Evaluation of the continental variations of Norway's export trade across continents: an applications of two-stage hierarchical non-full rank linear econometric models

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Keywords
Export trade of Norway, continents, export items, international structural trade,two-stage hierarchical non-full rank econometric model

Abstract
International trade is a vital component to the government's growth and prosperity agenda. The emphasis on facilitating international trade and investment and increasing exports, it is important to review recent trade performance in order to understand international trade patterns and how to adapt to future trends. This paper applies the two-stage hierarchical non-full rank linear econometric model to make a deep analysis based on revenue generated from key Norwegian export items over the world's continents. The model's ability to analyse the variation of Norway's export trade gives us following interesting details: (1) for each continent intra and inter variation of export items, (2) access to deep knowledge about the characteristics of the Norway's export items revenue, (3) to quantify the economic importance and sustainability of export items within continents; and finally (4) comparing a given export item economic importance across continents. The results suggest the following important policy implications for Norway. First, Europe is the most important trade partner for Norway. In fact, 81,5% of Norwegian export items are transported to Europe. Second, there is a structural shift in Norwegian exports from North and Central America to Asia and Oceania. Third, the new importance of Asia and Oceania is also emphasized by the 85% increase in export revenues over the period 1988-2012. The trade pattern has changed and trade policy must change accordingly. The analysis has shown that in 2012 there are two important export continents for Norway: Europe and Asia & Oceania.

Introduction
International trade is a vital component of the government's growth and prosperity agenda. Given the emphasis on facilitating international trade and investment and increasing exports, it is important to review recent and global trade performance in order to understand patterns in global trade and adapt to future trends. The recent global downturn has accelerated the shift in global market share towards emerging economies. The contraction was once in a lifetime event. The period covering the Great Depression and two world wars also had a devastating impact on global trade, but afterwards there were sixty years during which world goods trade fell in only eight years, and never by more than 4%. World trade now looks set to return to growth far exceeding that of world GDP in 2011-2012.

The main focus of this paper is unravelling the most important Norwegian export trade items over time and across continents. Analysis of these factors can shed light on how and why trade performance has differed, shifted, and whether pre-2008 patterns in trade growth are likely to continue. Recent trade patterns globally include a global shift of goods market share towards emerging economies; a rapid increase in intermediate goods trade; a shift in developed

economies´ exports towards advanced manufacturing and services; and increasing demand for differentiated products amongst the middle classes of emerging economies. Consequently, developed countries have lost market shares in goods exports to emerging economies, especially China. However, developed countries, especially in the EU, retain a clear advantage in high-end goods. This analysis is an attempt to see these influences on Norwegian export revenues. The Norwegian export numbers have continued to climb in recent years. Figure 1 shows Norwegian total export for the period 1988-2012. Export to Europe on the right axes and other continents on the left axes. By studying the axis numbers the figure shows that export from Norway to the European continent distances significant other continents. Moreover, Norwegian export has shown a slow but constant growth with the exception of North- and Central-America from about year 2000. Norwegian export has shown a steady increase from 1988 until today with some
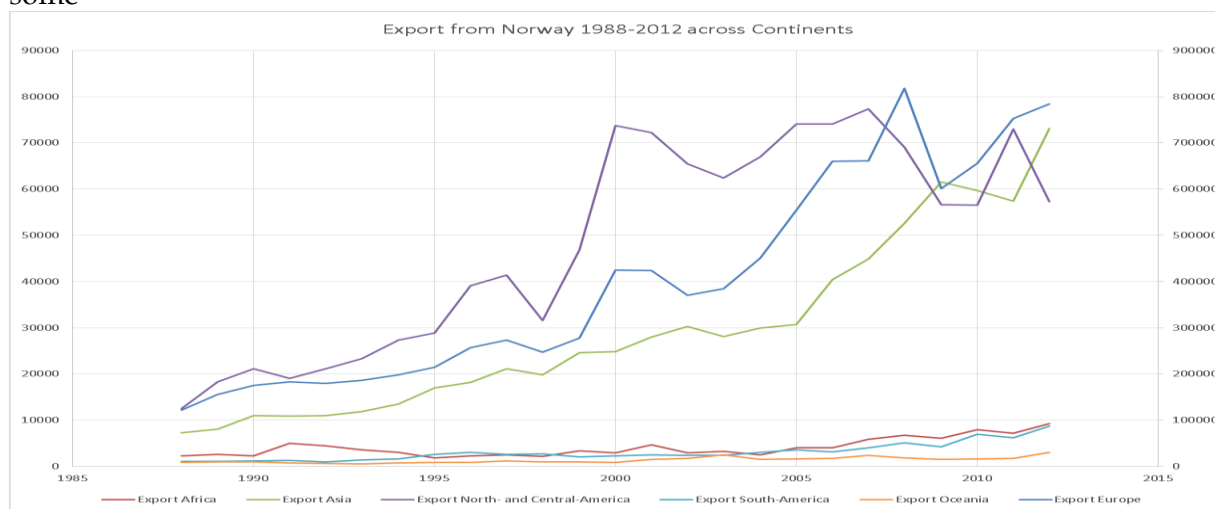

Figure 1. Total Norwegian Export 1988-2012 across continents

reduction during the financial crisis in 2009 and 2010 for all continents. The remaining three other continents report smaller export revenue. However, South-America has shown rapid growth recent years. Importantly, a market share loss by most advanced economies is due to the increase in export from emerging and newly industrialised economies. China's world export share, for instance, has increased by 500% since 1990, to 9,6% in 2009, overtaking Germany to become the largest goods exporter.

Felbermayer and Kohler (2006) present detailed evidence that the post-war increase of world trade took place through both the larger quantities traded between countries (the country intensive margin) and an increase in the number of country pairs that engage in trade (the country extensive margin). Growth in trade is therefore driven by changes in both the extensive and intensive margin. Differences at the extensive margin generally contribute more to explaining trade patterns while distance and other non-tariff barriers affect the extensive margin most strongly. This paper focus on Norway's trade pattern and may therefore fall into the extensive margin. However, the gravity model of Tinbergen is the major model to analyse the determinants of bilateral trade. The model is using the philosophy of the Newton Gravitational equation and use variables as Gross domestic product (GDP), Gross National Product (GNP) per capita, population size, colony, bilateral exchange rate, common currency, distance between capital cities, common language, and membership of a trading partnership to identify determinants. The negative "gravity" relationship between trade and distance for example is driven almost entirely by the extensive margin: Both the number of trading firms and the

number of traded products decline significantly with distance. Moreover, most studies find a strong response to the extensive margin to changes in trade barriers or country size.

This paper focuses on Norwegian export trade variations over both export items and continents. In this setting the gravity model has a number of limitations. First, in time series trade data factors like structural change, price volatility, changes in demand (substitutes) are important for a nation's export trade. The gravity model will ignore these factors. Second, the gravity model hypothesised that the strength of the bilateral trade is negatively correlated with the distance between the capital cities of the trading partners. However, the model ignores the fluctuation of transportation cost which is negatively correlated with the geographical coverage of the flow of goods. Moreover, in reality it is the type of the good that determine its demand from the import partners and forced to move any distance. Example, most of the oil in the world is produced in the Middle East, nevertheless transporting large distances most of the goods are traded in the USA. Third, the gravity model becomes illogical for the analysis of the export of high value to volume ratio products and low cost countries. Moreover, the gravity model ignores an important aspect of the emergence of new competent importer and exporter nations. Example the emergence of China in the global economy made to shift the direction of the international trade. More importantly, the gravity model tried to identify the contributing factor of the bilateral trade trading partnership of nations. However, in the modern globalized world it is economic dependence is responsible to run the bilateral trade between the nations. Fourth, the interpretation of the results from the gravity model for either countries having high share in the international trade or low share in the international trade, is similar. In this respect the solution from the gravity model for how to characterize the strength of the export trade of the given nation, is weak. Specifically, the solution from the gravity model will push us to the aggregate prediction about the export sector of the given nation. In this aspect a lot of information will be hidden. It is the characteristics of strong nations that in order to be competent and consequently improve their shares in the international trade each the nations have their own internal assignment respect of the item and the destination. Among the internal assignments, it is vital to identify the characteristics the revenue generated from their export trade with.

In order to get insight of the variation of the export trade we make a deep analysis using the revenue generated from the different items of export (category of similar items) and its destination (country or continent wise). Once we structured our analysis framework, we can give a solution using the hierarchical model. The important advantages of the model to analyse the variation of the export trade of the given country is (1) the model it allow us to determine the intra and inter variation of the items of export across its destination, (2) the model enables precise estimators by providing large degrees of freedom to the items of export. We obtain information about the characteristics the revenue of the export items, (3) the model allows us to quantify the sustainability of the export of economic importance of nested factors in a given nesting factor; and finally (4) it enables us to compare a given nested factor across different nesting factors.

The objective of the study is therefore to apply an econometric model that can show and give quantitative information about the variation of the export trade of Norway based on the revenue obtained from export items across continents. Specifically the paper tries to give solution on: (1) to assess whether the average revenue earned from the export sector of the country is consistent; (2) to assess whether continental or export item effects exists on the revenue earned from the export sector of the country or not; (3) to analyse intra-continental characteristics of the export trade of the country with respect of the importance of the item of export and its short and long run contribution to the export sector of the country; and finally (4)

to analyse inter-continental comparisons of the destination continents of the important items of export to the country.

3. The Norwegian dataset and the hierarchical model
3.1   The Norwegian External Trade Dataset
The dataset 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 is organised yearly ranging from 1988 to the end of 2012 (25 years). The export items listed in these data from Statistics Norway the items may overlap. That is, the item Export excluding ships and oil-rigs may partly overlap Mainland export. However, based on data from Statistics Norway this is the closest we find individual export items. The interpretations however from the models results interpret all export items as individual items without overlap. Table 1 show a sub-sample of data for the Norwegian export numbers. Some of the years are not reported due to space considerations[1]. The data is organised suitable for the objectives set by the hierarchical model (see next section).

3.2   The hierarchical model: The two way nested classifications
The two-way nested classifications are linear models having two independent factors in which one of the factors is nesting the other factor. More specifically, given two factors A and B, the levels of B are said to be nested within the levels of A (or simply B is nested within A) if every levels of B appears within each level of A (Douglas, 2004 and Leeuw et al., 1998). The model for nested classifications is given as (Searle, 1971):

$$y_{ijk} = \mu + \alpha_i + \beta_{j(i)} + \varepsilon_{ijk} \qquad (1)$$

$i = 1,2,3...a$, is the level of the nesting factor

$j = 1,2,3...b$, is the level of the nested factor

$k = 1,2,3...n$, the number of replications within each nested factor

where

y_{ijk} is the observed value of the kth cell from the jth nested factor within the ith nesting factor,

μ is the grand mean of y_{ijk},

$\beta_{j(i)}$ is the jth factor nested under the ith nesting factor effects,

α_i is the ith nesting factor effects, and,

ε_{ijk} is the random error term of the model.

3.3   Model Adequacy Checking
It is always necessary to check the model whether it fulfils the theoretical assumptions of the model. The entire model adequacy is done by analysis on residuals ($\hat{\varepsilon}_{ijk} = y_{ijk} - \hat{y}_{ijk}$). Generally we have two basic categories, the data problem and the statistical problems. In particular, the data problem consists of the existence of out liars and the statistical problems consist of distribution assumption, heteroscedasticity and autocorrelation.

We can identify observations, which cause out liar problem by transforming the residuals into studentized residuals and standardized residuals (Cook et al, 1982). We can also

test heteroscedasticity using the Bartlett's test (Bartlett, 1937). The important sign and consequence of the existence of out liars and heteroscedasticity is quite similar. Both problems results to reduce the coefficient of determination and increasing the means square error. As a result, we found important predictors may be insignificant. Therefore, we use a variance minimization of transformation to handle these problems, like the logarithm transformation.

4   Empirical results

In advance we make further econometric analysis and elucidation, we have to check whether the two stage non-full rank linear nested model is suitable or not. The technique of analysis is made up of of two-factors. These factors are the continental categories (the nesting factor) and the export items (the nested factor). The observations are the revenue from exports (in 100 million of Norwegian Kroner). The domino effects of the model adequacy test are prevails that our structure of econometric analysis is properly set. The fit of the model give as intimation that the export trade of Norway showed heterogeneity either the destination continent or the item of export.

As can be seen from the Table 3, the F-statistic is significant. Consequently, the two stage nested non-full rank linear model adequately describes the total variation of the export trade of Norway across continents. Now, we need to see whether the continental and item effects are significant.

We found that observe firstly that the average revenue netted from the export sector of Norway is increasing over time. Secondly, the items and continental effect corrected for the mean, is statistically significant. The implication is that at least one of the continental categories and/or export items does have a significant impact over the others on the overall export trade of Norway. Third, the items effect corrected for the continental effects and mean is statistically significant. This point toward that at least one of the export items significantly contributes over the others on export trade of Norway controlling for the continental effects (or adjusting for the effects of the destination continent). The result indicates that the export sector can exist without considering the impact of destination continent. Moreover, the items of export have different contribution to the export sector of the country within/or across the destination-continent. Fourth, the continental effects (adjusted for the mean and without adjusting for the mean are statistically significant. The implication is that at least one of the continents does have a significant over the others affect on the overall export trade of Norway. This is an indicator inducing that the export trade of Norway is heterogeneous trade with respect of the amount of revenue generated from the export sector.

The estimable function of the two stage nested non-full rank model show that 96.67% of the export trade sector of Norway can be quantified. The significant results show that 9666,79/9681,04 =96,67% of the export trade of Norway is explained by the significant items of export across continents. Only the rest, that is 322,58/9681,04 = 3.33% of the export trade of the country is identified from non-significant export items across continents. The significant items of the export trade of Norway are the exports excluding ships and oil platforms (48,7%), exports of crude oil (19%), mainland exports (21,2%) and natural gas (7,9%). Secondly, the continents that affect the export trade of Norway significantly (main trade continents) are by most Europe (81,5%), North and Central America (9,4%) and Asia and Oceania (5,8%). Norway seems very dependent on European trade numbers.

5   Policy Implications

The results from this analysis of two-stage hierarchical econometric model show some important implications. Europe is Norway´s main trading partner in the world. For stable and significant trade numbers Europe count for 81,5% of total export. The analysis shows that Europe are followed by North and Central America with 9,4% and Asia and Oceania with 7,8%. For the Norwegian export industry the European continent seems extremely important. Moreover, the export is stable over time and consequently also expected to be important in the future. Any trade policy of Norway must therefore acknowledge Europe as a considerable contributor to Norwegian welfare, employment and economic growth.

6   Summary and Conclusions

This paper has applied the Two-Stage Hierarchical Non-Full Rank Linear Econometric Models to analyse export trade of Norway over five continents. The model is linear having two independent factors in which one of the factors is nested in the other factor. Specifically, the dependent variable export trade of Norway is regressed against the two independent variables where export items are nested within export continents.

The estimation results show important implications for Norwegian export. First the European continent dominates all other continents over all export items. Secondly, there has been a shift from North and Central America to Asia and Oceania for mainland exports. The results suggest important for policy implications for Norwegian authorities and emphasis on new and improved free trade zones for Norwegian mainland merchandises.

Finally, while the modelling technique is challenging the results are interesting and contain important policy implications. For Norwegian authorities, all actions reducing variable trading costs and transport costs for the growing, stable and important trading partners will increase the number of Norwegian firms able to export, enabling growth and welfare for Norwegian citizens.

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