be an incentive, to spread the risk or the fact that the other country has got higher growth prospects. How come then that they choose to invest abroad instead of just trading or licensing their technology to foreign firms? The reasons are that they can be more efficient, get a better access to markets and a better access to resources. According to Reuber (1973) opportunistic investment symbolises a third group of FDI incentives and he

¹ “The prohibition applies to aids that facilitate “certain undertakings or the production of certain goods”- that is to say, to selective provisions – and clearly includes within its scope special tax provisions” (Easson 2004).

² “The code concerns those measures that affect, or may affect, in a significant way the location of business activity within the Union” (Easson 2004).

³ ECOFIN is an independent group of companies that works within banking and finance, pensions, investment consulting and financial planning for private investors.

refers to it as “government-initiated investment” which is when the government in the host-country decides about the investment project, such as big infrastructure project like building a bridge.

When a firm invests in another country, sometimes only one alternative exists and then the decision is straightforward. These are the factors that are important for all kinds of investment if the firm has several different alternatives:

- Economic and political stability
- Adequate physical, business and legal infrastructure
- Absence of bureaucratic obstacles
- Adequate communications
- Appropriately skilled labour force
- The ability to repatriate profits freely
- The availability of an adequate dispute resolution mechanism (Easson 2004)

When the location for the investment is determined the size of the market is more important than the size of the population. Table 2.1 shows the leading recipients of FDI, both population and GDP are ranked.

Table 2.1, Leading recipients of FDI

Country	Average FDI, 1996-2000 \$billion	Ranking (population)	Ranking (GDP)
1.USA	187 676	3	1
2.UK	68 324	20	4
3.Germany	55 028	12	3
4.Bel/Lux ⁴	51 115	70	18
5.China	41 825	1	6
6.France	33 468	21	5
7.Netherlands	32 567	56	15
8.Canada	26 444	34	8
9.Hong Kong	25 129	94	24
10.Brazil	24 526	5	9
11.Sweden	23 580	81	20
12.Spain	16 174	29	11
13.Mexico	12 186	11	10
14.Argentina	11 738	31	16
15.Ireland	9 529	125	38

Note: Population rankings are for the year 2000.
Source: UNCTAD; World Bank.

⁴ Belgium/ Luxembourg

What can be seen in Table 2.2 is that it is important to have a large market measured in GDP. To be a member in a large customs union or a common market is also an important factor. By looking at the average of FDI that a country receives one can see how successful this country is, which can be seen in the *World Investment Report 2001*(UNCTAD 2001).

Flows of FDI in relation to GDP are, in Table 2.2, measured together with the share of exports and also the share of employment. By looking at the score of a country according to the investigation a country that received 1.0 has inward FDI exactly in the right proportion of the size of the economy, higher than 1.0 indicate the over-achievers while those below has got a lower share of inward FDI than expected (Easson 2004).

Table 2.2, Inward FDI index

Top 10 performers (1998-2000)	
1.Belgium/Luxemburg	13.8
2.Hong Kong	5.9
3.Angola	5.1
4.Ireland	5.1
5.Malta	4.6
6.Sweden	4.1
7.Netherlands	3.3
8.Azerbaijan	3.1
9.Nicaragua	3.1
10.Bolivia	3.0

Source: Easson 2004

Notice that the results might have been very different in another time period. In this Table the United States, who is the leading country when it comes to receiving FDI end up as number 74 out of 140 countries (Easson 2004). By looking at the ratio of FDI to GDP Sweden showed a rate of 8.2 per cent in a recent survey, this compared to Germany with 2.7 per cent (Finfact 2005).

2.2 The importance of tax policies in FDI decisions

The impact of taxation on FDI has been the main subject of a number of studies made during the last 30 years and with widely different results (Easson 1999). The overall impression does, according to Wilson (1993), suggest that taxation is becoming an increasingly important factor. Holland and Owens (1996), on the other hand, points out the fact that taxation and the tax system are not one of the more important factors in the decision process of FDI. Tax incentives have a negative effect since they create economic distortions. A firm will act in another way than if purely economic considerations were involved (Easson 2004).

Tax systems are becoming more and more sophisticated and are constantly changing and developing in phase with the changes in the economic structure (Bentley 2003). Theoretical studies emphasize the importance of taxation since it influences both profits and production costs. In econometric studies the relation between tax and FDI is mostly inconclusive since many other variables exist that might have an impact on the flows of FDI (Easson 1999). The most efficient system of business income taxation, viewed from an overall economic perspective, would be one in which investments and other business decisions was not influenced by differences in tax rates or type of tax treatments among the world (Musgrave 2002). But since no two countries have the same national tax systems it

does not completely work, even though there are some principles that most countries have adopted, especially within the field of international transactions (Easson 2004). An international tax system does not however exist on an international level. A number of international tax concepts have been taken into use by most countries (Frenkel et al. 1991). A convergence between different national tax systems can be seen over the past 30 years and of the international organisations World Trade Organisation seem to have had the greatest impact on national tax systems. Earlier, the rules from the GATT/WTO⁵ had restrictions on international trade of goods and therefore only had marginal application to foreign investment. In the Uruguay Round, which was concluded in 1994, new agreements were reached who had a greater effect on the use of tax as a form of subsidy (Easson 1999). As mentioned earlier, taxation can be used as a subsidy but it can also take the form of a tariff. What can be difficult to determine is where direct taxes⁶ are used as substitutes for subsidies and tariffs (Bentley 2003).

According to Easson (2004) the tax in the host country giving the largest effect is the taxation on business profits, which can be referred to as “corporate income tax”. Most of the countries have rates between 30 and 40 per cent. Sweden has a rate on 28 per cent (Finfact 2005).

Corporate income taxes do not tell the full story since they do not take differing rules on depreciation, inventory costs and other business expenses into account, neither of financial transaction taxes, sales taxes and other levies on investments. The study of Finfact (2005) has taken all these levies into consideration and has calculated an “effective” corporate tax rate for 36 different countries. Observe that only Manufacturing and Services are taking into account here together with the Average number. In Table 2.3 below the numbers for Germany and Sweden are given.

Table 2.3, Corporations, by country, 2005 (percentages)

	Statutory Corporate	Manufacturing	Services	Average
Germany	38.4	37.7	36.3	36.9
Sweden	28.0	12.8	11.6	12.1

Source: CD Howe Institute

According to CD Howe Institute the tax regime in Germany can be seen as a serious disincentive to capital investments. Sweden is an example of a country that has a gap between the classical, traditional measurement and the “effective” rate given in this study. In Sweden, two-thirds of the GDP comes from government revenues which includes direct taxes, profits from state-owned enterprises together with user fees, which have one of the highest values in the world. Sweden has also a basic corporate tax rate on 28 per cent, but due to a fast depreciation rate for tax purposes, the effective tax rate on capital is only 12.1

⁵ World Trade Organization, the WTO emerged from the General Agreement of Tariffs and Trade (GATT) formally in 1995.

⁶ Direct taxes are taxes that are paid directly in opposite to indirect taxes, such as tariffs and business taxes. Direct taxes include income taxes and property taxes.

per cent. A low value of effective tax rates on capital increases the attractiveness for FDI (Finfact 2005).

A cost that also has a great impact for foreign direct investors is the personal income tax together with social security contributions and payroll taxes; the reason for this is due to the effect that they have got on labour costs (Easson 2004).

The impact that the tax system in the host country has on FDI differs depending on the type of investment, if it is market-oriented or resource-oriented. In the case of market-oriented FDI, the taxation seems to have a minimum impact, unless the host country has a tax with an unusual high burden. What should be taken into account is the fact that taxes incentives in a large scale will be looked upon as “signals” that indicate how receptive a country is to FDI. It is even possible that an absence of tax incentives might be read as a negative signal (Easson 2004).

A sufficient market is important according to Easson (2004) and to receive a larger market within the bio fuel sector the demand for fossil fuels must be reduced. If prices on fossil fuels were increased due to higher taxes on carbon dioxide or sulphur, the demand of fossil fuels decreased (Brännlund 1997).

3 Tax reform

Tax reforms can be an important factor when investment decision will be taken. In Great Britain firms who want to establish receive tax guidance before deciding to invest, so there will be no surprises later. The previous section looked at theories of optimal host countries in this section the tax system and its relationship with FDI will be investigated. At the end of this part Sweden's environmental tax system will be analysed more closely. The tax system in Germany will be looked upon briefly for comparison to Sweden.

3.1 Green tax reforms

Green tax⁷ reform has become one of the more important political issues in countries all over the world in recent years. The Kyoto protocol has forced many countries within the OECD to put more effort into decreasing their emissions of greenhouse gas. An efficient instrument to decrease the emission is taxation, which also generates revenues for the government. Environmental tax reforms are supposed to give incentives for producers and consumers to change their behaviours and to avoid externalities. The change in consumer behaviour refers to the choice that the taxpayers face when they can avoid a tax by choosing a substitute good instead of the taxed good (EEA 1996).

The Corlett-Hague rule implies that goods with an inelastic demand should have higher tax rates than goods with highly elastic demand. Preferably the good or service that is taxed should be complementary to an untaxed good (Sinn 2005).

Environmental policies have changed the earlier command-policies towards more market-based policies, which give firms incentives to decrease their emissions (Panayotou and Yajun 1999). There are different types of environmental taxes and researchers have classified them into four different groups.

- Effluent and emission taxes - taxes that directly charge according to the quantity and quality of the emissions.
- Product and input taxes - products that contribute to environmental externalities in production or consumption.
- Environmental subsidies – subsidies that encourage more environmentally-friendly and sustainable behaviour.
- Investment tax incentives – taxes that gives incentives for investors to invest in more environmentally technology and equipment (Bosquet 2000, Panayotou and Yajun 1999 and OECD 1997).

These types of taxes have three fundamental functions (EEA 1996). They should first of all cover the costs for the damage that the pollution has caused and the control cost of monitoring the emissions. Secondly, they should create incentives for consumers and producers to behave in an environmentally sustainable way (Hogg 1999). The last function is that environmental taxes increase the tax revenues for the government. In this case the environmental effect is just a side-effect (Ribeiro 1999).

⁷ Other names can be ecological tax reform, environmental fiscal reform, green tax swap and green tax shifting (EC 1997).

A conflict exists between economic efficiency and political viability within the fields of environmental taxes. Governments that use environmental taxes to reach environmental goals need a sufficiently large tax shifting effect. This means that the government must adopt the environmental tax to make a redistribution of the taxation burden. Intuitively as little distributional effects as possible is preferable, an example for this would be if governments redistribute income by using environmental taxes, they may actually reduce the possibility that environmental taxes will indeed be introduced (De Mooij 2000).

The failure of double-dividend⁸ can not be seen as a reason for not imposing environmental taxes; these taxes should be justified on the basis of their positive effects on the environment (De Mooij 2000).

The whole idea of an environmental tax reform is to shift taxes from labor and capital to the users of natural resources who then pay the cost of the environment externality that they cause (EC 1997). Many of the taxes that are normally used by governments are distortionary taxes that have a negative effect on individuals' willingness to work, save and invest and have positive effects on things like leisure and consumption. Instead of having distortionary effects, environmental taxes have a corrective effect. This means that instead of giving incentives for behavior that are costly for society, environmental taxes gives incentives that encourage manners that counteracts costly social behavior (Panayoutou and Yajun 1999).

One can argue that the green taxes are a good instrument to direct the prices and at the same time the consumers can be directed away from a high use of fossil fuels (Svenska Naturskyddsföreningen 2005).

According to OECD (1997) environmental taxation has little impact on the location of the production. OECD has not been able to observe any evidence that firms would relocate to "pollution havens" and therefore environmental taxes should not be seen as an issue when firms decide where to locate.

Increased taxes are generally not welcomed by tax payers since a higher tax automatically decreases real income. Therefore when environmental taxes are being introduced, taxes in other areas, for example income taxes and value added taxes, are often reduced. The idea that one tax is reduced because an environmental tax is introduced is known as "neutral revenue policy". This is the most common policy even though departures from this have occurred in some countries (EC 1997, Panayoutou and Yajun 1999). The effects on welfare that occur from a revenue neutral green tax reform can be looked upon in three different parts: revenue recycling effect, environmental benefits and a tax interaction. The first two effects are positive and the last one has a negative effect (Brännlund 1997).

It is often difficult to measure how effective environmental taxes are. The main effect that an environmental tax should have is a positive environmental effect. This means that if it is effective it should change the behavior of producers and consumers. But it should also have an economic effect i.e. the tax should cover the costs of the externality related to the consumption or production of a taxed good (EEA 1996 and Ribeiro 1999). The effectiveness of an environmental tax depends on several factors. Most important is how the tax is related to the externality. According to Pearce (2000) the tax should be related as

⁸ Profit from both better environment and higher tax revenues.

closely as possible to the externality to get the most effective result. He has listed different kinds of taxes to show their efficiency.

1. Taxing the polluted emission is the most efficient way of taxing an externality since it gives incentives to the producer to produce with more environmentally friendly techniques or inputs.
2. The government can also choose to put a tax on a special input (e.g. coal to generate electricity) to create incentives to change to other fuels, such as wind power.
3. One can also put a tax on products that create externalities so that the demand for the product declines (Pearce 2000).

A high tax on petrol might in the short run have a larger effect on certain groups, such as rural dwellers (Pearson and Smith 1990). Over a longer period this might lead to a change in the pattern of location (Smith 1995).

When taxes on products are paid by consumers there is a significant risk that the tax will have a higher impact on households with lower income than on the households with higher incomes. This is the case when a tax is put on the product itself instead of the product that damages the environment (Pearce 2000). When this occurs, the tax is said to have a regressive effect and should be avoided if possible (OECD 1997). However, if some groups are exempted from the tax it will not be as effective as without exemptions (Pearce 2000 and OECD 1997).

When taxes on energy are included as a part of private consumption, the short run effect, considered from a fiscal perspective, may be very efficient. If the objective for the tax is to reach a specific environmental target it should be clear that an ambitious target requires large changes to the corresponding taxes (Brännlund 1997).

3.1.1 Environmental taxes in Sweden

The wide use of fossil fuels in our society and in the economy is clearly affecting the environment. These effects are of importance for society, not only because of the climate changes that it contributes to but also due to other costs that arise when a society is dependant on fossil fuels, such as other environmental externalities (Brännlund and Kriström, 1997). The Swedish Minister for Sustainable Development, Mona Sahlin wrote in a debate article in the Swedish newspaper Dagens Nyheter that Sweden is aiming to be the first country in the world not to be dependent on oil and fossil fuels. In the article she says that this will be done before 2020 and will take place with help from different kinds of incentives such as support for R&D within renewable fuels and more efficient energy use. It will also be done with help from tax-cuts for conversion from oil to renewable fuels. (Sahlin 2005)

Environmental taxes are considered as a durable means of controlling and directing the development. Selective purchase taxes have been used as means of control in the Swedish government for a long time. Already in the 1920s the license of vehicle and the selective purchase tax on petrol were introduced and then in the 1950s the energy tax and the tax on electricity were introduced in the Swedish market. These taxes were introduced purely to improve the finances of the government. Later in the 1970s and 1980s selective purchase taxes on energy and fuels started to be motivated also for environmental and energy policy reasons. An example of taxation used to achieve political targets is that diesel used for

heating is taxed less than diesel used for transports and also the fact that some pilot projects intended to develop more environmental friendly fuels are excluded from the energy tax. The energy taxes are also an important income source for the government; in 1998 the income that it brought to the government was roughly 37 milliards SEK (SCB 2000).

The first time energy taxes were introduced as environmental taxes was in 1986 when the government established a tax differentiation between unleaded and regular premium petrol. This was the beginning of a series of new environmental taxes, which included a sulfur tax on coal and oil and a carbon dioxide tax on fossil fuels (Brännlund and Kriström 1997). One Swedish tax that had a large impact was the sulphur tax which was implemented in 1991. The tax led to a reduction of sulphur in fuel oils with approximately 40 percent under the legal levels (OECD 1997, EEA 1996). In the middle of the 1990s the debate about the so called green taxes began in Sweden. The purpose of the green taxes is, as mentioned earlier, to shift taxes from labour to consumption of environmentally unfriendly goods, mostly taxes on carbon dioxide emissions and electricity (Ghalwash, 2004).

Brännlund (1997) has investigated the effect that taxes on fossil fuels have on the demand for fossil fuels. He concludes that an increase in the price of fossil fuels caused by taxes, leads to a decrease in the demand for fossil fuels, hence the industry reacted in the way that was expected.. The effects in the short-run are expected to be small which implies that with further increases in the carbon dioxide tax we cannot expect any larger effects on the environment.

In 1995 the Swedish Green Tax Commission was launched. This indicates two things. Firstly it showed an increase in the interest for environmental improvement in Sweden and secondly, taxes might be a cost efficient economic policy instrument to reach environmental goals. The commission raised the question of the possibility of achieving a second dividend through an improved environment together with an improvement in the allocation of resources. So to clarify their idea they wanted to tax “bad” things, such as emissions, to a higher extent compared with “good” things (Brännlund 1997). The main point for the Commission was to keep all tax changes revenue-neutral, i.e. an increase in tax revenues due to new green taxes had to be compensated by a reduction in some other tax. They do not want to earmark the revenues given by green taxes but suggest that each dollar should be used where the highest utility can be reached (Brännlund 1997). In Sweden and Finland a revenue-negative policy has been used. This means that when an environmental tax is implemented, no other taxes are reduced. (Park and Pezzey, 1999)

The energy policy in Sweden combines a large influence from the government with a sensible use of market forces. For example by having high energy tax rates to form patterns for consumers and producers and at the same time one of the world’s most liberalised electricity markets. What has to be resolved in Sweden is the future of the nuclear plants that in year 2003 provided approximately 32 percent. The government must work to find a solution that is credible (OECD.org).

Fees for non-environmental friendly vehicles have been introduced in Stockholm city as an incentive by the government to increase the demand for biofuels. In January 2005 a decision was made so that environmental friendly cars have free parking and they do not have to pay the fee to enter the city, this together with lower tax have increased the demand for these cars, which gives the suppliers an incentive to produce more (Svenska bilindustriföreningen 2005). Until September this year, 5300 environmental friendly cars

were sold in Sweden, an increase with 900 cars compared with the same time last year (Dagens Nyheter 2005).

3.1.2 Environmental taxes in Germany

Germany was the first country to introduce literature that was dealing with the integration of tax policies and environmental effects. This happened at the same time as the Green Party (Die Grüne) got a major role in the German politics in the 1980s. All this gave Germany an outstanding role of new environmental policies, in the European Community. In 1992 an international agreement on the Global Convention on Climate Change was signed in Rio. The agreement was to reduce the emissions of greenhouse gases to 1990s level by year 2000. Germany decided to reach a more restrictive goal of 25 per cent, which equalled the emissions of the year 1987, by the year 2005. As a step towards this goal a carbon/energy tax was introduced in 1991. Fossil fuels were taxed with two components, one related to their energy content and the other to their carbon content (Smith 1995).

In 1999 the green tax policy was extended with a tax of electricity, fuel and heating. Germany has an income neutral tax reform, unlike Sweden where the social costs are lowered at the same time as the energy costs increase (Svenska Naturskyddsföreningen 2005).

This is explained by looking at the goal for the German government of "environmental modernization", which is to protect natural resources and in the same time promote employment and a sustainable economic growth. The environmental tax reform is a central policy used to achieve this goal since an increase in the price of oil, electricity and gas, will change the demand for energy sources. The revenue resulting from the green taxes is used more or less entirely to lower and stabilise the non wage labour costs. In April 1999 an increase in oil taxes took place on:

- Motor fuels, 3.07 cents per litre
- Heating oil, 2.05 cents per litre
- Natural gas, 0.164 cent per kilowatt hour
- Liquid petroleum gas by 12.78 euros per 1000 kilograms
- Introduction of electricity tax with a regular tax rate of 1.02 cents per kilowatt hour

The next steps in the environmental tax reform were taken in year 2003.

- Increase in the tax rates of fossil fuels
 - natural gas (for heating)
 - light petroleum gas (for heating)
 - heavy fuel oil
- Increase in the tax rate of electricity (German Embassy 2005).

Germany has a goal to phase out the use of nuclear plants by year 2025. This makes it natural for Germany to put focus on developing domestic fuels and renewable energy. According to the national policy a level of 12.5 per cent of generated electricity should be from renewable energy by year 2010 (IEA 2002).

3.2 Determinants of the oil price

Energy policy in Sweden is to a large extent influenced by the fluctuations in the oil price, which started after the oil crisis in the 1970's. The change in energy policy after these crises was to make Sweden less dependent on oil. This was done through investments in nuclear power together with excise taxes on oil (Brännlund 1997).

But the factors that have the highest impact on the oil price in most countries are the taxes on oil. In Sweden the price that consumers pay for gasoline is mainly tax, approximately 70 per cent, which is normal compared with other countries in Europe (Svenska Petroleuminstitutet 2005).

In Sweden oil or petrol is charged with three different taxes, energy tax, carbon dioxide tax and a value added tax (VAT). The energy tax and the carbon dioxide tax are constant and are added to the gasoline price. The energy tax is added with 2.94 SEK per litre and the carbon dioxide tax is added with 1.77 SEK per litre. On top of this VAT is added at a rate of 25 per cent. The same principle goes for other fossil fuels such as diesel (Svenska Petroleuminstitutet 2005).

4 Empirical Analysis

In this chapter we empirically analyze whether there is a connection between high taxes on fossil fuels and an increased demand for biofuels i.e. biofuels consumed in Sweden. This is done by using a regression analysis. Before the regression analysis comes an introduction that gives an over viewing picture of trends and relationships between taxes on fossil fuels and how the demand for biofuels have changed in the examined time period.

In Figure 4-1 the energy supply from biofuels and crude oil between 1970 and 2003 is plotted. From the diagram it is possible to see that the energy supply from crude oil has decreased during this time period with approximately 40 percent from 350 TWh to 210 TWh per annum. That is a notable decline since the total demand for energy sources increased from 457 TWh to 624 TWh during this period. In other words, the demand for crude oil declined even though the total demand for energy increased.

Conversely to the decrease in the supply of crude oil, the diagram also shows that the supply of biofuels has increased under the same period from 43 TWh to 103 TWh per annum. That is an increase of 139 per cent and biofuels have now become an energy source that substantially contributes to the total energy supply in Sweden.

Figure 4-1 shows a trend indicating that oil is getting less important for the total energy supply in Sweden. However, oil is still the most important energy source from which many industries get their energy supply.

As stated earlier in the theory section, the ambition for the Swedish government is to be the first country in the world not to be dependent on oil and fossil fuels. This is supposed to be accomplished by the year 2020 (Sahlin 2005).

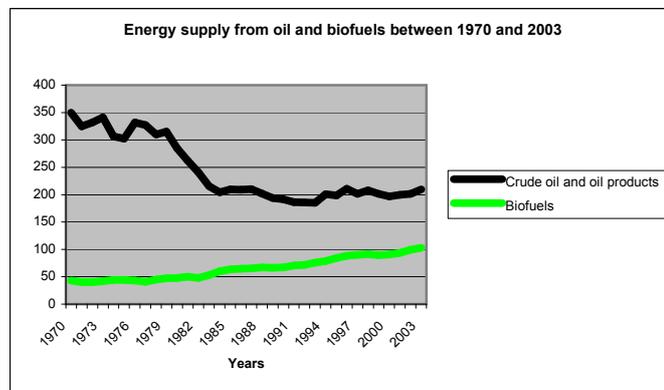


Figure 4-1 Source: Swedish Energy Agency

Figure 4-2 and 4-3, on the following page give an indication of how important the role of oil in the total energy supply was in the beginning of the 1970s and how alternative fuels have developed over the last 30 years. From almost being the only source for energy supply, oil has now become one large source among several others since alternatives have developed. In 1970, oil contributed with more than 75 percent of the total energy supply and was indisputably the most important source for energy. But in the late 1970s, OPEC drastically decreased the supply of oil, which led to an excess demand for oil and in turn a sharp increase in the oil price and the oil crisis was a fact. The oil crisis with its high prices brought severe changes on the energy markets all over the world and many other energy sources were developed.

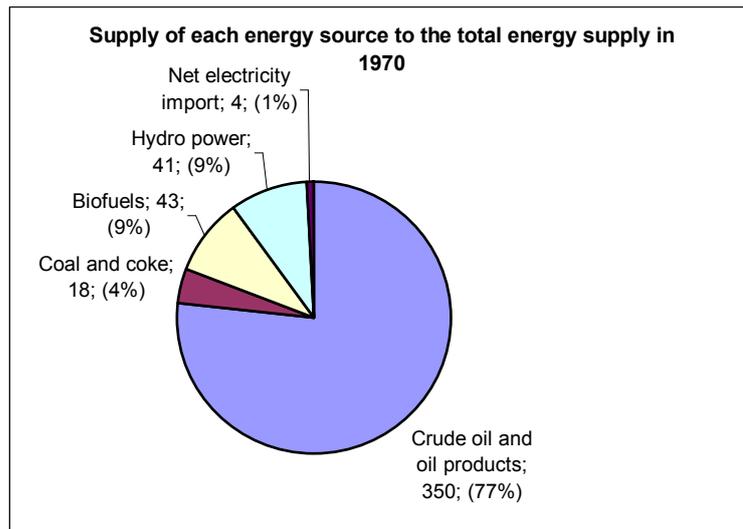


Figure 4-2 Source: Swedish Energy Agency

The energy market was turbulent between 1970 and 2003 and several factors have influenced the development of the market. In 1970 the oil share to the total energy supply was approximately 77 percent, which is shown in Figure 4-2. In 2003 the share that the oil contributed to the total energy supply with had changed to 34 percent which is a significant decrease, visualised in Figure 4-3.

Under the same period the share that biofuels contributes with has increased from 9 per cent to 17 per cent of the total energy supply in Sweden and is today the largest “clean” energy source. Disregarding the energy received from nuclear power which is not to be seen as an environmentally friendly energy source even though its discharge not affecting the pollutions from carbon dioxide.

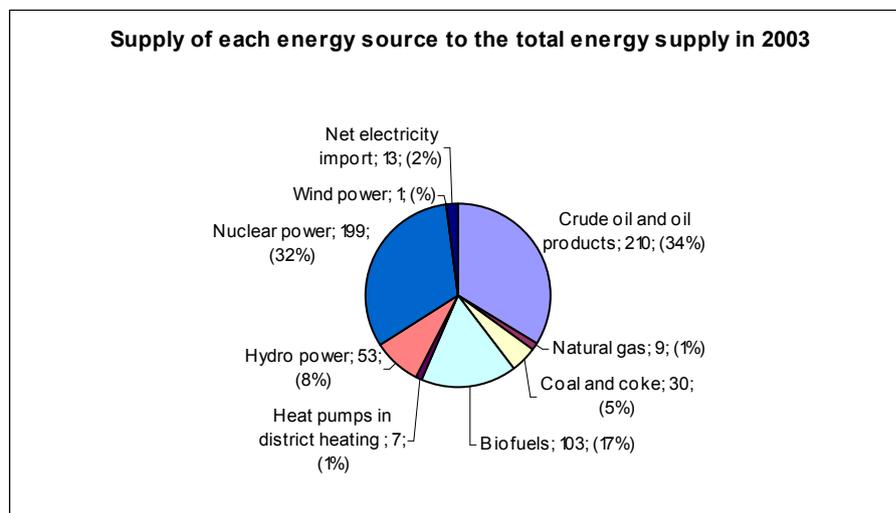


Figure 4-3 Source: Swedish Energy Agency

The oil crisis is not the only reason for the sharp increase in oil prices. During the 1980s, the government implemented several tax policies on fossil fuels in order to achieve an environmentally friendly policy.

In Figure 4-4 the prices for fuel prices with and without taxes are shown, taxes have a very large impact on the fuel price. In 2003 is the cost of one barrel of fuel 86.4 dollars, out of that is 52.1 dollars tax. As mentioned earlier in the theory section, the final fuel price that the consumer pays includes three different taxes, energy tax, carbon dioxide tax and a value added tax. The former ones are constant and the third one is added as a percentage to the price including taxes. All together the tax is approximately 70 percent of the final price.

The price that is shown in the Figure 4-4 is the price on premium petrol with and without taxes. The reason that this is shown only on premium fuel is to show an example on the high impact that taxes has on fossil fuels. The ratio is approximately the same on other fuels such as unleaded petrol.

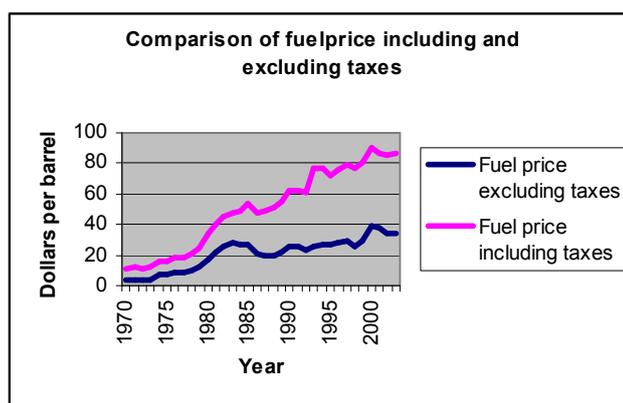


Figure 4-4 Source: Swedish Energy Agency

The beginning of this section was made to give an overall picture of the energy development from 1970 to 2003, before dealing with the regression analysis, which follows in the next section.

4.1 Regression analysis

The theoretical framework showed that an environmental tax will change the behavior of the consumer and the producer, if it is effective. To see if this has been the case in Sweden, regressions between different variables such as green taxes and the demand for biofuel have been done. The focus will be on what different factors influence the demand for biofuel as well as looking at which specific factor has the largest impact.

The variables that will be used in the regression analysis are the real oil price, Gas oil, Medium heavy fuel, petrol premium diesel oil under a the time period 1970 to 2003. Gas oil and medium heavy fuel are both fuels that are used for heating. Petrol premium and diesel oil both are fuels that are used as fuel for motor vehicles.

A logarithmic function will be used to achieve the percentage effect and the elasticities. Taxes are assumed to have a time lag on the influence on bio fuel demand.

$$\text{LOG}(X_t) = \beta_1 + \beta_2[\text{LOG}(x_{t-1})] + \dots + \beta_3[\text{LOG}(y_{t-1})] + \beta_4[\text{LOG}(z_{t-1})] + \beta_5[\text{LOG}(q_{t-1})] + \varepsilon_t \quad (1)$$

The model is estimated on a time-series analysis on annual data for the period 1970 to 2003. This time-period was chosen because of lack of data before 1970. We are expecting

to receive positive values on the coefficients since an increase in a specific tax should, according to Brännlund (1997) lead to an increase in the demand of biofuel.

Regression 1

The first regression investigates the impact that the real oil price has got on the demand for biofuels in Sweden over the last 30 years. The dependent variable is demand for biofuel.

Table 4.1 Effect of real oil price

Variable	B	Std. Error	t-value	Sig.
Real Oilprice	3,8839	5, 9851	0, 6489	0,5212
Dependent variable: Biofuel		R ₂ = 0, 0134		
Number of observations = 33		Adj. R ₂ = -0,0184		
Durbin Watson = 0, 0252				

With a t-value as low as 0.64, the real oil price itself does not seem to be of importance for the demand for biofuels. (This view is also supported by a p-value of 0.52, which is also insignificant) R-squared shows how much of the change in the biofuels that is explained by the real oil price and a value of 0.013 is very low.

Figure 4- 5 shows the negative relationship between the real oil price and the demand for biofuels. The real oil price is the price given with today's value i.e. adjusted to inflation. Important is that the taxes are not included, here it can clearly be seen that the real oil price has decreased over time periods. As the graph states a negative relationship, a decrease in the real oil price gives an increase in the biofuel demand. By studying this diagram together with the regression analysis, one can draw the conclusion that the real oil price itself has no considerable effect on the demand of biofuel. This implies that the demand of biofuels is dependent on other variables more than the real oil price.

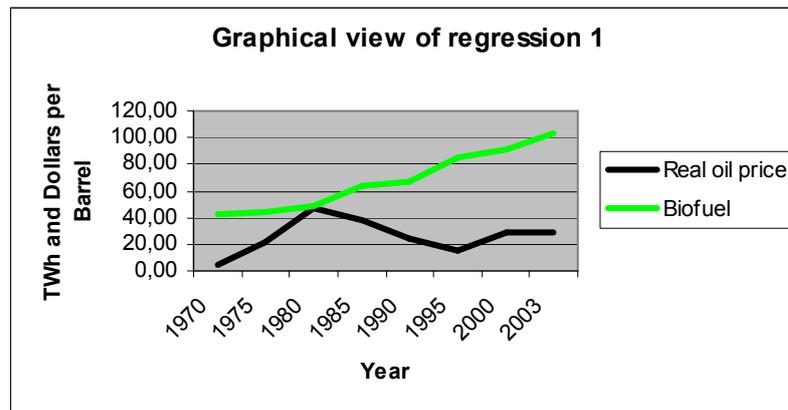


Figure 4-5

As stated earlier in the theory section taxes are a major part of the price that consumers as well as producers face (Svenska Petroleum Institutet 2005). Therefore it comes natural to continue the study towards taxes and their impact.

Regression 2

The second regression investigates the impact that the tax rates of different fossil fuels have on the demand for biofuels over the last 30 years. The dependent variable is demand for biofuel. We found the following estimated equation (t-values in parentheses):

$$\text{LOG}(X_t) = -12.96675 + 44,5653 [\text{LOG}(\text{Taxrate M-H fuel}_{t-1})] + \epsilon_t \quad (2)$$

(3,0138)

Table 4.2 Effect of tax rates

Variable	B	Std.	t-value	Sig.
Taxrate Gasoil	-20.1627	17,2613	-1.1681	0,2526
Taxrate M-H fuel	44,5653	14,7871	3,0138	0,0054
Taxrate petrol	-3.3324	15,9282	-0.2092	0,8358
Taxrate Diesel oil	2,5254	3,9506	0,6392	0,5279
Dependent variable: Biofuel			R ₂ = 0,8637	
Number of observations = 33			Adj. R ₂ = 0,8443	
Durbin – Watson = 0,6481				

First we investigated how taxes influence the demand for biofuel. By looking at the coefficients we can see the elasticities for each tax. Only the variable of medium heavy fuel shows significance, with a t-value of 3.0138. The variable has an elasticity of 44.5653, which indicates that an increase of one unit in the tax rate on medium heavy fuel would lead to an approximately increase in the demand for biofuels with 44.56 units. The other explanatory variables are insignificant.

Durbin- Watson show a value of 0.648096 which can be seen as low since the optimal value are supposed to be 2. A low value can indicate existence of a first order error autocorrelation. An autocorrelation is a correlation of the value that a variable shows with the values of the same variables when it is lagged one, two, three or more time periods back.

A value of 0.86 for R-squared indicates that 86 percent of the change in demand for biofuels is explained by the independent variables in our model.

Tax rates have not constantly increased over the time period chosen in this study. Adjustments have been done several times in order to prevent an ineffective price level from an economic as well as environmentally perspective. According to Brännlund (1997) a further increase in the carbon dioxide tax will not lead to any positive environmental effects, in the short-run. This implies that adjustments in the tax rate must be made in order to suit an optimal level on the price of fuel. When the government does not have a tax neutral policy, like the case is in Sweden, higher costs for the society in terms of lower real income will occur (EC 1997, Panayoutou & Yajun 1999).

The tax on medium heavy fuels was the only variable with a positive elasticity and a significant t-value. This can be due to indulgence in our model. Since neither the oil price or the taxes individually seems to be significant as determinants for the demand for biofuels, the most suitable way of finding a relation will be to look at the prices on fuels including taxes. This makes sense since that is the price that consumers actually face.

Regression 3

Since regression 2 does not indicate that tax rates alone have a strong influence, regression 3 is extended to include prices of different fossil fuels including taxes. This extension is made since the tax rates have been adjusted to the oil price over the years in order to prevent distortionary effects for both the society and the industry. This can be shown in Figure 4-6, where the tax rate on diesel oil is reduced due to an increase in the oil price. The tax rate is adjusted to changes in the oil price.

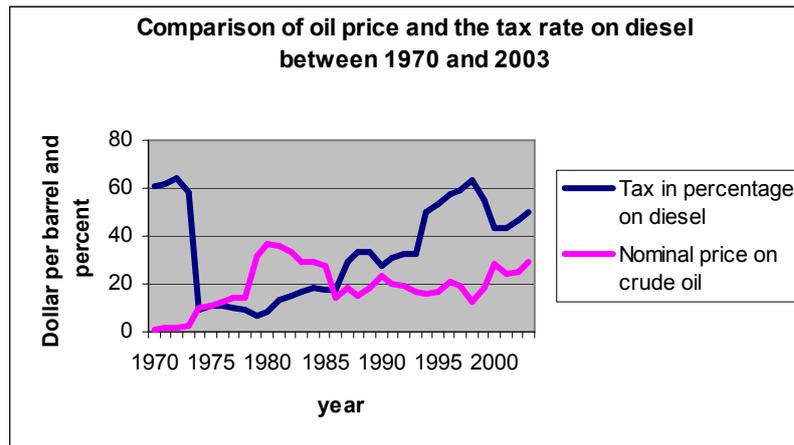


Figure 4-6

Source: Swedish Energy Agency

The following estimated equation was found (t-values in parentheses):

$$\text{LOG}(X_t) = -88.35860 + 48.0815 [\text{LOG}(\text{Price on Gasoil inc. tax}_{t-1})] + 12.9406 [\text{LOG}(\text{Price on M-H fuel inc tax}_{t-1})] + \varepsilon_t \quad (2,3644) \quad (2,0818) \quad (3)$$

Table 4.3 Effect of fuel prices including taxes

Variable	B	Std. Error	t-value	Sig.
Price on Gasoil inc. tax	48.0815	20.3353	2.3644	0.0252
Price on M-H fuel inc tax	12.9406	6.2161	2.0818	0.0466
Price on petrol premium inc. tax	-8.7729	20.6072	-0.4257	0.6736
Price of Unleaded Petrol inc tax	-15.8982	18.0068	0.8821	0.3848
Price on Diesel oil inc. tax				
Dependent variable: Biofuel		R ₂ = 0,8992		
Number of observations = 33		Adj. R ₂ = 0,8848		
Durbin – Watson = 0,502				

Two independent variables, petrol premium and diesel oil, are significant with t-values of 2.36 and 2.081 respectively which are ≥ 2 together with P-values ≤ 0.05 . The elasticities for these two variables give values of 48.08 and 12.94 which are positive as expected. This indicates that an increase of the price of premium fuel by one unit would lead to an increase in the demand for biofuel with 48.08. R-squared has a value of 0.8992, so the independent values explain approximately 90 per cent of the change in the dependent variable, here the demand for biofuel. A larger value than given in regression 2, which

indicates that the prices including taxes, indicates a better model, compared with only the tax rates.

There is a risk that the relationship between prices including taxes and the demand for biofuels is a spurious relationship that only has time as a combining factor. To find out whether there is a spurious relationship the data have been changed in regression 4, so that instead of showing real terms it shows the percentage change between each observation and time period. When using this data in the same regression model as we can exclude the risk that the significant results calculated in regression 3, is results affected by autocorrelation.

Regression 4

The regression below is done with the same model as in regression 3 but with the data transformed so that it shows the percentage change between each observation and time period.

Table 4.4 Effect of fuel prices including taxes (percentage change)

Variable	B	Std. Error	t-value	Sig.
Price on Gasoil inc. tax	0,0156	0. 0084	1. 859	0. 0927
Price on M-H fuel inc tax	-0.0281	0. 0271	-1.038168	0.3236
Price on petrol premium inc.	-0.0075	0. 0109	-0. 6906	0. 5056
Price on Diesel oil inc. tax	0,0184	0. 0197	0. 9372	0. 3708
Dependent variable: Biofuel		R ₂ = 0,2958		
Number of observations = 33		Adj. R ₂ = 0,0142		
Durbin – Watson = 3, 2394				

In regression 4, none of the variables are significant. Both R-squared and adjusted R-squared show low values. This does not support our hypothesis and theory since a positive relation between taxes on fossil fuels and demand for biofuels was expected.

By looking at the four regressions surprisingly few variables show significant values. According to us, the reason for this could be weaknesses in the model such as wrong time perspective. Taxes might have a longer implementation time and therefore larger impact in the long run. This leads to difficulties to further investigate the problem in this paper due to lack of observations. With a longer time period including more data, a more statistically reliable result can be seen.

Another factor that might influence our result might be the absence of adequate substitutes for fossil fuels such as biofuels. Bio energy has increased rapidly in the last 20 years, which also implies an increased effect of the green taxes.

5 Conclusions

The purpose of this thesis is to analyse the impact that different taxes on fossil fuels have on the demand for biofuels. Then investigate if an increase in these tax rates can lead to an increase in Foreign Direct Investments within the field of biofuels.

The environmental taxes on fossil fuels are classified as product and input taxes, which mean that they contribute to environmental externalities, both in production and consumption. According to OECD, environmental taxation does not affect the firms' decision on where to locate the production. This implies that a high environmental tax in Sweden does not affect the attractiveness of FDI. We even think that higher environmental taxes could increase the interest of investing in the biofuel industry in Sweden, since the potential of the biofuel market would increase. As stated earlier in the theory section; the size of the market and the economy is more important for FDI than the size of the population. This can be seen in Table 2.2 where Sweden is one of the top 10 performers when it comes to inward FDI. When looking at possible increases that might occur within FDI, Greenfield investment is the one that seems to be the most suitable for the biofuel industry. This since investors put focus on creating new assets in the host country, instead of shifting ownership of already existing resources. In this case foreign investments are desirable to increase modern technology.

Incentives to attract foreign investors are not commonly used in Sweden. This despite the fact that both financial and fiscal incentives are normally involved when large investments take place. The fact that Sweden does not normally have any tax incentives for FDI, might even be seen as a negative signal for investors. We therefore draw the conclusion that Sweden should implement some kind of tax incentive only to give a positive impression. Germany is a good example of a country with a tax neutral policy that has been successful in their transformation towards more environmentally friendly energy sources. The case of Germany could be looked upon as a role model where Sweden could benefit through a decrease on the tax pressure, as well as becoming more attractive for foreign investors. The environment will not be influenced in a negative way by such an action, rather in a opposite way since it might even encourage the population to act more environmentally friendly.

The regression analysis in this study does not allow us to draw any conclusions about our hypothesis. However, by looking at trends graphically presented in the empirical section, a positive relation between prices on fossil fuels and the demand for biofuels can be observed. This gives strength to our hypothesis; an increase in taxes on fossil fuels might be seen as an indirect incentive for foreign investors to invest in Sweden. A high price on fossil fuels leads to a higher demand for biofuels, which in turn increases the market potential for biofuels. We therefore believe that taxes on fossil fuels can be seen as an indirect incentive for FDI within the biofuel industry.

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