Does Trade Matter for Economic Growth?  
Empirical Evidence from the Scandinavian Countries

Desislava Borisova  
desislava.borisova.760@student.lu.se

Abstract: The debate about the link between economic growth and foreign trade is still open amongst scholars. There exist four main hypotheses regarding the relation between imports, exports and economic growth. The first one states that growth can come only through increasing the volume of exports of the country, i.e. export – led – growth hypothesis. The second one (growth – led – exports hypothesis) suggests that growth is an endogenous process and only after reaching certain level of development, the country should start exporting. The last two hypotheses are the import – led – growth and the growth – led – imports hypothesis. The former states that an increase in imports, for example highly technological goods can bring economic growth through knowledge spillovers and increased productivity. The latter argues that imports increase due to achieved economic advance.

This paper examines whether the economic growth in Denmark, Norway and Sweden follows any of the four hypotheses for the time between 1980 and 2007. This research shows relationship between growth and trade volumes for Sweden and Denmark and provides contradicting results for Norway.

Key words: Imports, exports, economic growth, VAR model, Granger causality
# Table of contents:

List of tables ...........................................................................................................3

List of graphs and figures ......................................................................................5

1. Introduction ........................................................................................................6

2. Theoretical background.....................................................................................8
   2.1. Trade-provoked growth................................................................................8
      2.1.1. Export-led growth hypothesis.................................................................9
      2.1.2. Import-led exports hypothesis...............................................................10
   2.2. Growth-provoked trade...............................................................................10
      2.2.1. Growth-led exports hypothesis...............................................................11
      2.2.2. Growth-led-imports hypothesis.............................................................12

3. Past empirical research....................................................................................12

4. Countries’ economic profiles........................................................................18
   4.1. Denmark.......................................................................................................18
   4.2. Sweden.......................................................................................................20
   4.3. Norway.......................................................................................................21

5. Data..................................................................................................................23

6. Methodology....................................................................................................24

7. Results and discussion....................................................................................31

8. Robustness check............................................................................................42

9. Conclusion.........................................................................................................49

References ...........................................................................................................53

Appendix A ..........................................................................................................56

Appendix B..........................................................................................................59

Appendix C..........................................................................................................61

Appendix D..........................................................................................................64
List of tables

Table 1: Results from Model 2, Model 3 and Model 4 of Johansen cointegration test for Norway, 1980 – 2007, 2 lags specification.

Table 2: Results from Model 2, Model 3 and Model 4 of Johansen cointegration test for Sweden, 1980 – 2007, 1 lag specification.

Table 3: Results from Model 2, Model 3 and Model 4 of Johansen cointegration test for Sweden, 1980 – 2007, 2 lags specification.

Table 4: Results from Model 2, Model 3 and Model 4 of Johansen cointegration test for Denmark, 1980 – 2007, 1 lag specification.

Table 5: Results from Model 2, Model 3 and Model 4 of Johansen cointegration test for Denmark, 1980 – 2007, 2 lags specification.

Table 6: Results from Model 2, Model 3 and Model 4 of Johansen cointegration test for Denmark, 1980 – 2007, 3 lags specification.

Table 7: Granger causality test on differenced series (growth rates) of imports, exports and GDP for Norway, 1980 - 2007

Table 8: Granger causality test on differenced series (growth rates) of imports, exports and GDP for Sweden. 1980 - 2007

Table 9: Granger causality test on differenced series (growth rates) of imports, exports and GDP for Denmark, 1980 - 2007

Table 10: Alpha (short run) coefficients from VECM

Table 11: Beta (long run adjustment) coefficients from VECM

Table 12: PP and KPSS tests on TFP, Exports and Imports in levels and differences, Sweden, 1980 - 2007

Table 13: Granger causality test on differenced series (growth rates) of imports, exports and TFP for Sweden, 1980 - 2007

Table 14: PP and KPSS tests on TFP, Exports and Imports in levels and differences, Sweden, 1980 - 2007
Table 15: Granger causality test on differenced series (growth rates) of imports, exports and TFP for Norway, 1980 - 2007

Table 16: PP and KPSS tests on TFP, Exports and Imports in levels and differences, Denmark, 1980 - 2007

Table 17: Granger causality test on differenced series (growth rates) of imports, exports and TFP for Denmark, 1980 - 2007

Table D1: ADF, BG, PP and KPSS tests on GDP, Exports and Imports in levels, Sweden, 1980 - 2007

Table D2: ADF, BG, PP and KPSS tests on GDP, Exports and Imports in first differences, Sweden, 1980 - 2007

Table D3: ADF, BG, PP and KPSS tests on GDP, Exports and Imports in levels, Norway, 1980 - 2007

Table D4: ADF, BG, PP and KPSS tests on GDP, Exports and Imports in first differences, Norway, 1980 - 2007

Table D5: ADF, BG, PP and KPSS tests on GDP, Exports and Imports in levels, Denmark, 1980 - 2007

Table D6: ADF, BG, PP and KPSS tests on GDP, Exports and Imports in first differences, Denmark, 1980 – 2007
List of graphs and figures:

Figure A1: Top 10 Export partners of Sweden in 2012, as a percentage of total exports for the current year.

Figure A2: Top 10 Import partners of Sweden in 2012, as a percentage of total exports for the current year.

Figure A3: Top 10 Export partners of Norway in 2012, as a percentage of total exports for the current year.

Figure A4: Top 10 Import partners of Norway in 2012, as a percentage of total exports for the current year.

Figure A5: Top 10 Export partners of Denmark in 2012, as a percentage of total exports for the current year.

Figure A6: Top 10 Import partners of Denmark in 2012, as a percentage of total exports for the current year.


Graph 4: Total factor productivity (TFP) for Sweden, Norway and Denmark, 1980 – 2007.

Graph B1: Growth rates of Exports, Imports and GDP for Denmark, 1980 – 2008


Graph B3: Growth rates of Exports, Imports and GDP for Norway, 1980 – 2008

Graph C1.1: Volumes of Exports, Imports and GDP for Sweden, 1980 – 2008, bln of national currency for 2005 constant prices, seasonally unadjusted
Does trade matter for economic growth? Evidence from the Scandinavian countries

1. Introduction

According to the Governor of Bank of England Mervyn King, the financial crisis of 2007-2008 is the worst since the Great Depression in the 1930s (Telegraph, 2013). The drop in many country’s GDP and the economic slowdown brought up the question to what could be done in order to get the economy back on track. One of the fairly advocated suggestions is that the countries should increase their trade on foreign markets. A contradicting theory is that causes for growth can come firstly within the country itself and later on, after satisfying the home market, the country can start exporting. The purpose of this dissertation is twofold. The first task is to examine the nexus between international trade and economic growth for the three Scandinavian countries – Denmark, Norway and Sweden. The second task is to draw political implications from the obtained results.

The three countries have been amongst the richest in Europe for the last 60 years, as also remain amongst the wealthiest after the crisis. All share similar economic conditions and have their economies strongly embraced with foreign trade. This paper will examine the relation between their economic growth and volumes of their international trade for the period from 1980 to 2007. The interest in the period is due to the fact that the countries have gradually increased their GDP and also because two main determinants of trade has changed – the first one is the increased number of country markets and the second one is the ease with which trade can happen in the face of the newly widespread telecommunication technologies.

In the 1960s and 1970s many countries obtained their independence from their colonisers (Read, 2008). For the older countries this led to increased possibilities to conduct trade and foreign affairs with many new foreign markets. Due to the fact that after their occurrence the new countries are supposed to be unstable in terms of persistent political decisions and international trade policies, this paper assumes that at the beginning of the examined period all the new countries have taken their
position on the international markets. The second significant change which distinguishes the new trade reality from the one before 1980s is the widespread of computers, internet and wireless communication technologies. Through easing the access to information and the ability to communicate, the realization of international transactions and orders have never been easier.

The paper focuses on the relationship between exports, imports and economic growth (which is measured by two different determinants) and tries to examine which theoretical relation between the variables is more suitable for the Scandinavian case. The four relations are as follows: export-led growth, growth-led exports, imports-led growth and growth-led imports.

David Ricardo’s comparative advantage theory suggests that through opening trade countries would achieve gains (Alhajhoj, 2007). His model suggests export-led growth type of framework, where each country can optimize its profits through specializing in the production of a single product. The same applies to other countries which would specialize in the manufacturing of other goods. Through exchange, each of the countries would benefit from the better quality of the traded goods and also realize profits due to the weak competition in the chosen product or service of specialization. This way both nations would be better off. Proponents of the neoclassical trade theory, which supports the idea of growth-led exports, suggest a causal relationship from country’s endowments and productivity towards export (Ramos, 2001). Once the country has satisfied its national market, it would export the excess goods, as also it would export a country-specific good, which is rare or scarce in other countries. An explanation of the import-led growth hypothesis is that as most of the countries do not possess all the resources they need in order their economies to function properly, they are forced to seek those resources though international trade. After obtaining them, they can realize economic growth and increase their development. Another channel through which imports can promote economic growth is through the import of high technological products that would bring the country knowledge spillovers and would increase productivity. As the countries become richer over time, they may exhibit increased demand for consumption, which can only be satisfied through an increased volume of imports. This can be a possible explanation for the growth-led imports theory.
The paper will proceed in the following order: Section II describes the theoretical relationship between GDP, imports and exports, Section III presents results from previous empirical work on the subject, Section IV provides the economic profiles of the three countries, Section V and VI discuss the methodology and data used, Section VII discussed the obtained results, Section VIII provides a Robustness check of the results and Section IX concludes.

2. Theoretical background

2.1. Trade-provoked growth

Proponents of international trade theory argue that trade between countries promote economic growth. The most commonly used frameworks used to explain the benefits of trade, are the Ricardian and Heckschel – Ohlin model\(^1\). In order to explain the gains from trade, Ricardo introduces the concept of comparative advantage in factor productivity which a country has. Assume that country A and country B produce the same good \( G_1 \) at different costs. Country A has comparative advantage in producing good \( G_1 \), if it produces it at lower opportunity costs\(^2\) than country B. Assume that there exists another good - \( G_2 \), for which country B has the comparative advantage. If both countries A and B specialize in the production of the goods, in which productions they face the smallest opportunity costs and thus are most efficient, both countries will be better off if they exchange the produced goods with one another (Krugman et al., 2011). For example, the Scandinavian countries are capital abundant and thus will be better off if they specialize in the production of capital-intensive goods. Asian countries, on the other hand, have lots of cheap labour and thus for them it will be more beneficial if they specialize in the production of labour-intensive goods. Through trade, Scandinavian countries can obtain the labour-intensive goods at a lower price, in comparison if they have to produce the good themselves, paying higher wages to the workers. This way, after obtaining the good cheaper, they will be able to free their labour force and employ it in more beneficial sectors such as services or some country specific sectors. If Asian countries import capital-intensive goods from Scandinavia, they will also be better off because they can have the

\(^{1}\) Both models assume free trade amongst the participants and thus do not account for any trade barriers such as taxes or transport costs, etc.

\(^{2}\) Opportunity costs include not only direct inputs for production, but also costs such as time, quality etc.
goods cheaper and can free their own capital for other purposes – for example investment.

Heckscher – Ohlin develops the Ricardian framework further, but this time discusses the comparative advantage which countries have in terms of country endowments. As geographically, the countries have different characteristics (lakes, climate, forests, ores etc.) they are entitled to different amounts of natural resources. The model sets the comparative advantage in terms of factor endowments. Assume country A has plenty of resource $R_1$ and less of resource $R_2$. The country produces good $G_1$, using its $R_1$ and good $G_2$, using its $R_2$. As the resource $R_1$ is easily found in the country, its price is cheaper than the price of resource $R_2$. Thus, the production of good $G_1$ will be cheaper than the production of $G_2$ which uses the more expensive resource.

Country A has comparative advantage in producing good $G_1$. Applying the same logic for country B, which have abundance in resource $R_2$ and not big quantity of resource $R_1$, the country will have comparative advantage in producing good $G_2$. Both countries will be better off with trading as they will gain more for the price of their resources in comparison with if they produce the wanted goods with their less abundant resource (Krugman et al., 2011). For example, for the case of Norway, the large presence of oil in the North Sea gave comparative advantage of the country for producing oil products as also exporting oil. As one of the main trade partners of the country is the United Kingdom (look at Figure A3 and Figure A4 in Appendix A), Norway is better off exporting petrol for UK and importing, for example English tea than to produce the good by itself.

The two theories suggest that a country is always better of when trades with another country to which it has comparative advantage in either factor productivity or resource endowments. Through trade, the country can realize economic gains and to increase its level of growth.

2.1.1. Export-led growth hypothesis:

Although the above theories explained how imports and exports lead to economic growth, this subsection will focus more on the export side of the trade relations. The idea behind this hypothesis is that the increase in exports would increase the economic advance of the country. The openness to foreign markets has several benefits amongst which are the knowledge and technology spill-overs. As the firms
have to be competitive with the foreign companies they will try producing high
technology goods with better characteristics. Thus, companies will invest in high-tech
products which would lead to a spillover effect within the national borders and would
eventually increase GDP. Another benefit is that when countries start to export, they
will try to diversify their product, which would expand their production and would bring
more employment to the market. Trade can provide foreign exchange, which could
be used to import intermediate goods for production. Amongst other benefits are:
more efficient resource allocation, economies of scale, greater utilization of capacity
etc. (Awokuse, 2007; Ramos 2001). Studies, such as Alhajhoj (2007) confirmed the
export provoked growth in Saudi Arabia from 1970 to 2005. Thornton (1996) has also
found empirical evidence for the causality of exports towards growth for Mexico in the
years between 1895 and 1992.

2.1.2. Import-led growth hypothesis:

Examining the channels through which imports affect economic growth led to
discussing the import-led growth hypothesis. The hypothesis suggests that the
increase in imports would increase the Gross Domestic Product of the country. As
most of the countries do not have all the possible factors for production on their
territory, they would need to import those from foreign markets in order to complete
the production cycle. In this case the imports mainly consist of intermediate goods,
obtained to be used in production. Another possibility for promoting GDP growth is
through the better access of foreign technology. Importing innovative products can
optimize the production process and bring gains in the society. Evidence for Import-
led growth was found for Poland from 1995 to 2004 (Awokuse, 2007) and for Italy in
its pre-World War One period (Pisoreti & Rinaldi, 2012).

2.2. Growth-provoked trade

Some scholars challenge the idea for trade-led growth and suggest that economy
can reach economic advance only from forces originating within the country itself.
This is the so called endogenous growth theory. Two the possible channels through
which growth can be obtained are discussed by Lucas (1988), who presents the
effects of training on the economic performance and Romer (1990), who shows the
effects on growth when a new invention is made. The first author presents a model, where a worker can either work or attend training. The effects of the training will come with a lag, as the worker needs time to obtain the knowledge and also for the time of the educational process, he/she will not contribute to the production process. However, with the obtained knowledge the worker will increase the quality of his/her work, which in general will increase the productivity and thus lead to economic growth. Romer (1990) represents a model to how would new inventions affect growth. In the model, the agents have free access to previous discoveries. In the model there are three sectors – sector producing the final output, machinery producing one and invention sector. Each of the inventions is unique and translated into new capital good. Thus, the capital stock has risen. Introducing the invention to the production chain will increase the output (as the production process is optimized and thus the waste in resources has decreased) and thus will lead to economic growth. Endogenous growth theories suggest that change in political frameworks can support some of the channels for achieving economic advance. For example, if a government raises its subsidies to worker’s education, R&D expenditure or support for research centers and university this may lead to faster economic growth in the country.

2.2.1. Growth-led exports

After a country has increased its development levels from within its borders and has satisfied its demand on the domestic markets, it can start exporting some of its excess products. Melitz (2003) argues that only high-productivity firms can start exporting as they face higher entrance costs to new markets in comparison to locally operating firms. In order to establish a firm on the local market, one faces some amount of entry costs. When one wants to found a firm, which would operate on international markets, he/she faces not only the locally based entry costs, but also additional amount of costs related to trade permissions, open currency accounts, transport costs etc. Thus, only firms with high productivity can survive in the trade sector as only they will be able to cover the additional costs. The channel from internally promoted growth to increase in productivity and thus exports can be an example of the growth-led hypothesis.
Empirical support of Growth-led exports was found by Hsiao (1987) for the case of Hong Kong from 1966 to 1982 and Ramos (2001) for the case of Portugal (1865 – 1998)

2.2.2. Growth-led imports

There is also another possible relationship between imports and GDP growth. Consumer’s love of variety can provoke increased demand for foreign goods. Once the GDP has grown enough to provide consumers with the ability to afford such goods, the imports would increase. Evidence for Growth-led imports was found by Pisoreti & Rinaldi, (2012) in post- Second World War Italy.

3. Past Empirical Research

The debate between scholars, regarding the relation and causal directions of trade and economic growth has triggered lots of empirical studies. As some authors argue that trade is the “backbone of economic growth, especially in Less-Developed Countries (LDCs)” (Alhajhoj, 2007, p.3649), others, such as Todaro and Michael (1989)3 argue that the effects for LDCs are not as big compared to the ones in more advanced countries, as the later have higher income elasticity of demand. Below are presented some of the studies which were conducted in order to examine the trade – growth causality for countries in various stages of economic development.

Beginning with investigation of the trade – growth nexus for developing countries Hsiao (1987) examines four of the Asian’s fastest developing countries – Hong Kong, South Korea, Singapore and Taiwan. The author uses Sims and Granger’s causality tests in attempt to determine whether their growth is due to export promotion or not. Hsiao (1987) examines trade data with similar time span – 1960 to 1982 for South Korea and Taiwan; 1961 to 1982 for Hong Kong and 1966 to 1982 for Singapore. The time period is suggested in order to trace any effects followed by the countries’ export promotion policies from 1960s and 1970s. The author finds contradicting results from the two conducted tests. On one hand, Sims test speaks for a feedback effect between GDP and exports, as on the other hand Granger causality test, does

3 In Alhajhoj (2007)
not find any statistically significant results for any causality between the variables, except for Hong Kong, where the test has discovered evidence for one-way causality from GDP towards exports. Hsiao (1987) concludes that the growth in the mentioned Asian countries has more likely originated not only from the export promotion policies, but more likely from internal growth in the countries and import substitution. Hsiao suggest that developing countries can follow the example of South Korea, Hong Kong, Singapore and Taiwan and focus not only on exports but also on more effective resource usage, improve manufacturing efficiency, and can improve the political environment and infrastructure.

Examining Asia further, Ahmad and Harnhirun (1995) conduct another empirical study on different set of countries, namely Indonesia, Malaysia, the Philippines, Singapore and Thailand. The authors use yearly data from 1966 till 1990 about real GDP and real Exports. The researchers are interested in the long run relationship between the two variables and thus they use unit root and cointegration test. After discovering that there is presence of cointegration for Singapore, the authors proceed with estimating a Granger causality test and an error correction model for the country. The results speak for a bi-directional causality between growth and exports. Thus, the Ahmad and Harnhirun (1995) conclude that the two series are connected through strong, reinforcing bonds with one another for Singapore. As no cointegration was found for the other participants in the research, the general results of the study do not yield any robust results in support of export-led growth nor growth-led exports in the Asian countries.

Shifting the focus to other continents, Thronton (1996) examines the growth-trade relation for Mexico. The author examines the period from 1895 to 1992, using yearly data for real exports and real GDP. After conducting unit root tests and causality ones, the author discovers that there exists cointegration relation for the case of Mexico, which means that exports and GDP have a long-run dependency over time. Examining this further, Thronton (1996) discover that there is a significant evidence for a unidirectional causality from exports to economic growth in the country for the appointed period.

Alhajhoj (2007) turn the focus towards the Middle East and presents the case of the oil-rich Saudi Arabia. In the paper, the author traces the link between real exports
and real GDP, real private consumption, real government expenditure, real investment, real imports and growth rate of world’s GDP. He specifies VAR model for all the seven variables, after which he uses an Impulse Response Functions (IRF) in attempt to understand better how do the variables react after a shock to the system is introduced. The research proceeds with using a Granger causality test to evaluate the direction of causality between the variables. The results of the tests point out a one-way causal relation from exports to GDP as also to other sectors of the economy such as consumption, government spending and investments. The results of IRF show that a shock in exports causes a strong response in economic growth. The author concludes that the export sector in Saudi Arabia is liable for big part of the economic growth in the country, as also in other sectors in the long run. Those findings are not surprising if one considers the export-led hypothesis where a resource-rich county is willing to trade its endowments (after satisfying its home market) in exchange for foreign currency or goods.

Awokuse (2007) focuses on another type of countries – ones which changed their political and economic regimes and conducts tests for the causal relation between exports, imports and GDP in three transitional economies - Bulgaria, Czech Republic and Poland. After the usual unit root tests and cointegration tests, the author discovers presence of cointegration and thus long run relationship in all the three republics. He proceeds with estimating a Vector Error Correction model in order to answer how the variables are linked over longer time periods. The data used for the research is quarterly and spreads over 1994Q1 to 2004Q3 for Bulgaria, 1993Q1 to 2002Q4 for Czech Republic and from 1995Q1 to 2004Q2 for Poland. According to the obtained results, Bulgaria exhibits a bi-directional causality between exports and GDP. The two series do not exclude one another but rather supplement each other and work together. When looking at the Czech results, the tests provide evidence that exports granger cause growth as the same is valid for imports – there is a unidirectional link from imports towards economic progress. Poland does not provide any indication for relationship between exports and growth. On the other hand, when looking at the nexus between imports and growth, the Polish data shows evidence for an import-led growth. According to Awokuse (2007) the results point that the connection between imports and growth should not be neglected when examining the cases of transitional countries.
Martin (1992) shift the research from developing to developed countries and focuses his approach on four industrialized countries – United States, United Kingdom, Germany and Japan. Here the author uses countries' productivity and exports in order to examine the export-led growth hypothesis for the countries. The period of the research is from 1960Q1 to 1987Q2 and consists of data for the exports of manufacturing, terms of trade, labour productivity and log of OECD output at constant prices. The research follows the usual path of stationarity tests, cointegration ones and Granger causality. Cointegration relations were found for Japan, Germany and the United States, but none for the United Kingdom. The results reveal a one-way causality from exports to increase in productivity of the countries. As increased productivity leads to increased growth, the causality relation from exports to growth cannot be rejected for the four countries.

Kónya (2004) conducts time series research on 25 OECD countries between 1960 and 1998. He uses data for real GDP and real exports and tries to answer whether the evidences for export-led growth or growth-led exports are stronger between the participants of the research. Unlike most of the mainstream papers, he uses Wald test within VAR in levels and/or differences and also modified Wald test in augmented VAR in order to examine the relations between the variables. He divides the results in 4 groups – countries having presence of export-led growth are Australia, Austria, Ireland and Iceland. Evidence for growth-led exports was found for Finland, Portugal, United States, Canada, Japan, and Korea. A two-way causality is present for Sweden and United Kingdom. No causality results were found for Luxembourg and Netherlands, Denmark, France, Greece, Hungary, Norway. Conclusions for Belgium, Italy, Mexico, New Zealand, Spain, and Switzerland were hard to make due to the controversial results obtained from the tests used in this research.

Later in 2006, Kónya (2006) conducts a panel research on 24 OECD countries from 1960 to 1997 using Seemingly Unrelated Regressions and Wald test with country-specific bootstrap critical values and examines two models: one for the relation between GDP and exports and one examining the relations between GDP, exports and openness. The aftermath of his study is one – way relation between exports and GDP for Belgium, Denmark, Iceland, Ireland, Italy, New Zealand, Spain, and Sweden. A one-way relation from GDP to exports was found for Austria, France,
Greece, Japan, Mexico, Norway, and Portugal. Bidirectional causality is revealed for Canada, Finland and Netherlands. No causal relations are traced for Korea, Austria, Luxembourg, Switzerland, United Kingdom and United States. As seen from the two researches, the results change depending on the econometrics technique used. Also, there is no evidence for a hypothesis which holds for all the countries in the sample.

Ramos (2001) examines a longer period for Portugal – 1865 to 1998 and the relation between exports, imports and GDP. In addition to Kónya (2004, 2006) Ramos (2001) adds another dimension (imports) to the model of growth and trade. He discovers bidirectional causality between exports and growth as also a feedback relation between imports and GDP through using Granger causality test and estimating a Vector Error Correction Model. As a drawback of his research, the author points out the possible instability of trade policy of the country within the long period.

Pistoresi and Rinaldi (2012) also define a three-dimensional VAR for estimating the trade-growth relation for Italy. They use data for real imports, real exports and real GDP from 1863 to 2004. The authors separate the period at three subsets – before the First World War (1863 to 1913) before the Second World War (1863 to 1939) and after World War Two (1951 to 2004). The researchers discovered no cointegration relation in the 1863 to 1939. For the other two time periods they found an evidence of cointegration and thus long run relationship. Examining the pre-war period (1863 - 1913) it was discovered and indication that imports were driving the economic growth. This led to export growth later on. The interwar period was marked from drop in exports and reduction in the Italian trade. The post-World War period (1951 - 2004) the authors discovered a feedback relationship between imports and exports as also a weak evidence for export-led growth and growth-led imports. The bi-directional relation between imports and exports according to Pistoresi and Rinaldi (2012) is most likely due to an increase in intra-industry trade in the country. Further, the authors concluded that the trade – growth pattern for Italy changes over time and is not marked by a constant relation.

The above discussed studies presented empirical analyses on the trade – growth relationship for various countries at different level of development. When looking at developing and countries in transition evidences for export-led growth were found in Mexico (Thronton, 1996), Saudi Arabia (Alhajhoj, 2007) and Czech Republic.
growth-led exports relation was found for Hong Kong (Hsiao, 1987), bi-directional link between exports and GDP for Singapore (Ahmad and Harnhirun, 1995) and Bulgaria (Awokuse, 2007); no causal relation between growth and exports for South Korea and Taiwan (Hsiao, 1987) and import-led growth for Poland (Awokuse, 2007). The researches did not find confirmation of the growth-led imports hypothesis. This is not surprising when one keeps in mind the budget constraints of the developing world which prevents them from the opportunity to increase their consumption and thus the demand for imported goods.

Changing the focus from developing to developed countries, the studies confirm evidences for all the four hypothesis. Kónya (2004) finds results supporting export-led growth (Austria, Ireland, Iceland, etc.), growth-led exports (Finland, Portugal), no relation (Luxembourg, Netherlands) or bi-directional causality (Sweden, United Kingdom). Ramos (2001) confirms bi-directional causality between imports and growth for Portugal, Pistoresi and Rinaldi (2012) confirm both import-led growth and growth-led imports for Italy in different stages before and after the First and Second World Wars. As the scope of the current paper is to examine the trade – growth relation in Scandinavian countries, focusing on the results of Kónya (2004) and Kónya (2006) find slightly different results for the growth – export relationship in Denmark, Sweden and Norway. He finds bidirectional or unidirectional causality in the two studies. Due to the fact that two of the variables used for the current research are the ones used by Kónya (2004, 2006), namely real GDP and real exports, and also the time span of interest is partially covered by the author, I expect to discover similar results for the growth – exports nexus. Nevertheless, as Pistoresi and Rinaldi (2012) find in their paper, the growth – trade relations may vary over time. Thus, the findings of this paper do not necessarily have to confirm the ones of Kónya (2004; 2006).

A conclusion based on the findings of all the mentioned papers above is that there is no unique hypothesis which holds for all the countries which share the same level of development. According to Alhajhoj (2007) the differences in direction and causality between economic growth and trade is mainly due to country specific characteristics, structure of economy and the role which trade played in the history of the country.
4. Countries’ Economic Profiles

Denmark, Norway and Sweden are situated in the northern part of the European continent. The countries are amongst the smallest by population in Western Europe but amongst the richest. For the last ten years Norway had been the second wealthiest in Europe surpassed only by Luxembourg. Sweden and Denmark were also amongst the leaders for the same period (OECD, 2013). The three countries share similar historical and cultural heritage. They are open to foreign trade and participate in various economic agreements. Both Denmark and Sweden are part of the European Union. Although that Norway did not join, the country is one of the founders of the European Free Trade Area and is also a member of European Economic Area, which trades freely with countries of the EU. In 1995, all the Scandinavian countries joined the World Trade Organisation with which they gained new opportunities on the international trade market.

4.1. Denmark

Denmark is situated on the Jutland Peninsula and about 400 small islands around and has area of 43 094 km². Its capital is Copenhagen. The population in 2012 is 5.6 million people.

The country’s GDP per capita for 2011 is 25 percentage points above the average for European Union, which places the country 8th richest in Europe for the year (Eurostat, 2013). The unemployment of the country is lower than the average for the continent – 7.2% for March 2013 opposed to 10.9% for EU. The main sectors in the economy are high technological agriculture, fishing and ship industry, chemical and pharmaceutical, renewable energy, ores and food production (EUbusiness, 2013). The country is largely dependent on trade. Its imports of goods and services are evaluated as 44.9% of GDP and its imports at 50.5% (OECD, 2013). The main exports consist of energy and food products and the imports are mainly raw materials for the local production. The country’s exports consist of 21.6% agriculture, 11.7% fuel and mining products and 64.4% manufacturing. The exports are channeled to the European Union (59.4%), Norway (6.2%), United States (5.1%), China (2.2%). The country’s imports consist of 16.8% agriculture, 11% Fuel and mining products
and manufacturing – 70.7%. The main sources of imports are EU (70.6%), China (6.9%), Norway (4.5%) (WTO, 2013). More detailed trade division by country is presented in Appendix A, Figure A1 and Figure A2.


When looking at historical data for the Danish exports, imports and GDP from 1980 till 2008 (Graph 1), it can be seen a constant increase in all the three variables over time. In the beginning of the period the exports and imports shared similar volumes with exports being slightly bigger than the imports. Around 1986Q2 it can be seen that imports take over the exports of the country for a short period. After 1990Q1 the exports prevail and a clearer diversification in the volumes can be seen. The peak of the three variables is in 2007Q3 where they are followed by a drop due to the financial crisis. As noted before, the period of the crisis is excluded in our analysis.

Looking at the variables’ growth rates over the period (Graph B1 in Appendix B), one can note that GDP grows slower over time in comparison to the growth of the exports and imports. The two trade variables follow similar growth pattern between 1980 and 2007.
4.2. Sweden

Sweden is situated on the Scandinavian Peninsula and includes several islands in Baltic Sea. It has the biggest population amongst the Scandinavian countries – 9.5 mln in 2012. The area of the country is 449 964 km² and the capital is Stockholm.

The country’s GDP is higher than the average for the European Union – 27 percentage points higher, which makes the country 7th richest in Europe in 2011. The unemployment for March 2013 is higher in comparison to Denmark, but still lower than the average for the EU – 8.4%. The main sectors in the country are forestry, machinery, automobile industry, steel, electronics and paper. Those are also amongst the country’s main exports. Trade has main role in the country’s economy. Sweden ranks 28th exporter and importer of merchandise in the world. The trade consists of 8.2% exports of agricultural products, 13.2% Fuels and ores and 76.2% manufacturing. Imports consist of 10.3% agriculture, 17.9% Fuels and ores and 71.4% manufacturing. The biggest Swedish trade partners are EU (54.6% exports, 68.7% imports), Norway (9.4% exports, 8.4% imports), US (5.9% exports and 3% imports), China (3.2% exports, 3.9% imports) and the Russian Federation (2.2% exports, 5.5% imports) (WTO database). More detailed information with the country’s top 10 trade partners for 2012 can be found in the Appendix A Figure A3 and Figure A4.


Source: (IMF, 2013)
Graph 2 presents information about the volumes of Swedish imports, exports and GDP from 1980 to 2008. There can be seen a slight drop in GDP volumes in the beginning of 1990. This decrease can be explained with the fact that the country faced a financial crisis in 1990s also known as the Swedish Banking crisis (Englund, 1999). Nevertheless, GDP starts to recover after the middle of 1993. Looking both at the imports and exports of the country, one would notice that the two series are pretty much having the same values as in some cases imports prevail exports. A clearer divergence can be spotted after the year of 2000, when exports have clearly bigger volumes than the imports. However, the patterns of both remain the same for the period. Focusing on the growth rates of the three variables (Graph B2 in Appendix B), one can notice that the speed of growth of GDP is pretty consistent and relatively steady over time. In comparison, the growth rates of export and imports are fluctuating in different directions (both increasing and decreasing growth rates) as also are subjects to different speed. For example, in the beginning of the period (1980 to 1985) it can be spotted a rapid growth in the variables, opposed to a steadier growth in 2005 to 2007.

4.3. Norway

The country is situated on the Scandinavian Peninsula and also islands in the surroundings and sums up to area of 385 199 km². The population of Norway is about 5 million in 2012. The capital of the country is Oslo.

Norway is the richest country in Europe for the past 10 years, excluding Luxembourg. Norway’s GDP is more than ¾ times higher than the average for the EU. After discovering oil in the North Sea in the late 1960s exports become a main ingredient for the Norwegian economy. Other home industries are fishing, agriculture, forestry, ship building, hydroelectric power and mining. The country’s exports are about 42% of GDP and imports are 28% of GDP in 2011. The main export is fuel and ores – 74% followed by manufacturing – 15.4% and agriculture – 6.9%. Exports are channeled towards EU (81.2%), US (5.6%), China (1.8). Norway imports consist of 74.1% manufacturing, 14.4% fuel and ores and 9.7% agricultural goods. Main import partners are EU (62.8%), China (9.1%), US (5.4%), Canada (4.1%)
Data with the top Norwegian 10 exporters and importers are provided in the Appendix A Figure A5 and Figure A6.

**Graph 3:** Volumes of Exports, Imports and GDP for Norway, 1980 – 2008, bln of national currency for 2005 constant prices.

Graph 3 represents how did exports, imports and GDP volumes for Norway changed for the period 1980 – 2008. All the indicators have increased their mass over time. Difference from the Norwegian trade indicators and the same indicators for Sweden and Denmark is that it could be made a clear distinction between the imports and exports volumes – exports are clearly bigger than the imports for the whole time span. In the beginning of the period (from 1980 to 1986) the ratio between imports and exports looks steadier in comparison to later periods. After 1986 it can be spotted an increasing gap between the two trade variables, which begins closing after 2002, when the volumes of imports begin to increase and the volumes of exports appear to become steadier. The financial crisis in 2008 brought the mass of exports and imports to become the closest after 1990. Unlike the other two countries, Norway does not to seem that affected by the crisis as the only variable which decreases its values is the imports. In the mentioned period, GDP and exports become steady (exports have a slight increase at the end of 2008).

Examining the growth rates of the variables (Graph B3, Appendix B) reveals similar pattern as the one discussed in volumes. GDP increases constantly over the period. The growth rates of imports and exports are also increasing over time but with different pace. From 1986 to 1992 the imports growth rate appears to be steady, after which it increases faster than the increase in exports. From 2001 till the end of the
period, the exports growth ratio also appears to become steady, while imports are constantly increasing

5. Data

The data for this research consists of data used in the main research, and data for the supplementary research (robustness check). It is obtained from various sources.

The primary research consists of 3 variables of interest – GDP, exports and imports. The variables are reported quarterly from 1980 quarter 1 until 2007 quarter 4. This sums up to 112 observations per country. Data for the three countries is collected from the International Monetary Fund (IMF) database and is reported in billions of national currency calculated by prices for the current year. As prices are highly unlikely to have stayed constant over the 27 years timespan, all the variables have been deflated by different deflators – GDP deflator, Exports deflator and Imports deflator. According to Pistoresi & Rinaldi (2012) in order to obtain the real values of the variables, it is important to execute the deflation with the appropriate deflators because when deflated by the same deflator (authors such as Thronton (1997)\(^4\) has used GDP deflator for all the three series) the co-movement in the series increases and the results become less reliable. For the sake of comparison, all deflators are taken as an index for 2005 base year which helped obtaining the real values of all the variables. A problem that may arise from the fact that the data is reported quarterly is that the series may exhibit a seasonal variation. For example, the trade volumes of import and/or export can be bigger in certain quarters than others (such as winter or summer months). The same is applicable for GDP series. After examining the data and its ocular expectation, repeated seasonal patterns were spotted. Thus, the series were corrected for seasonality in order to improve the accurateness of the estimations. The plots of the series before and after the correction are reported in Appendix C. After assuring that the series are adjusted for imperfections, their logarithms were calculated and used for conducting the research.

\(^4\) In Pistoreti and Rinaldi (2012)
The data used for the robustness check of this research is export and import series reported yearly and also the Total Factor Productivity (TFP) of the separate countries. As TFP is not reported, it was calculated through using three supplementary variables – GDP, capital stock and hours worked. As the last two variables could hardly be found in monthly or quarterly datasets, their yearly values were taken. The nominal yearly GDP was obtained from the IMF database. Its deflator is taken from KLEMS database for 1995 index prices. KLEMS datasets were also used for collecting the capital stock data (adjusted for 1995 prices). The hours worked variable was collected from the OECD database and was transformed in millions per year. After normalizing all the variables, TFP was calculated by the formula:

\[ Y = AK^\alpha L^\beta \]

Where \( Y \) is real GDP in mln., \( K \) is capital stock in mln., \( L \) is hours worked in mln. and \( A \) is the residual, which presents the TFP. After transforming the formula, the TFP growth can be computed as:

\[ \text{TFP} = \frac{dA}{A} \]

Although the period of interest is from 1980 until 2007, the limitation of the data did not allow examination of the whole period. Thus, the data for the robustness check differs amongst the three countries and results in 14 yearly observation points for Sweden (from 1994 until 2007), 21 observation points for Norway (from 1981 until 2001) and 27 for Denmark (from 1981 until 2007). Despite that the time series data is quite small, the robustness check will still be concluded and its estimators would be treated with caution. The export and import series are reported yearly and are deflated by the appropriate deflators.

6. Methodology

As the purpose of this study is to understand better the relationship between economic growth and international trade (exports and imports) in the three countries. The methodology section follows Asteriou & Hall, 2011.
Scandinavian countries during 1980 and 2007, an appropriate technique to be used is a causality test in a time-series framework. Although a causality relation can be estimated in a dynamic panel model, here this opportunity will not be preferred because the main interest is not in the growth-trade relation per se, but the causal relationship in each of the countries separate.

A broadly used variable to measure economic growth is the Gross Domestic Product (GDP). Thus, this variable will be used for the same purposes in this study. By construction, exports and imports are an ingredient in calculating GDP\(^6\).

\[
GDP = C + I + G + (X - M)
\]

where \(C\) is private consumption, \(I\) is gross investment, \(G\) is government spending, \(X\) is export and \(M\) is import. It is easily seen from the formula, that when holding the consumption, investment and government spending steady, an increase in exports would lead to increase in GDP. Also, a rise in imports would decrease GDP. Although that mathematically the relation is rather clear, economically the connection between the variables stays ambiguous. On one hand, exports and imports can be provoked by a change in GDP. For example, with positive economic growth people become richer and thus they can start exporting domestically produced goods with average characteristics and import more sophisticated and/ or luxurious externally produced goods. On the other hand, the increase in exports (imports) can bring not only profits but also knowledge diffusion, spillovers etc. which would lead to an increase in GDP. The problem, when one variable causes another and the latter is also explained by the former is known as endogeneity. Consequently, in the case of GDP and exports and imports endogeneity is present. Conducting classical regressions in the presence of endogeneity would lead to results which do not show the true relation amongst the variables (inconsistent and biased results).

A time-series model solving the problem with endogeneity is a Vector Auto-Regressive Model (VAR). The model treats all the variables symmetrically and thus there is no need to specify if a variable is exogenous or not. The approach accounts that all the variables are endogenous. In our case, the VAR is three-dimensional and

\(^6\) The formula below presents the expenditure method for computing GDP.
consists of the logarithms of GDP, exports and imports. The formula is presented below:

\[ G_t = \langle Y_t, Exp_t, Imp_t \rangle \]

\[ G_t = A_0 + \sum_{i=1}^{p} A_1 G_{t-i} + U_t \]

Where \( U_t = (u^y_t, u^{exp}_t, u^{imp}_t) \)

With \( E(U_t) = 0 \) and \( E(U_t U_s) = \begin{cases} \Omega, & t = s \\ 0, & t \neq s \end{cases} \)

The number of lags which have to be included in the model is decided based on information criteria tests such as Akaike Information criteria (AIC), Schwarz's Bayesian information criterion (SBIC), Hannan – Quinn information criteria or Likelihood Ratio (LR). A decision is made based on the results presented by each of the criteria. Usually, the two most commonly used information criteria are AIC and BIC. As BIC yields better results in a larger sample, it is possible that the test chooses too few lags in the model. The positive side of it is that it is less likely to choose too big model of estimation (model with many lags). On the other hand, AIC has bigger possibility to choose bigger numbers of lags but less chance to choose too small model. When taking decision, it is important to understand that with increase of the lag length the model loses degrees of freedom. However, if the lags are too few, there is an increased possibility for autocorrelation in the disturbance terms. Both judgments lead to problems in estimation (inefficient estimators) especially if the sample is small.

Amongst the main advantages of VAR is that, as already mentioned, it does not need to define which variable is exogenous and which not. Another merit is that the model is simple to estimate (it uses OLS to estimate the equations). Moreover, the obtained forecasts of the model are often better than ones estimated with more complex models. Nevertheless, the model has also some disadvantages such as the vulnerability of specification. A critique from Ljungberg and Nilsson (2009) for the reliability of the VAR models is that before setting them, one should conduct tests for stationarity and cointegration, which have the possibility to yield not very robust results. Thus, a VAR specified on those tests may have bias in its own results. According to Asteriou and Hall (2011), one of the biggest shortcoming of VARs is that
they are atheoretical, i.e. not founded on any economic theory. This makes the models hard to interpret. In the case of this research the VAR models used for the three countries try to seek which of the four theories about the trade – growth relationship has stronger support – namely the export-led growth, growth-led exports, import-led growth, growth-led imports or any combinations of them. Thus, the obtained results from the VAR models would be interpreted as a confirmation of the mentioned theories.

Although that theoretically VAR solves the endogeneity problem, one may argue that the endogeneity between the variables is so strong, that the model does not predict credible results. Thus, a robustness check will be presented in Section VII.

In order to estimate a VAR, the properties of the time-series data should be examined. As the data is collected over equal time periods, it can reveal information about the effect and duration of possible shocks introduced to the system, i.e. whether the effect of a political (or any kind of change) dies out over time. If the shocks decreases and consequently disappears over time and the series return to their long-run mean values, the series are considered to be stationary. If after a shock, some permanent part of it still persists, then the series are considered to be non-stationary (unit root series). Such series have no long-run mean and the variance will approach infinity with increasing the time. Whether a series is stationary or not is important, because if the classical OLS regressions are executed on non-stationary data, their results would be inaccurate and thus not valid. Such regressions are known as “spurious regressions”7. Hence, it is important to perform analysis with stationary series.

The most commonly used tests for detecting unit roots (non-stationary series) are Augmented Dickey – Fuller (ADF), Philips – Perron (PP) and Kwiatkowski–Phillips–Schmidt–Shin (KPSS) tests. The null hypothesis of ADF test is: Ho: $\phi = 1$ (in other words we have unit root and the shock lasts for ever), versus the alternative hypothesis H1: $\phi < 1$, where the shock fades away over time8. The null hypothesis of PP test is also in favour of a unit root versus the alternative of no unit root. The

---

7 Usually when OLS is used on non-stationary series, it finds high R-square and t-ratios, while in reality the variables are not related.

8 When looking at an autoregressive model (AR(1)), for example $y_t = \varphi y_{t-1} + u_t$ if we find that $\varphi = 1$ this means that the shock lasts forever, i.e. there is presence of a unit root process. (Asteriou and Hall, 2011, p. 343)
difference between the both is the way they control for serial autocorrelation in the errors. As PP uses Newey-West consistent standard errors to “whiten” the errors (Asteriou & Hall, 2011 p.344), ADF adds more lags to the model to solve the same problem. It is important to note that big number of lags decreases the degrees of freedom and small one may lead to false results. Thus, after performing ADF test, a Breusch-Godfrey test for residual autocorrelation in the errors would be conducted. Contrary to ADF and PP test, where the null hypothesis is for the presence of a unit root process, KPSS has as its main hypothesis stationarity of the series versus the alternative hypothesis of non-stationarity. The test is appropriate for small samples. Here it will be used for making a better judgement as in some of the cases ADF and PP give contradicting results. A common problem with ADF and PP test is that both suffer from low power, i.e. they fail to reject the null hypothesis when it is not true (committing a Type II error). According to Hobbin et al (1998), KPSS also suffers from Type II error quite often. The final decision for stationarity would be taken after the analysis of all three tests. For all the countries, all the series were concluded to have unit root process in their levels and to become stationary after differencing them once. Thus, the variables are interpreted as integrated of order 1.

An important step after discovering that all the series are I(1) is to check whether the series cointegrate (have a long-run relation). A cointegration relation can occur between 2 or more non-stationary series when there exists a “linear combination [between the variables] that is a stationary variable (and I(0) variable)” (Asteriou & Hill 2011, p. 356). In other words there is a process which links the two (or more) variables together. Throughout examining the link, we can gain information about the long run and/or equilibrium relation of the variables. In this study, cointegration would be examined through Johansen test for cointegration, following the Pantula principle. The merit of the test is that it allows examining for cointegration relations between more than two variables and thus providing the ability for discovering more than 1 cointegration relations. A note should be made that the number of cointegrating vectors cannot be more than the number of variables. Thus, the number of the cointegration (long run) relations could be equal to k-1, where k is the number of variables. In our case, with three variables, we can expect not more than two cointegration vectors. When estimating the cointegration relationship, Johansen test

---

9 The principle is explained with an example in the Results and discussions section.
begins with plotting “no cointegration relation” as its null hypothesis versus the alternative of at least 1. If the Ho is rejected, the test proceeds with testing the second hypothesis for at most 1 cointegration versus Ha of at least 2. The test proceeds with increasing the number of cointegration relations until it cannot reject the null hypothesis. The test does analogical estimations in models with different specifications, through gradually easing the model restrictions such as no deterministic trends or intercept in VAR or the cointegration equation, no trends or intercept in VAR or cointegrating equation and so on until it allows for both constant and trend in both VAR and cointegration equation.

After discovering one cointegration relation for Denmark (when VAR is specified to have 1 lag) the research will continue with estimating a Vector Error Correction model (VEC) for Denmark. As no cointegration was detected in the cases or Sweden and Norway, the causality relation will be examined through VAR in differences and Granger causality test.

Discovering that Denmark has a cointegration between GDP, exports and imports does not allow estimating VAR in differences\(^\text{10}\). However, if the cointegration is ignored and besides it a VAR is estimated, the obtained results would be biased and would not reveal any long run relations. On the other hand, estimating a VEC allows capturing both short run and long run effects between the variables and provides better understanding for the connection and causality. The model has the following structure:

\[
\begin{align*}
\Delta y_t &= \alpha_{11} \varepsilon_{1,t-1} + \alpha_{12} \varepsilon_{2,t-1} \sum_{i=1}^{z} \varphi_{11,i} \Delta y_{t-1} + \sum_{i=1}^{z} \varphi_{12,i} \Delta x_{t-1} + \sum_{i=1}^{z} \varphi_{13,i} \Delta m_{t-1} + u_1 \\
\Delta x_t &= \alpha_{21} \varepsilon_{1,t-1} + \alpha_{22} \varepsilon_{2,t-1} \sum_{i=1}^{z} \varphi_{21,i} \Delta y_{t-1} + \sum_{i=1}^{z} \varphi_{22,i} \Delta x_{t-1} + \sum_{i=1}^{z} \varphi_{23,i} \Delta m_{t-1} + u_1 \\
\Delta m_t &= \alpha_{31} \varepsilon_{1,t-1} + \alpha_{32} \varepsilon_{2,t-1} \sum_{i=1}^{z} \varphi_{31,i} \Delta y_{t-1} + \sum_{i=1}^{z} \varphi_{32,i} \Delta x_{t-1} + \sum_{i=1}^{z} \varphi_{33,i} \Delta m_{t-1} + u_1 
\end{align*}
\]

\(^{10}\) In the case of Denmark cointegration was found in model with only 1 lag. When increasing the lags to 2 or more, the tests did not reveal any cointegration. Thus, I will estimate both VEC and VAR for the sake of comparison.
where \( y_t \) is logarithm of real GDP, \( x_t \) is logarithm of real exports and \( m_t \) is a logarithm of real imports.

As it was not found any cointegration for Sweden and Norway, the analysis for the two countries proceeds with estimating VAR in differences of the series. Not discovering a cointegrating vector means that the variables have no effect on each other over long run period. Thus, VAR can only show their short run relation. After specifying VAR, a Granger causality test is conducted in attempt to understand which variable is more likely to predict the other.

Considering that VAR works only with stationary data, it is important to transform the unit root series into stationary ones. Often used technique to do that is through differencing them. The number of times a non-stationary series was differenced in order to become stationary tells the order of its integration. After conducting tests for stationarity, all of the variables were discovered to be I(1)\(^{11}\) and so VAR would be estimated on differences. Specifying a correct VAR is important in order to proceed with the estimation of the causal relationship between the variables. After examining the normality of the VAR, a Granger causality test is performed. The Granger causality test can reveal at least in econometric sense the direction between the variables. Causality in econometric sense is the ability one variable to predict another. Nevertheless, the fact that one variable is better explained by the past values of another does not necessarily reveal the true relation between them. It can only show the lagged correlation between the variables. Finding correlation amongst the variables is necessary but not sufficient element for causality.

Theoretically, the relation between 2 variables can be written as

\[
x_t = \sum_{i=1}^{m} \alpha_i x_{t-i} + \sum_{i=1}^{m} b_j y_{t-i} + \varepsilon_i
\]

\[
y_t = \sum_{i=1}^{m} \rho_i y_{t-i} + \sum_{i=1}^{m} \tau_j x_{t-i} + \varepsilon_i
\]

Thus, there are 4 possibilities for an outcome between \( x_t \) and \( y_t \). The example is described for 2 variables for simplicity.

\(^{11}\) Differenced once to become stationary.
• $x_t$ Granger causes $y_t$.
• $y_t$ Granger causes $x_t$
• $x_t$ Granger causes $y_t$ and $y_t$ Granger causes $x_t$ (two-way causation)
• Neither of them predicts the other

When it is said that “$X$ Granger-cause $Y$”, this means that the $X$ variable can be predicted better, when it is estimated on past values of $Y$, ceteris paribus.

The hypotheses of Granger causality test are:

$H_0: \sum_{i=1}^{n} \beta_i = 0$, i.e. $x_t$ does not cause $y_t$

$H_a: \sum_{i=1}^{n} \beta_i \neq 0$, i.e. $x_t$ does cause $y_t$

The test assumes all the variables to be endogenous, thus the sequence of variables does not matter. All the possible relationships are examined. In our case we have three variables of interest. Thus, the test will have the following structure:

$$y_t = \alpha_1 + \sum_{i=1}^{z} \alpha_i y_{t-i} + \sum_{i=1}^{z} \beta_j x_{t-i} + \sum_{i=1}^{z} \gamma_j m_{t-i} + \epsilon_i$$

$$x_t = \alpha_2 + \sum_{i=1}^{z} \pi_i x_{t-i} + \sum_{i=1}^{z} \phi_j y_{t-i} + \sum_{i=1}^{z} \tau_j m_{t-i} + \epsilon_i$$

$$m_t = \alpha_3 + \sum_{i=1}^{z} \rho_i x_{t-i} + \sum_{i=1}^{z} \lambda_j y_{t-i} + \sum_{i=1}^{z} \sigma_j m_{t-i} + \epsilon_i$$

where $y_t$ is logarithm of real GDP, $x_t$ is logarithm of real exports and $m_t$ is a logarithm of real imports.

### 7. Results and discussion

After ocular inspection of the data series for the three countries none of the series appear to be stationary. In order to be able to answer with certainty whether GDP, imports and exports are stationary or not, ADF, PP and KPSS tests for stationarity were conducted. The results are presented in tables D1.1 to D.3.2 in Appendix D.

As shown by the tables, in all the three countries there is at least one variable for which the three tests give contradicting results. The test statistics, which do not match the results obtained from the other tests, are printed in different font. For the
case of Sweden, all three tests support the fact that there is a presence of a unit root process in the levels of all the three series. After differentiating them and examining the differences for stationarity, the tests show that the exports and imports series become stationary. Thus, it can be concluded that for the case of Sweden both the series are integrated of order 1 (I(1) series). A conflict is found in the differenced series of GDP. In that case the ADF test does not reject the null hypothesis of unit root. As already mentioned, ADF suffers from low power and it is possible to not reject a false null hypothesis (Type II error). On the other hand, Philips–Perron rejects the probability of non-stationarity in the differenced GDP. Furthermore, KPSS do not reject the null hypothesis of stationarity in the differences. Thus, it will be concluded in favour of stationarity in the series after taking their growth rates. The GDP is considered to be I(1).

A similar problem, where ADF gives opposing results to the ones obtained from a PP and KPSS tests is seen this time in the exports and imports level data for Denmark. Here ADF concludes in favour of stationarity in the levels for both series. On the contrary, Phillips – Perron do not reject the unit root hypothesis in levels. KPSS rejects the null hypothesis, which states that the series are stationary. As the low power of ADF test was already discussed and the other two tests suggest that the exports and imports series in levels exhibit non-stationarity, it will be concluded that the series are non-stationary. After differentiating the three series of interest for Denmark and testing them for stationarity, all the three tests support the conclusion that the differences are stationary. Thus, for the case of Denmark, it will be concluded that all the series are integrated of order one.

Looking at the Norwegian series, if only conducting ADF and PP it can be concluded that the series are I(1). KPSS supports this conclusion for the GDP and import series. Nevertheless, the test gives contradicting results for exports. For the export series, the test concludes non-stationarity in differences. According to Hobijn et al. (1998), KPSS often rejects the true hypothesis of stationarity. According to the authors, choosing too large or too small bandwidth of the test may lead to over or underestimating the long run variance which would lead to false results if the process is highly autoregressive. As KPSS is also entitled to commit Type II error, and ADF and PP tests speak for stationarity in the differenced exports, I will decide in favour of
stationarity in the differenced series and thus will account for the exports in Norway as a $I(1)$ series.

After discovering that all of the series are non-stationary and of the same order, the research continues with conducting Johansen test for cointegration. The test begins with specifying the lag length of the model. This step is important, as if the lags are not determined properly, any omission of them will result in increase of the error term. The aim is to reduce the unexplained terms and obtain homoscedastic, unautocorrelated and normal errors. The selection of a proper form of the test is based on examining the different suggestions from the AIC, BIC, HQ and LR. For the case of Sweden the BIC suggest the inclusion of 1 lag, as AIC suggests 2 lags and is supported by HQ and LR. The same suggestion is observed for Denmark – BIC suggests 1 lag, as all the other speaks for including 2 lags in the model. For the case of Norway, all the information criteria suggest using 2 lags in the model. As already discussed before, the BIC and AIC give conflicting suggestions due to their estimation approach. AIC is more likely to allow for bigger number of lags and thus decreased degrees of freedom leading to inefficient estimators. BIC, on the other hand tends to predict the lag length too short, which may lead to autocorrelation in the errors and thus inefficient estimators again.

As all the criteria suggested the same lag length for Norway, the test for the country will be estimated through using two lags as suggested by all the information criteria. For Sweden and Denmark, there will be conducted tests with one and two lags as the criteria yield different suggestions, after which the results will be compared.

The next step in Johansen test is to determine the appropriate components of the system – i.e. to see whether to include trends and/ or intercepts in the VAR and/or the cointegrating equation. Johanses provides 5 possible variants of model specifications:

Model 1) no intercept, no trend in cointegrating equation (CE) or VAR

Model 2) intercept no trend in CE, no intercept or trend in VAR

Model 3) intercept in CE and VAR, no trends in CE and VAR

Model 4) intercept in CE and VAR, linear trend in CE, no trend in VAR
Model 5) intercept and quadratic trend in CE, intercept and linear trend in VAR

As model 1 and 5 are theoretically less likely to be plausible, all the other 3 variants were estimated for each of the countries (for Sweden and Denmark, the models were estimated twice with different lag length). In order to decide between the models, I have applied the Pantula principle. The principle compares the trace statistics obtained from the estimation of the three models starting from the most restrictive one – Model 2 and proceeding to the least restrictive one – Model 4\(^12\). The test stops, when the null hypothesis is not rejected for the first time. For the case of Norway, all the 3 models are estimated with 2 lags. The results are presented in the table below\(^13\):

**Table 1: Results from Model 2, Model 3 and Model 4 of Johansen cointegration test for Norway, 1980 – 2007, 2 lags specification.**

<table>
<thead>
<tr>
<th></th>
<th>Model 2</th>
<th>Model 3</th>
<th>Model 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>rank</td>
<td>trace statistic</td>
<td>5% critical value</td>
<td>trace statistic</td>
</tr>
<tr>
<td>0</td>
<td>62.2772</td>
<td>34.91</td>
<td>22.2520</td>
</tr>
<tr>
<td>1</td>
<td>19.7540</td>
<td>19.96</td>
<td>3.9996</td>
</tr>
<tr>
<td>2</td>
<td>3.1992</td>
<td>9.42</td>
<td>0.7926</td>
</tr>
</tbody>
</table>

*Note: I reject the null hypothesis if the obtained trace statistics > 5% critical value.*

I begin a discussion about Model 2, starting with 0 cointegrating vectors. The trace statistics is 62.28 and the critical value is 34.91. I reject the null and proceed to model 3, where obtained t-statistics is 22.25 and the critical value is 29.68. In this case I cannot reject the null and thus conclude that in the case of Norway, there are zero cointegrating vectors. Following the same logic, I conclude that for the case of Sweden, when conducting the tests both with 1 lag (as suggested by BIC) and with 2 lags (as suggested from AIC). The results of the tests are presented in Table 2 and Table 3 below. The results are robust and thus a conclusion is drawn that there is no long run relation between the variables in the case of Sweden.

\(^{12}\) Models 1 and 5 are not estimated, due to their high unlikeliness.

\(^{13}\) The number of cointegration relations (rank), trace statistics and critical values are presented in different font.
Table 2: Results from Model 2, Model 3 and Model 4 of Johansen cointegration test for Sweden, 1980 – 2007, 1 lag specification.

<table>
<thead>
<tr>
<th></th>
<th>Model 2</th>
<th></th>
<th>Model 3</th>
<th></th>
<th>Model 4</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>rank</td>
<td>trace statistic</td>
<td>5% critical value</td>
<td>trace statistic</td>
<td>5% critical value</td>
<td>trace statistic</td>
<td>5% critical value</td>
</tr>
<tr>
<td>0</td>
<td>45.2924</td>
<td>34.91</td>
<td>21.6168</td>
<td>29.68</td>
<td>37.0254</td>
<td>42.44</td>
</tr>
<tr>
<td>1</td>
<td>13.4893</td>
<td>19.96</td>
<td>7.5595</td>
<td>15.41</td>
<td>16.6770</td>
<td>25.22</td>
</tr>
<tr>
<td>2</td>
<td>3.5887</td>
<td>9.42</td>
<td>0.5907</td>
<td>3.76</td>
<td>4.5304</td>
<td>12.25</td>
</tr>
</tbody>
</table>

Note: I reject the null hypothesis if the obtained trace statistics > 5% critical value.

Table 3: Results from Model 2, Model 3 and Model 4 of Johansen cointegration test for Sweden, 1980 – 2007, 2 lags specification.

<table>
<thead>
<tr>
<th></th>
<th>Model 2</th>
<th></th>
<th>Model 3</th>
<th></th>
<th>Model 4</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>rank</td>
<td>trace statistic</td>
<td>5% critical value</td>
<td>trace statistic</td>
<td>5% critical value</td>
<td>trace statistic</td>
<td>5% critical value</td>
</tr>
<tr>
<td>0</td>
<td>69.6378</td>
<td>34.91</td>
<td>22.6168</td>
<td>29.68</td>
<td>31.3494</td>
<td>42.44</td>
</tr>
<tr>
<td>1</td>
<td>10.2655</td>
<td>19.96</td>
<td>4.0617</td>
<td>15.41</td>
<td>11.8573</td>
<td>25.32</td>
</tr>
<tr>
<td>2</td>
<td>2.9374</td>
<td>9.42</td>
<td>0.0110</td>
<td>3.76</td>
<td>2.2736</td>
<td>12.25</td>
</tr>
</tbody>
</table>

Note: I reject the null hypothesis if the obtained trace statistics > 5% critical value.

When following the procedure for Denmark, I obtain conflicting results based on the lag specification of the model. When conducting the Johanssen test on a model with 1 lag, I obtain evidence for 1 cointegrating relation in Model 3. When the same is estimated with 2 lags, I obtain zero cointegration and again the iterations are stopped at Model 3. As the two results are different, I conduct another test, with including 3 in attempt to see whether the results are going to support the cointegration or the lack of such. I find that there is no presence of cointegration. Results are presented in tables 4, 5 and 6. Although the lack of cointegration is supported by more tests, I will estimate both a VAR in differences and a VEC model for Denmark. I will discuss and present the results later in the discussion part.
Table 4: Results from Model 2, Model 3 and Model 4 of Johansen cointegration test for Denmark, 1980 – 2007, 1 lag specification.

<table>
<thead>
<tr>
<th>Denmark 1 lag specification</th>
<th>Model 2</th>
<th>Model 3</th>
<th>Model 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>rank</td>
<td>trace statistic</td>
<td>5% critical value</td>
<td>trace statistic</td>
</tr>
<tr>
<td>0</td>
<td>61.7649</td>
<td>34.91</td>
<td>35.5575</td>
</tr>
<tr>
<td>1</td>
<td>27.4405</td>
<td>19.96</td>
<td>8.1157</td>
</tr>
<tr>
<td>2</td>
<td>7.8034</td>
<td>9.42</td>
<td>0.1527</td>
</tr>
</tbody>
</table>

Note: I reject the null hypothesis if the obtained trace statistics > 5% critical value.

Table 5: Results from Model 2, Model 3 and Model 4 of Johansen cointegration test for Denmark, 1980 – 2007, 2 lags specification.

<table>
<thead>
<tr>
<th>Denmark 2 lags specification</th>
<th>Model 2</th>
<th>Model 3</th>
<th>Model 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>rank</td>
<td>trace statistic</td>
<td>5% critical value</td>
<td>trace statistic</td>
</tr>
<tr>
<td>0</td>
<td>66.0771</td>
<td>34.91</td>
<td>19.96</td>
</tr>
<tr>
<td>1</td>
<td>19.1604</td>
<td>19.96</td>
<td>6.0379</td>
</tr>
<tr>
<td>2</td>
<td>5.3468</td>
<td>9.42</td>
<td>0.2471</td>
</tr>
</tbody>
</table>

Note: I reject the null hypothesis if the obtained trace statistics > 5% critical value.

Table 6: Results from Model 2, Model 3 and Model 4 of Johansen cointegration test for Denmark, 1980 – 2007, 3 lags specification.

<table>
<thead>
<tr>
<th>Denmark 3 lags specification</th>
<th>Model 2</th>
<th>Model 3</th>
<th>Model 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>rank</td>
<td>trace statistic</td>
<td>5% critical value</td>
<td>trace statistic</td>
</tr>
<tr>
<td>0</td>
<td>41.8023</td>
<td>34.91</td>
<td>13.1790</td>
</tr>
<tr>
<td>1</td>
<td>13.1256</td>
<td>19.96</td>
<td>3.5129</td>
</tr>
<tr>
<td>2</td>
<td>3.4605</td>
<td>9.42</td>
<td>0.0271</td>
</tr>
</tbody>
</table>

Note: I reject the null hypothesis if the obtained trace statistics > 5% critical value.

After discovering that for at least two of the countries there is no long run relationship between the variables, I proceed with estimating VAR in differences and Granger causality test. With this I seek to discover what is the short run relationship and causality between the variables.

The first country for which a VAR is going to be estimated is Norway. I begin with specifying the lags, which are about to be included in the VAR. According to the
information criteria I decide in favour of 1 lag. After running the model and testing it for normality, skewness, kurtosis and autocorrelation in the lag order, I discovered some problems with the model. Thus, those were resolved through including more lags in it. After specifying VAR with good characteristics, I conducted a Granger causality test in order to estimate statistically the causality between the variables. The results are presented below.

Table 7: Granger causality test on differenced series (growth rates) of imports, exports and GDP for Norway, 1980 - 2007

| Granger causality test on differenced series for Norway, 1980 - 2007 |
|-----------------------------------------------|-------------------|------------------|
| 0 -Hypothesis: A => B: A do not Granger cause B | Prob > chi² | Conclusion |
| D. exports => D. GDP                           | 0.336             | D. exports DO NOT Granger cause D. GDP |
| D. imports => D. GDP                           | 0.762             | D. imports DO NOT Granger cause D. GDP |
| D. GDP => D. exports                           | 0.316             | D. GDP DO NOT Granger cause D. exports |
| D. imports => D. exports                       | 0.439             | D. imports DO NOT Granger cause D. exports |
| D. GDP => D. imports                           | 0.369             | D. GDP DO NOT Granger cause D. imports |
| D. exports => D. imports                       | 0.812             | D. exports DO NOT Granger cause D. imports |

*Note: D denotes first differences*

According to the results of the test, no significant causality direction was estimated for any of the variables. When interpreting these findings, one should not forget how the Granger causality test works. When estimating the causality between $x$ and $y$, the test will show that $y_t$ Granger causes $x_t$, if $x_t$ is better predicted through using lagged values of $y_t$ ceteris paribus, than if such past values of $y_t$ are not included (Asteriou and Hall, 2011). For example, when predicting the causality between GDP and exports, the test checks whether GDP can be predicted more accurately through the past values of exports, when nothing else changes in the model.

Thus, in our case, the results can be interpreted as none of the past values of any of the variables is important for predicting any other variable. In order the variables to be causing each other, one of the conditions is that they have to be correlated. However, this condition does not seem to be supported by the tests. If a causal
relation exists amongst the variables it is probably expressed through some indirect channel which the test cannot capture. To conclude, Granger test for causality between GDP, exports and imports in Norway does not support any of the theoretical frameworks for Export-led Growth, Growth-led exports, Import-led growth or Growth led imports.

Conducting analogical analysis for the case of Sweden, I discovered that the information criteria for VAR in differences suggest 1 or 2 lags to be included. After estimating the model with both of these suggestions, I discovered that normality, skewness, and kurtosis are violated. I have fixed the parameters with increasing the number of lags. After assuring that the model is corrected, I conducted Granger causality test. The results are presented below:

Table 8: Granger causality test on differenced series (growth rates) of imports, exports and GDP for Sweden. 1980 - 2007

| Granger causality test on differenced series for Sweden, 1980 - 2007 |
|-----------------------------------------------|-----------------|------------------|
| 0 -Hypothesis: A≠>B: A do not Granger cause B | Prob > chi²      | Conclusion       |
| D. exports ≠>D. GDP                          | 0.004           | D. exports DO Granger cause D. GDP at 1% significance level |
| D. imports ≠>D. GDP                          | 0.008           | D. imports DO Granger cause D. GDP at 1% significance level |
| D. GDP ≠>D. exports                          | 0.000           | D. GDP DO Granger cause D. exports at 1% significance level |
| D. imports ≠>D. exports                      | 0.016           | D. imports DO Granger cause D. exports at 5% significance level |
| D. GDP ≠>D. imports                          | 0.002           | D. GDP DO Granger cause D. imports at 1% significance level |
| D. exports ≠>D. imports                      | 0.017           | D. exports DO Granger cause D. imports at 5% significance level |

Note: D denotes first differences

Unlike the case of Norway, here all the results are significant at the 5% level and reveal bi-directional causality between exports and GDP, imports and GDP and exports and imports. Thus, the results support all the four theories. The Swedish economy looks much more integrated than the Norwegian one. Apparently both exports and growth re-enforce each other as an increase in GDP would raise the growth rate of exports. Exports, on the other hand would also lead to increase in GDP over time and this way the two variables would interact and move in an upward spiral manner. The same applies for growth and imports. With increasing the volumes of imports, the country sees economic progress. As Sweden might not have all the
resources which it needs to sustain its economy (or find them cheaper on the international market) the country imports those from abroad. This could lead to better optimization of resources or if importing high-technological goods to increase productivity and thus to result in economic growth. The bidirectional causality between exports and imports can be explained through the assumption that for the production of the exported goods, there is some need for inputs which can be found on foreign markets cheaper or are imported because the inputs are scarce or absent on the local markets. With increased demand of exports, the imports for their production would increase. Also a rise in imports for locally produced goods for exports would lead to increase in exports, as the companies aim at gaining from economies of scale.

When conducting Johansen test for cointegration for Denmark, I discovered that the results depend on the lag length of the specified model. As only one of the information criteria supported the lag length resulting in a cointegration relation and all the others supported the same lag length which did not show the presence of a cointegration vector amongst the variables I will estimate both VAR in differences and a VEC model for Denmark. A note should be made that if there is a presence of cointegration the results obtained from the VAR should be treated with caution as they might result in a bias.

When specifying VAR with 1 lag, as suggested by the information criteria I discover that all the normality, skewness, kurtosis and autocorrelation in the lags are in the norms of the test. Thus I proceed with estimating VAR in differences with the same characteristics. After that I perform a Granger causality test, which yields the results presented in the table below:
Table 9: Granger causality test on differenced series (growth rates) of imports, exports and GDP for Denmark, 1980 - 2007

<table>
<thead>
<tr>
<th>0 -Hypothesis: A≠&gt;B: A do not Granger cause B</th>
<th>Prob &gt; chi²</th>
<th>Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>D. exports ≠&gt;D. GDP</td>
<td>0.554</td>
<td>D. exports DO NOT Granger cause D. GDP</td>
</tr>
<tr>
<td>D. imports ≠&gt;D. GDP</td>
<td>0.086</td>
<td>D. imports DO Granger cause D. GDP at 10% significance level</td>
</tr>
<tr>
<td>D. GDP ≠&gt;D. exports</td>
<td>0.215</td>
<td>D. GDP DO NOT Granger cause D. Exports</td>
</tr>
<tr>
<td>D. imports ≠&gt;D. exports</td>
<td>0.073</td>
<td>D. imports DO Granger cause D. exports at 10% significance level</td>
</tr>
<tr>
<td>D. GDP ≠&gt;D. imports</td>
<td>0.281</td>
<td>D. GDP DO NOT Granger cause D. Imports</td>
</tr>
<tr>
<td>D. exports ≠&gt;D. imports</td>
<td>0.521</td>
<td>D. exports DO NOT Granger cause D. Imports</td>
</tr>
</tbody>
</table>

Note: D denotes first differences

As seen here, the test reviles short run causality only from imports to GDP and from imports to exports, with 10% significance level. As the level is higher than the conventional 5% level, one can say that nonetheless the relations are not that strong. Justification for the causality can be that as the country is relatively small in comparison to the world market, the need to import resources and technology is significant in order to maintain economic growth. As the county has small area and resources, some of the imports are also needed as an ingredient for the production of goods, which later on would be used for exports. This can be a possible explanation for the relation from imports towards the other two variables.

Finally, I estimate a Vector Error Correction model in the three Danish series in attempt to examine what could be the possible long run relation amongst the variables. I do that through specifying a model with 1 lag and of rank 1. Analyzing the short run effects show that exports and GDP seem to be weakly exogenous to the system. Their coefficients are insignificant, which means that they do not adjust in the short run to the cointegration relation but is more likely that they drive the system. In order a variable to be weakly exogenous, it must be a function of lagged values and not significantly adjusting to the system. According to the model, only imports adjust in short run with about 3% per year until they reach the steady state relation. Test for weak exogeneity show that the obtained results are significant.

14 The number of rank shows how many cointegration relations exist between the variables.
Table 10: Alpha (short run) coefficients from VECM

|                  | Coefficient | Standard deviation | P>|zl| |
|------------------|-------------|--------------------|-----|
| D_Ingdpa         | 0.0027      | 0.3479             | 0.937 |
| _ce1 L1          |             |                    |      |
| D_Inexp          | -0.0123     | 0.0809             | 0.880 |
| _ce1 L1          |             |                    |      |
| D_Inimp          | 0.2983      | 0.0726             | 0.000 |
| _ce1 L1          |             |                    |      |

Note: D denotes first differences; _ce denotes alpha coefficient

As it was discovered that both GDP and Exports are weakly exogenous to the system, I normalize the model on GDP and discover that both exports and import are significant and thus both of the variables have effect on GDP in the long run. Looking at Table 11 below, it can be seen that over time, the volume of imports adjust to the cointegration relationship determined by GDP. On the other hand, exports exhibit reverse direction in their movement towards the relation. Normalizing the long run relations on the other two variables confirm long-run adjustments between GDP and imports and imports and exports. The results are presented in the table below:

Table 11: Beta (long run adjustment) coefficients from VECM

|                  | Coefficient | Standard deviation | P>|zl| |
|------------------|-------------|--------------------|-----|
| ln_GDP           | 0.7035      | 0.1454             | 0.000 |
| ln_exp           | -1.0557     | 0.14665            |      |
| ln_imp           |             |                    |      |

After comparing the obtained results with the ones of the existing literature (Kónya, 2004; 2006), I discover that the findings of this paper confirm the ones found by Kónya (2004). The VAR model for Sweden confirms the bidirectional causality between exports and GDP. For Norway, the estimated VAR did not find any causality between the growth and import variables which is supported by the findings of Kónya (2004). The same findings hold for the case of Denmark – no causal relation between
exports and economic advance. The current study differs from the one of Konya (2004) not only by the different model used and the different time span, but also because it adds another trade variable in the regressions – imports. Thus, the import – growth and the growth – import causality cannot be compared to any of the previous researches regarding the Scandinavian countries. In the case of Norway, the import series do not exhibit any relation neither between growth not between exports. On the other hand, for the case of Sweden the variable shows its deep causal relationship with both growth and exports (significant at 1% and 5% level). This shows that the economic structures of Sweden and Norway are very different from one another even that the two countries have geographic proximity and share similar linguistic characteristics and historical background.

When trying to investigate whether Danish economy fits closer to the one of Sweden or Norway, the research showed that when comparing the economies based on the growth – export relationship, Denmark looks closer to the economy of Norway – in none of the country case there is presence of any causality between the variables. Nevertheless, when looking at the bigger picture and compare the trade - growth nexus in general, we see a well-established causality between imports and growth. Apparently in the Danish case, imports are causing both increase in exports and GDP. As the Swedish economy is also quite integrated with the country’s trade flows, one can conclude that Danish economy is more alike to the Swedish rather than the Norwegian one. These results are not surprising, because when looking at the parameters of the two economies (volumes of imports, volume of exports, economic sectors, etc.) one can see them more similar in economic structure than the oil – rich Norway.

**Robustness check**

As some may criticize that the endogeneity problem between GDP, exports and imports of the countries may be too big, this section examines the robustness of the obtained results from the previous section through using a proxy for economic growth. Authors such as Solow have argued that technological advance could explain economic growth. Thus, in this section I will use Total Factor Productivity
(TFP) to see test its relation with exports and imports. According to the Cobb-Douglas production function, the total output of the country (GDP) is a function of labour, capital and technology.

\[ Y = AK^\alpha L^\beta \]

Where Y is GDP, A is technology, K is capital and L is labour.

Changes in technology can affect both capital and labour. There exist three types of technological progress:

- Harrod neutral – when the technology changes the labour productivity in the model,
- Solow neutral – when the technology changes the capital or
- Hicks neutral – when changes in technology do not change the capital/labour ratio.

In this study, I assume that the technological progress in Denmark, Sweden and Norway is Hicks neutral. After transforming the formula and substituting the parameters with data for GDP, capital stock and hours worked, I obtain the logarithmic values for technological change, which I will use in the estimations of the causal relation between economic growth and trade. Due to the limitations of the data for estimating TFP, there are 14 observation points for Sweden (from 1994 until 2007), 21 observation points for Norway (from 1981 until 2001) and 27 for Denmark (from 1981 until 2007). Despite of the small size of the sets, the causality relation is still examined. I use yearly data for exports and imports in real terms. All the variables are in 1995 constant price values in order to be suitable for comparison. The graph below compares the TFP of the three countries of interest. According to it, Denmark exhibits the largest technological advance compared to the other two countries.
Graph 4: Total factor productivity (TFP) for Sweden, Norway and Denmark, 1980 – 2007.

Sources: (OECD 2013; KLEMS, 2013)

I begin the robustness check, following the same methodology as when exploring the causality relation between GDP and exports and imports. Firstly, I examine the series for stationarity. I proceed with cointegration test (Johansen test for cointegration) and later I estimate VAR using the differenced series of TFP, exports and imports.

The first country to be examined is Sweden. This time only PP and KPSS tests for stationarity are performed. The reason why ADF is not used at this section is because the test is sensitive to lag specification. As the datasets have only few observations for each country, the use of ADF is limited. The results from PP and KPSS are presented in the table below:

Table 12: PP and KPSS tests on TFP, Exports and Imports in levels and differences, Sweden, 1980 - 2007

<table>
<thead>
<tr>
<th></th>
<th>PP</th>
<th>5% Critical value</th>
<th>KPSS</th>
<th>5% Critical value</th>
</tr>
</thead>
<tbody>
<tr>
<td>TFP</td>
<td>-13.778</td>
<td>-12.500</td>
<td>0.0938</td>
<td>0.146</td>
</tr>
<tr>
<td>D. TFP</td>
<td>-15.556</td>
<td>-12.500</td>
<td>0.119</td>
<td>0.146</td>
</tr>
<tr>
<td>Exports</td>
<td>-2.638</td>
<td>-12.564</td>
<td><strong>0.141</strong></td>
<td><strong>0.146</strong></td>
</tr>
<tr>
<td>D. Exports</td>
<td>-15.654</td>
<td>-12.532</td>
<td>0.084</td>
<td>0.146</td>
</tr>
<tr>
<td>Imports</td>
<td>-2.776</td>
<td>-12.564</td>
<td><strong>0.140</strong></td>
<td><strong>0.146</strong></td>
</tr>
<tr>
<td>D. Imports</td>
<td>-16.624</td>
<td>-12.532</td>
<td>0.0813</td>
<td>0.146</td>
</tr>
</tbody>
</table>

Note: All variables are in natural logarithms; D denotes difference
Data source: (OECD 2013; KLEMS, 2013)
From the table it can be seen that both PP and KPSS suggest that TFP are stationary in levels. Thus, the series are concluded to be I(0). For exports and imports, PP and KPSS provide contradicting results – PP suggests that the levels of the series are non-stationary, while KPSS suggests that they are stationary. As the results obtained from KPSS are close to the rejection area and the test is likely to commit Type II error, I look as a reference to the trade series in the previous section. The series are concluded to be unit root processes, thus I decide in favour of the non-stationary of the levels of exports and imports. The results from the two tests conducted on the first differences are that after being differenced once, both the series become stationary. Thus, I conclude that imports and exports are integrated of order 1 (I (1)).

According to Asteriou and Hall (2011), every linear combination between an I(0) and I(1) series will always result in a non-stationary series (Asteriou and Hall, 2011, p. 364). Thus the three series cannot cointegrate. I proceed with estimating a VAR model to capture any short run relation between the variables. A problem occurs, because VAR can be only estimated on stationary series. A way to proceed is to take the first differences of the trade variables and estimate a VAR with them. As TFP is stationary, it is not necessary to be differentiated. Nevertheless, I will take its first difference\(^{15}\) (growth rate) and will estimate a VAR on the growth rates of all the variables in order to make the interpretation more precise.

Based on the information criteria, I estimate a VAR model with 3 lags, good normality, skewness, kurtosis and no autocorrelation in the lags. Based on it, I run a Granger causality test to examine the causal relations amongst the variables. The results are presented in Table 13.

\(^{15}\) A difference of stationary series is also stationary.
Table 13: Granger causality test on differenced series (growth rates) of imports, exports and TFP for Sweden, 1980 - 2007

<table>
<thead>
<tr>
<th>Granger causality test on differenced series for Sweden, 1980 - 2007</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 -Hypothesis: A≠&gt;B: A do not Granger cause B</td>
</tr>
<tr>
<td>D. exports ≠&gt;D. TFP</td>
</tr>
<tr>
<td>D. imports ≠&gt;D. TFP</td>
</tr>
<tr>
<td>D. TFP ≠&gt;D. exports</td>
</tr>
<tr>
<td>D. imports ≠&gt;D. exports</td>
</tr>
<tr>
<td>D. TFP ≠&gt;D. imports</td>
</tr>
<tr>
<td>D. exports ≠&gt;D. imports</td>
</tr>
</tbody>
</table>

Note: D denotes first differences

The test confirms bi-directional causality between TFP and exports, TFP and imports and also imports and exports. The results confirm the results obtained in the previous section, where a bi-directional causality between GDP and exports, GDP and imports and imports and exports was discovered. Thus it can be concluded that the obtained results for Sweden are robust and the country exhibits economic progress, which is highly incorporated with the trade determinants of the country.

I proceed with examining the causal relation between TFP, exports and imports for Norway. The stationarity tests suggest that TFP is I(0) series, as exports and imports are I(1). The results do not contradict each other thus I accept the findings.

Table 14: PP and KPSS tests on TFP, Exports and Imports in levels and differences, Sweden, 1980 - 2007

<table>
<thead>
<tr>
<th></th>
<th>PP</th>
<th>5% Critical value</th>
<th>KPSS</th>
<th>5% Critical value</th>
</tr>
</thead>
<tbody>
<tr>
<td>TFP</td>
<td>-12.091</td>
<td>-12.500</td>
<td>0.0657</td>
<td>0.146</td>
</tr>
<tr>
<td>D. TFP</td>
<td>-17.813</td>
<td>-12.500</td>
<td>0.0682</td>
<td>0.146</td>
</tr>
<tr>
<td>Exports</td>
<td>-0.384</td>
<td>-12.500</td>
<td>0.1560</td>
<td>0.146</td>
</tr>
<tr>
<td>D. Exports</td>
<td>-17.236</td>
<td>-12.500</td>
<td>0.1430</td>
<td>0.146</td>
</tr>
<tr>
<td>Imports</td>
<td>0.209</td>
<td>-12.500</td>
<td>0.1600</td>
<td>0.146</td>
</tr>
<tr>
<td>D. Imports</td>
<td>-14.242</td>
<td>-12.500</td>
<td>0.0843</td>
<td>0.146</td>
</tr>
</tbody>
</table>

Note: All variables are in natural logarithms; D denotes difference
Data source: (OECD 2013; KLEMS, 2013)
Due to the fact that the series are from different order, they cannot cointegrate and I proceed, as in the case of Sweden, with estimating VAR in differences. The model has 2 lags and good characteristics. Based on it, I proceed with estimating a Granger causality test. The results are presented below.

Table 15: Granger causality test on differenced series (growth rates) of imports, exports and TFP for Norway, 1980 - 2007

<table>
<thead>
<tr>
<th>Granger causality test on differenced series for Norway, 1980 – 2007</th>
<th>Prob &gt; chi²</th>
<th>Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>D. exports ≠&gt; D. TFP</td>
<td>0.146</td>
<td>D. exports DO NOT Granger cause D. TFP</td>
</tr>
<tr>
<td>D. imports ≠&gt; D. TFP</td>
<td>0.002</td>
<td>D. imports Granger cause D. TFP at 1% significance level</td>
</tr>
<tr>
<td>D. TFP ≠&gt; D. exports</td>
<td>0.014</td>
<td>D. TFP Granger cause D. exports at 5% significance level</td>
</tr>
<tr>
<td>D. imports ≠&gt; D. exports</td>
<td>0.016</td>
<td>D. imports Granger cause D. exports at 5% significance level</td>
</tr>
<tr>
<td>D. TFP ≠&gt; D. imports</td>
<td>0.156</td>
<td>D. TFP DO NOT Granger cause D. Imports</td>
</tr>
<tr>
<td>D. exports ≠&gt; D. imports</td>
<td>0.275</td>
<td>D. exports DO NOT Granger cause D. imports</td>
</tr>
</tbody>
</table>

Note: All variables are in natural logarithms
Data source: (IMF, 2013)

This time the results differ from the ones obtained when GDP was used to measure the economic growth of the country. When TFP is used instead, the Granger causality test discovers a one-way causality from imports to TFP and from TFP to exports. Those finding might be translated into a possible import of high-technological goods, which would lead to increase in TFP and thus lead to an economic growth of the country. As the productivity within the country has increased, this will lead to optimizing the production process and to increase in exports. This way, the imports may indirectly affect exports. Nevertheless, a direct causality is not detected by the conducted test. As the main export of Norway is oil, the high-tech imports may suggestively be in the oil-producing sphere which would lead to increase in exports of oil products. In order to make a conclusion for sure, a further research should be conducted.

The last country to be examined is Denmark. Methodology follows the already discussed cases. The results from the stationarity tests are presented below. The
tests agree that TFP is stationary but disagree on the presence or absence of unit root.

**Table 16: PP and KPSS tests on TFP, Exports and Imports in levels and differences, Denmark, 1980 - 2007**

<table>
<thead>
<tr>
<th></th>
<th>PP</th>
<th>5% Critical value</th>
<th>KPSS</th>
<th>5% Critical value</th>
</tr>
</thead>
<tbody>
<tr>
<td>TFP</td>
<td>-19.531</td>
<td>-12.532</td>
<td>0.0881</td>
<td>0.146</td>
</tr>
<tr>
<td>D. TFP</td>
<td>-31.928</td>
<td>-12.500</td>
<td>0.0706</td>
<td>0.146</td>
</tr>
<tr>
<td>Exports</td>
<td>0.147</td>
<td>-12.532</td>
<td>0.0539</td>
<td>0.146</td>
</tr>
<tr>
<td>D. Exports</td>
<td>-22.063</td>
<td>-12.500</td>
<td>0.0534</td>
<td>0.146</td>
</tr>
<tr>
<td>Imports</td>
<td>0.357</td>
<td>-12.532</td>
<td>0.1040</td>
<td>0.146</td>
</tr>
<tr>
<td>D. Imports</td>
<td>-25.815</td>
<td>-12.500</td>
<td>0.0407</td>
<td>0.146</td>
</tr>
</tbody>
</table>

Note: All variables are in natural logarithms; D denotes difference.
Data source: (OECD 2013; KLEMS, 2013)

Here it is again concluded non-stationarity in the levels of exports and imports series as the same was discovered earlier based on more detailed quarterly data.

The estimated VAR in differences has good normality, skewness, kurtosis and no autocorrelation in the lags and includes 3 lags in its specification. After assuring that the VAR model has good properties, a Granger causality test was conducted. The results are presented below.

**Table 17: Granger causality test on differenced series (growth rates) of imports, exports and TFP for Norway, 1980 - 2007**

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Prob &gt; chi²</th>
<th>Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>D. exports =&gt; D. TFP</td>
<td>0.000</td>
<td>D. exports DO Granger cause D. TFP at 1% significance level</td>
</tr>
<tr>
<td>D. imports =&gt; D. TFP</td>
<td>0.001</td>
<td>D. imports DO Granger cause D. TFP at 1% significance level</td>
</tr>
<tr>
<td>D. TFP =&gt; D. exports</td>
<td>0.233</td>
<td>D. TFP DO NOT Granger cause D. exports</td>
</tr>
<tr>
<td>D. imports =&gt; D. exports</td>
<td>0.027</td>
<td>D. imports DO Granger cause D. exports at 5% significance level</td>
</tr>
<tr>
<td>D. TFP =&gt; D. imports</td>
<td>0.502</td>
<td>D. TFP DO NOT Granger cause D. imports</td>
</tr>
<tr>
<td>D. exports =&gt; D. imports</td>
<td>0.125</td>
<td>D. exports DO NOT Granger cause D. imports</td>
</tr>
</tbody>
</table>

Note: All variables are in natural logarithms.
Data source: (IMF, 2013)
The obtained results confirm one-way causality from exports towards TFP, from imports towards TFP and from imports to exports. The last two results match the ones obtained when GDP is used as a measure for growth. The difference in results is that when TFP is used, there was discovered a unidirectional causality from exports to increase in productivity. This can be explained with the hypothesis that when firms enter into foreign markets, they try to match the high productivity which is exhibit by the other exporters. This eventually results in optimizing the production process and using high technological equipment.

In most of the cases, the robustness check confirmed the results obtained from the estimations, where GDP was used as a measurement of economic growth. Thus, it can be concluded that the obtained results are fairly stable to choice of variables, which would signal that the problem of endogeneity might not be as big as literature suggests. Thus, for the case of Sweden it can be concluded the presence of all four hypotheses: import – led – growth, growth – led – exports, import – led – growth and growth – led – imports. The results for Denmark support the import – growth hypothesis as also suggest an export – growth causality when total factor productivity accounts for economic progress. However, this hypothesis might need to be further tested. The country which yield different results when used TFP as a measurement of progress, is Norway. In the case of technological progress, the causality test detected one-way Granger causality from imports to TFP and from imports to exports. This can be evidence for the import – led – growth hypothesis discussed before. As the results are not confirmed when GDP is used, a further research is needed in order to confirm the trade – growth relation for sure.

Conclusion

The reasons why some countries are richer than others and what triggers the economic growth of the countries have long been discussed amongst scholars. The answer is even more valuable in times of crisis or straight after them. The purpose of this paper was to examine what is the relation between economic growth and
international trade in some of the richest countries in Europe – Denmark, Sweden and Norway.

There are four fairly advocated hypotheses about the relation of international trade and economic prosperity. The first one is the export-led growth theory. According to it, a country becomes richer only after opening its policy for international trade and increases the volumes of its imports. An opposing theory is the one supporting the endogenous growth and thus growth-led exports. The hypothesis states that a country can increase its exports only after reaching certain level of development and that the reasons for growth can only come from factors within the country. The third theory for growth is the import-led growth theory, which advocates that increase in economy comes after raised imports of new technology and resources from abroad. The last theory supports the hypothesis that imports increase only after an increase of the welfare of the country and is also known as growth-led imports theory. This research examines all the four hypothesis for the Scandinavian countries from 1980 to 2007 (straight before the financial crisis of 2008). In order to examine the robustness of the results and to improve the truthfulness of my research, I investigated the relationship using two different measurements for economic advance – GDP and Total factor productivity (TFP).

After conducting tests for stationarity, cointegration and causality tests, I found no evidence for long run relationship between the variables. Only in the case of Denmark, there is a possible cointegration relationship when I use GDP as a measurement for country’s growth. The cointegration is not supported if I change the specification of the model. Also, when I change the variable for growth to TFP, I find no long run effects for Denmark. Thus, I conclude that there is no strong statistical evidence for supporting any long run relationship between growth and trade in the Scandinavian countries.

After using different model specifications and two different variables to measure the economic growth of the countries, for the case of Sweden it was discovered bi-directional causality between growth and exports. The finding is common to the one of Kónya (2004). Evidences for bi-directional causality in the model were also suggested between imports and growth and imports and exports. The results are robust for model and variable specifications and thus it for the case of Sweden it can
be concluded, that the country confirms all four hypotheses: export – led – growth, growth-led exports, import-led growth and growth-led imports. The country has high level of integration between growth and trade.

The results from the tests for Denmark showed empirical support for one-way causality from imports to growth (measured both as GDP and TFP) and from imports to exports. Thus it can be concluded that the import-led growth hypothesis plays essential role for the development of the country. When taking different measurements for economic growth the tests for causality slightly differ in their results. When using GDP to account for growth the tests reveal no causal relation between growth and exports. The same finding was confirmed by Kónya (2004) for earlier time period. When the measurement of growth is changed to using TFP, the Granger causality test supports the unidirectional link from exports to growth. This can be interpreted as a support of the export-led growth hypothesis for the country.

When examining Norway, both TFP and GDP specifications support the finding by Kónya (2004) for no export – growth nexus in the country. Regardless this, a support for import-led growth was found when using the Norwegian total factor productivity as a measurement for growth. The test using TFP as measurement also found that the increase in imports in the country would lead to an increase in exports.

Looking at the findings for the three countries, it can be concluded that trade has role in the countries’ economies, although with different magnitudes. When comparing the economies, it was discovered that Sweden is the country, which has integrated its trade at most. Compared to it, Denmark also uses international business affairs to promote its growth. Although that it was expected that export – growth relation in the countries might be stronger, evidence for such was not confirmed neither for the Danish nor for the Norwegian case. Norway is the country which compared to the others is less dependent on trade according to the tests. This is a bit ambiguous as the country’s trade is about 42% of GDP and consists mainly of oil and ores. Nevertheless, import-led growth of the country cannot be outcast.

Although that most of the research papers focus on the export – growth nexus, the finding of this paper suggest that for the case of Scandinavia, imports have quite big role in the countries’ development. Some of the implications that may follow is that when countries decide to embrace their economic growth with increase in
international trade, they should not forget to develop import policies. Examples of such are reducing trade barriers, easing the border regimes, improving the infrastructure etc. The findings that imports increase the levels of imports suggest that big part of the imports may be used for the production of later exported goods. An implication arising from this could be that the country can revise its tax policy on intermediate goods, i.e. imports which are meant to be included as ingredient of exports production should be taxed lower than the ones which are channeled for consumption. The last suggestion drawn on the base of the findings of this paper is that more research in the import – growth relation are needed on different levels of country development.
References:


Eurostat (2013): common statistics


International Monetary Fund (2013): common database

KLEMS (2013): common database


Organisation for Economic Co-operation and Development (2013): common data base


World Trade Organization (2013): common database
Appendix A

Top 10 import and export partners of the countries

Figure A1: Top 10 Export partners of Sweden in 2012, as a percentage of total exports for the current year.

Source: (OECD, 2013)

Figure A2: Top 10 Import partners of Sweden in 2012, as a percentage of total exports for the current year.

Source: (OECD, 2013)
Figure A3: Top 10 Export partners of Norway in 2012, as a percentage of total exports for the current year.

Source: (OECD, 2013)

Figure A4: Top 10 Import partners of Norway in 2012, as a percentage of total exports for the current year.

Source: (OECD, 2013)
Figure A5: Top 10 Export partners of Denmark in 2012, as a percentage of total exports for the current year.

Top 10 Export Partners in 2012

<table>
<thead>
<tr>
<th>Country</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Germany</td>
<td>23%</td>
</tr>
<tr>
<td>Sweden</td>
<td>20%</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>14%</td>
</tr>
<tr>
<td>United States</td>
<td>10%</td>
</tr>
<tr>
<td>Norway</td>
<td>9%</td>
</tr>
<tr>
<td>Netherlands</td>
<td>7%</td>
</tr>
<tr>
<td>France</td>
<td>5%</td>
</tr>
<tr>
<td>Italy</td>
<td>4%</td>
</tr>
<tr>
<td>China, P.R.: Mainland</td>
<td>4%</td>
</tr>
</tbody>
</table>

Source: (OECD, 2013)

Figure A6: Top 10 Import partners of Denmark in 2012, as a percentage of total exports for the current year.

Top 10 Import Partners in 2012

<table>
<thead>
<tr>
<th>Country</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Germany</td>
<td>29%</td>
</tr>
<tr>
<td>Sweden</td>
<td>18%</td>
</tr>
<tr>
<td>Netherlands</td>
<td>10%</td>
</tr>
<tr>
<td>China, P.R.: Mainland</td>
<td>9%</td>
</tr>
<tr>
<td>Norway</td>
<td>8%</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>8%</td>
</tr>
<tr>
<td>Italy</td>
<td>5%</td>
</tr>
<tr>
<td>United States</td>
<td>4%</td>
</tr>
<tr>
<td>Poland</td>
<td>4%</td>
</tr>
</tbody>
</table>

Source: (OECD, 2013)
Appendix B

Growth rates of exports, imports and GDP for the countries

**Graph B1: Growth rates of Exports, Imports and GDP for Denmark, 1980 – 2008**

Source: (IMF, 2013)

**Graph B2: Growth rates of Exports, Imports and GDP for Sweden, 1980 – 2008**

Source: (IMF, 2013)
Graph B3: Growth rates of Exports, Imports and GDP for Norway, 1980 – 2008

Source: (IMF, 2013)
Appendix C

Seasonally adjusted and unadjusted data series for the countries

Graph C1.1: Volumes of Exports, Imports and GDP for Sweden, 1980 – 2008, bln of national currency for 2005 constant prices, seasonally unadjusted

Source: (IMF, 2013)

Graph C1.2: Volumes of Exports, Imports and GDP for Sweden, 1980 – 2008, bln of national currency for 2005 constant prices, seasonally adjusted

Source: (IMF, 2013)
Graph C2.1: Volumes of Exports, Imports and GDP for Norway, 1980 – 2008, bln of national currency for 2005 constant prices, seasonally unadjusted

Source: (IMF, 2013)

Graph C2.2: Volumes of Exports, Imports and GDP for Norway, 1980 – 2008, bln of national currency for 2005 constant prices, seasonally adjusted

Source: (IMF, 2013)
Graph C3.1: Volumes of Exports, Imports and GDP for Denmark, 1980 – 2008, bln of national currency for 2005 constant prices, seasonally unadjusted

Source: (IMF, 2013)

Graph C3.2: Volumes of Exports, Imports and GDP for Denmark, 1980 – 2008, bln of national currency for 2005 constant prices, seasonally adjusted

Source: (IMF, 2013)
Appendix D

Augmented Dickey – Fuller Test (ADF), Philips – Perron (PP), Kwiatkowski – Philips – Schmidt – Shin (KPSS) tests for stationarity and Breusch- Godfrey (BG) test for residual autocorrelation:

Table D1: ADF, BG, PP and KPSS tests on GDP, Exports and Imports in levels, Sweden, 1980 - 2007

<table>
<thead>
<tr>
<th>Functional Form</th>
<th>ADF</th>
<th>5% Critical value</th>
<th>BG, Prob &gt; chi^2</th>
<th>PP</th>
<th>5 % Critical value</th>
<th>KPSS</th>
<th>5% critical value</th>
</tr>
</thead>
<tbody>
<tr>
<td>lngdp</td>
<td>3.175</td>
<td>-1.950</td>
<td>0.9116</td>
<td>0.905</td>
<td>-13.722</td>
<td>0.443</td>
<td>0.146</td>
</tr>
<tr>
<td>lnexp</td>
<td>-2.073</td>
<td>-2.889</td>
<td>0.06706</td>
<td>-2.317</td>
<td>-13.722</td>
<td>0.177</td>
<td>0.146</td>
</tr>
<tr>
<td>lnimp</td>
<td>1.421</td>
<td>-1.950</td>
<td>0.2645</td>
<td>-2.628</td>
<td>-13.722</td>
<td>0.154</td>
<td>0.146</td>
</tr>
</tbody>
</table>

Note: All variables are in natural logarithms
Data source: (IMF, 2013)

Table D2: ADF, BG, PP and KPSS tests on GDP, Exports and Imports in first differences, Sweden, 1980 - 2007

<table>
<thead>
<tr>
<th>Functional Form</th>
<th>ADF</th>
<th>5% Critical value</th>
<th>BG, Prob &gt; chi^2</th>
<th>PP</th>
<th>5 % Critical value</th>
<th>KPSS</th>
<th>5% critical value</th>
</tr>
</thead>
<tbody>
<tr>
<td>D.lngdp</td>
<td>-1.753</td>
<td>-1.950</td>
<td>0.5060</td>
<td>-159.479</td>
<td>-13.720</td>
<td>0.0767</td>
<td>0.146</td>
</tr>
<tr>
<td>D.lnexp</td>
<td>-3.161</td>
<td>-1.950</td>
<td>0.2723</td>
<td>-94.165</td>
<td>-13.720</td>
<td>0.0842</td>
<td>0.146</td>
</tr>
<tr>
<td>D.lnimp</td>
<td>-3.511</td>
<td>-1.950</td>
<td>0.1890</td>
<td>-93.784</td>
<td>-13.720</td>
<td>0.0662</td>
<td>0.146</td>
</tr>
</tbody>
</table>

Note: All variables are in natural logarithms. D in front of the variable denotes first difference.
Data source: (IMF, 2013)
Table D3: ADF, BG, PP and KPSS tests on GDP, Exports and Imports in levels, Norway, 1980 - 2007

<table>
<thead>
<tr>
<th>Functional Form</th>
<th>ADF</th>
<th>5% Critical value</th>
<th>BG, Prob &gt; chi^2</th>
<th>PP</th>
<th>5% Critical value</th>
<th>KPSS</th>
<th>5% Critical value</th>
</tr>
</thead>
<tbody>
<tr>
<td>lngdp constant , trend, 7 lags</td>
<td>-2.582</td>
<td>-3.449</td>
<td>0.5233</td>
<td>-0.076</td>
<td>13.722</td>
<td>0.192</td>
<td>0.146</td>
</tr>
<tr>
<td>lnexp constant, no trend 9 lags</td>
<td>-1.617</td>
<td>-3.509</td>
<td>0.1246</td>
<td>-0.727</td>
<td>13.722</td>
<td>0.596</td>
<td>0.146</td>
</tr>
<tr>
<td>lnimp constant, trend, 7 lags</td>
<td>-1.926</td>
<td>-3.449</td>
<td>0.0911</td>
<td>0.775</td>
<td>13.722</td>
<td>0.434</td>
<td>0.146</td>
</tr>
</tbody>
</table>

Note: All variables are in natural logarithms
Data source: (IMF, 2013)

Table D4: ADF, BG, PP and KPSS tests on GDP, Exports and Imports in first differences, Norway, 1980 - 2007

<table>
<thead>
<tr>
<th>Functional Form</th>
<th>ADF</th>
<th>5% Critical value</th>
<th>BG, Prob &gt; chi^2</th>
<th>PP</th>
<th>5% Critical value</th>
<th>KPSS</th>
<th>5% Critical value</th>
</tr>
</thead>
<tbody>
<tr>
<td>D.lngdp constant, no trend 6 lags</td>
<td>-3.029</td>
<td>-2.890</td>
<td>0.4525</td>
<td>161.258</td>
<td>13.720</td>
<td>0.0952</td>
<td>0.146</td>
</tr>
<tr>
<td>D.lnexp constant, trend , 1 lag</td>
<td>-13.605</td>
<td>-3.449</td>
<td>0.0545</td>
<td>0.0091</td>
<td>123.087</td>
<td>13.720</td>
<td>0.224</td>
</tr>
<tr>
<td>D.lnimp no constant, no trend, 5 lags</td>
<td>-2.239</td>
<td>-1.950</td>
<td>0.1909</td>
<td>150.883</td>
<td>13.720</td>
<td>0.0463</td>
<td>0.146</td>
</tr>
</tbody>
</table>

Note: All variables are in natural logarithms. D in front of the variable denotes first difference.
Data source: (IMF, 2013)
Table D5: ADF, BG, PP and KPSS tests on GDP, Exports and Imports in levels, Denmark, 1980 - 2007

<table>
<thead>
<tr>
<th>Functional Form</th>
<th>ADF</th>
<th>5% Critical value</th>
<th>BG, Prob &gt; chi^2</th>
<th>PP</th>
<th>5% Critical value</th>
<th>KPSS</th>
<th>5% Critical value</th>
</tr>
</thead>
<tbody>
<tr>
<td>lngdp</td>
<td>-2.447</td>
<td>-3.450</td>
<td>0.0752</td>
<td>0.362</td>
<td>13.722</td>
<td>0.200</td>
<td>0.146 (I(1))</td>
</tr>
<tr>
<td>lnexp</td>
<td>-3.849</td>
<td>-3.449</td>
<td>0.1304</td>
<td>0.184</td>
<td>13.722</td>
<td>0.190</td>
<td>0.146 (I(1))</td>
</tr>
<tr>
<td>lnimp</td>
<td>-3.757</td>
<td>-3.449</td>
<td>0.0779</td>
<td>0.700</td>
<td>13.722</td>
<td>0.202</td>
<td>0.146 (I(1))</td>
</tr>
</tbody>
</table>

Note: All variables are in natural logarithms.
Data source: (IMF, 2013)

Table D6: ADF, BG, PP and KPSS tests on GDP, Exports and Imports in first differences, Denmark, 1980 - 2007

<table>
<thead>
<tr>
<th>Functional Form</th>
<th>ADF</th>
<th>5% Critical value</th>
<th>BG, Prob &gt; chi^2</th>
<th>PP</th>
<th>5% Critical value</th>
<th>KPSS</th>
<th>5% Critical value</th>
</tr>
</thead>
<tbody>
<tr>
<td>D.lngdp</td>
<td>-3.173</td>
<td>-2.890</td>
<td>0.0873</td>
<td>-</td>
<td>111.796</td>
<td>-</td>
<td>0.146 (I(0))</td>
</tr>
<tr>
<td>D.inexp</td>
<td>-5.549</td>
<td>-2.889</td>
<td>0.0621</td>
<td>-</td>
<td>155.602</td>
<td>-</td>
<td>0.146 (I(0))</td>
</tr>
<tr>
<td>D.inimp</td>
<td>-6.384</td>
<td>-2.890</td>
<td>0.6680</td>
<td>-</td>
<td>121.238</td>
<td>-</td>
<td>0.146 (I(0))</td>
</tr>
</tbody>
</table>

Note: All variables are in natural logarithms. D in front of the variable denotes first difference.
Data source: (IMF, 2013)