The Blue Maritime Cluster Crisis: Financial Instability and Supply Chain Management Effects

BY Viktoriia Koilo & Ola Honningdal Grytten

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The Blue Maritime Cluster Crisis: Financial Instability and Supply Chain Management Effects

Viktoriia Koilo[†] Ola Honningdal Grytten[‡]

Abstract

The present paper investigates the offshore crisis 2015-2017 and its impact on one of the most complete maritime clusters, more precise the Blue Maritime Cluster, located at Møre og Romsdal at the North Western Coast of Norway.

As this cluster is heavily involved in offshore petroleum operations, it experienced an almost devastating blow during the crisis. The cluster lost almost one third of its employees as its value added contracted by 39 percent.

The crises is basically seen as result of the falling oil prices and, thus, lower activity and squeezed profit margins, particularly in marginal oil and gas fields. The paper does not dispute this. However, it also investigates the crisis in the light of financial instability and chain reactions down the maritime supply chain.

By collecting data from the Blue Maritime Cluster and the Norwegian central company register one is able, both to trace the fall in activity due to the crisis and measures of financial strength. The study approaches the data by using structural time series analysis in order to map cycles as deviations from polynomial trends.

The conclusions are that financial instability was dominant within the Blue Maritime Cluster during its boom before the crisis. Debt ratios, and thereby gearing or leverage was high. Thus, the companies could not meet their obligations when the crisis hit, due to low solidity and loss of financial stability.

The paper also finds that narrow focused supply chain management, made the cluster fall deep in to the abyss when ship owning companies and shipyards were hit. Companies with a more diversified portfolio were able to meet the hard years better than others.

Keywords: Maritime, Cluster, Supply Chain Management, Financial instability, Financial crisis

JEL classifications: G32, L22, L91, M21, N74

[†] Associate Professor PhD, Hauge School of Management, NLA University College, Viktoriia.Koilo@nla.no

[‡] Professor Dr Oecon, Department of Economics, Norwegian School of Economics NHH, Ola.Grytten@nhh.no

1. Introduction

After years of significant growth, maritime industries connected to offshore petroleum production experienced a global crisis manifested from early 2015 and lasting throughout 2017, with shock waves even further out in time. One of the most complete maritime clusters in Norway, called the Blue Maritime Cluster (BMC), concentrated to the North-western coastline of Norway, experienced an almost devastating blow during this crisis.

The crisis was basically explained by the considerable contraction of oil and gas prices from the summer 2014, and thus, lower activity in offshore oil fields (Koilo, 2019). This made a significant share of ocean going vessels engaged in the oil and gas industry redundant. Access supply made prices on services to the oil sector, freight rates and shipyard activity fall dramatically. Resulting in a slump for offshore oriented industry worldwide.

It should be indisputable that the huge fall in oil and gas prices was the main triggering factor for this international maritime crisis. However, little has been done in order to investigate lack of financial stability and supply chain management defaults prior to the crisis. The BMC, concentrated around the city of Ålesund, saw a deeper crisis than most actors in the market. In this paper we investigate the crisis of this cluster in light of a financial instability hypothesis connected to supply chain management defaults.

The paper holds two explicit research questions:

1. Did financial instability play an important role for the depth of the offshore crisis within the Blue Maritime Cluster?
2. Did supply chain management influence the depth of the same crisis?

In order to answer these questions the paper utilise data on turnover, value added, employment, operational margins, rentability, and asset structure. These are compiled from the Blue Maritime Cluster and the national register for companies.[1]

The data are used to conduct a structural time series analysis in order to identify deviations from trends, to check if financial instability was present. Thereafter, we study the chain reaction downstreams and upstreams the supply chain in order to throw light on its impact on the crisis.

2. Theory

2.1. Financial Instability

Financial stability is considered central for sustainability both in financial markets and for firms. It can be defined as a financial systems robustness to survive in bad times. This implies that it should be able to provide sufficient capital for business to survive in bad times. This should be equities, loans, credits or any other special means of funding (Grytten and Hunnes 2016, pp. 87-94).

[1] https://www.bluemaritimecluster.no/gce/reports--publications/cluster-analysis/cluster-analysis/, https://www.bluemaritimecluster.no/gce/reports--publications/annual-reports/annual-reports/ and https://www.brreg.no

According to Minsky lack of financial stability is the most common reason for the evolvement of financial crises. Financial stability is commonly lost during booms in the markets. Profit opportunities make investors willing to put money into projects with high risk, due to expectations of continuous upheavals. Not investing means loss of market share, and thereby loss of potential profit. Hence, companies are willing to borrow large sums of money to benefit from the boom.

Minsky describes three forms of income-debt relations for economic units in his financial taxonomy (Minsky, 1992):

1. Hedge finance, which basically is reinvestment of profits. This is basically a balanced and sustainable way of growth.
2. Speculative finance, which is funding on the basis of positive expectations. More precise this funding take place during upheavals, where one is willing to invest more money than common profits allow, due to expectations of increasing market price on invested capital.
3. Ponzi finance, which means that growth continuous due to increase in capital base, despite diminishing returns on invested capital. The upheaval has gone so far that returns may be shrinking and creditors are reluctant to invest, but business is going due to increasing capital base.

At the last stage one is close to the turning point of the markets, often called the Minsky Moment. Minsky put emphasis on markets at large, as applied by Grytten and Koilo on Eastern Europe (Grytten and Koilo, 2019). Nevertheless Apreda shows that the model is applicable on a corporate finance level (Apreda 2012).

On the basis of Minsky's financial instability hypothesis, Kindleberger made his theory of crisis anatomy, claiming that financial markets go through three stages towards financial crises (Aliber and Kindleberger, 2015):

1. Mania, where a positive external shock leads to euphoristic expectations of future profits and make actors willing to invest. During this stage investors basically take profits from increase in asset prices rather than from returns. This is a stage of financial instability, and it not sustainable.
2. Panic, occurs when investors realise that asset prices are too high and they fare the market will turn from upheaval to depression. They seek for ways out in order not to loose money.
3. Crash, occurs if panic sets in the market and the willingness to supply new capital is far lower than the eagerness to get out of the market. Prices on assets fall and business run into liquidity problems.

Hence, both Minsky and Kindleberger conclude that financial crises very often occur due to financial instability mirrored in high gearing, i.e. high debt ratios, which cannot be served during financial stress.

2.2. Leverage cycle

Drawing on both Minsky and Kindleberger along with empirical work by Grytten and Hunnes one can follow a common pattern of debt and asset development prior to and during financial crises (Grytten and Hunnes 2014). This development is described in figure 1.

Acharya and Plantin argue that in good times companies would over invest in order to gain market shares and short-term competitive advantages. In order to invest they will increase their level of debt and reinvest profits, making equities apart from reinvested profits stable, unless asset emissions are carried out. Increased debt makes the gearing component, i.e. the share of assets financed by debt, increase, meaning that their leverage is getting larger (Acharya and Plantin, 2017). When the turning point hits the market and a crisis is at hand, often denoted the Minsky Moment, the companies have to use their assets as a buffer for losses. If the losses continue over time all equity will be lost. The companies may go into insolvencies and debt negotiations or bankruptcy take place. This development is sometimes called the Minsky leverage cycle (Bhattacharya, 2011).

Thus, figure 1 shows that assets increase with increased debt as source, when equities are held stable in good times (booms or mania). After the Minsky Moment (Panic), when net margins fall dramatically and even become negative (Crashes), companies will use their assets as a buffer by drawing on their equities. Finally, the equities may be lost, and even negative and the firms may go into bankruptcy.

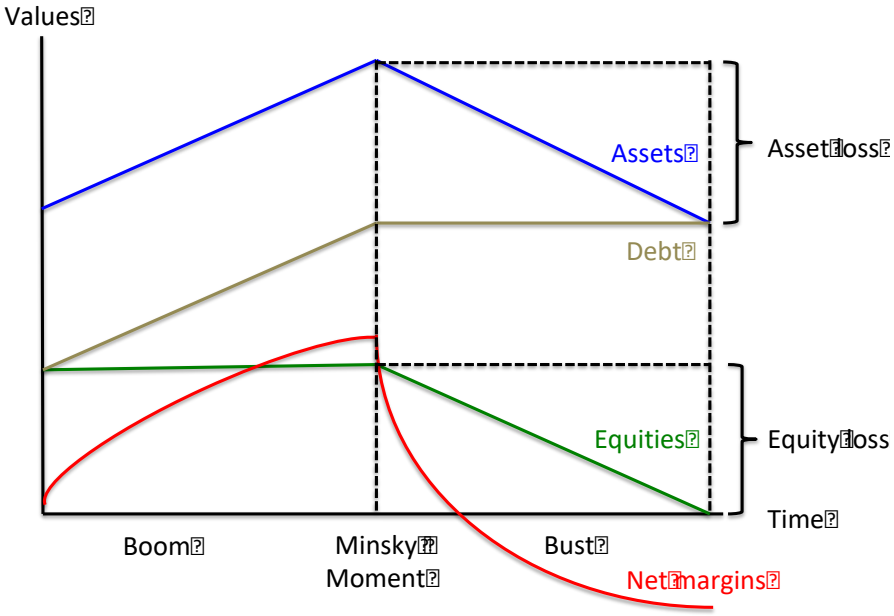


Figure 1. Development of assets linked to financial instability hypothesis.

2.3. Applications for maritime industries

The maritime industry is very sensitive to business cycles. In the short run supply of vessels is fairly constant, implying a steep supply curve. Thus, even small shifts in demand may cause huge fluctuations in operational rates (Jugovic, 2015). Stopford has mapped four and seven years cycles within shipping on the basis of match and mismatch of supply and demand (Stopford, 2008, p. 97), when Kavussanos look at the speculative elements of shipping investment, leading to over heating in good years and revulsion thereafter (Kavussanos, 2010, pp. 709-745). Chew, Lee and Tang on their side put emphasis on the importance of maritime supply chains in the industries development Chew, 2011, pp. 217-218).

Tenold has also highlighted the sensitiveness of shipping related industries in his extensive research into Norwegian maritime history (Tenold, 2019, pp. 195-230). Together with Ojala he also concludes that historically shipping is over sensitive to maritime trade and economic activity (Ojala and Tenold, 2017).

2.4. Supply chain management

There are many definitions of supply chain management (SCM). And the literature gives many different views and understandings of the concept. On the basis of Larson and Rogers a very simplified definition of supply chain management would be the management of a product chain from the start as raw materials to fully processed and consumed products (Larson and Rogers, 1998)

In line with the research by LeMay et al another more normative definition could be planning, administering and organizing product and information chains within or between different companies or industries in order to obtain efficient floats and production at lowest possible costs given quality standards (LeMay, 2012).

This means that SCM is often seen as part of logistics and optimization of production organization. It involves a conglomerate of components. Also, it is important with successful SCM in order to sustain a competitive industrial environment.

When one talks about the BMC one basically focus on the maritime industry. Leaving most marine operations, such as fishing, aquaculture and petroleum drilling out. However, maritime operations linked to these should be included.

Since the 2015-2017 crisis took place in the offshore chain, i.e. maritime operations connected to the production of oil and gas, the paper will concentrate on these. The offshore fleet belongs to several supply chains. Three of the most evident would be the supply chain for raw materials, for offshore freights, and for financial operations. These can be summed up as in figure 2, which shows product flows from the origin to the customers, when demand flows basically go in the opposite direction. Moving towards the right means higher up in the supply chain (upwards movement), when moving to the left means lower in the supply chain (downward movement).

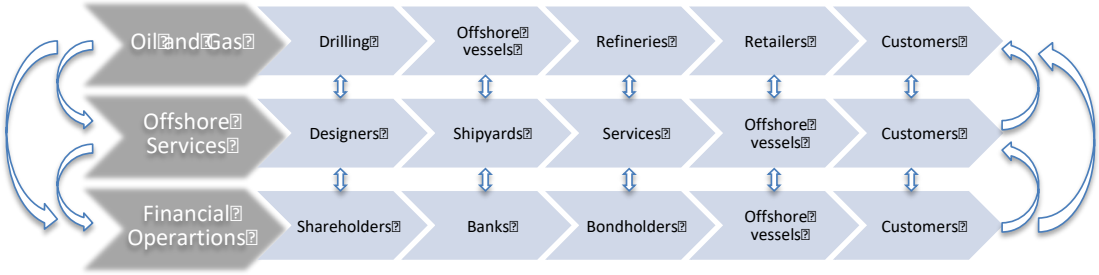


Figure 2. Supply chains related to offshore maritime operations.

Here we can see the maritime sector is inter-linked with marine operations connected to the production of oil and gas (row 1). Offshore services (row 2)

present more of a hard-core maritime supply chain, when the last (row 3) represents the financial system linked to offshore services.

The crisis started in the first supply chain, when oil and gas prices fell rapidly from the summer of 2014 and onwards. This had an effect in the supply chain, by causing lower drilling activity and lower demand for offshore vessel services, which influenced the other two chains.

Offshore vessels became abundant and demanded less services, shipbuilding and design activity in supply chain 2. Lower activity made it difficult to meet financial obligations, and thus, supply chain 3 was influenced by loss for bondholders, banks and finally shareholders. Via the supply chain mismatch between supply and demand of oil and gas in the world market evolved to a financial crisis in offshore-related industries, in particular in the very sensitive maritime related part. This reveals that the financial system was too fragile to stand against negative stress of this kind, causing troubles for almost the entire supply chain.

This study holds ship owning companies and shipyards as the hub of the maritime cluster and supply chain when it comes to investigating the effect of the offshore crisis. Thus, a more tailored supply chain for this investigation is presented in figure 3, showing the production chain from raw materials for the shipyards, like steel and other metals to refined oil and gas for customers.

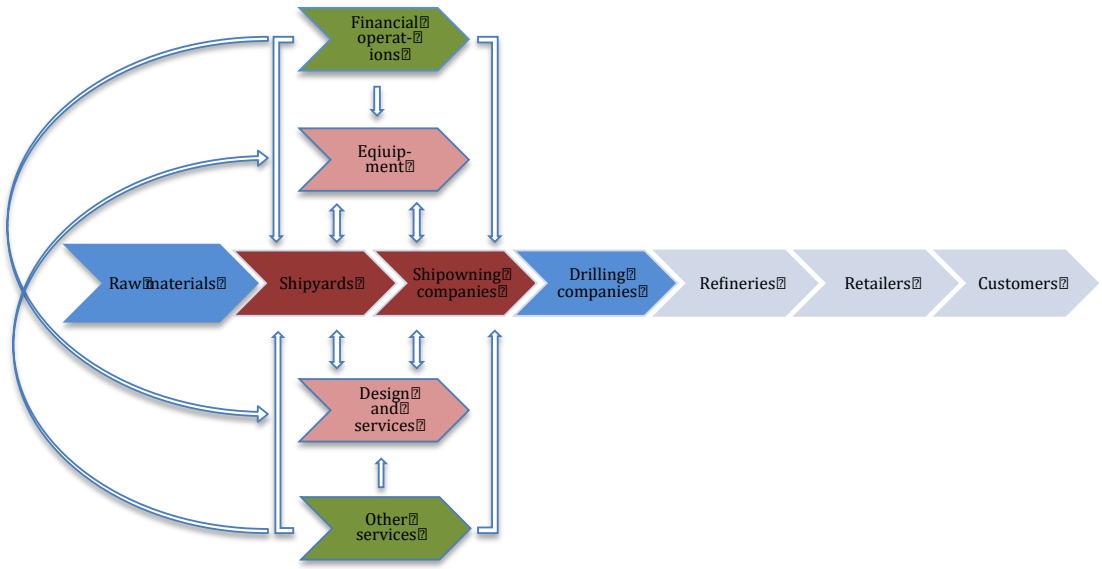


Figure 3. Supply chain related to BMC.

Here ship owning companies and shipyards, as the hubs, are coloured in dark red, and the other core components, i.e. ship equipment and ship designing and services, are coloured light red. Financial operations and other services as support industries are coloured in green, when raw materials and drilling activity are important industries for the supply chain, and coloured dark blue, when the periphery of the chain is coloured light blue.

3. Data

3.1 Business activity

In order to carry out this study one needs to gather key figures on business activity and financial indicators. Some of the most relevant data for business activity would be turnover, value added, net operational margin and employment. These provide some of the best information on success or failure. The relevant data are basically available from annual reports and cluster analysis made for the BMC.

The annual reports are made by BMC itself partly on the basis of research done by Møreforskning from 2009 and Menon from 2015. Additionally there is cluster analysis, done almost annually since 2004. These were first made by Hervik, then by Møreforskning from 2009 and lately by Menon from 2015 (Hervik, 2008; Møreforskning, 2009; Menon, 2015).

In order to arrive at a valid sets of time series these data had to be reorganised in a persistent way, by using the latest definitions and standards for the data, basically as done by Menon (2018). The data series are meant to represent the entire cluster, and basically close to full datasets are compiled by around two thirds of the companies answering questionnaires. These data are supplemented by public registered data from the central national data register. Thus, one arrives at valid and reliable data for our purpose

3.2. Key financial indicators

Also, financial indicators are important for this analysis. Here we use total rentability, equity rentability, liquidity, equity and debt ratios, and again net operational margins. These are taken for the hub for this study, i.e. ship owning companies and shipyards. We include all companies in the BMC involved in these industries by compiling data from their financial accounts, operational and balance sheets.

These data are again taken from the national data register, the so-called Brønnøysundregistrene, and they contain open information on financial dispositions.[2] In some cases firms went to restructuring processes during the crises, due to lack of equity, and one has to adjust for some of these structural shifts in the data by letting out obvious out layers more reflecting book keeping principles than reality. One also has to close the books for companies, which *de facto* exited from the regional cluster.

One is also able to cross check these data with data reported on a more random basis in the cluster analyses and annual reports of the BMC.[3] Having done this, one arrives at valid and reliable data for financial indicators within the cluster.

4. The Blue Maritime Cluster

Before we start our analysis of the BMC it is also necessary to give a definition of the term cluster. According to Porter a cluster is ”a geographically proximate

[2] https://www.brreg.no

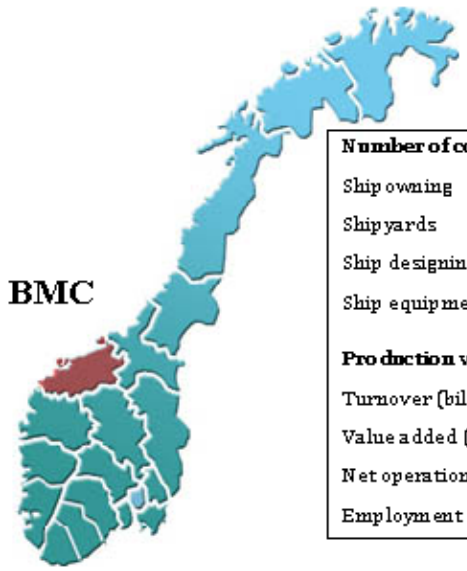
[3] https://www.bluemaritimecluster.no/gce/reports--publications/cluster-analysis/cluster-analysis/, https://www.bluemaritimecluster.no/gce/reports--publications/annual-reports/annual-reports/

group of interconnected companies and associated institutions in a particular field, linked by commonalities and complementarities" (Porter, 2000, pp. 16).

Cooke describes the following typical attributes to a cluster (Cook, 2001, pp. 24):

1. It displays a shared identity and future vision.
2. It is "turbulent" with spin-offs, spinouts and start-ups.
3. It is an arena of dense and changing vertical input-output linkages, supply chains and horizontal inter-firm networks.
4. It is likely to have third-party governance associations providing common services and lobbying.
5. It may have caused governments to assist clusters, in particular when market-failures are present.
6. It may reveal features of emergence, dominance and decline over time.

It is quite evident that the BMC applies to most of these criteria. Its location is geographically limited to the county of Møre and Romsdal, were the Ålesund area hosts the bulk of the companies and activities. Furthermore, it consists of interrelated companies and industries all linked to the maritime sector. In 2014, the same year as the formally organized cluster was awarded the status of global centre of expertise, it reached its peak activity level as summed up in table 1 (BMC, 2015).



Number of companies	
Ship owning	20
Shipyards	14
Ship designing and services	13
Ship equipment	169
Production volumes	
Turnover (bill euros)	8.42
Value added (bill euros)	3.12
Net operational margin (%)	8.3
Employment	18800

Table 1. Descriptive statistics BMC as of 2014.

Source: BMC (2014 and 2015).

The BMC has traditionally been known as tightly vertically structured. It sits on global excellence in designing, equipment production and service providence. During the last decades petroleum related businesses have increased their presence. Companies in the cluster are world leading in most parts of the supply chain.

In the annual report of the cluster several world leading companies in their fields are mentioned (BMC, 2018), such as Skipsteknisk, Ulstein Design, Havyard Design

and Marine Teknikk. These are designers of some of the most advanced offshore vessels in the world, operating in most challenging oceanic environments at.

Shipping companies, such as Bourbon, Island, Havila and Olympic, with their modern, advanced and world-leading equipment serve offshore fields across the globe. The majority of the ships are designed and produced by local shipyards belonging to the maritime cluster, like Kleven, Ulstein, Vard and Havyard. The yards use equipment, e.g. motors, propulsion, winches and dynamic positioning, produced locally by Rolls-Royce Marine, IP Huse and Brunvoll, also belonging to the cluster.

In addition to the core participants of the cluster, some sectors are important in its framework, such as financial institutions, providing necessary liquidity, research and education, helping strengthening the innovation speed and level of the cluster and educating skilled labour force for it.

Also, government policy both on regional and national level give important political and bureaucratic frameworks for the cluster, when different kinds of associations connected to the activities of the cluster both give support and limitations to its development. The business environment in general is important for a cluster. A well-developed business environment may give synergy effects through technological development, skilled labour force and access to capital.

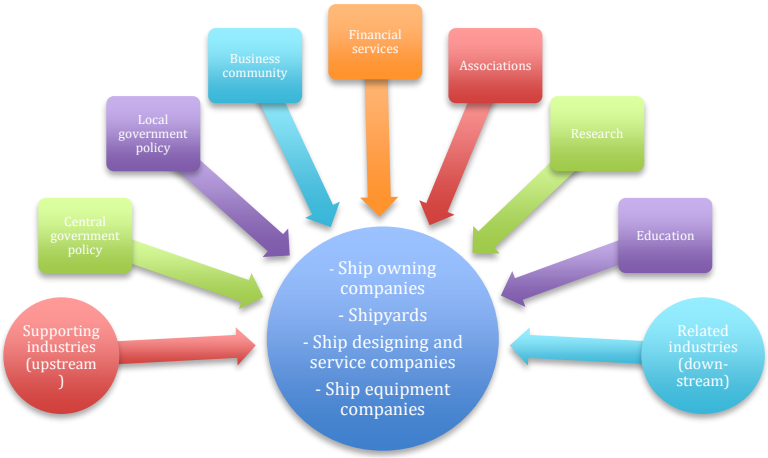


Figure 4. BMC and its framework.

Hence, we can map the Blue Maritime Cluster and its framework as done in figure 4.

5. From boom to bust

If a cluster works as an interlinked conglomerate it should give several advantages. From Marginean we can extract eight advantages (Marginean, 2009):

1. Superior technology access
2. High innovation activity
3. High innovation speed
4. Good access to capital
5. Improved human resources
6. Improved productivity

7. Low costs
8. Better market access

These benefits have been attributed to the BMC both by internal and external actors (Hervik, 2012). However, being an inter-linked cluster with distinct supply chains also make one vulnerable. Asbjørnslett has highlighted vulnerability for downturns in the industry or the market via an open supply chain, creating an interlinked algorithm of downfalls by contamination form one company to the other and one industry to the other (Asbjørnslett, 2009, pp. 16-19). Thus, Aarset stresses the necessity of risk and crisis management, in particular connected with sensitive industries linked to marine and maritime operations (Aarset, 2010).

5.1. Boom

Until 2014 the cluster experienced very good times, basically caused by high petroleum prices and high degree of innovation. Between June 2009 and October 2014 monthly prices on North Sea oil, Brent Crude, for most months fluctuated between 80 and 120 US dollars per barrel. From July 2005 until October 2008 spot prices moved between 80 and 160 dollars per barrel.[4] Thus, even oil fields with high marginal costs reached break even. Hence, volumes of production and developments of new fields were both high.

In consequence, demand for the offshore fleet was high and increasing. The profitability of marginal fields with immense technical challenges was welcomed by the BMC, which had developed one of the most advanced offshore fleets globally. As implication there was huge demand for both upstream and downstream production in the supply chain, as the ship owning companies needed new vessels and equipment, when related industries demanded the clusters services. Despite Norwegian oil production saw its peak around 2001-2002, there was high activity concerning discovering potentially new fields. Also, the Norwegian offshore fleet gained contracts offshore elsewhere.

The upheaval made ship owners less risk averse, and they acted uniformly by over investing. One of the largest owners in the cluster, Per Sævik form the family dominated Havila and Havyard group expressed this by stating:

”Everybody reasoned the same way, and nobody reasoned very much” (Sunnmørsposten, 2016).

Over investment took place, not because profits were increasing after 2009, but because the market actors wanted to take part in the huge increase in offshore shipping activity, and fared to loose market shares.

5.2. Bust

However, during the fall of 2014 the OPEC cartel saw huge challenges from the rapid increase in oil and gas production elsewhere. In particular they feared the growing production of shale oil would destroy the market by surplus supply. Thus, OPEC countries, among them the dominant producer Saudi Arabia, decided to increase exports of petroleum. Given the inelasticity of demand for price reductions and vice versa the huge price elasticity for increase in supply, prices

[4] https://www.macrotrends.net/2480/brent-crude-oil-prices-10-year-daily-chart

fell dramatically in the world market. Spot market prices of crude oil fell from 115 US dollars per barrel in June 2014 to less than 30 dollars in February 2016 as shown in figure 5. Long-term prices were also very low, indicating low future expectations in the market, decisive for exploration and investment levels.

Figure 5. Brent crude oil prices in US dollars per barrel August 2009-August 2019.

Source: Macrotrends.no

In consequence of low prices, the drilling activity in the fields with the highest break even prices were reduced, basically by putting aside new planned or unplanned projects. At the same time oil and gas companies had to reduce costs by being more efficient. The demand for offshore vessels fell at the same time as newly contracted ships were launched. Hence, a significant mismatch between supply and demand, materialised and a huge surplus of tonnage emerged.

In consequence, ship-owning companies cancelled new construction orders. This had further consequences downstream the supply chain, as shipyards ran into problems, and thereof also maritime service and equipment companies, due to a negative shift in demand of their products.

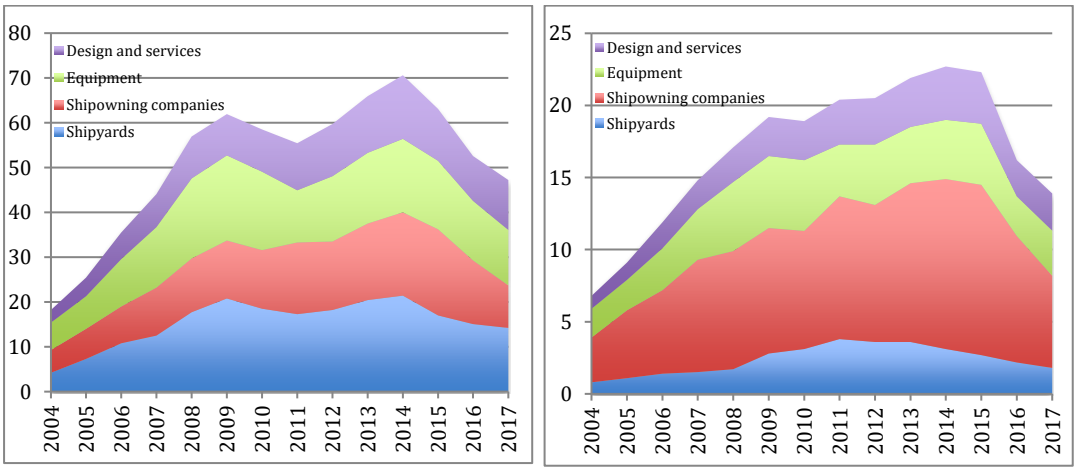


Figure 6. Turnover (left) and value added (right) in the BMC 2004-2017 in bill NOK.

Source: BMC (2004-2018).

As shown in figure 6 both turnover and value added (economic value creation) in the BMC fell dramatically from around 2015 after years of growth. Net operating margin in the cluster as a whole has been estimated to minus six percent in 2015 and devastatingly minus 25 percent in 2016. Value added fell by 39 percent, turnover by 33 and employment by 29 percent in three years 2014-2017. In consequence of the significant contractions, market relations in the cluster were severely damaged. Innovation impulses from the shipping companies to the rest of the supply chain were almost cut off and weakening the internal linkages within the cluster. Unemployment increased as employment in the cluster fell.

6. Testing for over expansion and revulsion

A central question for this study is if the financial instability hypothesis applies for the BMC. In order to study that we will follow central financial components before and during the fall to the abyss. Let us first look at the anatomy of the development itself, i.e. how the crisis evolved.

According to the financial instability hypothesis busts follow times of over heated markets. This should be mirrored in key variables clearly above sustainable equilibriums, followed by revulsion with key variables clearly under sustainable equilibriums.

It is of course difficult to know what these equilibriums should be. However, markets will in the long run move towards a pattern of steady state development. Thus, a long run trend should reflect this development. This trend is by no means linear. Rather both supply side and demand side alterations make such trends polynomial, i.e. they are shifting throughout time.

6.1. Model

To be able to decide on the upturns and the downturns of the BMC the paper maps deviations from trends of key financial indicators. We then use polynomial trends, which reflect smoothed versions of the actual series. In order to do so we use structural time series analysis, separating observed time series (x_t) into trend components (g_t), a cycle components (c_t) seasonal components (s_t) and irregular components (i_t):

$$(1) \qquad \boldsymbol{x_t = f(g_t, c_t, s_t, i_t)}$$

An arithmetic approach to this function gives the following relationship:

$$(2) \qquad \boldsymbol{x_t = g_t + c_t + s_t + i_t}$$

Here it is natural to consider i_t as the residual:

$$(3) \qquad \boldsymbol{i_t = x_t - (g_t + c_t + s_t)}$$

In the present analysis it is natural to see i_t and s_t as part of c_t. hence, a reduced form of equation (2) will be as in equation (4):

$$(4) \qquad \boldsymbol{x_t = g_t + c_t}$$

By using a Hoderick-Prescott filter one might identify these components. The HP-filter minimizes the variance of c_t subject to a penalty for variation in the second difference of g_t:

(5)

$$\min_{g_t} \sum_{t=1}^{T} (x_t - g_t)^2 + \lambda \sum_{t=2}^{T-1} [(g_{t+1} - g_t) - (g_t - g_{t-1})]^2$$

In equation (5) $(x_t - g_t)$ gives the cycle component of the time series, when $[(g_{t+1} - g_t) - (g_t - g_{t-1})]$ gives the difference in the trend growth rate from period t until t+1. Also, λ, controls the smoothness of the growth components of the time series.

One may calculate cycle components by deducting the trend component from the observed time series:

(6) $\boldsymbol{c_t = x_t - g_t}$

To be able to calculate relative gaps, which are far more relevant than absolute numbers in our analysis, we use logs of the parameters x_t and g_t, which also gives log values of c_t.

(7) $\boldsymbol{log(c_t) = log(x_t) - log(g_t)}$

By using the HP-filter from equation (5) on equation (6) one arrives at the following relationships:

(9)

$$\min_{g_t} \sum_{t=1}^{T} (x_t - g_t)^2 = x_t - \lambda \sum_{t=2}^{T-1} [(g_{t+1} - g_t) - (g_t - g_{t-1})]^2$$

Here the cycle component is $\min_{g_t} \sum_{t=1}^{T} (x_t - g_t)^2$ is the residual. Applying this on equation (7) one arrives at relative deviations from the polynomial trend, i.e. relative cycles:

(10)

$$log(c_t) = log(x_t) - log(\lambda \sum_{t=2}^{T-1} [(g_{t+1} - g_t) - (g_t - g_{t-1})]^2)$$

High smoothing parameters give trends with minor fluctuations, and thus, significant cycles. A smoothing parameter equal to zero means that changes in the observed series should be explained by trend developments only. Thus, high

smoothing parameters make cycles decisive components in time series. Low smoothing parameters give trends with large fluctuations, and thus, minor cycles. Rules of thumb suggest a smoothing-parameter of λ = 100 for annual figures, λ = 1,600 for quarterly figures, and λ = 14,400 for monthly figures.

6.2. Results

Using the data compiled from the BMC and the national register in the stated model one is able to map cycles from trend, or deviations from polynomial trends. We test the following parameters:

1. Value added, showing value creation of the BMC
2. Turnover, showing the gross value of economic activity in the BMC
3. Employment, showing numbers of annual man-hours in the BMC
4. Net operational margin, showing profitability of the activity in the BMC.

The available data limits one to basically run the analysis on annual data 1999-2018. Thus, we use λ = 100. Since there negative observations for net operational margines one cannot use the HP-filter as such for estimation of deviations from trend. Thus, for this parameter the paper reports maximum and minimum values in the cycle. Years of peaks and troughs are reported in brackets. The results are reported in table 2.

Table 2. Cycle components by industry for the BMC 1999-2018.

(N=20x5x4=400)	Shipyards	Ship owning companies	Equipment	Design and services	Total
Value added (N=20x5=100)	0,297 (2011) -0,393 (2017)	0,174 (2014) -0,424 (2017)	0,105 (2015) -0,291 (2016)	0,159 (2014) -0,244 (2016)	0,131 (2014) -0,324 (2017)
Turnover (N=20x5=100)	0,157 (2014) -0,215 (2017)	0,199 (2015) -0,494 (2017)	0,077 (2014) -0,157 (2017)	0,193 (2014) -0,200 (2016)	0,149 (2014) -0,242 (2017)
Employment (N=20x5=100)	0,190 (2014) -0,090 (2017)	0,190 (2014) -0,351 (2017)	0,106 (2013) -0,122 (2017)	0,113 (2015) -0,199 (2017)	0,123 (2014) -0,193 (2017)
Net operational margin (N=20x5=100)	0,112 (2011) -0,020 (2017)	0,225 (2013) -0,750 (2016)	0,032 (2012) -0,160 (2016)	0,099 (2011) 0,000 (2015)	0,110 (2011) -0,250 (2016)

Table 2 reveals major positive deviations from polynomial trends prior to the offshore crisis unfolding from the second half of 2014. Most remarkable are shipyards with a peak of 29.7 percent in value added in 2011 followed by turnover peaks of 19.9 and 19.3 respectively by ship owning companies and design and service companies in 2015 and 2014. On aggregated level value added peaked with 13.1 percent over the trend, turnover with 14.9 and employment with 12.3 percent, all in 2014. Net operational margin peaked with 11.0 percent in 2011, showing that returns were on their way downward before the crisis hit.

The fall during the crisis was even bigger than the peaks. For all four industries value added was 32.4 percent under its trend in 2017, turnover 24.3 and employment 19.3. Net operational margin reached its bottom with -25 percent in 2016, indicating profits were improving after that.

All in all this test reveals that substantial over heating took place in the offshore markets and thus in the BMC in the years prior to 2014. In fact our data conclude that this over heating started before the outbreak of the financial crisis and rapid fall of petroleum prices during the autumn of 2008, and it continued after the prices came back to high levels during 2009.

7. Financial instability?

7.1. Loosing stability

After the Asian crisis towards the end of the 1990s, oil prices, with few exceptions, stayed surprisingly high until the financial crisis evolved during the autumn of 2008. After a significant drop, they regained their high level shortly after. At the same time the production level of oil was going down in the North Sea. Thus, high prices led to huge willingness to search for new fields of exploitation in the seabed west of Norway. Thus, there was large demand for offshore vessels, and thus for construction of these, giving a boom to shipyards, designing and service companies and to equipment producers. Between 2004 and 2009 the total turnover in the BMC stepped up by a factor of more than 200 percent, when value added increased almost at the same pace (BMC, 2015).

During the financial crises from the autumn of 2008 growth took a break until late 2010, before a new period of growth dominated along with high petroleum prices until the summer of 2014.

The maritime sector and the petroleum sector are both very sensitive to price fluctuations and business cycles. Thus, it should be in the interest of the involved companies to use the upswing as an opportunity to increase equities in order to create more financially solid companies. However, did this happen? Or did the positive demand shock due to high petroleum prices make them go into the financial taxonomy fallacy as described by Minsky.

In order to answer this question, we have compiled financial accounts data from the hub of the cluster, i.e. ship owning companies and shipyards. The key indicators we look at are:

1. Total rentability of capital, i.e. profits as share of total assets.
2. Equity rentability, i.e. profits as percentages of invested equities.
3. Equity ratios, i.e. equities as percentages of total assets.

4. Debt ratios, i.e. debt as percentages of total assets.
5. Liquidity ratios, i.e. liquidity as percentages of total assets.
6. Operational returns, i.e. net profit form operations as percentages of turnover.

These figures for ship owning companies and shipyards within the BMC are reported in figure 7.

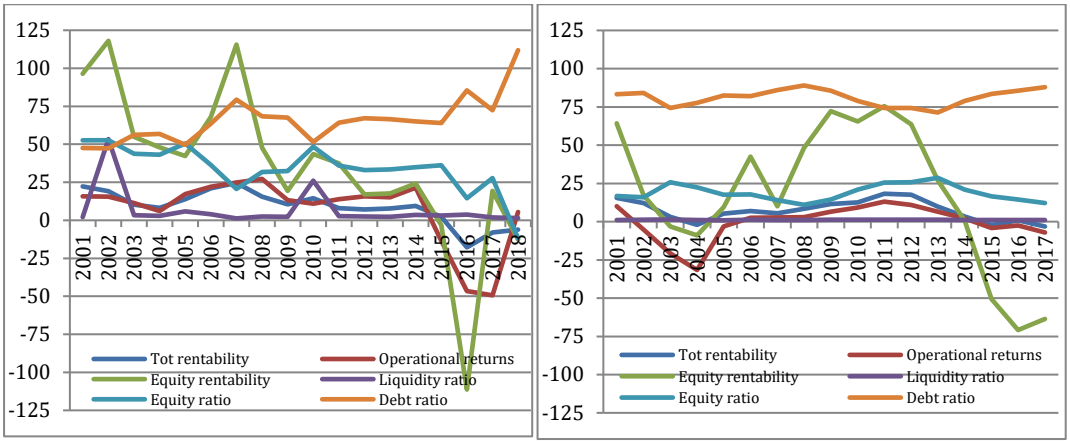


Figure 7. Key financial accounts figures for Ship owning companies (left) and shipyards (right) in the BMC 2001-2018.

Source: brreg.no

They reveal that equity ratios did not increase during the upswing. Contrary, debt ratios were increasing until 2007/2008. From almost 50 to 80 percent in ship owning companies and form 80 to 90 percent in shipyards. At the same time liquidity ratios fell dramatically. In other, words huge profit margins, mirrored in high rentability and operational returns were not channelled into more solid companies. Rather they increased gearing in order to defend or even gain market shares.

In consequence of the financial crisis investments were temporarily cut down and equity ratios increased. However, after a few years the companies increased their gearing again, and they were not at all ready to cope with any financial downturn when they entered into 2015. In other words, one can trace that the BMC went in to a leverage cycle causing a deep downturn.

7.2. Consequences of lost stability

After petroleum prices started their giant fall from Summer 2014, most of the ship owning companies still did well for some time due to long term contracts to fixed prices for their fleet. However, after these contracts were terminated and they had to rely more on spot market rates and new long term contracts with far lower prices thy rapidly went into huge problems. Liquidity fell and huge deficits made equities shrink and liquidity be squeezed.

Bremnes, Sandsmark and Vekve have given an overview of the crisis and its consequences (Sandsmark, 2018, pp. 21-33). She argues that the huge concentration around supply vessels made the cluster vulnerable. The offshore fleets expansion was already seen as risky business by banks and they had to rely

on borrowing capital by selling bonds with high interest rates. During 2015 and 2016 most of the companies were not able to fulfil their obligations to their creditors. The four largest belonging to the BMC and all family owned companies, Farstad Shipping, Havila Shipping, Olympic Shipping and Rem Supply, had to go into debt negotiations.

Since it was impossible for them to meet their obligations banks and bond holders demanded to transform credits to equity at a higher rate than the owners would accept. Rem was the first to give up as a basically family owned company in order to be sold to Solstad Offshore at the end of July 2016. After several rounds with creditors the same happened with the biggest of them all, Farstad, which as one of the largest companies in the world market hosted more than 70 ships and 2200 employees in its worldwide operations. On March 24th 2017 the general assembly finally decided the company had to merge with Solstad Offshore (Sunnmørsposten, 2017).[5]

After several rounds with their creditors Havila Shipping and Olympic Shipping survived as a local family owned companies. Their losses were huge, and they were not at all financially sound and solid in order to meet the crisis. So why did they survive? Partly, because Solstad found more interest in Farstad and Rem. But we also find that their owners had a more diversified portfolio, giving them several pillars to rest on and by that also creditors more willing to arrive at favourable agreements.

The Sævik family behind the Havila group had invested heavily in shipyards, hotels, fisheries, ferry companies both in Norway and abroad. In particular their acquisition of the ferry company Fjord1 proved to be very profitable, and gave alternative income (Sunnmørsposten, 2016).[6] These investments made the family controlled group even bigger than Farstad, but offshore vessels were only part of their portfolio. They later also gained license to coastal voyages for tourists and local passengers and cargo along the coast from Bergen to Kirkenes.

8. Supply chain effects

As discussed, vertically integrated clusters may have problems with crisis contaminating up and down in the supply chains: in order to build a defence against these chain reactions one need financial stability with solid firms and possible diversification of portfolios to avoid high degree of risk concentration. So what happened in the supply chain of the BMC?

8.1. Supply Chain reactions

A study of the chronology of the offshore crisis shows it closely followed the supply chain of the cluster. The shipyards were the next to be challenged by a rapid fall in demand on their products, and thereof designers, service and equipment companies followed. A huge challenge was their dependence of the offshore fleet. Most of them had specialized in construction of or deliveries to offshore vessels.

[5] https://www.smp.no/naeringsliv/2017/06/21/Solstad-Farstad-fusjonen-fullført-14905819.ece

[6] https://www.smp.no/nyheter/2016/11/28/--Var-helt-åpent-hvordan-det-skulle-gå-13855929.ece

Thus, it should be expected that one would see mass bankruptcies in these industries. It is not at all difficult to find they were struggling with negative bottom lines, debt escalation and liquidity problems. However, we find that all these related industries did better than the offshore shipping companies. Despite the shipyards ran into huge problems, one only find moderate negative profits for this industry as a whole in the BMC, with net operating margin of two percent in 2015 and 2017.

When the crisis evolved many yards quite rapidly looked for alternative engagements. According to Helseth et al they showed a significant degree of market adaptability (Helseth, 2019, pp. 6-13). One obvious alternative was in the rapidly growing cruise market or emission reduced vessels as the government demanded these.

These new engagements partly compensated for the downturn in the offshore market. However, a problem was insufficient experience. Cost calculations were made too low due to lack of the same efficient competence as in the offshore sector. Some new projects proved to be non-profitable. In addition the shipyards struggled with finding new buyers to cancelled ships.

When the crisis started the aggregated debt ratio of the yards, and by that the financial leverage or gearing, was even higher than among ship owning companies. Thus, they could easily be victims of the crisis. A study of the dominant shipyards reveals that the family owned Kleven Verft ran into the worst problems by loosing their equity in several rounds of losses. In 2017 their equity became negative and in consequence they were close to bankruptcy

However, they were building two ships for the coastal voyage, freighting passengers by the coast along the bulk of the Norwegian coastline from Bergen to Kirkenes. In June 2018 the same company rescued the yard with new capital of 600 million Norwegian kroner, in order to secure the completion of these ships. Through this package 750 employees kept their jobs for another year, when the crisis struck again due to lack of profitable orders and the new owners eagerness to pull out (Sunnmørsposten, 2019).[7]

8.2. Diversification as survival strategy

The other significant shipyards, like the Havyard group, the Ulstein group and the Vard group also struggled. The number of employees in the shipyards belonging to the BMC was reduced by a third between 2014 and 2015. However, vertical integration between the different companies in fact to some degree secured some demand from the ship owning companies to the yards. This happened when then Havila group, controlled by the Sævik family, secured demand for the Havyard grouped controlled by the same family, when the Vard group reduced its local engagement significantly. Important for the Sævik group was that they were engaged in other maritime sectors than offshore. Thus, substantial demand for the shipyards could still be secured.

The Ulstein Group had over a longer period of time paid focus to limited diversification by vertical integration through buying or establishing several firms

[7] https://www.smp.no/naeringsliv/2019/07/25/Vi-skal-jobbe-knallhardt-og-det-skal-byggjast-nye-båtar-ved-Kleven-Verft-19567504.ece

as part of the supply chain. When the crisis illuminated the problems of the industry, the group had 13 different production companies on the first line under the mother company, engaged in different parts of the supply chain. This had of course a high degree of market risk, but the financial risk was spread into different levels of the chain. To some degree this made the group stand on many different legs financially. Also, as a vertically integrated group involved in different parts of the supply chain they could benefit from internal orders. At the same time they were among the first to step into the hybrid market of ships, reducing emissions to the environment, giving them an environmental competition advantage (Sysla, 2019).[8]

Also, the shipyards were able to negotiate lower costs from the equipment industry. This is mirrored in the fact that the contraction in output from the shipyards during the crisis was significantly higher than the contraction within the equipment branch. However, the deficits were significantly bigger among equipment producers than shipyards.

8.3. Chain reactions from the hub

The problems in the shipyards went further along the maritime supply chain and design and service companies along with equipment companies were the next to face financial problems. However, these were often smaller companies and more financially solid. Despite this fact, the equipment industry saw a heavy contraction in turnover, value added and net operating margin. The largest equipment company, Rolls Royce Commercial Marine, lost engagements and capital in Norway. However, as part of a huge international group, they kept financially solid given the depth of the crisis.

The net operating profit margin for the equipment branch of the cluster reached minus five percent in 2015 and minus 15 percent in 2016 (figure 8).

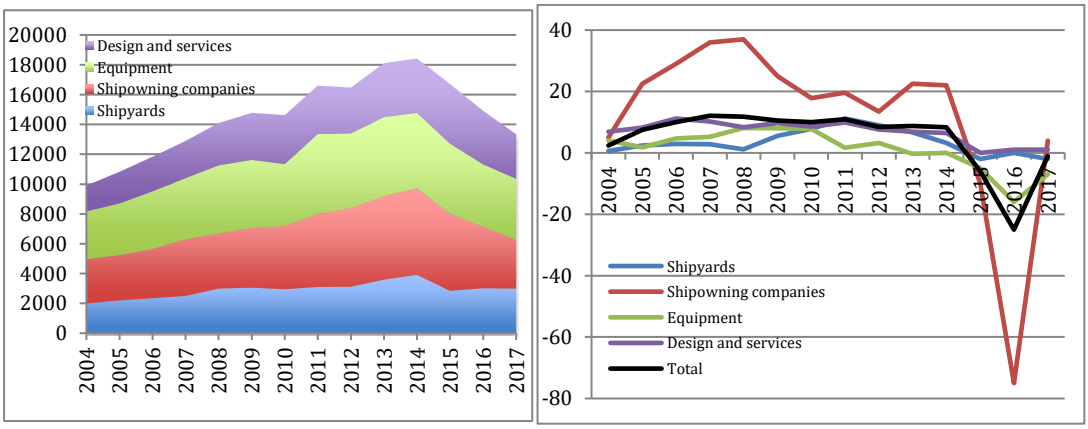


Figure 8. Employment (left) and net operating margins in percent of turnover (right) in the BMC 2004-2017.

Source: BMC (2004-2018).

During July 2018 Rolls Royce negotiated an agreement with the Kongsberg group about taking over the firm for a price of 5.3 billion Norwegian kroner, where the

[8] https://sysla.no/maritim/verdens-storste-hybridskip-levert-fra-ulstein-til-color-line/

Norwegian government would contribute with 2.5 billion in order to secure that high-tech jobs were kept domestically (Maritime Executive, 2019)[9]

As for design and services, they experienced lower contraction in both turnover and net operational margin than the other industries belonging to the cluster, as they as a group never reported any significant losses during the crisis period. However, their margins were reduced as value added and employment fell drastically. Profits went down to zero in 2015 and stayed marginally above in the two following years, when employment was reduced by 29 percent between 2015 and 2017 (BMC, 2018).

Designing companies were engaged in designing smarter and more cost efficient solutions along with designing of new types of vessels for maritime and marine operations.

9. Conclusions

The present research seeks to explore the role of financial instability and supply chain effects to the evolvement and spread of the maritime offshore crisis of 2015-2017 to the Blue Maritime Cluster (BMS) located at the North West coast of Norway. The crisis was quite deep and effects of the crisis were still evident some years after the fall of the markets. To conduct the study the paper offers time series of the activity level and key financial indicators.

In order to map if the markets went into a Minsky-Kindleberger cycle of over expansion and contraction, the paper use structural time series analysis to map cycle deviations from polynomial trends, and concluded that this pattern definitely took place. Looking at financial indicators the paper concludes that that this was mirrored in increased gearing during the upswing and a financial crisis with lost equities thereafter. Which is according to the Minsky leverage cycle.

In other words, we find that during the booming years prior to the offshore crisis of 2015-2017 the companies belonging to the BMC to a large degree fell into financial instability. During these good years they over invested funded by borrowed money in order to sustain or even gain market shares. Thus, instead of increasing their equity base, it became smaller, with debt ratios of more than 90 percent in several companies within the hub of the cluster, i.e. ship owning companies and shipyards. In addition loans were not granted easily, and they had to pay high-risk premiums via high interest rated in bond markets.

When the negative shock came with a significant fall of prices of oil and gas from the summer of 2014, leading to rapidly shrinking demands for their products, they did not have sufficient solidity to withstand the crisis.

Because of the clusters dependence on offshore shipping and shipyards, the crisis spread rapidly in the supply chain. And due to lack of financial stability to set up a proper defence significant actors were sold to companies outside the cluster, accounting for more than one third of the fall in the volumes.

One also finds that narrowly focused supply chain management, related to the cluster alone had a negative effect. There is a tendency, that groups with a higher

[9] https://www.maritime-executive.com/article/kongsberg-completes-acquisition-of-rolls-royce-commercial-marine

diversification in investments and activity portfolio did better than those narrowly limited to their own hub as the crisis spread down through the supply chain of the cluster.

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NORGES HANDELSHØYSKOLE
Norwegian School of Economics

Helleveien 30
NO-5045 Bergen
Norway

T +47 55 95 90 00
E nhh.postmottak@nhh.no
W www.nhh.no