VALUE RELEVANCE
IN THE AQUACULTURE INDUSTRY

BY HAAKON ZAPFFE

SALMON PRICE

HARVEST VOLUME (GW)

BOOK VALUE OF EQUITY

BIOMASS IN SEA (LW)

BIOLOGICAL ASSETS

NET INCOME
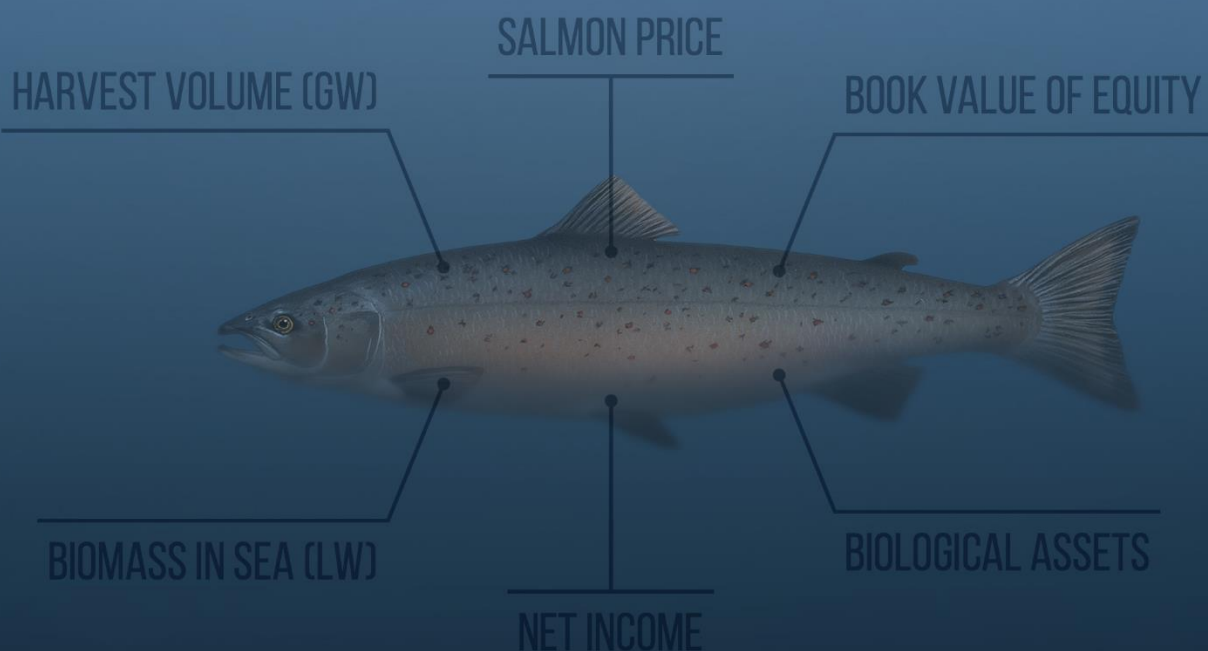
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Abstract

I study which variables are value relevant in the Aquaculture Industry. The first part of the thesis establish that the Residual Income Valuation Model (RIV-model) and Value Relevance field of research is applicable in this industry. I find that my results are in line with what the field of value relevance research predicts.

The second part of the thesis looks at the Aquaculture industry more thoroughly. I look at which variable is most suitable as a proxy for eliminating the effect of company size, different choices for proxies, both in abnormal earnings and in "other information". Here, I apply a unique handpicked dataset containing operating data from quarterly financial statements. I find that total assets is the best proxy for the size effect of the companies, net income is the best proxy for abnormal income, the salmon price is the best single proxy for other information and the salmon price, biological assets, harvest volumes and intangible assets are jointly the best variables for other information.

I contribute to the field of value relevance by establishing that the RIV-framework is applicable, by ascertaining which variables are value relevant and which variables should be used in the aquaculture industry. In addition, I build on Dechow (1994); Eccher & Healy (2000); Wu, Koo & Kao (2005) and Misund & Osmundsen (2007) by applying the Vuong-test to determine value relevance in the aquaculture industry.

Keywords: Value Relevance, Aquaculture Industry, Company Valuation, Residual Income Valuation Model

Thesis Layout

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Dictionary

Abbreviations:

BA: Biological Assets

BV: Book Value of Equity

FAO: Food and Agriculture Organization of the United Nations

GWT: Gutted Weight in Tonnes

HA / HV: Harvested volume of fish

LWT: Live Weight in Tonnes

MV: Market Value of Equity

NI: Net Income

PPE: Plant, Property and Equipment

R^2 (r-squared): the coefficient of determination

RIV: Residual Income Valuation Model

TA: Total Assets

Vuong-test: Vuong's Closeness test

Introduction

First, I want to establish that Ohlson's residual income model is applicable in the aquaculture industry. This entails proving that market value of equity is explained by the following independent variables: book value of equity, abnormal earnings and other value relevant information. The aquaculture industry has grown considerably over the years and is popular among investors. In addition, seafood and particularly salmon is a very popular product, both in terms of health benefits and sustainability of production. It is long overdue that someone examine this industry in terms of value relevance.

The second part of the research question focuses on selection of variables for the model. It is divided into three main bodies: proxy for company size, proxy for abnormal earnings and proxies for other value relevant information. The second part is a natural extension of the first research question as it goes further, in order to establish which variables are value relevant and to ascertain which variables should be used as proxies.

This thesis will contribute to the field of value relevance by establishing that the RIV-framework is applicable, which variables are value relevant and which variables are best to use in models in the aquaculture industry.

I use regression analysis and the Vuong-test in order to address the research questions.

I structure the thesis into three main parts. The first part consists of literature reviews: an overview of the aquaculture industry, field of value relevance and econometrics. The second part is formulation of the hypotheses, research method, data and samples. The last part presents the results, discussion and conclusion. Additionally, there is a list of references and appendices with information not included in the main body of thesis.

Part I; Literature Review

1.0. Aquaculture

Aquaculture (aquafarming, fish farming or marine culture) can be defined as the human cultivation of organisms in water (Asche & Bjørndal, 2011). The degree of control over the process is what separates aquaculture from fisheries (Anderson, 2002). In many ways, the aquaculture industry shares more similarities with modern husbandry than with fisheries. A fitting analogy would be to compare a farmer to a huntsman. This chapter reviews history and characteristics of salmon farming.

1.1. History of Salmon Farming

The Norwegians started in the 1960's with raising Atlantic salmon in sea cages to harvestable size. The industry went through a commercialization in the 1970's and became a viable industry in the 1980's. After the initial success in Norway the aquaculture of Atlantic salmon spread to Scotland, Ireland, the Faroe Islands, Canada, the North Eastern seabed of the US, Chile and Tasmania, Australia. There was no coincidence that the Norwegian was the pioneers. Norway has a great potential for Salmon Farming, with stable seawater temperature of 5-15 degrees Celsius, good infrastructure, large inland fjords, long coastline and archipelagos. From the 1990's to the 2000's the industry has been subject to mergers between the largest producers.

In the 1970's the Aquaculture Industry produced 4% of the world's total seafood production, while in 2012 the Industry accounted for 42.2% (92 million tonnes, live weight where fish constituted 70.5 million tonnes) of the world's production (FAO, 2014). The annual growth rate in production has been 7% since 1971, while the estimated growth of fish production from 2012-2013 is 5.8% (FAO, 2014). The combined effects of market growth and productivity growth have made the aquaculture industry the fastest growing animal-based food sector during the last decades (FAO, 2006; Smith et al., 2010). Today, a Salmon Farmer gets 50% of the retail value of the fish, while a Cod Fisherman gets between 10-25% (Asche & Bjørndal, 2011).

1.2. Characteristics of Salmon Farming

The purpose of this part is to give the reader insight about industry specific traits affecting Salmon Farming. In addition to giving the reader a general understanding of the industry, I later use the information presented here to formulate the hypotheses of this dissertation.

1.2.1. The Control of Supply

Salmon Farming operates with a closed production system, from cradle to grave. More control over the production increases technological innovations, decreases cost per unit[1] and thereby increases profits (Asche & Bjørndal, 2011). The degree of supply control has been a contributing factor to the success of Salmon Farming, as the supply is more predictable, adjustable according to seasonal market demand and capable of delivering a fresh product (Asche & Bjørndal, 2011).

1.2.2. The Salmon Price

Graph 1 show the historic salmon price in NOK. The average price from 1996-2016 was 29 NOK, while the Median 25 NOK, indicating there are extreme values in the price path. Currently the salmon is at a historical high at 66.2 NOK (Fish Pool, 2016). Although the long-term development in the salmon price seems stable, Oglend & Sikveland (2008) state that the salmon price, historically, has been subject to high short-term volatility. The financial situation of the salmon farming companies is largely depended upon the Salmon Price (Schmid & Helseth, 2015). It is evident that the salmon price affect profits directly. Moreover, the current salmon price plays an important role in the valuation of biological assets[2] and thereby is instrumental in the valuation of the salmon farming companies.

Graph 1

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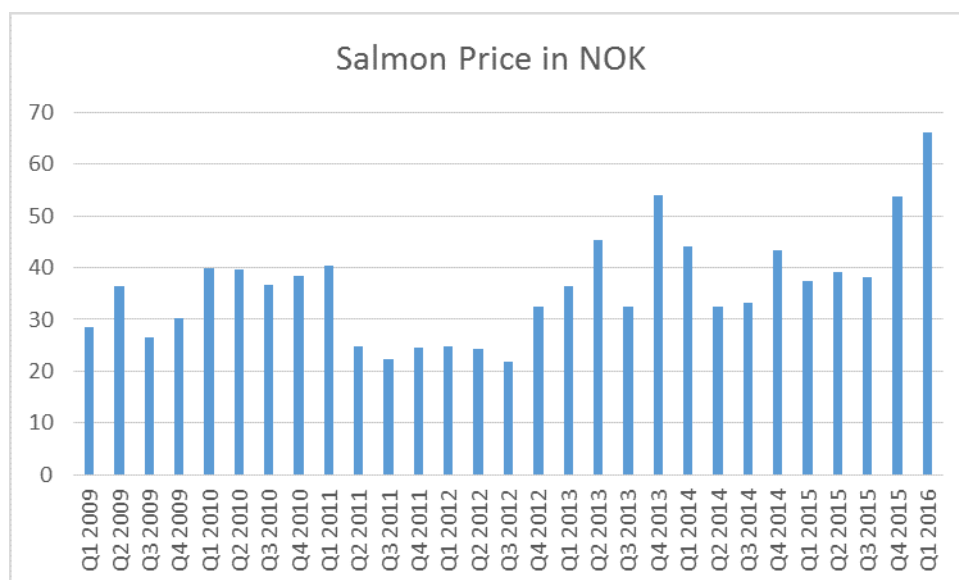
[1] Because the technological innovations allows large-scale production.
[2] As demonstrated in that section later on, 1.2.6.

1.2.3. Salmon Market

The law of one price holds for farmed salmon and wild salmon (Asche et al 1999, 2005), which means they are close substitutes. Because most farmed salmon is sold fresh and wild salmon is sold frozen, it implies that there also is a close relationship between fresh and frozen salmon (Asche & Bjørndal, 2011). Further studies suggest that there is no separate market for fresh salmon in the EU or globally (Asche & Sebulonsen, 1998; Asche, Bjørndal & Young, 2001). Even though Asche & Bjørndal (2011) state that the price of salmon supplied by Chile and Canada is not that strongly correlated with the price of Salmon supplied by Europe in the short run, they will be aligned in the long run. The Salmon Industry Handbook (2015) shows that the price development of Norwegian gutted Atlantic salmon, Chilean Atlantic salmon (Miami FOB) and fresh Atlantic salmon (FOB Seattle) is correlated, this graph is included in the Appendix IV. This thesis later exploits the fact that the market for Salmon is global and that frozen and fresh Salmon are close substitutes by applying both the Salmon Price from Fish Pool and the Miami FOB from SalmonEx.

1.2.4. Cycles of profitability

Cycles of profitability in agriculture production has been studied since Ezekiel (1938). The Salmon Farming Industry is no exception; Periods with high margin instigate overinvestment and thus drive margins down (Asche & Bjørndal, 2011). It takes approximately 3 years from the Salmon is spawned to it reaches harvestable size. Depending on seawater temperature, it varies between 14-24 months until the fish is 4-5 kg (Salmon Industry Handbook, 2015, p. 29). Asche & Sikveland (2015) find a recurrent 6 year cycle in operating earnings in the Norwegian salmon farming industry.

1.2.5. Regulations

Regulation of the Aquaculture Industry aims primarily to protect vulnerable habitats. There are regulations ensuring environmental standards are met in all countries where the Salmon Farming is present. However, there is no global regulations and each country differ in its regulation policy (Asche & Bjørndal, 2011). On the West Coast of Canada, there was a complete stop of licences from 1995-2002 effectively bringing industry growth to a halt. A licencing system is the common form of regulation, ensuring controlled growth in the industry. The licensing systems differs, Chile grants licenses at indefinite time and the owner has the right to sell it, while other countries are more restrictive. Scotland does not have licenses per say, the producer leases the site from the Crown at a time horizon of 15-20 years. Farm size is

also subject to regulation in Norway, while in Scotland it is not. Ownership regulations are present in Norway, while Scotland and Chile do not practise it.

1.2.6. Accounting Treatment of Biological Assets

Biological Assets is regulated by IAS 41 Agriculture, which has been regulating the treatment of biological assets since the implementation of IFRS 13 "measurement of fair value" in 2013 (Schmid & Helseth, 2015). Biological assets are recognized at fair value less sales expenses, both at procurement, during the growth period and at the time of slaughter. The valuation of inventory at fair value is recognized at expected sale price less remaining costs and an estimated profit at remaining growth. The measurement of living farmed fish is recognized at fair value, even though the Fish Farm industry claims that it is impossible to measure the exact weight of the fish[3]. Atlantic Salmon is ready to be sold at 4 kg; fish below this is valued as:

$$[E(revenue) - E(cost)] \; x \; \frac{actual\ weight - 1kg^4}{4kg^5 - 1kg^6}$$

In order to get consistence estimates the Salmon Price (GWE) for 4 kg and the normalized[7] cost of raising a fish of 4 kg is used. Smolt and Fish live below 1 kg are measured at cost less impairment losses, as the fair value cannot be measured reliably.

1.2.7. Antibiotics

In the late 1980's the Industry received much criticism due to its extensive use of antibiotics, since then Vaccine-programmes has been initiated and virtually eliminated the use of antibiotics in the Salmon Farming (Asche & Bjørndal, 2011). On the other hand, Chile has struggled to implement the necessary precautions in order to mitigate the issues of infectious salmon anemia (ISA), from 2005 to 2010 the production of Atlantic salmon was reduced from 400 000 tonnes to 100 000 tonnes (Asche, Hansen & Tveterås, 2009).

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[3] Before the Norwegian Ministry of Finance decided that living farmed fish should be recognized at fair value in accordance to weight and current salmon price, the industry recognized the fish at historic cost.
[4] Minimum weight for fish valued in the model
[5] Minimum weight for fish ready for slaughter
[6] Minimum weight for fish valued in the model
[7] Normalized refers to the fact that costs higher than normal for the location or region is kept outside.

1.2.8. Environmental Impact

Wild Salmon require 6-8 kg of feed to grow 1 kg (Asche & Bjørndal, 2011). It takes 2.5 kg of wild fish to produce 1 kg of salmon (The Fish Site, 2011; Asche & Bjørndal 2001). In 1999, the most efficient farmers could produce 1 kg of fish with less than 1 kg of feed (Sikveland, 2012). Farmed Salmon is also an efficient way to produce a protein rich food source with a relatively low carbon footprint, see graph 2. Compared to other sources of protein, Farmed Salmon has the greatest conversion ratio of feed into growth (Salmon Industry Handbook, 2015), as seen in graph 3. This is mainly because Salmon is cold-blooded and therefore does not use energy to heat their bodies.

Graph 2

Greenhouse gas emissions

(source:http://www.thefishsite.com/articles/1068/the-fish-feed-story)
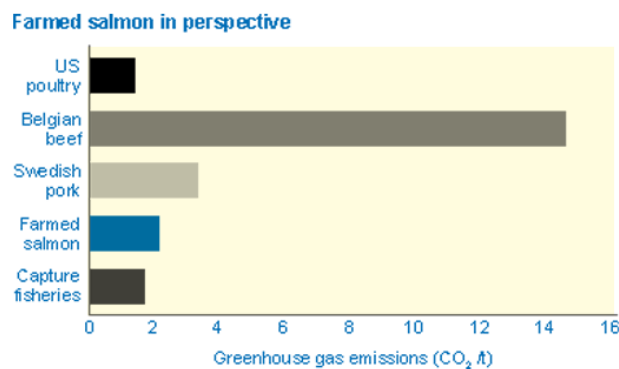
Graph 3

Conversion ratio of feed to growth

Note (1): FCR of cattle varies between 4.2 and 9.8 depending on feed (finished on cereal or grass)
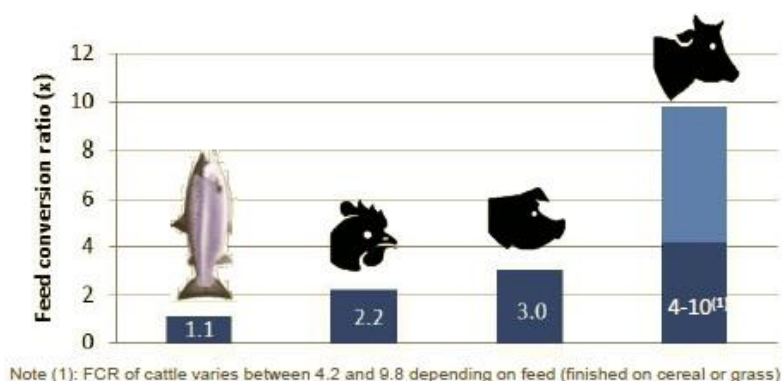
1.2.9. Sea Lice

Registration shows that the heaviest infections of wild salmon are limited to areas with a high density of salmon farms (Asche & Bjørndal, 2011). This is because high density of farmed salmon facilitates growth of sea lice and escaped farmed salmon spreads sea lice to the wild salmon. The Sea Lice problem is one of the problems that still needs to be resolved. Farmers use several methods to litigate the problem. The Farmers use cleaner fish to litigate the problem in Norway and to a lesser extent in Scotland, Shetland and Ireland (Treasurer, 2002). "Snorkel Sea Cages", where the sea cage is below the habitat in which the sea lice lives, shows more promise as a permanent remedy to the problem (Hanssen 2014).

1.2.10. Salmon Escapes

Data from the Norwegian Directorate of Fisheries shows that in recent years, there has been a decline in escaping salmon as seen in Graph 4. The main causes of salmon escapes are winter storms, propeller damage and wear and tear of equipment (Asche & Bjørndal, 2011). It is thought to be an issue with underreporting of this number, as salmon escapes are bad publicity for famers, sometimes it takes time to discover and the farmers does not have complete control over the number of fish in each sea cage (Asche & Bjørndal, 2011). Studies seem to indicate that Atlantic salmon (*Salmon Salar*) is an unsuccessful colonizer and escapees does not pose a real threat in habitats where it is not native (Thorstad et al, 2008).

Graph 4
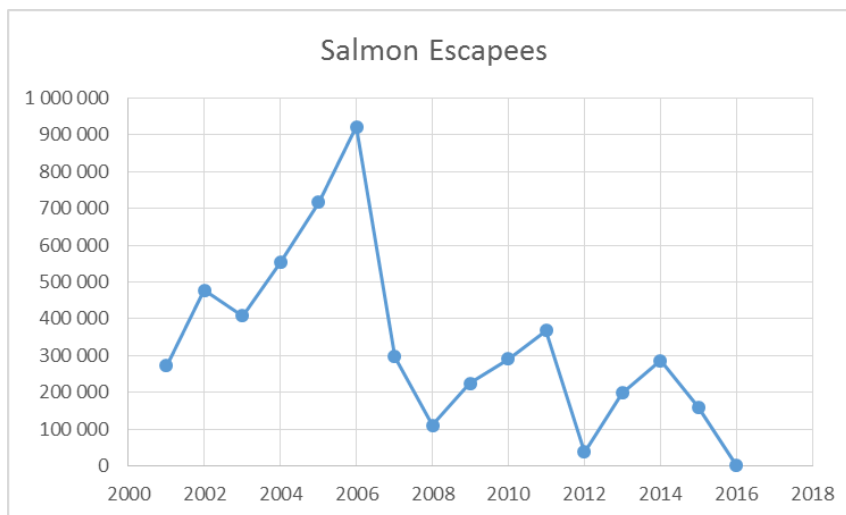
(Source: Norwegian Directorate of Fisheries)

1.2.11. Demand

In general, seafood is perceived as healthy by consumers and particularly fatty fish like Salmon and is documented to have positive health benefits (Mozaffarian & Rimm, 2006). Demand for fish products is increasing due to increasing global urbanization (FAO, 2014). Urban city dwellers devout more of their income to purchasing food and urbanization facilitates cold storage and increased quality of infrastructure, increasing the supply of fish goods (FAO, 2014). The current per capita world average consumption is 19 kg per year (FAO, 2012). The increased demand for fish products could help to reduce wastage in the industry and divert more fish to meet human consumption demand instead of becoming feed. FAO (2014) predicts that Aquaculture production and not fisheries will meet the future increasing world demand for fish products.

1.3. Political Issues

This section reviews the political issues affecting the salmon farming industry. Historically, embargos and trade restrictions has affected the Norwegian part of the industry. These political issues has been a risk factor affecting export and trade levels.

1.3.1. US trade Restrictions

The US imposed trade restrictions on Salmon produced in Norway in 1991, effectively eliminating the market for Norwegian export. These restrictions were lifted in 2012 and the Salmon Import to the US has increased the subsequent years. In 2015, it reached 37 657 tonnes (Seafood.no, 2016).

1.3.2. Quarrels with the EU

After dumping complaints in 1989, the EU initiated trade restrictions on trade with Norwegian Salmon. The quarrels with the EU was resolved in 1997 with a trade agreement, where a minimum price on Norwegian Salmon was introduced, ceiling on Norwegian exports and a 3% marketing levy on the Norwegian exports to the EU (Asche & Bjørndal, 2011). When the Salmon trade agreement expired in 2004, the Scottish farmers were quick to accuse the Norwegians of dumping again and this lead to restrictions of export. It was not resolved until 2008 when Norway took the Europeans' safeguard measures to the World Trade Organisation. After the WTO ruled in favour of Norway, Norwegian access to the European market has been less of an issue since. In 2015, the total Norwegian export to EU amounted to 793 000 tonnes (Seafood, 2016).

1.3.3. Chinese Salmon Campaign against Norway

China instigated a boycott of Norwegian Salmon in 2010, when the Nobel Institute awarded the Norwegian Peace Prize to the dissident Liu Xiaobo. Xianwen Chen[8] states in an article, in Sciencenordic[9], that Norwegian salmon has not lost market share in China, due to importers finding workarounds. Even stating that imports has been rising since 2010, following an increase in price and decrease in quality due to the workarounds (Risbråte, 2015).

1.3.4. Russian Sanctions

In August 2014, Russia effectuated an embargo of food imports, including seafood. The target of the embargo was The United States, EU, Australia, Canada and Norway. So far one of the consequences for Norwegian salmon export has been a decrease in the Herfindahl Index[10] for Norwegian salmon export, indicating that Norwegian exports has become less dependent upon big importers (Lien, 2016)[11] [12]. The trend of more diversified exports has made the salmon industry more robust to shocks from independent importing countries. Although some producers faced limited short-term costs by the export loss in Russia, they have been successful in diverting their exports to other countries (Lien, 2016). Lien (2016) presents in her article that the biggest losers of the Russian embargo were not the Salmon Producers, but the Russian middle-class consumers, who got lower purchasing power due to the fall of the Russian Rouble and also met higher prices for salmon as the supply diminished substantially.

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[8]A phD candidate, who has researched Norwegian exports to China in his doctoral dissertation

[9] Covers independent news from the Nordic Countries, in cooperation with forskning.no and videnskab.dk

[10] The index is defined as the sum of squared import share of each import country. An index value of 1 indicates that all exports were destined for one country, while the index value approach zero as number of countries exported to is increased.

[11] This follows the trend, which has been since the 1990's, of more diversified exports.

1.4. Outlook Aquaculture Industry

New development in the industry suggests that the future of aquaculture might not continue in fjords, but at the open sea as the producers are applying for permissions to initiate pilot-offshore-projects. Currently, only Salmar has obtained permit to start offshore-experimentation. However, there are 21 applications for offshore experiments under consideration at the Norwegian Directorate of Fisheries at this moment (Norwegian Directorate of Fisheries, 2016). Most notable of these are perhaps Marine Harvest's "The egg", a closed-cage offshore production facility (Berge, 2016), the offshore sea cages of Norwegian Royal Salmon and Aker (Redaksjon, 2016) or Lerøy's Pipefarm (Soltveit, 2016). If these technologic innovations are successful, the industry might finally mitigate the problem of sea lice, salmon escapes and reduce its environmental impact. On the other hand, this development might also render old competitive advantages obsolete and irreversibly revolutionize the Aquaculture Industry.

2.0. Value Relevance

According to Beisland (2009) value relevance can be described as following: "…the ability of financial statement information to capture and summarise information that determines the value of the firm." Francis & Schipper (1999) defines value relevance as the accounting information's ability to determine the value of a firm. The most common research question is whether relevant accounting information has predictive power in regards to the market value of the firm. Accounting information is value relevant if it has predictive power regarding the market value. Analysis concerning value relevant accounting information leads to an insight about what investors collectively think are value drivers of the market value (i.e. net income, book value). Aboody, Hughes & Liu (2002) draws a link between value relevance studies and the efficient market hypothesis, where they state that value relevance researchers implicitly state that the market efficiency is semi-strong, even though the market may not be so efficient in processing all of the public information.

Economists consider value relevance research as an independent field or as a part of market efficiency/fundamental analysis and valuation. Kothari (2001) divides capital market-based research into test of market efficiency, fundamental analysis and valuation and the role of accounting numbers in contracts and politics. According to Beaver (2002) the capital market-based research can be sub-categorized as such: market efficiency, Feltham-Ohlson modelling, value relevance, analysts behaviour and discretionary behaviour.

This field of research originates from the capital market-based research initiated by Ball & Brown (1968) and Beaver (1968). It was Feltham and Ohlson's revitalization of the residual income model RIV (Ohlson, 1995, 1999; Feltham & Ohlson, 1995, 1996) that provided the proper framework linking accounting figures to valuation. Consequently making it possible to link market value of equity to fundamentals, such as earnings and book value of equity. This prompted a lot of research in the field (see Beisland, 2009).

2.1. From the Dividend Discount Model to the linear price regression

$$P_t = \sum_{\tau=1}^{\infty} \frac{E_t[D_{t+\tau}]}{(1+rf)^\tau}$$

Where, P denotes the price, E indicates expected value, D is dividends paid and rf is the risk free discount rate[13]. In this simple model, only a change in expected dividends or the risk free discount rate can affect the price of the firm.

Let Earnings and Book Value of Equity be denoted:

$$E_t = earnings\ of\ the\ period\ (t-1,t)$$

$$BV_t = Book\ Value\ at\ date\ t$$

The model requires the clean surplus equation to hold[14]:

$$BV_t = BV_{t-1} + E_t - D_t$$

The current book value of equity is given by the previous year's book value plus current earnings and subtracted current dividends. This is consistent with Modigliani Miller (1961) proposition about dividend irrelevance.

The models assume that dividends reduce book value, but not earnings.

$$\frac{dB_t}{dD_t} = -1$$

$$\frac{dE_t}{dD_t} = 0$$

In the residual earnings model the abnormal earnings is important. Abnormal earnings is earnings less the cost of capital (rf) multiplied by the book value at the beginning of the period. Let abnormal earnings be denoted:

$$E_t{}^a = E_t - rfB_{t-1}$$

Applying the restriction of the clean surplus equation:

$$D_t = E_t{}^a - B_t + rfB_{t-1}$$

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[13] Assumes: risk neutral world, constant risk free rate over time
[14] The opposite, is a hidden dirty surplus, this can be remedied (however this complicates the argument)

By substituting the above expression into the original DDM equation Ohlson obtains:

$$P_t = B_t + \sum_{\tau=1}^{\infty} \frac{E_t[E^a{}_{t+\tau}]}{(1+rf)^{\tau}}$$

The expression states that the current Book Value plus the Expected Abnormal Earnings, discounted at the cost of capital, explains the current price of the firm. The model establishes the theoretical explanation for the difference between market value and book value of equity.

Ohlson (1995) expresses the former equation as a linear solution under the assumption of linear information dynamics.

(1) $$P_t = B_t + \alpha_1 E_t{}^a + \alpha_2 V_t$$

Where, V_t is the other information affecting the market value, other than the accounting information. α_1 and α_2 are given by:

$$\alpha_1 = \frac{\omega}{R_f} - \omega \geq 0$$

$$\alpha_2 = \frac{R_f}{(R_f - \omega)(R_f - \Upsilon)} > 0$$

Where ω and Υ are the persistence parameters in the $(x_t{}^a \cdot V_t)$ process[15].

2.2. The Linear Price Regression

The linear price regression[16], from the RIV framework, is central to most value-relevance-research (Beaver, 2002; Kothari, 2001; Barthe et al., 2001; Holthausen & Watts, 2001; Amir, 1993). Researchers, who study how the change in the market value of equity, is related to value creation as measured by the accounting system, applies the return regression[17]. According to Kothari & Zimmerman (1995) price models are better specified because the stock price contains the cumulative information content of both expected earnings and the surprise component of earnings. However, the current earnings does not contain any information about future earnings that is in the stock price. This leads to the price regression model having an uncorrelated omitted

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[15] The persistence parameters are fixed and known, with the restriction of not to be negative and less than one.
[16] $P = \beta_0 + \beta_1 BVS + \beta_2 EPS + \varepsilon_i$

[17] The return regression: $R = \beta_0 + \beta_1 E + \varepsilon_i$

variable that reduces the explanatory power. Price models are also often subject to heteroscedasticity.

2.3. Empirical Studies

2.3.1-3. lays the foundation for both the book value and abnormal earnings – part of the price regression model. 2.3.4. explains the proxy for size effect.

2.3.1. Abnormal Earnings

The original event study of Ball & Brown (1968) look at abnormal returns in the months before and after earnings announcement dates. They conclude that income is an informative number, explaining 50 percent or more of all the information about an individual company that is available during a year. Beaver (1968) also conclude that the information content of earnings is significant. His findings include a dramatic increase of in trade volume of stocks during the week of earnings announcements. Moreover, the magnitude of the stock price changes during the announcement week is substantially greater than the average during the non-report period. These results suggest that earnings announcement lead to a change in the probability distribution of future returns for investors, again confirming that the earnings report has information content. Ohlson (1995) defines abnormal earnings as earnings less the cost of capital multiplied by the book value at the beginning of the period. This of course implies that one must observe the cost of capital, which is not straightforward. Researchers applies earnings because it is in theory thought to be correlated with abnormal earnings, and therefore can be used as a proxy (Beisland, 2009). Dechow (1994) found, by using the Vuong-test, that earnings are more value relevant than the cash from operations and net cash flow. Biddle, Seow & Siegel (1995), Rayburn (1986) and Sloan (1996) also support the view that earnings are more value relevant than operating cash flow. However, Francis & Schipper (1999), Bradshaw & Sloan (2002) and Hodge (2003) suggest that earnings quality has decreased in recent years. Biddle, Seow & Siegel (1995) and Aharony, Falk & Yehuda (2003) suggest that value relevance of earnings compared to cash flow varies with industry affiliation. Beisland (2009) states that the most common proxy in value relevance research is net income. When regressing normal earnings on stock price, you will get the value relevance of reported earnings. This is what I am going to apply in this thesis.

2.3.2. Book Value

There is a lot of research documenting that book values are highly associated with stock prices (Ohlson & Penman, 1992; Collins, Maydew & Weiss, 1997; Deschow, Hutton & Sloan, 1998; Ayers, 1998; Barth et al, 1998; Dontoh, Radhakrishnan & Ronen, 1998). Most studies find that

the association between stock price and book value is stronger than for stock price and earnings. Value relevance of book value is however subject to bias, due to valuation principles applied to assets and debt components. Some empirical studies conducted on historic cost estimates vs. fair value estimates, show that fair value estimates are more value relevant than the former (Barth, Beaver & Landsman, 1998; Caroll, Linsmeier & Petroni, 2003). However, Khurana & Kim (2003) found that historic cost was more value relevant when there were no objective market-determined fair value measure available

2.3.3. Empirical evidence for applying both net income and book value

Barth et al (1998) find that omitting either net income or book value potentially leads to model misspecification. Deschow et al (1999) also support this view; in addition, they find that book values of equity convey additional information over earnings in explaining contemporaneous stock prices.

2.3.4. Proxy for the effect of size

Researchers most commonly use total assets and market value of equity as scale in their models (Beisland, 2009). Researchers also apply assets in different forms. Misund, Asche & Osmundsen (2007) use the year-end values of amount of oil and gas reserves as scale for market value of equity, earnings, cashflows from operations, accruals and book value of equity. In the studies of Kothari & Zimmerman (1996) and Barth, Beaver & Landsman (1992) suggest using per-share values. Although this is primarily motivated by a desire to reduce heteroscedasticity. Barth & Kallapur (1995) find that the per-share value specification does not satisfactorily control for the effect of size. Brown et al (1999) show that for accounting studies that investigate the relation between stock price and accounting variables such as EPS or BVPS, the R^2 is likely to be upwardly biased and increasing in the coefficient of variation of the scale factor. R^2 in regressions of price on EPS and BVPS are positively correlated with the cross-sectional coefficient of variation of the scale factor. Furthermore, they propose that, in order to deflate per-share values in price regressions, researchers should use lagged price as a scale proxy. I tried to setup a model on per share basis and with lagged price as a scale proxy. This model was not successful and I therefore resorted to use a model in total values and scale by an accounting figure. In this thesis, I use total assets as the proxy variable for the effect of company size in the main model. In order to determine the best proxy variable for scaling of the model I use the Vuong-test to test total assets, biological assets, harvest volumes, intangible assets and PPE.

2.4. The Role of R^2 as metric of Value Relevance

R^2 is the common metric of value relevance research. That is because the R^2, or the explanatory power, easily translates into a measure of value relevance. This is evident when stock prices are regressed on accounting variables. Researchers often use the R^2 to examine if an accounting figure or other variables are value relevant. Researchers also use it when they want to rank the value-relevancy of different variables. There are pitfalls with using this as a metric as Brown, Lo & Lys (1999) state that price regressions might be inflated due to scale effects[18]. I use R^2 extensively throughout the work with the model.

2.5. The Vuong-test

In addition, to using R^2 as a determinant of value relevance, I also use the Vuong's closeness test in order to decide which variables to include in the model (See econometric part for more about this). Dechow (1994) determined that earnings are more value relevant than cash from operations and net cash flow, by using the Vuong-test. Eccher & Healy (2000) use the Vuong test to determine the difference of explanatory power before and after IFRS was introduced to China. Wu, Koo & Kao (2005) employ the Vuong-test to find which reporting model provides more explanatory power. Misund & Osmundsen (2007) applied the Vuong-test in order to determine whether certain accounting measures are significantly more value-relevant than others.

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[18] Elaborated in 2.3.4. Proxy for the size effect paragraph

3.0. Econometrics

This chapter will explain econometrical method and issues dealt with in this thesis.

3.1. Regression analysis

Regression analysis is a statistical technique used to derive an equation that relates a single criterion variable to one or more predictor variables (Iacobucci & Churchill, 2015). For simplicity, I only use the term dependent and independent variable throughout this thesis. The dependent variable is defined as a variable whose value is determined by the value of an independent variable (The American Heritage Science Dictionary, 2016).

3.2. The linear regression model

Let the simple linear regression (SLRM) be defined as:

$$Y_i = \beta_0 + \beta_1 X_i + \varepsilon_i$$

Where Y represents the dependent variable and "i" denothes the i'th observation. β_0 is the population Y's intercept (predicts the value of Y when X equals zero) and β_1 is the slope coefficient of the independent variable X_i (indicates value of Y when X increases by one unit) these two represent the linear component of the regression model. ε_i represents the random error term component (what is not explained by the independent variable X_i, also known as unobserved by the model).

The bivariate linear regression is a linear regression with only one independent variable. This regression might test a hypothesis of association (there is no association between the variables). However, it cannot determine causality.

3.3. The multiple linear regression model

Let the multiple linear regression model (MLRM) be expressed as:

$$Y_i = \beta_0 + \beta_1 X_{1i} + \beta_n X_{ni} + \varepsilon_i$$

Where, "n" is any number of variables, "i" is number of observations, ε is the error term, β_1 is the slope coefficient of X_{1i} and β_0 is the intercept. The coefficient β_1 shows the percentage change in Y, when changing X_1 by one unit, while $(X_{2i},…,X_{ni})$ are held constant. The intercept β_0 is the expected value of Y when all the independent variables equals zero.

The multiple linear regression model is different from the SLRM by the fact that it incorporates more than one independent variable. In addition to describing the linear relationships between variables the MLRM can also describe a non-linear relationship (exponential etc.). The MLRM

shows the effect of the change in one independent variable X_{li} has on the dependent variable Y, while the other independent variables $(X_{2i},..,X_{ni})$ are held constant. This is possible because multiple regression analysis considers the changes of $(X_{2i},..,X_{ni})$ when estimating X_{li}.

3.5. Ordinary Least Squares (OLS)

Ordinary Least Squares is a method for estimating the parameters of a multiple linear regression model. The ordinary least squares estimates are obtained by minimising the sum of squared residuals (Wooldridge 2014). Visually seen as the difference between the sum of the vertical distances between each point of data in the set and the corresponding point on the regression line (the smaller the differences, the better the model fits the data). The technique calculates regression coefficients such that the line of regression is as close as possible to the observed data. The difference between the observed data is measured by the sum of squared residuals by estimating Y given X.

3.6. Important assumptions OLS

Woolridge (2014, p. 56-94) presents this list of assumptions, which if satisfied, will yield the best linear unbiased estimators of the true parameters:

- Assumption 1: Linear in parameters. The dependent variable is a function consisting of a number of independent variables and an error term.
- Assumption 2: Random Sampling. The sample is a random sample of n observations, $\{(X_{1i},…,X_{ki}, y_i): i = 1,2, …,n\}$, following the population model in assumption 1.
- Assumption 3: No perfect collinearity. None of the independent variables is constant, and there are no exact linear relationship among the independent variables. They can be correlated, but not perfectly correlated.
- Assumption 4: Zero conditional mean. The error u has an expected value of zero given any values of the independent variables. $E(u|x_1, x_2 … , x_k) = 0$. This can happen if the functional relationship between the explained and the explanatory variables is misspecified (quadtric term for one explanatory variable for example). Omitting an important factor that is correlated with any of $x_1, x_2 … , x_k$, such that assumption four fails.
- If these four assumptions holds the OLS estimators are unbiased estimators of the population parameters $E(\hat{\beta}_j) = \beta_j, j = 0,1, … , k$.
- Assumption 5 Homoscedasticity. The error u has the same variance given any value of the explanatory variables. Var $(u|x_1, …,x_k) = \sigma^2$.

- If assumptions 1-5 are satisfied, the estimated estimators are the best linear unbiased estimator of the true parameters, Gauss-Markov Theorem.
- No serial correlation. $Corr(U_t, U_s)$, for all $t \neq s$

3.7. Violation of the OLS assumptions

3.7.1. Omitted variable bias

Omitted variable bias arises in the OLS estimators when a relevant variable is omitted from the regression. Sometimes variables are omitted because they are not directly observable; in that case, the normal fix is to include a variable that is highly correlated with the omitted variable, such that the correlation between the independent variables and the error term is reduced. Researchers use relevant theory[19], t-testing and adjusted R^2 to decide if an explanatory variable has explanatory power and therefore should be included in the model. I decided which variables to include in the final model by using relevant theory, R^2 and the Vuong test.

3.7.2. Functional form

The RIV-model of Ohlson (1995) is the basis for this thesis, where the functional form is linear. As discussed in the Value Relevance chapter there is a choice between level model and the return model. The level model best addresses the purpose of this thesis, as this explains the value relevance of the accounting figures.

3.7.3. Multicollinearity

Multicollinearity is the correlation between independent variables. The term perfect multicollinearity refers to a perfect correlation between two variables (Woolridge, 2014), it is only then it violates the underlying assumptions of the OLS. I checked for perfect multicollinearity by looking at the correlation between the independent variables, there was none (table 1).

3.7.4. Autocorrelation

Autocorrelation or serial correlation is correlation between the errors in different time periods and therefore violates the assumption that $Corr(U_t, U_s)$, for all $t \neq s$. I use The Wooldridge test for autocorrelation in panel data Wooldridge (2002) and Drukker (2003) to test for autocorrelation in the model.

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[19] The relevant theory in this thesis refers to the literature in the Value Relevance research.

3.7.5. Heteroscedasticity

Heteroscedasticity is where the variance of the error term, given the explanatory variables, is not constant. I use the statistical software program Stata to conduct heteroscedasticity test of the main model. The test I use applies both Breusch-Pagan (1979) and Cook-Weisberg (1983) -test for heteroscedasticity.

3.7.6. Adjusting the t-values for the presence of Autocorrelation and Heteroscedasticity

Both of the preceding tests reject the null hypothesis; these results indicates that the model might be affected autocorrelation and heteroscedasticity. I therefore estimate a model using Newey-West standard errors (Newey & West, 1994). The estimated t-values does not significantly change and I therefore conclude that the autocorrelation and heteroscedasticity is not a problem for the model. The output from estimating the Newey-West model is in Appendix VI.

3.8. Time series data

Time series data is a dataset that contains sample data collected at different points of time. It is often subject to temporal correlation between the variables, since one assumes that a variable is affected by the time it exists in (Woolridge, 2014). Therefore, it needs to be explicitly stated assumptions about how the errors are related to the explanatory variables in all time periods and about the temporal correlation in the errors themselves (Woolridge, 2014).

3.9. Panel data

Panel data, or cross-sectional time-series data, is a dataset that contains a variable indicating a particular property of the collected data, which help to observe the behaviour of the entities across time. Such entities might be companies, countries or individuals etc. One can apply panel data when collecting data from individual firms in order to find common factors for the whole industry. By using panel data one can increase the number of observations in an otherwise limited dataset (in terms of time or few observations). Each variable for the entity controls for fixed or random effects associated with that individual entity, thus leaving only the pure effect of the independent variable. The dataset in this thesis is a panel dataset with company as the indicating property variable.

It is common in a panel dataset that there is an imbalance between observed variables for each entity, leading to an unbalanced dataset. Missing Data is categorized into three groups: Missing completely at random, independent both of observable variables and of unobservable parameters of interest and occur entirely at random. Randomly missing data occurs when the

lack of data is not random, but where lack of data can be fully accounted for by variables where there is complete information. Non-randomly missing data, the data is missing because of some inherent quality of the data. Missing completely at random is often a strong assumption. Data that is missing completely at random or is randomly missing does not by itself induce a bias, however if the data is not missing at random, there will be a bias in the data (Woolridge, 2014).

3.10. Approximation

In Econometrics, one differentiates between the true model and the estimated model. The true model is unobserved, has perfect fit and an error term that equals zero. Difficulties in obtaining the data needed for the true model, means that one must use proxies instead of the real data. For example: intelligence is an unobserved variable that is hard to measure, however one can use IQ-scores as a proxy for intelligence. By using a proxy for a variable one does not use the real data and the coefficient of the variable thus becomes an estimated one. This thesis deals with several unobservable variables; abnormal earnings, other value relevant information and company size.

The closer the estimated Y-variable is to the true unobserved Y-variable the greater the fit of the model, which in turn can describe the error term as: $e_i = Y_i - \hat{Y}_i$.

3.11. Goodness of fit[20]

R^2, the coefficient of determination, indicates how well the data fit a statistical model. An R^2 of one indicates that the regression line perfectly fits the data, while an R^2 of zero indicates it does not fit at all.

$$R^2 \equiv \frac{SSE}{SST}$$

Where total sum of squares SST measures the total sample variation in the y_i as such:

$$SST = \sum_{i=1}^{n}(y_i - \bar{y})^2$$

SSE measures the sample variation in $\bar{y}_i$. The explained sum of squares

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[20] For Goodness of Fit as a coefficient of determination, see 2.4.

$$SSE = \sum_{i=1}^{n} (\hat{y}_i - \bar{y})^2$$

Given these definitions, one can see that R^2 is a ratio of the explained variation compared to the total variation. It is the fraction of the sample variation in the dependent variable that is explained by the independent variable. The R^2 will always increase when one more variable is added to the regression. It is for that reason common to adjust R^2 for degrees of freedom, (N-1). The common notation for adjusted R^2 is $\bar{R}^2$.

3.12. Hypotheses tests

A hypothesis test takes the form of a statement of the true value for a coefficient or an expression involving the coefficient. The null hypothesis is the hypothesis being tested, H_0. The alternative hypothesis is the opposite of the null, H_A. If the H_0: $\beta_1 = 1$, then the H_A: $\beta_1 \neq 1$. Rejecting the null does not imply accepting the alternative hypothesis; it just means we cannot prove that H_0 is true. Two types of error may occur; Researcher might reject the null hypothesis when it is true (Type I) or they might not reject the null, when it is false (Type 2) (Iacobucci & Churchill, 2015). The significance level relates to the probability of making a Type I error. Type II errors relates to the effect size, the difference between the assumed value under the null hypothesis and the true unknown value (Iacobucci & Churchill, 2015). The selection of significance level is predetermined before the analysis. In this thesis, a significance level of 10% is chosen. This means that a p-value of 0.10 or lower is required to reject the null.

3.13. F- test

Tests whether a group of variables has no effect on the dependent variable. The H_0 is that the independent variables does not have a joint significance on the dependent variable (Woolridge, 2014). The common interpretation is that it tests whether something is going on in the model or not.

3.14. Model Selection; the Vuong test

Vuong closeness test is a likelihood-ratio-based test for model selection using the Kullback-Leibler information criterion. The test is primarily for non-nested models. Nonnested model is a model where no model can be written as a special case of the other by imposing restrictions on the parameters (Wooldridge, 2014). Vuong (1989) defines a model G_y to be nested in a model F_θ by : "G_y is nested in F_θ if and if G_y is part of F_θ. The AIC and BIC approach are more common with nested models. The null hypothesis of the test is that the two models are equally close to the true data generating process, against the alternative hypothesis that one model is closer. The model does not state that the "closer" model is the true model. The Vuong Z-statistic is directional. A significant and positive Z-statistic indicate that model 1 is preferred to model 2. Conversely, a significant and negative Z-statistic indicate that model 2 is preferred to model 1. The Voung test requires an equal amount of observed data on every variable for every company included in the dataset. This limitation is problematic in an unbalanced panel-dataset. In order to perform several of the tests in this thesis, I need to reduce the data set, both in terms of number of time periods and number of companies included. I perform the tests on basis of how much coherent data I have available. The Vuong-test is instrumental in the selection of the proxy for size in the scaling of the models, choice of abnormal earnings proxy and proxy for other information. An example: For abnormal earnings several models are estimated with only the proxy for abnormal earnings being the difference, in that way the Vuong-test will indirectly test which variable is the better proxy for abnormal earnings.

Part II; Methodology

4.0. Methodology

This Section contains the formulation of the hypotheses and research design. Moreover, it explains how I obtain the data and describes the samples I use to run the regressions in the last part of the thesis.

4.1. Formulating the Hypothesis

4.1.1. First model

I want to establish that the RIV-framework is applicable in the aquaculture industry. This entails that book value, abnormal earnings and "other value relevant information" are independent variables of the dependent variable market value of equity, as the RIV-framework predicts (Ohlson, 1995, 1999; Feltham & Ohlson, 1995, 1996). I will do this by regressing a traditional price level regression with the data obtained from the aquaculture industry. The null will be that the value relevance theory is not applicable, meaning that evidence proving value relevance theory is applicable in the aquaculture industry, must be presented. The null is rejected if the independent variables, book value, net income and the salmon price does have a joint significance, the coefficients is as predicted by value relevance theory and, in order to be relevant, the model needs a minimum of goodness of fit[21].

H_0: The RIV-framework cannot be used for the Aquaculture Industry.

H_A: The RIV-framework is appropriate for the Aquaculture Industry

4.1.2. Model Scale

In Value Relevance Research, the scaling of the model is important to remove the effect of the company's size. As seen in the literature review there is a lot of option for this proxy. Biological assets are inspired by the research of Misund et al (2007), where they use year-end gas reserve, as a proxy for company size, in the Oil and Gas industry. I discuss the correlation between intangible assets and PPE in the subsequent part about correlation. The Vuong-test will also provide results on which one of these variables are preferred. Harvest volumes is an interesting scale with the regards to it not being a monetary figure. The most common proxy for size effect in value relevance research is total assets (Beisland, 2009).The null hypothesis is consequently that total assets is the best scale in the Aquaculture Industry. I will reject the null hypothesis if

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[21] I consider a R^2 of more than 5% to be sufficient for this.

the Vuong-test provides substantial evidence against it. This rejection will require the Vuong Z-statistic to be negative and at least statistically significant at a 10 per cent level.

H_0: Total Assets is the best scale for the model

H_A: Intangible Assets, PPE, Biological Assets, Harvest Volumes (GWE) or Biomass (LWT) is the best scale.

4.1.3. Abnormal Earnings

Abnormal earnings is a variable that is not observable. It is common to use some form of earnings as a proxy. I formulate the hypothesis with the null hypothesis stating that net income is the best proxy for abnormal earnings, because it is the most common proxy in research (Beisland, 2009). The alternative hypothesis states that earnings before interest and tax (EBIT), earnings before interest, tax, depreciation and amortization (EBITDA) and Disaggregated Earnings (Cash flow from operation and Accruals) are better proxies than net income. I require a negative Vuong Z-statistic, statistically significant at a 90 per cent confidence level, in order to reject the null hypothesis.

H_0: Net Income is the best proxy for Abnormal Earnings

H_A: EBIT, EBITDA or Disaggregated Earnings (CFO+Accruals) are better options.

4.1.4. Other value relevant information

There are no preliminary Value Relevance Research done on the Aquaculture Industry. Consequently, I need to ascertain which variables are suitable candidates for the other information part of the equation. The salmon price evidently affects the aquaculture companies, as presented in the aquaculture chapter. The development of certain types of assets might be value relevant to an investor. For that reason, I include biological assets, PPE and intangible assets. The production volume of the companies is a unit of interest to investors; therefore, I include the non-monetary unit harvest volumes (GW). The variables are viable candidates if they yield statistical significant coefficients and present a logical interpretable coefficient. Biological assets, biomass in sea, PPE and harvest volumes are variables that should, ceteris paribus, have a positive correlation with market value of equity. The correlation between intangible assets and market value of equity is a bit more complicated as intangible assets, can be interpreted as percentage of assets being intangible. This interpretation can also be reversed:

$$1 - \frac{intagible\ assets}{total\ assets} = \frac{tangible\ assets}{total\ assets}$$

I would expect an investor to appreciate an increase in the tangible assets ratio instead of intangible assets. For the reason that an increase in a tangible assets ratio would entail an increase of assets, that is easier to value. It is reasonable to predict that the tangible assets ratio is positively correlated with market value of equity. Consequently, I predict that intangible assets will have a negative correlation with market value of equity. The variables are accepted as value relevant if they are statistical significant at a 90 per cent confidence level.

The Vuong-test of other information

In other industries, price of the underlying commodity has proven successful as a proxy. In addition, it is logical that the Salmon Price affects the Aquaculture Companies, as discussed in 1.2.2. the salmon Price[22]. Since I have no better alternative I formulate the hypothesis test against the null that the salmon price is the best proxy for other information. The null is rejected if the Vuong-test provides sufficient evidence against it. Sufficient evidence would entail a negative Vuong-Z-statistic, which is statistically significant at a 90% confidence level.

H_0: The Salmon Price is the best single proxy for "Other Information".

H_A: Intangible Assets, PPE, Biological Assets, Harvest Volumes (GWT) or Biomass (LWT) is a better proxy for "other information".

4.2.1. Research design

The main design for this thesis is regression analysis by using panel data. By the means of quantitative analysis, I can transform numerical relations, where the results can be generalized to the population of interest. I hope to generalize my results to the Aquaculture Industry by using the sample I have obtained. The metric of interest is the sign of the coefficient, not the size, and whether the variables are statistically significant. More information about the variables are found in Appendix I.

4.2.2. The First Model

The first goal of this thesis is to establish that the RIV-framework is applicable in the Aquaculture Industry. The basis for this part is the simple price regression presented in 2.2 linear price regression. The equation (1) states that the price of company "j" is explained by the book value and abnormal earnings of firm "j" and other value relevant information affecting firm "j", "t" refers to the time the variable is available to investors. This equation is the

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[22] Additionally, the results of the Vuong-test for the Salmon Price and currency choices are in Appendix V.

theoretical background for the model I use to test the hypotheses. When estimating the model I use the price regression in total value (equation 2). This simplification does not alter the result or interpretation of the result; it only removes number of outstanding shares from the equation.

(1)
$$P_{jt} = B_{jt} + \alpha_1 E_{jt}{}^a + \alpha_2 V_{jt}$$

I estimate the price regression in total value[23], such that:

(2)
$$MVE_{jt} = BV_{jt} + \alpha_1 E_{jt}{}^a + \alpha_2 V_{jt}$$

4.2.3. The Vuong-tests

The Second part of the thesis tests alternative variables to those I use in the first part, abnormal earnings proxy, "other information"-proxy and the model-scale variable. I do this by constructing alternative models and performing Vuong's closeness test. These models are price regression models in total value. The samples I use to perform the Vuong-test needs to be without missing observations on any of the variables. For that reason, I need to apply different samples for these Vuong-tests.

4.2.4. Scale of the model

I use the Vuong-test in order to ascertain which variable is the best proxy for size and thereby scale the model. I do this by estimating the models:

(3)
$$\frac{MVE_{jt}}{Scale_{jt}} = \frac{BV_{jt}}{Scale_{jt}} + \frac{E_{jt}{}^a}{Scale_{jt}} + SalmonPrice_t$$

Where, scale is substituted by total assets, biological assets, harvest volumes (GW), intangible assets and property, plant & equipment. "j" refers to firm specific variable, "t" refers to the time, when the information is available to investors.

4.2.5. Abnormal Earnings Proxy

I ascertain the proxy for abnormal earnings with the same methodology:

(4)
$$MVE_{jt} = BV_{jt} + E_{jt}{}^a + SalmonPrice_t$$

Where, the scale of the variables is total assets, the term $E_t{}^a$ is substituted by Net Income, EBIT, EBITDA and CFO & Accruals.

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[23] $P_j \; x \; outstanding \; shares = Market \; Value \; of \; Equity$

4.2.6. Other value relevant information

Before I perform the Vuong-test for other information, I ascertain which variables are value relevant by regressing models with the different proxies for "other information". I accept the variables as value relevant if they are statistical significant at a 90 per cent confidence level.

I estimate the models I use for performing the Vuong-tests of the "other information"-bracket as follows:

(5) $$MVE_{jt} = BV_{jt} + Net\ Income_{jt} + V_{jt}$$

Where, V_{jt} is substituted for salmon price, biological assets, harvested volumes (GW), intangible assets and property, plant & equipment. Total assets scale the models.

4.3. The Dataset

There are no preliminary studies in the field on this industry; I therefore constructed this dataset myself with data from Datastream and by going through quarterly financial reports. The dataset consists of 12 publically traded international aquaculture companies[24]. The majority of companies has data ranging from 2009-2016. I use a quarterly time interval to obtain more observations, because most part of the firms are listed a relatively short time ago. The 12 companies in the dataset, constituted in 2014 50% of the world's production of harvested farmed fish (Salmon Industry Handbook 2015). The sample is the largest sample possible to obtain, because the remainder of the industry is either not publically traded or too small and difficult to obtain data for. There is more information about the companies in Appendix II.

4.4. Data Collection

I use Datastream[25] to obtain the data on the following variables: Market value of equity, book value of equity, net income, EBIT, EBITDA and cashflow from operations. Historical Norwegian Salmon Prices are from Fish pool (2016). The Chilean Salmon Prices are from SalmonEx[26]. I obtain the data for Harvested fish volumes, Biological Assets and Biomass at Sea by going through quarterly reports. Historical exchange rates, used to convert monetary values from quarterly reports, are from Oanda. The observations range from Q1 2009 – Q1 2016. Although some companies are listed after 2009.

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[24] The companies in question are: Marine Harvest, Salmar, Lerøy, Grieg Seafood, Norway Royal Salmon, Empresas AquaChile, CIA Pesquera los fiordos, Blumar. Australis Seafood, Scottish Salmon Company, Austevoll and Bakkafrost.

[25] Datastream is database containing financial information about companies and markets.

[26] It is the Miami FOB salmon price, given by Javier Pero at SalmonEx.

4.5. Organization of data

 I organize the data according to company and time. First is all the observations of company 1, then all of the observations of company 2, and so on. This organization is the standard setup for panel data. Accounting information is available to investors at the date it is reported, therefore the accounting information is "lagged" to when it was available to investors in order for it be coherent with the market value. This natural time lag, leads market value in quarter t to be explained by accounting information reported at t-1.

4.6. Multicollinearity: correlation between independent variables

Table 1 display the correlations between the variables. A common rule of thumb states that multicollinearity is a problem if the correlation exceeds 0.60. Variables that are based on the same accounting information such as Biomass in Sea and Biological Assets or EBIT and EBITDA should be correlated. Market Value of Equity and Book Value of Equity is often highly correlated and is not problematic[27]. The correlation matrix confirms this as Biological Assets and Biomass in Sea has a correlation of (0.73) and EBIT and EBITDA has a correlation of (0.98). These variables will not appear in a model together. Intangible assets and property, plant & equipment has a correlation of (-0.8). The negative correlation between intangible assets and PPE is not surprising as PPE could be described as a tangible asset. It might be problematic that Cash flow from operating activities and Accruals are correlated at this level, as they are a part of Disaggregated Earnings.

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[27] Multicollinearity is only between independent variables.

Table 1

Correlation Matrix

Correlation	MV	BV	NI	Salmon	BA	HA	BIO	CFO	ACC	EBIT	EBITDA	IA
MV	-											
BV	0.80	-										
NI	0.47	0.50	-									
Salmon	0.43	0.17	0.33	-								
BA	-0.21	-0.29	0.03	-0.06	-							
HA	0.14	0.30	-0.04	0.17	0.28	-						
BIO	-0.16	-0.28	-0.19	0.04	0.73	0.52	-					
CFO	0.26	0.30	0.06	-0.02	-0.20	-0.17	-0.50	-				
ACC	0.06	-0.01	-0.47	-0.28	-0.05	0.06	-0.10	0.63	-			
EBIT	0.18	0.27	0.55	0.33	-0.17	-0.27	-0.42	0.36	-0.48	-		
EBITDA	0.19	0.25	0.46	0.34	-0.20	-0.25	-0.45	0.44	-0.38	0.98	-	
IA	-0.70	-0.42	-0.35	-0.37	-0.34	-0.30	-0,33	-0.35	-0.01	0.05	0.07	-
PPE	0.44	0.25	0.03	0.30	0.36	0.47	0.51	0.19	0.14	-0.23	-0.22	-0.81

Variables definitions (total assets scale all variables, except salmon): MV is market value of equity end of quarter, scaled by the lagged total assets. BV is book value of equity. NI is reported net income. Salmon refers to the Salmon Price, both the Norwegian and Miami FOB. BA is biological assets. HA is harvested volume of fish (gutted weight). BIO is biomass at sea (tonnes). CFO is cash from operations. ACC is accruals (net income – cfo). EBIT is earning before tax and interest. EBITDA is earnings before tax, interest, depreciation and amortization. IA is intangible assets. PPE is property, plant & equipment.

4.7.1. The sample of the first model

The first model use all the data available in the dataset. Table 2 shows the descriptive statistics of the variables[28] I use in the estimated model in part 1. It includes 12 international aquaculture companies[29]. The observations span from Q1 2009 – Q1 2016. The sample is unbalanced, due to later listings of some of the companies and randomly missing data. Market value, book value, total assets and net income are in million USD. To control for the effect of company size total assets scale market value, book value and net income. Salmon NOK is the salmon price obtained from fishpool.eu, while salmon Miami is the salmon price from SalmonEx (in USD). They both constitute the variable salmon price.

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[28] More information about the specific variables are found in Appendix I

[29] More information about the companies are found in Appendix II

Table 2

Descriptive statistics main sample

	Observations	Average	Median	Std	Min	Max
Market Value	270	889.6	421.5	1100	36.95	6002
Book Value	258	538.6	314.4	575	19.250	2739.4
Net Income	266	16.2	7	33.78	- 106.5	217.2
Salmon NOK	29	36.1	36.6	12.05	21.78	66.19
Salmon Miami	17	4.27	4.08	2.23	3.16	5.41
Total Assets	267	1100	639.3	1171	111.5	5661.4

4.7.2. Vuong-test samples

Table 3 sums up the information about the different samples I use to perform the Vuong-tests. The samples are restricted because the Vuong –tests, I use in the second part, require an equal number of observations per variable for every company in the sample. The samples I use in the Vuong-test are the largest obtainable under this restriction. The model-scale variable sample spans from Q2 2011 – Q1 2016, quarterly time interval and includes six companies. The abnormal earnings proxy sample spans from Q3 2007 – Q1 2016, quarterly time interval and includes four companies. The sample for other-information proxy, spans from Q2 2011 – Q1 2016, quarterly time interval and includes six companies.

Table 3

Descriptive statistics the Vuong-tests samples

Sample	Time Interval	Time Period	Companies
Model-Scale Variable	Quarterly	Q2 2011 – Q1 2016	Marine Harvest, Salmar, Lerøy, Grieg Seafood, Norwegian Royal Salmon and Bakkafrost
Abnormal Earnings Proxy	Quarterly	Q3 2007 – Q1 2016	Marine Harvest, Salmar, Lerøy and Grieg
Other-information Proxy	Quarterly	Q2 2011 – Q1 2016	Marine Harvest, Salmar, Lerøy, Grieg Seafood, Norwegian Royal Salmon and Bakkafrost

Part III

5.0 Results

The following section contains the chronological results from testing the hypotheses derived in the previous chapter. This part is divided into establishing value relevance theory in the aquaculture industry and the tests of variables I use as scale and proxy for abnormal earnings and other value relevant information. Sample descriptions, model specifications, research design and the hypotheses are in the Methodology-chapter, while further discussions about the results are in the subsequent chapter Discussion and Conclusion.

5.1. The First Part; Applying Value Relevance Theory

Table 4 shows the results from the estimated model. I expect the coefficient of book value to be positive and that the variable is statistically significant at minimum a 10% level, in accordance with theory reviewed in the value relevance chapter[30]. Abnormal earnings should have a positive coefficient and be statistically significant at a 10 percent level[31]. I propose on basis of the discussion in 1.2.2 the salmon price, that the salmon price is an independent variable of the market value of equity. I expect the coefficient of this variable to be positive, as the salmon price increases the market value of equity of salmon companies increases, due to the effects of both increased profits and increased value of assets[32]. The results of the estimated model are in accordance with what value relevance theory predicts, as the coeffcients all have the expected values. A high R^2 (0.4327) and a statistical significance at a 99 per cent confidence level in both the joint significant test and of the independent variables are good indicators that the model is successful. An increase in the book value of equity, net income or the salmon price will, ceteris paribus, increase the market value of equity of aquaculture companies. The results of the estimated model is in accordance with what value relevance research predicts. I reject the null-hypothesis, meaning that I cannot say that Value Relevance theory is not applicable for aquaculture companies.

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[30] In Accordance with Ohlson & Penman (1992); Collins, Maydew & Weiss (1997); Deschow, Hutton & Sloan (1998); Ayers (1998); Barth, Beaver & Landsman (1998); Dontoh, Radhakrishnan & Ronen (1998); Beisland (2009) and more.
[31] In accordance with: Ball & Brown (1968); Beaver (1968); Barth, Beaver & Landsmann (1998); Deschow, Hutton & Sloan (1999); Beisland (2009) and more.
[32] As shown in 1.2.2. and 1.2.6.

Table 4

Regression Results from the Estimated Model

Variable	Coefficient	P-value	
Intercept	-0.00064	0	
Book Value	0.00267	0	
Net Income	0.00225	0.007	
Salmon Price	4.82e-06	0.001	
R-squared adjusted			0.4327
Joint Significance (p-value)			0
Number of Observations			267

The model is estimated as: $MVE_{jt} = BV_{jt} + NI_{jt} + Salmonprice_t$. Total assets scale the model.

5.2. The Second Part; Selection of variables for the model

5.2.1. Scale

The variables affected by company size, needs to be scaled by a variable correlated with company size, in order to mitigate its effects. The following part is about the selection of this proxy.

Total assets is the most common scale to use in value relevance theory (Beisland, 2009), therefore I expect this variable to be the best fit. A high positive Vuong Z-statistic, suggests that the first model is preferred over the second. Conversely, a negative Z-statistic suggests the opposite. Therefore, I expect the model containing total assets to show a positive, highly significant, Vuong Z-statistic against the other models. In Table 5, the first models are in the vertical column and the second models are in the horizontal column. Table 5 show the Vuong-test-statics is significant and highly positive for total assets against all the other options. The Vuong-test results strongly indicates that total assets is preferred as the proxy for company size in the model. I consequently fail to reject the null, that total assets is the best proxy for company size. Biological assets is the second best alternative to total assets, as the Vuong-test prefers it to the rest of the variables. The test also prefers PPE to intangible assets. Harvest volume is the least preferred choice of scale according to the results. The strong rejection of this variable might be due to the fact that it is the only non-monetary scale variable.

Table 5

Vuong-test Scale results

	Biological Assets	Harvested Volumes	Intangible Assets	Property, Plant & Equipment
Total Assets	39.73***	93 ***	14.58 ***	29.73 ***
Biological Assets		59.1***	3.563 ***	3.792 ***
Harvested Volumes			-18.33 ***	-33.86 ***
Intangible Assets				-0.901 ***

The table is read from the vertical column. For example: 39.73 indicates a Vuong Z-statics of 39.73 in favour of the model containing total assets against the model containing biological assets. *** represents a confidence level at 99 per cent. I perform the test by scaling $MVE_{jt} + BV_{jt} + NI_{jt}$ by the variables: Total assets, biological assets, harvested volumes of fish, intangible assets and property, plant and equipment. I did not have enough observations of biomass in sea (LWT) to include it in the test.

5.2.2. Abnormal Earnings Proxy

Abnormal earnings is not directly observable; therefore, I need to find a proxy for this part of the equation. This part presents the results from the Vuong-test that I use to ascertain which variable is the best proxy for abnormal earnings.

Table 6 displays the Vuong-test results. I presented, in the value-relevance-theory-review 2.3.1., that net income is the most common proxy for abnormal earnings. Some researchers use disaggregated earnings in situations where normal earnings does not perform well. The model using net income as proxy for abnormal earnings is preferred by the Vuong-test compared to all the alternatives, except for disaggregated earnings, where it is inconclusive. This result might be in line with the notion of net income and disaggregated earnings' interchangeability. The test shows that net income and disaggregated earnings are more value relevant than EBIT and EBITDA. The Vuong-test does not provide sufficient evidence to reject the null, that net income is a better proxy for abnormal earnings than EBIT, EBITDA and disaggregated earnings. The results are in line with previous research in the field (Deschow 1994; Biddle et al 1995; Rayburn 1986; Sloan 1996).

Table 6

Vuong-test Abnormal Earnings proxy

	EBIT	EBITDA	CFO + ACC
Net Income	1.282*	1.325 *	- 1.055
EBIT		0.715	-1.570*
EBITDA			-1.623*

The table is read from the vertical column. 1.282 is a positive Vuong Z-statistic for the model containing net income against the model containing EBIT. * refers to a confidence level at 90 per cent.

5.2.3. The other value relevant information proxy

Firstly, I establish that the variables are value relevant and afterwards I perform the Vuong-test in order to ascertain which variables are the best proxy for other information.

Table 7 presents the results from regressions with different proxies for other information. The salmon price, biological assets, intangible assets and biomass in sea are statistical significant at a 99 per cent confidence level, PPE is statistical significant at a 95 per cent confidence level and harvest volumes is statistical significant at 90 per cent confidence level. They all present decent adjusted R^2 as they are between 0.4 and 0.5. The variables differ in the quantity of observations as intangible assets and PPE has the highest number of observations with 282 observations, while biomass in sea has the lowest number of observations with 132. Furthermore, all the coefficients has the anticipated correlation, except for PPE, which has a negative correlation. I accept all the variables as value relevant.

Table 7

Other information variable candidates

Variables	Coefficients	P-Value	T-Value	Adjusted R^2	Observations
Salmon	4.82e-06	0	3.38	0.4327	267
Biological Assets	0.0010	0	2.8	0.4381	203
Harvest Volumes	0.0076	0.099	1.6	0.4870	165
Intangible assets	-0.0006	0	-2.9	0.4553	282
PPE	-0.0005	0.028	-2.2	0.4486	282
Biomass at Sea	0.0095	0	3.1	0.4450	132

The model is MVE = BV + Net Income + V, where V is substituted by the variables. Total assets scale the models.

5.2.4. Vuong-test for other information proxy

Table 8 presents the results from the Vuong test. The Vuong-test shows that the model including the Salmon Price is preferred to all the other variables except for intangible assets, where the Vuong test does not provide sufficient evidence that the model including the Salmon Price fits the true model better than the model including intangible assets. The Vuong test does not provide sufficient evidence to say that the salmon price is not the best proxy for "other information", because the Vuong-test does not provide sufficient evidence that intangible asset is better than the salmon price as a proxy. I therefore fail to reject the null.

Table 8

Vuong-test for other-information

	Biological Assets	Harvest Volume	PPE	Intangible Assets
Salmon Price NOK	2.42 ***	2.26***	2.44***	-0.43
Biological Assets		-0.366	-0.021	-3.086 ***
Harvest Volume			0.44	-2.996 ***
PPE				-3.856 ***

The table is read from the left vertical column. 2.42 is a positive Vuong Z-statistic in favour for salmon price against biological assets. The model is specified as $MVE_{jt} = BV_{jt} + NI_{jt} + V_{jt}$, where total assets scale the model and V_{jt} is substituted by the alternative variables. *** refers to a statistical significance at a 99 per cent confidence level.

The test cannot evaluate if the true model contains more of these variables. This point might be closer to the truth, that the "other information"- bracket contains more than one variable. I explore the idea of a multiple variable "other information"-model in Discussion 5.3.2.

5.3. Discussion

5.3.1. Part 1; Applying Value Relevance Theory

The correlation between the independent variables does not violate the assumption of no perfect multicollinearity. Book value and net income 0.37, book value and salmon price 0.05, net income and salmon price 0.49. The Breusch-Pagan/Cook-Weisberg –test yields: chi2 of 21.24 and a p value of zero. This result leads to the conclusion of rejecting the null, that is constant variance and by that confirming heteroscedasticity in the model. I re-estimate the model in order to deal with these results, using the Newey-West standard errors[33]. The new estimation does not significantly alter the value obtained through the original estimation of the model. I examine the sign of the coefficients and whether they are statistically significant. These relations does not change. Consequently, I conclude that heteroscedasticity and serial correlation is not a problem for the results from the original model.

5.3.2 Other value relevant information

Table 9 presents a comparison between the samples I use in the Vuong-test and the largest obtainable sample. The adjusted R^2 shows similar results to the Vuong-tests results in the "Vuong-test-sample". However, the adjusted R^2 in the main sample contradicts this result. I suspect that the Vuong-test would yield similar results if the dataset enabled a larger Vuong-test sample.

Table 9

Comparison between Vuong-test and main model samples

Variable	Adjusted R^2 Vuong-test sample	Adjusted R^2 main sample
Salmon Price	0.6097	0.4327
Biological Assets	0.5429	0.4381
Harvested Volumes	0.5480	0.4870
Intangible Assets	0.6236	0.4553
Property Plant and Equipment	0.5431	0.4486

The model is specified as MVE = BV + NI + V, where V is substituted by the alternative variables.

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[33] This model is included in the Appendix VI.

R^2 is well established as a value relevance metric in the value relevance theory[34]. Ohlson's term "other information" is a dynamic term that allows for different types of variables, but also multiple variables. On basis of this theory and on the suspicion of the small "Vuong-test"-sample being biased, I propose an extended "other-information"-model (6). Biomass in sea is removed due to high correlation with biological assets (0.7716). Using biological assets instead of biomass at sea allows for 50 more observations in the model. PPE is removed due to high correlation with intangible assets (-0.6729).

(6)   MVE = BV + NI + Salmon price + Biological Assets + Harvest Volume + Intangible Assets

Table 10 contains the result of the regression. The extended "other information"-model has 107 fewer observations, four variables representing other information and a higher adjusted R^2 (0.6 compared to 0.4) than the model containing only the Salmon Price. This result suggests that the model containing information about the salmon price, biological assets, harvest volumes and intangible assets has a greater ability to capture value relevance than the first estimated model, containing only the salmon price.

Table 10

Regression Results of the extended "other-information"-model

Variables	Coefficient	P-Value	T-Value
Intercept	-0.0003	0.23	-1.2
Book Value	0.0028	0	8.79
Net Income	0.0019	0.046	2.01
Salmon	0.00001	0	4.87
Biological Assets	-0.0010	0.025	-2.26
Harvest Volume	0.0092	0.028	2.21
Intangible Assets	-0.0018	0	-5.92
R-squared (adjusted)			0.6334
F-test (p-value)			0
Number of observations			160
Scale			Total Assets

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[34] See value relevance review, 2.4.

5.4. Conclusion

I establish that the RIV-framework proposed by Feltham & Ohlson is applicable in the aquaculture industry. Moreover, I find that the salmon price, biological assets, harvest volumes, biomass in sea, intangible assets and PPE all are value relevant variables in the aquaculture industry. Additionally, I find that total assets is the best proxy for company size, net income is the best proxy for abnormal earnings and that salmon price together with biological assets, harvest volume and intangible assets makes up the best variables for other value relevant information.

5.5. Limitations & Suggestions for Further Research

I had to exclude variables due to limited time. I wanted to include use of antibiotics, where harvest volumes were not available[35]. Important cost-factors for the companies such as feed cost and sea lice. The effects of the profitability cycles will affect my results and should have been controlled for. The companies in the aquaculture industry are primarily exporting their products, which means they are directly affected by fluctuations in exchange rates. For this reason, the exchange rates should have been included to control for its effects. However, the salmon price contains this information indirectly, as it is in NOK and not USD as the rest of the accounting figures. Furthermore, the dataset is unbalanced and periods with more observations may distort the results. The Vuong-tests were performed on smaller samples than ideal. In the future, there will be more observations available because the companies has become gradually better at reporting in their financial reports. In addition, there will be more coherent data available to perform the Vuong-tests I have carried out in this thesis.

Further research should address these shortcomings.

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[35] because the use of antibiotics and production volume is correlated

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Appendices

Appendix I

The Variables

The choice of variables are inspired by research conducted in other industries and value relevance theory, as reviewed in the aquaculture-part 1.1 and the value relevance-part 2.1. The following appendix explains the variables, used in the thesis.

Market Value.

The market value is the dependent variable of the model. The market value is in the form of millions of USD, it is in total value and not on a per share basis.

Book value of equity

The book value is an independent variable as described in Ohlson's RIV model. The variable is essential in Value Relevance theory and research. Mathematically the variable is calculated as:

$$Book\ value\ of\ equity = Total\ Assets - Total\ Debt$$

The variable is in millions of USD. I calculated the book value from a per share basis to total value by multiplying with number of common shares outstanding.

Total Assets

The variable is a proxy for the effect of company size in the main model, where it scales the model.

Proxies for Abnormal Income

The following variables are candidates for the proxy of Abnormal Earnings($E_t{}^a$):

(1)
$$P_t = B_t + \alpha_1 E_t{}^a + \alpha_2 V_t$$

Net Income

Net income is Earnings after tax, before extraordinary items and dividends. It is the most commonly applied proxy for abnormal earnings in the value relevance field. The variable is in millions of USD.

EBIT and EBITDA

The variables: Earnings before interest and tax and Earnings before interest, tax, depreciation and amortization are obtained through Datastream. The advantage of using these variables compared to net income is that they might mitigate the effect of differences in debt, depreciation and taxes of the different companies.

Cash flow from Operating Activities and Accruals

CFO is obtained through Datastream, while Accruals is calculated by subtracting net income from CFO. See for example Akbar and Stark (2003).

$$\text{Net Income}_{it} = \text{CF}_{it} + \text{Acc}_{it}$$

Then substituting the disaggregated earnings equation into equation (2) yields:

$$\text{MVE}_{it} = \text{BV}_{it} + \text{CF}_{it} + \text{Acc}_{it} + \text{V}_{it}$$

Proxies for other value relevant information

The following variables are candidates for a proxy for other value relevant information (V_t)

$$P_t = B_t + \alpha_1 E_t{}^a + \alpha_2 V_t$$

Harvested Fish, Gutted Weight in Tons (GWT)

The independent variable is in 1000 tons. The variable is independent of currency fluctuations as it is not a monetary value. I obtained the variable by going through quarterly reports.

Biomass in sea, Live Weight in Tons (LWT)

The independent variable is in 1000 tons. The variable is independent of currency fluctuations as it is not a monetary value. I obtained the variable by going through quarterly reports. The variable is calculated as:

$$\text{Beginning Inventory} + \text{Growth}_{\text{period}} - \text{Harvested}_{\text{period}} = \text{Ending Inventory}$$

Intangible Assets

The variable is an accounting figure and by that, the effect of company size will be present in this variable, therefore total assets scale it. This scaling opens up a new interpretation of this variable as it becomes ratio for intangible assets, or inversely a ratio for tangible assets. See discussion in 4.1.4 Formulating the hypothesis, other information.

Property Plant and Equipment

As with intangible assets, PPE is an asset and when total assets scale it, it too can be interpreted as a PPE percentage of total assets.

Salmon Price

The salmon price is a proxy for other value relevant information affecting the firms in the Aquaculture Industry. The Salmon price at 30 of March corresponds to the Market Value in the first quarter. It is not lagged because it is instantly available to investors. The different firms in the sample are trading with different salmon prices. The salmon price given by Fish Pool is an average of the whole industry in Norway at that given time and it best describes the salmon price the Norwegian companies are facing. The equivalent of this price, in Chile, is the Miami FOB[36], where most of the Chilean companies are trading Atlantic salmon. The Vuong-test stated that the salmon price in Norwegian Kroners were preferred to the alternative models using other currencies for the Norwegian companies and the Miami FOB in USD were best for the Chilean companies. Therefore, the variable salmon price includes both of these prices. The Vuong-test as well as graphs showing the Norwegian salmon price and Miami FOB are in Appendix III.

Biological Assets

The accounting figure is given in Norwegian Kroners in the quarterly reports of the Norwegian Companies. I convert the Biological Assets, reported in NOK, at the exchange rate for NOK/USD at the time of reporting[37] [38]. For Accounting Treatment of Biological Assets see 1.2.6.

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[36] Provided by SalmonEx
[37] (i.e. Biological assets Q1 is converted by the exchange rate at 30. March)
[38] Bakkafrost reports in DKK and is treated in the same way with the DKK/USD-exchange rate

The Companies

This appendix presents more information about the companies used in the samples of this thesis.

Marine Harvest (formerly known as Pan Fish) has its headquarters in Bergen, Norway. The company is the biggest aquaculture company in world. Producing 25-30% of the world's supply of salmon and trout and having 11.700 employees in 24 countries[39]. The Farming activities are located in Norway, Scotland, Canada, Chile, Ireland and the Faroe Islands. Marine Harvest's product portfolio consists of salmon, halibut, coated seafood, smoked seafood and elaborated seafood, among others. The firm is divided into three segments; Farming, Sales and processing and sales of Seafood in the European Market. From MOWI to Marine Harvest, the company has seen a rapid growth, through organic growth, but also acquisitions like Morpol ASA, Stolt-Seafarm and Fjord Seafood.

Salmar ASA is a Norwegian company active in the fish farming industry and processing sector. The company is the second largest in Norway, producing 13% of Norway's total harvest and 7.5% of the global production. The Norwegian entrepreneur Gustav Witzøe founded Salmar ASA. The Fish farming activity is located in central Norway, northern Norway and fish farming elsewhere (Rauma segment). The company owned shares in Bakkafrost P/F until 12 of December 2013.

Lerøy Seafood Group ASA's headquarters is in Bergen, Norway. The company is the third largest in Norway. Lerøy employs 2300[40] and produces 12.3% of the total Norwegian Harvest and 7% on a global scale. Their products are Atlantic Salmon, Fjord Trout, Halibut, Cod and a large variety of pelagic fish and shellfish. The Farming is in Norway, while some processing plants are located abroad and the firm has a network of smaller marketing and distribution companies. The biggest shareowner in Lerøy is Austevoll at 57.5%[41] (another company in the sample).

Grieg Seafood ASA is an international seafood company with headquarters in Norway. The Farming activities is in Finmark and Rogaland, Norway; in British Colombia, Canada; and

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[39] http://www.marineharvest.com/people/
[40] https://www.leroyseafood.com/en/Business/About-us/Leroy-in-brief/
[41] https://www.leroyseafood.com/en/Investor/Investor/Largest-shareholders/

Shetland, the United Kingdom. Grieg's fish harvest constitutes 3.5% of the domestic production and 3.4% of the global production. The company has a workforce of 700 employees.

Norway Royal Salmon ASA is a Norway-based fish farming and sales company. The company specializes in both fresh and frozen, salmon and trout. The company has the ninth largest harvest in Norway, 2.1% of the domestic production and 1.2% on a global scale. As the name suggests, the company's primary product is Atlantic salmon. The company made the news in 2016 when it announced its cooperation with the oil and gas offshore company; Aker ASA in an offshore aquaculture project[42].

Empresas AquaChile is a Chilean company operating in both the Aquaculture and Fishing industry. The company has the third largest harvest in Chile, 9.9% of the domestic production and 4.8% of the global production. The company operates in Chile, Costa Rica, Panama and the United States, employing 5.500 workers. AquaChile activities include farming, processing and distribution of Atlantic and Pacific Salmon, trout, tilapia and fish feed. The company is the most important exporter of fresh Tilapia to the US and is the number one producer of Pacific Salmon and Sea Trout. Marine Harvest and Aqua Chile ended their cooperation for a fusion during the second quarter of 2015.

CIA Pesquera Camanchaca SA operates in two business; fishing and aquaculture. The firm is primarily a fishing company. It is the number six producer in Chile, in terms of harvested fish. Camanchaca stands for 1.9% of the fish harvest in the world. The main products of the Aquaculture part of the company is: Atlantic salmon, Mussels and Abalone. The main market for its fresh Atlantic salmon is the US.

Blumar SA is a Chilean company engaged in fishing, food processing and fish farming. The main activity of the company fish meal and fish oil production plants, freezing and breaded plants, fish unloading warehouses and fattening centres, which are located in Caldera, Coronel, Corral, Talcahunao, Los Lagos and Aysen. The aquaculture part of the company is producing salmon and mussels. It is the seventh greatest producer of salmon, it constitutes 6.6% of the total Chilean production. In 2014, Blumar produced 1.8% of the world's total production of farmed fish.

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[42] http://e24.no/boers-og-finans/aker/slik-vil-aker-og-norway-royal-salmon-drive-oppdrett-paa-aapent-hav/23641282 and https://www.undercurrentnews.com/2016/03/18/nrs-aker-join-norway-offshore-salmon-farming-trend-with-joint-plans/

Australis Seafood SA is a Chile-based company engaged in farmed salmon production and 0exportation. The company had a share of 4.8% of the total Chilean production of Salmon in 2014. The company produces both Atlantic and Pacific Salmon and Rainbow Trout.
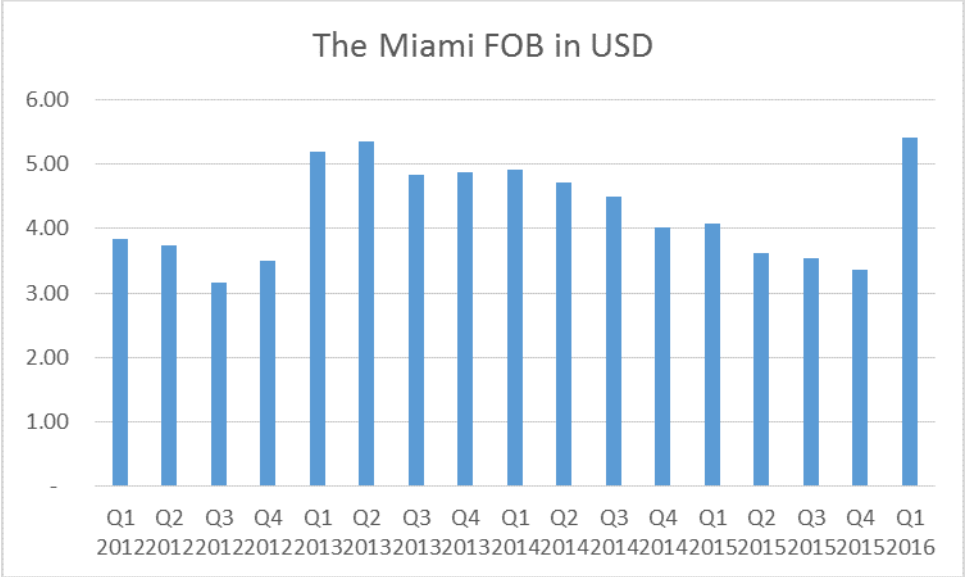
The Scottish Salmon Company is a British company producing Scottish Salmon both for export and for the local market. It is second to Marine Harvest in the UK in terms of production. The Company produces 20% of the UK production and 1.6% of the global production. The Hatcheries, farms and processing facilities lies on the West Coast of Scotland, from the Hebrides in the North to Argyll and Arran in the South.

Austevoll Seafood ASA is a Norwegian company operating and owning fishing vessels, fishmeal plants, canning plants, freezing plants, salmon farming and marketing. Lerøy Seafood Group ASA is one of its subsidiaries.

Bakkafrost P/F is a Faroese fish farming company. The Faroe Islands is the place of production. Its activities are divided into three segments: Fish Farming, Value Added Products, and production and sale of fishmeal, oil and feed. Bakkafrost's subsidiaries Havsbrun and Hanstholm Fiskemelsfabrik are the producers of the fishmeal, oil and feed. On 26 March 2010, Bakkafrost was listed on the Oslo stock exchange. Just before, it merged with another Faroese Aquaculture company, Vestlax. Bakkafrost is the largest private employer on the Faroe Islands.

The Miami FOB, Chilean Salmon Price

(Source: SalmonEx)

Development Atlantic salmon prices

Average yearly price development of Atlantic salmon

Price - Norwegian gutted Atlantic salmon (FCA Oslo)
Price - Chilean Atlantic salmon fillet (FOB Miami)
Price - Fresh Atlantic salmon (FOB Seattle)
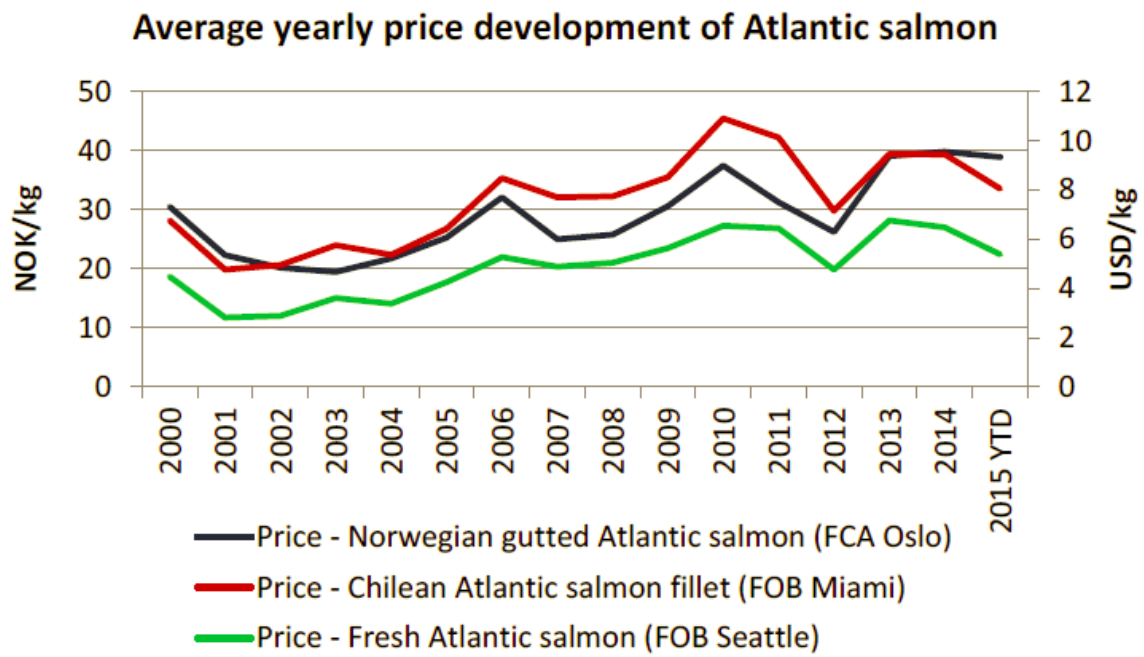
(Source: Marine Harvest's Salmon Industry Handbook 2015)

Appendix V

Vuong-test Salmon Price variable

The Vuong-test prefers the combination of the Norwegian salmon price (NOK) and Miami FOB price (USD) for the Norwegian and Chilean companies

	Salmon (USD+USD)	Salmon (NOK)	Salmon (EURO)	Salmon (USD)
Salmon (NOK+USD)	1.574 *	1.507 *	2.195 **	2.309 ***
Salmon (USD+USD)	-	0.175	1.478 *	1.38 *
Salmon (NOK)		-	1.540 *	1.204
Salmon (EURO)			-	0.745

Salmon (NOK + USD) is the Norwegian salmon price and Miami FOB in the respective currency. Salmon (USD + USD) is the Norwegian salmon price and Miami FOB in the respective currency. Salmon (NOK) is the Norwegian salmon price in NOK. Salmon (EURO) is the Norwegian salmon price in EURO. Salmon (USD) is the Norwegian salmon price in USD. The model is specified: MVE = BV + NI + V, where V is substituted by the variables for salmon price. A highly positive vuong Z-statistic suggests that the test prefers the model with the variable in the left column and a negative vice versa. *** refers to a confidence level of 99 per cent, ** refers to a confidence level of 95 per cent and * refers to a confidence level of 90 per cent.

Appendix VI

Newey-West Standard errors

```
. newey mvta bvta nita salmon, lag(0)

Regression with Newey-West standard errors         Number of obs  =        267
maximum lag: 0                                      F(  3,   263)  =      35.48
                                                    Prob > F       =     0.0000

                          Newey-West
        mvta      Coef.    Std. Err.      t    P>|t|    [95% Conf. Interval]

        bvta    .0026694    .0002988     8.93  0.000     .002081     .0032578
        nita    .0022503    .0008977     2.51  0.013    .0004827     .0040179
      salmon   4.82e-06    1.54e-06     3.13  0.002    1.79e-06     7.85e-06
       _cons   -.0006431    .0001489    -4.32  0.000   -.0009363    -.0003498


. newey mvta bvta nita salmon, lag(2)
time is not regularly spaced
r(198);

. newey mvta laggedbvta laggednita laggedsalmon, lag(0)

Regression with Newey-West standard errors         Number of obs  =        253
maximum lag: 0                                      F(  3,   249)  =      33.70
                                                    Prob > F       =     0.0000

                             Newey-West
         mvta       Coef.    Std. Err.      t    P>|t|    [95% Conf. Interval]

   laggedbvta    .0025241    .0003145     8.03  0.000    .0019046     .0031435
   laggednita    .0030501    .0009874     3.09  0.002    .0011054     .0049947
 laggedsalmon   5.58e-06    1.54e-06     3.63  0.000    2.55e-06     8.61e-06
        _cons   -.0006004    .0001524    -3.94  0.000   -.0009006    -.0003002
```