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Structure of the Norwegian Imports Trade Concentration: The Seemingly Unrelated Autoregressive Regression Modelling Approach

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Abstract
Purpose: This article is proposed to analyse the structure of the trade concentration index (HHI) of Norwegian imports across continents.
Design/ Methodology/ Approach: The paper analyse the concentration index (HHI) by fitting a seemingly unrelated (SUR) regression model using exogenous variables of revenue collected from export and number of Norwegian export countries.
Findings: The results suggest that the structure of the concentration index (HHI) Norwegian imports show different feature across continents. The estimation result predicts that the Norwegian import: from the continent of Africa is increasing in the extensive margin, from the continent of Asia and Oceania is increasing in the intensive margin, from the continent of Europe is increasing in both the extensive and the intensive margin, from the continent of North and Central America shows stagnation for both the extensive and the intensive margin, and from the continent of South America is increasing in the intensive margin.
Research implications: The overall econometric analysis suggested that the Norwegian bilateral trade with European countries benefits Norway.
Originality/ Value: The methodological approach employed in this study is unique and new to analyse trade concentration index (HHI).

Keywords: Trade Concentration Index (HHI), determinants of HHI, SUR models and Norway

Introduction

Tesfay (2015) has substituted by evaluation the variation of the Norwegian import trade across continents and over time using a new econometric model. The model helps to analyse potential structural breaks and is able to identify the influential items of import and their origin continents. The estimation results of the econometric analysis show that the import expenditure is heterogeneous over both the destination continent and the import item. The analysis confirms that the Norwegian import trade is sustainable in the short and the long run after controlling for

the effect of import items from any origin continent. The analysis also suggests that potential structural breaks exist in different items of import. Furthermore, the results show that the continent of Europe is the most influential continent with an estimated import share of 69.3 %. The continent of Asia and Oceania, North and Central America, South America and Africa covers import shares of 17.4%, 9.1%, 2.3% and 1.9%, respectively. The most influential item of import across continents is the item machinery and transport equipment, which cover a share of 39.06 % of the total imports. The next top three influential items of Norwegian imports are manufactured goods classified chiefly by material, miscellaneous manufactured articles, and chemicals and related products cover import shares of 14.97 %, 14.72% and 9.67 %, respectively. The rest of import items cover a share of 21.58%.

In order to obtain detailed quantitative information for both the intra-continental and the inter-continental import trade pattern of Norway, Tesfay and Solibakke (2015a) employs the best linear unbiased estimator (BLUE) of estimable functions of the two-stage non-full rank hierarchical linear econometric model. The estimation results show that even after assuming structural breaks, the continent Europe will be the most influential importer to Norway in future trade patterns. The most important output from the econometric analysis is its ability to identify the stability and predictability of these trade patterns. In fact, the model identifies unique characteristics of the Norwegian imports from the continent of Europe, which is highly configured, stable and predictable. Tesfay and Solibakke (2015b) identified similar characteristics for Norwegian exports to the continent of Europe. The results confirm that the bilateral trade between some of European countries and Norway is strong.

The main emphasis of this paper is to measure the intensive and extensive margins of the Norwegian imports. Broadly speaking, the country's trade concentration is a function of the number of trading partners and impute/outputs of the country. In other words, trade concentration is a complicated function of the volume and value of the exchange of goods between trading partners, bilateral trade agreements and other commercial relationships, the investment in trade facilities, the reduction of trade barriers including tariffs, import quotas, export restraints, other trade barriers, and etc (Marianne and Michael 2005, Debaere 2003, Bacchetta and Eric 2000, Feenstra 2000).

Trade theory tried to give reasonable explanation of the factors that affect the exchange of goods flow. The first and the most important factor is the endogenous differences and economic growth between trading partners. Economic growth and resource dependence are therefore, the major factor playing a significant role in the volume and value of exchange of goods between trading partners (Feenstra 2000).

International economists substitute by figuring out that although economic growth and resource dependency between trading partners play a significant role in the magnitude of trade transaction, there are other convoluted factors affect the volume and value of trading partners' exchange of goods. The economy of scale argument is an important focus for the volume and value of exchange of goods. As the unit cost of production for a given good decreases, the possibility for large transport distances increases. Therefore, the wider the markets are apart, transport costs induce a cost advantage in both countries. Another important theory is based on monopolistic competition, whereby the wider markets due to trade increase product variety as buyers seek the special characteristics of foreign brands. That is, differentiated products trade flows both ways within product categories (Besedes and Prusa 2005, Glick and Andrew 2002, Feenstra and Gordon 2000, Feenstra 1994, Niehans 1987).

Free trade policies in international markets imply governments that do not restrict or reduce free trade using for example import quotas, taxes and non-tariff barriers on imports or exports (Bhagwati 2002). The doctrine and theory of free trade plays the overwhelming important role of demand and supply to establish market prices in order to bring resource endowments of

nations to the centre stage as the determining factor for mutually gainful trade (Pugel 2007). With this device, free trade theory moved away from the technology-based interpretations of the Ricardian comparative cost doctrine to an endowment based explanation for nations having similar access to technology.

The Problem

The main motivation of this paper is the idea raised by Felbermayer and Kohler (2006). According to this paper, after the post II-war, the increase of world trade took place through both the larger quantities traded between countries (the country's intensive margin) and an increase in the number of country pairs that engage in trade (the country's extensive margin). Growth in trade is therefore, driven by changes in both the extensive and intensive margin. According to Felbermayer and Kohler (2006) differences at the extensive margin, generally contributed more to explaining trade patterns while distance and other non-tariff barriers affected the extensive margin. This paper's overall hypothesis is the testing of the intensive and extensive margins for Norwegian import trade across the world continents and countries within continents. In order to support our analysis, we use both the expenditure in Norwegian kroner and the share of the import item (item expenditure over total expenditure) as our endogenous variables.

Economists used the Herfindahl–Hirschman Index (HHI) to evaluate the concentration of the markets (Hirschman 1964). Similarly, this analysis applies the HHI index to measure the import expenditure of Norway by summing the squared share of each country or continents (see the definition of HHI in section 3).

Therefore, this paper aimed to analyse the structure of the HHI of the Norwegian imports in each origin continent using the seemingly unrelated regression (SUR) models. The econometric analysis can provide the following important policy implications: Identifying the characteristics of the HHI of Norway's import trade within each continent. Furthermore, the finding will help by providing solid econometric framework about how to analyse the balance of payment of Norway's external trade.

Literature Review

One of the major task of the international trade theory is to give details about "how trade is related to the basic economic problems of, efficiency in motivation, efficiency in distribution and efficiency in the allocation of scarce resources nationally and internationally. This implies that the modern theory of international trade expected to give the solutions of the following fundamental questions. *First*, the international trade theory tried to give the solution about the goods and services are traded internationally. Furthermore, the trade theory also consists of the mechanism of the fundamental laws that govern the international flow of trade. From this point, we understand that trade concentration caused by the realization and practices of nations regarding the contributions of international trade to the proper utilisation of resources worldwide. *Second*, the international trade theory is responsible to analyse the prices of goods and services exchanged at the international trade. In this aspect, we see that trade concentration is related to the efficient pricing of goods and services exchanged by trading partners. This includes the role of governments on the international trade. *Third*, the theory of international trade has to address the gains from participation in international trade. In other words the international trade theory tried to address the effect of international trade in equitable distribution world-wide. Many international economists have shown theoretically and empirically that international trade is an important element of the economic development of nations (Henry 2011, Flanders 2008, Henry 1998, Anne and Tuncer 1982, Luc Soete 1981).

According to the comparative cost advantages trade theory, nations specialise in industries where they have a lower opportunity cost and trade based on these comparative advantages all the countries gains from international trade. The main distinguishing feature of the comparative advantage of trade theory was the international rigidity of factors of production. Factors were considered as perfectly and effortlessly movable within countries and absolutely immovable among countries, while goods were effortlessly movable inside and among countries at zero transport cost. Therefore, the theories of comparative advantage much solidifies and improve the absolute advantage of international trade by including important parameter to improve the nation's benefit from international trade (Boudreaux 2008, Marrewijk 2007, Krugman and Obstfeld 1988, Trefler 1995, Dixit and Norman1980). In 1930's Heckscher-Ohlin developed a model of factor endowment to study these subjects that were overlooked by the Ricardian model. The Heckscher-Ohlin model emphasized that international trade is based on metamorphoses in factor endowments of nations. Due to the different endowments of factors of production of nations, have comparative advantages in different industries and their comparative price levels fluctuate. The Heckscher-Ohlin analysis of the factor proportions model predicted that a country would have a comparative advantage in the good, which made relatively intensive use of its relatively abundant factor. This is the reason why each nation will export the goods intensive in its relatively abundant and cheap factor and import the goods intensive in its relatively scarce and expensive factor (Bernstein and Weinstein 2002, Trefler and Zhu 2000, Feenstra 1994).

The recent philosophy and practice of international trade demanded much concrete solution. After the World War II, Heckscher-Ohin theory was challenged by the advancement of international trade that it could not explain. Substantial flows of intra-industry trade based on product differentiation, exports of goods intensive in nations relatively scarce and expensive factors (the so called Leontief paradox), trade based on technological gaps, trade based on economies of scale and product cycles looked-for a new explanation (Krugman 2000, Helpman 1999, Duchin 1990).

Raymond Vernon developed a model of international product life cycle to give details about trade based on technological gaps. The model put together clarifications of international trade and investment flows that were succeeding in trade. Far ahead, this model was extended to explain internationalization of industries in the international industry life cycle model. The latest trade theory, combining old and new trade theory, suggest that inter-industry trade is driven by technology gaps and Heckscher-Ohlin differences in factor proportions, while intra industry trade is based on increasing returns to scale and monopolistic competition (Lancaster 1980, Dixit and Norman 1986, Krugman 1980, Helpman 1981 and Helpman and Krugman 1985). Much of intra-industry trade occurs in knowledge intensive products between highly developed countries, often in industries dominated by multinational companies, due to the fixed costs of R&D (Helpman 1984 and Markusen 1984).

Trade increases or decreases either on the intensive margin or on the extensive margin. At the country level, the extensive margin refers to the number of country pairs trading bilaterally with each other, versus the intensive margin, which is the amount of trade taking place within an existing trade partnership. The Melitz model (2003) is a dynamic industry model of a firm's decision to produce for the domestic market and their decision to export to foreign markets (creating trade at the extensive margin). In each country, the domestic market consists of firms differentiated by the varieties they produce and their productivity. Fixed production costs lead to the exit of inefficient firms whose productivities are lower than a threshold level, as they do not expect to earn positive profit in the future. There are then additional costs associated with exporting. However, the decision to export occurs after the firm observe their productivity in the domestic market. A firm enters exports markets if, and only if, the net profits generated

from its exports in a given country are sufficient to cover the fixed exporting costs. Helpman, Melitz and Rubinstein (2008) provide an updated probit model of the extensive margin of trade. A country will export to a given market if the most productive exporting firm has a ratio of variable export profits to fixed costs larger than one. Novy (2007) also model the calculation of trade costs from information on bilateral and internal trade flows.

The monopolistic competition model of Helpman and Krugman (1985) explain how fast-growing countries could experience rapid growth without declining terms of trade. If they developed new varieties of products to be exported (increasing the extensive margin), rather than increasing the volume of goods already exported (the intensive margin), the price of existing products would not be lowered.

Any trade barriers that may exist between bilateral trading partners limit international trade. As well as policy barriers, such as tariffs, these include natural barriers, such as transport costs, which tend to increase with distance and decrease with the sophistication of physical infrastructure, and can be as high as 40% of production costs. In Tinbergen's gravity model, bilateral trade flows depend on the market size of the country pair in question relative to the rest of the world, and the distance between them relative to the distance to all other potential trading partners (Anderson 1979 and McCallum 1995). Eaton and Kortum (2001) calculate that "zero gravity", i.e. no geographical barriers to trade, would imply a more than fivefold increase in world trade.

The presence of sizeable transport costs, combining with increasing returns, also creates the home-market effect (Corden 1970). Where there are possibilities of realising economies of scale, firms tend to concentrate production in one location, and transport costs are minimized if this location is within the larger market. Therefore, while some parts of production may be geographically fragmented, those operations where economies of scale are important, such as R&D, will tend to be geographically concentrated, often in the home market. Consequently, countries tend to export goods for which they have a large domestic market.

There has been an increasing focus on informal trade barriers as an explanation of why trade flows are not higher. These include weak enforcement of international contracts (Anderson and Marcouilier 2000) and inadequate information about international trading opportunities (Portes and Rey 2002). Grafton, Kompas and Owen (2007) present OLS and instrumental variable results that support the hypothesis that social barriers to communication, as measured by linguistic diversity, reduce total factor productivity.

Rauch's (2001) model shows that how business and social networks can affect trade. On the one hand, domestic networks can act as informal barriers themselves, with network members colluding to increase market power by restricting foreign competition. Immigration is expected to encourage trade within the country of origin, both through transnational network effect and through immigrant's taste for goods from their country of origin. Estimation results from gravity models suggest that migration flows can have a significant effect on trade flows, particularly intra-industry trade. Some studies of immigration find larger import elasticity compared to export elasticity, although a few find the opposite. Gould (1994), for example, estimates that 10% increase in immigrants to the USA will increase US exports to the country of origin by 4.7% and us imports from the country of origin by 8.3%.

Houthakker and Magee (1969) documents large differences in the income elasticity's of trade flow across countries. Hence, as growth rates start to slow in newly industrialized countries such as China, we would expect to see a simultaneous increase in the relative income elasticity of import demand. Finally, exchange rate effects on trade are not straight forward, and can be weak. Theory suggests that depreciation is more likely to increase trade at the extensive margin than the intensive margin. Higher import intensity in production reduces the potential competitiveness effect of depreciation.

The Data and Methodology

The Norwegian External Trade Dataset

The dataset for this economic analysis is from Statistics Norway (www.ssb.no) and is downloaded from Statbank Norway (www.ssb.no/en/statistikkbanken) and External Economy (External trade, External trade in goods, 08801). The data are organised yearly ranging from 1988 to the end of 2014.

The endogenous variable is the expenditure to import items.

The using the expenditure to import items, we define the following endogenous variables as:

(i). *Share of exporters* (continents or countries) of Norway, which is defined as:

$$Share_{it} = \left(\frac{Expandature_{it}}{\sum_{i=1}^{a} Expandature_{it}} X100 \right)\% \quad (1)$$

, where: $i = 1,2,3,...,a$ is the index represents origin continents or countries, $t = 1,2,3,...,T$ is the index represents time.

(ii). *Herfindahl–Hirschman Index (HHI)* is a measure of trade concentration. The HHI is defined as:

$$HHI_t = \sum_{i=1}^{a} Share_{it}^2 \quad (2)$$

The value of the Herfindahl–Hirschman Index (HHI) ranges from 0 (highly diversified) to 10,000 (highly concentrated).

The exogenous variables of the study are: [1]. Number of exporter countries to Norway and [2]. Norway's revenue from the export of goods.

The Model: Seemingly Unrelated Regression (SUR) model

Seemingly unrelated regression (SUR) models are the generalizations of a linear regression model that contains of more than one independent regression equations. The SUR model for the endogenous vector of $\{y_{1t}, y_{2t}, y_{3t}, ..., y_{at}\}$ and the exogenous vectors of $\{x_{11t}, x_{21t}, x_{31t}, ..., x_{a1t}\}$ and $\{x_{12t}, x_{22t}, x_{32t}, ..., x_{a2t}\}$ is given as (Davidson and MacKinnon 1993):

$$\begin{cases} y_{1t} = \beta_{10} + \beta_{11} x_{i1t} + \beta_{12} x_{12t} + \varepsilon_{1t} \\ y_{2t} = \beta_{20} + \beta_{21} x_{i1t} + \beta_{22} x_{12t} + \varepsilon_{2t} \\ \quad \vdots \\ y_{at} = \beta_{a0} + \beta_{a1} x_{a1t} + \beta_{a2} x_{a2t} + \varepsilon_{at} \end{cases} \quad (1)$$

, where: $i = 1,2,3,....,a$, $t = 1,2,3,...,T$, β_{i0} is the constant of the i^{th} regression model, β_{i1} and β_{i2} are the common coefficients of X_{i1} and X_{i2}, and for the $\varepsilon_{it} \sim iidN\left(0, \sigma_i^2\right)$ are the random error terms.

With the above specification, we can simply express the SUR model in equation 1 as:

$$y_{it} = \beta_{i0} + \beta_{i1}x_{i1t} + \beta_{i2}x_{i2t} + \varepsilon_{it} \quad (2)$$

For the estimation, under the complete Gauss Markov assumption the ordinal least squares (OLS) estimator is the best linear unbiased estimator (BLUE) of the model parameters for the regression models (Greene 2012, Fahrmeir et al. 2009).

Model Adequacy Checking: Seemingly Unrelated Autoregressive Regression model

It is always necessary to check the model whether it accomplishes the theoretical assumptions of the model (Andrews and Herzberg 1985, Rees 2000). Whenever we use time series data we encounter the problem of autocorrelation. This problem causes to underestimate or overestimate the variance of the random error term and increase the coefficient of determination. As a result, the model information gives a false confidence to the researcher (Samprit, et al, 2013, Judge, 1985). Therefore, in order to solve the problem of autocorrelation, we use the following algorithm.

Step 1: First estimate the OLS residuals as:

$$\hat{\varepsilon}_t = y_{it} - \left(\hat{\beta}_{i0} + \hat{\beta}_{i21}x_{i1t} + \hat{\beta}_{i2}x_{i2t}\right) \quad (3)$$

Step 2: Determine the structure of autocorrelation

At this step, we use the Brewish-Godfrey test of autocorrelation (Godfrey, 1978). The test procedure is given as:

Step 2.1: Set Hypothesis

The Null-Hypothesis (H_0): The error terms are independently distributed

The Alternative Hypothesis (H_1): The error terms are serially correlated of order h

Step 2.2: Regress the residual as:

$$\hat{\varepsilon}_{it} = \rho_{i1}\hat{\varepsilon}_{it-1} + \rho_{i2}\hat{\varepsilon}_{it-2} + ... + \rho_{ih}\hat{\varepsilon}_{it-h} + \varphi_{i21}x_{i1t} + \varphi_{i2}x_{i2t} + v_t \quad (4)$$

Step 2.3: Calculate the coefficient of determination of regression equation 4

$$R^2_{\hat{\varepsilon}} = 1 - \frac{SSE_{\hat{\varepsilon}}}{SST_{\hat{\varepsilon}}} \quad (5)$$

Where: $SSE_{\hat{\varepsilon}}$ is the sum of squares of the error and $SST_{\hat{\varepsilon}}$ is the total sum of squares.

Step 2.4: Calculate the Brewish-Godfrey test statistic

$$BL = nR^2_{\hat{\varepsilon}} \sim \chi^2_h \quad (6)$$

Step 2.4: Decision: Reject H_0 if $BL = nR^2_{\hat{\varepsilon}} > \chi^2_{h,\alpha}$

Step 3: Controlling autocorrelation from SUR model

If we do not reject our null-hypothesis we take the model fit is free from the problem of autocorrelation. In order to control autocorrelation problem we can apply the Cochrane-Orcutt recursive autoregression estimation on each the independent regression equations. The the Cochrane-Orcutt recursive autoregression estimation is applied as follows (Cochrane and Orcutt 1949).

First we specify a reasonable the model to avoid such problem as:

$$y_{it} = \beta_{i0} + \beta_{11}x_{i1t} + \beta_{i2}x_{i2t} + \varepsilon_{it} \quad (7)$$

, where: $\varepsilon_{it} = \rho_i\varepsilon_{it-1} + v_{it}$, $|\rho_i| < 1$ is the coefficient of autocorrelation and $v_{it} \sim iidN\left(0, \sigma^2_{iv}\right)$

Let's apply the Cochrane-Orcutt transformation to eliminate the autocorrelation from the model.

$$y_{it} = \beta_{i0} + \beta_{i1}x_{i1t} + \beta_{i2}x_{i2t} + \varepsilon_{it} \quad (8)$$

$$\rho_i y_{it-1} = \rho_i\beta_{i0} + \rho_i\beta_{i1}x_{i1t-1} + \beta_{i2}x_{i2t-1} + \rho_i\varepsilon_{it-1} \quad (9)$$

Subtract equation 9 from 8 we have:

$$y_{it} - \rho_i y_{it-1} = (\beta_{i0} - \rho_i\beta_{i0}) + (\beta_{11}x_{i1t} - \rho_i\beta_{i1}x_{i1t-1}) + (\beta_{i2}x_{i2t} - \rho_i\beta_{i2}x_{i2t-1}) + (\varepsilon_{it} - \rho_i\varepsilon_{it-1}) \quad (10)$$

$$y^*_{it} = \beta^*_{i0} + \beta_{i1}x^*_{i1t} + \beta_{i2}x^*_{i2t} + v_{it} \quad (11)$$

, where: $y^*_{it} = y_{it} - \rho_i y_{it-1}$, $\beta^*_{i0} = (\beta_{i0} - \rho_i\beta_{i0})$, $x^*_{i1t} = (x_{i1t} - \rho_i x_{i1t-1})$ and $x^*_{i2t} = (x_{i2t} - \rho x_{i2t-1})$

Since $v_{it} \sim iidN(0, \sigma^2_{iv})$, regression equation 10 has controlled the autocorrelation of the series. So, we can apply the Ordinary Least Square Estimator (OLS) recursively on regression equation 11.

Step 5: Repeat from Step 1 to Step 5 unless the Brewish-Godfrey test of autocorrelation confirms that there is no serial correlation on the random error terms.

Results and Discussions

Fitting SUR Model of the HHI of Norwegian Imports

In order to analyse the structure of the extensive and intensive margins of the Norwegian imports, we fit a seemingly unrelated regression (SUR) model of the HHI for the Norwegian imports using *exogenous variables* of the number of Norwegian export countries and Norway's revenue from export. The estimation result of the model is interpreted in the following section. The matrix scatter plot of the variation of the continent of Africa is given in Figure 2. According to Figure 2, the revenue collected from the export of goods and the numbers of Norwegian export countries from the continent of Africa is increasing with time. The HHI is decreasing in the numbers of Norwegian exporter countries and the revenue collected from the continent of Africa. In order to test the significance of the exogenous variables on the HHI for the Norwegian imports from the continent of Africa, we fit a regression model that is summarized in Figure 1. According to Figure 1 the model fit show an F-value of 5.19 (p-value=0. 03) which is a good fit at the 5 % level of significance. The estimates of the SUR model show that the number of Norwegian export countries from the continent of Africa is significant to the HHI. As the number of Norwegian export countries increases by one unit in Africa the HHI index of Norwegian import decreased by 158.11. However, the estimation result suggests that the revenue collected from export of goods to the continent of Africa is insignificant for the HHI. The result confirms that the Norwegian import is increasing in its extensive margin in the continent of Africa. The overall analysis shows that the bilateral trade relationship between Norway and African countries has generally benefited the African countries.

The matrix scatter plot for the continent of Asia and Oceania is shown in Figure 3. According to the Figure 3, the revenue collected from the export of goods and the numbers of Norwegian export countries from the continent of Asia and Oceania are increasing with time. The HHI is increasing with the numbers of Norwegian export countries and the revenue collected from the continent of Asia and Oceania. In order to test the significance impact of the exogenous variables on the HHI for the Norwegian imports from Asia and Oceania, we fit a regression model that is summarized in Figure 1. According to Figure 1 the model fit shows an *F*-value of 8.05 (*p*-value=0.01) which is a good fit at the 5% level of significance. The estimates of the SUR model show that the revenue collected from Norwegian export for the continent of Asia and Oceania is significant to the HHI. As the revenue collected from Norwegian export in billion NOK for Asia and Oceania, the HHI index of Norwegian import increased by 9.68.

Nevertheless, the estimation result suggested that the number of Norwegian export countries is insignificant to the HHI. This confirms that the Norwegian import is increasing its intensive margin in the continent of Asia and Oceania, especially to China. The overall analysis shows that the bilateral trade relationship between Norway and Asia and Oceania countries has generally benefited the Asian and Oceania countries, especially China.

The matrix scatter plot for the continent of Europe is shown in Figure 4. According to the Figure 4, the revenue collected from Norwegian export of goods and the numbers of Norwegian export countries to the continent of Europe are increasing with time. The HHI is decreasing with the numbers of Norwegian export countries and the revenue collected from the European continent. In order to test the significance impact of the exogenous variables on the HHI for the Norwegian imports from the European continent, we fit a regression model that summarized in Figure 1. According to Figure 1 the model fit shows an *F*-value of 104.42 (with a *p*-value=0.00), which is a good fit at the 5% level of significance. The estimates of the SUR model shows that the revenue collected from Norwegian export of goods and the numbers of Norwegian export countries to the continent of Europe are significant to the HHI. As the revenue collected from Norwegian export to the continent of Europe in billion NOK, the HHI index of Norwegian import decreases by 0.24. Furthermore, as the number of Norwegian export countries is increases by one unit, the HHI is reduced by 6.18. This confirms that the Norwegian import is increasing both its intensive and extensive margin for the European continent. The overall analysis shows that the bilateral trade relationship of Norway with European countries has generally benefited Norway.

The matrix scatter plot for the continent of North and Central America is shown in Figure 5. According to the Figure 5, the revenue collected from Norwegian export of goods to the continent of North and Central America is increasing with time. However, the number of Norwegian export countries to the continent is neither increasing nor decreasing but varies with time. The HHI is neither increasing nor decreasing with the numbers of Norwegian export countries. The Norwegian revenues from the continent are stable. In order to test the significance impact of the exogenous variables on the HHI for Norwegian imports to the continent of North and Central America, we fit a regression model that is summarized in Figure 1. According to Figure 1 the model fit shows an *F*-value of 0.089 (with associated *p*-value=0.915) which is not a good fit. The estimates of the SUR model shows that neither the revenue collected from Norwegian export of neither good nor the numbers of Norwegian export countries to the continent of North and Central America are HHI significant. Therefore, in order to get precise information about the bilateral trade relationship between Norway and North and Central America, extended analysis has to be performed, especially the impact of exchange rates.

The matrix scatter plot for the continent of South America is shown in Figure 6. According to the Figure 6, the revenue collected from the Norwegian export of goods to the continent of South America is increasing with time. However, the number of Norwegian export countries to the continent is neither increasing nor decreasing but varies with time. The HHI is increasing with the revenue collected from the Norwegian export of goods to the continent of South America. The HHI is not correlated with the number of Norwegian export countries to the continent. In order to test the significance, impact of the exogenous variables on the HHI of the Norwegian imports from the continent of South America, we fit a regression model that is summarized in Figure 1. According to Figure 1 the model fit shows an *F*-value of 56.18 (with associated *p*-value of 0) which is a good fit at the 5% level of significance. The estimates of the SUR model shows that the revenue collected from Norwegian export of goods to the continent of South America is significant to the HHI. As the revenue collected from Norwegian export of goods to the continent of South America increased in billion NOK, the HHI index of Norwegian

import increased by 346.43. This confirms that the Norwegian import is increasing its intensive margin in the continent of South America, especially Brazil. The overall analysis shows that the bilateral trade relationship of Norway with South American countries has generally benefited the South American (especially Brazil) countries.

Conclusions and Recommendations

Conclusions

In this study, we applied the seemingly unrelated regression (SUR) model to analyse the structure of the Herfindahl–Hirschman Index (HHI) for Norwegian imports. The analysis of the HHI helps us to determine the Norwegian extensive and the intensive margins. The model results suggest the following conclusions.

The estimates of the Herfindahl–Hirschman Index (HHI) of the Norwegian imports from the continents of Africa, Asia and Oceania, Europe, North and Central America, and South America are 2525.42, 2317.95, 1114.19, 4834.15 and 2705.13, respectively. The trend of HHI of the continent of: [1] Africa is decreasing with time with extreme high variability, [2] Asia and Oceania is increasing with time with small variability, [3]. Europe is very slightly decreasing with time with extremely negligent variability, [4] North and Central America is constant time with high variability, and [5] South America is sharply increasing with time with small variability.

The fit of the seemingly unrelated regression (SUR) model using exogenous variables of the number of Norwegian export countries and revenue collected from the Norwegian exports show that the structure of the HHI of the Norwegian imports has different features across continents. The Norwegian import from the continent of Africa is increasing in extensive margin. The Norwegian import from to the continent of Asia and Oceania is increasing in intensive margin. The Norwegian import from to the continent of Europe is increasing in both the extensive and the intensive margin. The Norwegian import from the continent of North and Central America is stable in the extensive and the intensive margin. The Norwegian import from to the continent of South America is increasing in intensive margin. The overall analysis shows that the Norwegian bilateral trade with European countries is beneficial for Norway.

Recommendations and Policy Implications

Our econometric analysis identified that the Norwegian import HHI from the continent of North and Central America is highly volatile. Furthermore, neither the number of Norwegian export countries nor the revenue from Norwegian export to the continents has significant impact on the HHI. Consequently, we cannot evaluate the benefits for Norway from the Norwegian bilateral trade with North and Central American countries, especially the Unites States of America and Canada. In this aspect, there are several important hypotheses, such as the impact of exchange rate, elasticity of particular items of imports, the impact of structural changes to the continent of Asia and Oceania etc. must be tested. Furthermore, we recommend that the Norwegian government find the necessary means foe the standardization of the bilateral trade with North and Central American countries.

The Norwegian imports from Asia and Oceania, and South America is progressively intensified for the countries of China and Brazil, respectively. In this aspect, we recommend that Norwegian exporters intensify their export efforts for China and Brazil.

We recommend that similar analyses to be conducted in the export trade of Norway. Furthermore, the result of this study confirms that the structure of the Norwegian imports from the five continents is different. This is a crucial impute for researchers when conducting similar studies.

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References

Anderson, J.E. (1979). A Theoretical Foundation for the Gravity Equation, Amer: Econ. Rcu. 69:l. pp. 106-16.

Andrews, D. F., and A. M. Herzberg (1985). Data: A Collection of Problems from Many Fields for the Student and Research Worker. New York: Springer.

Anderson, J. and D. Marcouilier (2000). Insecuirty and Pattern of Trade: An Empirical Investigation, Revision of NBER Working Paper #7000

Anne Krueger and Bilge Tuncer (1982). An Empirical Test of the Infant Industry Argument, American Economic Review, vol. 72..

Bacchetta, Philippe and Eric van Wincoop (2000). Does Exchange-Rate Stability Increase Trade and Welfare? American Economic Review 90(5) December, 1093-1109.

Besedes, T. and Prusa, T. (2005). Is trade in differentiated goods different? NBER Working Paper No. 9936

Bhagwati, Jagdish (2002). Free Trade Today. Princeton: Princeton University Press.

Blinder, Alan S. (2008). "Free Trade". In David R. Henderson (ed.). Concise Encyclopedia of Economics (2nd ed.). Indianapolis: Library of Economics and Liberty.

Boudreaux, Donald J. (2008). "Comparative Advantage". In David R. Henderson (ed.). Concise Encyclopedia of Economics (2nd ed.). Indianapolis: Library of Economics and Liberty.

Bernstein, J. R. & Weinstein, D. E. (2002). "Do endowments predict the location of production?: Evidence from national and international data", Journal of International Economics 56 (1): 55–76, doi:10.1016/S0022-1996(01)00108-8

Cochrane and Orcutt. (1949). Application of least squares regression to relationships containing autocorrelated error terms. Journal of the American Statistical Association

Corden, C.W. (1970). The efficiency effects of trade and protection, in I.A. McDougall and R. Snape, eds. Studies in International Economics: Monash Conference papers (North Holland, Amsterdam)

Davidson, Russell; Mackinnon, James G. (1993).Estimation and inference in econometrics. Oxford University Press.

Debaere, Peter (2003). "Relative Factor Abundance and Trade" Journal of Political Economy 11, 589-610.

Dixit, A. and V. Norman (1986), Gains from Trade Without Lump-Sum Compensation, Journal of International Economics, 21, pp. 111-122

Dixit, Avinash & Norman, Victor (1980). Theory of International Trade: A Dual, General Equilibrium Approach. Cambridge: Cambridge University Press. p. 2.

Duchin, Faye (1990). "Technological Change and International Trade," Economic Systems Research, 2(1), 47-52.

Eaton, J. and S. Kortum (2001). Trade in capital goods, European Economic Review, Elsevier, vol. 45(7), pages 1195-1235.

Fahrmeir, L., Kneib, T., and Lang, S. (2009). Regression. Model and Method (Second ed.). Heidelberg: Springer

Feenstra, R.C. (2000) "World Trade Flows, 1980-1997" University of California-Davis,

Feenstra R.C. (1994). New product varieties and the measurement of international prices American Economic Review, 84 (1), pp. 157–177

Feenstra, R.C. and Gordon H. H. (2000). Aggregation Bias in the Factor Content of Trade: Evidence from U.S. Manufacturing." American Economic Review, 90(2) Institute for Government Affairs Working Paper.

Felbermayer, G. J. and W. Kohler (2006). Exploring the Intensive and Extensive Margins of World Trade, Review of World Economics, 142:4

Flanders J.M. (2008). "International economics, history of," The New Palgrave Dictionary of Economics. 2nd Edition.

Glick, Reuven and Andrew Rose (2002). Does a Currency Union Affect Trade? The Time Series Evidence," European Economic Review 46(6), 1125-1151.

Godfrey, L.G., (1978). Testing Against General Autoregressive and Moving Average Error Models when the Regressors Include Lagged Dependent Variables, Econometrica, 46, 1293–1302.JSTOR

Gould, D.M. (1994). Immigrants Links to the Home Country: Empirical Implications for U.S. Bilateral Trade Flows, The Review of Economics and Statistics, vol. 76(2), pp. 302-317.

Grafton, R., Kompas, T. and Owen, D. (2007). Bridging the barriers: knowledge connections, productivity and capital accumulation,' Journal of Productivity Analysis.

Helpman, Elhanan (1999). "The Structure of Foreign Trade," Journal of Economic Perspectives, 13(2), 121-44.

Helpman, E. (1984). A Simple Theory of International Trade with Multinational Corporations, Journal of Political Economy, University of Chicago Press, vol. 92(3), pp. 451-71.

Helpman, Elhanan (1981). International Trade in the Presence of Product Differentiation, Economies of Scale and Monopolostic Compotition: A Chamberlain-Heckscher-Ohlin Approach, Journal of International Economics, 11(3), pp. 305-340

Helpman, E., M. Melitz and Y. Rubinstein (2008). Estimating Trade Flows: Trading Partners and Trading Volumes, The Quarterly Journal of Economics, MIT Press, vol. 123(2), pp.441-487, 05.

Helpman, E. and P.R. Krugman (1985). Market Structure and Foreign Trade: Increasing Returns, Imperfect Competition and the International Economy, MIT Press

Henry Burton (1998). A Reconsideration of Import Substitution Journal of Economic Literature, Vol. 36, No. 2

Henry Thompson (2011). "International Economics: Global MARKETS and Competition (3rd Edition)". Amazon.com

Hirschman, Albert O. (1964). "The Paternity of an Index". The American Economic Review 54 (5): 761. JSTOR 1818582

Houthakker, H. and S. Magee (1969). Income and Price Elasticities in World Trade, The Review of Economics and Statistics 51(2), 111-125.

Krugman, Paul (2000). "Technology, Trade, and Factor Prices," Journal of International Economics, 50(1), 51-71.

Krugman, Paul (1980). Scale Economics, Product Differentiation, and the Pattern of Trade", American Economic Review, 70, 950-959.

Krugman, Paul & Obstfeld, Maurice (1988). International Economics: Theory and Policy. New York: Prentice Hall. pp. 27–36.

Lancaster, K. (1980). Intra-industry trade under perfect monopolistic competition, Journal of International Economics, 10, pp. 151-175.

Luc Soete (1981).A General Test of Technological Gap TRADE Theory, Review of World Economics.

Marianne B. and Michael A. K. (2005). What Determines Bilateral Trade Flows? Federal Reserve Bank of Chicago, Accepted in May 2015 and available at www.chicagofed.org/~/media/publications/.../wp2005-11-pdf.

Markusen, J.R. (1984). Multinationals, multi-plant economies and the gain from trade, Journal of International Economics, 16, pp. 205-216

Marrewijk, Charles van. (2007). "Absolute Advantage". Department of Economics, Erasmus University Rotterdam: WORLD economy. Princeton University Press

McCallum, J. (1995). National Borders Matter: Canada-US Regional Trade Patterns, American Economic Review, 85:3, pp. 613-23.

Melitz, M. (2003). "The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity, Econometrica, 71:6, pp. 1965-1725

Novy, D. (2007). Is the Iceberg Melting Less Quickly? International Trade Costs after World War II. Mimeo, University of Warwick.

Portes, R. and H. Rey (2002). The Determinants of Cross-Border Equity Transaction Flairs, Working paper, London Business School.

Pugel, Thomas A (2007). International Economics, 13th edition. New York: McGraw-Hill Irwin.

Rauch, James E (2001). Business and Social Networks in International Trade, Journal of Economic Literature, Vol. 39, No. 4

Rees, D.G. (2000). Essential Statistics. (4th ed.) London: Chapman and Hall/CRC.

Smith, Charles (2007). International TRADE and Globalisation, 3rd edition. Stocksfield: Anforme.

Smith, George H. (2008). "Mercantilism". In Hamowy, Ronald. The Encyclopedia of Libertarianism. Thousand Oaks, CA: SAGE; Cato Institute. pp. 326–8.

Tesfay, Yohannes Yebabe (2015). A New Econometric Model to Analyze Variations and Structural Changes in International Trade: Applications to of Norway's Import Trade across Continents and over Time. International Journal of Trade and Global Markets

Tesfay, Yohannes Y. and Solibakke, Per B. (2015a). Econometric Evaluation of the Import Trade of Norway, Molde University College

Tesfay, Yohannes Y. and Solibakke, Per B. (2015b). Econometric Modelling of the Variations of Norway's Export Trade across Continents and over Time: The Two-Stage Non-Full Rank Hierarchical Linear Econometric Model Approach. Economics Research International

Trefler, Daniel (1995). "The Case of the Missing Trade and Other Mysteries". The American Economic Review 85 (5): 1029—1046. JSTOR 2950973

Trefler, Daniel & Zhu, Susan Chun (2000), "Beyond the Algebra of Explanation: HOV for the Technology Age", American Economic Review 90 (2): 145–149

Vaggi, Giann & Groenewegen, Peter (2003). A Concise History of Economic Thought: From Mercantilism to Monetarism, New York: Palgrave Macmillan.

List of Tables and Figures:

Table: Preliminary estimates of Herfindahl–Hirschman Index (HHI) of Norwegian imports

Dependent variable HHI		Statistic	Bootstrap[a]				
			Bias	Std. Error	95% Confidence Interval		Coefficient Variation
					Lower	Upper	
Africa	Mean	2525.4165	1.0702	248.7133	2078.5450	3014.8761	
	Std. Deviation	1272.75071	-42.17343	229.74905	730.19769	1650.09183	0.508643015
Asia and Oceania	Mean	2317.9511	-1.9327	79.5257	2161.8176	2480.7943	
	Std. Deviation	403.61322	-10.15444	49.40057	293.66412	482.16252	0.175737263
Europe	Mean	1114.1861	.2452	15.0689	1083.2045	1144.2283	
	Std. Deviation	78.91988	-2.04873	7.59165	61.73355	91.44888	0.071487721
North and Central America	Mean	4834.1527	-5.9999	122.1455	4585.8860	5055.4875	
	Std. Deviation	629.22278	-19.06771	103.38356	419.69684	818.71889	0.131367161
South America	Mean	2705.1349	-4.4006	153.4856	2405.7502	3002.6910	
	Std. Deviation	790.87512	-23.88265	111.16837	523.92151	964.64189	0.295067736
Continental	Mean	5605.2824	1.2205	57.0196	5500.0081	5721.0200	0.053187364
	Std. Deviation	295.39505	-7.46994	33.27985	216.64399	349.77519	

a. Unless otherwise noted, bootstrap results are based on 1000 bootstrap samples

Figure 1: Fit of seemingly unrelated regression (SUR) model of the structure of continental import trade concentration of Norway

Model SUR Model Fit										
Continents	SV	SS	DF	MS	F-cal	Sig.	R	R Square	Adj -R Square	Std. Error
Africa	Regression	7216195	1	7216195.0	5.189004	0.03154	0.414589	0.1719	0.139	1179.27
	Residual	34766765	25	1390670.6						
	Total	41982960	26							
Asia and Oceania	Regression	1181687	1	1181687.3	8.046886	0.00891	0.493456	0.2435	0.213	383.21
	Residual	3671257	25	146850.3						
	Total	4852944	26							
Europe	Regression	173751.7	2	86875.9	104.4239	0.00000	0.947063	0.8969	0.888	28.84
	Residual	19966.9	24	832.0						
	Total	193718.6	26							
North and Central America	Regression	72279.33	2	36139.7	0.088776	0.91535	0.085695	0.0073	0.075	638.04
	Residual	9770155	24	407089.8						
	Total	9842434	26							
South and Central America	Regression	17313940	2	8656970.0	56.17724	0.0000	0.907738	0.8240	0.809	392.56
	Residual	3698425	24	154101.0						
	Total	21012365	26							

Figure 1 continued

Parameter Estimates						
Continents		Coefficients	Std. Error	Standardized Coefficients	t	Sig.
Africa	Constant	7243.93	2125.26		3.408	0.0022**
	Number of Countries	-158.11	69.41	-0.4146	-2.278	0.0315**
	Revenue from export	-98.35	115.89	-0.2151	-0.849	0.4045
Asia and Oceania	Constant	2041.18	137.63		14.831	0.0000**
	Number of Countries	23.36	36.11	0.2399	0.647	0.5239
	Revenue from export	9.68	3.41	0.4935	2.837	0.0089**
Europe	Constant	1465.17	72.46		20.220	0.0000**
	Number of Countries	-6.18	2.04	-0.3330	-3.034	0.0060**
	Revenue from export	-0.24	0.04	-0.6590	-5.999	0.0000**
North and Central America	Constant	6664.25	1406.86		4.737	0.0001**
	Number of Countries	-47.74	69.54	-0.1378	-0.687	0.4995
	Revenue from export	-15.27	9.70	-0.3160	-1.575	0.1296
South and Central America	Constant	1652.89	139.51		11.848	0.0000**
	Number of Countries	150.80	98.84	0.1310	1.526	0.1402
	Revenue from export	346.43	33.89	0.8983	10.221	0.0000**

Cochrane-Orcutt autoregression estimation is used
SV=Source of variation, SS=Sum of squares, MS=Mean square,
** Significant at the 5% level of significance

Figure 2.1: Dynamics of Expenditure of African exporters to Norway

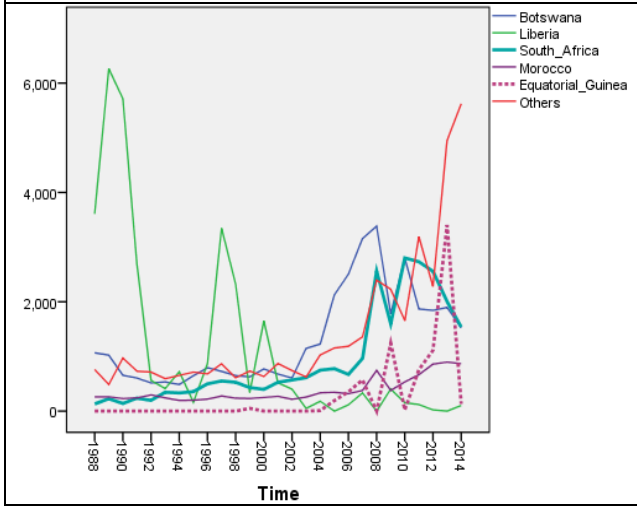


Figure 2.1: Dynamics of Expenditure of Asian and Oceania exporters to Norway

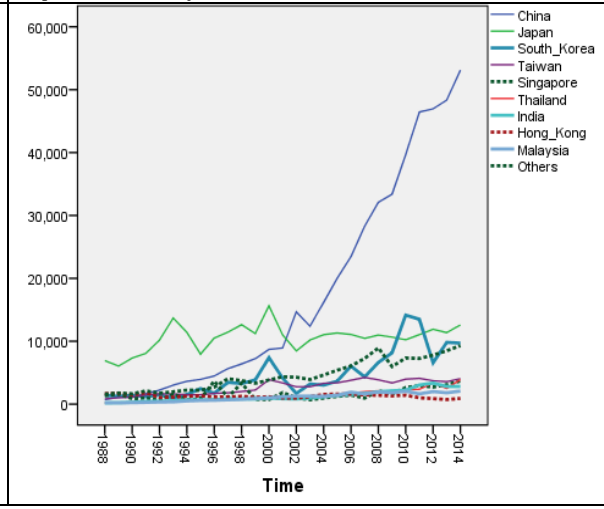


Figure 3.1: Dynamics of Expenditure of European exporters to Norway

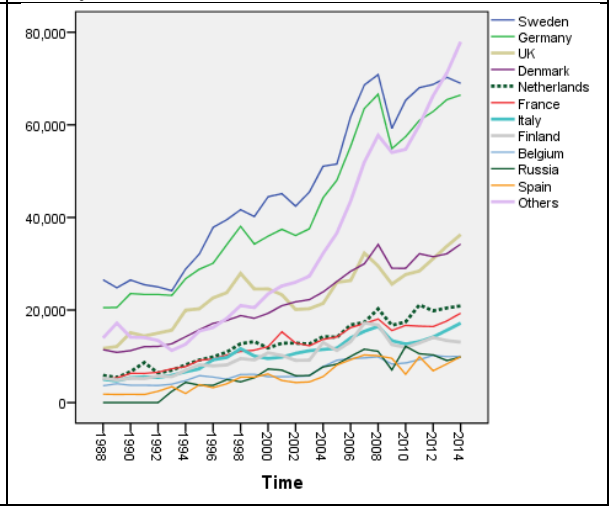


Figure 2.2: Dynamics of share of African exporters to Norway

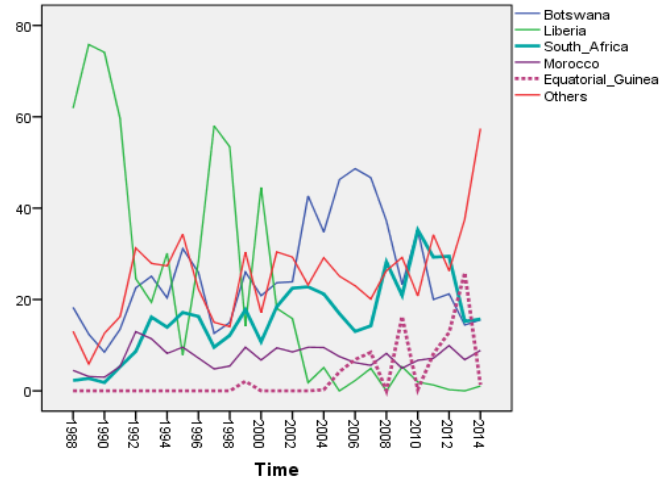


Figure 2.2: Dynamics of Share of Asian and Oceania exporters to Norway

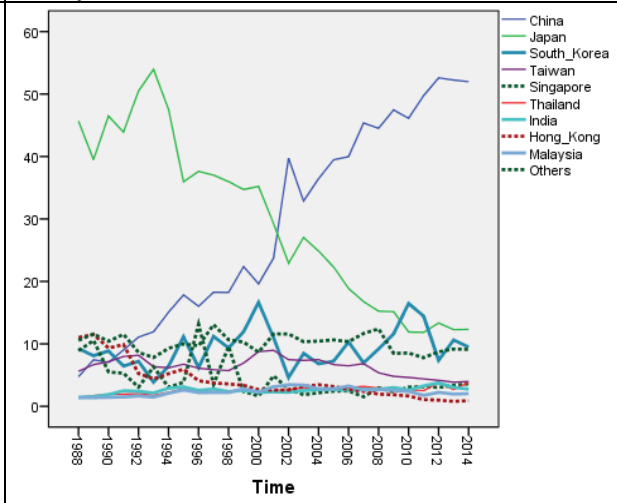


Figure 3.2: Dynamics of share of European exporters to Norway

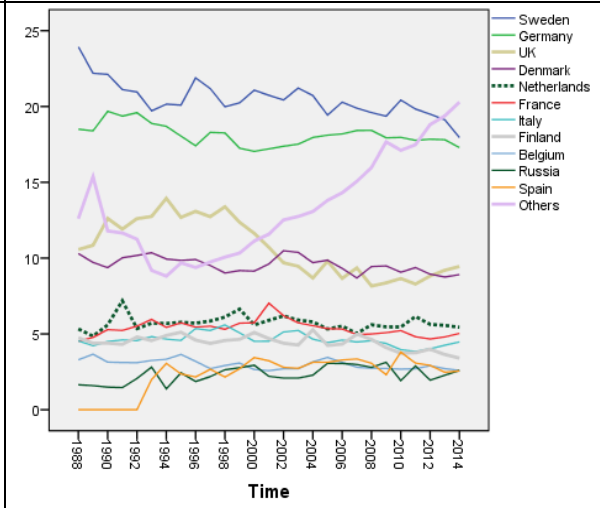


Figure 4.1: Dynamics of Expenditure of North and Central American to Norway

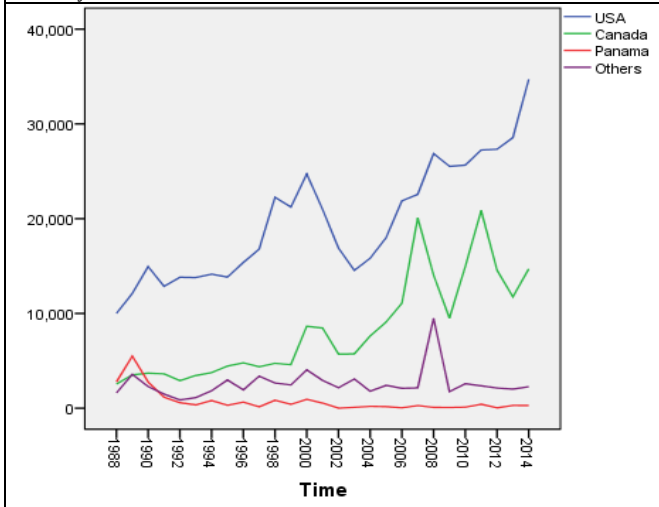


Figure 5.1: Dynamics of Expenditure of South American exporters to Norway

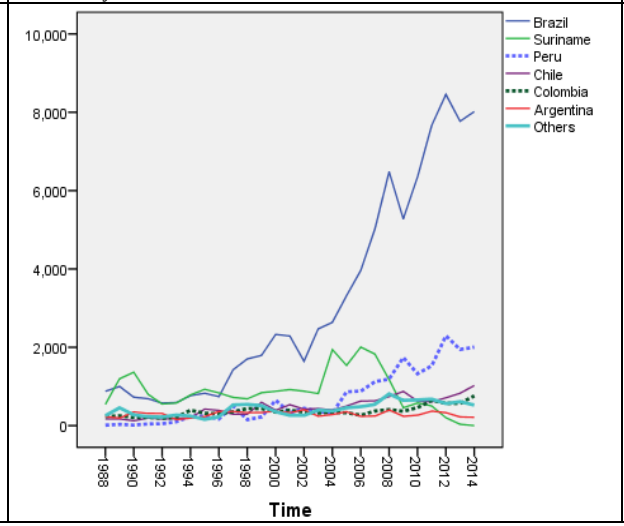


Figure 6.1: Dynamics of Expenditure of across continents of Norway

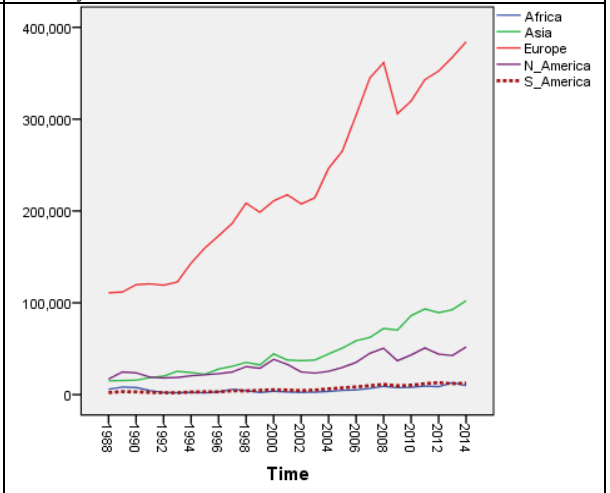


Figure 4.2: Dynamics of Share of North and Central American exporters to Norway

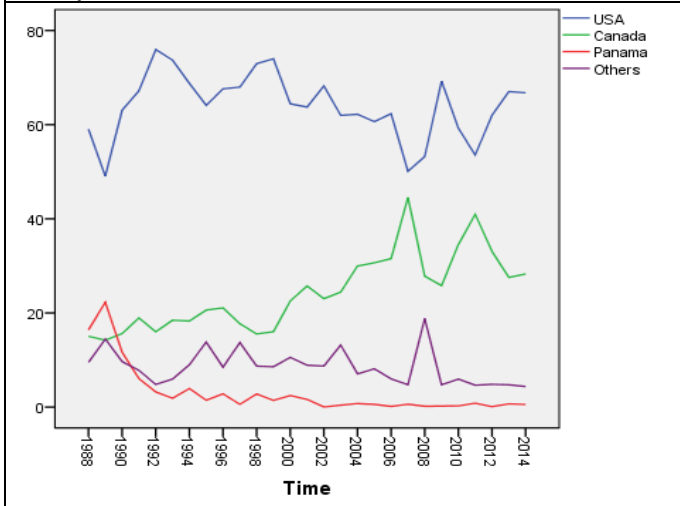


Figure 5.2: Dynamics of Share of South American exporters to Norway

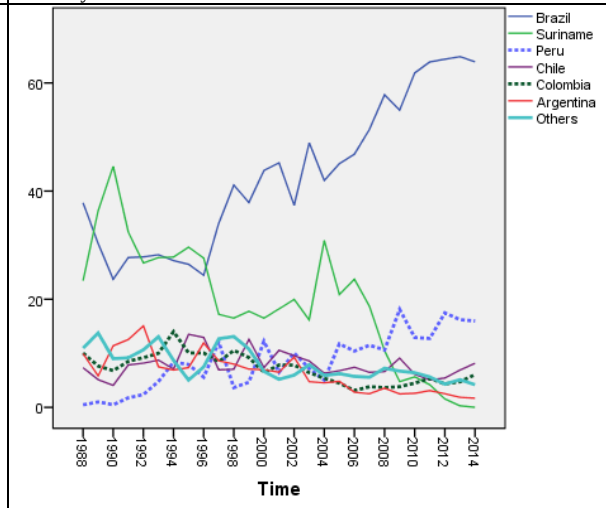


Figure 6.2: Dynamics of Share of across continents of Norway

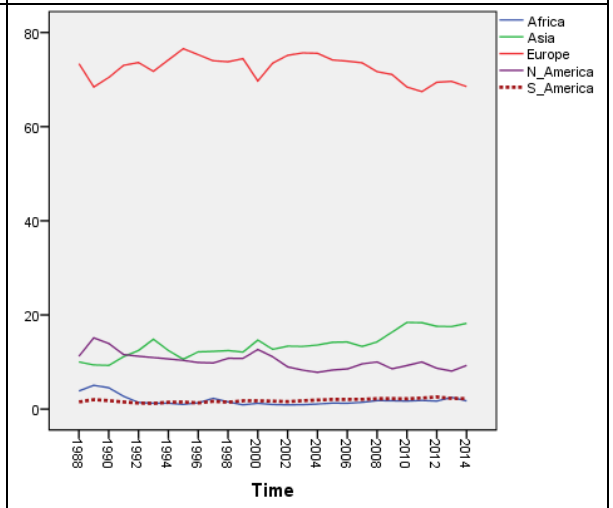


Figure 7: Continental trend of HHI

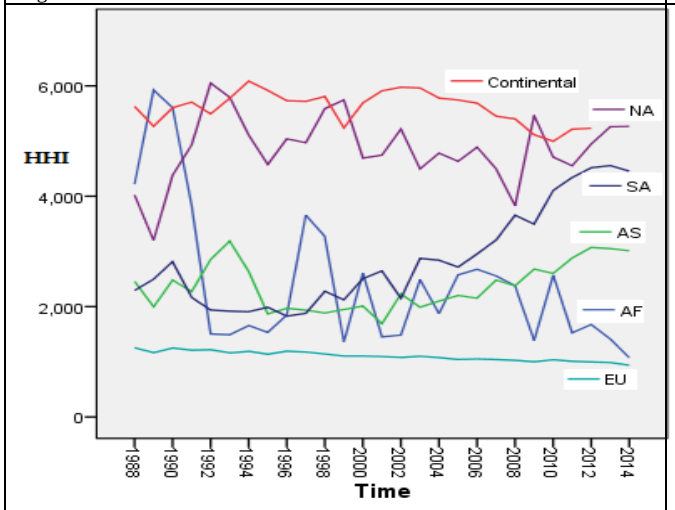


Figure 2: Matrix Scatter plot for import from Africa

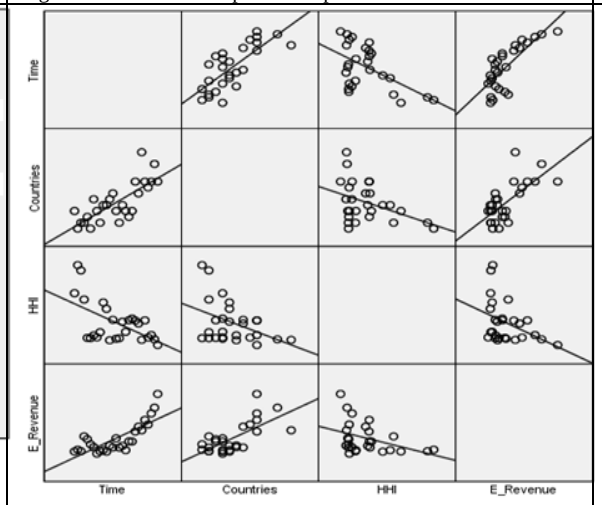


Figure 2: Matrix Scatter plot for import from Asia and Oceania

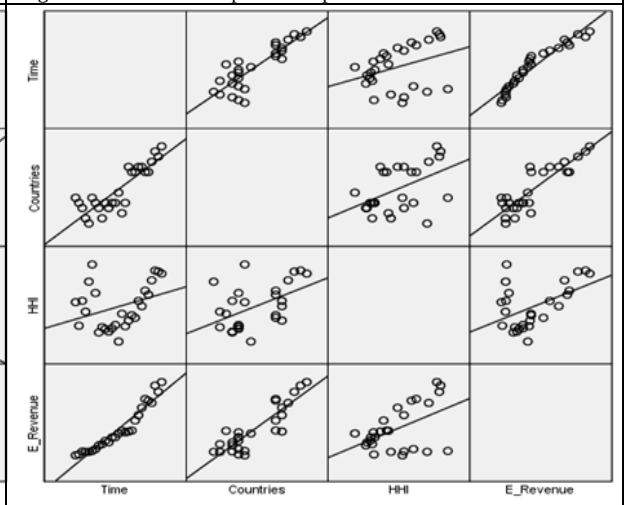


Figure 3: Matrix Scatter plot for import from Europe

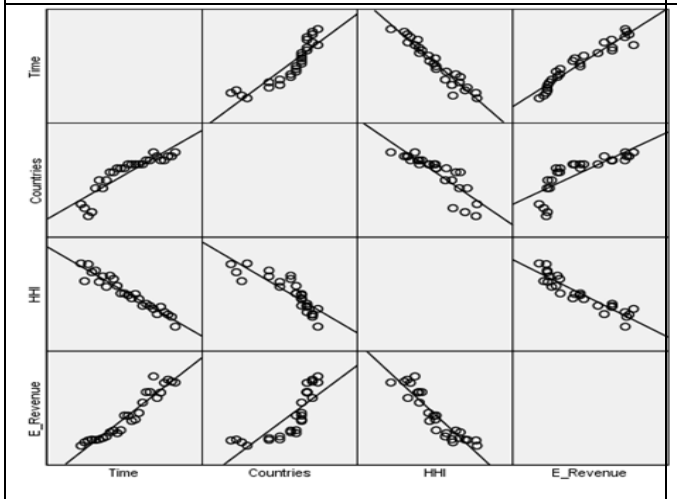


Figure 4: Matrix Scatter plot for import from North and Central America

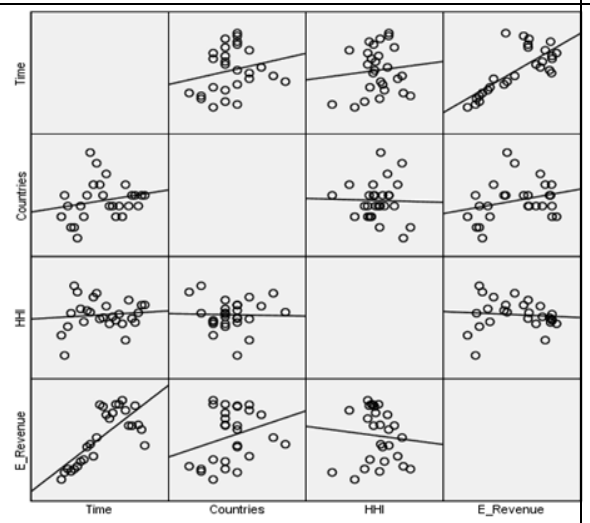
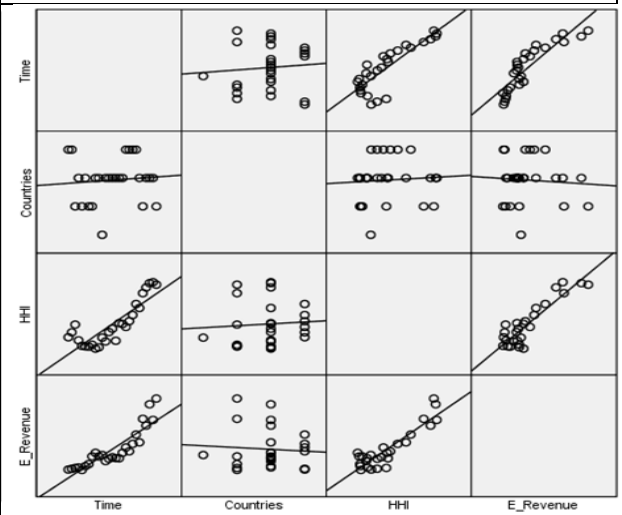


Figure 5: Matrix Scatter plot for import from South America



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