Lund University International Master's Programme in Environmental Science

Freight Transport and the Environment. Environmental Impact of Increased Transportation due to Product Price Differences

Master's Thesis

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Abstract

The scope of this thesis is the relationship between trade, freight transport and the environment. The freight transport has been growing steadily during the last decades due to trade liberalisation and continuous economic growth. The main hypothesis for this study is that the product price differences induce the unnecessary transport flows. The theoretical overview comes to the result that trade liberalisation is inducing the higher transport flows. The transport distances have been increasing after the removal of trade barriers and the modal shift occurs towards the sea in the freight transport in general and towards the road on land transport. The technological improvements help to mitigate the environmental stress from the transport but cannot offset the impact of the growth. The systematic analysis concludes that the price differences create the extra transport flows because although Swedish customers are fairly aware of environmental matters, they are still influenced by the prices in their purchase decisions, especially when they have relatively low income. Case study carried out gave the evidence that transporting the imported Coca-Cola puts more stress on the environment than transporting locally produced Coca-Cola.

Keywords: *freight transport, price differences, environmental costs, trade liberalisation, transport policy*

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The List of Abbreviations

CAP	Common Agricultural Policy
CLD	Causal Loop Diagram
CO	Carbon monoxide
CO_2	Carbon dioxide
CTP	Common Transport Policy
EEA	European Environment Agency
EC	European Commission
EPA	Environmental Protection Agency
EU	European Union
GATT	The General Agreement on Tariffs and Trade
HC	Hydrocarbons
LCA	Life Cycle Analysis
NO_X	Nitrogen oxides
NTM	Nätverket för Transporter och Miljön (The Network for Transport and the Environment).
OECD	Organisation for Economic Co-operation and Development
PM	Particulate Matter
SEK	Swedish Krona
SJ	Swedish State Railways
SO_2	Sulphur dioxide
VAT	Value Added Tax
WTA	Willingness-to-accept
WTP	Willingness-to-pay

1 Introduction

Freight transport in Europe increased by 55 percent between 1980 and 1998. The main reasons for this increase are globalisation, trade liberalisation, specialisation of production, customer preferences and decreasing transport costs (European Environment Agency, 2001). The growth rate for freight transport is currently estimated to be around 2,3 percent per year. Statistics show that each 1 percent of GDP growth is accompanied by a 0.9 percent increase in freight transport, demonstrating the direct correlation between economic and transport growth.

Transport contributes to a considerable amount of harmful emissions, which cause the problems that become costly to the environment and society. External costs of transport account for eight percent of the GDP in European Union (EU) countries and 35 percent of these costs are from freight transport (EEA, 2001). In fact, air pollution is the leading problem created by transport. The emissions cause severe effects on the environment and society, such as climate change, acidification, tropospheric ozone, negative health and genetic effects, and over-nutrition of soils and water (Alvarsson and Andersson, 1995). The transport sector contributes to 30 percent of the CO_2 emissions in OECD countries. Freight transport accounts for 32 percent of transport-emitted CO_2, whereas passenger transport accounts for 48 percent. The share of freight transport emissions is however increasing (Weaver, 1998). Transport also contributes to other kinds of air pollution, such as emissions of nitrogen oxides (NO_x), sulphur dioxide (SO_2), carbon monoxide (CO), particulate matter (PM), and hydrocarbons (HC). The effects of transport emissions on the environment are further analysed and described by many authors (Alvarsson and Andersson, 1995; OECD, 2000; van Noort, 1991), but will not be dealt with further in this study.

Although transport creates several serious problems in the EU, it has not been placed under common regulation. The Treaty of Rome defined three main policy areas: agriculture (Common Agricultural Policy, CAP), commerce (single market) and transport (Common Transport Policy, CTP). Although the Treaty of Rome gave each of these policy areas the same importance, they were from the beginning handled inconsistently, without equal examination and prioritisation within the three areas. The treaty provided no clear plans concerning what should be achieved in the CTP, nor in what timeframe (Ross, 1999). The CAP and single market policy were developed quickly and were constantly in the political agenda, whereas CTP did not get much attention until the 1980's. The politicians began to focus more on transport issues, especially at the end of 1980's when environmental concerns became more obvious and gained more importance.

In 1992 the white paper on the new common transport policy, which is based on new approach examining transport as an integrated system, not just individual modes, was approved by the EU (European Commission, 2001a). Another white paper for transport was worked out in 2001 in order to improve future common transport issues in the EU and to make transport sector more sustainable (EC, 2001c).

Transport policies usually engage much effort in regulating the passenger transport because it creates a number of problems in cities and is the fastest growing area. Freight transport however, has not received so much attention. The main reason is that the share of environmental impacts from private cars is greater than from the freight transport. For

example, 60 percent of energy in the transport sector is used by passenger transport, and only 40 percent by freight transport (Weaver, 1998). Nonetheless, freight transport has been growing faster than passenger transport during the last decades, although the total vehicle kilometres attributed to freight transport is lower than for passenger transport (OECD, 2001a). Furthermore, the growth of freight transport is expected to be closely linked to economic growth for the following decades (EEA, 2001). Therefore, freight transport issues should be handled to a higher degree in the policies in order to focus more thoroughly on the sustainability of freight transport.

1.1 The research problem

The initial research idea for this thesis was the comparison of the environmental impacts caused by the imported goods and locally manufactured Coca-Cola drink products; to uncover the type of transportation that is used to import these products and then estimate the environmental impact from that transport chain. In order to obtain the data it was planned to locate the actual importers, suppliers, transporters, and the modes of transport for these products. However, it was difficult to access the information about the importers of the products and about the actual transportation, therefore the research was obstructed. Finally, it was discovered that Coca-Cola import is often illegal and it is very hard to find good data about the import volumes and transportation means because the people involved were afraid of being discovered (Hleihel, 2001). In a study interview with Nilsson in Swedish customs it has become obvious that they are aware of the illegal import, but as they do not have the capacity to investigate these issues, they could not provide any further information (Nilsson, 2001a). Eventually, the original research idea was modified and developed into something more feasible.

The point of departure for this thesis is that the price differences in countries can create unnecessary transport volumes and have negative effects on the environment. This occurs especially under the conditions of free trade. The prices in Swedish retail outlets fluctuate to a certain extent, which enables to provide the products with the prices that are also affordable for customer groups with lower wealth. This price level is often accomplished by importing the products from countries where the production costs are lower. At the same time many similar products are also manufactured locally. An example is the Coca-Cola products that are manufactured locally but still imported from Eastern European countries and sold here at a lower price. The shop owners import cheap Coca-Cola drink products from Eastern Europe (Hleihel, 2001) in order to provide the same products as the grocery stores such as ICA and Konsum, but with more competitive prices that attract the customers. However, this kind of import is often done illegally in order to avoid taxes, which enables shop owners to keep the prices down. The share of illegally imported goods for example is estimated to be more than 50 percent in immigrant-owned convenience stores (Knowles, 2001).

The presence of cheap imported products shows that despite the extra transportation costs the products still have lower prices than the local goods, thus the extra volumes of transports are created. At the same time the transport costs do not include the environmental cost, which makes the transport — and therefore imported products — artificially cheaper. Consumers are influenced by the price differences and they buy the cheaper products, which increases the demand for such import and therefore have increasing effects on transport flows that cause harm to the environment.

1.2 Objectives of the study

The objective of the study is to analyse the relationship between trade and environment with the focus on the transport. It is important to understand the relationship between trade and environment in general. That enables to decide whether transport through trade adds weight to the environmental problems or is balanced off by the virtues that trade might have on the environment. Another aspect of the problem is the actuality of the price differences. Are the products imported from other countries really cheaper just because the price tag shows that they are?

In order to reach the objective the following questions are discussed:

- Is free trade good for the environment?
- How does free trade influence transport volumes?
- What is the environmental cost of transportation?
- What is the real price of imported goods?
- What possible solutions and policy measures could be suggested to improve the situation?
- Should there be harmonisation of economies, price levels?

1.3 Methods and methodology

It is important to understand how trade affects the environment in general and what are the implications of free trade on transport and the environment. Scientific texts including journal articles and books are used in order to provide a theoretical understanding and different points of views of the relationship between trade, environment and transport.

With this theoretical knowledge as a basis, a causal loop diagram (CLD) has been created in order to understand the connection and feedbacks between price differences and transport with the help of a systematic approach (Ford, 1999, pp 69-101).

The suggestions of the methods for reducing the environmental impact from transport have been provided as well as the possible policy measures to internalise the transport externalities are provided and the feasibility of these measures is analysed.

In order to provide the example of unnecessary transport and its impacts by estimating the environmental costs of importing Coca-Cola from the Czech Republic to Sweden the case study method have been used. Different databases for calculating the environmental costs from transport have been analysed in order to give an overview of the possibilities for estimating the transport-induced environmental impact. The empirical data about emissions and fuel consumption are taken from the Schenker and NTM databases and used to calculate the environmental cost of transporting Coca-Cola products.

Finally the results and the potential for harmonisation of environmental standards and price levels are discussed.

1.4 System boundaries

To be able to focus on the objectives set for the study boundaries have been defined. Several factors that are part of the system and have impact on system behaviour have been excluded from the analysis in order to carry out the study within the time limits:

1. The environmental cost of production is not analysed in this study. It can differ in various countries due to disparities in environmental standards, which makes the price differences higher or lower. This study does not go through the entire life-cycle analysis (LCA) but only the analysis of real transport cost.
2. The study examines transport issues and free trade in general, but when it comes to empirical data and policies the main focus is on European and OECD countries.
3. The study considers only the production and trade of soft drink products. It does not discuss other kinds of products. Furthermore, the products under analysis are exactly or essentially the same in all countries. It is important to show that quality issues and particular preferences do not affect the purchase decisions and that transport can be avoided when the prices are equal.
4. In this study only air pollution is considered as an environmental impact of transport. Transport has other effects such as accidents, water pollution, land use and habitat fragmentation, and noise pollution, which have direct or indirect impact on the environment and society. However, these impacts are difficult to quantify and the environmental costs are even harder to estimate. They are no doubt serious problems, but this study deals with the most important and the most severe problem from the transportation and that is air pollution.

2 Theoretical background

2.1 Free trade versus environment

"*Trade has been central to economic thinking since Adam Smith discovered the virtues of specialisation and of the markets that naturally sustain it*" (Bhagwati, 1993). Trade liberalisation has, therefore, been an important international issue since 1947 when negotiations on The General Agreement on Tariffs and Trade (GATT) started. Since then there have been various agreements to liberate and promote equal trade between countries. Based on the ideas that trade supports the economic growth and the development and gives benefits to any country by increasing the income, welfare, and the living standard, it is, however, questionable whether the trade liberalisation actually benefits the environment. Steininger (1995) explains well the main arguments on the free trade versus environment dilemma: from the one side, free trade and opened boarders are harmful for the environment because it induces the growth of resource use and waste and increases pollution. From the other side, free trade and an open economy enable access to cleaner technology and increase the efficiency of production and are hence good for the environment (Steininger, 1995, p 15). There are also other arguments that defend or attack free trade as an important actor causing environmental degradation. The following section provides an overview of the argumentation surrounding the relationship between trade and the environment. The discussion includes the main factors that influence the free trade impact on environment, such as environmental standards in countries, scale, technique, composition and product effect of free trade, technological improvements, property rights, and economic growth.

2.1.1 Trade liberalisation and environmental standards

"Trade liberalization will mitigate local environmental problems in developed countries (North) and magnify the problems in developing countries (South)" (Nordström and Vaughan 1999, pp 29-30). Production is often transferred to developing countries because the prices are lower and transport costs are not high enough to compete with the gain of production costs such as labour, raw material, energy, etc. Furthermore, in developing countries the

environmental standards tend to be lower, which enable industries to avoid the expenses on clean production or environmental taxes. The production is moved into so-called 'pollution havens,' which are in the countries where environmental standards are low and it is therefore cheaper to establish production there (Johnson and Beaulieu, p 36). At the same time, the environment in developed countries is saved since the production is moved away. In other words, free trade is better for the environment only locally not globally because developed countries practically export the environmental problems into developing countries.

An OECD report (2001b) on the other hand claims that environmental taxes do not influence the production to move abroad where the environmental taxes are lower. This is due to the relevant exemptions and rebates for the industries that are established in developed countries in order to avoid production relocations. This however, can lead to the situation that companies, which do not have to pay taxes, have lower incentives to reduce their emissions, whereas when they lose their exemptions and rebates then the urge to move the production to other countries becomes higher.

2.1.2 Scale, technique, composition, and product effect of free trade

In this overview the relations will be described by the scale effect, technique effect, composition or structure effect and product effect. Each of these can lead to positive or negative environmental impacts.

Scale effect is induced by growth and magnifies the economies of scale that bring about the excessive usage of resources as well as higher emissions and waste (Nordström and Vaughan, 1999, p 29). This obviously leads to greater environmental harm and has a negative effect, but there are a few factors that also have positive outcomes on the environment. As income tends to increase due to the scale effect, then the poverty-induced environmental impacts are likely to decrease because of the positive correlation between income increases and concern with environmental matters (OECD, 2001a). There is also more demand from the consumer side for environmentally friendly products and pressure to strengthen the environmental standards when earnings increase.

Although the scale effect has a total negative impact on environment due to increased production, the income-induced environmental standards are stricter and mitigate the overall negative effect. Antweiler, Copeland and Taylor have come to the conclusion in their study (1998) that pollution will become relatively smaller (lower per unit of production) when the production and per capita income increases, which shows that the resource use and emission rates do not grow linearly with the increase of production (Antweiler et al, 1998). This is also expressed by Kuznet's inverted U-curve that indicates that environmental harm from production increases only to a certain point after which the pollution per unit starts to decrease due to higher income (Hussen, 2000, p 145).

Technological improvements can help to remedy the scale effects of free trade by enabling higher efficiency in resource use and lower pollution rates (OECD, 2001a). Reppelin-Hill (1999) came to the result that technology diffuses faster in the economies that have more open trade policy regimes proving the hypothesis that free trade supports the diffusion and adoption of advanced technologies in developing areas. However, even though it is important to open the borders for trade to provide the advanced technology for the industries in order to reduce

the environmental impact from the production, it has to be considered that technology cannot alleviate all the pressures on the environment.

Composition or structural effect is based on Ricardo's comparative advantage theory and focuses on countries' benefits from free trade and specialisation (van Veen-Groot and Nijkamp, 1999). According to this theory each country specialises on the production of the commodities that it has a comparative advantage with (relatively lower production costs) (Suranovic, 1997). In other words, it manufactures the products with the lowest opportunity cost[1]. In that way countries can benefit from trade and specialisation by increasing the efficiency and economies of scale. Countries specialise in certain industries and trade with the rest of the world for the other products rather than produce and provide most of the products locally.

The composition effect increases the production volumes and improves the efficiency in production. The impact on the environment, however, depends on the nature of industry that the country specialises in because capital-intensive industries tend to be more polluting than labour-intensive industries (Nordström and Vaughan 1999, p 31). For example, developed countries have higher environmental impacts because of the specialisation on capital-intensive industries due to higher income in the country. Developing countries have lower environmental impacts due to the specialisation on labour-intensive industries because labour costs are relatively lower in these countries. The global pollution is therefore likely to reduce because highly polluting production (capital-intensive industry) occurs in developed countries, which tend to have stricter environmental standards.

At the same time the strict environmental standards in developed countries increase tax burdens on capital-intensive and more polluting industries and lead to higher relative costs of these industries, which reduce their competitiveness (OECD, 2001b). This might lead to increased exemptions and rebates of taxes in order to strengthen the competitiveness of industries in the developed countries, which would offset the composition effect of free trade.

Environmental stress from economic activities is usually regarded as a result of production, whereas consumption has serious impacts on the environment as well. The product effect of trade is based on consumption while other effects arise from production (van Veen-Groot and Nijkamp, 1999, p 342). Developed countries transfer their production to developing countries so their environment is not exposed to harmful effects of production. Increased production and economic development increases the per capita income and therefore enables higher consumption. With the increased per capita income consumers can consequently afford environmentally sound goods that tend to be more expensive. Therefore, the effect on environment depends on the scale of consumption of environmental friendly products compared to the general increase in consumption. However, the overall trend in developed countries is an extensive over-consumption of the products (OECD, 2001a). This is also influenced by the effective marketing that convinces people that they have needs that they essentially might not have.

[1] Opportunity cost – "*The next best alternative that is given up when a choice is made*" (The Mint, 1999), "*the amount of one product given up to produce one more unit of the other product*" (Suranovic 1997)

2.1.3 Property rights and the environment

Property rights, defined by Hanna (1996, p 17) as "*the bundles of entitlements defining owners rights and duties in the use of resource*", are important determinants whether production in the country is environmental friendly. Well-defined property rights are important prerequisites for market-regulated resource usage and leads to proper and sustainable usage of resources (Hussen, 2000, p 21). In developing countries the property rights are not clearly defined, which leads to hostile usage of resources. So called ill-defined property rights can give the comparative advantage to developing countries and therefore reduce the costs of production compared to the costs in developed countries (Nordström and Vaughan, 1999, p 30). The artificially low resource prices and trade liberalisation attract the investors to establish the production in the developing countries causing the environmental degradation due to resource exploitation as well as pollution.

2.1.4 Economic growth and the environment

It is claimed that sufficient economic growth enables countries to protect their environment (Daly, 1993; Nordström and Vaughan, 1999). Developed countries are good examples of this. Their economic development is better than in developing countries whereas their environmental protection is also more advanced because they have possibilities and finances to give more attention to the environment (Johnson and Beaulieu 1996, p 37-38). At the same time the heavy industry and excessive consumption patterns in developed countries have degraded the environment to the extent that it needs protection, whereas in developing countries the environmental standards are not so high but there is also less pressure on the environment. The developing countries could learn from the developed world and avoid the environmental degradation before it gets so serious that it is difficult to remedy the environmental problems. It should not be so that the environment is destroyed by heavy production to increase income and then there are enough finances to protect it (Daly, 1993).

2.2 The influence of free trade on transport

The relationship between free trade and transport is not a highly analysed issue. The effect of free trade on the environment is mainly given from the production point of view, analysing how production in countries with different development level and environmental standards affect the environment. At the same time, it is a logical conclusion that trade liberalisation, specialisation on production and globalisation induce higher movements of goods, thus leading to higher volumes of transport. However, this link has not been thoroughly analysed in the literature. A few authors have noticed the lack of research in this area and have based their work on the analysis of trade and transport rather than the general trade versus environment approach (Gabel and Roller, 1992; van Veen-Groot and Nijkamp, 1999).

There are several aspects in the discussion on environmental impact of free trade through transportation. Three aspects will be briefly discussed in the following section. First, it is important to know whether and how the transport volumes change after removal of trade barriers. Secondly, since different transport modes have different impacts on the environment, what kind of modal changes occur in the transport sector? Thirdly, what kind of technological changes influence the transport sector?

2.2.1 The effect of free trade on transport flows

In a study by Gabel and Roller (1992) they lend evidence to the argument that trade liberalisation increases the transport flows. The study covers the analysis of the outcome of

trade liberalisation in the EU after trade barriers were removed. Trade with the rest of the world intensified, which means that the trade flows outside the EU increased. The products that were mainly traded within the EU are now traded outside, leading to an increase in the distance that products travel before reaching the target market. Therefore, after the removal of trade barriers not only the volume of trade in units increase, but the transportable products are moved to further distances, which in total causes even greater environmental harm from transport.

2.2.2 Environmental impact from transport

Another aspect concerning trade liberalisation and transportation is the environmental impact from transport. Gabel and Roller came to the conclusion that there has been a modal shift of transport due to trade liberalisation. More goods are transported by sea than by land, which is a positive shift in terms of environmental impacts. Sea transportation enables the simultaneous movement of larger volumes and is therefore a more efficient transport mode. Thus, it is reducing the environmental impact per unit of transported goods due to lower emission rates per unit and higher energy efficiency. On the other hand, there has been a shift in land transportation from rail to road. 80 percent of total tonnes are currently transported by road (EEA, 2001). This increases the environmental impacts from transportation because rail is the most environmentally friendly transport mode for freight transport and is being exchanged for less efficient and more polluting road transport.

Van Veen-Groot and Nijkamp (1999) state in their article that the high flows of transport that are needed due to free trade are more likely to occur through less sustainable modes of transport. The product development trend is moving in the direction where products have less volume but higher value. This leads to the need for fast and reliable transport, which is road transport on a single continent and air transport between continents, both relatively harmful to the environment.

2.2.3 The scale effect in transport sector

The growth of transport due to trade liberalisation also leads to the scale effect in the transport sector (van Veen-Groot and Nijkamp 1999, p 333). The effect on transport costs is the same as in the case of the scale effect in production – the costs decrease. The same outcome follows better fuel efficiency achieved by economies of scale in the transport sector – the fuel prices decrease. The reduction in the cost of transportation due to the scale effects decreases the importance of transport costs and leads to even higher flows of transport.

2.2.4 Technological improvements and transport

Technological changes and improvements have impact on the efficiency and emissions of transport modes. Engines become more efficient, using less fuel as well as emitting less polluting substances. The technological development also affects the fuels that are used in transportation. Engines that use alternative, cleaner and more sustainable fuels, such as bio-fuels, biogas, etc. come to the market and the extensive usage of such technology reduces the consumption of fossil fuels as well. At the same time, technological improvements reduce harmful emissions. Catalytic converters are already used in big trucks in order to reduce the emission of harmful compounds. Many technological changes have already been made that improve the sustainability of transport, and this trend is likely to continue in the future. Even though the technological effect does not decrease the transport flows, it does decrease the environmental impact from transport (van Veen-Groot and Nijkamp, 1999). The problem,

however, is that the transport flows increase faster than the technological improvements, so that the absolute impact on the environment is still negative. The evidence for this is the energy efficiency of freight transport that has not been improved (EEA, 2001).

2.3 Conclusion

The debate between economists and environmentalists about the impact of free trade on the environment has been going on for decades. Yet there is no single answer to the question of whether free trade favours or degrades the environment. Trade liberalisation can be a positive agent for the environment by improving resource allocation, promoting economic growth and increasing general welfare if prices and property rights are set right and effective environmental policies are in place and implemented. However, increased trade also induces increased flows of transport to further distances. However, the scientific evidence for this is still rather weak, and not much effort has been made on analysing the relationship between trade liberalisation and changes in the transport sector. Technological improvements can offset the increasing effect of trade, but if transport volumes continue growing at a rapid pace then the absolute result would lead to environmental degradation and increased problems for the environment and society.

3 The effect of price differences on the trade volumes and transport

The following chapter analyses the hypothesis that was proposed for the current thesis – price differences between countries lead to unnecessarily increased transport flows. The thorough cost structure was worked out in order to allow for a clear overview of all costs that are or should be included in the product price.

3.1 The cost structure

Before analysing the relationship between price differences and transport it is important to evaluate what is constituted in the price of the product and why prices differ from country to country. Figure 1 provides a clear overview of the factors that affect the real price of the product. The real price of the product includes all the costs that are connected to the creation, consumption, transportation or the end of the life of the certain product.

3.1.1 Production costs

Production costs consist of several expenses that are directly and indirectly connected with the creation, production, and selling of the product. Labour and raw material costs are two of the most important costs in production. Labour costs include the costs that are paid for all company employees including even those who are not directly working with the production, such as managers, administrative staff, marketers, etc. Raw material costs include the costs of material and resources that are used in order to produce particular products.

The rate of salaries and resources depends on the development level of the country. In developing countries the raw material and labour prices are low, which gives a competitive advantage for those countries. Developed countries, on the other hand, compete with "*non-price factors such as technology and ideas*" (Shahin, 1999, p 57). Therefore the technological improvements allow the decrease of production costs and lead to lower product prices.

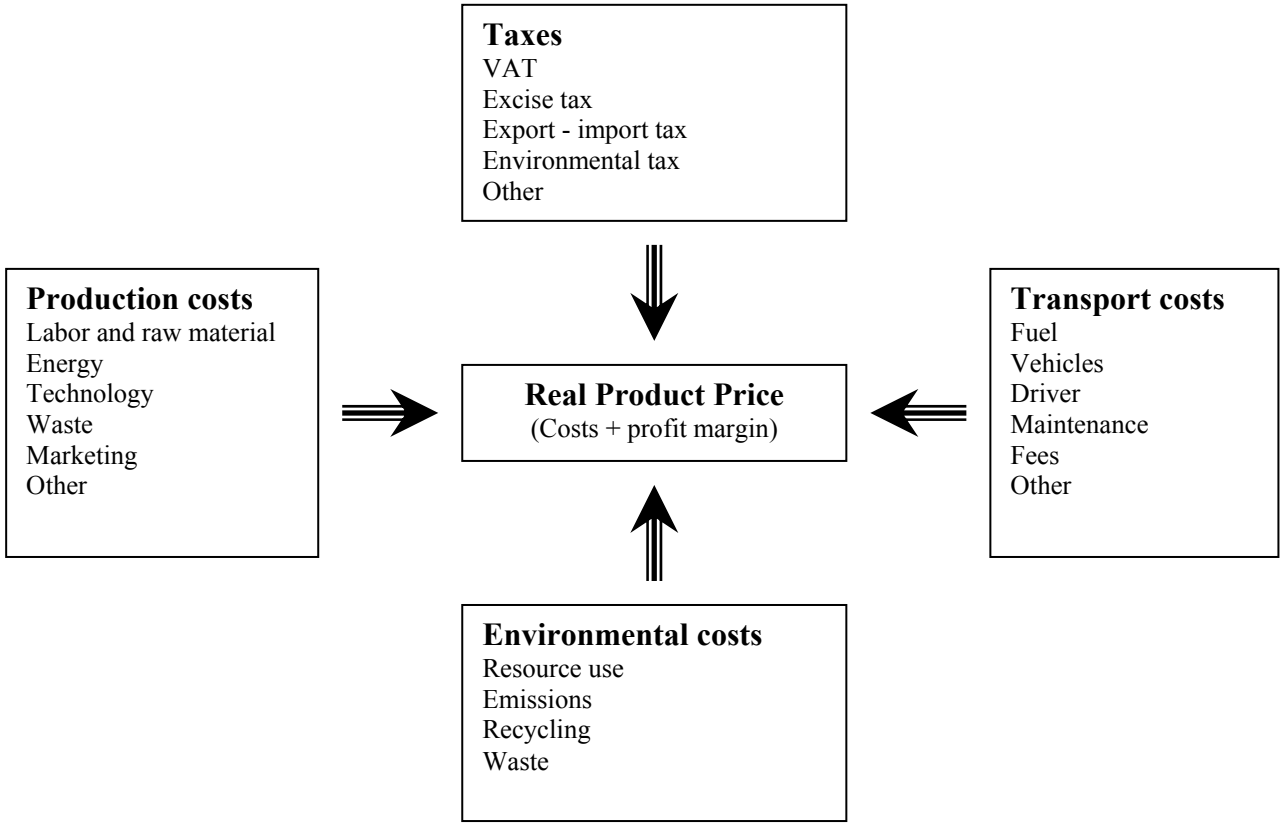

Figure 1 Factors that make up the real price of the product

Labour costs are an important part of the production costs. The low labour costs are also reason for out-sourcing from high labour cost countries i.e. developed countries, which means that part or all of the production is transferred into another country in order to reduce costs. For example, the goods are sent over long distances to add value by repackaging or processing of the products and then sent back to the initial country.

Natural resources can be cheaper in developing countries because of price distortions due to ill-defined property rights and/or government policy. In the first case, the resources do not have any true or well-defined owner, which means that there is a high supply that keeps the prices low. Cheap resources due to government policies exist when the resources are subsidised in order to make industries more competitive. Low prices reduce production costs considerably, but also lead to inefficiency and over exploitation of resources (Munasinghe, 1995).

Energy costs include both the energy that is used in the production and the electricity used in the production, offices, and administration. The energy sector is often government owned and subsidised. The subsidy level is usually higher in developing countries, which creates the price distortions that artificially reduce the production costs and allow for a higher comparative advantage (Munasinghe, 1995). At the same time, subsidies reduce the motivation for energy efficiency, which leads to higher environmental degradation.

Technological investments in production are beneficial because state-of-the-art technology increases the efficiency in production and allows for the economies of scale (Grübler, 1998, pp 195-203), which have a diminutive effect on costs. Technology helps to increase energy efficiency, reduce labour costs when production is automated, and use the resources economically. Therefore, the development level can be the same in two countries but one country has put more emphasis on production technology, which has the final impact on the prices. Implementation of technological changes require capital, therefore the state-of-the-art technology is often implemented in developed countries where it is also required by higher environmental standards. In developing countries the main price determinant is labour and raw material prices, whereas technology is less modern and often imported from developed countries where there is no use for the old technology (OECD, 2001a).

Waste-related and abatement[2] costs are also part of the production costs because often waste is expensive to deposit, especially when it must be treated before it is deposited. Production waste can also be reused or recycled in the production, which adds to the costs but also to the overall benefits that are received on account of lower raw material costs and resource use (look at environmental costs at 3.1.4).

Marketing costs include all the expenses related to product development and sales, such as product development, promotion and advertisement.

Besides the expenses mentioned above there are also other production-related costs, such as administrative costs, office supplies, rent, water, telecommunications, etc., which are known as fixed costs. Water can also be an important part of the production costs, as it is in the pulp and paper industry. However, the cost depends on the water management policy of the country and whether the water is fully priced or subsidised.

Production costs form the main part of the product price because this includes all the expenses that are connected to the companies' activities. They have to cover all the costs that the companies have in their activities, except the costs that are added by the request of the government (taxes), in trade (transport costs), or created externally (environmental costs).

3.1.2 Taxes

Taxes are set by the government in order to finance governmental activities. Most taxes are levied from people's and companies' activities such as income taxes, consumption taxes, etc. in order to collect funds. Other taxes serve regulating purposes, such as environmental taxes. In this section the most important taxes are explained. Governments have set number of other taxes on individuals and companies but handling all of those taxes is beyond the scope of this study.

The Value Added Tax (VAT) is the most common tax on products and is charged on almost all goods and services, including imports (Department of Finance Canada, 2001). It is the specific percentage that companies add onto the price of a product, which means that suppliers do not pay this tax but consumers do. The rate of VAT varies from country to country, whereas various products and services can also have different VAT rates. Excise tax

[2] "*Abatement costs are the costs of reducing the quantity of residuals being emitted into the environment, or of lowering ambient concentrations*" (Field, 1997, p 89).

is also paid by consumers but is usually added only to special and luxury products (gas, alcohol, cigarettes, cars, and luxury products) (Department of Finance Canada, 2001). Other taxes connected to products include taxes that have to be paid by companies during production, such as employment, and income taxes; or during the selling process, such as import and export taxes.

Environmental taxes (so called Pigouvian taxes or green taxes) include charges on greenhouse gases, pollution, emissions, fuel, pesticides, etc. (Turner, Pearce and Bateman, pp 166-167). Generally the environmental taxes are levied on emissions, or products (fuel and other natural resources) in order to protect the environment (OECD, 2001b). The effect of tax rates on product price is stronger when the pollution rate is higher or when highly polluting and harmful substances are used in production. Trash taxes can be established to increase the rate of reuse and recycling (Miller, 1999, p 584). The taxation rates depend on the country's environmental policy – the stricter the environmental standards in the country, the higher the environmental tax rates.

3.1.3 Transport costs

All products have some sort of transportation included in their life cycle. Even when products are manufactured and consumed locally they are still delivered to the customer or the middleman. However, in the case of export and import the transport costs become more significant because the goods are moved further distances and the environmental impacts from this are also higher. Transport cost is formed by direct and indirect costs of transportation, such as fuel, and labour costs, expenses on vehicles, maintenance, road fees, etc.

Fuel forms the most important cost of transportation and depends on the type of fuel that is used and the fuel consumption rate. Cheaper fuels usually lower the transport costs but tend to have higher emission rates and are more harmful on the environment and therefore have higher environmental costs. Fuel consumption in road transport depends on the engine of the truck as well as the state of the truck, driving style, road conditions, weather conditions, etc. The relation of these factors to fuel consumption is further examined in chapter 5.1.

Driver cost is also labour cost because drivers have to be paid for the time they transport the goods. The cost size is also dependent on the development level of the country, as are the labour costs in the production. The cost of vehicles depends on the quality of the vehicles, the age and the technology used in the vehicle (engine, catalytic treatments, telecommunications, etc). The vehicles with higher quality and technology level tend to be more expensive but also have lower impacts on the environment and thus lower the environmental cost. The trucks are expensive but the costs are divided between numerous trips made with the vehicle. With proper maintenance the vehicles have lower environmental impacts as well as longer endurance, which in the long term will bring the costs down. Maintenance expenditures are also added to transport costs.

Fees for roads and bridges increase the transportation costs. Even though the turnpikes are more costly to use for transportation, they have lower environmental impacts because these roads are better maintained and are in better condition than the usual roads (the impact of road conditions are also discussed in chapter 5.1.5).

Trade liberalisation and specialisation inevitably leads to increased transport since the products become cheaper and more competitive in the other market. The transport costs are not high enough to reduce the marginal profits from trade. Transport costs are much smaller compared to the profits from increased economies of scales. This is only possible because the transport costs are artificially low because they do not include the environmental costs. If transport and environmental policies were changed so that transport costs internalised all external costs, then it would not be economically feasible to transport by unsustainable transport mode over long distances.

3.1.4 Environmental costs

Environmental costs, also called external costs or externalities, are losses that society has to bear even though it has not contributed to their creation and sometimes does not even get the benefits from. Field (1997, p 9, 69) defines the externalities as costs that *"are felt by people other than the individuals whose behaviour actually produces them,"* or the cost in the companies' operations that *"while representing the true cost to society, does not show up in the firm's profit-and-loss statement."* The externalities of transportation include loss of fossil fuels, air pollution, noise pollution, acidification, eutrophication, etc.

The damage on the environment caused by externalities can be evaluated and so the environmental cost is calculated. The different ways of calculating the external costs are explained by many authors (Hussen, 2000, pp 288-312; Turner et al, 1994, pp 108-127). Environmental costs are hard to estimate because there are several ways to carry through the evaluation of environment and different methods provide dissimilar results. For example, the result of willingness to pay – willingness to accept approach (WTP–WTA) depends on the people valuing the environment and their priorities and principles can be different, leading to a consensus that does not please everybody. The replacement cost that estimates the cost of restoring or replacing the damaged asset, seems to be a more realistic approach because it can be based on the market prices and is not connected to the personal opinions of citizens.

Resource use

The environmental cost of excessive and unsustainable resource use is connected to its option value - the cost of using the resource now instead of in the future (Turner et al, 1994, p 113). In the case of non-renewable resources, the amount of resources is limited, which means that once it is used it cannot be renewed and used again. If fossil fuels are extracted and used in the production or transport today then they cannot be used after 10 years. The problem is even more serious when the alternative fuels are not so well developed and in use. However, alternative fuels also have an option value, which is related to the production. For example the production of biomass can degrade the soils and increase the environmental costs because the soils cannot be used for cultivation if used over its regenerative capacity. Besides, in the case of ill-defined property rights the owner of the resources is not clearly defined, which leaves the resources open for exploitation by everybody, leading to excessive usage of resources that increases the environmental cost.

Emissions

Air pollution created by emissions can have various external effects on nature and society such as climate change, acidification, eutrophication, health problems, damage to materials, etc. The harm caused by pollution, however, has to be born by nature and society. Nature

suffers quality losses and a decreased renewal capacity, whereas society has to bear the costs of damaged materials, climate change, health problems, and environmental degradation.

Waste
Taking care of waste can be costly but is often not born by the producer. The product should be designed in such a way that at the end of a product's lifecycle, the waste left behind is kept to a minimum. The waste should be reused or recycled as much as possible in order to preserve resources. Reuse is better than recycling since it entices a smaller amount of energy for preparing the product for re-consumption. For example, glass bottles need to be washed and cleaned carefully before reuse, whereas in the case of plastic bottles and aluminium cans the package is melted and then reprocessed into package form again. The latter process, however, is a rather energy-intensive process (Svenska Returpack, 2001). Yet, when the package that is meant to be recycled is just thrown to waste then a loss of resources is suffered and is therefore regarded as environmental cost. The environmental cost is even higher in case of plastic and aluminium or other non-carbonate based packaging. These packages are not biodegradable and it takes a long time for them to decay.

3.1.5 Conclusion

All of the costs mentioned build up the cost of the product. The price is finally formulated when profit margin is added to the cost. Production and transportation costs and taxes are actually included in the price, whereas the environmental costs that should also be part of the price are often excluded. The underlying goal for the private business is increasing income and profit for the company (the higher the profit the more competitive the company). However, the demand for each product is only present at certain price limits, which means that companies cannot add any profit margin when they please. When the price ceiling is reached but the costs are still too high to make a reasonable profit, then companies strive for cost reductions. Costs can be decreased by increasing efficiency or lowering standards (Daly, 1996, p 146). If certain standards are not strictly required by government authorities then companies may increase their profit at the expense of nature and society through increased externalities. The effect of strict environmental policy however can be that local producers find it less profitable and less competitive to produce locally because of the high taxes and requirements (Swedish Ministry of Finance, 1997). Therefore they locate their production facilities into the countries where the costs are lower due to the cheap labour, ill-defined property rights and weak environmental standards (Daly, 1993). In that way some external costs are avoided and profits are increased.

4 Price differences versus imports

The theoretical discussions about free trade, environment, and transport in chapter 2 focused on the general matters such as effects of economic growth, trade liberalisation, environmental standards, property rights, etc on environment, and the effect of trade liberalisation, technological improvements on the transport and transport induced environmental impact. This section attempts to get further into the discussion of trade and transport, namely how do price differences affect transport flows and why. These relationships are analysed through causal loop diagram to express clearly the important links between different factors that affect the system.

In order to decide whether the price differences affect the transport flows the system dissecting the customer decisions is worked out. The CLD expressed in the Figure 2 is based

on two countries – domestic and country X, which is the country that is the potential exporter. The price formulation is the same for both countries because the products are essentially the same, so the system has two sides that are similar. In the middle the decision making process in the domestic country is analysed.

4.1 The price formulation

The price formulation is based on the cost structure analysed in chapter 3.1 where all the costs were thoroughly examined. Therefore, in order to make the system more simple and clear only the main categories are used in the CLD: production costs, transport costs, taxes, and environmental costs. The price formulation is similar for both countries.

The development level of the country has a positive effect on the level of production costs, taxes, and technology level and environmental standards in the country. A high development level leads to an advanced level of technology, costly production, increased taxation and strict environmental standards, which in return has an increasing effect on taxes. A low development level, on the other hand, has an opposite effect on the named factors. Technological improvements contribute to better efficiency and economies of scale, both decreasing the production costs.

The trade barriers i.e. export and import taxes, increase the prices of the imported products. Trade liberalisation, however, has negative effect on trade barriers, which means that free trade keeps the prices of imported products down.

The factor *price of product* is the price that the company asks from the customers after the production. In the case of import the transport costs are added to the price before it is sold to the customers. In order to set the prices right, the environmental costs from the transport should also be added in the transport costs. That means that all the externalities related to the transport are internalised and born by the consumers.

4.2 Decision making process

The decision, which product customers choose (imported or domestic), depends on their environmental awareness and wealth. The shop owners supply their store according to the consumer demand. The demand, however, is determined by the customers' consideration about the environment; whether they take the environmental cost into consideration when they make their purchase decisions. People who care about environment and the impact of their consumption consider the environmental impact of the products that they consume.

4.2.1 Environmental awareness

The level of environmental awareness determines how much consumers take into consideration the environmental cost of the products when they make purchase decisions. If they are highly conscious of environmental impact from their consumption habits then they take account of the full environmental cost including the impact from transporting the products and they would choose the local products that have lower environmental costs. On the other hand if they are not aware of environmental issues and they do not care about the environmental impact of their consumption then they choose according to the price of product. The choice also depends then on whether the environmental costs are included into the price, which would make the choice correct from the environmental point of view. On the

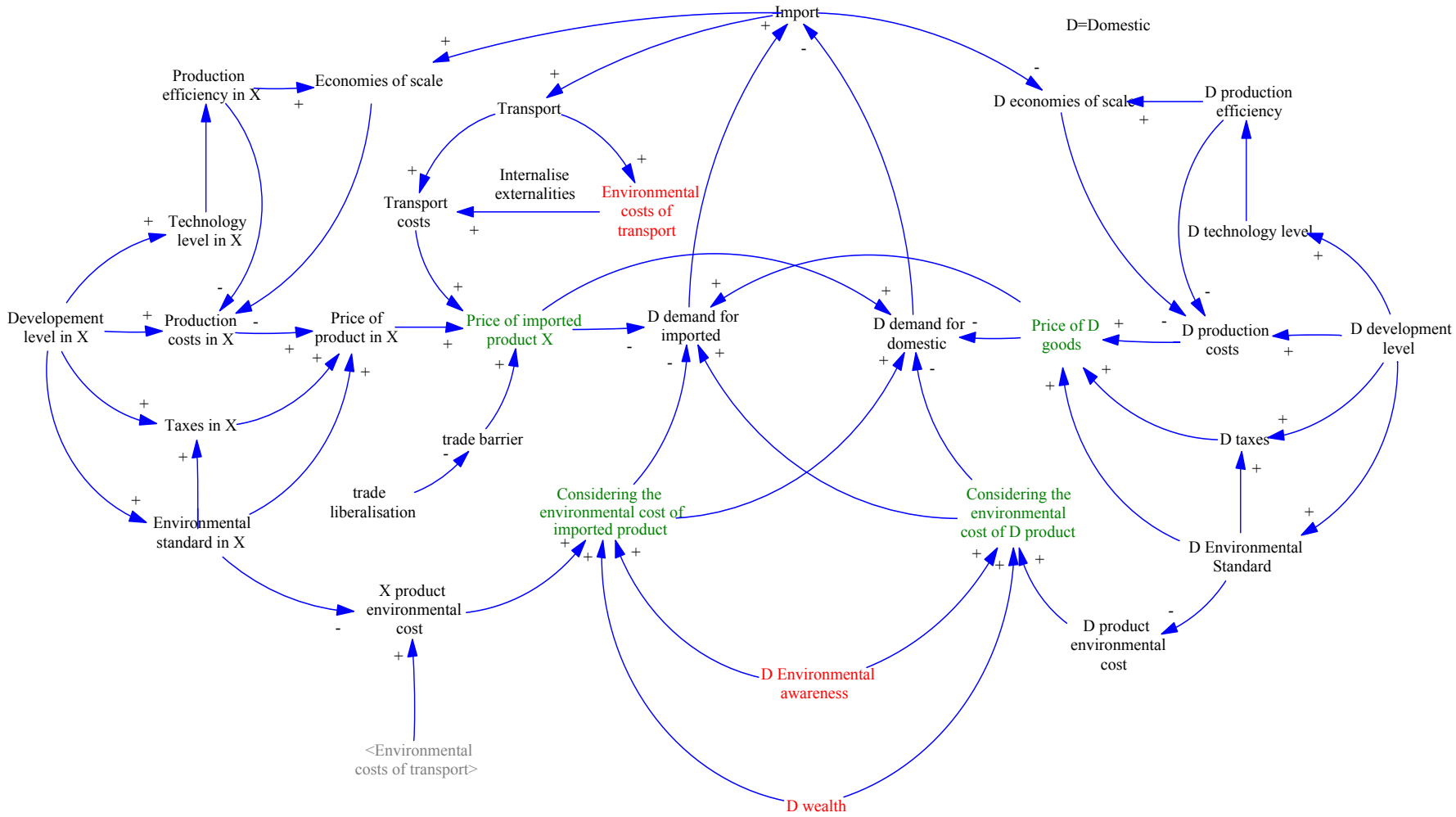

Figure 2 The relationship between prices differences and import flows

other hand if the externalities or transport are not internalised then the price of imported products would probably be lower, which leads to higher consumption of the imported products by environmentally unaware customers. Strict environmental standards and high taxes lead to increased prices of local product. This might also influence the customer preferences towards the imported products that besides having higher impact from transportation can also be produced less environmentally sound way (Swedish Ministry of Finance, 1997).

4.2.2 Wealth

In the case of low wealth the consumers are forced to consider the prices as the most important factor in their purchase decisions. Therefore, they often consider less the environmental impacts of their consumption habits. They base their choice on price differences, which means that cheaper imported goods are preferred by less wealthy consumers. At the same time, the external costs are not included in the transport price, which makes the products cheaper than they really are. However, internalised externalities would set the prices right and then the local goods would be cheaper and the poor customers would purchase local products without being aware of the environmental impact, but still have the environmentally sound consumption habits.

Certain customer groups in Sweden do not or cannot consider environment in their purchasing decisions. These people are usually immigrants but also Swedish originated people who have social problems in terms of low income and insufficient self-support. These people prioritise products that have the lowest price. In case they are unemployed they have enough time to find the cheaper offer in the shops and they have time and motivation to locate the stores that have the lowest prices (Hleihel, 2001). If the shop owners are entrepreneurial enough to supply what their customers demand, they provide products cheaper than the local Swedish and environmentally benign products. The low-price products are often also imported, which increases the environmental impact even more.

4.2.3 Import

The demand for product, either for imported or domestic, determines the import volumes. Considering the environmental cost of domestic product decreases the demand for domestic product and increases the demand for imported product because if domestic environmental cost is taken into consideration then domestic products are relatively less environmentally friendly than imported products. The same logic applies when considering the environmental cost of imported product, which decreases the demand for imported products and increases the demand for domestic products. When both considering the environmental cost of imported product and considering the environmental cost of domestic product are compared then the final demand for imported and domestic products is balanced based on the environmental cost of both products, which determine the rate of considering the environmental costs of both products.

The import volumes have a positive effect on country X's production efficiency and economies of scale because their production grows, whereas the import of product X has the opposite effect on the domestic efficiency and economies of scale. Finally, the import volumes also influence the transport volumes and the environmental cost from transport.

4.2.4 Environmental costs of product and transport

In the countries where the environmental standards are high there is pressure on the companies to change to cleaner and more environmentally sound production. The taxes are established to internalise the externalities from the production and consumption. This leads to a situation where the external environmental cost of the product is lower than in the countries where environmental standards are lower. However, the link between environmental costs and transport costs (the dotted line the Figure 2) is missing or very weak, which leads to unsustainable consumption habits and increased import and transport flows.

4.2.5 Key factors of the system

In order to make the CLD clearer the colours have been added to the diagram. Green colour shows the key factors (price of imported product X, price of D goods, D demand for imported goods, D demand for domestic goods) that determine the level of import, whereas the red factors (environmental costs of transport, considering the environmental cost of domestic product, considering the environmental cost of imported product) are the variables that directly influence the green key factors. The magnitude of the red variables determines the customers' choice. The higher environmental awareness leads to decreased demand for imported products and the lower wealth leads to increased demand for imported products. The size of the environmental cost of transport affects the price (in the case it is internalised) and therefore influences the demand for imported products.

4.3 Conclusion

From the system analysis it can be concluded that price differences can create extra flows of transport. It depends on the environmental awareness of the consumer, customer wealth and the prices. If consumers are highly aware of environmental issues and always prefer the environmentally benign products then they would prefer local products even when the prices of the imported products are lower due to the exclusion of the full environmental cost. In real life, unfortunately, customers are more elastic[3] about their purchase decisions, which means that price differences influence their purchase decisions even when they tend to prefer environmentally friendly products. Besides there are consumers who have income problems and those customers are very sensitive to the price differences and are always attracted to the cheaper products without consideration of the environmental impact of the consumption patterns. Therefore, in order to influence the purchase decisions towards more environmental considerate manner the prices have to include the environmental costs. If then imported products are still cheaper due to high efficiency or economies of scales or other kinds of competitive advantage then the consumption cannot be considered as environmentally harmful.

5 Reducing and internalising the externalities

The transport causes many problems in the society and nature through externalities, such as air pollution. Increasing trend in the transport flows has direct impact on the level of pollution. There are mainly two ways to decrease the impact from transport: first, reduce the transport volumes and flows; secondly, decrease the externalities from transport. The first is challenging measure since it contradicts with the current economic activities but it can be accomplished by the government policy measures; the second is putting more pressure on the

[3] Price elasticity is a measure of the responsiveness of the demand (supply to a change in price. Inelastic demand is when the price increase of X% brings about the reduction of demand less than X% (OECD, 2001a).

companies' action. In the following section the possible measures to decrease the externalities and transport volumes are discussed.

5.1 Methods to reduce externalities

The reduction of externalities require first of all controlling the emissions and fuel consumption of vehicles, which are the main determinants of externalities. It can be accomplished by several methods. Some require external cooperation and higher finances in order to achieve good results (technological solutions, alternative fuels); others are less costly and mostly accomplishable within the company (driving style, good maintenance of vehicles).

5.1.1 Technological solutions

Technological improvements to decrease the emissions and fuel consumption of transport modes include both the advancement of engines and the exhaust control technologies. Changes in the engine design, combustion conditions, and the catalytic after-treatment are the main elements reducing the emissions from engines. The engine technology improves for all transport modes but especially for trucks because that is the market where competition is the toughest so the improvements are the most important in order to stay competitive. There are various new engine technologies that have different qualities, some use more fuel but have significantly lower emissions, and others have lower fuel consumption but less reduction on emissions. The state of the art engines today emit no particulate matter that forms smoke, less NO_X and hydrocarbons, have the efficient fuel consumption, and are less noisy (Faiz, Weaver & Walsh, 1996).

One of the most effective emission control devices is the catalytic converter. The catalytic converters can be used only when the certain type of fuel (unleaded) is used but the results are significant. Depending on the type of catalytic converter it is possible to reduce the emissions of NO_X, hydrocarbons, and carbon monoxide (Faiz, Weaver & Walsh, 1996).

5.1.2 Alternative fuels

Fossil fuels that are currently the main energy carriers for transportation store high amounts of energy content. Fossil fuels are created over millions of years in the earth crust from the decomposed parts of plants and animals (Miller, 1999). Biofuels and biogas are the potential substitute energy carriers for the transportation. Blinge has carried through extensive study (1998) analysing the fuel supply systems in Sweden, including the analysis of different alternative fuels such as biofuels and biogas. The biofuels, such as methanol, ethanol, dimethyl ether, rapeseed methyl ester, etc. and biogas are fuels produced from the biomass and can be used as alternatives for fossil fuels or mixed with fossil fuels in order to reduce the transport emissions. The life-cycle analysis (LCA) approach has been taken to evaluate the real effectiveness of using the alternative fuels in transportation (Blinge, 1998). The conclusion of the research, however, does not favour one single fuel that has the best environmental performance. The results show that when fossil fuels are to be used then gaseous fuels, such as natural gas, and dimethyl ether have fewer emissions than liquid fossil fuels (petrol and diesel). The environmental performance of biofuels, however, depends on the type of energy used in the production process. Currently the fossil fuels are used in the production and that decreases the environmental friendliness of the biofuels.

The problem about biofuels is related to the infrastructure of fuel production and vehicles (Blinge, 1998, p 106). Some types of biofuels require particular types of engines, which are

currently not extensively used, that result in the high prices of the vehicles that use biofuels. The vehicles remain expensive until the sufficient infrastructure of fuel production is available and the demand for biofuel-based vehicles is increased to necessary level.

Biogas and biofuels are the most realistic solutions for decreasing the negative impact from transport. They are already used in reality but are still not widely spread due to high expenses. There are also other possibilities to reduce the fossil fuel usage and emission levels. Technology for using fuel cell and solar cells in the vehicles has also high potential but it still requires further research and there are many obstacles that need to be overcome before they can be commercially spread. The potential and problems of using fuel cells and solar cells in the transport sector is further analysed by other authors (Miller, 1999).

Electric cars are also potential for decreasing the fuel consumption and emissions. The overall impact, however, is possible to evaluate only through LCA method because the environmental impact depends on the electricity production and its impact. There are also many complications that need to be solved before electric cars can be spread commercially.

5.1.3 Driving style

Driving style can significantly influence the fuel consumption and emissions (NTM, 2000). Acceleration and braking require more energy and is therefore more polluting, so smooth driving without sudden accelerations and heavy braking is more environmental friendly driving style. Therefore, it is crucial that companies have appropriate training for their driving personnel. It is equally important that training and education of the drivers is followed up so that it results in the changes in the actual driving style. Emissions are hard to control when drivers are on the road but the fuel consumption can be controlled. The drivers with lower fuel consumption can therefore be rewarded through a remuneration system so that drivers have motivation to use the economical driving style.

5.1.4 Maintenance

A proper maintenance of the trucks is important prerequisite for cleaner transport. It is essential that the trucks' condition is regularly checked to make sure that different parts of the trucks work properly. Factors, such as low air pressure in the tyres, dirty air filter, have a significant effect on emissions (NTM, 2000). The companies can initiate the maintenance of trucks but it can also be required by government. Therefore inspection and maintenance programs for vehicles have been worked out in many countries to ensure the necessary level of maintenance and correct operating of emission controls. These programs involve the regular quality control and the inspection of the vehicles but also the repair and mechanic training in the government level (Faiz, Weaver &Walsh, 1996, pp 127-129).

5.1.5 Other factors

There are several other factors that affect the emission rates such as the type of road, topography, weather conditions, traffic lights and road junctions (NTM, 2000). The fuel consumption and emissions can differ 2-3 times depending on the road type and conditions, whether it is the motorway or city central area, hilly or flat area, straight and wide or curvy and narrow road, which is not easily passable (Blinge & Lumsden, 1996). Therefore, it is important to plan the routes for trucks. Software solutions are better for planning because they enable to take all the factors under consideration. For example, the comparison of the road conditions and the distances covered. It would be easier with the help of software to compare

whether longer but good quality road would have higher environmental impact than shorter road with bad condition and low passing capacity. The weather conditions, however, cannot be planned ahead but they also have substantial effect on emissions. Strong wind, rain, and snow obstruct the movement of the vehicle and thus it needs more fuel to move on, which increases the emissions.

5.2 Measures to internalise externalities

If the transport volumes were to decrease it would put restrictions on the trade volumes as well. However, it is possible to reduce the relative transport volumes and environmental impact from it by an advanced transportation strategy in the company. However, it can be costly for companies so they lack the motivation to take initiative and therefore it is important to regulate that on the state level.

Large international companies are usually innovative and thus the leaders improving their environmental performance in all areas of their activities because they have high turnovers and profits and can afford higher investments on environmental work. It is also important for them to build reputation amongst the customers. For example, Ikea is a global company and has production units in all continents (Ikea, 2001). In 2000 80 percent sales came from Europe; 75 percent of manufacturing took place in Europe, 23 percent in Asia and the rest in North America (Nilsson, 2001b). Ikea is expecting its global transport volumes to quadruple within the next five years. This leads to increased transport distances and higher environmental impact. Ikea cannot avoid the increase of transport but it is striving for reducing the environmental impact from the transport. Ikea is constantly looking over the transport supply chain to find a better mix of suppliers and distribution set-up. The criteria like supply delivery times, lead times, order systems, etc. are carefully considered when decisions about transport matters are under consideration (Nilsson, 2001). The smaller firms with lower profits, however, do not have as much motivation to change their environmental performance. These companies decide often to increase their returns by having fewer costs on the environmental achievements. Therefore, it is important to influence them on the state level to take the environment into consideration in all activities. The economical instruments such as pollution taxes, pollution permits etc. are the ways to influence the companies to reduce their environmental impact.

5.2.1 Policy measures

The most common measures to provide an appropriate incentive for companies to reduce their environmental impact is establishing taxes to control the pollution levels. Pollution taxes can also be substituted with the tradable pollution permits or the subsidies that are paid for the abatement of pollution. Measures are chosen according the goal that needs to be achieved and/or on the policy of the country.

Pigouvian taxes are taxes levied according to the actual emissions and are directly connected to the pollution rates that a company has (Turner et al, 1997, pp 166-167). Approximations to Pigouvian taxes are indirectly connected to emission levels but the objective is still to decrease the pollution (Smith, 1996). In transport the latter taxes are more used. For example, taxes on the fuels and vehicles are not related to emission levels but are affecting the final pollution levels. Fuels have often also different rates of taxes - more polluting fuels have higher taxes than the less polluting ones in order to promote the consumption of less polluting fuels. Swedish experience has shown the success of differential taxes (Swedish EPA, 1997). It

has been possible to phase out the usage of leaded petrol between 1986-1995, and significantly increase the usage of environmental Class 1 compared to Class 2 and 3 diesels by differentiating the fuel taxes.

One objective of the taxes is to reduce the pollution and emissions and motivate the companies to reduce their environmental impact. The other objective is to receive the funds to remedy some of the damage. The revenues from the taxes however, cannot be considered as constant income because the main idea about taxes is to reduce the emissions, which means that if the fiscal measures are effective in diminishing the environmental impact then the revenues are likely to decrease, too (Smith, 1996, pp 234-235)

Taxation is the most common policy measure to control the emission rates. The opposite to taxes are subsidies that basically work according to the same principle as taxes, only instead of companies paying for the pollution they emit, they are subsidised for each unit of pollution that they abate (Smith, 1996, pp 224-225). This can be a good incentive for the companies to constantly strive for further abatement of pollution but it puts higher pressure on the government expenditure, which might lead to the increase of the other taxes.

The third measure to control the pollution is tradable emission permits. In this case government authorities determine the total pollution that is allowed in a certain area and then a market for pollution rights is created (Hussen, 2000, pp 263-265). Companies have their emission permits for emitting certain amounts of pollution. If they are efficient enough and reduce their emission rates by better cleaning technologies or increasing efficiency then they can trade their emission permits in the market. Consequently, the pollution always stays under certain level set by the government authorities.

The latter two market incentives – subsidies and tradable emission permits - are good for influencing the industries to decrease their emission levels. They are, however, difficult to use in the transport sector since it is complicated to measure the emissions from the transport.

Sweden is one of the countries where environmental policy has been worked out carefully and various economic instruments are used effectively and extensively (Swedish Ministry of Finance, 1997). Sweden has thus effectively applied the polluter pays principle in its environmental policy. Taxes have had quite good results in terms of reducing the fuel consumption and the emissions. Changing the consumed fuel type has been particularly successful and has enabled to almost phase out the less environmental friendly fuels. The unleaded petrol for example that in 1985 was the only petrol used has been by 100 percent replaced with unleaded petrol. The results of the various taxes are also significant but not in every case as much as expected (Swedish EPA, 1997). The reduction of the emissions have been successful in case of SO_2 (80 percent of reduction of traffic induced SO_2) but have not given any significant result of decreasing the NO_x from the traffic (Swedish Ministry of Finance, 1997). This is evidence that taxes on emissions and fuels may help to reduce emissions where it is possible through technological improvements or fuel exchange but it does not help to reduce the volumes of transport because the costs are still not high enough to provide an incentive to have less transport. It shows that the fuel and transport have inelastic demand.

One negative point of Swedish environmental policy is that it has been mainly focusing on private transport sector as the most growing sector (Swedish Ministry of Finance, 1997). This reduces the influence on the commercial transportation sector that does not motivate the companies to reconsider their import volumes due to high transport prices. The environmental taxes have more impact on the heavy industries such as pulp and paper industry, the chemical industry, the iron and steel industry, and the stone quarrying (Swedish Ministry of Finance, 1997). This indicates that the economic instruments have more effect on the production and heavy industries rather than the import activities.

OECD report (2001b) on the other hand argues that even though the fuel taxes have rather inelastic effect on demand, they still have an effect and in longer-term perspective this can lead to significant reductions in transport volumes. The length of the period when these changes start being evident is however questionable. The transport volumes still show growing trend and by the time this trend starts changing the externalities from the transport sector can have serious damage on the environment.

Sweden as explained has rather efficient environmental policy. It is, however, insufficient when only one country has high environmental requirements. There is tendency to avoid the production in this country because the environmental standards require investments on the clean technologies and the environmental impact from the activities is taxed, thus increasing the prices and lowering the returns in this country. In order to avoid the gain from the prices differences the environmental standards and the environmental policies have to be harmonised and the environmental taxes should be similar in all countries (Swedish Ministry of Finance, 1997). Only then it is possible to have the full impact from the taxes because then companies do not have possibility to avoid taxes. The countries, however, are reluctant to establish high taxes on the industries because that increases the costs of production and thus reduces their competitiveness (OECD, 2001b).

To increase the competitiveness of the industries the exemptions and rebates of taxes are offered for industries. This at the same time reduces the harmonisation of environmental standards and still leads to unequal competition between the countries. In order to have the effective environmental policies the exemptions and rebates have to be gradually reduced and finally phased out (OECD, 2001b). Only then it is possible to have the real effect from the economic incentives, otherwise companies still do not have the full incentive to reduce emission rates. It is also hard to have the equal level of environmental taxes when countries have different rates of exemptions and rebates even though the same taxation is established according to international agreement in all countries.

Harmonisation of environmental standards is important in order to guarantee the similar price levels and reduce the trade induced by price differences. It can however, become problematic because of the different characteristics of countries. The same standards cannot be set everywhere due to variations of nature and critical load. What is strict enough in one place can be loose in the other country because the nature in that country is far more fragile. Whereas, when the standards and taxes are set according to the latter country then it could turn out to be too strict in the first country (Johnson and Beaulieu, 1996, p 49-50). Therefore, there is the conflict how similar should the taxation be in the countries. It should however be set at the rate that does not violate the environment in any country.

6 Case study - Estimation of environmental impact and costs of transporting Coca-Cola products

6.1 Methods to estimate the externalities (environmental cost)

It can be seen from the theoretical discussion in chapter 2 that free trade and price differences are inducing higher volumes of transport but at the same time the price of products do not include the environmental costs of transport. Therefore it is important to estimate the environmental costs of transport in order to evaluate the real price of the product. The amount of externalities must be estimated before the environmental cost can be calculated. Externalities are mainly evaluated through the emission rates and fuel consumption of transport modes.

There are several ways to estimate the environmental impact from the transport. Three potential methods were chosen for the case study – NTM database, Schenker database and the computer model Copert III for calculating the environmental impact from transport. First, the information about databases was examined and the strengths and weaknesses of each method were analysed. Then the suitable methods for the case study calculations were picked out. In the following section the methods are described and the results of the analysis - pros and cons of each method are explained. The overview of all methods is given in Table 1.

Table 1 The overview of pros and cons of different methods for calculating the emission data

Calculation method	Pros	Cons
NTM database	- accurate and flexible data - includes all transport modes (road, rail, water, air)	- many manual calculations - only Sweden centred
Schenker database	- easily accessible - easy to use - fast results	- not accurate - not flexible
Copert III computer models	- accurate and flexible - complex and detailed - free access for everybody	- complicated - difficult initial data - only about road transport - considers only emissions - passenger car

Source: Nätverket för Transporter och Miljön, 2000; Schenker, 2001a; Kouridis, Ntziachristos & Samaras, 2000

6.1.1 NTM database

Nätverket för Transporter och Miljön (NTM, the Network for Transport and the Environment) has worked out in co-operation with many transport companies and organisations the common database for calculating the environmental impact from transport in Sweden (NTM, 2000). The database consists of tables that give a thorough analysis of emissions and fuel consumption of different transport modes. The total environmental impact can also be calculated for transport chains consisting of different types of transport modes by combining the data from respective tables. The data has to be picked from the tables manually, which makes the process slower but the results more accurate.

It is possible to have rather accurate data about road transport when the truck, engine, and fuel type is combined with the weight of the consignment and the distance covered. The

information about road transport can be calculated quite precisely because the emission data about trucks does not vary much. There are several factors that influence the emissions and fuel consumption such as driving style, road and truck conditions, etc (further discussed in chapter 5.1) but the average data can still be rather close to reality.

The calculation data about environmental cost from trains is based on the concrete sales of electricity to Swedish railway system. The evaluation considers not only emissions of power stations but takes into consideration the whole life cycle of electricity production, including losses. Not all trains in Sweden are powered by electricity though, 5 percent still use diesel (Environmental Class 1) and these emissions are also given in tables. The data however, can only be used in Sweden because all the calculations are made based on the electricity that SJ purchases, which is so-called Swedish Environmental Choice eco-labelled electricity and have relatively low emissions, whereas in other countries the emissions can be entirely different because of the other kind of electricity production.

Both the data about sea and air transport is very oriented for Sweden and cannot be taken as a basis for calculation in other countries. The average emission data about ships cannot be given precisely because each vessel has its own characteristic fuel consumption and emission rates. However, NMT has attempted to take under consideration the vessels used in Sweden and estimate the average environmental impact from those. The same applies with air transport. The tables about air transport provide data only about certain airplanes that are used in Sweden and cover only two average distances - 600 km and 1200 km. As taking off and landing have higher energy consumption and emission rates, then the impact cannot be calculated per ton km but per route. However, the formula is given for calculating the emission rates also for other distances.

6.1.2 Transport company databases

Good environmental performance of transport companies is important only in those countries where the environmental standards are high in general (Borglin, 2001). For example, Schenker is an international transport company that operates in 57 countries around the world (Schenker, 2001b). Environmental performance of the company is not the same in all countries. Environmentally friendly transport is provided only in those countries where it is demanded by the customers, it is not a fundamental strategy of the company. On the web sites of Scandinavian local companies the environmental matters are important and are well reported, whereas it is not possible to find anything mentioned about environment on the Baltic countries web sites (Schenker, 2001b). It takes time before these countries reach a certain development level and good environmental performance becomes a demand of customers.

Transport companies have pressure from their customers to conduct environmentally sound transport services; the pressure is also induced by the demand for environmental friendly products from the end-use customer. Many transport companies have, therefore, worked out their own databases for calculating the emissions and fuel consumption to keep the customers updated about the environmental impact of their transportation service. Schenker is one of those companies that have thorough database for the calculation of environmental impact from transport through various distances. The database is accessible and easily usable for anybody through 'Online Emission Calculation' in the company's web page and results are given instantly (Schenker, 2001a).

The data is given only about road, rail, and sea transport. Air transport is not included in the estimations. The calculation of rail, sea and some of the truck emissions are based on the database worked out by NTM. The initial information needed for the calculation is the starting point, destination and the volume, length or weight of the consignment. After all these data is inserted the computer calculates the emissions, energy need and transport production in ton km and gives the result in the table. It does not, however, estimate the fuel consumption for the trip.

The setback of this calculation method is that it is inaccurate and inflexible. First, the volume, length and the weight of the consignment cannot be combined, which makes the calculation inflexible. Second, the system offers itself the transport modes from the start to the destination without the possibility to choose it manually, which also ends in less accurate results. Third, it does not allow taking into account different fuel and engine types used in Scandinavia and the rest of Europe, the database offers itself which engine types and fuels are used.

Schenker is one of the few transport companies that has the database available for public use. Other companies such as Danzas and DFDS Transport, however, do offer the possibility for their customers to calculate the environmental impact from their services but it is not possible to have the access to it through internet. They make the calculations only by the request of the customer (Boberg, 2001). It takes time before the environmental data of companies is easily available for the public.

6.1.3 Computer models

There are different types of models worked out for calculation of environmental costs of transport. Such models are flexible and give accurate data about environmental impact of transport chains including different transport modes. European Environment Agency (EEA) has worked out a computer model (Copert III) for calculating the emissions from road transport. The model enables to calculate the emissions of transporting products to different destinations around Europe (Kouridis et al, 2000). The model is very complex and requires detailed initial information about countries such as fuel type, monthly temperature variations, fuel vapour pressure, mean trip distance, cold start parameters, technology (engines) details, etc. Therefore, the results are also accurate and close to reality. However, the Copert III model is only for calculating emissions from road transport including passenger transport in every particular country, whereas freight transport includes also modes like trains, vessels and airplanes. Therefore the model cannot give the complete data about the environmental impact of freight transport.

6.1.4 Conclusion

The calculation of environmental impact gives various results in case of the different transport modes. The environmental cost of road transport is the easiest to calculate. The average fuel consumption and emissions are well known for different types of engines, fuels or trucks. The environmental impact from the train can also be rather accurate when the thorough research has been carried through for a particular country. The emission data about the trains cannot be generalised like in the case of road transport because each country uses different kinds of energy mix for rail transport. The sea transport is also less accurate since the vessels and ships are very different and it is hard to estimate the average impact unless the exact data about the ships is known as well as the exact routes. The data about the air transport cannot be provided

by ton km as the data about other transport modes because the landing and taking off have relatively higher environmental impact than the rest of the journey. Therefore, the data has to be calculated for each trip separately.

All analysed methods of estimating the environmental impact take into consideration only the emissions of the transportation as a service. However, the transport involves many other parameters that indirectly affect the total environmental impact from the transport sector. These parameters include the construction and maintenance of infrastructure, production of vehicles and fuel (Blinge and Lumsden, 1996). The estimation of environmental impact from these sectors however, is beyond the scope of this study and requires far more extensive research than can be included into this study.

None of the presented methods consider the noise pollution, which is a serious externality of transport, especially in the case of road, rail and air transport. 30 percent of the EU population is exposed to the noise pollution created by the traffic (EEA, 2001). It is, however, difficult to estimate the noise per unit of goods and it is also problematic to value the noise pollution and set the environmental cost from it.

6.2 The calculation of external costs of transport induced by price differences

The objective of the case study is to show the environmental impact from the increased transportation that could be avoided. This extra transport is induced by the demand for the Coca-Cola products that are cheaper than locally manufactured Coca-Cola drinks.

6.2.1 Introduction to Coca-Cola case study

Coca-Cola is a well-known brand all over the world and the company's strategy is to provide drink products of the same quality everywhere in the world (Coca-Cola, 2001). The syrup for Coca-Cola production is produced in the USA and from there it is distributed to the daughter companies around the world where it is mixed with water sugar and is carbonated to produce the Coca-Cola drink. Other Coca-Cola drinks such as Sprite and Fanta are also produced from the syrup but the only difference of these drinks is that they can be adapted to the local conditions, which means that there might be slight taste differences. In short, Coca-Cola tastes exactly the same and Fanta and Sprite are similar in various countries. This strategy should support the consumption of locally produced drinks everywhere and thus avoid the import-export induced transportation of Coca-Cola drinks. However, Coca-Cola products are still imported to the countries that already have their own production.

Sweden has its own production plant in Jordbro, close to Stockholm where all the manufacturing for the Swedish market takes place and from there the drinks are distributed in Sweden. However, Swedish Coca-Cola is not the only one that can be bought in Sweden. Small grocery shops, convenient stores, and fast food places tend to sell Coca-Cola products that are imported from Germany or Eastern European countries such as Poland, the Czech Republic, Slovakia, etc.

Czech Coca-Cola products were taken as a basis for comparison of environmental impact of imported and local Coca-Cola products because the Czech Republic is the most common exporter of Coca-Cola drinks to Sweden (Hleihel, 2001). In the Czech Republic the labour and raw material prices are lower so they can produce cheaper Coca-Cola than Swedish Coca-Cola Company. Sweden has also higher environmental standards, which has resulted in taxes

to protect the environment. Sweden has established taxes for various emissions such as CO, CO_2, NO_x, sulphur, etc (Swedish Environmental Protection Agency, 1997), which in return increase the prices. Both the low prices and high environmental requirements reduce the Swedish competitiveness (Shahin, 1999) so Czech can take advantage from the situation and increase their profits by exporting to Sweden. The internalisation of external costs however, is higher in Sweden because they pay taxes on emissions.

6.2.2 Basis and data for the calculations

Despite the fact that Coca-Cola drink products have been transported through long distances the prices are still relatively cheaper compared to locally produced drinks (see the price differences in Table 2). The prices have been received from Malmborgs supermarket in Lund (in August 2001), from the small immigrant-owned grocery shop in Rosengård, Malmö (in August 2001) and from the interview with the importer Hleihel on September 12th, 2001. All the prices are approximate, meaning that in other similar kinds of shops the prices can vary but the magnitude is the same.

Table 2 The prices of Coca-Cola in different countries

Product	Retail Price [SEK per 1 l]
Coca-Cola[1] (2 l) Czech	5
Coca-Cola (0,33 l) German	6,4
Coca-Cola (1,5 l) Swedish	8,6
Coca-Cola (0,33 l) Swedish	8,8

[1] Sprite and Fanta are sold at the same price as Coca-Cola

The calculations of emission rates and fuel consumption are made based on Schenker and NTM database. Emission rates are taken from Schenker database because it is based on the figures in the NTM database, so the results are similar. Environmental cost is calculated based on the Swedish taxes levied on air pollution. The rates of taxes are given in Table 3.

Malmö is taken as the destination distance for both Swedish Coca-Cola and Czech Coca-Cola. In Sweden Coca-Cola is produced in Jordbro, which is a small place close to Stockholm (Coca-Cola, 2001). The distance between Malmö and Stockholm is 617 km. The calculations are made for both road and rail transport to see the difference of environmental impact. Coca-Cola in the Czech Republic is produced close to Prague (Coca-Cola Czech, 2001). The distance between Malmö and Prague is 930 km, whereas 174 km is covered by the ferry (Schenker, 2001a). The results of the emission rates and energy consumption are given in Table 4.

Table 3 The price of air pollution

The air pollutant	Environmental cost [SEK per kg]
CO	20
CO_2	0.36
NO_x	40
HC	20
SO_2	15
Particulate matter	Not specified

Source: Alvarsson & Andersson, 1995; Swedish EPA, 1997

The calculations in the Table 4 are made by the volume. One truck contains 40m^3, which in return carries 80 Euro pallets, each holding 96 bottles (each 2 l) of Coca-Cola. All the calculations are made based on the same amount of bottles in order to have the comparable results.

6.2.3 Results

It is well known that the train transport is more environmental friendly mode compared to road transport because it has high capacity and it is more energy efficient. This is confirmed by the results because transporting the same load of Coca-Cola from Stockholm to Malmö by train has significantly lower emissions rates and environmental cost. However, the trains are not used in Coca-Cola transportation (Ericsson, 2001). The Coca-Cola Company owns the distribution company that organises all the transportation in Sweden, which occurs by trucks.

Table 4 Emission rates and environmental cost

	CO_2 [kg]	HC [kg]	NO_x [kg]	PM [kg]	SO_2 [kg]	CO [kg]	Transport production [ton km][v]	Energy consumption [kWh]	Total cost [SEK]
Stockholm to Malmö [i]	0.02	$7.3x10^{-5}$	$7.3x10^{-5}$	$7x10^{-6}$	$3.6x10^{-5}$	$5.5x10^{-5}$	6910	290	
Environmental cost [SEK]	7.32	0.03	0.01	N [iv]	0.004	0.01			7.37
Stockholm to Malmö [ii]	320	0.35	3.3	0.063	0.081	0.15	6910	1200	
Environmental cost [SEK]	115.2	7	132	n	1.215	3			258.42
Prague to Malmö [iii]	590	0.53	11	1	6.2	0.83	12387	2300	
Environmental cost [SEK]	212.4	10.6	440	n	93	16.6			772.60

Source: NTM, 2000; Schenker, 2001a

[i] by train: distance 617 km
[ii] by road: truck 60 ton; engine Euro 1 [engines that meet the EU standards on pollutant emissions after 1993 (EC, 2001b)]; distance 617 km
[iii] by road: truck 40 ton; engine: Euro 0 [engines that meet the EU standards on pollutant emissions before 1988 (EC, 2001b)]; distance: 756 km; by ferry: 174 km
[iv] not specified
[v] Transport production is expressed in ton-kilometres that show the number of kilometres each ton is transported

The environmental costs of importing Coca-Cola products from the Czech Republic are higher than transporting them locally in Sweden (Figure 3). The difference is not as magnificent as compared to truck and train transport within Sweden but there are noticeable disparities in terms of emissions and environmental cost. Environmental cost of transport is three times higher when the products are imported from the Czech Republic giving the clear evidence that it is more harmful for the environment to import Coca-Cola products from Eastern Europe. However, if environmental cost of transporting Coca-Cola from Prague were divided between the bottles then the price for each 2-litre bottle would increase only 10 öre.

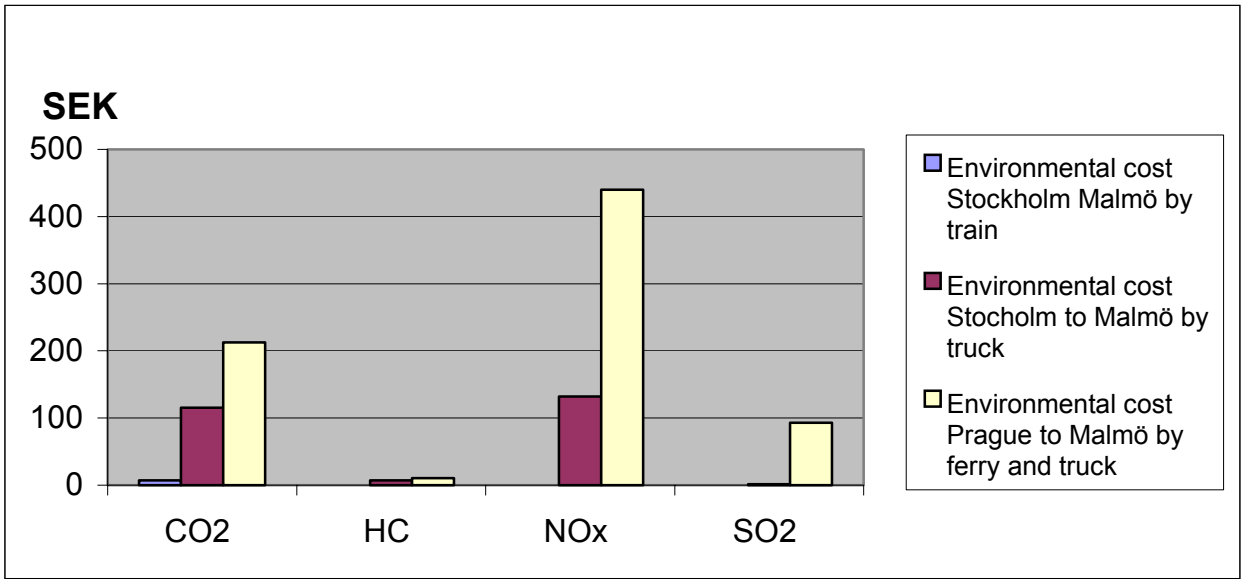

Figure 3 Environmental cost of transporting Coca-Cola products

7 Discussion

7.1 Changes from the government and companies side

The price differences caused by the disparities in the development level or technology in the country induce the extra transport flows, especially under the conditions of free trade. As long as these price differences are present there is always demand for the cheaper products by the people who do not have enough income or who do not know or care about environmental problems. And vice versa, as long as there is demand for cheaper products, there are always entrepreneurial businessmen who find a way to fulfil that demand, especially if there are loopholes in the government policy and legislation. Therefore the harmonised environmental standards are required in order to balance the price levels in countries.

The harmonization of the environmental standards has to occur through the international agreements on environmental performance. European Union is the ideal organisation to regulate the environmental requirements. Common Transport Policy was one of the three pillars together with CAP and The Single Market on the Treaty of Rome but the environmental policy has not been part of the common policy areas (Swedish EPA, 2000). But it is essential that environmental policy is also considered as common policy so that the environmental standards and requirements together with the economic measures are

harmonised and equalised in all the member countries in the EU. However, the current environmental taxation rates in the EU member states vary great deal and provide insufficient effectiveness to regulate the environmental performance (Swedish EPA, 2000; OECD, 2001b). The differences between the EU member and non-member states are even greater. Therefore, the Swedish importer that has high environmental taxes in domestic country can avoid the taxes on transportation by using the transport companies in the Czech Republic that probably has lower environmental standards and taxation rates. If the export prices are low due to the moderate development level in the Czech Republic then the transportation is most likely also cheaper because of the lower costs in the Czech Republic and the inexistent or low taxes on the transportation.

The results of the case study show that even when the environmental taxes are paid by transportation it does not increase the Coca-Cola prices considerably. The environmental cost of transporting Coca-Cola from Prague is only 10 öre per 2-litre bottle. This is no doubt very small increase of a price and would not have any effect on those decisions that are made based on price. Therefore, it is questionable that the taxes levied by Swedish authorities are high enough to influence the purchase decisions and transport flows. It is also doubtful whether these environmental taxes are included the price of imported Coca-Cola because Czech transport companies can likely be used in transportation and these companies do not pay the same rate of taxes on emissions as Swedish expeditors. If Swedish transport companies were used in transportation and the taxes paid then the price differences of local and imported Coca-Cola products would still be large enough (look at Table 2) to induce the consumption of imported Coca-Cola by the consumers whose decisions are influenced by the price. Therefore, it would be important to discover the real environmental costs of transport-induced externalities and charge that from the transport sector. This would probably contradict with the economic objectives by reducing the profits but would be fair for the environment.

The price differences between Sweden and the Czech Republic are mainly induced by disparities in development level and environmental policies and taxation. However, when the Czech Republic becomes a member of the EU then they have to adapt the EU policies. The economic differences will be step by step decreased and the general price level will probably not vary that greatly in the future. This outcome of the Czech Republic joining with the EU is speculative because there are price differences also within the EU. This is probably due to the varieties in technological level as well as the differences in environmental standards and taxation because the common policies still have not harmonised all price levels. For example the German Coca-Cola is also cheaper than the Swedish (look at Table 2) although Germany is also the EU member country. Therefore it is not sure how the membership of Czech induces the final differences of price levels.

One aspect about German imported Coca-Cola is that shop-owners often go with their own vans to import the drink products not as companies but as private citizens (Hleihel, 2001), which is not illegal or cannot be forbidden. It is, however, questionable whether similar kinds of import would happen with Eastern Europe because Germany is close to Sweden and it is easier to purchase Coca-Cola form there than from Eastern Europe.

7.2 Changes from the consumer side

Government can impel the companies through the environmental policies for better environmental performance but companies are always influenced by the demand. Therefore, it

is important that consumers also change their consumption habits. It was seen from the purchase decision system that the consumption decisions are determined by the environmental awareness of the consumer and high awareness would lead to environmentally sound consumption.

The decision-making criteria according to the system are very simple - environmental awareness and wealth. High environmental awareness in reality, however, does not always lead to environmental friendly behaviour and consumption (Lundgren, 1999). When customers are wealthy enough and environmentally aware then they consider environmental cost of the product and buy only environmentally benign products. The lower wealth may lead to consumption of environmentally harmful products because these are usually cheaper (Lundgren, 1999). However, in reality the purchase decisions are not that simple. People with low income might care for the environment and live environmental friendly way, whereas people with high income and knowledge about environmental problems still consume environmentally harmful products because it is easier, cheaper, more convenient or gives more pleasure. For example, it would be easier and more convenient to buy a bottle of Coca-Cola from a convenient store in the corner (owned by immigrant) because there is no queue, it is cheaper and the shop is on the way to work. It can be concluded, therefore, that people are more influenced by the prices and also convenience than the concern about the environment. As long as there is an option to buy imported and cheap products next to local expensive ones the consumers cannot be relied on as environmental aware consumers who consider the environment always when they make purchase decisions.

The Czech Coca-Cola can be considered environmentally less friendly than local Coca-Cola for two reasons: firstly, due to the extra transportation but secondly, due to the environmentally more harmful production because of the low environmental standards in the Czech Republic. When consumers choose to buy the cheaper and environmentally not sound products (imported Coca-Cola) then they save more money than people who select the environmentally friendly but more expensive products (local Coca-Cola). The amount saved depends on the quantity of cheap Coca-Cola products they buy. That, however, leads to question how is this saved money used later. The money saved from consuming the Czech Coca-Cola as environmentally unfriendly product might lead to even higher consumption of environmentally harmful goods. For example, people who buy environmentally sound products have less money left for other unsustainable consumption such as car driving. At the same time, people who have less money to purchase environmentally friendly products buy cheaper products and might have money saved for the consumption of other unsustainable goods. The real outcome of consumer preferences of course requires further research on how consumers make their choices. What criteria do they really use because in reality there are probably more criteria than just environmental awareness and wealth. Also what further impact do their purchase decisions have on the whole consumption habits?

Another problem is that people do not consider the environmental impact from all perspectives. Not all aspects about the product are taken into account. Swedish consumers, for example, are more environmentally aware than consumers in many other countries, and prefer the products that are ecologically produced and environmentally friendly. The imported products, however, are still often chosen by consumers (Carlsson, 1995, p 34), which show that environmental harm from the transport is not taken into consideration when imported products are purchased. This is especially true in the case of soft drinks because, the imported

Coca-Cola drinks seem to have the same environmental impact than the locally produced ones because they look and taste the same.

Swedish government could put more focus on restricting the illegal import. Right now, for example, Sweden does not have control over the illegal import of Coca-Cola. They do not have data about the volumes of the Coca-Cola illegal import nor have they capacity to investigate that (Nilsson, 2001a). According to the Danish example it can be estimated that the share of illegally imported products in the immigrant-owned stores can reach up to 70 percent (Knowles, 2001). Illegal import reduces the government income and should be taken under control, which has double effect – increases the taxation revenues and reduces the transportation and inhibits the environmentally harmful consumption. Besides, it might also reduce the overall environmental impact from transport because illegal import probably takes place through the cheapest transportation that tends to have higher environmental cost (look at transport costs at 3.1.3)

It has become evident that even if people are environmentally aware the prices still play important role in every day purchase decisions. That is even more obvious in the case of people with low wealth. Consumers have the right to make the choice between the goods that are sold in the stores whatever the environmental impacts are. It should, however, be regulated in the government level that consumers have more chances to make environmental-friendly decision. The import of the products that are produced also in Sweden, such as Coca-Cola products should be hindered by the government. It cannot, however, be forbidden because of the free trade agreements. The high taxes established on transportation increase the import prices and therefore reduce the consumption of imported Coca-Cola.

At the same time these taxes would affect all trade and this contradicts with economic activities and goals and reduce the potential profits. Therefore, establishing high environmental taxes and implementing a strong environmental policy will impede the economic growth (Turner et al, 1993, p 241). It seems that the society is still in the situation that the environmental gains are compared to economic returns. This leads to the predicament that the trade offs between the economy and the environment ends up favouring the economic activities so that the environmental taxes are only established to the rate that they are reconciling with the economic goals not with the environmental needs. Therefore, the dilemma between the economical activities contradicting with the environmental issues remains.

7.3 Limitations

The main limitation of this study is that it is very general. It only estimates the air pollution in average terms it does not get specific. It does not get deeper into other environmental and societal problems such as congestion, noise pollution and land use. The reason for that is that the study wants to prove that there is a problem and to give an overview of the situation. The magnitude of the problem can then later be analysed in the further studies.

The analysis of the price differences and the estimation of the product real price would be more accurate if the environmental costs of the production in both countries were taken under consideration. Right now the existence of environmental cost of transporting these products has been proved. The logical deduction has been that the environmental costs from the

production in the Czech Republic are higher because of the lower standards. This study, however, does not provide scientific empirical evidence to the statement.

The environmental cost of emissions (given in Table 3) is taken according to the environmental taxes in Sweden. Whether these tax rates are enough to cover the environmental costs caused by transport has not been evaluated in this study but should be analysed in the further studies.

8 Conclusion

The world is facing the increasing transport flows due to the free trade and different environmental standards and prices in the countries. Consumer behaviour in the western world is moving towards environmental-friendly consumption habits due to the higher environmental awareness. Even though customers are increasingly concerned about the environment the consumption decisions are still influenced by factors such as price and convenience.

Trade liberalisation is increasing the transport flows. Free trade opens the boarders between countries, which leads to longer distances travelled by freight transport. At the same time the free trade is inducing the diffusion of the technology, which reduces the overall impact from the transportation. But as economic growth accompanies with the transport growth the technological improvements cannot offset the overall environmental impact from freight transport due to the rapid growth rate.

Higher transport flows are induced by the price differences in countries. Price differences are caused by the disparities in the level of development and technology, environmental standards and taxation. At the same time price does not include all the environmental costs of transporting the products, which makes the imported products artificially cheaper.

Consumer purchase decisions are guided by environmental awareness and wealth of the consumers. Environmentally aware consumers consider the environmental impact of the products they consume and prefer therefore environmentally friendly products. Financially less wealthy people cannot afford to buy environmentally benign products because these tend to be more expensive. At the same time the environmentally aware costumers are also influenced by the prices. Therefore, if all the external costs were internalised then all consumers would be impelled to make the environmentally sound purchase decisions.

Governments strive for the environmental and transport policies that would support the sustainable transport systems and internalise the externalities. The establishment of the taxes, however, is complicated because there is a conflict between the economic growth and environment. As long as there are countries that have weak environmental standards and lower taxation rates, have thus formed easier terms for the industries, which creates the disparities in the price levels and causes the differences in the level of competitiveness in the countries. Even though it is important to protect the environment and set the prices right in the countries, the taxation might still violate the competitiveness of the country in the world market, which induces the governments to reconsider the taxation rates.

8.1 Further research

Further research fields should cover the estimation of the real price differences. This study came to the conclusion that price differences create unnecessary transport. At the same time the prices do not include the environmental costs of the production and transport. The further research should analyse the price differences in European countries. To define the real price differences the life-cycle analysis approach should be taken in order to analyse the costs of products from cradle to grave. Also the estimation of environmental costs of transportation and how high should the taxes be in order to really internalise all the externalities. There is also need for further research on how trade liberalisation influences the transport flows and how to break the link between economic growth and the transportation.

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