Forecasting maritime logistics costs – will the low oil price remain?

Abstract
Reliable forecasting of elements that have an impact on business processes generally is important and certainly supports success in both industries and society. The aim of this paper is to estimate and present impacts that low oil price has on maritime fuel costs, as well as how this influences the economy of an export industry. Historically, forecasting the relevant supply chain factors accurately has been a challenge for freight owners and logistics service providers. Bunker prices represent important cost factors, and a variety of parameters influence them, including ship emission regulations, which the logistics actors should take into account continuously. Researchers have scantily examined this topic in previous journals and discussions. Our simulations highlighted that all markets are rather unique because of different logistics routes, sold products and invoice prices. Nevertheless, the gross margins of export would seem to improve clearly, if bunker prices dropped 80 percent. Transport researchers should be alert to sudden changes in oil prices, and try to reveal their future developments and the impacts they cause.

Keywords: Forecasting, bunker prices, maritime logistics.

1. Introduction

Reliable forecasting of elements that have an impact on business processes generally is important and certainly supports success in both industries and society. The aim of this paper is to estimate and present impacts that low oil price has on maritime fuel costs, and finally to the economy of export industry. Elder and Serletis (2010) address that the oil price uncertainty has a significant impact on national economy as well as the world, and the modelling and forecasting of the crude oil return volatility are of considerable interest among academics (Yudong et al. 2016). Oil is a key topic for global maritime transport and logistics chains, especially in export dependent countries. In addition to oil price fluctuations in the market, Rehmatulla and Smith (2015) have listed large amount of company-based barriers to energy-efficient and simultaneously low-carbon shipping. There is a so-called energy-efficient gap, which is the difference between ideal implementation and actual implementation preventing better fuel efficiency. Yudong et al. (2016) remind that in recent years, large fluctuations in crude oil prices have caused grave concern among both market participants and regulators. Stefanakos and Schinas (2014) described and commented that it is rather challenging to accurately estimate bunker prices:

1. It is not possible to proceed to any type of statistically sound forecasting before an extensive investigation is conducted on the underlying probability structure of the time series, including the probability distribution functions. The analysis should include seasonal effects, trend analysis and nonstationary features of the time series.

2. Analysts should be very careful on the sample data they use. Various sources offer data on ‘‘monthly averaged’’ or ‘‘weekly averaged’’ prices, and confusions between various fuel types are also possible. Generally, analysts should be careful with the data they base their forecasting upon.

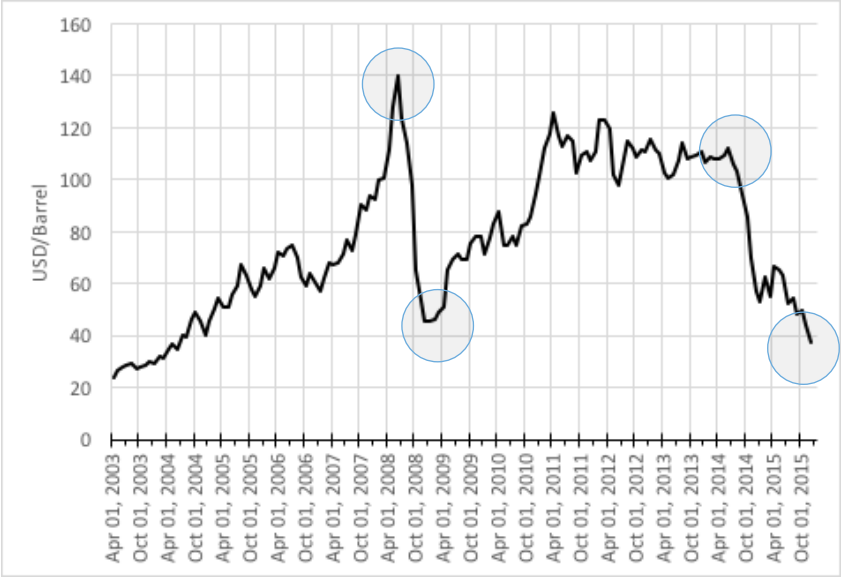
3. The scope of the analysis also determines the direction of the forecasting, e.g. the estimation of absolute vs. differential values implies the formulation of two distinct problems.

Historically, it has been a challenge for freight owners and logistics providers to forecast supply chain factors accurately, since they seem to have volatility to different directions with various outputs. Fuel prices and now ship emission regulations as well are important factors, which the logistics service actors should take into account continuously. Due to turbulent global economy, adequate estimations have become more topical in all industries due to rapid changes in the global market. Rehmatulla and Smith (2015) address that forecasting the real oil prices is important yet notoriously difficult. Muckstadt et al. (2001) point out that the level of uncertainty – be it political, market economic, etc. – must be dealt with explicitly to determine if negative impacts exist.
The structure of this study is as follows: The theoretical perspectives that contributed to the composing of this paper and the background about oil price in relation to maritime fuels are presented in section 2. Section 3 highlights how marine fuel price follows oil price development, and there are simulations with empirical data on how oil price, and thus bunker price estimations and actual prices, would affect sea freights, transport costs and gross margins. The conclusions of the study are presented in section 4; finally, section 5 contains an evaluation and discussion of the results.

2. Short history of oil price

Already in 2009-2011 (Fig. 1, 3/2003-12/2015), after the short global recession of 2008-2009, the oil price skyrocketed, and this naturally had its impacts on sea freights and transportation costs for the peripheral Nordic countries. During the aforementioned years, there are heavy fluctuations in oil prices, which were rather difficult to estimate. It is an

Fig. 1 The monthly development of the oil price in USD/Barrel between 4/2003-12/2015 (EIA, 2016)



obvious fact that oil price variations and their impacts are inherited from the developments of global and regional economy; the state of the political climate and the suddenly appeared crisis; as well as production decisions made by oil producers. Other reason for oil

price impacts are the development of new oil technology, such as shale oil production in the US; new raw oil findings; and impacts of other substitute energy solutions; and so on. Oil prices were rather low in the pre-1973 period even with large US-imports, from 1973 until 1985 the cartel of OPEC increased prices, and after 1985 OPEC's role was diminishing. Economic growth, especially in Asia and particularly in China, increased the demand of oil, and the US imports as well.

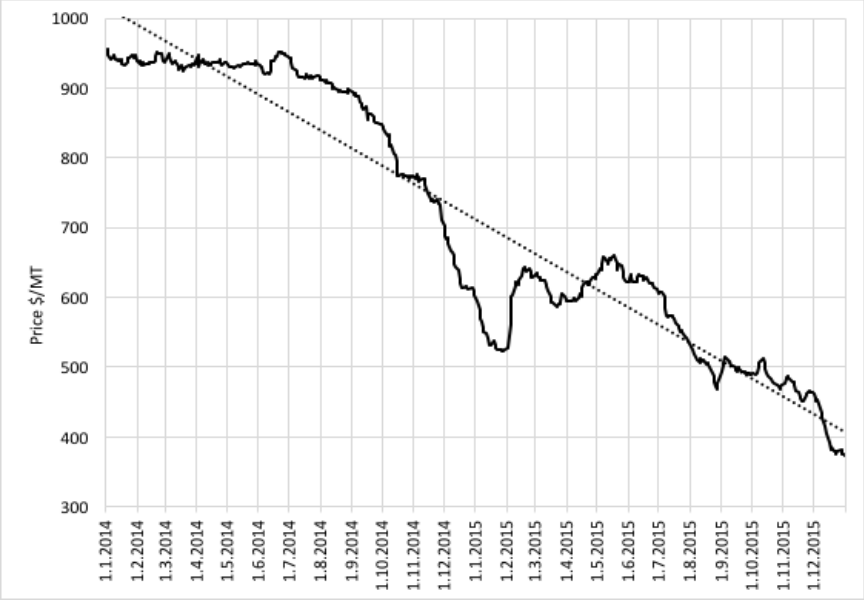
The variations of oil price increased heavily after 1973 following a rather stable period from 1948 to 1973, when the so-called oil crisis started. In 2005-2014, there was a real turbulence in oil prices, and then after 2014 rather deep fall until now. Late 2015 was soft for sulphur regulation implementation, as oil price declined (Brent) significantly from the level of 100-110 USD (late spring 2014) per barrel to 30-40 USD per barrel (January 2016). The growth of the Chinese economy recently slowing down has eased oil demand, and this has reflected in price significantly. The US's own shale oil and gas production has also supported oversupply. However, in long-term perspective oil is still having a high price, even costing around 30-40 USD per barrel now, as the early 70's price was 1.9 USD (BP, 2015). It is also notable that globally oil demand is still on the increase (EIA, 2016), and it has continued to do so for more than three decades (with some minor declines, like the year 2009); the upward trend is still very consistent and clear. In addition, the "peak oil" forecasted already for decades (like widely discussed in Leggett, 2006) could happen in just few years' time – not all volumes would disappear, but production would start to decline (an undesired situation since demand trend is showing a slow upwards movement). Numerous oil fields are reaching their Hubbert's peak in production volumes, and many countries have already clearly done so, such as the UK, Denmark and Norway. In other countries, it is a bit more difficult to make trustworthy analysis about the situation and its development as wars and economy conflicts (sanctions) have delayed production a lot; the bell shape of Hubbert's production cycle theory does not materialize in its ideal fashion.

3. Marine fuel price follows oil price development

The International Maritime Organization (IMO) and the European Parliament (EP) made decisions (in 2005 and 2012) that ships must lower their sulphur emissions significantly from the year 2015 onwards, starting first in a specific region of Northern Europe. This area is called the Sulphur Emission Control Area (SECA). The sulphur content in bunkers cannot exceed 0.1 percent, so the heavy fuel oil (HFO) replaced the light fuel oil (LFO). There were heavy discussions between 2009-2014 especially in the Nordic countries on which level the marine diesel oil (MDO, sulphur < 0.1%) price would stay at the beginning of 2015 because of the SECA – decision. Before 2014-2015, maritime experts presented many forecasting calculations to anticipate a correct MDO price-level from January 2015 onwards (Swedish Forest Industries Federation 2009, EMSA 2010 and Trafi 2013). Notteboom et al. (2010) addressed boldly in their study that the price of the MDO would increase from 25 percent up to 200 percent in 2015 in comparison to the existing bunker fuel price. Analogically to above-mentioned studies, the European Maritime Safety Agency (EMSA 2010) made forecasts that the MDO (< 0.1%) in the SECA-region will be some 60–70 percent more expensive than the 1.0 percentage oil at the beginning of 2015. Logistic service providers faced with a challenge that there were large variations in those MDO price estimations, who to believe and trust? Jiang et al. (2014) anticipate in their resent study that the bunker price is subject to fast changes, and is thus greatly uncertain. The price gap between the MDO and the HFO was expected to widen from 2015 onwards, because then the MDO would be in higher demand than the HFO. It seems that at the

moment the price gap in percentage between HFO/MDO is round on same level, yet at a much lower level due to drop of oil price (Bunkerworld 2016). Without exception, all estimations done during 2010-2014 proposed that MDO prices would increase from 2015 onwards. Notteboom (et al. 2010) and the IMO (2010) estimated that the bunker price of HFO in the SECA-region could increase from 2015 onwards up to around 50 percent to 750-800 USD/t.. Shipping companies were doubtful that the capacity of oil refineries could fulfil the needs of the LFO (<0,1%) in the SECA-region so the LFO prices would rise even more to 1300-1500 UDS/t. This explains the shipping companies' anxiety during 2010-2014 caused by the SECA - decision and its impacts from 2015 onwards for the vessel operation costs. Experts argue that fundamentals drive oil prices, not speculative flows. Figure 2 presents how the price of MDO has developed during the last two years. The price was as high as 950 USD/MT at the beginning of 2014. That time the logistics providers, shipping companies and industrial organizations got rather worried about what the fuel price in the SECA-region would be at the beginning of 2015, when the low sulphur fuel (MDO) was the only fuel allowed in the SECA-region in vessels without scrubbers. Shipping companies were afraid there would be a shortage of low sulphur fuels that would

Fig. 2 The monthly development of the marine diesel oil price between 1/2014-12/2015 in USD/MT (Bunkerindex.com, 2016).



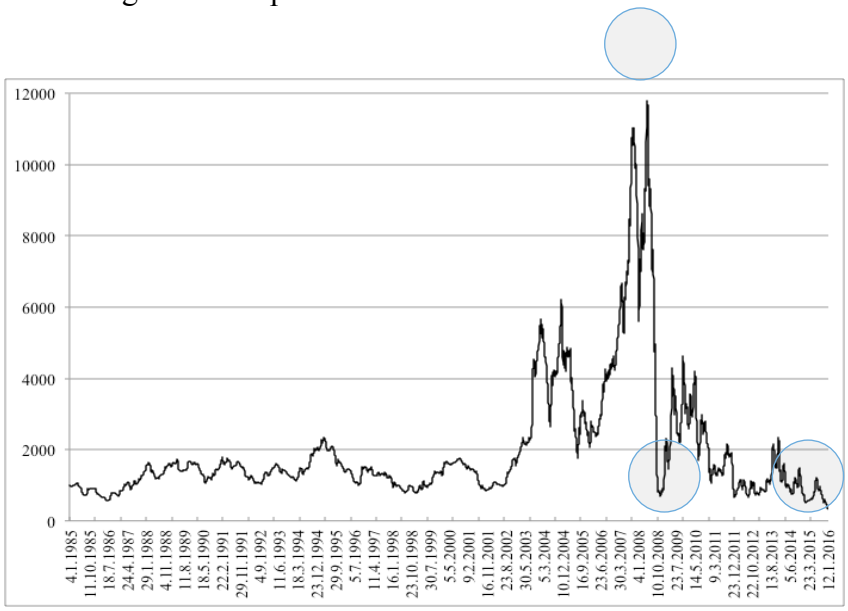
also cause the MDO prices to increase dramatically. However, as mentioned earlier, the estimations did not match with the real world, and now (1/2016) fuel with low sulphur costs round 350 USD/MT, which is only 1/3 (60 %) of the highest price peak. Researchers reminded that it is also difficult to estimate the supply-demand balance of the different distillates, such as the MDO and the HFO, in the European markets.

One interesting point should be noted here. Many studies before 2015 predicted an increase of transportation costs leading to a modal shift from maritime freight transport to road and/or rail freight transport (Notteboom 2011; Holmgren et al. 2014). Consequently, shipping companies wanted eagerly to mitigate impacts of high oil price with new technical solutions like scrubbers (HFO as basic fuel), which were related to high costs

(Czermański et al. 2014, 10 pp; Bergqvist et al. 2015). These technical solutions were designed rapidly for vessels to remove extra sulphur from the HFO. Afterwards these costly investments, comprising installation, maintenance and waste management for effluents, could be considered to having been wrong decisions, because oil price/bunker price started to drop dramatically. However, future will tell. About 88 percent of the ship owners announced they would use the MDO in their ships in 2015 and onward when the ship owners were asked that in a survey (Alhosalo, 2013) carried out by University of Turku, Centre for Maritime Studies. Additionally, some researchers (see e.g. Hämäläinen, 2015) and shipping companies examined that in the SECA -region slow steaming would mitigate the impacts of the costly bunker fuel, because when speed is decreased by 40 percent, emissions and fuel consumption are lowered even more, up to 60 percent. Some shipping companies were testing slow steaming when operating in the Baltic Sea region (inside the SECA).

There are some changes in real life as well as in statistics. For example, RO-RO traffic between Estonia-Finland increased 17,8 percent% and between Estonia-Sweden 21.1 percent in 2015 (https://cns.omxgroup.com/cdsPublic/viewDisclosure.action?disclosureId=691381&messageId=863720). Of course, there is big influence of the low bunker prices. At the same time, there should be clearer understanding or certain formula about the total supply chain cost.

Fig. 3 Development of BDI from 1985 to 2016.



Additionally, one of the big reasons to low bunker prices in the increased traffic between Estonia-Finland and Estonia Sweden is a small ferry ticket cost for RO-RO units in comparison to the total supply chain cost. At the same time the ferry ticket also includes port dues and charges, yet again in comparison to all other supply chain costs, including total land transport, forwarding etc., it is very competitive. Due to this, there are no big reasons to change the modal shift from sea, for example, to railway and/or road. The Estonian authorities announced that they could not see any reasons for the modal shift change from sea to railway. The main reason is that terminal expected a 20 percent increase of the ferry transportation, but this in fact did not happen in 2015. Additionally, railway as a transport mode is very slow and uncomfortable for short distances. Moreover, by today, trucks are servicing distances up to 2,000 kilometres.

How about future oil prices and supply chain? Fogelholm (2000) argued that supply chain theories fail to empirically show the accuracy and reliability of forecasting, which could support an in-depth understanding of this important phenomenon. There are several methods to forecast a logistics and business activity, such as the Baltic Dry Index (BDI). Figure 3 presents the actual situation of the index, thus as far back as 30 years ago. The sudden turning points are marked as an example of how quickly situation may change. Rodrigue (2013) defines the BDI as an assessment of the average price to ship raw materials (such as coal, iron ore, cement and grains) on a number of shipping routes (about 50) and by ship size. It is an indicator of the cost paid to ship raw materials on global markets, and thus an important component of input costs.

As such, Rodrique addresses that the index is considered as a leading indicator of economic activity (looking forward) since it involves events taking place at the earlier stages of global commodity chains. A high BDI index is an indication of a tight shipping supply due to high demand, and it is likely to create inflationary pressures along the supply chain. A sudden and sharp decline of the BDI is likely to foretell a recession, since producers have substantially curtailed their demand leaving shippers having to reduce their rates substantially in an attempt to attract cargo. Finally, Rodrique (2013) notes that like all market indexes, the BDI is constantly changing, reflecting its price discovery mechanism. The BDI describes that shipping transport is on very low level now, and a very good question is whether the turn is waiting behind the corner (Fig. 3). Nevertheless, the BDI has struggled a lot in recent years, and this change has been long expected by everyone. Now, even oil is having much lower price than in the earlier years (in the last five years). However, clear spiking in sea transportation demand is still waiting to materialize. On one side, the world trade is not growing so rapidly, yet on the other hand and most importantly, investments to capacity (especially in dry bulk shipping) have been too high before the credit crunch of 2009 (see e.g. dry bulk order book development in United Nations, 2015). As Lun et al. (2013) concluded from this situation with their data ending to year 2010: *"However, structural problem in shipping is so huge that it will take another 20 years that new boom period is experienced in orders and production."* This points to that upwards movement in freight rates (in sustainable fashion) shall still take years to materialize. Currently, this situation can be detected in vessel spot market rental rates – they are on a very low level (or as to some classes, extremely low).

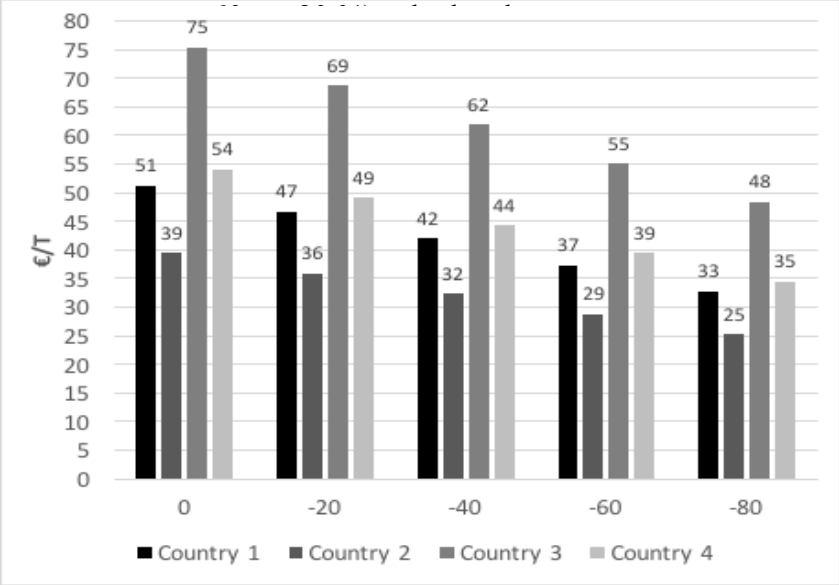
How will bunker prices develop when maritime transport emissions must be lowered globally with cleaner fuels to help stop the global climate change? New technical solutions will lower oil consumption in many areas such as road transports. Global environmental agreements support the decrease of all emissions, and the marine sector has to participate in this process through every means available. These upcoming climate agreements may affect freight costs negatively in the future. Technical solutions and cleaner fuels are available now, and soon investments will determine when they are all in full use. However, the challenges on how to estimate oil accurately, and thus bunker fuel prices, remain. Globally, now in the beginning of 2016, oil supply is estimated to stay bigger than demand the whole year (IEA 2016). This will mitigate transportation costs globally, even if the BDI-index is also at its lowest level since 30 years. The environment-inherited SECA - directive has not (yet) become an additional cost burden for the Nordic industry as was forecasted.

4. Empirical scenario analysis using paper industry case

In this section, we will make some simulations with empirical data received from one export company in Finland. We have received one mill' cost structure of logistics chain from site to foreign customers averagely per country. Moreover, we have received from the company the gross margins €/t, which are directly influenced by transport costs. All figures are from 12/2015, and they have been used only in research purposes as proportional. As to maritime transport costs, we assumed that in those ships that visited Finnish ports, average fuel costs are 45 percent of a ship's operating costs. The updated research data shows that if the sea freights to Country 1 are 51 €/T, then the fuel costs are circa 23 €/T, which is 45 percent of the freight price (Fig. 4). Gross margins are calculated as follows: Sales price - transport costs - variable costs - fixed costs = gross margins. Therefore, all the components of transport costs have direct impacts to gross margins. We have assumed in our study that shipping companies are putting lowering fuel costs as such to freight prices, and therefore freight prices will lower, or also increase, if bunker prices soar. In the Nordic countries logistics costs from turnover are big, averagely 14-20 percent depending on the industrial sector, also covering maritime transportation abroad (Solakivi et al. 2015).

Figure 4 presents the simulations with empirical mill data on how sea freights would

Fig. 4 Estimation between sea freights in €/T and lower bunker prices (0, -20, -40, -

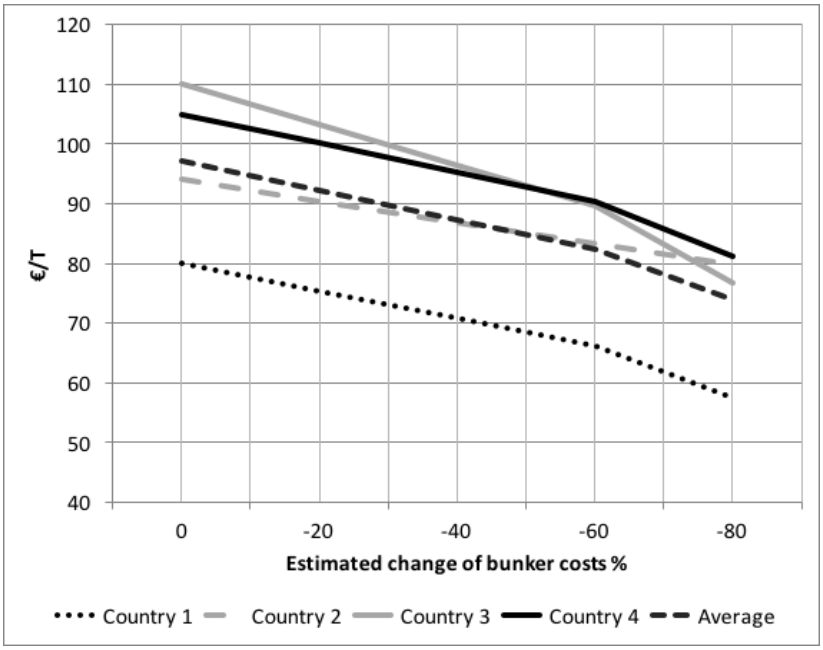


develop from Finland to European markets, if bunker fuel prices lowered 0, -20, -40, -60 or -80 percent. Figure 4 confirms that the bunker price has rather direct impacts on sea freight costs. Hämäläinen (2015) and Hämäläinen and Hilmola (2015) estimated nearly opposite, thus how much the bunker price would increase from 2015, if oil was at a much higher level (see e.g. Notteboom 2011, Hilmola 2015) from the existing price level. Hämäläinen (2015) simulated that if fuel costs increased 100 percent then gross margins of export paper industry in main market areas could drop in worst case as much as 8-40 percent. Due to euro-USD exchange rate development, prices in euros actually increased in euro terms roughly 4-5 percent (euro has been weak against USD lately). The existing low MDO bunker price level, which has dropped even 60-70 percent from the highest prices in 2014, brings benefits to the Nordic export industries especially, but also to all maritime

transportation. It should be remembered, as Jiang et al. (2014) anticipate in their recent study, that the bunker price is subject to fast changes, and thus highly priced fuel will mitigate the costly distance frictions, which maritime transport generally tends to eliminate otherwise as well.

Total transport costs, which cover land transport, port operations and sea freights, are in the centre of heavy export industry. Figure 5 presents the development of total transport

Fig. 5 Estimated changes in average transport costs (€/T) if bunker prices decreased 0, 20, 40, 60 or 80 %, calculated to four European countries.

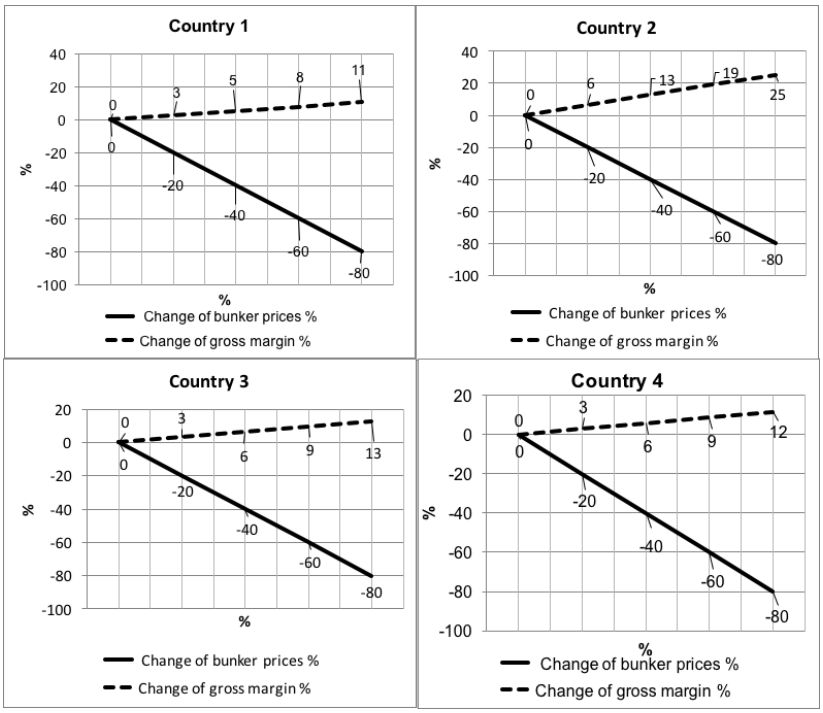


costs in €/T from site to four different markets i.e. countries in Europe. The transport costs would drop tens of percent in the best-case scenario, and this would mitigate even the impacts of clean fuel because of environmental regulations. Logistics service providers do not probably tend to move lower bunker prices in full scale to freight prices, therefore the freight cost decrease might obviously not be linear with oil price development. On the other hand, the global economy reflects heavily to freight prices as the BDI in Fig. 3 describes.

The export companies are always interested in profitability, and therefore maritime transport is in the centre, especially in heavy industry. We estimated with four countries how the lowering bunker price through decreasing freight costs would affect gross margins in various markets (Fig. 6). The figure highlights clearly that the impacts differ from market to market, so all the markets are rather unique because of different logistics routes, products and invoice prices of saleable products. At the highest, the gross margins would improve round 25 percent, if bunker costs dropped 80 percent. This can even be indirectly noticed in recent economic magazines, because lately, the Nordic export industry has not been moaning about the existing oil and freight prices.

As to bunker prices soaring in 2009-2011, Hilmola (2013) addressed that this would create a better possibility for road transport to take a considerably higher share in the long-distance transport instead of the short sea shipping. However, case study-based findings of Daduna and Prause (2016) revealed that modal shifts in the Baltic Sea region are not expected, even due to increasing bunker prices related to the SECA regulations, with the exception of very short route sections where these modal shifts might appear (see also Bergqvist et al 20015). A linked open research question is the related impact of the

Fig. 6 Estimated changes bunker prices in percent (0, 20, 40, 60, 80 %), and impacts on average gross margins in four different European countries.



competition between the North Sea and the Baltic Sea harbours, on one side, and the Eastern Mediterranean and Black Sea harbours, on the other, which arises from unequal competition conditions of different emission regulations in the said seas. In the following years it will be interesting to follow how the oil prices will develop and how the bunker prices will affect the economic efficiency of different sea areas on the long run. Looking back, the high and sudden volatility exists, and the global economy has a great influence to the cost components of maritime transport. Plenty of mathematical models and estimations have been and are done on how oil prices will develop, yet it was quite difficult to perceive that the oil price would go as low as 10-20 USD/barrel due to big exports from Saudi-Arabia, and also in the future from Iran and Iraq. Experts notice that the price of oil may not get higher than 60-70 USD because the US and Canada shale oil production is then again profitable. We have interesting years ahead, and the academic society researching transport issues should follow actively this topic, which is very important for the EU and especially the Nordic countries.

5. Conclusions

Reliable forecasting of the elements affecting business processes generally is important and certainly supports success in both industries and society. The aim of this paper was to estimate and present impacts of low oil price on maritime fuel costs, as well as how this influences the economics of an export industry. In this paper, we revealed that the estimations made in 2010-2014 on how bunker prices would develop from 2015 onwards were rather weak and linear. There were some justifications about why the LFO would be even 100 percent more expensive in 2015 that in 2010, yet global economy showed its strength and the oil price dropped down to 34-40 percent in January 2016. Therefore, the fall from highest peak was round 70 percent. The MDO was 950 USD/MT in 2014, and now the MDO is 380 USD/MT. Therefore, the MDO costs even less in USD/MT than the HFO in 2014.

The main target of this article was to reveal how a low bunker perice influences supply chain costs of an export company (bulk product). The existing low MDO bunker price level, which has dropped even 60-70 percent of the highest prices in 2014, bring benefits to especially the Nordic export industries, but also to all maritime transportation. The transport costs dropped tens of percent in the best-case scenario, and this would mitigate even the impacts of clean fuel because of environmental regulations. Logistics service providers do not probably tend to move lower bunker prices in full scale to freight prices, so the decrease of transport costs might obviously not be linear with oil price development. The study highlighted clearly that the impacts of an affordable bunker price are different from market to market. All the markets are rather unique because of different logistics routes, products and invoice prices of saleable products. At highest, the gross margins would improve round 25 percent, if bunker costs dropped 80 percent.

There remains an open question, which is related to the long-term impact of unequal competition between the North Sea and the Baltic Sea harbours, on one side, and the Eastern Mediterranean and Black Sea harbours, on the other, due to different emission regulations. We can already detect changes in the used transportation modes in the SECA area, even in the middle of a low-priced oil, as roro-transports are more frequently used in short connections – putting increasingly more trucks on long-distance journeys through e.g. the Baltic States and Poland. However, at the same time, sea transportation has been able to keep its base within bulk transportation at the Baltic Sea, which hedges transportation mode changes in “the big picture”.
The question on how the oil price develops is a problematic forecasting challenge. The IEA estimates that supply will remain bigger than demand the whole of 2016, but history tells there can be rather quick turns depending on global political tensions and economical decisions. This current price level is good for maritime and all freight transportation, yet the BDI tells that the shipping transportation is now clearly fainting and waiting for better days. Of course the BDI is heavily dependent on China, as most bulks are transported there (and currently, the volumes have been somewhat slowing).

6. Further research

More research has to be done on the regional integration within intercontinental shipping routes as well as on the assessment of unequal competition conditions of different emission

regulations in the North Sea and the Baltic Sea, on one side, and in the Mediterranean and the Black Sea, on the other. The research question in this context will be wheter and to what extent changes will appear in the transport demand of the container traffic. Since the future development depends on existing technical alternatives and their related costs, it is important that the transport researchers continuously update their research papers and try to forecast how logistics and supply chain costs develop. This will give an opportunity for shipping companies and freight owners to plan better their economies in order to do investments that are more accurate when the time is right.

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