DET SAMFUNNSVITENSKAPELIGE FAKULTET, HANDELSHØGSKOLEN VED UIS

MASTEROPPGAVE

STUDIEPROGRAM:	OPPGAVEN ER SKREVET INNEN FØLGENDE SPESIALISERINGSRETNING:
Master i Økonomi og Administrasjon	Anvendt Finans
	ER OPPGAVEN KONFIDENSIELL? Ja (**NB**! Bruk rødt skjema ved konfidensiell oppgave)

TITTEL:

An empirical study on the determinants of price-earnings ratio: Norwegian seafood industry

FORFATTER(E)

Kandidatnummer:	Navn:
1013 …………………	Aigerim Itemgenova …………………………………….
…………………	…………………………………….

VEILEDER:

Marius Sikveland

Abstract

This research aims to fill the gap in the existing literature by examining the factors explaining the variations in price-earnings ratio for the Norwegian seafood industry. Employing a Random effects model, we demonstrate that the return on equity is the major determinant of price-earnings ratio. Moreover, the findings suggest that the price-earnings ratio of the Norwegian seafood stocks are positively associated with the excess return, contradicting the widely used Discounted Dividend model. Depreciation of the Norwegian krone against the euro and the US dollar seem to have no significant impact on the price-earnings ratio of the seafood stocks. The evidence derived from this research enhances our understanding about the use of earnings multiplier in the Norwegian seafood industry. The findings give insights to investors and portfolio managers about the outcomes of equity valuation and have implications for decision making and investment strategies.

Preface

First and foremost, I would like to express my heart-felt thanks to my supervisor, Associate Professor Marius Sikveland for his invaluable guidance and support given to me throughout this semester. He gave me inspiration to complete this thesis with enthusiasm, and was always available for meaningful feedback. I am indebted to Associate Professor Bård Misund for his overwhelming support and input to my academics over the past two years. It has been an invaluable experience working with him and I will always remember him as a person who inspired me to move forward towards my goals.

I want to thank my husband for keeping things going and standing behind me throughout this journey. Moreover, this research would not have been possible without the support and love of my family. Hence, I dedicate this research to my parents, Итемгенов Нурмаш and Туреходжаева Маржанкуль. Last, but definitely not the least, I would like to thank all my friends, especially Rimini, Kristina, Tatyana, Ragne and Max for the wonderful times and coffee chats we have had together.

.

Table of content

List of figures

List of tables

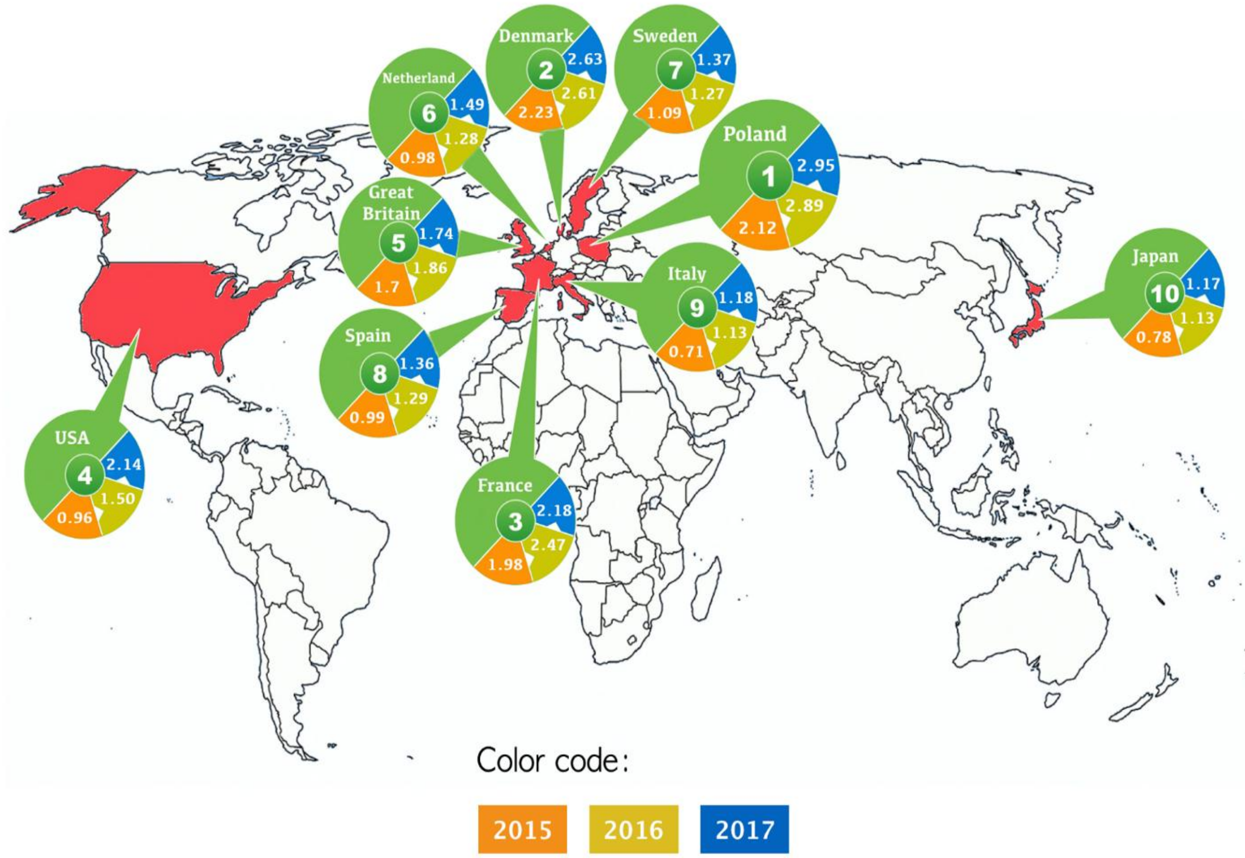
CHAPTER 1. INTRODUCTION

1.1 Background

There has been a tremendous growth in the Norwegian seafood industry since the late 1960s, making Norway the world's leading producer of salmon and the Fish Pool the most significant market places for trading financial salmon contracts. Over the last 45 years, the production of salmon has risen from less than 1000 tons to 1.2 million tons in 2014. (Hersoug (2015)) Approximately 60% of the total Norwegian aquaculture production comes from the farming of Atlantic salmon.

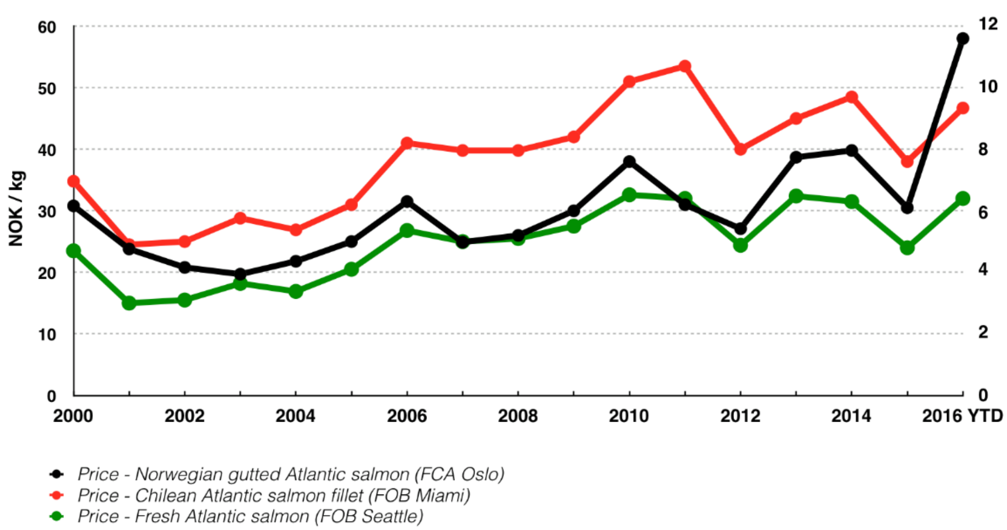
Different factors have contributed to the perfect market conditions from the perspective of the salmon industry in Norway, increasing its role in the international market. For example, the spread of algal bloom disease and the subsequent loss of salmon harvests in Chile negatively affected the already tight global supply of salmon. Consequently, many retailers shifted away from the Chilean to the Norwegian seafood farmers to address consumer concern about the use of antibiotics at the Chilean farms. Eventually, after a period of consumer aversion to the Norwegian salmon due to negative publicity, France recovered its demand and is now one of the largest importers of the Norwegian salmon. Moreover, the depreciation of the Norwegian krone against the euro and the US dollar boosted the demand for the Norwegian salmon from the European countries and USA, resulting in high soaring salmon prices, record high export volumes and high revenues for the Norwegian seafood companies, as can be seen from the Figure 1 and Figure 2.

Figure 1. Exported value of the Norwegian seafood 2015-2017 (in bln NOK)



Data for export value is retrieved from https://seafood.no/. Author of the graph: Itemgenova A.
Note* Countries are ranked by the export value of Norwegian seafood, 1 being denoted as the highest rank

Figure 2. Average yearly price development of Atlantic salmon 2000-2016



Data and graph are retrieved from Salmon Farming Industry Handbook 2017 by Marine Harvest ASA.

The significant growth in demand for the Norwegian seafood products, accompanied with the soaring salmon prices have caught investors' attention, making the stocks of the publicly traded Norwegian seafood companies one of the attractive securities to invest. PanFish was the first Norwegian seafood company that was listed at the Oslo stock exchange (OSE) in 1997, marking the beginning of a new era for the Norwegian seafood securities. (Asche, Roll, Sandvold, Sørvig, and Zhang (2013)) Certainly, these facts highlights the importance of studying appropriate valuation tools which could be used by investors in making investment decisions related to the seafood stocks.

As is well known, investors often employ a price-earnings ratio as a quick way to get a snapshot of a company's value. It has gained popularity among investors due to its simplicity and ability to compare the stocks without deeply embarking on the details of an accounting report. Hence, it is not as sophisticated as a Discounted Cash flow model.

In light of the great popularity of this valuation tool, one might be concerned about what determines the price-earnings ratio of the Norwegian seafood companies. Despite being an easy-to use and intuitive valuation metric, the price-earnings ratio must be interpreted with caution along with its determinants which in turn might vary from one industry to another. This factors have provoked the research question which is further investigated in this thesis.

1.2 Research problem and research objective

Numerous researchers have engaged themselves to test the validity of the price-to-earnings ratio hypothesis; to examine the relationship between price-earnings ratio and its fundamental determinants both in developing and developed markets. Many scholars have carried out market analysis and provided evidence of the possible determinants of price-earnings ratio. However, literature that dealt with the determinants of price-earnings ratio at company level by controlling for industry and year effect are scant. To the best of my knowledge, nor such study has been undertaken in the Norwegian seafood industry.

This research aims to fill the gap in the existing literature by examining the determinants of price-earnings ratio of the seafood stocks listed at the OSE.

Many factors are believed to affect the price-earnings ratio of the Norwegian seafood companies and this research addresses the following research objectives:

- to analyze whether dividend payout ratio, return on equity, excess returns on stock, leverage ratio, lagged price-book value ratio, depreciation (appreciation) of the Norwegian krone against the euro and the US dollar determine the price-earnings ratio of the Norwegian seafood stocks;
- to elaborate on previous literature and analyze the excess returns on the Norwegian seafood stocks;
- to test whether the price-earnings ratio can be used to separate winners from loser to generate higher excess returns in the Norwegian seafood industry.

This research contributes to the literature in several ways. First, this research provides the first empirical evidence on the determinants of the price-earnings ratio in the Norwegian seafood industry. Secondly, this research shows that the semi-strong form of the efficient market hypothesis is rejected in the example of the Norwegian seafood industry. Hence, price-earnings ratio can be used to separate winners from loser to generate higher excess returns.

The results of this research broaden our understanding about the price-earnings ratio and implications of using it in the Norwegian seafood industry.

1.3 Disposition

The remainder of this paper is organized as follows. Chapter 2 provides a brief review of the existing literature and prior empirical findings. Chapter 3 describes the methodology used to study the research question. The data sample and the descriptive statistics of the variables, as well as the estimation of the excess returns on the stocks are discussed in Chapter 4. The main findings and the discussion, as well as the limitations of the thesis and suggestions for future work are provided in chapter 5. Chapter 6 summarizes the main aspects of the previous chapters and concludes the thesis.

CHAPTER 2. LITERATURE REVIEW

This section reviews the existing literature relevant to this study. It begins with a detailed discussion of the relevant literature on the determinants of price-earnings ratio, both in developed and developing markets, as well as in different industries. This is then followed by an empirical review of literature relevant to the seafood industry. A short summary of the existing literature and possible research questions that are open for future works are given at the end.

2.1 Price-earnings ratio and its fundamental determinants.

The efficient market hypothesis suggests that the prices of securities fully reflect all available information in an unbiased way, hence denying the possibility of making excess return. The price-earnings ratio hypothesis however suggests that the price-earnings ratio might be a good indicator of future investment performance due to the investors' exaggerated expectation. Hence, over the past decades, the importance of finding determinants of price-to-earnings ratio has been on rise. Numerous researchers have engaged themselves to investigate this issue in different markets and many opinions have been given to shed light to this puzzle.

As is well known, a constant-growth Dividend Discount model can be written as following:

$$P_0 = \frac{Dividends_0(1+g)}{k-g} \qquad \text{Eq.1}$$

The price-earnings ratio can be derived by dividing both sides of the formula by earnings per share:

$$\frac{P}{Earnings\ per\ share} = \frac{Dividend\ payout\ ratio(1+g)}{k-g} \qquad \text{Eq.2}$$

where g – constant annual growth rate of dividends, k – discount rate or required rate of return. Hence, the price-earnings ratio is an increasing function of the dividend payout ratio and decreasing function of the required rate of return. Higher the volatility of return, higher the required rate of return, and lower the price-earnings ratio. (Gordon and Shapiro (1956), Gordon (1959))

Fritzemeier (1936) was one of the first who studied investment performance of low priced stocks. He concluded that the low priced stocks earned higher excess returns than the high priced stocks. Pinches and Simon (1972) studied different portfolios that consist of low priced stocks at the American Stock Exchange and came to the same conclusion that returns were higher for the low priced stocks. Basu (1977) demonstrated that the portfolios with low price-earnings ratio had on average, higher risk-adjusted rates of return than their high price-earnings ratio counterparts. Bondt and Thaler (1985) developed a winner-loser anomaly hypothesis; concluding that the stocks with low price-earnings ratio outperform the market in the subsequent years and the inverse is true about the stocks with high price-earnings ratio.

Aforementioned studies have laid the foundation for further subsequent researches to study fundamental determinants of price-earnings ratio as they have always been a focus area of interest for investors, market participants and fund managers due to its simplicity in application.

Beaver and Morse (1978) grouped common stocks into different portfolios based on their price-earnings ratios to examine whether growth of earnings and risk can explain the difference in price-earnings ratios. They found that the initial price-earnings ratio differences among the portfolios remain up to 14 years and growth of earnings has little impact to explain it. The correlation between growth of earnings and price-earnings ratio is negative in the beginning years of portfolio formation and positive in the subsequent years. Moreover, they concluded that the correlation between price-earnings ratios and market risk can be either positive or negative depending on the markets of the given year being examined. It has been suggested that the difference in accounting methods can be the possible explanation of the persistence in price-earnings ratios, but neither risk nor growth of earnings can supply a reasonable explanation of it. Craig, Johnson, and Joy (1987) sought to investigate the effect of accounting methods on price-earnings ratios. The results suggest that the inventory and investment tax credit methods have a significant impact on price-earnings ratio such that companies working with LIFO inventory and deferred investment tax credit have a higher price-earnings ratio than those companies that work with FIFO and flow-through tax credit.

Reilly, Griggs, and Wong (1983) investigated the determinants of price-earnings ratio for S&P500. The derived empirical results suggest that there is a positive relationship between price-earnings ratio and dividend payout ratio, dividend and realized earnings growths, while a negative relationship exists between price-earnings ratio and earning volatility, risk-free return and inflation. Multiple regression analysis had been employed for quarterly data for the years of 1963-1980. Kane, Marcus, and Noh (1996) reexamined it by using data for the years of 1953-1994 and confirmed that price-earnings ratio increases when inflation and market volatility decreases. Nonetheless, the negative reverberation of dividend yield and real rate seem to be statistically insignificant.

Penman (1996) demonstrated that the relation between price-earnings ratio and current return on equity ratio is negative, while the relation between price-earnings ratio and anticipative net assets is positive. Shamsuddin and Hillier (2004) had used quarterly data for the Australian stock market (ASX200) for the period of 1984-2001 to examine the fundamental determinants of price-earnings ratio. The results suggest that there is a positive relation between price-earnings ratio and dividend payout ratio, change in GDP and consumer's confidence index, Australian dollar appreciation, while a negative relationship exists between market volatility and interest rates. Tse (2002) gave a detailed discussion about how the past returns and dividend yield can predict price-earnings ratios and can be employed as a tool in creating asset allocation strategy and market timing in stock markets. He employed multiple regression analysis by using data for the period of 1991-2000 for the four biggest real estate stocks in Hong Kong. He concluded that a low dividend yield is associated with a high price-earnings ratio. Simple regression analysis had been applied by Huang, Tsai, and Chen (2007) to examine the relationship between price-earnings ratio and investment performance of the stocks in NYSE in the period of 1982-2002. The research results were similar to the previous works and they concluded that the price-earnings ratio is positively related to the long run growth rate, dividend payout ratio, and size of the firm. Moreover, the stocks with low price-earnings ratio outperformed stocks with higher price-earnings ratio. A price-earnings ratio adjusted for risk and growth had been proposed by Estrada (2005) and he showed that the strategies based on this metric outperform; regardless of whether investor or fund manager rebalances the portfolio, or rebalances it every 5 or 10 years. However, the sample used to obtain this empirical evidence is limited and one must utilize this approach with caution while making an investing strategy.

There are some empirical studies that investigated the determinants of price-earnings ratio by aggregating sectoral and year effects. Alford (1992) studied that cross-sectional variation in price-earnings ratios can be explained by risk, growth and the industry itself. Anderson and Brooks (2006) concluded that the price-earnings ratio of the stock is partly affected by the year the ratio is being measured, the size of the firm and the industry it belongs to. Data for all UK firms for the period of 1975-2003 had been analyzed and a modified version of price-earnings ratio which decomposes aforementioned impacts had been proposed. The results suggest that the modified price-earnings ratio has the power to double the gap in annual returns between the glamour and value deciles, and so can be considered as a useful tool for hedge fund managers. Cho (1993) used data for more than 1000 US firms to study the relationship between company size, industry and EP ratio. The results suggest that there is a negative relationship between firm size and earnings-price ratio. Afza and Tahir (2012) investigated the determinants of price-earnings ratios in the chemical sector of Pakistan. They used the ordinary least square regression for pooled data of 25 firms. He concluded that the dividend payout ratio had the biggest influence on price-earnings ratio meaning investors feel comfortable paying high for stocks which pay high dividends. Moreover, they showed that the investors are willing to pay high for the stocks with high volatile prices. This can be explained by the investor's ambition to obtain high capital gains. Similar studies have been carried out in the Jordan stock market by Al-Mwalla, Al-Omari, and Ayad (2010). They employed the vector-error correction model to elaborate the causal relationship between price-earnings ratio, stock prices, dividend yield and firm size. There is an empirical evidence stating informational lack of efficiency and investors used price-earnings ratio and size anomalies to gain excess returns.

To the best of my knowledge, no study has examined the determinants of the price-earnings ratio in the seafood industry. Hence, it is open for discussion and investigation. This paper fills the gap by examining the determinants of price-earnings ratio in the Norwegian seafood industry.

2.2 Norwegian seafood industry

Many scholars have engaged themselves to study different aspects of the Norwegian seafood industry. In order to study how the global seafood market might look like in 2030, Kobayashi et al. (2015) employed a global, partial equilibrium and multi-market model and suggested that the fish supply might grow from 154 million tons in 2011 to 186 million tons in 2030. In actual fact, however, the annual growth has been diminishing in recent years; being approximately 6% in the period of 2004-2015. (MarineHarvest, 2016) This slowdown might be partially explained by the Chilean salmon disease that started to spread in the late 2008. (Asche, Hansen, Tveteras, and Tveterås (2009)) Apparently, the demand shifted away from the Chilean salmon farmers, thereby increasing the demand for Norwegian salmons. Not surprisingly, this led to high salmon price volatility. Of note, high price volatility could have arisen from the unique commodity-specific characteristics of salmon such as its long production time and perishable nature of salmon. (Oglend and Sikveland (2008), Oglend (2013))

While one group of scholars have been engaged in investigating the operational and market risks, another group of scholars have been occupied with examining valuation of salmon companies.

CAPM and Fama-French three factor model had been employed by Ewald and Salehi (2015) to examine the performance of two OSE listed companies; Scottish Salmon Company and Marine Harvest in the context of the Fish Pool market and the influence of futures maturity on the price of the aforementioned stocks. Asche and Sikveland (2015) examined the economic performance of salmon firms from an accounting point of view. They conducted unit root test to check whether EBIT and EBIT per kg are stationary. The results suggested that EBIT was nonstationary while the EBIT per kg was stationary. One of the takeaways from this study is that salmon production makes EBIT more stochastic in comparison with EBIT per kg. Furthermore, they provided an interesting evidence of the six-year cycle in EBIT per kg. Moreover, both production and fishmeal had no impact on EBIT per kg and the first differences of EBIT. The authors assumed that the results of Asche (1996), Xie and Myrland (2011), Andersen, Roll, and Tveterås (2008) could serve as a possible explanation to the fact that demand and supply are more inelastic in the short run and that the demand is becoming less elastic.

Misund (2016a) studied the relationship between returns at the OSE listed salmon stocks and the common market, macroeconomic, industry-specific risks. Using a step-wise approach, he suggests that the market risk premium, Fama-French risk factors, as well as changes in salmon price can significantly explain the returns on salmon equities. Salmon production and inventory (biomass), oil prices, devaluation of Norwegian krone against the US dollar and the euro, all apparently have no impact on the returns on salmon stocks. The Johansen's test had been adopted to examine the interdependence between the prices of four major salmon stocks, as well as the cointegration between the individual stock prices and commodity price by Zhang, Myrland, and Xie (2016). The results failed to present any evidence of common stochastic trends between the prices of salmon stocks, and the size of the firms might have played a role in deriving such results.

Misund (2016b) gave a detailed discussion on how the market pricing of stocks is influenced by the disclosure of the profits before and after the fair-value adjustment. Of note, fish farmers argue that the quality of their earnings get worse after adjustments of the profits, most especially so when the salmon prices are volatile. He adopted value-relevance methodology and came to the conclusion that the pre-fair-value adjusted profits are most relevant for investors since fair-value adjustment results in higher volatility of profits and the existing literature suggests that higher volatile profits result in lower quality earnings measure. Furthermore, Xie, Kinnucan, and Myrland (2008) demonstrated that exchange rate pass-through was complete for the major seafood exporters like Chile and the UK and incomplete for Norway. This means that salmon export prices are affected by non-tariff trade barriers and market power, or both.

2.3 Summary of the literature

The existing literature has categorized the determinants of price-earnings ratio to market analysis and sector analysis. There are many papers which carried out market analysis and provided evidence of the possible determinants of price-earnings ratio. Fritzemeier (1936), Pinches and Simon (1972), Basu (1977), Bondt and Thaler (1985) investigated investment performance of stocks and suggested that the high priced stocks earned lower than the low priced stocks. Beaver and Morse (1978), Craig et al. (1987), Reilly et al. (1983), Kane et al. (1996), Penman (1996), Shamsuddin and Hillier (2004), Tse (2002), Huang et al. (2007) examined which factors explain the variations in the price-earnings ratio in different markets (American, British, Australian, Hong Kong, Jordanian markets, etc.)

The studies that examined the determinants of price-earnings ratio by aggregating sectoral and year effects are scant. Alford (1992) concluded that risk, growth and the industry itself can explain the cross-sectional variations in price-earnings ratio, and Anderson and Brooks (2006) stated that price-earnings ratio is influenced by the year, size and the industry the firm belongs to. Afza and Tahir (2012) showed that investors pay high for the stocks with high volatile prices.

In the backdrop of growing interests in the Norwegian seafood products in international markets, and its tremendous growth, there have been many papers which examined the operational and market risks in the Norwegian seafood industry, as well as the valuation of salmon companies. Nonetheless, to the best of my knowledge, no study has been undertaken to investigate the determinants of the price-earnings ratio in the seafood industry. This research aims to fill the gap in the existing literature by examining the determinants of price-earnings ratio of seafood stocks listed at the OSE.

CHAPTER 3. RESEARCH METHODOLOGY

This section focuses on the research design and methodology employed in this paper. Longitudinal data approach is employed to investigate the determinants of price-earnings ratio for the Norwegian seafood industry. The results of this research are based on the Random Effects model. Detailed discussions of the procedures are explained throughout this section. First, a general definition and description of Random effects and Fixed effects models are discussed. This is followed by the detailed discussions of the specification tests, their interpretations, significance to specify the effects in the model. At the end, modified version of the Breush-Pagan Lagrange Multiplier and Pesaran's cross-sectional dependence tests are explained. Lastly, a discussion of the unit root tests is presented.

3.1 Longitudinal data

Longitudinal data is often employed to solve the research question due to its ability to control for unmeasurable or unobserved sources of individual heterogeneity that vary across units but are invariant over time. While doing a research, one might suspect that the dependent variable is influenced by the omitted variable. Longitudinal data allows us to control for these factors by constructing more complicated models.

We can write the basic unobserved effects model (further UEM) for cross sectional observation i as following:

$$dv_{it} = \alpha + \beta iv'_{it} + \varphi_i + u_{it} \qquad \text{Eq.3}$$

where

i – units, $i = 1, 2, \ldots, T$

dv_{it} – dependent variable

α – intercept

iv'_{it}– independent variables

φ_i – the unit-specific effect and the heterogeneity, and possibly other unit-specific factors

u_{it} – idiosyncratic error term or idiosyncratic disturbance, changes across t as well as i

The unobserved or unmeasurable unit-specific factors φ_i can be viewed as random effects or fixed effects, depending on whether the φ_t and the observable independent variables iv_{it} are correlated or not. In next sections, the Random effects and Fixed effects models are described.

3.2 Random effects model

This model is employed when the unobserved unit heterogeneity is assumed to be uncorrelated with the independent variables. Moreover, the followings assumptions must be adopted:

RE1. Unrelated effects. The unit-specific effects are random. $E(\varphi_i|iv_i) = E(\varphi_i) = 0$

RE2. Effect Variance. Unit-specific effects have a constant variance. $V(\varphi_i|IV_i) = \sigma_\varphi^2 < \infty$

RE3. Identifiability. It is assumed that the independent variables are not perfectly collinear, the variance is non-zero and there are not so many extreme values.

$E(W_i'W_i) = A_{ww}$ is finite and positive definite; $w'_{it} = (1, x'_{it})$ as well as,

$rank(W) = 1 + K < NT$, $E\left(W_i'\Omega_{v,i}^{-1}W_i\right) = A_{w\Omega w}$ is finite and positive definite.

Then the Random effects model can be written as following:

$$dv_{it} = \alpha + \beta iv'_{it} + \theta_{it} \quad \text{Eq.4}$$

where $\theta_{it} = \varphi_i + u_{it}$.

Then, Ω takes a special form such as:

$$\Omega_{\theta,i} = V(v_i \mid IV_i) = \begin{bmatrix} \sigma_\theta^2 & \sigma_\phi^2 & \cdots & \sigma_\phi^2 \\ \sigma_\phi^2 & \sigma_\theta^2 & \cdots & \sigma_\phi^2 \\ \vdots & \vdots & \ddots & \vdots \\ \sigma_\phi^2 & \sigma_\phi^2 & \cdots & \sigma_\theta^2 \end{bmatrix} \qquad \text{Eq.5}$$

where $\sigma_\theta^2 = \sigma_\phi^2 + \sigma_u^2$ Eq.6

When Ω can be expressed as in Eq.5 and Eq.6, then it has the random effect structure. The Random effects model can be run in a (feasible) generalized least squares (GLS) framework and estimator can be written as following:

$$\begin{pmatrix} \hat{\beta} \\ \hat{\alpha} \end{pmatrix} = (W'\widehat{\Omega_\phi^{-1}}W)W'\widehat{\Omega_\phi^{-1}}dv \qquad \text{Eq.7}$$

where $W = (\varsigma NT\ IV\ DV)$, ςNT is a $NT \times 1$ vector of ones.

As discussed above, the error covariance matrix $\Omega_{\theta,i}$ solely depends on σ_ϕ^2, σ_θ^2 which can be calculated as: $\widehat{\sigma_\theta^2} = \frac{1}{NT}\sum_{t=1}^{T}\sum_{t=1}^{T}\widehat{\theta_{it}^2}$.

Once all the RE1-RE3 assumptions are adopted, the estimators of the Random effects model are consistent and asymptotically normally distributed.

$$\widehat{\beta_{RE}} = \left(\sum_{i=1}^{N} IV_i'\widehat{\Omega^{-1}}\, IV_i\right)^{-1}\left(\sum_{i=1}^{N} IV_i'\widehat{\Omega^{-1}}\, dv_i\right) \qquad \text{Eq.8}$$

$$\begin{pmatrix} \widehat{\beta_{RE}} \\ \widehat{\alpha_{RE}} \end{pmatrix} \sim^K N\left[\begin{pmatrix} \beta \\ \alpha \end{pmatrix}, Kvar\begin{pmatrix} \widehat{\beta_{RE}} \\ \widehat{\alpha_{RE}} \end{pmatrix}\right]$$

Since the RE2 assumption is held and $\widehat{\sigma_\phi^2}$ and $\widehat{\sigma_\theta^2}$ are consistent estimator of σ_ϕ^2 and σ_θ^2 respectively, $\widehat{\alpha_{RE}}$ and $\widehat{\beta_{RE}}$ are asymptotically efficient. Moreover, the asymptotic variance can be consistently evaluated as $\widehat{Kvar}\begin{bmatrix}\widehat{\beta_{RE}}\\ \widehat{\alpha_{RE}}\end{bmatrix} = (W'\widehat{\Omega_{\phi}^{-1}}W)^{-1}$. (Schmidheiny and Basel (2011), Wooldridge (2010), Clarke, Crawford, Steele, and Vignoles (2010), Bollen and Brand (2010))

In this thesis, the Random effects model is applied to solve the research question. The Huber-White sandwich variance-covariance matrix of the estimator is applied to adjust for heteroskedasticity and serial correlation of the errors. Robust variances provide a precise estimation of the sample-to-sample variability of the parameter estimates even in the case where the model is misspecified. (Huber (1967), White (1980))

The small sample Swamy-Arora estimator of the unit-level variance components have been used instead of the default consistent estimator to have more improved small-sample adjustments, since the panel data utilized in this study is unbalanced and is considered as a small-sized. (Swamy and Arora (1972), Baltagi and Chang (1994)) The results of the Random effects model are discussed in Chapter 5.1.

3.3. Fixed effects model

Fixed effects model allows us to estimate the "net" effect of the independent variables on the dependent variable by controlling for the unobserved or unmeasurable omitted variables. Most importantly, it can be employed when φ_i or the omitted unit-specific effects are correlated with the included independent variables.

The following assumptions are adopted to run the fixed effects model:

FE1. Related effects. It explicitly refers to the absence of the first assumption of the random effects model RE1.

FE2. Effect Variance. It explicitly refers to the absence of the second assumption of the random effects model RE2.

FE3. Identifiability. It is assumed that the time-varying independent variables have non-zero variance, don't have too many extreme values and are not perfectly collinear. That being said, iv_{it}' cannot have time-invariant variables.

Next we do Fixed effects transformation or within transformation. If we subtract $\overline{dv_\iota} = \frac{1}{T}\sum_t dv_{it}$ from the basic unobserved effects model in Eq.3, we get the following equation:

$$d\ddot{v}_{\iota t} = \alpha + \ddot{\beta}\iota v_{\iota t}' + \ddot{u}_{\iota t} \qquad \text{Eq.9}$$

where $d\ddot{v}_{\iota t} = dv_{it} - \overline{dv_\iota}$, $\iota\ddot{v}_{\iota t} = iv_{it} - \overline{\iota v_\iota}$, $\ddot{u}_{\iota t} = u_{it} - \overline{u}_\iota$.

The time demeaning of the Eq.4 has canceled the unit-specific effects φ_i. Then, the fixed effects estimator can be written as following:

$$\widehat{\beta_{FE}} = (I\ddot{V}'I\ddot{V})^{-1}I\ddot{V}'d\ddot{v} \qquad \text{Eq.10}$$

Moreover, the slope coefficient of $\widehat{\beta_{FE}}$ is unbiased under FE3 even in panel data with small sample size: $\widehat{\beta_{FE}} \sim^K N(\beta, Kvar[\widehat{\beta_{FE}}])$. The asymptotic variance can be evaluated consistently as $\widehat{Kvar}\left[\widehat{\beta_{FE}}\right] = \widehat{\sigma_u^2}(I\ddot{V}'I\ddot{V})^{-1}$. (Schmidheiny and Basel (2011), Wooldridge (2010))

In the same way as in the Random effects model, the Huber-White sandwich variance-covariance matrix of the estimator is applied to adjust for heteroskedasticity and serial correlation of the errors. The results of the Fixed Effects model are provided in Chapter 5.2.

3.4 Hausman specification test

3.4.1 Classic Hausman specification test

Once the Fixed effects and Random effects models have been discussed, an inevitable question arrives: which model should we apply to examine the determinants of the price-earnings ratio for the Norwegian seafood industry?

Hausman (1978) developed a specification test that allows us to define the preferred specification of the random or fixed effects and decide which model to use. Basically, it tests for orthogonality of the common effects and the independent variables. The null hypothesis states that the preferred model is a random effects model in contrast to the alternative hypothesis which states that the preferred model is a fixed effects model. It tests whether the unique error term u_i is correlated with the independent variables.

H_o: $Cov(\varphi_{i_i}, iv_{it}) = 0$

H_1: $Cov(\varphi_{i_i}, iv_{it}) \neq 0$

If we reject the null hypothesis, then the Random effects model is inconsistent and Fixed effects model is preferred. If we fail to reject the null hypothesis, then the Random effects model is preferred as it provides more efficient estimator.

Hausman test statistic is of the form:

$$H = (\widehat{\beta_{RE}} - \widehat{\beta_{FE}})' [Var(\widehat{\beta_{RE}} - \widehat{\beta_{fE}})]^{-1} (\widehat{\beta_{RE}} - \widehat{\beta_{fE}}) \quad \text{Eq.11}$$

$$\sim \chi^2(\#\widehat{\beta_{FE}}), \text{ provided } \#\widehat{\beta_{FE}} = \#\widehat{\beta_{RE}}$$

where $\widehat{\beta_{FE}}$, $\widehat{\beta_{RE}}$ are the coefficient vectors for the time-varying independent variables. (Hausman (1978), Ahn and Low (1996), Hausman and Taylor (1981), McManus (2011))

3.4.2 Robust Hausman specification test based on bootstrap procedure

The classic Hausman specification test should not be employed in the presence of autocorrelation and heteroskedasticity within panels. Kaiser (2014) improved the classic version of the Hausman test and proposed a Robust Hausman specification test to determine the preferred specification of the random effects or fixed effects models in the presence of autocorrelation and heteroskedasticity within panels. The test is based on the bootstrap procedure. The test statistic of the Robust Hausman specification test can be calculated in the following way:

$$H = (\widehat{\beta_{RE}} - \widehat{\beta_{FE}})' [V\_bootstrapped(\widehat{\beta_{RE}} - \widehat{\beta_{fE}})]^{-1} (\widehat{\beta_{RE}} - \widehat{\beta_{fE}}) \sim \chi^2(k) \qquad \text{Eq.12}$$

where $\widehat{\beta_{RE}}$, $\widehat{\beta_{FE}}$ – k×1 vectors of the estimated coefficients from the Random effects and Fixed effects models. $V\_bootstrapped(\widehat{\beta_{RE}} - \widehat{\beta_{fE}})$ is a covariance matrix of $(\widehat{\beta_{RE}} - \widehat{\beta_{fE}})$ and it is derived from the bootstrapped joint distribution.

3.5 Breush-Pagan Lagrange multiplier test

3.5.1 Simple Breush-Pagan Lagrange multiplier test

Breusch and Pagan (1980) developed a tool to decide whether to apply a Random effects model or a pooled OLS model to estimate the relationship between the dependent and independent variables.

H_o: $\sigma^2_{\varphi_i} = 0$

H_1: $\sigma^2_{\varphi_i} \neq 0$

Put differently, we test for: $Cov(\theta_{it}, \theta_{is}) = Cov(\varphi_i + u_{it}, \varphi_i + u_{is}) = Cov(u_{it}, u_{it})$. The null hypothesis states that the variances across units are zero, hence, there is no panel effects. That is why, the model can be estimated by pooled OLS. The test statistic of the Breush-Pagan Lagrange multiplier can be expressed in the following way:

$$LM = \frac{NT}{2(T-1)}\left[\frac{\sum_{i=1}^{N}\left[\sum_{i=1}^{T}\widehat{u_{it}}\right]^2}{\sum_{i=1}^{N}\sum_{t=1}^{T}\widehat{u_{it}^2}} - 1\right] \quad \sim \chi^2(1) \qquad \text{Eq.13}$$

where $\widehat{u_{it}} = dv_{it} - [iv_{it}' \; 1]\begin{bmatrix}\hat{\beta}\\ \hat{u}\end{bmatrix}_{Pooled}$, $J_T = i_T i_T'$.

Baltagi and Li (1990) extended Breush-Pagan Lagrange Multiplier test to suit for an unbalanced panel data. The null and alternative hypotheses are the same, but its test statistic is calculated as following:

$$LM = \frac{\sum_{i=1}^{N}T_i}{2(\sum_{i=1}^{N}T_i(T_i-1))}\left[\frac{\sum_{i=1}^{N}\left[\sum_{i=1}^{T}\widehat{u_{it}}\right]^2}{\sum_{i=1}^{N}\sum_{t=1}^{T}\widehat{u_{it}^2}} - 1\right] \quad \sim \chi^2(1) \qquad \text{Eq.14}$$

3.5.2 Modified version of the Breush-Pagan Lagrange multiplier test

Sosa Escudero and Bera (2008) have combined aforementioned Breusch and Pagan (1980) Lagrange Multiplier, Baltagi and Li (1991) joint test for random effects and autocorrelation, Baltagi (1995) test for first order autocorrelation and Bera, Sosa-Escudero, and Yoon (2001) robust tests to check the null hypothesis of no random effects in an unbalanced panel data.

It produces seven detailed specification tests, namely the one-sided and two-sided unadjusted Lagrange multiplier tests for random effects, assuming no autocorrelation; the one-sided and two-sided adjusted Lagrange multiplier tests for random effects, assuming possible autocorrelation; the Lagrange Multiplier tests for first-order autocorrelation, with and without random effects; the Lagrange Multiplier joint test for random effects and autocorrelation.

We write the linear model (Eq.1) for longitudinal data. The random effects and first-order autocorrelation might present in the model:

$$dv_{it} = \alpha + \beta iv'_{it} + \theta_{it}, \quad \theta_{it} = \varphi_i + u_{it}, \quad u_{it} = \rho u_{i,t-1} + \epsilon_{it}$$

Let a be the total number of observations: $a = \sum_i^T T_i$ and $b = \sum_i^T T_i^2$. The modified two-sided test statistics for random effects and autocorrelation can be calculated as following:

$$R_\varphi{}' = \frac{a^2(A+2B)^2}{2(b-3a+2N)} \qquad \text{Eq.15}$$

$$R_\rho = \left[B + \frac{a-N}{b-a}A\right]^2 \frac{(b-a)a^2}{(a-N)(b-3a+2N)} \qquad \text{Eq.16}$$

where $A = 1 - \frac{\sum_{i=1}^N (\sum_{t=1}^{T_i} e_{it}^2)^2}{\sum_{i=1}^N \sum_{t=1}^{T_i} e_{it}^2}$ and $B = \frac{\sum_{i=1}^N \sum_{t=2}^{T_i} e_{i,t} e_{i,t-1}}{\sum_{i=1}^N \sum_{t=1}^{T_i} e_{it}^2}$

The modified test for autocorrelation assuming no random effects can be calculated as following:

$$R_\rho = \frac{a^2B^2}{a-N} \qquad \text{Eq.17}$$

The modified two-sided test for random effects assuming no autocorrelation is derived as:

$$R_\varphi = \frac{\frac{1}{2}a^2A^2}{b-a} \qquad \text{Eq.18}$$

The modified one-sided tests for random effects assuming autocorrelation and no autocorrelation can be calculated by taking the square root of the original two-sided tests $R_\varphi{}'$ and R_φ.

The joint test for no random effect model and no first order autocorrelation can be found by:

$$R_{\mu\rho} = \frac{NT^2}{2(T-1)(T-2)}[A^2 + 4AB + 2TB^2] \qquad \text{Eq.19}$$

Based on earlier discussed specification tests, the null hypothesis of no random effects and no autocorrelation is tested.

H_o: $\sigma^2_{\varphi_i} = 0,\ \rho = 0$

H_1: $\sigma^2_{\varphi_i} \neq 0,\ \rho \neq 0$

If the null hypothesis is not rejected, then the model can be estimated using the simple pooled OLS approach while if the alternative hypothesis is accepted, the model should be estimated using the Random effects model. The results of the modified version of the Breush-Pagan Lagrange multiplier test are discussed in Chapter 5.4.

3.6 Cross-sectional dependence test

Robertson and Symons (2000), Pesaran (2007) argued that longitudinal data sets might have cross-sectional dependence because of the common shocks and unobserved common factors that are part of the error term. This can be explained by high financial and economic integration of companies and countries, which refers to the strong interdependence between cross-sectional individuals.

In the presence of cross-sectional dependence, the estimators of the Random effects and Fixed effects models are consistent, but might be not efficient. Moreover, the estimated standard errors might be biased. This is likely to occur when the cross-sectional dependence is due to the common factors that are not observed, but are part of the error term and are uncorrelated with the included explanatory variables. Moreover, the extent by how the cross-sectional dependence affects the estimation depends on different factors, such as greatness of the correlation across individuals, etc.

There are several tests, that can be conducted to test whether the panel data has cross-sectional dependence. The tests proposed by Pesaran (2004), Friedman (1937) and Frees (1995) are often applied by the researchers. In this research, the approach proposed by Pesaran (2004) is employed to check for the cross-sectional dependence within the panel data.

3.6.1 Pesaran's cross-sectional dependence test

Pesaran (2004) improved the Lagrange Multiplier test given in Breusch and Pagan (1980). The Lagrange multiplier test statistic is expressed as following in the latter mentioned literature:

$$LM = T \sum_{i=1}^{n-1} \sum_{j=i+1}^{n} \widehat{\rho_{ij}^2} \qquad \text{Eq.20}$$

where $\widehat{\rho_{ij}} = \widehat{\rho_{ji}} = \frac{\sum_{t=1}^{T} \widehat{u_{it}} \widehat{u_{jt}}}{\left(\sum_{t=1}^{T} \widehat{u_{it}^2}\right)^{0,5} \left(\sum_{t=1}^{T} \widehat{u_{jt}^2}\right)^{0,5}}$.

However, the Breush-Pagan Lagrange Multiplier statistic is not well centered for finite T and as the n gets larger, the bias is likely to get worse.

The following test improvements to check the null hypothesis of no cross-sectional dependence in a balanced and an unbalanced panel data have been developed by Pesaran (2004):

$$Pesaran\ CD = \sqrt{\frac{2T}{n(n-1)}} \left(\sum_{i=1}^{n-1} \sum_{j=i+1}^{n} \widehat{\rho_{ij}}\right) \quad \text{– for balanced panel data} \qquad \text{Eq.21}$$

$$Pesaran\ CD = \sqrt{\frac{2}{n(n-1)}} \left(\sum_{i=1}^{n-1} \sum_{j=i+1}^{n} \sqrt{T_{ij}} \widehat{\rho_{ij}}\right) \quad \text{– for unbalanced panel data} \qquad \text{Eq.22}$$

where $T_{ij} = \neq (T_i \cap T_j)$ $\quad \widehat{\rho_{ij}} = \widehat{\rho_{ji}} = \frac{\sum_{t \in T_i \cap T_j} (\widehat{u_{it}} - \overline{\widehat{u_i}})(\widehat{u_{jt}} - \overline{\widehat{u_j}})}{\left[\sum_{t \in T_i \cap T_j} (\widehat{u_{it}} - \overline{\widehat{u_i}})^2\right]^{0,5} \left[\sum_{t \in T_i \cap T_j} (\widehat{u_{jt}} - \overline{\widehat{u_j}})^2\right]^{0,5}}$ $\quad \overline{\widehat{u_i}} = \frac{\sum_{t \in T_i \cap T_j} \widehat{u_{it}}}{\#(T_i \cap T_j)}$

The results of the Pesaran's test are provided in Chapter 5.5.

3.7 Unit root test

Before estimating the relationships between variables, one must make sure that all variables are stationary, because models with nonstationary variables can lead to spurious results. Granger and Newbold (1974) explained the consequences of estimating a "spurious regression model" such as a high R-squared when in fact series are likely to be independent of each other, and a low value of Durbin-Watson statistics when in fact the residuals are serially correlated.

3.7.1 Augmented Dickey-Dickey Fuller unit root test

The test proposed by Dickey and Fuller (1979) is often used among the researchers to check if the time series are stationary. As an autocorrelation might present, Augmented Dickey-Fuller (ADF) test accounts for it and includes lags of the first difference of x_t:

$$\Delta x_t = \psi x_{t-1} + (constant,\ trend) + \xi_t \qquad \text{Eq.23}$$

H_0: $\psi = 0$

H_1: $\psi < 0$

The null hypothesis tests if the process is nonstationary. The test statistics are calculated as following and then compared to the relevant critical value of the Dickey-Fuller test.

$$Test\ statistics = \frac{\hat{\psi}-1}{\varrho} \qquad \text{Eq.24}$$

ϱ – unbiased estimator of the variance of the disturbance terms.

In this research, all variables that are used to calculate the excess returns are checked for unit root by ADF unit root test. The results are discussed in Chapter 4.1.2.2.

3.7.2 Fisher type panel unit root test in the presence of cross-sectional dependence

Before running the Random effects and Fixed effects models, all variables must be checked for unit root. There are different tools that can be conducted to do a panel unit root testing. However, most of them, i.e. Levin-Lin-Chiu test, Harris-Tzavalis, Breitung test and Hadri Lagrange Multiplier test cannot be used in this research since they require the panel data to be strongly balanced. Then, we can check for unit root using the Fisher-type test and Im-Pesaran-Shin test. Nell and Zimmermann (2011) argued that the Fisher-type panel unit root test outperforms the Im-Pesaran-Shin test with respect to the size-adjusted power. Hence, the Fisher-type panel unit root test proposed by Maddala and Wu (1999) and Choi (2001) is employed. The test conducts ADF test in each panel. Moreover, the existing literature argues that unit root tests must account for possible cross-sectional dependence, because cross-sectional dependence might influence the finite sample behavior of the panel unit root test. (O'Connell (1998)) Hence, a cross-sectionally demeaned version of the Fisher-type test is applied. The results are discussed in Chapter 4.3.

CHAPTER 4. DATA ANALYSIS AND INTERPRETATION

This chapter focuses on the analysis of data collection and descriptive statistics of the variables included in the models.

4.1 Data description

The analysis has been carried out for eight out of ten seafood companies listed at the OSE: Scottish Salmon Company PLC and Hofseth BioCare ASA are excluded from the panel data. It is possible to collect the financial statements of the first mentioned company only for the period of 2013-2016 in datastream and for the purpose of consistency, it is preferable to collect the same set of the data for all companies from one source. The latter company has reported only negative earnings per share so far, hence no price-earnings ratio is available for that company.

Most of the seafood companies operating in Norway are either privately owned or subsidiaries of large companies. Hence, the number of the stocks that can be included in the sample is limited and this is the obstacle this research work met in the data collection process. The same limitation has been discussed by Misund (2016a).

Quarterly data on trailing twelve months price-earnings ratio, dividends per share, earnings per share, return on equity, total debt, total equity, price-book ratio for the aforementioned eight seafood companies, as well as exchange rates of norwegian krone against the euro and the US dollar are collected from datastream.

Morever, excess returns on the stocks are calculted using the Fama-French three factors model and the results are discussed hereunder.

4.1.1 Available variables

Price-earnings ratio (PE)

This variable is calculated by dividing the closing price of the stock at the last trading day of the quarter by the trailing twelve months basic earnins per share (EPS) excluding extraordinary items. The basic EPS excluding extraordinary items has been chosen to remove the short-term volatilities that might be affected by one-time items, extraordinary income and expenses. Even though it is mathematically possible to have a nonpositive price-earnings ratio, it is reported only when it is positive since a negative price-earnings ratio does not carry any meaning in financial community. Since the price-earnings ratio of some stocks is missing for some periods, the panel data is unbalanced.

Dividend payout ratio (DP)

This variable is calculted by dividing quarterly dividends per share for common stocks by the trailing twelve months EPS excluding extraordinary items.

Return on equity (ROE)

This variable is calculated by dividing quarterly income available to common shareholders excluding extraordinary items for the trailing twelve months by the same period average common equity. Average common equity is the average of the common equity at the beginning and the end of the trailing twelve months.

Price-book ratio (PB)

Penman (1996) demonstrated that the price-book value ratio is a good indicator of earnings growth. He also showed that the price-earnigs ratio and price-book value ratio are positively related. By taking into account that an inclusion of a lagged dependent variable as a regressor in the Random effects and Fixed effects models might create complications, as well as keeping in mind the evidence of Penman (1996), lagged price-book value ratio is included in the analysis. Price-book value ratio is calculated by dividing the closing price of the stock at the last trading day of the quarter by its book value per share for the same period. Book value per share is calculated by dividing total equity from latest quarter by total shares outstanding at the same period. The lagged price-book ratio is used in the analysis.

Leverage ratio (LEV)

This variable is calculated by dividing quarterly total debt by the total equity for the same period. Total debt represents total debt outstanding which includes notes payable, short-term debt, current portion of long-term debt, debt/capital leases and total long-term debt. Total equity consists of the equity value of common and preferred shareholders, general and limited partners, but does not include minority shareholders' interest.

Changes in exchange rates of NOKUSD and NOKEUR (Rnokeur and Rnokusd)

Norwegian seafood companies are exposed to the depreciation (appreciation) of the Norwegian krone since the majority of the production is exported to another countries. Changes in exchange rates of NOKUSD and NOKEUR are included in the model since the majority of the export volume is traded in EUR and USD. These variables are calculated by dividing the closing cross rates of

NOKUSD and NOKEUR at the last trading day of the quarter by the closing cross rates of the last trading day of the quarter $t-1$, and minus one.

4.1.2 Estimation of the excess returns

Misund (2016a) suggested that both the common market-wide and the industry-specific risk factors can significantly explain the excess returns of the seafood stocks. He demonstrated that the salmon spot price is the only fundamental risk factor which is associated with the excess returns. Moreover he showed that the Fama-French three factor is more appropriate than the Capital Asset pricing model (CAPM) to estimate the excess returns on the seafood stocks.

Hence, we apply the Fama-French three factor model to find the montly excess returns on the Norwegian seafood stocks and include the changes in the salmon spot prices to the model.

$$r_{it} = r_f + \beta_1(r_{mrk} - r_f) + \beta_2 SMB + \beta_3 HML + \beta_4 r_{Salmon\ price} + \varepsilon_{it} \qquad \text{Eq.25}$$

Since the data might contain autocorrelation and heteroscedasticity, Huber-White Robust Sandwish Estimator is used. Since the panel data is based on quarterly data, the monthly excess returns are converted to the quarterly excess returns. This variable is given under “ExcessR” name hereafter.

Changes in the stock prices (R_company name)

This variable is calculated by dividing the closing price at the last trading day in month t by the the closing price at the last trading day in month $t-1$, minus one. The data is collected from datastream.

Changes in the salmon price (R_salmon)

This variable is calculated by dividing the last weekly price in month t by the last weekly price in month $t-1$, minus one. Nasdaq salmon index is used as a proxy for the salmon spot prices and is collected from the website of Fish Pool.

Other variables

Returns on the value-weighted market portfolio that consists of most stocks at the OSE and Fama-French three risk factors for the stocks listed at the OSE are collected from the website of Prof. Bernt Arne Ødegaard.

Monthly rate of return on five-year Norwegian governement bonds are retrieved from the website of the Norwegian Central Bank.

4.1.2.1 Descriptive statistics

The descriptive statistics for the data sample used to derive the excess returns on the stocks are given Table 1. Except Marine Harvest and Austevoll, all stocks exhibited higher average returns than the market (0.13) , which in turn can be explained by higher salmon prices. The highest and the smallest changes on the stock prices have been reported by Marine Harvest and Grieg Seafood, and are equal to 1.20 and -0.523 respectively.

The correlation matrix for the variables used to calculate the excess returns on the stocks is given in Table 2. The correlation between the change in salmon price and market returns is positive. No multicollinearity problem seem to arise during the analysis.

Table 1. Descriptive statistics for the data sample used to derive the excess returns

Variable	Mean	Std. Dev.	Min	Max
R_AKVA	0.014	0.110	-0.302	0.318
R_AUSS	0.011	0.110	-0.330	0.500
R_BAKKA	0.032	0.085	-0.156	0.228
R_GSF	0.024	0.167	-0.523	0.901
R_LSG	0.020	0.101	-0.355	0.300
R_MHG	0.008	0.221	-0.779	1.200
R_NRS	0.041	0.118	-0.321	0.337
R_SALM	0.020	0.088	-0.214	0.255
R_mrk	0.013	0.053	-0.215	0.144
R_rf	0.027	0.015	0.006	0.069
R_salmon	0.015	0.122	-0.276	0.358
SMB	0.004	0.039	-0.110	0.133
HML	-0.001	0.039	-0.160	0.093

*Note. R_AKVA, R_AUSS, R_BAKKA, R_GSF, R_LSG, R_MHG, R_NRS, R_SALM denote the price changes of the stocks. R_mrk denotes the return of the value-weighted market portfolio. R_rf denotes monthly rate of return on five-year Norwegian governement bonds. R_salmon denotes the changes in the salmon prices. SMB and HML are the Fama-French risk factors.

Table 2.Correlation matrix for the variables used to derive the excess returns

variable	R_mrk	R_rf	R_salmon	SMB	HML
R_mrk	1.000				
R_rf	-0.071	1.000			
R_salmon	0.043	-0.112	1.000		
SMB	-0.519	0.102	0.043	1.000	
HML	-0.160	0.118	0.012	0.011	1.000

*Note. R_mrk denotes the return of the value-weighted market portfolio. R_rf denotes monthly rate of return on five-year Norwegian governement bonds. R_salmon denotes the changes in the salmon prices. SMB and HML are the Fama-French risk factors.

4.1.2.2 Augmented Dickey-Fuller test

The results of the ADF unit root in Table 3 indicates that we reject the null hypothesis for all variables and confirm that all variables are stationary at level. Then we can proceed to the Fama-French three factors model to calculate the excess returns on the stocks.

Table 3. Results of the Augmented Dickey-Fuller test

variable	Level 1	p-value	variable	Level 1	p-value
R_AKVA	-1.013	0.000	R_SALM	-0.989	0.000
R_AUSS	-0.729	0.000	R_mrk	-0.831	0.000
R_BAKKA	-1.180	0.000	R_rf	-0.018	0.009
R_GSF	-0.630	0.000	R_salmo	-1.073	0.000
R_LSG	-0.865	0.000	SMB	-1.005	0.000
R_MHG	-0.874	0.000	HML	-1.063	0.000
R_NRS	-0.788	0.000			

*Note. Test statistics have been compared with the 5% critical values of ADF. R_AKVA, R_AUSS, R_BAKKA, R_GSF, R_LSG, R_MHG, R_NRS, R_SALM denote the price changes of the stocks. R_mrk denotes the return of the value-weighted market portfolio. R_rf denotes the monthly rate of return on five-year Norwegian governement bonds. R_salmon denotes the changes in the salmon prices. SMB and HML are the Fama-French risk factors.

4.1.2.3 Excess returns

Once we finish pre-estimation procedures, the model (Eq.25) with the Huber–White robustification is applied to estimate the excess returns on the stocks. The regressions results are given in Table 4. As it can be seen from the results, the stocks of Austevoll, Grieg Seafood, Marine Harvest and Norwegian Royal Salmon are more volatile than the market. The salmon price has a substantial impact on the excess returns and the results are consistent with the findings of Misund (2016a). The monthly excess returns are converted into quarterly excess returns and further used in the panel data analysis. This variable is denoted as $ExcessR$ hereafter.

Table 4. Results of the Fama-French three factor model

	AKVA	AUSS	BAKKA	GSF	LSG	MHG	NRS	SALM
intercept	-0.005	0.004	0.013	0.013	-0.001	-0.005	0.023	0.002
R_mrk	0.658***	1.503*	0.297	1.445*	0.941*	1.596*	1.229*	0.712*
SMB	0.403	0.640***	0.388	0.286	0.367	0.700***	0.685	0.112
HML	-0.176	0.457***	0.099	-0.042	0.046	0.254	0.128	0.018
R_salmon	0.079	0.042	0.143	0.302***	0.189*	0.377**	0.210***	0.202*
Adjusted R^2	0.087	0.390	0.081	0.279	0.288	0.186	0.190	0.284
prob > F-test	0.033	0.000	0.202	0.000	0.000	0.000	0.008	0.000

*Note. R_mrk denotes the return of the value-weighted market portfolio. SMB and HML are the Fama-French risk factors. R_salmon denotes the changes in the salmon prices.. *, ** and *** means that the coeffients are statistically significant at the 1%, 5% and 10% confidence intervals respectively.

4.2 Descriptive statistics for the panel data

The descriptive statistics for the sample used in the panel data are given in the Table 6. As it can be seen from the Table 6, the panel data is unbalanced. The gap between the maximum and minimum values of the variables seem to be arguablable taking into account the industry-specific factors and the nature of the business cycle in the seafood industry. As discussed earlier, it is recommended to have a larger sample size to be able to correct outliers. However, most of the seafood companies operating in Norway are either privately owned or subsidiries of the large companies, and some of them have been listed at the OSE not that long. That is why, the number of the inividiuals and observations included in the pane data is limited. The limited sample size in the norwegian seafood industry has been also discussed by Misund (2016a). Hence, the dataset is assumed to not have any “unusual” extreme values and outliers are not corrected for the reason

Table 5. Descriptive statistics for the panel data

Variable		Mean	Std. Dev.	Min	Max	Observations
PE	overall	21.061	29.502	2.590	350.218	N=276
	between		9.920	9.594	40.664	n=8
	within		27.794	-13.758	330.615	T-bar=35
ROE	overall	0.146	0.174	-1.053	0.785	N=311
	between		0.112	0.045	0.353	n=8
	within		0.145	-0.995	0.843	T-bar=39
ExcessR	overall	0.046	0.130	-0.380	0.472	N=338
	between		0.015	0.020	0.061	n=8
	within		0.129	-0.378	0.474	T-bar=42
DP	overall	0.189	0.985	-0.286	14.500	N=330
	between		0.206	0.062	0.698	n=8
	within		0.973	-0.509	13.991	T-bar=41
LEV	overall	0.746	1.093	-8.800	7.000	N=331
	between		0.220	0.425	1.038	n=8
	within		1.072	-9.092	6.708	T-bar=41
Lagged PB	overall	2.880	7.124	0.270	68.453	N=325
	between		2.135	1.046	7.637	n=8
	within		6.725	-4.375	63.696	T-bar=41
Rnokeur	overall	-0.002	0.041	-0.151	0.121	N=337
	between		0.003	-0.007	0.001	n=8
	within		0.041	-0.154	0.118	T-bar=42
Rnokusd	overall	-0.004	0.063	-0.160	0.181	N=338
	between		0.007	-0.016	0.003	n=8
	within		0.062	-0.166	0.176	T-bar=42

*Note. PE is the closing price of the stock at the last trading day of the quarter divided by the trailing twelve months basic earnins per share (EPS) excluding extraordinary items. DP is the quarterly dividends per share for common stocks divided by the trailing twelve months EPS excluding extraordinary items. ROE is the quarterly income available to common shareholders excluding extraordinary items for the trailing twelve months divided by the same period average common equity. ExcessR is estimated by Fama-French three factor model. LEV is the quarterly total debt divided by the total equity for the same period. PB is the closing price of the stock at the last trading day of the quarter by its book value per share for the same period. Rnokeur and Rnokusd is the closing cross rates of NOKUSD and NOKEUR at the last trading day of the quarter by the closing cross rates of the last trading day of the quarter $t-1$, and minus one.

that the number of seafood companies and observations included in the panel data is not enough large and we don't like to drop off some observations to not make them even smaller, as well as to not wipe off the "true effects" that might exist between the variables. That is why the data set is kept as it is.

The correlation matrix for the variables is given table Table 6. The correlations between the price-earnings ratio and the divident payour ratio, return on equity and leverage, as well as the price-book value ratio are positive while the correlation between the price-earnings ratio and the changes in exchange rates is negative. Absolute value of all correlation coeffients is lower than 0.5, meaning that no multicollinearity problem should be faced during the analysis.

Table 6. Correlation matrix for the variables in panel data

	PE	ROE	Excess R	DP	LEV	laggedPB	Rnokeur	Rnokusd
PE	1.000							
ROE	-0.298	1.000						
ExcessR	0.004	0.074	1.000					
DP	0.311	-0.130	0.112	1.000				
LEV	0.186	0.129	-0.210	-0.010	1.000			
laggedPB	0.212	0.416	-0.120	-0.036	0.734	1.000		
Rnokeur	-0.053	0.098	0.153	-0.032	-0.007	0.049	1.000	
Rnokusd	-0.055	0.087	0.215	-0.047	-0.023	-0.010	0.562	1.000

*Note. PE is the closing price of the stock at the last trading day of the quarter divided by the trailing twelve months basic earnins per share (EPS) excluding extraordinary items. DP is the quarterly dividends per share for common stocks divided by the trailing twelve months EPS excluding extraordinary items. ROE is the quarterly income available to common shareholders excluding extraordinary items for the trailing twelve months divided by the same period average common equity. ExcessR is estimated by Fama-French three factor model. LEV is the quarterly total debt divided by the total equity for the same period. PB is the closing price of the stock at the last trading day of the quarter by its book value per share for the same period. Rnokeur and Rnokusd is the closing cross rates of NOKUSD and NOKEUR at the last trading day of the quarter by the closing cross rates of the last trading day of the quarter $t-1$, and minus one.

Normalities in the panel data is tested using the tool proposed by Galvao, Montes-Rojas, Sosa-Escudero, and Wang (2013) and we fail to reject the null hypothesis of normality in error terms.

4.3 Fisher type panel unit root test in the presence of cross-sectional dependence

The Fisher-type tool based on Augmented Dickey-Fuller unit root test is applied and the results are provided in Table 7. The null hypothesis which states that all panels contain unit root is rejected for all variables at the 1% confidence interval.

Table 7. Results of the Fisher type panel unit root test

Variable	t-p	Inverse chi2	Modified inv. ch2	Variable	t-p	Inverse chi2	Modified inv. chi2
PE	statistics	173.926	27.918	Leverage	statistics	58.435	7.502
	p-value	0.000	0.000		p-value	0.000	0.000
DP	statistics	272.728	45.384	laggedPB	statistics	102.033	15.209
	p-value	0.000	0.000		p-value	0.000	0.000
ROE	statistics	80.961	11.484	Rnokeur	statistics	199.989	32.525
	p-value	0.000	0.000		p-value	0.000	0.000
ExcessR	statistics	209.831	34.2647	Rnokusd	statistics	221.350	36.301
	p-value	0.000	0.000		p-value	0.000	0.000

*Note. PE is the closing price of the stock at the last trading day of the quarter divided by the trailing twelve months basic earnins per share (EPS) excluding extraordinary items. DP is the quarterly dividends per share for common stocks divided by the trailing twelve months EPS excluding extraordinary items. ROE is the quarterly income available to common shareholders excluding extraordinary items for the trailing twelve months divided by the same period average common equity. ExcessR is estimated by Fama-French three factor model. LEV is the quarterly total debt divided by the total equity for the same period. PB is the closing price of the stock at the last trading day of the quarter by its book value per share for the same period. Rnokeur and Rnokusd is the closing cross rates of NOKUSD and NOKEUR at the last trading day of the quarter by the closing cross rates of the last trading day of the quarter $t-1$, and minus one.

CHAPTER 5: RESULTS AND DISCUSSION

This chapter focuses on the analysis of the Random and Fixed effects models and discusses the findings. First, the results of the Random effects and Fixed effects models are provided. Then the results of the Robust Hausman specification test, Breush-Pagan Lagrange Multiplier test and modified version of the Pesaran's cross-sectional dependence test are presented. These are then followed by a discussion and an interpretation of the empirical evidence derived from the Random effects model.

5.1 Random Effects model

After having discussed all variables and making sure that the assumptions are held, we can rewrite the Eq.4 as following:

$$PE_{it} = \alpha + \beta_1 DP_{it} + \beta_2 ROE_{it} + \beta_3 ExcessR_{it} + \beta_4 LEV_{it} + \beta_5 * PB_{i(t-1)} + \beta_6 Rnokeur_{it} + \beta_7 Rnoksusd_{it} + \theta_{it}$$

In order to make the estimators of the Random effects model robust to cross-sectional heteroskedasticity and within-panel serial correlation, the procedures proposed by Arellano (1987), Wooldridge (2013) are applied. The results of the Random effects model with the Huber-White sandwich robustification and Swamy-Arora's transformation are given in Table 8.

Uncentered variance inflation factors (VIF) are calculated as a post-estimation procedure to detect multicollinearity among the independent variables and constant term. The output for the uncentered VIF is given in Appendix B. According to Chatterjee and Hadi (2012), one must be concerned about the multicollinearity problem if the (uncentered) VIF is greater than 10. Some other authors suggest, that the collinearity problem exists if the VIF is greater than 30. (O'brien (2007)) The post-estimation VIF results show that the largest uncentered VIF is less than 3. So, no concern about the multicollinearity problem should arise.

The results of Random effect model indicate that the major determinant of the price-earnings ratio is the return on equity. There is a negative relationship between the return on equity and price-earnings ratio and a positive relationship between the dividend payout ratio and excess returns. The depreciation (appreciation) of the Norwegian krone against the euro seem to have a positive (negative) effect on the price-earnings ratio. However, we don't discuss the results and whether they are consistent with the results of the existing literature now since more steps should be done before we conclude that the Random effects model is appropriate tool to describe the relationship between the price-earnings ratio and independent variables.

Table 8. Results of the Random effects model

	DP	ROE	Excess Ret	LEV	laggedPB	Rnokeur	Rnokusd	intercept
coefficient	7.119	-101.231	12.366	-5.984	2.329	-29.099	5.180	35.439
robust stand.error	1.066	30.155	7.063	3.458	0.281	11.136	11.634	7.419
p-value	0.000	0.001	0.080	0.084	0.000	0.009	0.656	0.000
Adj R^2								
within	0.264		prob > chi2	0.000				
between	0.718		nr obs	269				
overall	0.306		nr indiv	8				

*Note. PE is the closing price of the stock at the last trading day of the quarter divided by the trailing twelve months basic earnins per share (EPS) excluding extraordinary items. DP is the quarterly dividends per share for common stocks divided by the trailing twelve months EPS excluding extraordinary items. ROE is the quarterly income available to common shareholders excluding extraordinary items for the trailing twelve months divided by the same period average common equity. ExcessR is estimated by Fama-French three factor model. LEV is the quarterly total debt divided by the total equity for the same period. Price-book value ratio is the closing price of the stock at the last trading day of the quarter by its book value per share for the same period. Rnokeur and Rnokusd is the closing cross rates of NOKUSD and NOKEUR at the last trading day of the quarter by the closing cross rates of the last trading day of the quarter $t-1$, and minus one.

5.2. Fixed effects model

We rewrite the Eq.9 as following and run the model with the Huber-White sandwich robustification to cross-sectional heteroskedasticity and autocorrelation.

$$\ddot{PE}_{it} = \alpha + \ddot{\beta}_1 DP'_{it} + \beta_2 \ddot{ROE}'_{it} + \beta_3 \ddot{Excessret}'_{it} + \beta_4 \ddot{LEV}'_{it} + \beta_5 \ddot{PB}'_{i(t-1)} + \beta_6 \ddot{Rnokeur}'_{it} + \beta_7 \ddot{Rnokusd}'_{it} + \ddot{u}_{it}$$

The results of the Fixed effects model are provided in Table 9. The results clearly show that the major determinant of the price-earnings ratio in the seafood industry is the return on equity. The sign of the all coefficients are the same as in the Random effects model, however some of them are statistically insignificant. The post-estimation results of the uncentered VIF suggest that there is no multicollinearity problem.

Table 9. Results of the Fixed effects model

	DP	ROE	ExcessRet	LEV	laggedPB	Rnokeur	Rnokusd	intercept
coefficient	6.609	-118.896	11.964	-5.765	2.254	-30.837	13.965	38.946
robust stand.error	1.370	42.558	6.794	2.569	0.274	9.292	10.617	6.617
p-value	0.002	0.027	0.122	0.060	0.000	0.013	0.230	0.001
Adj R^2								
within	0.270		prob > chi2	0.000				
between	0.656		nr obs	269				
overall	0.300		nr indiv	8				

*Note. PE is the closing price of the stock at the last trading day of the quarter divided by the trailing twelve months basic earnins per share (EPS) excluding extraordinary items. DP is the quarterly dividends per share for common stocks divided by the trailing twelve months EPS excluding extraordinary items. ROE is the quarterly income available to common shareholders excluding extraordinary items for the trailing twelve months divided by the same period average common equity. ExcessR is estimated by Fama-French three factor model. LEV is the quarterly total debt divided by the total equity for the same period. Price-book value ratio is the closing price of the stock at the last trading day of the quarter by its book value per share for the same period. Rnokeur and Rnokusd is the closing cross rates of NOKUSD and NOKEUR at the last trading day of the quarter by the closing cross rates of the last trading day of the quarter $t-1$, and minus one.

5.3 Robust Hausman specification test based on the bootstrap procedure

Robust Hausman specification test is conducted based on the bootstrap procedures in order to test whether the error term is correlated with the explanatory variables and to decide which model to use to analyze the relationship between the variables. The test results clearly show that we fail to reject the null hypothesis with chi-square value of 6.84 and p-value of 0.446. Hence, Random effects model is preferred since it provides more efficient estimator.

5.4 Modified version of the Breush-Pagan Lagrange multiplier test

Once it is decided that the Random effects model is preferred over the Fixed effects model, we perform modified version of the Breush-Pagan Lagrange multiplier test to check for the existence of the random effects within the panel. Put differently, we decide whether the Random effect model or the simple pooled OLS should be applied. The results of the test are provided in Table 10.

As it can be seen from the test results, the unadjusted version of the tests for the one-sided and two-sided random effects (LM(Var(u)=0) and serial correlation LM(lambda=0) clearly indicate to reject their null hypothesis at the 5% and 10% significance level respectively. The joint null hypothesis (Var(u)=0,lambda=0) of no random effect and no serial correlation is also rejected. Bera et al. (2001) showed that the rejection of the joint null hypothesis might occur due to the presence of either serial correlation, random effects, or both. That is why, the conclusion about the direction of the misspecification should be taken with care. As the results of the tests show, the adjusted version of the test for random effects still reject the null hypothesis of no random effects, while the adjusted version of the test for serial correlation fails to reject the null hypothesis of no serial correlation.

Table 10. Results of the modified version of the Breush-Pagan Lagrange multiplier test

Random effects, Two Sided:			
Unadjusted LM(Var(u)=0)	5.460	prob>chi2(1)	0.020
Adjusted LM(Var(u)=0)	3.880	prob>chi2(1)	0.049
Random effects, One Sided:			
Unadjusted LM(Var(u)=0)	2.340	prob>N(0.1)	0.010
Adjusted LM(Var(u)=0)	1.970	prob>N(0.1)	0.024
Serial Correlation:			
Unadjusted LM(lambda=0)	3.290	prob>chi2(1)	0.070
Adjusted LM(lambda=0)	1.710	prob>chi2(1)	0.190
Joint Test:			
LM(Var(u)=0,lambda=0)	7.170	prob>chi2(2)	0.028

Hence, we conclude that the presence of random effects rather than serial correlation leads to the misspecification and the presence of random effects confounds the unadjusted test for serial correlation and leads to spuriously reject the null hypothesis of no serial correlation.

We conclude, that the Random effects model rather than the pooled OLS should be applied to study the determinants of the price-earnings ratio for the Norwegian seafood industry.

5.5 Pesaran's cross-sectional dependence tests

Since the stocks might face common shocks and unobserved common factors that are part of the error term, the panel data might have a cross-sectional dependence. The Pesaran's cross-sectional dependence test is conducted to reveal if the residuals are correlated across units. The test results show that the null hypothesis of no cross-sectional dependence is strongly rejected. However, in the presence of the cross-sectional dependence, the results of the Random effects model are consistent, but inefficient. Hence, the next task is to remove the cross-sectional dependence.

Table 11. Results of the Pesaran's cross-sectional dependence tests

	Pesaran's test
test statistic	2.988
average absolute value of the off-diagonal elements	0.269
probability	0.003

There are several ways to solve this issue. In the case of the Fixed effects and pooled OLS models, the Driscoll-Krall estimator can be used. (Driscoll and Kraay (1998)) Moreover, time dummies can be included with the purpose to purge the cross-sectional dependence in the model. (Hoechle (2007))

Asche and Sikveland (2015) provided an interesting evidence of the six-year cycle in EBIT per kg in the salmon industry. Moreover, there are several stages in the salmon life cycle, which lasts several years to complete, from spawn to adult. The production of the salmon might be affected by different factors, including the temperature, climate, etc.. These kinds of events might be associated with one of the observed years and might affect all the seafood companies. In order to control for the year effects, the time dummy variables for the years excluding the first observation year are introduced in the model.

The results of the random effects model after including time dummy variables and the results of the Pesaran’s cross sectional dependence test are provided in Table 12 and Table 13 respectively.

Table 12. Results of the Random Effects model after including the time dummy variables

	DP	ROE	Excess Ret	LEV	laggedPB	Rnokeur	Rnokusd	Intercept
coefficient	7.504	-97.498	11.062	-3.208	2.175	-18.588	-0.316	27.280
robust stand.error	0.823	27.123	5.126	6.987	0.437	34.840	16.254	52.855
p-value	0.000	0.000	0.031	0.646	0.000	0.594	0.984	0.606

	2002	2003	2004	2005	2006	2007	2008	2009
coefficient	-6.786	0.488	-1.732	1.509	5.933	21.129	9.232	3.267
robust stand.error	49.340	49.269	46.674	44.162	49.140	38.328	44.594	43.593
p-value	0.891	0.010	-0.040	0.030	0.120	0.550	0.210	0.070

	2010	2011	2012	2013	2014	2015	2016
coefficient	3.630	-0.121	2.287	5.218	2.995	9.815	10.549
robust stand.error	47.600	46.692	45.166	48.662	46.621	44.875	47.751
p-value	0.080	0.000	0.050	0.110	0.060	0.220	0.220

Adj R^2	within	0.303	prob > chi2	0.000
	between	0.716	Nr obs	269
	overall	0.341	Nr indiv	8

*Note. PE is the closing price of the stock at the last trading day of the quarter divided by the trailing twelve months basic earnins per share (EPS) excluding extraordinary items. DP is the quarterly dividends per share for common stocks divided by the trailing twelve months EPS excluding extraordinary items. ROE is the quarterly income available to common shareholders excluding extraordinary items for the trailing twelve months divided by the same period average common equity. ExcessR is estimated by Fama-French three factor model. LEV is the quarterly total debt divided by the total equity for the same period. Price-book value ratio is the closing price of the stock at the last trading day of the quarter by its book value per share for the same period. Rnokeur and Rnokusd is the closing cross rates of NOKUSD and NOKEUR at the last trading day of the quarter by the closing cross rates of the last trading day of the quarter $t-1$, and minus one.

The post-estimation results of the uncentered VIF show no multicollinearity problem exists. (see Appendix C) As it can be seen from Table 13, we were able to purge the cross-sectional dependence by including the time dummy variables. Now, the estimators of the Random effects model are consistent and efficient.

Table 13. Results of the Pesaran's cross-sectional test after including the time dummy variables

Pesaran's test statistics	1.190
probability	0.234
average absolute value of the off-diagonal elements	0.313

5.6 Discussion

The results of the Random effects model which is robust for heteroscedasticity, serial correlation and cross-sectional dependence (see Table 12) suggest that among the included variables, return on equity has the major explanatory power to explain the price-earnings ratio of the Norwegian seafood stocks. The sign of the coefficient of the return on equity is negative and statistically significant at the 1% confidence interval. The results of the previous studies are mixed. For example, Maginn, Tuttle, McLeavey, and Pinto (2007) demonstrated a positive relationship between the price-earnings ratio and return on equity. Penman (1996) showed that price-earnings ratio is related to current return on equity. However, we found in the example of the Norwegian seafood industry that the price-earnings ratio is a decreasing function of the return on equity, which is consistent with the findings of Tamilselvan and Manjula (2016). On the one hand, it might be odd to find contradictory evidence to the aforementioned statement of the positive relationship between the return on equity and price-earnings ratio since return on equity shows how efficiently the firm manages shareholder's money in the business to generate a profit. In other words, it is a measure of what the firm generates from each Norwegian krone of capital the shareholders invested in that business. Logically, higher the profitability, higher the investors are willing to pay for each share, or higher the price-earnings ratio. On the other hand, the return on equity should be considered with care, because depending upon the sector or industry the firm operates, the return on equity might look different and therefore might not show the true picture of the company's profitability and operation. Hence, one must interpret it with care and investigate what actually triggers high return on equity. The increase in return on equity could be fueled by the increase either in net profit margin, asset turnover or leverage. That being said, one of the possible explanation to the negative relationship between the return on equity and price-earnings ratio in the Norwegian seafood industry could be the contention that the seafood companies bore high debts or used share buybacks which might have exhibited an artificially strong return on equity. Any business that finances growth through debt eventually meets higher interest burden and higher risk of financial distress which in turn will impact the company's profitability in the long term. And these facts might be priced into the seafood stocks and, hence, the stocks with high return on equity have low price-earnings ratio. Moreover, the net income available to common shareholders is a nominator in return on equity calculation. As discussed earlier, Asche and Sikveland (2015) provided the evidence of six-year cycle in EBIT per kg of salmon. Moreover, Beaver and Morse (1978) demonstrated that shares with relatively low earnings growth during the year have relatively high price-earnings ratio. Another explanation to the negative relationship between return on equity and price-earnings ratio could be the argument that earnings bear transitory components and so investors price the seafood stocks accordingly.

The results of the Random effects model demonstrate that the dividend payout ratio has a positive effect on price-earnings ratio, which is consistent with the Discounted dividend model, Malkiel and Cragg (1970), Loughlin (1996). Basically, investors are willing to pay higher for the stocks that pay larger dividends to their shareholders. The coefficient is significant at the 1% significance level and the price-earnings ratio increases by approximately 7.504% for a 1% increase in the dividend payout ratio.

Interestingly, we find empirical evidence of a positive relationship between the price-earnings ratio and excess returns on the stocks, and it is statistically significant at the 5% confidence interval. This finding contradicts the results of Basu (1977), Pinches and Simon (1972), Bondt and Thaler (1985) and most importantly, the widely used Discounted Dividend model. Beaver and Morse (1978) argued that the relationship between the price-earnings ratio and market risk could be either positive or negative, depending on the market conditions. For example, price-earnings ratio of the high beta stocks seem to be higher than the market-wide price-earnings ratio during the years of high transitory earnings. This can be explained by the behaviour of the earnings of the high beta stocks which are more sensitive to the economy-wide factors. Conversely, price-earnings ratio of the high beta stocks seem to be lower than the market-wide price-earnings ratio during the years of low transitory earnings. Nonetheless, they concluded that risk bears little capacity to explain the behaviour of price-earnings ratio.

Our finding is in agreement with Ibrahim and Yong (1991), Afza and Tahir (2012) and Pala (2014) who found a positive relationship between the price-earnings ratio and excess returns on common stocks. Ibrahim and Yong (1991) employed a nonparametric test, namely Spearman rank correlation tool to check this relationship on thirty stocks. In all sub-periods, the high price-earnings ratio stocks outperformed those with lower price-earnings ratio. However, the correlation between the return and price-earnings ratio in one of the sub-periods seem to be statistically insignificant. Afza and Tahir (2012) used a simple ordinary least square regression for data of 25 firms in the chemical sector of Pakistan. They found a positive relationship between the market return and price-earnings ratio, though it was statistically insignificant. Moreover, they demonstrated that the variability in market price of the stocks are positively associated with the price-earnings ratio of the corresponding stocks and the coefficients are statistically significant at the 5% confidence interval. Pala (2014) investigated the effect of gold and petroluem prices, valuation ratios on equity returns, namely on returns of ISE-100 (Istanbul Stock exchange). They found a positive relationship between the equity returns and price-earnings ratio, which is statistically significant at the 1% confidence interval.

We are used to assume that higher the cost of equity, lower the price-earnings ratio of the stock. As supported by Ibrahim and Yong (1991), Afza and Tahir (2012) and Pala (2014), this is not the case for the Norwegian seafood industry. There might be several possible explanations to account for this. Firstly, measured by the number of listed firms, the OSE is the second largest financial market place for energy and oil and gas companies, and the world's leading financial market place for the seafood industry. As we know, the price-earnings ratio and the share price of a firm are affected not only by factors that characterize that partular firm or the industry the firm operates in, but also by the price movements on the market as a whole. In recent times, we have witnessed the salmon prices hit high records when the oil price was at its lowest point. Last year, the value of a standard-sized salmon from Norwegian fish farming facilities was worth approximately 330 norwegian krone while a barrel of North Sea crude oil was worth of 270 Norwegian krone. (Berglund, 2016) Since mid-2014, the oil industry has been facing investory glut while the demand for the Norwegian salmon has been increasing. This can explain the behaviour of the market participants or investors who are willing to pay higher for the seafood stocks even though the systematic risk is high. Moreover, this positive association can be explained by the investors' positive expectation about the future of the company. This leads one to assume that the high volatility of the seafood stock prices increased the excess return, which in turn pushed the price-earnings ratio of the corresponding stock up, not down. Further analysis into the links between the price movements of North Sea crude oil and salmon price is left to future research.

Secondly, aligned with Misund (2016a), we found that salmon price is an important determinant of the excess returns on the seafood stocks. (discussed in Section 4.1.2.3) That is why, the excess returns were calculated by Fama-French three factor model including the salmon price changes. The inclusion of the salmon price changes into the excess returns calculation might have affected to a positive relationship between the price-earnings ratio and excess returns.

That being said, the seafood stocks with higher price-earnings ratio outperforms the stocks with lower price-earnings ratio. Hence, the semi-strong form of the efficient market hypothesis is rejected.

Penman (1996) showed that price-book value ratio reflects the influence of future profitability, therefore is a good indicator of earning growth. He further demonstrated that price-earnings ratio and price-book value ratio are positively related. He came to this conclusion by ranking portfolios based on price-book ratio for the period of 1968-1985, and providing an empirical evidence of how above-median values of price-earnings ratio are accompanied by above-median values of price-book value ratio. As is well known, the current level of a variable might be determined by its past level. However, lagged dependent variable creates some complications in the Fixed effects and Random effects models and can lead to biased estimates. (Bollen and Brand (2010)) To avoid having a lagged dependent variable as an explanatory variable in the model and taking into account aforementioned empirical evidence provided by Penman (1996), the lagged price-book value was included in the model. By inference, the results of the Random effects model suggest that lagged price-book value has an explanatory power to explain the variations in the price-earnings ratio. The coefficient of the lagged price-book value ratio is positive and statistically significant at the 1% confidence interval. The empirical evidence derived in this research extends the findings of Penman (1996) and suggests that the lagged price-book value ratio has an explanatory power to explain the price-earnings ratio of the Norwegian seafood companies.

Furthermore, the results of the Random effects model suggest that there is a negative relationship between the price-earnings ratio and leverage or debt-equity ratio. The logic behind this relationship is simple. High debt increases the risk of financial distress, which in turn leads to lower price-earnings ratio. As discussed earlier, increase in borrowings potentially leads to artificially higher expected returns on equity and as well as higher riskiness in those returns, which in turn pushes the price-earnings ratio down. Nonetheless, the coefficient of the leverage ratio is statistically insignificant. The finding is consistent with Constand, Freitas, and Sullivan (1991), Cho (1993), and Afza and Tahir (2012).

Over the last years, the foreign demand for the Norwegian seafood products have increased substantially. This phenomenon might be connected to the depreciation of the Norwegian krone against the euro and the US dollar. The results of the Random effects model show that the weak Norwegian krone against the euro and the US dollar increases the price-earnings ratio of the seafood stocks, howbeit, the coefficients are statistically insignificant. Hence, the depreciation (appreciation) of the Norwegian krone is not an important determinant of the price-earnings ratio of the Norwegian seafood stocks. Proffered explanation is the fact that salmon is a scarce resource in the world market and the significant increase in the export price for salmon could be due to the reduced global export volumes. For example, the Chilean salmon disease in late 2008s contributed to the shift in demand; away from Chili to Norway, which in turn boosted the prices of Norwegian salmons. Moreover, Xie et al. (2008) demonstrated that exchange rate pass-through was complete for the major seafood exporters like Chile and the UK and incomplete for Norway. By implication, salmon export prices are affected by non-tariff trade barriers and market power, or both. Misund (2016a) found that the changes in NOKEUR and NOKUSD could not explain the excess returns on the Norwegian seafood stocks. However, in considering other sectors, Shamsuddin and Hillier (2004) found a positive relationship between the appreciation of the Australian dollar against the US dollar and the price-earnings ratio for the ASX200 index. On the one hand, the depreciation of the Norwegian krone against the euro and the US dollar could increase demand for the Norwegian seafood products and seafood equities, which in turn increases the seafood stock prices. On the other hand, it could increase the total export volume in Norwegian krone or earnings of the Norwegian seafood companies due to the high salmon price and high demand for the Norwegian seafood products. Hence, the net impact of the weak Norwegian krone on the price-earnings ratio of the seafood stocks might be offset by two opposing effects.

Further the model has been analyzed keeping only the most important determinants of the price-earnings ratio, i.e. dividend payout ratio, return on equity and excess returns. The results are given in Appendix D. The adjusted between R-squared decreased by 2.8% from being 71.6% to 68.8% while the adjusted within R-squared decreased by 2.4% from being 30.3% to 27.9%. Hence, the inclusion of the lagged price-book value ratio in the model improved the model increasing the adjusted between and within R-squared by approximately 2.37% and 1.8% respectively.

5.7 Limitations and suggestions for future works

The small number of observations is the major limitation of this research. Currently, only ten seafood companies are listed at the OSE. Two of them, namely Scottish Salmon Company PLC and Hofseth BioCare ASA are excluded from the panel data due to the following reasons:

- The financial statements of the Scottish Salmon Company PLC are available for the periods of 2013-2016 in datastream. For the purpose of consistency, it is preferable to collect the same set of data for all companies from one source.
- Hofseth BioCare ASA has reported only negative earnings per share; hence no price-earnings ratio is available for that company.

However, to the best of my knowledge, no definitive number for what constitutes a small number of observations has been established in the literature.

This research employs the company level seafood industry data from only one country; Norway, which is the leading producer of Atlantic salmon and the second largest seafood exporter in the world. Other large markets such as Chili, China and the US are not considered in this research due to the country-specific market environments which might differ from country to country and the variables that might be needed to explain the determinants of the price-earnings ratio for the seafood industry of that countries, e.g. model to estimate the excess returns, Fama-French risk factors for each market, exchange rates, etc. Future empirical studies on the determinants of the excess returns and price-earnings ratio may be conducted on the seafood industry of other countries. Moreover, the results of this research are subject to the drawbacks of the Random effects model and the specification tests that are employed during the research.

CHAPTER 6. CONCLUSION AND SUMMARY

A geographical location of Norway with jagged and long coastline facilitates the country's perfect conditions for fish farming. With government support and sustainable resource management, the Norwegian aquaculture has been in growth since the late 1960s. Currently, Norway is the leading producer of salmon and Fish Pool ASA is one of the most important market places for the trading of financial salmon contracts.

Various factors have contributed to the perfect market conditions from the perspective of the Norwegian seafood industry, resulting in increasing demand for the Norwegian salmon, soaring salmon prices, record high export volumes and high revenues for the Norwegian seafood companies. These combined factors have made the stocks of the Norwegian seafood companies attractive to investors.

The focus of recent studies has been on the operational and market risks to which the Norwegian seafood stocks are exposed, and the valuation of salmon companies. (Oglend and Sikveland (2008), Asche and Sikveland (2015), Ewald and Salehi (2015), Misund (2016a), Misund (2016b), Zhang et al. (2016)) Of valuation models, price-earnings ratio is widely used by investors and analysts as a quick way to glimpse into the relative values of companies. It is popular among the investors due to its simplicity and ability to compare the stocks without embarking on the details of an accounting report. Despite being an easy-to-use valuation tool, the price-earnings ratio must be interpreted with caution along with its determinants which in turn might vary from industry to industry. It can be too informative, as well as difficult to parse. That is why the price-earnings ratio is often misused and misinterpreted by investors and analysts. In the backdrop of growing interest in the Norwegian seafood industry and in the light of great popularity in the use of the price-earnings ratio as a valuation tool, one might be concerned about what actually determines the price-earnings ratio of the Norwegian seafood companies.

The studies that had investigated the determinants of price-earnings ratio at company level by controlling for industry and year effect are scant. To the best of my knowledge, no such study has been undertaken in the Norwegian seafood industry. Hence, this research sought to fill the gap in the existing literature by investigating the determinants of the price-earnings ratio in the Norwegian seafood industry.

Eight out of ten seafood companies listed at the OSE have been analyzed. The obtained panel data is unbalanced. After conducting the unit root tests, Robust Hausman specification test, modified version of the Breush-Pagan Lagrange Multiplier test and purging the cross-sectional dependence problem, the Random effects model is selected to analyze the determinants of the price-earnings ratio of the Norwegian seafood companies.

This research contributes to the literature in several ways. Firstly, this research provides the first empirical evidence of the determinants of the price-earnings ratio for the Norwegian seafood industry. A positive relationship was found to exist between the price-earnings ratio and excess returns on the stocks, and this is consistent with the results of Ibrahim and Yong (1991), Afza and Tahir (2012) and Pala (2014). The resuts however contradicts the findings of Basu (1977), Pinches and Simon (1972), Bondt and Thaler (1985) and most importantly, the widely used Discounted Dividend model. There are several explanations to this finding. One of them can be the nature of the price-earnings ratio which is affected not only by factors that characterize the specific firm or the industry the firm operates, but also by the price movements on the market. OSE is the second largest financial market place for energy and oil companies, and the world's foremost financial market place for the salmon companies. The salmon price has been on the increase due to high demands, therby hitting a record high, while the oil price has been facing a downward trend due to inventory glut. These facts can explain the behaviour of investors who are willing to pay higher for the seafood stocks despite high systematic risk in aims of gaining high profits. It shows investors' positive expectation about the future of the seafood companies. Further analysis into the links between the price movements of North Sea crude oil and salmon price is left to future research.

The findings also suggest that the price-earnings ratio of the Norwegian seafood companies is a decreasing function of the return on equity. These results are consistent with the finding of Tamilselvan and Manjula (2016). One of the possible explanation could be the contention that the seafood companies bore high debts or used share buybacks which in turn exhibited an artificially strong return on equity. However, financing of growth through debt eventually leads to higher interest burden and greater risk of financial distress which will in turn impact the company's profitability in the long term. These facts might be priced into the seafood stocks pushing the price-earnings ratio down. Another possible explanation could be the argument that earnings bear transitory components and so investors price the seafood stocks accordingly.

From this study, a positive relationship is found to exist between the price-earnings ratio and dividend payout ratio, which is quite intuitive. The depreciation (appreciation) of the Norwegian krone against the euro and the US dollar positively (negatively) affects the price-earnings ratio, but the coefficients are found to be statistically insignificant.

Secondly, the findings derived from this research extends beyond the findings of Penman (1996) and suggest that the lagged price-book value ratio has some explanatory power to explain the priceeanings ratio. Penman (1996) demonstrated that price-book value ratio is a good indicator of earning growth and price-earnings ratio is positively associated with price-book value ratio. By taking into account these findings, we included a lagged price-book value ratio in the model to avoid having a dependent variable as a regressor in the model since it creates complications in the Fixed effects and Random effects models.

Thirdly, in concurrence with Misund (2016a), this study found that salmon price is an important determinant of the excess returns on the seafood stocks. (discussed in Section 4.1.2.3) Hence, the excess returns were calculated by Fama-French three factor model which included salmon price changes.

Finally, the findings demonstrate that the semi-strong form of the efficient market hypothesis is rejected in the example of Norwegian seafood industry as the seafood stocks with higher price-earnings ratio outperform those with lower price-earnings ratio.

The evidence derived from this research enhances our understanding of price-earning ratio and the consequences of using equity valuation in the Norwegian seafood industry. The findings provide insights to investors and portfolio managers about the outcomes of equity valuation and contribute to decision making and investment strategies.

The small number of observations utilized in this study is the major limitation of this research. Moreover, the analysis utilized data from the Norwegian seafood companies. Hence, future works can study the determinants of price-earnings ratio for the seafood industry of other countries.

reference

Afza, T., & Tahir, S. 2012. Determinants of price-earnings ratio: the case of chemical sector of Pakistan. *International Journal of Academic Research in Business and Social Sciences*, 2(8): 331.

Ahn, S. C., & Low, S. 1996. A reformulation of the Hausman test for regression models with pooled cross-section-time-series data. *Journal of Econometrics*, 71(1): 309-319.

Al-Mwalla, M., Al-Omari, A. M., & Ayad, F. 2010. The relationship between P/E ratio, dividend yield ratio, size and stock returns in Jordanian companies: A co-integration approach. *International Research Journal of Finance and Economics*, 49(7): 87-103.

Alford, A. W. 1992. The effect of the set of comparable firms on the accuracy of the price-earnings valuation method. *Journal of Accounting Research*: 94-108.

Andersen, T. B., Roll, K. H., & Tveterås, S. 2008. The price responsiveness of salmon supply in the short and long run. *Marine Resource Economics*, 23(4): 425-437.

Anderson, K., & Brooks, C. 2006. Decomposing the price-earnings ratio. *Journal of Asset Management*, 6(6): 456-469.

Arellano, M. 1987. Practitioners' corner: Computing Robust Standard Errors for Within-groups Estimators. *Oxford bulletin of Economics and Statistics*, 49(4): 431-434.

Asche, F. 1996. A system approach to the demand for salmon in the European Union. *Applied Economics*, 28(1): 97-101.

Asche, F., Hansen, H., Tveteras, R., & Tveterås, S. 2009. The salmon disease crisis in Chile. *Marine Resource Economics*, 24(4): 405-411.

Asche, F., Roll, K. H., Sandvold, H. N., Sørvig, A., & Zhang, D. 2013. Salmon aquaculture: larger companies and increased production. *Aquaculture Economics & Management*, 17(3): 322-339.

Asche, F., & Sikveland, M. 2015. The behavior of operating earnings in the Norwegian salmon farming industry. *Aquaculture Economics & Management*, 19(3): 301-315.

Baltagi, B. H. 1995. Editor's introduction Panel data. *Journal of Econometrics*, 68(1): 1-4.

Baltagi, B. H., & Chang, Y.-J. 1994. Incomplete panels: A comparative study of alternative estimators for the unbalanced one-way error component regression model. *Journal of Econometrics*, 62(2): 67-89.

Baltagi, B. H., & Li, Q. 1990. A Lagrange multiplier test for the error components model with incomplete panels. *Econometric Reviews*, 9(1): 103-107.

Baltagi, B. H., & Li, Q. 1991. A joint test for serial correlation and random individual effects. *Statistics & Probability Letters*, 11(3): 277-280.

Basu, S. 1977. Investment performance of common stocks in relation to their price-earnings ratios: A test of the efficient market hypothesis. *The journal of Finance*, 32(3): 663-682.

Beaver, W., & Morse, D. 1978. What determines price-earnings ratios? *Financial Analysts Journal*: 65-76.

Bera, A. K., Sosa-Escudero, W., & Yoon, M. 2001. Tests for the error component model in the presence of local misspecification. *Journal of Econometrics*, 101(1): 1-23.

Bollen, K. A., & Brand, J. E. 2010. A general panel model with random and fixed effects: A structural equations approach. *Social forces; a scientific medium of social study and interpretation*, 89(1): 1.

Bondt, W. F., & Thaler, R. 1985. Does the stock market overreact? *The Journal of finance*, 40(3): 793-805.

Breusch, T. S., & Pagan, A. R. 1980. The Lagrange multiplier test and its applications to model specification in econometrics. *The Review of Economic Studies*, 47(1): 239-253.

Chatterjee, S., & Hadi, A. S. 2012. The Problem of Correlated Errors. *Regression Analysis by Example, Fourth Edition*: 197-219.

Cho, J. Y. 1993. Determinants of earnings-price ratios: a reexamination. *Review of Financial Economics*, 3(1): 105.

Choi, I. 2001. Unit root tests for panel data. *Journal of international money and Finance*, 20(2): 249-272.

Clarke, P., Crawford, C., Steele, F., & Vignoles, A. F. 2010. The choice between fixed and random effects models: some considerations for educational research.

Constand, R. L., Freitas, L. P., & Sullivan, M. J. 1991. Factors affecting price earnings ratios and market values of Japanese firms. *Financial Management*: 68-79.

Craig, D., Johnson, G., & Joy, M. 1987. Accounting methods and P/E ratios. *Financial Analysts Journal*: 41-45.

Dickey, D. A., & Fuller, W. A. 1979. Distribution of the estimators for autoregressive time series with a unit root. *Journal of the American statistical association*, 74(366a): 427-431.

Driscoll, J. C., & Kraay, A. C. 1998. Consistent covariance matrix estimation with spatially dependent panel data. *Review of economics and statistics*, 80(4): 549-560.

Estrada, J. 2005. Adjusting P/E ratios by growth and risk: the PERG ratio. *International Journal of Managerial Finance*, 1(3): 187-203.

Ewald, C.-O., & Salehi, P. 2015. Salmon Futures and the Fish Pool Market in the Context of the CAPM and the Fama & French Three-Factor Model.

Frees, E. W. 1995. Assessing cross-sectional correlation in panel data. *Journal of econometrics*, 69(2): 393-414.

Friedman, M. 1937. The use of ranks to avoid the assumption of normality implicit in the analysis of variance. *Journal of the american statistical association*, 32(200): 675-701.

Fritzemeier, L. H. 1936. Relative price fluctuations of industrial stocks in different price groups. *The Journal of Business of the University of Chicago*, 9(2): 133-154.

Galvao, A. F., Montes-Rojas, G., Sosa-Escudero, W., & Wang, L. 2013. Tests for skewness and kurtosis in the one-way error component model. *Journal of Multivariate Analysis*, 122: 35-52.

Gordon, M. J. 1959. Dividends, earnings, and stock prices. *The review of economics and statistics*: 99-105.

Gordon, M. J., & Shapiro, E. 1956. Capital equipment analysis: the required rate of profit. *Management science*, 3(1): 102-110.

Granger, C. W., & Newbold, P. 1974. Spurious regressions in econometrics. *Journal of econometrics*, 2(2): 111-120.

Hausman, J. A. 1978. Specification tests in econometrics. *Econometrica: Journal of the Econometric Society*: 1251-1271.

Hausman, J. A., & Taylor, W. E. 1981. Panel data and unobservable individual effects. *Econometrica: Journal of the Econometric Society*: 1377-1398.

Hersoug, B. 2015. The greening of Norwegian salmon production. *Maritime Studies*, 14(1): 16.

Hoechle, D. 2007. Robust standard errors for panel regressions with cross-sectional dependence. *Stata Journal*, 7(3): 281.

Huang, Y., Tsai, C.-H., & Chen, C. R. 2007. Expected P/E, Residual P/E, and Stock Return Reversal: Time-Varying Fundamentals or Investor Overreaction? *International Journal of Business and Economics*, 6(1): 11.

Huber, P. J. 1967. *The behavior of maximum likelihood estimates under nonstandard conditions*. Paper presented at the Proceedings of the fifth Berkeley symposium on mathematical statistics and probability.

Ibrahim, I., & Yong, O. 1991. Relationship between price-earnings ratios and expected return of common stocks: The case of Malaysia. *Jurnal Pengurusan*, 10: 95-103.

Kaiser, B. 2014. RHAUSMAN: Stata module to perform a (cluster-) robust Hausman test. *University of Bern*.

Kane, A., Marcus, A. J., & Noh, J. 1996. The P/E multiple and market volatility. *Financial Analysts Journal*: 16-24.

Kobayashi, M., Msangi, S., Batka, M., Vannuccini, S., Dey, M. M., & Anderson, J. L. 2015. Fish to 2030: the role and opportunity for aquaculture. *Aquaculture Economics & Management*, 19(3): 282-300.

Loughlin, J. J. 1996. *Determinants of the Price-earnings Multiple for the Standard & Poor's 500 Composite Stock Index and the Effects of Determinant Volatility*.

Maddala, G. S., & Wu, S. 1999. A comparative study of unit root tests with panel data and a new simple test. *Oxford Bulletin of Economics and statistics*, 61(S1): 631-652.

Maginn, J. L., Tuttle, D. L., McLeavey, D. W., & Pinto, J. E. 2007. *Managing investment portfolios: a dynamic process*: John Wiley & Sons.

Malkiel, B. G., & Cragg, J. G. 1970. Expectations and the structure of share prices. *The American Economic Review*, 60(4): 601-617.

MarineHarvest. 2016. Salmon Farming Industry Handbook 2016: 94.

McManus, P. A. 2011. *Introduction to regression models for panel data analysis*. Paper presented at the Workshop in methods, USA: Indiana Unviersity. Slides.

Misund, B. 2016a. Common and Fundamental Risk Factors in Shareholder Returns of Norwegian Salmon Producing Companies: University of Stavanger.

Misund, B. 2016b. Valuation of salmon farming companies. *Aquaculture Economics & Management*: 1-18.

Nell, C., & Zimmermann, S. 2011. Summary based on Chapter 12 of Baltagi: Panel Unit Root Tests. *PhD-Course: Panel Data, Vienna*: 2-8.

O'Connell, P. G. 1998. The overvaluation of purchasing power parity. *Journal of international economics*, 44(1): 1-19.

O'brien, R. M. 2007. A caution regarding rules of thumb for variance inflation factors. *Quality & Quantity*, 41(5): 673-690.

Oglend, A. 2013. Recent trends in salmon price volatility. *Aquaculture Economics & Management*, 17(3): 281-299.

Oglend, A., & Sikveland, M. 2008. The behaviour of salmon price volatility. *Marine Resource Economics*, 23(4): 507-526.

Pala, A. 2014. The Effect of Valuation Ratios, Gold Price, and Petroleum Price on Equity Returns: A Comparison of Static Panel and Quantile Regressions. *Asian Economic and Financial Review*, 4(1): 80.

Penman, S. H. 1996. The articulation of price–earnings ratios and market-to-book ratios and the evaluation of growth (digest summary). *Journal of accounting research*, 34(2): 235-259.

Pesaran, M. H. 2004. General diagnostic tests for cross section dependence in panels.

Pesaran, M. H. 2007. A simple panel unit root test in the presence of cross-section dependence. *Journal of Applied Econometrics*, 22(2): 265-312.

Pinches, G. E., & Simon, G. M. 1972. An analysis of portfolio accumulation strategies employing low-priced common stocks. *Journal of Financial and Quantitative Analysis*, 7(03): 1773-1796.

Reilly, F. K., Griggs, F. T., & Wong, W. 1983. Determinants of the aggregate stock market earnings multiple. *The Journal of Portfolio Management*, 10(1): 36-45.

Robertson, D., & Symons, J. 2000. *Factor residuals in SUR regressions: estimating panels allowing for cross sectional correlation*: Centre for Economic Performance, London School of Economics and Political Science.

Schmidheiny, K., & Basel, U. 2011. Panel data: fixed and random effects. *Short Guides to Microeconometrics*: 2-7.

Shamsuddin, A. F., & Hillier, J. R. 2004. Fundamental determinants of the Australian price–earnings multiple. *Pacific-basin finance journal*, 12(5): 565-576.

Sosa Escudero, W., & Bera, A. K. 2008. Tests for unbalanced error component models under local misspecification. *Documentos de Trabajo del CEDLAS*.

Swamy, P., & Arora, S. S. 1972. The exact finite sample properties of the estimators of coefficients in the error components regression models. *Econometrica: Journal of the Econometric Society*: 261-275.

Tamilselvan, M., & Manjula, V. 2016. Price earnings ratio and financial performance Nexus using panel data regression model: The case of Oman. *International Journal of Business Management & Research (IJBMR)*, 6(2): 79-84.

Tse, R. 2002. Price-earnings ratios, dividend yields and real estate stock prices. *Journal of Real Estate Portfolio Management*, 8(2): 107-113.

White, H. 1980. A heteroskedasticity-consistent covariance matrix estimator and a direct test for heteroskedasticity. *Econometrica: Journal of the Econometric Society*: 817-838.

Wooldridge, J. M. 2010. *Econometric analysis of cross section and panel data*: MIT press.

Wooldridge, J. M. 2013. Correlated Random Effects Panel Data Models. *IZA Summer School in Labor Economics*.

Xie, J., Kinnucan, H. W., & Myrland, Ø. 2008. The effects of exchange rates on export prices of farmed salmon. *Marine Resource Economics*, 23(4): 439-457.

Xie, J., & Myrland, Ø. 2011. Consistent aggregation in fish demand: A study of French salmon demand. *Marine Resource Economics*, 26(4): 267-280.

Zhang, D., Myrland, Ø., & Xie, J. 2016. Firm Size, Commodity Price, and Interdependence Between Firm-Level Stock Prices: The Case of Norwegian Salmon Industry. *Applied Economics and Finance*, 3(4): 179-189.

Webpages

Berglund, N. (2016). Salmon worth more than a barrel of oil. Retrieved from *http://www.newsinenglish.no/2016/01/15/salmon-worth-more-than-oil/*

Oslo Børs. Listed Norwegian Seafood stocks at the Oslo Stock Exchange. Retrieved from *https://www.oslobors.no/ob_eng/Oslo-Boers/Listing/Shares-equity-certificates-and-rights-to-shares/Energy-shipping-and-seafood/*

Ødegaard B. A. (2017) "Asset pricing data at OSE", Fama-French risk factors, Value-weighted market portfolio. Retrieved from *http://finance.bi.no/~bernt/financial_data/ose_asset_pricing_data/index.html*

Norges bank. Figures on the treasury bills and government bonds. Retrieved from *http://www.norges-bank.no/en/Statistics/Interest-rates/*

Fishpool. Weekly salmon spot prices. Retrieved from *http://www.fishpool.eu/*

Food and Agriculture Organization of the United Nations. A return to production growth in 2017 but global salmon shortage here to stay. Retrieved from *http://www.fao.org/in-action/globefish/market-reports/resource-detail/en/c/887679/*

Norwegian Seafood council. Exported value of Norwegian seafood 2015-2017. Retrieved from *https://seafood.no/*

Marine Harvest ASA. Salmon Farming Industry Handbook 2017. Retrieved from *http://marineharvest.com/*

Appendix A. Test for normality based on bootstrap replications

	chi-squared (2)	Prob > chi2
Joint test for normality on residuals overall error term	3,67	0.160
Joint test for normality on residuals within units	0.49	0.782
Nr obs	269	
Nr replications	50	

Appendix B. Uncentered variance inflation factors for the models without time-dummy variables

For the Random effects and Fixed effects models without time-dummy variables

variable		1/VIF	variable		1/VIF
DP	1,07	0.936	laggedPB	2,14	0.467
ROE	2,17	0.461	Rnokeur	1,51	0.661
ExcessRet	1,25	0.800	Rnokusd	1,48	0.674
LEV	2,93	0.341			

*Note. DP is the quarterly dividends per share for common stocks divided by the trailing twelve months EPS excluding extraordinary items. ROE is the quarterly income available to common shareholders excluding extraordinary items for the trailing twelve months divided by the same period average common equity. ExcessR is estimated by Fama-French three factor model. LEV is the quarterly total debt divided by the total equity for the same period. PB is the closing price of the stock at the last trading day of the quarter by its book value per share for the same period. Rnokeur and Rnokusd is the closing cross rates of NOKUSD and NOKEUR at the last trading day of the quarter by the closing cross rates of the last trading day of the quarter $t-1$, and minus one.

Appendix C. Uncentered variance inflation factors for the models with time-dummy variables

variable	VIF	1/VIF	dummy variable	VIF	1/VIF	dummy variable	VIF	1/VIF
DP	1.140	0.875	2002	1.050	0.954	2009	1.730	0.577
ROE	5.390	0.186	2003	1.090	0.918	2010	1.940	0.517
ExcessRet	1.750	0.572	2004	1.090	0.914	2011	1.900	0.528
LEV	6.560	0.152	2005	1.210	0.826	2012	1.510	0.664
laggedPB	4.310	0.232	2006	1.350	0.742	2013	2.150	0.465
Rnokeur	1.880	0.531	2007	1.300	0.767	2014	1.940	0.515
Rnokusd	1.870	0.534	2008	1.390	0.718	2015	1.650	0.604
						2016	1.810	0.552

*Note. DP is the quarterly dividends per share for common stocks divided by the trailing twelve months EPS excluding extraordinary items. ROE is the quarterly income available to common shareholders excluding extraordinary items for the trailing twelve months divided by the same period average common equity. ExcessR is estimated by Fama-French three factor model. LEV is the quarterly total debt divided by the total equity for the same period. Price-book value ratio is the closing price of the stock at the last trading day of the quarter by its book value per share for the same period. Rnokeur and Rnokusd is the closing cross rates of NOKUSD and NOKEUR at the last trading day of the quarter by the closing cross rates of the last trading day of the quarter $t - 1$, and minus one.

Appendix D. Random effects model with only three most important explanatory variables

	DP	ROE	Excess R	2002	2003	2004
coefficient	7.68	-79.65	13.28	-93.54	-84.96	-88.63
robust stand.error	0.81	22.94	4.86	10.61	11.04	9.83
p-value	0.00	0.00	0.01	0.00	0.00	0.00
	2005	2006	2007	2008	2009	2010
coefficient	-86.81	-81.19	-64.11	-75.57	-86.10	-86.19
robust stand.error	5.64	10.75	10.64	12.46	6.37	7.37
p-value						
	2011	2012	2013	2014	2015	2016
coefficient	-88.50	-85.47	-83.11	-84.14	-75.62	-75.47
robust stand.error	8.55	7.49	7.46	7.52	5.32	7.43
p-value						

Adj R^2			
within	0.279	prob > chi2	0
between	0.688	Nr obs	271
overall	0.317	Nr indiv	8

*Note. ROE is the quarterly income available to common shareholders excluding extraordinary items for the trailing twelve months divided by the same period average common equity. ExcessR is estimated by Fama-French three factor model.

Abbreviations

ADF test – Augmented Dickey-Fuller test

DP – dividend payout ratio

LEV – leverage

OLS – Ordinary Least Squares

OSE – Oslo stock exchange

PB – price-book value ratio

PE – price-earnings ratio

ROE – return on equity

VIF – variance inflation factor