Determinants of Swedish Pharmaceutical Exports

Master-thesis within Economics
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Abstract

In this thesis factors that explain Swedish pharmaceutical export as been analyzed. The period investigated is from 1995 to 2010. The investigation is concluded through the use of a gravity model. It investigates not only the GDP and distance variable but also the effects of GDP/capita, exchange rates and the effect of being a part of the internal market of EU. The effects of having access to the ocean and if the country has English as its official language is investigated as well as the effect of sharing the same religion. The results show that only a smaller subset of countries make up for most of the pharmaceutical export. The results also shows that the pharmaceutical export can be explained by the same variables as most other goods.
# Table of Contents

1 Introduction........................................................................................................... 1

2 Review of the literature and empirical studies .............................................. 2
   2.1 Discussion, empirical studies ....................................................................... 3

3 Theoretical background and models............................................................... 4
   3.1 Early trade models and theory .................................................................... 4
   3.2 Modern trade theory .................................................................................. 5
   3.3 Product lifecycle theory ............................................................................ 6
   3.4 Discussion, trade theory and pharmaceuticals .......................................... 7

4 The pharmaceutical industry ............................................................................ 9
   4.1 The pharmaceutical sectors importance for Sweden .............................. 9
   4.2 R&D and its importance for the pharmaceutical industry ........................ 10
   4.3 Discussion, Pharmaceutical industry ....................................................... 11

5 Empirical analysis.............................................................................................. 12
   5.1 Method and data ...................................................................................... 12
   5.2 Descriptive statistics .............................................................................. 14
   5.3 Method of analysis .................................................................................. 17
   5.4 Results & analysis ................................................................................... 18
   5.5 Discussion of the results ......................................................................... 21

6 Conclusion and suggestions for further research ........................................ 23

7 List of References.............................................................................................. 24

8 Appendix ........................................................................................................... 26
1 Introduction

The pharmaceutical industry is one of the most important Swedish export sectors. As such, it is very interesting to analyze the factors that affect the export. In 1995 the pharmaceutical industry contributed with 3.2% to the Swedish export, 16 years later in 2010 the industry has increased its export share to 6%. The pharmaceutical export value in 2010 was 66 000 million SEK. Statistics Sweden (2012a)

The pharmaceutical industry is characterized by a high degree of investment in Research and Development (R&D). The industry is highly competitive and it is strictly regulated. The industry’s high R&D is due to high failure rates, significant costs of clinical trials and the amount of resources needed to get approval by the regulatory agencies. European Federation of Pharmaceutical Industries and Associations (2010)

The thesis will analyze which factors affect the Swedish exports of pharmaceuticals. The method chosen is a quantitative method, a panel data regression model.

The question is; can the export in the pharmaceutical industry be explained by the same variables as trade in other goods?

I intend to investigate factors in the destination countries such as GDP and GDP/Capita, and cultural similarities as religion and language. Is the destination country a member of the same customs union (EU) as Sweden, and does this affect the export of the industry and if so how. I will also analyze the effects of physical distance to the export destinations and if they have access to the ocean or if they are landlocked and the effects on trade. The changes in the Swedish exchange rate and its effect on the pharmaceutical export will also be investigated and its effects on trade. I will also investigate how the variables affect the export price of pharmaceuticals. I will use panel data from 93 individual export destinations, covering a time period of 16 years starting with 1995 up to 2010. The method chosen is panel regression.

The main purpose of this thesis is to investigate the factors that explain export of pharmaceuticals. The industry is also one of Sweden’s larger export sectors; as such it is also very important for the balance of trade.

The outline of the thesis is as follows:

In Chapter 2), earlier empirical studies and literature is reviewed, in Chapter 3) the theoretical background and models are presented to better understand the reason to trade in pharmaceuticals. In Chapter 4) the pharmaceutical industry is explained with its characteristics and regulations. Chapter 5) presents the data and descriptive statistics as well as statistical analysis and a discussion about the results. And the conclusion is in Chapter 6).
2 Review of the literature and empirical studies

Anderssons (2007) analyses 150 export destinations over a 7 year period and identifies difference in costs of entering the familiar compared to the unfamiliar markets, where the latter was more costly. The physical distance also has a negative effect on trade, and having access to the ocean has a positive effect on trade. The author also found that Sweden traded more with English speaking countries.

Hacker and Einarsson (2003) made an analysis of the trade between 19 European countries and found that the Baltic nations traded relatively more with the Scandinavian countries than with its close neighbours Russia and Poland. They also concluded that GDP/Capita was more important for Swedish export than the actual distance to the export destination.

Countries that are similar in size, GDP/Capita, and have a similar culture as language and religion trade more, all else equal. What constitutes a cultural product or an artifact is not only the nonmaterial and nonmilitaritarian goods. There is a reciprocal relationship that exists between cultures as the economy becomes more commoditized and goods become more culture laden. (Lash and Urry 1994; Power 2002)

Customs unions are integrated markets where trade barriers are removed. Sweden is a member of the European Union (EU) since 1995. In 2001 Baier & Bergstrand undertook a comprehensive analysis of the world trade growth. They found that reduction in tariffs and trade liberalisation are important in explaining growth in the world trade. Badinger & Breuss (2003) followed in their footsteps by analyzing the intra-EU trade between 1960 and 2000. They found that trade has been growing steadily between the member states over the years, with an intra-EU growth rate of 1200%, and a 730% growth between members and the non EU-countries. Their analysis showed the same results as Baier and Bergstrand. Income growth was the most important factor, and reduction of tariffs was the second most important factor explaining intra-EU trade growth. They also came to the conclusion that reduction in transport cost has had almost zero effect on trade growth.

Sweden has its own currency, the Swedish Krona (SEK). In a paper from 2003 Hacker and Hatemi-J (2003) found evidence of a J-curve in the small North European economies. Thus there is a relation between exchange rate and the current account. This implicitly means that the export industry reacts positively to a depreciation of the currency. Athukorala and Menton (1995) investigated the relation between pricing to market and the exchange rate in the Swedish machinery export. They found that companies adjust mark-ups in relation to the exchange rate to increase their profits and gain market shares.

Swedish trade has been the focus of many studies. In a master thesis from 2007 Adolfsson analyzed the pharmaceutical industry’s exports from 1997 to 2003. The results in his work were interesting. Adolfsson found that similarities in culture as sharing a common religion (Christianity) had strong positive effects on exports of pharmaceuticals. He also concluded that EU members imported less than non EU members, all else equal. He also found that close proximity to Sweden was showing strong negative effects on export of pharmaceuticals, all else equal. These interesting results inspired to investigate the pharmaceutical industry further.
2.1 Discussion, empirical studies

There are consensus that GDP and GDP/Capita have positive effects on trade. There is also a consensus that an increase in distance between trading countries has a negative effect on trade. Having access to the ocean has a positive effect on trade.

Baier and Bergstrand (2001) as well as Badinger and Breuss (2003) found that reducing tariffs and trade liberalisation had strong positive effect on trade. Sweden is a member of the European Union and its internal market since 1995, this internal market is equal to trade liberalization and removal of tariffs. Thus one may expect that the relative importance of the export to EU has increased for the Swedish firms.

As noted by Andersson (2007), Johansson and Vahlne (1975) Sweden exports more to English speaking countries. Adolfsson (2007) noticed that sharing a common religion had positive effects on exports of pharmaceuticals.

A depreciation of the exchange rate has positive effects on trade, as noticed by Hacker and Hatemi-J (2003). The export industry also uses the depreciation to increase their margins as noticed by Athukorala and Menton (1995). The pharmaceutical export should thus be affected positively by a depreciation of the SEK.
3 Theoretical background and models

This chapter aims to give the reader a presentation of the economic theories necessary to analyze and explain trade in pharmaceutical products. First, the old trade theory is presented in section 1), then in section 2) the modern trade theory and also the product life cycle theory and its importance to the pharmaceutical industry. In section 3) a discussion follows and a summary of the chapter.

3.1 Early trade models and theory

The growth stimulating effects of trade was recognized by Adam Smith in his work “The Wealth of Nations” published in 1776. Though his work did not deal with comparative costs and reciprocal demand, Smith found that the long run effects of trade and its positive effects on the domestic economies as the total pool of resources and products increased. Myint (1977)

Two very important and influential trade models are David Ricardo’s theory of comparative advantage dating back to 1817 and the factor abundance model developed by Heckscher-Ohlin in 1919 and 1933.

Ricardo’s trade model recognized the concept of comparative advantage, where one goods is less costly to produce than another. In other words, to produce a good, how many units of the other good does one have to give up in order to do so. This equals the opportunity cost of the good. Thus it was beneficial to trade in the good where one had a relatively lower cost and a comparative advantage, and import the other goods from a mirror country. Ruffin (2002)

The Heckscher-Ohlin model is a 2x2x2 model with two countries trading in two homogenous goods, using two factors of production. The model assumed perfectly competitive goods as well as perfect factor markets. Both countries’ good’s manufacturing was assumed to be operating under constant returns to scale. The transport cost was not incorporated into the model thus assumed to be zero. The model also assumed that the factors of production were immobile and locked into each country. The difference between the trading countries was in the factor endowments, and that difference caused factor price differentiations. This difference in prices of factors of productions, labor and capital is thus the reason for trade. In autarky each country produces both goods and the factor proportions explain the relative price of the goods. As the countries opened up for trade they would export products that contained a larger input of the factor that the country was well endowed in.

The country well endowed in workers will export labor intensive goods and import capital intensive goods. In the same way as the other country well endowed with capital will export capital intensive goods, and import labor intensive goods.

The trade in the model led to factor price equalization and made both countries converge economically.

There are several limitations of the model. The assumption of immobility of capital do not fully agree with the modern world, as well as immobility of the workforce. The transport cost is a reality that the model do not take into account, and trade barriers as tariffs. The production function assumed constant return to scale, though some industries operates under increasing return to scale. Dunning (1988)
3.2 Modern trade theory

Krugman (1980; 1981) stated that there had been some considerable skepticism about the old trade theory’s ability to explain the modern trade development. Krugman concludes that many empirical studies of international trade can not be explained by comparative advantage or differences in factor endowments. Krugman noticed that much of the world trade is conducted between countries with similar factor endowments. The post war trade is characterized by a strong growth in the intra industry trade rather than inter industry trade. Krugman developed trade models where monopolistic competition was taken into account. Monopolistic competition is an imperfect type of competition between firms. The firms differentiate their products from another where the goods are not perfect substitutes like commodities. The core product may be the same though the differences may be in branding, quality or location. Each firm has some market power and can set its own price as the product faces its own downward sloping demand curve. Thus the elasticity is unique for each product. In the short run the firms act like monopolies where they profit maximize. In the long run more firms enter the market and close substitutes become available and the benefit from differentiating becomes less important as the goods become more commoditized over time.

In a paper by Krugman (1982) entitled “Trade in Differentiated products and the Political Economy of Trade Liberalization” the intra industry trade pattern and trade in different industry sectors was analyzed. A model was presented to explain trade between two countries, each with two industry sectors, and in each sector there were multiple industries producing a number of differentiated products. There is no cost of differentiating the goods, so two firms will never produce the exact same good. The industries are grouped after their factor proportions, high skilled and low skilled workers.

On the demand side the consumers are assumed to have the same taste in both countries. There consumption is based on a utility function where consuming one more variety increase their utility more than consuming one more unit of the same good. The consumption pattern was also subject to elasticity of substitutes. The labor force is industry specific with a country specific labor supply of each labor type. The wage in each sector is determined by the demand for its goods. This leads to intra industry specialization and results in intra industry trade in the model.

Krugman showed that the model successfully simulated and explained trade patterns based on the settings above. The model suggested that if both sectors opened up for trade the outcome was often that both countries gained. Even though one country’s industry sector saw a reduction of its wages, the countries’ overall real consumption increased. If trade was only allowed in a sector with low extensive margin, the country with a comparative disadvantage would often lose from opening up for trade. This explains why trade liberalization has been weaker between countries that are more heterogenic. Trade will be favorable for both countries if neither of the countries have a strong comparative advantage in the industries and the products are differentiated. The more similar the countries were the more they gained from the trade. Krugman’s analysis offers an explanation to why the strongest trade growth has been mostly...
between similar countries and why the strong trade growth is intra industry rather than inter industry. Krugman (1982)

3.3 Product lifecycle theory

The product lifecycle theory was first developed by Kuznets in 1929, and was further developed by Schumpeter in 1939 and Vernon in 1966. There are four stages that can be depicted in an arc; 1) market introduction stage 2) Growth stage 3) Maturity stage 4) Saturation and Decline stage.

According to Krugman (1979), the product life cycle can explain the world trade patterns. At first the new product is only produced in the innovation country, but when technology becomes available as the patent expires or the technology becomes available the product is manufactured in less developed countries with lower wages. Krugman calls this the technological lag, where the developed countries export new products and import old standardized products at low cost. This is also the reason for the focus on R&D in the developed nations. The price of the product becomes more important the further into the life cycle the product moves. This gives the companies who develop new products an advantage over other companies, at least in the beginning or as long as a patent lasts.

This means that in the beginning of the product life cycle, the developed world exports the product and in the later phase the product is imported. In graph 3.4 Krugman’s theory has been applied on the pharmaceutical product lifecycle.

The standard patent for a medicine is 20 years, considering that it takes an average of 10-13 years to develop and get a medicine approved and sold on the market, the effective patent is 7 to 10 years. The cycle starts with the R&D phase and when the product is approved by the pharmaceutical authorities and the marketing starts, this is the introduction phase and also the export phase. The product will then gain sales and stabilizes in the mature phase. When the patent expires, the product starts its decline phase as it faces competition from low cost generic equivalents that are imported.
This chapter has presented theories that explain why countries trade in goods. David Ricardo’s trade theory identifies comparative advantages as the reason for trade. A country well endowed with human capital (high educated workforce) may well have a comparative advantage in R&D intensive goods.

The Heckscher-Ohlin model explained gains from trade with differences in endowment in factors of production. The factors of production were labor and capital, and the difference in endowments equaled differences in the factor prices. Sweden is well endowed in high educated workers, seen as a factor of production this may arguably explain trade in pharmaceuticals.

Krugman, with the new trade theory took another approach explaining trade between countries. Krugman found that most growth in trade was observed in the intra industry rather than the inter industry trade. The trade growth had also been the strongest between countries that were similar to each other in size, factor endowments and comparative advantage. The trade pattern observed was the opposite from the Ricardo and Heckscher-Ohlin theories’, where they predicted that most gains from trade would be between heterogenic countries. Krugman found that the consumers love for variety and increasing return to scale in the production and

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**Graph 3.4** The Pharmaceuticals life cycle combined with phases of research and development process and the export and the import phases. Graph based on European Federation of Pharmaceutical Industries and Associations (2010), graphics made by the author.

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3.4 Discussion, trade theory and pharmaceuticals

This chapter has presented theories that explain why countries trade in goods.

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the differentiation of goods explained the modern trade pattern better than the old models. Implicitly the differentiation of products would equal a patent or a brand of pharmaceutical products, thus the trade of goods may be described in the terms of monopolistic competition. As the products patent expires, more firms enter the market and the product becomes more of a commodity driving the profit to zero.

Krugman (1979) draw direct links between the product lifecycle theory and the trade patterns. The developed world invests in R&D that materializes in new products that they export at high prices under monopolistic competition. The products are patented or are manufactured using specialized technology. The products are produced in high wage countries and the monopoly on the product still makes it profitable. As the products patent expires or the technology becomes commonly available the developed world stops producing the good and the product becomes standardized and the product is instead imported from low wage countries.

All mentioned trade theories can offer explanations why we trade in pharmaceuticals. Both the Ricardo and Heckscher-Ohlin model would be applicable as Sweden is well endowed with high educated worker. The new trade theory may explain trade in the sense of monopolistic completion. Though the focus on this thesis is to investigate the factors that explain trade rather than the theoretical models that explain trade.
4 The pharmaceutical industry

The chapter will give a more thorough insight of the pharmaceutical industry and its characteristics. The industry is highly competitive and research intensive. The research and development in the pharmaceutical industry is lengthy; it takes between 10 to 13 years to develop a new product.

4.1 The pharmaceutical sectors importance for Sweden

The Swedish pharmaceutical sector employ’s 13 500 people and had a turnover of 70 000 million SEK in 2010. Statistics Sweden (2012e) The pharmaceutical industry is one of Sweden’s larger export sectors. The largest exporters are; road vehicles, telecommunications, paper articles, petroleum products, industrial machinery and pharmaceuticals. During the last 4 years the industry has had a position in the top 6 of the major export sectors.

During the period 2002 – 2010 the pharmaceutical industry’s export shares was approximately 6 percent of the Swedish total export. During the same period the import shares of pharmaceuticals is making up approximately 2.5 percent, creating a positive balance of trade.

The development of the pharmaceutical sector’s export and import shares can be seen in graph 4.1, starting from 1995 up to 2010. In 1995 the pharmaceutical export made up 3.2% of the total Swedish export. During the 1990s the export grew steadily and much faster than the imports of pharmaceuticals and has become more important to the Swedish trade over time. Statistics Sweden (2012c)


The value of the pharmaceutical sector’s export in 2010 was 66 000 million SEK, this means that 94% of the production value is exported. In 2010 the pharmaceutical industry had a positive balance of trade equal to 36 700 million SEK, (measured in real 2010 SEK). Statistics Sweden (2012c)
The steady increase of exports in the pharmaceutical industry has been strong, especially compared to the other three major export sectors; road vehicles, telecommunications and paper articles. These sectors have been growing in real terms but not at the same rate as the pharmaceutical export. To illustrate the real export growth of pharmaceutical compared to the three major export sectors, see graph 4.2.

![Graph 4.2](image)

**Graph 4.2** Pharmaceutical export value as volume index 1995 = 100, compared with three major export industries year 1995-2010. Volume on the Y-axis, year on the X-axis. Source; data from Statistics Sweden, graphics by the author

### 4.2 R&D and its importance for the pharmaceutical industry

Sweden is an R&D intensive country. In 2009, Swedish R&D expenditures constituted 3.59 percent of GDP. OECD (2011b) In 2009 there were 75 500 people full time employed in R&D in Sweden. The Swedish pharmaceutical industry employs 4700 people in R&D. This makes the pharmaceutical sector the third largest employer of researchers, only vehicle and the electronic sector employs more people in R&D. The pharmaceutical industry’s total cost for R&D in 2009 was 6 319 million SEK equal to 11.8 percent of the Swedish pharmaceutical sector’s aggregated turnover. In 2009 the pharmaceutical industry’s R&D was basically self financed, and only a fraction was government financed. Björkbacka and Hultgren. (2009) Almost half of the R&D was invested in developing new products, and one fifth was invested in improving excising products. Statistics Sweden (2012d), see table 4.2 for details.

Developing a new medicine is costly and risky. Out of 5 000 compounds investigated only one or two can be expected to reach the market as a product. The average cost of developing a medicine is over 10 000 million SEK. Of the few new products only some 30 percent will
produce revenues that match or exceed the R&D costs before losing the patent protection. European Federation of Pharmaceutical Industries and Associations (2010)

**Table 4.2** Swedish Pharmaceuticals R&D activity expenditure in percent 2009.

<table>
<thead>
<tr>
<th>R&amp;D activities:</th>
<th>Per cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dev. new but on the market exiting products</td>
<td>8.8</td>
</tr>
<tr>
<td>Dev. new products</td>
<td>47.3</td>
</tr>
<tr>
<td>Improvements of existing products</td>
<td>20.2</td>
</tr>
<tr>
<td>New processes and systems</td>
<td>9.9</td>
</tr>
<tr>
<td>Dev of exciting processes and systems</td>
<td>5.1</td>
</tr>
<tr>
<td>General knowledge improvement</td>
<td>8.7</td>
</tr>
</tbody>
</table>

Source: Statistics Sweden

### 4.3 Discussion, Pharmaceutical industry

The industry is very important to the Swedish economy with a strong positive balance of trade. The industry has seen a strong growth of its export during the time period. The characteristics of the industry also explain why 94 percent of the production value is exported. Seen to the cost of developing a new medicine and the small Swedish home market, it would be hard for the industry to cover the development cost on so few consumers. Thus the Swedish pharmaceutical industry is depending on the export of their products to reach a larger market to recover the investments in R&D and at best making a profit.
5 Empirical analysis

In this chapter the empirical analysis is presented. In Section 1) the method and data are presented and a detailed description of the variables that are to be investigated are also presented. In Section 2) the descriptive statistics will be presented with analyses and comments. In Section 3) the analysis method is presented. In section 4) the estimated results and analysis are presented followed by a discussion in Section 5).

5.1 Method and data

To explain the export of pharmaceuticals and which factors to investigate, previous research and theories have been analyzed and used as an influence. The effects are expected to be either positive or negative for exports. In table 5.1 the variables are presented with an explanation of how the different variables are measured.

The gravity model often offers an explanation of trade between locations. The model itself originates from Newton’s gravity law dating back to 1687. The model has been modified and used in economics to explain trade between locations, first by Stewart (1947, 1948) and then Isard in 1960 and Tinbergen in 1962 and many others.

The basic structure of the gravity equation is as follows:

\[
\text{Trade}_{ij} = C + \beta_1 Y_i + \beta_2 Y_j + \beta_3 D_{ij} + \epsilon_{ij}
\]

Trade is the trade flow from country i to j, C is a constant, \(Y_i\) is the GDP of the exporting country, \(Y_j\) is the GDP of the importing country, \(D_{ij}\) is the geographical distance between the countries and should be viewed as the logistic cost. \(\epsilon_{ij}\) is the error term that captures what can not be explained by the model. The \(\beta_1\)\(-2\)\(-3\) are parameters that have to be estimated. The trade has a positive relationship with the size of the economies, and a negative relationship with the geographical distance. (Krugman, Obstfeld 2009)

The variable \(\text{GDP}\) measures the GDP in the receiving country and therefore economic size of the market. The variable \(\text{GDP/Capita}\) measures the per capita income of the receiving country. The variable \(\text{Distance}\) measures the distance in kilometers from Sweden’s capital Stockholm to the receiving countries’ capitals and is to be seen as a proxy for transport cost. These variables are included because previous research and theories have proven them very important to explain trade patterns. The export destinations economic size and the per capita income are expected to have a positive relationship with trade, and the distance to the export location is expected to have a negative relation with trade and should be seen as transport cost. The GDP, population, GDP/Capita data are collected at UNdata\(^1\). The GDP and GDP/Capita are converted to real 2010 US dollars, using inflation data from OECD-Statistics (2012a). The distance data is provided by Mayer and Zignago (2011).

The \(\text{Exchange rate}\) variables measure the changes in the US$/SEK exchange rates. There are two exchange variables; one measures the changes in exchange rate at time t, and the second measure the changes in the exchange rates lagged one year (t-1). The reason for including these variables is because previous research has pointed to the exchange rate’s effect on export and I’m intending to investigate the direct effects as well as lagged effects of a deprecia-

\(^1\) In a few cases where data is missing, OECD or World Bank data has been used; GDP for Taiwan is collected at statistics Taiwan.
tion of the SEK. A depreciation of the SEK relative to the US Dollar is expected to have a positive effect on export. A depreciation of the SEK is also expected to have a positive relation to the pricing of pharmaceuticals, where the industry are pricing to market. The changes in the exchange rate US$/SEK, is collected from Bank of Sweden (2012).

The **Religion** variable measures the percentage of Christians in the receiving country. Religion proxies cultural similarities with Sweden. Previous research has suggested that Sweden export more pharmaceuticals to Christian countries. The religion variable indicates the percentage of the countries’ populations that are Christians; the source is US State Department's International Religious Freedom Report (2010).

The dummy variable **D\_Language** will take the value of 1 if the receiving country has English as its official language, 0 otherwise. The reason to include the language dummy is because previous research has found that Sweden trade more with English speaking countries, this information is from Mayer and Zignago (2011).

The **D\_EU** variable is a dummy variable that takes the value of 1 if the country is a member of EU at time t, 0 otherwise. The reason to include this variable is because of the European Union’s “free trade” customs union agreements that Sweden is a member of. Previous research has pointed to the importance of free trade and tariffs and red tape and its effects on trade. We expect the EU dummy to be positive on export value. The effects on price per kilo is expected to be negative as there are no tariffs or barriers of trade.

The **D\_Harbour** is a dummy variable that takes the value of 1 if the receiving country has access to the ocean through an own port, the dummy takes the value of 0 if the country is landlocked. The reason to include this variable is because transports of goods with ships are less costly than road or air transport. Previous research also showed that countries with access to the oceans trade more, thus we expect D\_Harbour to have a positive sign. The harbour parameter indicates whether the country has access to the ocean through a sea port, this information is from Mayer and Zignago (2011).

The error term captures what cannot be explained by the independent variables.

The first two variables in table 5.1 are the dependent variables that are to be explained. The focus in this thesis is on the variable **InExport\_SEK** where we measure the export value in thousands of SEK from Sweden to country j.

The second dependent variable is **InExport\_Price/Kilo**, this measures the price per kilo of pharmaceutical products, and this will explain how the industry prices their product in relation to the variables. The price per kilo is the export price per kilo in real 2010 SEK. The data is collected from Statistics Sweden.

The previous research and theories suggest what relationship one can expect between the independent variables and the dependent variables. There are nine independent variables and their expected effects on exports can be seen in Table 5.1. The effects on exports are expected to be either positive (+) or negative (-). Some of the variables have both a plus and a minus sign (+/-), and in these cases the effect are either unknown, or its effects are expected to be negligible.
Table 5.1 Dependent and independent variables to be evaluated and their hypothesized effects on export value.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Explanation</th>
<th>Expected effect, export value</th>
<th>Expected effect, export price per kilo</th>
</tr>
</thead>
<tbody>
<tr>
<td>lnExport\textsubscript{ijt}</td>
<td>ln Export from country i to country j in SEK at time t</td>
<td></td>
<td></td>
</tr>
<tr>
<td>lnExport\textsubscript{ijt}</td>
<td>ln Export from country i to country j in price per kilo at time t</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Independent variables:</td>
<td></td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>lnGDP\textsubscript{j}</td>
<td>ln GDP for country j at time t</td>
<td></td>
<td></td>
</tr>
<tr>
<td>lnGDP/Capita\textsubscript{j}</td>
<td>ln GDP/Capita for country j at time t</td>
<td></td>
<td></td>
</tr>
<tr>
<td>lnDistance\textsubscript{ij}</td>
<td>ln Distance in Km between country i and country j</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Exchangerate\textsubscript{t}</td>
<td>Change in exchange rate US$/SEK at time t</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exchangerate\textsubscript{t-1}</td>
<td>Change in exchange rate US$/SEK at time t-1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D\textsubscript{EU}</td>
<td>1 if country j was a member in EU at time t, 0 otherwise</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D\textsubscript{Harbour}</td>
<td>1 if country j has a access to the sea, 0 otherwise</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D\textsubscript{Language}</td>
<td>1 if country j has English as official language, 0 otherwise</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Religion\textsubscript{j}</td>
<td>Percentage Christians in country j</td>
<td></td>
<td>+/-</td>
</tr>
</tbody>
</table>

The pharmaceuticals export data is collected from Statistics Sweden. The export data that is analyzed is collected from the top 93 pharmaceutical export destinations. The data is annual starting with 1995 up to 2010, in all 16 years. The top 93 export destinations combined export value equals 99.97 percent of the pharmaceutical export. The export is measured in real 2010 SEK, inflation data is collected at OECD-Statistics (2012).

5.2 Descriptive statistics

The Swedish pharmaceutical industry’s export in 2010 was 66 000 million SEK, compared to 21 500 million SEK in 1995 (inflation adjusted real 2010 SEK). The analysis will examine the top 93 pharmaceutical export destinations, where their total export value makes up 99.97 percent of the total export. See graph 5.1.

The export destination countries’ export values are heavily skewed. This means that there is a smaller subset of countries that makes up for most of the export value. The top 23 destinations combined export values make up for 92.93 percent of the total export. The top 23 countries are listed in table 5.2. The next 70 export destinations ranked 24 to 93 makes up 7.04 percent of the total export value; these 70 countries are listed in the appendix.

Over the period investigated, the largest single destination is USA. The second, third and fourth largest export destinations were Germany, France and UK, see table 5.2.

Table 5.2 Swedish Pharmaceutical Top 23 export destinations, making up 92.93% of the periods total export value. Rank, country and percent shares of the total export.

<table>
<thead>
<tr>
<th>Rank</th>
<th>Country</th>
<th>Percent shares</th>
<th>Rank</th>
<th>Country</th>
<th>Percent shares</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>United States</td>
<td>17.84</td>
<td>13</td>
<td>Japan</td>
<td>2.91</td>
</tr>
<tr>
<td>2</td>
<td>Germany</td>
<td>12.73</td>
<td>14</td>
<td>Netherlands</td>
<td>1.53</td>
</tr>
<tr>
<td>3</td>
<td>France</td>
<td>10.71</td>
<td>15</td>
<td>Turkey</td>
<td>1.18</td>
</tr>
<tr>
<td>4</td>
<td>United Kingdom</td>
<td>6.89</td>
<td>16</td>
<td>Greece</td>
<td>1.18</td>
</tr>
<tr>
<td>5</td>
<td>Belgium</td>
<td>5.40</td>
<td>17</td>
<td>China</td>
<td>0.87</td>
</tr>
<tr>
<td>6</td>
<td>Norway</td>
<td>5.09</td>
<td>18</td>
<td>Mexico</td>
<td>0.76</td>
</tr>
<tr>
<td>7</td>
<td>Spain</td>
<td>4.37</td>
<td>19</td>
<td>Switzerland</td>
<td>0.75</td>
</tr>
<tr>
<td>8</td>
<td>Canada</td>
<td>4.20</td>
<td>20</td>
<td>Saudi Arabia</td>
<td>0.69</td>
</tr>
<tr>
<td>9</td>
<td>Australia</td>
<td>3.99</td>
<td>21</td>
<td>Austria</td>
<td>0.67</td>
</tr>
<tr>
<td>10</td>
<td>Italy</td>
<td>3.95</td>
<td>22</td>
<td>Taiwan</td>
<td>0.57</td>
</tr>
<tr>
<td>11</td>
<td>Denmark</td>
<td>3.28</td>
<td>23</td>
<td>Brazil</td>
<td>0.54</td>
</tr>
<tr>
<td>12</td>
<td>Finland</td>
<td>3.16</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Statistics Sweden

In 2010 the mean price per kilo was 1361 SEK, compared to 1096 SEK in 1995 (inflation adjusted real 2010 SEK).
Sweden became a member of the European Union in 1995. Comparing the export data from 1994 to the exports in 2010 reveals whether there have been any general changed patterns in the trade after entering the customs union. In 2010 the largest export market for Swedish pharmaceuticals was the European Union and its members, their imports equal 39 160 million SEK accounting for 59 percent of the total export. In 1994 the same countries aggregated import was 14 800 million SEK$^2$ accounting for 65 percent of the total export. Indicating that the EU countries import share has decreased since Sweden entered the customs union. In 2010 the average price per kilo for the European members was 928 SEK. The same countries average price per kilo in 1994 was 1119 SEK, this means that the real price per kilo for EU members has decreased since Sweden became a member of the customs union. In 2010 the average price per kilo for the non European Union members was 1213 SEK, and in 1994 it was 960 SEK. Thus the average price per kilo to the non European Union has increased during the same period.

In 2010 the average export of Swedish pharmaceuticals to the 16 English speaking countries was 1 630 million SEK, compared to 563 million SEK for the other 77 countries. This suggests that the English speaking countries import 2.4 times more in average. Two large export destinations are the United States and the United Kingdom and they are both English speaking. If the United Kingdom and the United States would be excluded from the data then the figures would be the opposite, the remaining 14 English speaking countries would import in average 17 percent less than the other countries.

Of the top 93 export destinations 84 countries have access to the ocean through a sea port and 9 countries are landlocked. The countries that have access to the oceans through a sea port imported Swedish pharmaceuticals for 785 million SEK in average in 2010, compared to the landlocked countries’ average of 198 million SEK. The countries with a port imported in average 3.9 times more than the land locked countries. The price per kilo was 1029 SEK compared to 933 SEK for the landlocked countries. When analyzing the same data from year 1995, the average import value was 253 million SEK compared to 105 million SEK for the landlocked countries. In 1995 the average import value was thus 2.4 times more for the countries with access to the oceans. The price per kilo was 1066 SEK compared to 1045 SEK for the landlocked countries. Access to a port implies lower transport costs compared to other means of transport, though when it comes to pharmaceuticals the effect of a sea port on the price seems to have become less important over time.

The export destinations’ GDP and the export of pharmaceuticals are highly correlated at 76 percent. This means that there is a strong positive relation between GDP and export of Swedish pharmaceuticals. The same pattern can be seen between GDP/Capita and export of pharmaceuticals, but with a lower correlation at 18 percent. The export of pharmaceuticals and distance to the importing country depicts the opposite relation at 14 percent. This negative correlation means; as the distance increases the export decreases. The descriptive statistics is presented in table 5.3. In the descriptive statistics the minimum-, maximum-, mean- and median values are presented as well as the standard deviation and the numbers of observations for each of the estimates.

---

$^2$ Measured in inflation adjusted real 2010 SEK
Table 5.3 Descriptive statistics table of the estimates.

<table>
<thead>
<tr>
<th>Top 93 export destinations:</th>
<th>#Obs</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>Median</th>
<th>Std Dev</th>
</tr>
</thead>
<tbody>
<tr>
<td>Export Value 2010</td>
<td>91</td>
<td>58</td>
<td>8186131</td>
<td>727363</td>
<td>71468</td>
<td>1725680</td>
</tr>
<tr>
<td>Export Value 1995</td>
<td>90</td>
<td>3.6</td>
<td>3122673</td>
<td>238664</td>
<td>24935</td>
<td>557195</td>
</tr>
<tr>
<td>Price per kilo 2010</td>
<td>89</td>
<td>40.9</td>
<td>8305</td>
<td>1361</td>
<td>1032</td>
<td>1343</td>
</tr>
<tr>
<td>Price per kilo 1995</td>
<td>85</td>
<td>7.1</td>
<td>7756</td>
<td>1096</td>
<td>678</td>
<td>1238</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Top 23 export destinations:</th>
<th>#Obs</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>Median</th>
<th>Std Dev</th>
</tr>
</thead>
<tbody>
<tr>
<td>Export Value 2010</td>
<td>368</td>
<td>160033</td>
<td>8186131</td>
<td>2655085</td>
<td>1642107</td>
<td>2635544</td>
</tr>
<tr>
<td>Export Value 1995</td>
<td>368</td>
<td>74382</td>
<td>3122673</td>
<td>847033</td>
<td>643700</td>
<td>85527</td>
</tr>
<tr>
<td>Price per kilo 2010</td>
<td>368</td>
<td>217.02</td>
<td>4555</td>
<td>1170</td>
<td>1528</td>
<td>1228</td>
</tr>
<tr>
<td>Price per kilo 1995</td>
<td>368</td>
<td>243.5</td>
<td>7756</td>
<td>1875</td>
<td>1461</td>
<td>1784</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Low 24th – 93rd export destinations:</th>
<th>#Obs</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>Median</th>
<th>Std Dev</th>
</tr>
</thead>
<tbody>
<tr>
<td>Export Value 2010</td>
<td>68</td>
<td>58</td>
<td>607608</td>
<td>75340</td>
<td>24300</td>
<td>110883</td>
</tr>
<tr>
<td>Export Value 1995</td>
<td>67</td>
<td>3.6</td>
<td>156426</td>
<td>29821</td>
<td>9022</td>
<td>39681</td>
</tr>
<tr>
<td>Price per kilo 2010</td>
<td>66</td>
<td>40.9</td>
<td>8305</td>
<td>1302</td>
<td>909.7</td>
<td>1385</td>
</tr>
<tr>
<td>Price per kilo 1995</td>
<td>62</td>
<td>7.1</td>
<td>4015</td>
<td>807.2</td>
<td>565.4</td>
<td>806.7</td>
</tr>
</tbody>
</table>

Export in real thousand SEK (2010)
Price per kilo is in real SEK (2010)

5.3 Method of analysis

The method used to analyze the Swedish export of pharmaceuticals is panel regression estimating random effects. The equations that will be estimated are the following:

Regression 5.1

\[
\ln\text{Export}_{it}^{\text{SEK}} = \alpha + \beta_1\ln\text{GDP}_{jt} + \beta_2\ln\text{GDP/Capita}_{jt} + \beta_3\ln\text{Distance}_{ij} + \beta_4\text{ExchangeRate}_i + \beta_5\text{ExchangeRate}_{11} + \beta_6\text{EU} + \beta_7\text{Harbor} + \beta_8\text{Language} + \beta_9\text{Religion}_j
\]

The regression above is the focus of the thesis analysis as it explains the value of the export measured in thousand SEK.

Regression 5.2

\[
\ln\text{Export}_{ij}^{\text{Price/Kilo}} = \alpha + \beta_1\ln\text{GDP}_{jt} + \beta_2\ln\text{GDP/Capita}_{jt} + \beta_3\ln\text{Distance}_{ij} + \beta_4\text{ExchangeRate}_i + \beta_5\text{ExchangeRate}_{11} + \beta_6\text{EU} + \beta_7\text{Harbor} + \beta_8\text{Language} + \beta_9\text{Religion}_j
\]

The regression above will explain the price per kilo. The price per kilo is calculated by dividing the export value in SEK with the export in weight. The price per kilo estimates will give an indication how a variable affects the pricing of pharmaceuticals.

The analysis will examine the pharmaceutical top 93 export destinations, their export value makes up 99.97 percent of the total export. The countries’ export values are heavily skewed. For this reason I have decided to make three estimates. One estimate of the top 93 export destinations as well as dividing the countries into two groups, one for the larger and one for the smaller export destinations. The division of the groups is done arbitrary. The two groups’ estimates will tell us if the factors have the same effects on the larger and smaller export destinations.

The first estimate containing the top 93 destinations; a second estimate of the top 23 export destinations, their combined export value accounting for 92.93 percent of the total export.
And a third estimate of the next 70 export destinations ranking 24th to 93rd, their combined export value accounting for 7.04 percent of the total export.

5.4 Results & analysis

In this section the estimated results of the regressions will be presented. The focus will be on regression 5.1 where the export value in SEK is the dependent variable. The parameter estimation result from regression is displayed in table 5.4.

Table 5.4 Estimates of parameters in Regression 5.1 Export in thousand SEK is the dependent variable.

<table>
<thead>
<tr>
<th>Variables</th>
<th>All 93 export destinations</th>
<th>Top 23 export destinations</th>
<th>Low 24-93 export destinations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coefficient</td>
<td>t-Stat</td>
<td>Coefficient</td>
</tr>
<tr>
<td>α</td>
<td>-14.42</td>
<td>-7.07**</td>
<td>-1.67</td>
</tr>
<tr>
<td>lnGDPij</td>
<td>1.08</td>
<td>20.13**</td>
<td>0.48</td>
</tr>
<tr>
<td>lnGDP/Capita_{jt}</td>
<td>0.14</td>
<td>1.83*</td>
<td>0.50</td>
</tr>
<tr>
<td>lnDistance_{ij}</td>
<td>-0.56</td>
<td>-3.04**</td>
<td>-0.53</td>
</tr>
<tr>
<td>Exchangerate_{ti}</td>
<td>0.45</td>
<td>2.86**</td>
<td>0.35</td>
</tr>
<tr>
<td>Exchangerate_{t-1}</td>
<td>0.9</td>
<td>5.69**</td>
<td>0.87</td>
</tr>
<tr>
<td>D^EU</td>
<td>0.01</td>
<td>0.09</td>
<td>0.01</td>
</tr>
<tr>
<td>D^Harbour</td>
<td>0.52</td>
<td>1.14</td>
<td>1.36</td>
</tr>
<tr>
<td>D^Language</td>
<td>0.6</td>
<td>1.65*</td>
<td>0.89</td>
</tr>
<tr>
<td>Religion_{ij}</td>
<td>0.33</td>
<td>0.78</td>
<td>0.13</td>
</tr>
<tr>
<td>F-Statistics</td>
<td>55.2**</td>
<td>81.7**</td>
<td>16.11**</td>
</tr>
<tr>
<td>R^2</td>
<td>25.6</td>
<td>67.3</td>
<td>12.0</td>
</tr>
<tr>
<td>Adj.R^2</td>
<td>25.1</td>
<td>66.5</td>
<td>11.1</td>
</tr>
<tr>
<td>DW</td>
<td>1.89</td>
<td>2.00</td>
<td>1.88</td>
</tr>
<tr>
<td>#obs:</td>
<td>1457</td>
<td>368</td>
<td>1089</td>
</tr>
<tr>
<td>Percent export value:</td>
<td>99.97</td>
<td>92.93</td>
<td>7.04</td>
</tr>
</tbody>
</table>

** means significant at 5% significance level
* means significant at 10% significance level


In Table 5.4 one can see that all F-values are statistically significant. The R^2 of the 93 export destinations is 25.6 percent. The top 23 export destinations R^2 is high and indicates that the independent variables can explain 67.3 percent of the changes in the dependent variable; “the

3 “All” 93 export destinations, making up 99.97 percent of the total export value.

4 The model has been tested for robustness where independent variables have been excluded, the signs remain the same but the values change.
export value measured in thousand SEK”. The lower group has a relatively low $R^2$ at 12 percent.

The top 23 export destinations have a high $R^2$, and 7 of the independent variables are statistically significantly different from 0 at the 5 percent level. Only two of the variables are not significant at the 5 percent level. The two variables that are not significant are the EU dummy, and the religion variable.

The GDP and GDP/Capita are both positive, as expected. This means that an increase in GDP and higher welfare equals more imports of Swedish pharmaceuticals. The distance variable carries a negative sign as expected, meaning that the further away an export destination is, the less pharmaceutical it imports.

The change in exchange rate at time 0 is significant. This is also true for the changes in exchange rate in the previous year (t-1), where the latter has a larger impact on the export, meaning that a depreciation of the SEK equals an increase in pharmaceutical exports.

The harbor dummy variable is positive as expected. Meaning that having access to the ocean increase the countries import of Swedish pharmaceuticals.

The EU Dummy is neither economically nor statistically significant, this finding is also in line with the analysis of the data in the descriptive statistics section. This means that lower tariffs and trade liberalization has had no effect on the Swedish export of pharmaceuticals.

The variable “language” is significant at the 5 percent level. Meaning that Sweden export more pharmaceuticals to English speaking countries. The religion variable is not statistically significant. Meaning that sharing a common religion has no effect at export of pharmaceuticals.

Comparing the result with the low (24-93) group one can see that the only two of the variables are significant at the 5 percent level; the variables are GDP and the lagged exchange rate. At the 10 percent level GDP/Capita and the exchange rate are significant and carries the right signs. One can also see that the EU and religion variable are not economically significant or statistically significant, this is the same result as in the top 23 export destinations.

The distance variable is negative as expected, though not significant with a low t-value. The harbour variable is positive as expected but not significant, one explanation for this would be that small volumes are transported with trucks and airfreight rather than ships. The language variable is positive, but not significant as it was in the top 23 destinations.

**Price per kilo estimations:**

In regression 5.2 the price per kilo is estimated. The regression gives an indicator of the factors that determines the pricing of the pharmaceutical products. In Table 5.5 the results of regression is presented:
Table 5.5 Estimates of parameters in Regression 5.2, Exports price per kilo as the dependent variable

<table>
<thead>
<tr>
<th>Variables</th>
<th>All 93 export destinations</th>
<th>Top 23 export destinations</th>
<th>Low 24-93 export destinations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coefficient</td>
<td>t-Stat</td>
<td>Coefficient</td>
</tr>
<tr>
<td>$\alpha$</td>
<td>-2.79</td>
<td>2.40**</td>
<td>-1.56</td>
</tr>
<tr>
<td>$\ln \text{GDP}_{it}$</td>
<td>0.18</td>
<td>4.07**</td>
<td>0.21</td>
</tr>
<tr>
<td>$\ln \text{GDP/Capita}_{it}$</td>
<td>0.10</td>
<td>1.97**</td>
<td>0.08</td>
</tr>
<tr>
<td>$\ln \text{Distance}_{ij}$</td>
<td>0.46</td>
<td>6.01**</td>
<td>0.36</td>
</tr>
<tr>
<td>$\text{Exchangerate}_{i}$</td>
<td>0.50</td>
<td>2.96**</td>
<td>0.42</td>
</tr>
<tr>
<td>$\text{Exchangerate}_{i,t-1}$</td>
<td>0.78</td>
<td>3.82**</td>
<td>0.45</td>
</tr>
<tr>
<td>$D_{EU}$</td>
<td>-0.33</td>
<td>-2.13**</td>
<td>0.09</td>
</tr>
<tr>
<td>$D_{\text{Harbour}}$</td>
<td>0.11</td>
<td>0.30</td>
<td>-0.73</td>
</tr>
<tr>
<td>$D_{\text{Language}}$</td>
<td>-0.16</td>
<td>-0.92</td>
<td>0.26</td>
</tr>
<tr>
<td>Religion$_j$</td>
<td>0.16</td>
<td>0.64</td>
<td>-0.02</td>
</tr>
</tbody>
</table>

F-Statistics     | 13.14** | 21.7** | 10.08** |
R$^2$:            | 7.94 | 35.4 | 8.31 |
Adj. R$^2$:       | 7.34 | 33.6 | 7.49 |
DW:               | 1.80 | 1.98 | 1.80 |
#obs:             | 1380 | 368 | 1012 |
Percent export value: | 99.97 | 92.93 | 7.04 |

** means significant at 5% significance level  
* means significant at 10% significance level  

Regression 5.2 estimated the relation between the exports’ price per kilo and its relation to the dependent variables. In Table 5.5 one can see that the F-values are all statistically significant. The R$^2$ of the top 93 export destinations is low at 7.94 percent. The top 23 export destinations R$^2$ is higher and indicates that the independent variables can explain 35.4% of the changes in the dependent variable; “the export price per kilo”.

The top 23 export destinations R$^2$ is high, but 2 of the 7 independent variables are significant at the 5 percent level. The 2 variables that are not significant are the EU dummy, and the religion variable. The GDP and GDP/Capita have the right sign; they have a positive relation

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5 “All” 93 export destinations, making up 99.97 percent of the total export value.

6 The model has been tested for robustness where independent variables have been excluded, the signs remain the same but the values change.
with the price. Meaning that the pharmaceutical industry are pricing to market, an increase in GDP & GDP/Capita equals a higher price on the products.

The distance variable is positive as expected, and it is also significant. An increase in the distance to the export destination equals that the export value of the product is higher.

The changes in exchange rate, both at time t and lagged (t-1) have a large impact on the pricing. This indicates that the industry are actively pricing to market, where they use a depreciation not only to increase market shares but also to increase the markup.

The EU variable is not significant in the top 23 export destinations. This indicates that the internal market with no tariffs and trade barriers has no effect on the price to the larger export destinations. As expected, the religion variable has no effect on price per kilo.

The harbour variable indicates that having access to an ocean equals lower price per kilo, this is in line with expectations. Ships are the most economical mean of transport for larger volumes.

Comparing the result with the low (24-93) export destination group one can see that 4 of the 9 variables are significant at the 5 percent level, and one variable at the 10 percent level. This indicates that the pricing of pharmaceuticals is consistent also in the lower group. The religion variable had no effect in the top 23 group and it has no effect in the low group.

The EU dummy variable estimates are ambiguous, in the top group it is neither statistically nor economically significant, but in the low group it indicates that countries that are EU members pay a lower price per kilo. The language variable is also ambiguous; the smaller export destinations pay a lower price per kilo if they have English as their official language.

The harbour variable is positive, and not significant in the low group. One can only speculate why. Transport by ship is economical for larger volume, the smaller export destinations may use trucks or airfreight as their volumes are smaller.

5.5 Discussion of the results

When comparing the results with Andersson (2007) and Hacker and Einarsson, (2003) the pharmaceutical export follows their findings. The market size is of importance, and the physical distances are also an important factor. The estimates of the GDP and the GDP/Capita have a positive relation to export value and the distance parameter has a negative relation to the export value and the findings are all in line with their results.

Comparing the results with Andersson (2007) who also found that Sweden trade more with English speaking countries. The language variable was significant in the top 23 destinations export value; this result is in line with previous research. Sweden exports more pharmaceuticals to English speaking countries, all else equal. Adolfsson (2007) found that sharing the same religion had positive effects on export of pharmaceuticals. The results do not agree with that finding. The religion variable was not significant and did not explain export value or pricing in any of the estimates. This indicates that the customers do not care where the goods were manufactured; cultural similarities are not of importance when it comes to pharmaceuticals. The implication of this would be that religious similarities should not be a factor when pharmaceutical firms are making decisions on market commitments.
Comparing the results with Baier and Bergstrand (2001) and Badinger and Breuss (2003) the results for pharmaceuticals do not fully agree with their findings. The trade liberalization and lower tariffs do not explain exports of pharmaceuticals. Adolfsson (2007) found that EU had a negative effect on export of pharmaceuticals. The EU variable represent the customs union that Sweden is a member of, it also equals trade liberalisations as well as no tariffs on the internal market. The EU variable is close to zero and it is not significant in explaining export value. One may only speculate why trade liberalization has no effect on pharmaceuticals. One reason may be that this type of good is patented and there is little competition from substitutes.

Comparing the results with Hacker and Hatemi-J (2003), who found that the changes in the exchange rate affect the trade for the small Nordic countries. Athukorala and Menton (1995) found that firms use the exchange rates as a means to be more efficient in pricing to market, thus increasing their market shares as well as their margins. The result are fully in line with their findings, the changes in exchange rates both at time t and lagged one year (t-1) are significant as well as having an relatively large effect on explaining export of pharmaceuticals as well as pricing. This indicates that pharmaceuticals industry are actively pricing to market as noticed by Athukorala and Menton.

The results shows that the export value can be explained by the same variables as most other goods. The variables that explain export value to the larger export destinations are highly significant giving a good indication of the factors that matters. The factors that have a positive effect on export value are: GDP, GDP/Capita and the exchange rate both at time t and lagged one year, and also the harbour and the language variable. The distance variable has a negative effect on trade in the top 23 destinations.

The factors that explain pricing of pharmaceutical are more consistent in the larger and smaller export destinations. This is to be expected as the export firms are setting the prices of the products. The factors that increase the price per kilo are: GDP, GDP/Capita, Distance and the exchange rate both at time t and lagged one year. The factor that decreases the price for the larger export destinations is access to a harbour. The factors that decrease the price per kilo for the smaller export destination are the EU variable and the language variable.
6 Conclusion and suggestions for further research

The purpose of this thesis is to investigate which factors that affected the Swedish export of pharmaceutical products. In doing so, data from 16 years starting with 1995 up to 2010 has been analyzed. The data was mainly collected at Statistics Sweden, UNdata, and OECD.

The analysis shows that a relatively small subset of export destinations makes up almost 93 percent of the total export value. The empirical findings show that the GDP is one of the most important factors explaining export value of pharmaceuticals. The GDP/Capita where the population size is taken into account is also important. The physical distances to the export destinations are still of important explaining export pattern in this industry as there is an inverse relationship between distance and export. The price per kilo of the pharmaceuticals is positively related to GDP, GDP/Capita and the distance to the destination country.

Even though the EU is the largest export market for Swedish pharmaceuticals, there is no statistical evidence that the customs union in itself has any effects on the export value of pharmaceuticals. However, the results show that the smaller export destinations who are members of the customs union are paying a lower price per kilo than other countries. Sweden export more pharmaceuticals to English speaking countries.

The changes in the exchange rate explain export value of pharmaceuticals. The effects are direct as well as lagged where previous years changes have the most impact on both export value and price per kilo. A depreciation of the SEK has positive effects on the export, where they also use the depreciation as a mean to compete as well as increase their margins.

A cultural similarity as sharing a common religion has no effect at all on the export value or the pricing of pharmaceuticals.

The thesis set out to investigate what factors affects the export of pharmaceuticals. The results suggest that pharmaceutical export can be explained by the same factors as most other goods.

There may be several theoretical models explaining why Sweden trade in pharmaceuticals. Sweden is a research intensive country. Arguable Sweden has a comparative advantage in R&D intensive goods like pharmaceuticals. There for Ricardo’s and Heckscher-Ohlin’s trade models may explain export of pharmaceuticals. The new trade theory may also explain trade in pharmaceuticals, where the goods are patented or branded as in monopolistic competition. The Swedish pharmaceutical industry export 94 percent of its production value. The reason why the Swedish pharmaceutical industry is export oriented can also be explained by the characteristics of the industry. The cost of developing a new product is high (10 000 million SEK) and the Swedish market small, to recover the R&D investment and at best make a profit the pharmaceutical industry need a larger market, thus exporting.

Suggestion for further research; the exchange rate has been relatively important in explaining export growth in the Swedish pharmaceutical sector. From this angle it would be interesting to see how the currency explains pharmaceutical export in the Euro countries and in the USA.
7 List of References


OECD. (2011b) Main Science and Technology Indicators (MSTI) 2011/2 edition


### Appendix

List of countries included in the analysis:

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