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Fiscal Waves in Aquaculture

An Empirical Analysis of the Impacts of the Resource Rent Tax on the Norwegian Salmon Aquaculture Industry

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Abstract

This thesis demonstrates that shocks from tax policy changes significantly affect stock market returns within an industry. We examine the effects of the recently implemented resource rent tax on the Norwegian salmon aquaculture industry. The research primarily unfolds through three analytical perspectives: an event study, a Fama-French three-factor analysis, and a difference-in-difference estimation. The event study identifies substantial abnormal returns, with a decrease of -23.87% on the tax announcement day and an increase of 9.72% on the tax agreement day. The Fama-French analysis, covering September 2021 to March 2024, shows a trend of progressively decreasing alpha, indicating increasingly negative abnormal returns over time. Meanwhile, the difference-in-difference approach evaluates ROA across the broader aquaculture industry over time. It confirms public assertions of increased industry returns post-2014, demonstrating a rise in ROA of approximately 2.94% after 2014 compared to earlier years, relative to a control group. Although the thesis highlights the short-term adverse effects on stock prices, it does not reach a definitive conclusion regarding the justification of the resource rent tax, presenting compelling arguments for both sides. Thus, while the immediate impacts are clear, the long-term implications of the tax remain uncertain.

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1. Introduction

On September 28, 2022, the Norwegian government proposed a 40% resource rent tax on aquaculture, commonly referred to as the "salmon tax" (Ministry of Finance, 2022b). The proposal sparked considerable political debate. Following extensive political discussions, a revised tax rate of 25% was approved by a majority in the Storting on May 25, 2023, reflecting a significant reduction from the initial proposal (Resvoll et al., 2023). The legislation was officially passed on May 31, 2023, with a vote of 93 in favor and 76 against. Additionally, the tax framework includes a controversial provision with a 70 million kroner deduction intended to shield smaller enterprises (Brennmoen, 2023).

Fishing has provided a livelihood for Norwegians for ten thousand years, and fish products have generated significant export revenues for several hundred years (Dørum & Hallenstvedt, 2023). As early as the 1100s and 1200s, fishing emerged as an important export industry. During the 1800s, the industry saw remarkable growth, with stockfish, clipfish, and salted herring becoming key export commodities to numerous countries. At the beginning of the 20th century, fishermen were able to interact more independently with the trading community (Dørum & Hallenstvedt, 2023). Post-World War II, Norway's fishing fleet was modernized and professionalized, transitioning to a system of year-round fishing. This period also saw a consolidation in the industry, with fewer fishermen and larger companies and vessels, such as trawlers, dominating the industry. Since the 1970s, Norway has developed a new branch of the fishing industry, aquaculture, primarily focused on salmon farming, which has created thousands of jobs and generated billions in export revenues (Dørum & Hallenstvedt, 2023).

Seafood now ranks as Norway's second largest export industry, following petroleum (Furuset, 2024). In 2023, Norwegian seafood exports reached a record-breaking value of 172 billion kroner, equivalent to about 39 million meals each day. Notably, salmon constituted 71% of this value, amounting to 122.5 billion kroner, thereby establishing itself as the cornerstone of Norwegian seafood exports (Norwegian Seafood Council, 2024).

This thesis examines the impact of the recently introduced resource rent tax on Norwegian salmon farming companies through three primary analyses. The first is an event study that investigates market reactions on a group of salmon stocks affected by the tax on two key dates: September 28, 2022, when the tax was first proposed, and May 25, 2023, when it was agreed on by a majority of the parliament. The second analysis uses the Fama-French 3-Factors to calculate abnormal returns for salmon companies from September 2021 to March 2024. The third analysis employs a difference-in-difference estimation to assess changes in return on assets (ROA) after 2014 relative to a control group. This leads to the formulation of the following research question for the thesis:

"How did the resource rent tax proposal and subsequent agreement affect the stock prices of Norwegian salmon farming companies, and was the resource rent tax economically justified?"

Hence, this thesis has a dual objective. First, it investigates how the proposal and finalized agreement of the resource rent tax impacted the abnormal returns for shareholders of salmon companies. This analysis is conducted using an event study of these two key events, supplemented by a Fama-French regression analysis covering periods before the tax proposal and after the tax agreement. Second, the thesis examines claims of high industry returns post-2014 by employing a difference-in-difference estimation to assess the ROA for aquaculture companies before and after 2014 in comparison to a control group. This analysis of ROA helps to determine the legitimacy of the resource rent tax.

In our event study, we assessed the immediate impact of the resource rent tax by analyzing five affected salmon farming companies. The findings revealed a significant negative effect on the stock returns of these companies on the announcement day, with an abnormal return of -23.87%. Conversely, the agreement day saw a positive market adjustment, with an abnormal return of 9.72%, suggesting that the agreed tax rate was lower than anticipated.

Furthermore, we conducted a comparative analysis for both the announcement and agreement days, examining the abnormal returns of the treatment group, comprising five salmon companies impacted by the tax, against a control group of five salmon companies not affected by the tax. The results support our initial findings, although the effects were slightly less pronounced. This suggests that the control group also responded to both the announcement and agreement of the resource rent tax, suggesting a potential industry-wide impact, likely driven by uncertainties and information asymmetry regarding impending tax changes. Overall, our study underscores how tax announcements can prompt investors to reassess the future valuations of affected companies.

Using the Fama-French 3-Factors, we investigated the abnormal returns of a group consisting of five salmon company stocks affected by the resource rent tax, concentrating on the period surrounding the tax announcement and agreement. Our findings indicate a progressively declining alpha, signaling a trend of worsening performance. From an investment standpoint, the abnormal returns were negative in a ten-month period following the tax agreement, suggesting that the tax has adversely affected the investment appeal of these companies. This result may strengthen the position of industry stakeholders who have opposed the implementation of the resource rent tax.

Our difference-in-difference estimation adopted a long-term approach to investigate the claims of high industry returns since around 2014. We conducted a regression analysis spanning from 2009 to 2022 to compare the ROA before and after 2014. The treatment group consisted of Norwegian aquaculture companies, which primarily import feed, their largest cost component, and export most of their production. In contrast, the control group included industrial companies that import raw materials used for production and export processed goods. This setup allows for a clear assessment of the economic impacts unique to the aquaculture industry by contrasting it with sectors that share similar trade and supply chain dynamics. The analysis revealed a significant increase in ROA of approximately 2.94% for the treatment group compared to the control group after 2014. This finding provides robust empirical evidence of a positive impact on aquaculture companies after 2014, potentially validating governmental claims regarding the tax's justification.

Our literature review focuses on the potential long-term effects on the industry, beginning with a discussion about resource rent in general and various ways to tax it. We then proceed to review specific studies concerning the taxation of the Norwegian salmon farming industry, highlighting both positive and negative views about the tax. Considering the substantial export revenues and the extensive direct and indirect employment the industry provides, particularly in coastal and sparsely populated regions of Norway, the long-term development of the industry is important for the country's economy (Johnsen et al., 2021).

The thesis is organized in the following manner: Section 2 provides background information on the resource rent tax and an overview of the Norwegian salmon farming industry, including its economic development. Section 3 reviews relevant literature from previous studies. In section 4, we outline the methodology employed for the event study, Fama-French regressions, and the difference-in-difference estimation. Section 5 presents the testable hypotheses. Section 6 describes the data collection process, additionally the section includes descriptive statistics. Section 7 presents the findings from our empirical analyses and examines the validity of these findings using econometric tests. Further, section 8 offers a general discussion on the potential economic implications of the resource rent tax, moreover it includes critical assessments and limitations of our findings. Finally, Section 9 summarizes the key findings and draws conclusions from the research.

2. Background

This section begins with an overview of the resource rent tax for the salmon aquaculture industry. It is followed by a historical look at the Norwegian salmon farming industry and an examination of the economic development within the industry. Lastly, we provide a brief overview of the companies included in our event study and Fama-French 3-Factor regressions.

2.1. Resource Rent Tax

Resource rent is defined as the surplus income generated from exploiting a natural resource once all necessary input factors are compensated at market rates. This surplus income is derived from the exclusive control over a natural resource, representing profits that exceed those typically expected from investments of physical and human capital in alternative business ventures (Greaker & Lindholt, 2019). Sectors such as petroleum and hydropower, which depend on finite resources, often generate extraordinary profits commonly referred to as resource rent. The Norwegian government states that natural resources belong to the society as a whole, and by implementing a resource rent tax, the government ensures that a portion of these extraordinary earnings is redistributed back to society (Office of the Prime Minister & Ministry of Finance, 2023).

Since the early 2000s, the Norwegian aquaculture industry, primarily driven by salmon farming, has experienced substantial and rapid growth. This expansion has led to the identification of significant resource rents within the sector (Greaker & Lindholt, 2019). Consequently, the government introduced a resource rent tax to the aquaculture sector (Office of the Prime Minister & Ministry of Finance, 2023).

There were several critical dates in the debate regarding the resource rent tax that we present below:

September 28, 2022

The Norwegian government proposed the introduction of a resource rent tax on aquaculture, effective January 1, 2023, and was seeking public consultation on the matter. The tax aims to ensure that society benefits from the extraordinary returns generated by the aquaculture industry, which has been identified by Statistics Norway as generating significant resource rents, particularly from salmon farming (Ministry of Finance, 2022b).

The proposed tax was specifically targeting the production of salmon, trout, and rainbow trout, applying a 40% effective rate on resource rents. It included a provision to protect smaller producers by introducing a tax-free allowance of between 4,000 and 5,000 tons. The proposal also ensured that local communities, which provide the natural resources, receive a share of the revenue (Ministry of Finance, 2022b)

Key aspects of the tax include that the tax will be structured as a cash flow tax, with revenues and investments taxed in the year they are incurred. The revenues from salmon should be based on a norm price linked to market prices. Deductions are allowed for fixed assets acquired before the tax's implementation, but not for license costs or related acquisition expenses. The tax is designed to accommodate fluctuations in income, allowing negative resource rent income to be carried forward with interest. Combined with the corporate tax, the total effective marginal tax rate amounts to 62% (Ministry of Finance, 2022b).

January 4, 2023

The deadline for public comments on the government's proposal to introduce a resource rent tax on aquaculture was Wednesday, January 4. Overall, 416 municipalities, county councils, interest groups, trade associations, and individuals submitted their feedback on the proposed tax. A review of these submissions reveals that 78% are negative towards the tax proposal, 8% are positive, and 14% have neutral views (Finansavisen, 2023; Ministry of Finance, 2022a).

For salmon, the proposed resource rent tax would be based on a norm price derived from exchange rates rather than the actual prices achieved. This aspect of the proposal received significant criticism in the responses, as it could result in discrepancies between the normative and actual prices, particularly in cases where salmon farmers are bound by long-term contracts with buyers and do not participate in spot market pricing (Lea, 2023).

March 28, 2023

The government issued a revised proposal that reduces the resource rent tax rate from 40% to 35%. When combined with corporate tax, this adjustment sets the effective marginal tax rate at 57%. Additionally, the government intends to establish an independent price board tasked with determining the market value of salmon, shifting away from the previous fall 2022 proposal that recommended setting prices based on the exchange's spot market rate. Furthermore, the revised proposal includes a basic deduction of 70 million kroner, designed to ensure that only companies with significant profits are subject to the resource rent tax. Fifty percent of the tax revenue will be allocated directly to the municipal sector, and the tax will be applied retroactively from January 1, 2023 (Aker & Parr, 2023; Office of the Prime Minister & Ministry of Finance, 2023; Ogre, 2023).

May 25, 2023, and May 31, 2023

On May 25, the governing parties secured a majority for the salmon tax, agreeing to a resource rent tax rate of 25%, a reduction from the previous proposal of 35%. The government's proposal for a resource rent tax on salmon farming was formally ratified after a vote in the Storting on May 31, 2023 (Resvoll et al., 2023; Vartdal & Knudsen, 2023).

2.2 The Norwegian Salmon Aquaculture Industry

2.2.1 Development and Regulation of the Industry

In the late 1960s, brothers Ove and Sivert Grøntvedt released the first salmon smolt into the sea. The initial harvest of farmed salmon followed in 1971. Their pioneering effort laid the foundation for modern fish farming in Norway. Today, Norway stands as the global leading producer of farmed salmon, accounting for over half of the global production (Misund, 2023).

From the 1970s to the early 1990s, each company was restricted to just one fish farming license. Additionally, the sale of farmed salmon was centrally managed through the Fiskeoppdretternes Salgslag (FOS). When FOS declared bankruptcy in 1991, regulations were relaxed to permit companies to hold multiple licenses. This catalyzed significant industry consolidation through a wave of mergers and acquisitions among aquaculture firms. In 1990, nearly 1,000 aquaculture companies operated in Norway, while today the number has been reduced to around 150. Notably, the ten largest producers now account for approximately 70% of Norway's total salmon production (Misund, 2023).

Today, salmon farming in Norway requires two government-issued licenses: a production license and a site license. These licenses authorize the farming of fish up to a specified production cap and allow farming at designated sites respectively (Hersoug, 2021). The industry has been regulated through various frameworks since its inception. In recent years, the regulatory system has been actively used to encourage innovations aimed at enhancing environmental sustainability. A key approach has been the use of mechanisms that indirectly limit production (Afewerki et al., 2023). Around 2010, access to new production sites became significantly restricted due to environmental concerns, which led to price increases for salmon as production growth was indirectly constrained. This site restriction is not unique to Norway but is a common challenge due to government regulations across all salmon-producing nations (Afewerki et al., 2023; Hersoug, 2021).

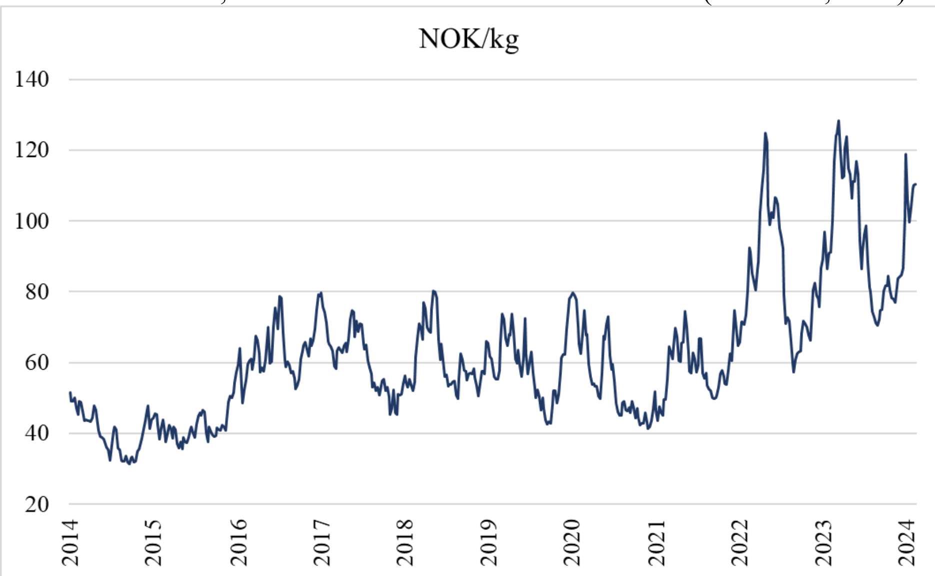
The design of salmon pens has significantly evolved over the years, not only increasing in size but also improving in functionality. Modern salmon pens are engineered to withstand harsher weather conditions than their predecessors (Afewerki et al., 2023). These innovations have enabled the maintenance of relatively healthy and high-quality fish stocks at economically sustainable cost levels.

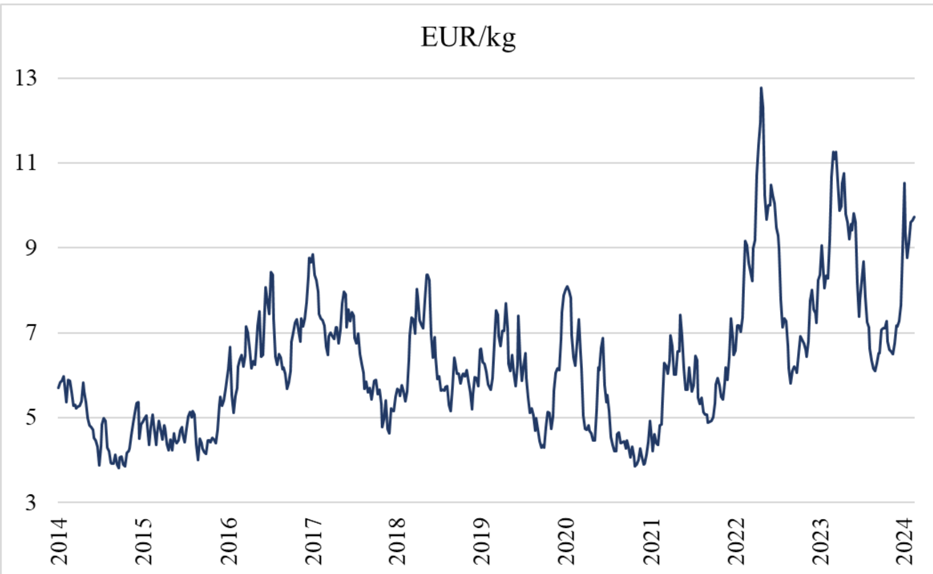
A pivotal advancement came with the introduction of oil-based vaccines, which led to a 99% reduction in the industry's antibiotic consumption around 1990. The development of these vaccines represents one of the most critical research-driven innovations in the Norwegian aquaculture industry, enabling the prevention of severe outbreaks of detrimental diseases (Afewerki et al., 2023). However, parasitic salmon lice infections remain a major challenge, as lice damage the fish's skin and stress the salmon. Various methods have been developed to treat and prevent salmon lice, requiring farmers to invest considerable time and financial resources on different salmon lice treatments (Afewerki et al., 2023; Misund, 2023). Presently, salmon lice represent the most significant environmental challenge for the salmon farming industry (Afewerki et al., 2023).

2.2.2 Economic Development

Figure 2.1 below illustrates historical salmon price per kilogram in NOK and EUR from 2014 until 2024. We see a volatile spot price for salmon and the development of a weaker NOK relative to EUR.

Figure 2.1: Historical Weekly Salmon Prices Based on the Fish Pool Index
Notes: This chart displays historical weekly salmon prices per kilogram in NOK and EUR from 2014 to 2024, based on data from the Fish Pool Index (Fish Pool, 2024).



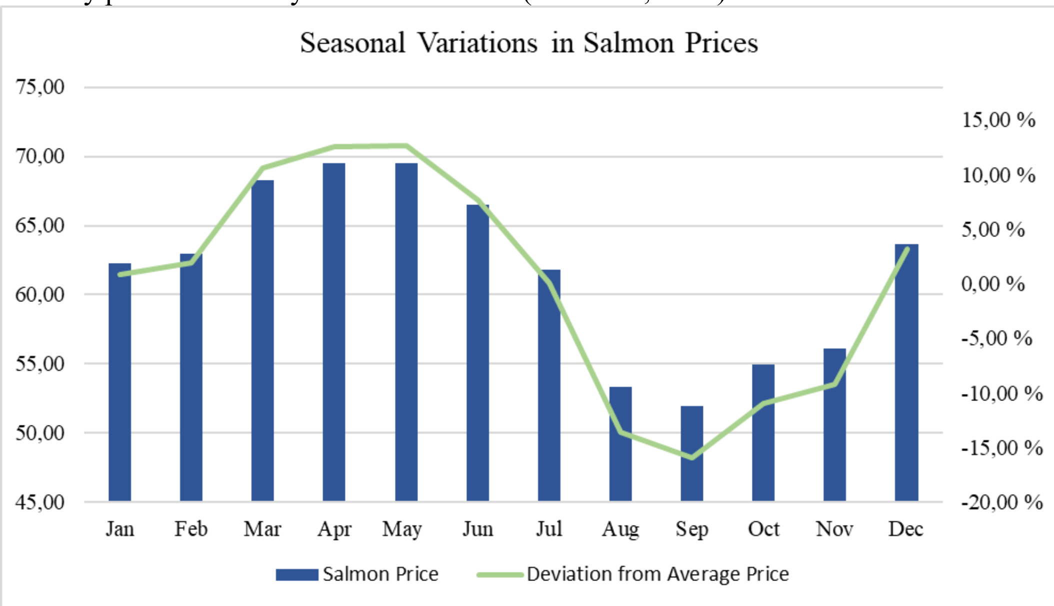


The salmon price has fluctuated significantly over the years. Which makes the revenue stream for the salmon farming companies volatile. Norwegian salmon is sold and consumed in markets all over the world and therefore, the majority of the sellers' revenues are in foreign currency (Egeness, 2023). Europe is the most important market for Norwegian salmon and consumes around 45% of the salmon produced in the world (Egeness, 2023). Hence, the exchange rate of the Norwegian krone against the euro is of great significance for the income of salmon companies.

From January 2014 to January 2024, the price of salmon in EUR increased by 57.54% (or an annualized rate of 4.65%), while in NOK, the increase was 96.16% (or an annualized rate of 6.97%). This disparity underscores how a weakening NOK relative to the EUR has at least partly contributed to the industry's recent profitability.

Figure 2.2 below shows the seasonal variation in salmon prices between 2014 and 2023. Farmed salmon production is highly seasonal, influenced primarily by sea temperatures and daylight, both of which dictate the salmon's growth conditions. These factors fluctuate regularly, causing corresponding variations in the farm's biomass throughout the year (Dahl et al., 2011).

Figure 2.2: Seasonal Variations in Salmon Prices From 2014 to 2023
Notes: This graph displays the average monthly salmon prices in NOK per kilogram, represented by blue bars, alongside the percentage deviation from the average price, depicted by the green line. The data is sourced from the Fish Pool Index, covering average monthly prices from the years 2014 to 2023 (Fish Pool, 2024).



Adverse growth conditions tend to decrease overall biomass while increasing the proportion of smaller fish. Consequently, poor growth conditions not only enhance the marginal value of the existing biomass but also elevate the relative worth of larger fish compared to small fish. In response, farmers aiming to maintain a stable supply of salmon to the market will want to increase the availability of large fish. To do this, the farmers must decrease the harvesting of smaller fish, allowing them to mature in the pens. Such strategic adjustments in response to growth conditions will impact salmon prices because it serves as the market’s indicator of the salmon's value. Even with efforts to stabilize supply, unexpected shifts in growth conditions can negatively affect both biomass and market prices (Dahl et al., 2011; Tveterås & Norwegian Seafood Research Fund, 2015).

Another consequence of these regular seasonal variations in biomass is the fluctuating costs associated with fish slaughtering throughout the year, which are essentially the opportunity costs of not allowing the fish to continue growing. For instance, if a farmer anticipates favorable growth conditions in the near term, such as in early summer, the cost of slaughtering during this period is high due to the potential growth forfeited. This leads the farmer to demand a higher price for slaughtering fish at this time. Conversely, autumn generally sees the completion of the growth cycle, making it the most cost-effective time for slaughtering. During this period, the fish will need to be fed in the pens without significant growth, prompting farmers to accept lower prices (Norwegian Seafood Research Fund, 2012). Farmers also want to harvest salmon before they reach reproductive maturity in the autumn, as this stage detrimentally impacts the quality and health of the fish. In futures markets, this dynamics typically results in contango conditions during the fall and winter, and shift to backwardation in the spring and early summer (Norwegian Seafood Research Fund, 2012; NOU 2019: 18, 2019).

Feed constitutes to the largest cost component in the production of salmon and accounts for around half of the total costs. Several of the input factors in salmon feed are priced in USD, therefore the exchange rate of the NOK against the USD is of great importance for production costs (Egeness, 2023). Thus, not only do the incomes of breeders increase when the NOK weakens, but the same is true for costs.

A weaker krone increases the price of salmon in Norwegian kroner without affecting the demand in the consumer market. This happens because consumers are shielded from the price increase in local currency. The competitive dynamics at the industrial level ensure that breeders capture the majority of the benefits from a weak krone (Egeness, 2023). Overall, the salmon industry benefits from a depreciating NOK, though this advantage is partially offset by rising costs due to the weaker krone against the USD (Egeness, 2023).

2.2.3. Company Sample

This subsection provides a brief presentation of the five salmon companies used as the treatment group, and the five salmon companies used as the control group.

Mowi

Mowi is the largest seafood company in the world in terms of market capitalization and leads as the top producer of Atlantic salmon. In 2023, Mowi reached a record harvest volume of 474,664 GWT (Gutted Weight Ton), which is estimated to be around 20% of the global production, with 62% of this volume farmed in Norway. Mowi was established in 1964 and has been listed on Oslo Stock Exchange since 1997 (Mowi, 2024).

SalMar

SalMar is the world's second-largest salmon producer, achieving a record harvest volume of 254,100 GWT in 2023, with 92% of its production supplied from Norway. SalMar was founded in 1991 and has been listed on Oslo Stock Exchange since 2007 (SalMar, 2024).

Grieg Seafood

Grieg Seafood reported 72,015 GWT harvested volume of salmon in 2023. 71% of the farmed volume was produced in Norway. Grieg Seafood was established in 1992 and has been listed on the Oslo Stock Exchange since 2007 (Grieg Seafood, 2024).

Lerøy

Lerøy reported a total salmon harvest of 159,620 GWT in 2023. Lerøy's commercial operations have existed since 1899, and Lerøy has been publicly listed on Oslo Stock Exchange since 2002 (Lerøy Seafood, 2024).

Måsøval

In 2023, Måsøval reported a salmon harvest volume of 24,500 GWT, exclusively produced in the Norwegian regions of Trøndelag and Møre. Måsøval was founded in 1973 and has been listed on Euronext Growth Oslo since 2021 (Måsøval, 2024).

Atlantic Sapphire

Atlantic Sapphire distinguishes their operations from the sample group in that they are solely relying on land-based aquaculture. From their facility in Miami, 99% of their supply reaches the US-market. Atlantic Sapphire was established in 2010 and has been listed on Oslo Stock Exchange since 2020 (Atlantic Sapphire, 2024).

Bakkafrost

Bakkafrost harvested 73,006 GWT of salmon in 2023, with 72% produced in the Faroe Islands and the remainder in Scotland. Bakkafrost was founded in 1968 and has been publicly traded on Oslo Stock Exchange since 2010 (Bakkafrost, 2024).

Icelandic Salmon

Icelandic Salmon operates exclusively in Iceland and reported a record high harvest volume of 17,919 GWT in 2023. The company was established in 2010 with its headquarters in Bíldudalur, Iceland, and has been listed on Euronext Growth Oslo since October 2020 (Icelandic Salmon, 2024).

Ice Fish Farm

Ice Fish Farm, solely operating in Iceland, harvested 4,395 GWT in 2023. The company was founded in 2012 and has been listed on Euronext Growth Oslo since June 2020 (Ice Fish Farm, 2024).

Arctic Fish Holding

In 2023, Arctic Fish Holding achieved an all-time high harvest volume of 11,878 GWT. Arctic Fish Holding was established in 2011 and has been listed on Euronext Growth Oslo since February 2021.

3. Literature Review

In this section, we will examine literature on resource rent and various ways to tax it. We will begin with theory from David Ricardo and continue with more recent literature. Further, we will review different views on resource rent in general and more specific for the salmon farming industry. We will see arguments both for and against a resource rent tax on the Norwegian salmon farming industry.

The economist David Ricardo introduced the theory “Law of Rents” in his book “On The Principles of Political Economy and Taxation, 1817.” Ricardo’s final revision, the third edition, was published in 1821. Ricardo's theory of rent remains relevant in discussions about economic policy, land use, and natural resource management today. It provides a theoretical foundation for evaluating how the natural advantages of land can lead to income disparities and how policy interventions can address these issues to promote social welfare.

Ricardo's “Law of Rents” states that the rent of a piece of land is determined by its productivity relative to the least productive land in use (Ricardo, 1821). According to Ricardo, all land varies in terms of fertility and location, which affects its ability to produce agricultural goods. The most fertile and favorably located land will produce more output for the same input of labor and capital (Ricardo, 1821). Intramarginal rent in fisheries, as the salmon farming industry, is comparable to agriculture as both have a resource rent resulting from natural capital and locations (Copes, 1972). The quality of location in salmon farming varies significantly, and the better locations will produce higher profits in the form of Ricardian rent (Flaaten & Pham, 2019).

Ricardo's theory supports the argument for a land value tax, which is a tax on the unimproved value of land (water). Since the rent is a surplus that does not affect the cost of production, taxing it can be seen as an efficient way of raising public revenue without discouraging investment or economic activity. As Norwegian fjords are in fixed supply, the rent paid by the farmers can be viewed as an economic rent brought on by the scarcity of land (water) (Montgomery & Wernerfelt, 1988).

One approach to increase the taxes paid by the salmon aquaculture industry could involve introducing a lump-sum tax. Lump-sum tax methods involve taxing businesses based on a fixed amount, rather than on their actual income or profits

(Mas-Montserrat et al., 2024). In theory, lump-sum taxes are highly efficient because they do not distort economic decisions. Since lump-sum taxes are not based on any observable actions or characteristics, they do not affect the behavior of taxpayers. This means they can achieve revenue goals without causing inefficiencies in the market (Mankiw et al., 2009).

The simplicity of lump-sum taxation helps lower compliance costs for taxpayers and enforcement costs for tax administrations. It simplifies the tax structure and makes it easier for small business owners to understand their tax obligations. While lump-sum methods are effective in reducing compliance burdens, they may face challenges in terms of fairness and adequacy of tax collection, especially if not carefully tailored to the specific economic circumstances of the businesses they target. Since lump-sum taxes do not consider the actual profits or economic conditions, businesses with lower profits may end up paying a disproportionately high amount of tax relative to their income (Mas-Montserrat et al., 2024).

Mas-Montserrat et al. (2024) suggests that lump-sum taxation should be designed to be fair and equitable, considering the diversity of business activities and sizes within the targeted group. It should align with the objective of simplifying tax compliance while ensuring that it does not incentivize under-reporting or misclassification by businesses capable of complying with more detailed tax systems (Mas-Montserrat et al., 2024).

Despite their theoretical appeal, lump-sum taxes are generally unpopular and rarely used because they are seen as regressive. They place the same tax burden on everyone regardless of their ability to pay. This characteristic can make them politically and socially unfeasible. Mankiw et al. (2009) suggests that the unpopularity and challenges associated with lump-sum taxes serve as a cautionary tale for policymakers. They underscores the importance of considering both economic efficiency and fairness in tax policy, which lump-sum taxes fail to balance effectively (Mankiw et al., 2009).

Boadway and Flatters (1993) focuses on the economic and policy aspects of imposing taxes on the extraction and use of natural resources. They conclude that the optimal tax for natural resources should ideally focus on capturing the economic rents generated from these resources, rather than merely taxing production or revenue. This approach aligns with the principle that taxes should be structured to minimize economic distortions while ensuring that the public receives a fair share of the profits from natural resource exploitation (Boadway & Flatters, 1993).

The discussion emphasizes that taxes on resource rents can be non-distorting and equitable, as they do not penalize productive effort but rather capture the unearned income from natural resources, which ideally belongs to the public. Boadway and Flatters (1993) advocate for taxes that target the economic rents (the surplus value after all costs have been covered) because these are considered non-distorting. A tax on rents does not discourage investment or production since it is levied only on the surplus generated beyond normal returns on investment. Unfortunately, in practice resource taxes frequently overestimate rents due to their typical failure to provide full deductions for all expenses, particularly capital costs (Boadway & Flatters, 1993).

One of the recommended approaches is the cash flow tax. This method is appealing because it aligns tax liabilities closely with the actual financial performance of the resource extraction, ensuring that taxes are paid only when the operation is profitable and not during periods of investment or low revenues. Because a cash flow tax allows for the deduction of all expenses as they are incurred, it is considered non-distorting. Overall, the cash flow tax is highlighted as a theoretically ideal mechanism for capturing rents from natural resources due to its efficiency, simplicity, and alignment with economic principles. However, practical implementation issues, especially related to cash flow volatility and the handling of negative tax liabilities, remain a concern (Boadway & Flatters, 1993).

While the paper by Boadway and Flatters (1993) discusses traditional methods like royalties and production taxes, it points out their potential to cause economic inefficiencies. However, it also acknowledges that these methods are simpler to administer. If used, they should be carefully designed to minimize their negative impacts, possibly by integrating allowances or exemptions that consider the profitability and specific economic conditions of extraction projects. Overall, Boadway and Flatters (1993) suggests that production taxes, although administratively convenient, are not the most efficient way of taxing natural resources due to their potential to distort production decisions and their insensitivity to costs and economic rents.

Further Boadway and Flatters (1993) discusses the auction of production rights as one of the alternative methods for governments to capture economic rents from natural resources. This approach involves companies bidding for the rights to exploit resources, with the auction designed to capture the expected future net rents from those resources. For the auction system to function effectively, it must be competitive, and all bidders should be equally well-informed. This ensures that the auction price reflects the true economic value of the resource.

Unlike traditional tax structures where payments are made over time based on production or profits, auctions require companies to make upfront payments. This can impact the bidding behavior of companies, particularly if there are capital market constraints. While auctions can potentially provide immediate revenue to the government and align payment more closely with the acquisition of rights, they may not always be efficient in terms of long-term resource management or maximizing public welfare (Boadway & Flatters, 1993).

Boadway and Flatters (1993) suggests that while auctions can be an effective tool for resource rent capture, their success heavily depends on the design of the auction and the broader economic and regulatory environment. They are contrasted with rent taxes, where the timing and amount of government revenue can be more predictable and potentially less disruptive to the economic decisions of resource-extracting companies.

Given the complexity of natural resource economics and the diverse objectives of public policy, Boadway and Flatters (1993) suggests that a hybrid system combining elements of various taxes might be necessary. This could involve using cash flow taxes in conjunction with royalties or production taxes, adjusted by profit-based elements to better capture economic rents while providing stability and predictability in revenue. The optimal tax structure should also take into account broader economic, social, and environmental goals. This includes encouraging sustainable resource management practices, supporting economic development in resource-rich areas, and ensuring that the tax system is fair and equitable (Boadway & Flatters, 1993).

The conclusion emphasizes that while there is no one-size-fits-all solution, the focus should be on designing tax systems that can capture the true economic rents from natural resources without discouraging investment or causing undue economic distortions. The goal is to balance efficiency, equity, and simplicity in taxation, considering the specific circumstances and development goals of the region or country in question (Boadway & Flatters, 1993).

The paper "Do corporate taxes hinder innovation?" by Mukherjee et al. (2017), investigates the impact of adjustments in corporate tax rates at the state level across the United States. They find that an increase in taxes leads to a decrease in future innovation. This decline is evidenced through a reduction in patents, research and development (R&D), and the introduction of new products. The research suggests that raising corporate taxes diminishes the incentives for innovators and discourages taking risks (Mukherjee et al., 2017). Given the global nature of salmon farming, with operations in countries such as Scotland, Iceland, and Chile, it's plausible to extrapolate Mukherjee et al.'s (2017) findings to suggest that the salmon farming industry might also be influenced by tax rates, potentially shifting new investments towards countries with more favorable tax environments.

Greaker and Lindholt (2021) define resource rent as the extra income generated from the utilization of natural resources, beyond the earnings typically expected from an investment. In their analysis, they calculate the resource rents within the Norwegian aquaculture sector from 1984 to 2020, employing data from national accounts and adhering to the definitions provided by the System of Environmental-Economic Accounting. Their findings reveal considerable resource rents in the Norwegian aquaculture industry starting from the year 2000, with a significant increase in resource rent observed from 2012 onwards (Greaker & Lindholt, 2021).

In their 1993 study, Amundsen and Tjøtta explored the concept of resource rent in Norway's hydropower industry. Their work is relevant to the fish farming industry as well, given both industries' scarcity of production sites. Their findings suggest that the hydropower industry's resource rent was estimated to be between eight to fifteen billion Norwegian kroner annually (Amundsen & Tjøtta, 1993).

Biological constraints, such as the need for specific seawater temperatures and other environmental conditions, limit sea salmon farming to the following countries: Norway, Chile, Scotland, the Faroe Islands, Ireland, Iceland, Canada, the USA, Tasmania, and New Zealand (Mowi, 2023). To operate a salmon farm in these regions, obtaining a license from the appropriate regulatory authorities is mandatory. These licenses set caps on the amount of production allowable for each operator and the industry at large, with the specifics of these licensing requirements differing from one jurisdiction to another (Mowi, 2023). Considering the limitations on available sites for production, competition in the industry might diminish, potentially leading to earnings that exceed the usual (expected) returns on investment. This scenario presents a case where the introduction of a resource rent tax may be reasonable.

Tveterås et al. (2019) address the potential challenges associated with introducing a resource rent tax in the aquaculture sector, similar to the approach taken in the hydropower sector. They argue such a tax could impede the growth of this vital regional sector, which plays a significant role in value creation and provides numerous jobs along the Norwegian coast. To achieve the potential for sustainable growth in the sector, substantial investments are necessary by 2030. However, they recommend exercising caution with respect to imposing taxes beyond the standard taxes and fees that all industries pay, pointing out the complexity of the aquaculture value chain and the possibility of making tax policy adjustments (Tveterås et al., 2019).

Furthermore, the report by Tveterås et al. (2019) highlights that the profitability of aquaculture projects has fluctuated over time. They express concerns that implementing a resource rent tax in Norway might diminish profits and affect the ranking of projects for international salmon enterprises. The report also points to the competition from alternative technologies, such as land-based facilities, and cost disparities as challenges for Norwegian salmon farming. The report concludes that a resource rent tax, inspired by the one in the hydropower industry, could deter financially sound projects, thereby weakening the prospects for sustainable growth in the aquaculture sector. The necessity for ongoing dialogue among regulators, the aquaculture sector, and additional stakeholders is underscored to develop future regulatory frameworks for aquaculture policies in a sustainable manner (Tveterås et al., 2019).

A report by Folkvord et al. (2019) presents a political consensus in Norway for a significant yet sustainable expansion in the aquaculture sector, targeting a production goal of five million tons by 2050. It underscores the importance of a taxation framework that considers the sector's specific challenges and opportunities. While acknowledging the industry's current profitability, Folkvord et al. (2019)

caution that extraordinary high profit margins are not sustainable over the long term due to global factors.

Folkvord et al. (2019) state that salmon farming in the future will be more global and take place on land, in coastal areas, and offshore. It is expected that the greatest cost reduction will be on land and offshore, starting from a high-cost base. All forms of production will expand internationally, and Norway will lead in the production of new knowledge and innovation. However, new technologies will be commercialized in an international market by both Norwegian and foreign companies. We will see a global salmon industry that responds more quickly to changes in national regulations, including taxes, by shifting investments and production (Folkvord et al., 2019). The report suggests financial incentives for municipalities that accommodate aquaculture activities and recommends careful consideration in devising a tax policy that could hinder the sector's sustainable growth in the future.

Folkvord et al. (2019) oppose the adoption of a special tax model based on experiences in the hydroelectric industry and suggest such a model could negatively impact economically feasible projects. They highlight the importance of careful consideration in developing a tax framework for aquaculture to prevent potential harm to the industry's sustainable development prospects (Folkvord et al., 2019).

Nøstbakken and Selle (2020) analyzed the impact of a periodized, excess-based resource rent tax in the aquaculture sector, specifically its neutrality properties and the extent of possible deviations. A tax is considered neutral if it doesn't influence the decision-making of private entities. In practical terms, this ensures that the relative rate of return on invested capital have to remain the same before and after tax when assessing the profitability of a project (Nøstbakken & Selle, 2020). The article makes a case that beyond being favorable for socio-economic efficiency, a resource rent tax is justified from a distributional viewpoint. This justification is based on the premise that certain entities achieve extraordinary returns on invested capital from their exclusive access to community resources, thus warranting the implementation of such a tax.

The article by Nøstbakken and Selle (2020) suggests that in sectors such as Norwegian aquaculture, where output is controlled via government concessions and prices are set by the market, the impact of a distorting tax would be negligible. For such a tax to negatively affect production or expansion, it would need to lower the bid value for concessions to zero among the most productive participants. Their analysis concludes that a resource rent tax is unlikely to hinder the aquaculture sector's growth, even in scenarios where investors consistently misjudge future cash flows in their financial evaluations (Nøstbakken & Selle, 2020).

The article by Nøstbakken and Selle (2020) compares its findings with those of a study by Folkvord et al. (2019), who argues that a resource rent tax would distort the market, whereas Nøstbakken and Selle (2020) highlight differences in assumptions and challenges the notion that the industry would continually misjudge future cash flows. While Folkvord et al. (2019) adopt the DCF method using WACC, Nøstbakken and Selle (2020) apply the APV method in their analysis. Folkvord et al. (2019) base their calculations on higher capital intensity and a lower risk-free rate compared to Nøstbakken and Selle (2020). Additionally, Folkvord et al. (2019) discount tax shields such as depreciation using a risky discount rate, whereas Nøstbakken and Selle (2020) use a risk-free rate. Furthermore, Folkvord et al. (2019) assume a higher rate for the special tax compared to Nøstbakken and Selle (2020).

In their conclusion, Nøstbakken & Selle (2020) emphasize that the aquaculture tax proposed by the aquaculture tax committee in 2019 would be neutral and hence not affect private investment decisions. This neutrality is anticipated to prevent any discriminatory effects across various forms of production or hinder the sector's technological progress. Ultimately, Nøstbakken and Selle (2020) supports the proposed taxation framework, arguing it would reduce economic inefficiencies in society while ensuring competitiveness and supporting the financing of Norway's welfare state.

A report by Greaker and Lindholt (2019) investigates the resource rent within Norway's aquaculture and electricity supply sectors from 1984 to 2018, commissioned by Havbruksskatteutvalget. The study defines resource rent as extraordinary returns derived from the exploitation of natural resources and the report utilizes data from the national accounts of Statistics Norway for analysis of the resource rent. Greaker and Lindholt (2019) finds that both the aquaculture and electricity supply sectors have experienced substantial resource rent since 2000. Taking into account various factors such as the required return on capital, labor expenses, and price indices, the report firmly concludes that there is a high resource rent present in both the aquaculture and electricity supply sectors (Greaker & Lindholt, 2019).

Before the 2000s, the resource rent in aquaculture was relatively modest, at times even negative. From 2000 to 2012, the sector experienced significant volatility, which was followed by a pronounced surge post-2012, with resource rent consistently surpassing 20 billion in the final three years of the study period, according to Greaker & Lindholt (2019). This notable increase in aquaculture's resource rent post-2012 is attributed to the rising prices of salmon (and trout). An analysis comparing inflation-adjusted salmon prices from the Directorate of Fisheries (Fiskeridirektoratet) with the aquaculture resource rent from 1994 to 2018 demonstrates a correlation between salmon prices and resource rent. This correlation has strengthened over time, with a correlation coefficient of 0.73 for the overall period studied, and an even more robust correlation of 0.98 for the years from 2000 to 2018 (Greaker & Lindholt, 2019).

In the 2023 budget, the Norwegian government put forward a proposal to introduce a resource rent tax in the aquaculture sector. This proposition sparked considerable debate, particularly following the Tax Committee's report release on December 19, 2022. Holtsmark and Schreiner (2023) explore the discussions held by the committee, with an emphasis on the potential for efficiency losses that could result from imposing a resource rent tax on a sector already undergoing extensive investments. The possibility for potential efficiency losses lends support to the committee's view that resource rent taxes also are appropriate for other industries with specific location and natural resources, like wind energy. The report underscores the importance of implementing such taxes without awaiting the realization of substantial profits (Holtsmark & Schreiner, 2023).

The time schedule of implementation, the considerations during this process, the structure of the tax, and variations in tax rates over time can cause socio-economic inefficiencies by shaping expectations about future taxation levels both within specific sectors and across different ones. This remains true even for taxes designed to be neutral by not directly impacting future investments in the sector (Holtsmark & Schreiner, 2023). The extent of efficiency consequences associated with resource rent taxes emerges as an important empirical question.

Holtsmark and Schreiner (2023) further point out that changes in various forms of taxation, not solely resource rent taxes, can influence expectations and subsequent investments. The efficiency losses for each krone/unit of revenue could be equally significant, or even more so, for other tax reforms suggested by the current administration, such as the hike in employer's national insurance contributions for high-income individuals. Moreover, the analysis suggests that the efficiency drawbacks linked to postponing the introduction of a special profit tax in the context of resource rent taxation do not inherently argue against their eventual introduction if they were not implemented from the outset. As with all taxes, the efficiency and distribution impacts of resource rent taxes must be weighed against the alternatives (Holtsmark & Schreiner, 2023).

4. Methodology

In the methodology section, we will outline the theoretical framework for our three main analyses. The first analysis employs an event study to gauge the immediate market reactions to both the announcement and the subsequent agreement of the resource rent tax. The second analysis aims to determine whether the companies in our treatment group experienced abnormal returns in three distinct periods: one year before the announcement, between the announcement and the agreement, and ten months after the agreement, utilizing the Fama-French 3-Factors. The third and final analysis focuses on accounting profits. Here, we explore whether aquaculture companies may have experienced increased resource rents after 2014 by analyzing the return on assets (ROA) through a difference-in-difference approach.

4.1 Event Study

This subsection delves into the methodology for analyzing stock performance, focusing on the calculation of cumulative returns, abnormal returns, and cumulative abnormal returns (CAR). By synthesizing these methodologies, the analysis aims to provide an understanding of stock behavior in response to the resource rent tax announcement and agreement, contrasting the performance of the treatment and control group within the market environment. This approach enables a nuanced analysis of the events, revealing the underlying patterns and impacts on stock valuation. The methodology employed for this event study follows MacKinlay's (1997) framework and we test whether the CAR for the treatment group is equal to zero and whether the CAR for the treatment group is equal to the CAR for our control group.

Efficient Market Hypothesis

Eugene Fama popularized the efficient market hypothesis (EMH) in his 1970 paper, "Efficient Capital Markets: A Review of Theory and Empirical Work," classifying market efficiency into three types: weak, semi-strong, and strong. Weak-form efficiency suggests that prices reflect historical price information, semi-strong form states that prices incorporate all publicly available information, and strong-form efficiency argues that prices reflect all information, including private (Fama, 1970).

The EMH is a fundamental yet contentious concept in modern financial theory, sparking debate among scholars and practitioners. Challenges in testing market efficiency arise from the absence of a specific test that explains it. Additionally, the notion of market efficiency is dynamic, and the degree of efficiency may change over time. A further complication is the joint hypothesis problem, where testing market efficiency is confounded by the asset pricing models used (Fama, 1991).

In practical applications, such as event studies, EMH enables the analysis of securities prior to and following significant events to assess how stock prices respond to new information. For example, in our study, we examine the effects of the announcement and agreement of a resource rent tax on stock prices by looking for abnormal returns and monitoring market responses. We will utilize the approach from MacKinlay (1997) for our event study.

Cumulative Return

Cumulative returns for the companies were calculated over the sample period using the formula:

$$R_{i,t} = \frac{P_{i,t}}{P_{i,0}} - 1 \tag{4.1}$$

Here, $R_{i,t}$ represents the cumulative return of company i at time t, $P_{i,t}$ is the price of company i at time t, and $P_{i,0}$ is the initial price at the start of the sample period. This metric helps to gauge the total return provided by a company over time.

Abnormal Return

Abnormal return measures the deviation of the actual stock return from its expected performance, according to the asset pricing model employed (Bodie et al., 2021). We calculate the abnormal returns using the approach from MacKinlay (1997), where the expected returns of each company are subtracted from the actual returns, following the formula:

$$AR_{i,t} = R_{i,t} - E(R_{i,t}) \quad (4.2)$$

Here, $AR_{i,t}$ represents the abnormal return for company i at time t, $R_{i,t}$ is the actual return for company i at time t, and $E(R_{i,t})$ is the expected return for company i at time t, based on the asset pricing model.

To determine the expected return, we utilize the market model from MacKinlay (1997), as it according to MacKinlay (1997) offers a potential advantage over the constant mean return model. The reason is that the variance of the abnormal return is reduced, since the model is able to remove the portion of the return that is linked to fluctuations in the market's return. The market model is specified as:

$$R_{i,t} = \alpha_i + \beta_i R_{m,t} + \varepsilon_{i,t} \qquad where\ E(\varepsilon_{i,t}) = 0 \quad (4.3)$$

In this model, $R_{i,t}$ is the return on stock i at time t, and $R_{m,t}$ is the market return at time t. ε represents the zero-mean disturbance term, and α_i and β_i are the parameters for the intercept and slope for stock i respectively. Given that ε is expected to be zero, the formula simplifies to:

$$R_{i,t} = \alpha_i + \beta_i R_{m,t} \quad (4.4)$$

Using the market models estimated parameters we can determine the normal return, and the abnormal return for any stock i in our sample is calculated as:

$$AR_{i,t} = R_{i,t} - \hat{\alpha}_i - \hat{\beta}_i R_{m,t} \quad (4.5)$$

The abnormal return is the market model's disturbance term that is calculated on an out of sample basis (MacKinlay, 1997). This concept is crucial for evaluating the impact of specific events on company performance, beyond what would be expected under normal market conditions.

Cumulative Abnormal Return

Cumulative Abnormal Return (CAR) aggregates the abnormal returns over a specified timeframe, providing insight into the cumulative effect of an event on stock prices (MacKinlay, 1997). The formula for CAR is:

$$CAR_i(t_1, t_2) = \sum_{t_1}^{t_2} AR_{i,t} \tag{4.6}$$

CAR calculates the sum of abnormal returns from a predefined start date to an end date, offering a comprehensive measure of an event's total impact on stock valuation. This metric is particularly useful for assessing the total impact of events, such as tax announcements or regulatory changes on the value of a company.

4.2 Fama-French 3-Factors

In our second analysis we run a regression on the Fama-French 3-Factors in order to investigate whether we find abnormal return for our treatment group in the pre-announcement period, intermediate period, and post-agreement period. First, we run a regression on constant betas before we run a new regression with changing betas and interaction terms.

In their study, "The Price of Sin: The Effects of Social Norms on Markets," Hong & Kacperczyk (2009) utilize Fama-French factors to analyze returns from sin stocks, which are avoided by certain investors for ethical considerations. Inspired by this approach, we apply a similar methodology to specifically assess the impact of the resource rent tax on stock returns within the Norwegian salmon farming industry. With this approach we can isolate the effects of the salmon tax on stock returns, distinguishing these from broader market movements, size effects, and value factors inherent to these stocks. Our approach integrates elements of the analytical standards set by Hong & Kacperczyk (2009) but tailors the approach to fit the specific needs of the study on salmon stocks, ensuring that the methodology is relevant to our hypotheses (Hong & Kacperczyk, 2009).

By adopting elements of the Hong & Kacperczyk (2009) technique we employ the Fama-French 3-Factors to calculate risk-adjusted returns. This research can quantify the financial consequences of the resource rent tax for the salmon farming industry, thereby providing valuable insights into how regulatory changes affect industry-specific equities.

In 1992, Eugene Fama and Kenneth French introduced the Fama-French 3-Factor model, an enhancement to the traditional Capital Asset Pricing Model (CAPM). This advanced formula calculates the expected return on stock market investments by incorporating three risk factors: market risk, size, and value. The model emerged from the observation that historically, small-cap stocks have tended to yield higher returns than large-cap stocks, and value stocks have generally outperformed growth stocks in the long term (Bodie et al., 2021; Hayes et al., 2024; Reed, 2022). The model is expressed as:

$$R_{i,t} - Rf_t = \alpha_{i,t} + \beta_1 \times (Rm_t - Rf_t) + \beta_2 \times SMB_t + \beta_3 \times HML_t + \varepsilon_{i,t} \quad (4.7)$$

Here, $R_{i,t}$ represents the total return for stock i, Rf_t is the risk-free rate, and Rm_t denotes the total return on the market portfolio. The $Rm_t - Rf_t$ term captures the market risk premium, which compensates investors for the increased volatility of the market compared to risk-free investments.

The alpha $(\alpha_{i,t})$ is a measure of the investment's ability to outperform the market based on its unique risks (Reed, 2022). If the alpha deviates from zero, it reveals that an investment either underperforms or outperforms relative to the expectations of the Fama-French model. This means the returns are weaker or stronger than predicted, considering the investment's characteristics in relation to the market's overall risk, size, and value factors. It's worth mentioning that while superior performance necessitates on achieving positive alpha, this alone does not ensure that a portfolio will outperform its benchmark. This is because exploiting mispricing involves moving away from full diversification, which will incur nonsystematic risk. Consequently, a portfolio may attain positive alpha but simultaneously experience increased volatility, potentially leading to a reduced Sharpe ratio (Bodie et al., 2021; Reed, 2022).

The Small Minus Big (SMB) factor measures the historical outperformance of small-cap stocks over large-cap stocks, based on market capitalization. Through linear regression, one can determine the beta coefficient for SMB, which reflects the extent to which small-caps exceed or fall below large-cap returns and can be either positive or negative. A positive β_2 value indicates a portfolio return weighted towards small-cap stocks (Chen & Bassett, 2014; Corporate Finance Institute, 2024; Reed, 2022).

The High Minus Low (HML) factor, also known as the value premium, captures the difference in returns between stocks with high book-to-market ratios (value stocks) and those with low book-to-market ratios (growth stocks). The beta coefficient for HML, indicates how much value stocks outperform growth stocks and can also be positive or negative. A positive β_3 value suggests a portfolio return weighted towards high book-to-market stocks (Corporate Finance Institute, 2024; Reed, 2022).

In summary, the Fama-French 3-Factor model provides a more comprehensive approach compared to the CAPM by considering the size and value factors of stocks alongside overall market risk, which has historically shown to improve the accuracy of predicting stock returns compared to CAPM alone (Reed, 2022). Our approach integrates elements of the analytical standards set by Hong & Kacperczyk (2009) but tailors the approach to fit the specific needs of the study on salmon stocks, ensuring that the methodology is relevant to our hypothesis.

4.3 Difference-in-Difference Analysis

Recent discussions have argued that Norway's aquaculture industry has experienced a significant rise in resource rent, particularly beginning between 2013 and 2014 and increased further in 2016 (Greaker & Lindholt, 2022). Our study investigates whether there has been an increase in the return on assets (ROA) for the aquaculture sector since 2014, relative to a control group. This analysis departs from traditional Difference-in-Differences (DiD) studies, which typically analyze the effects of specific events or shocks. Instead, we examine the ongoing trend of increasing resource rent by assessing ROA pre- and post-2014.

The DiD framework designates aquaculture companies as the treatment group. These companies primarily import feed, their most substantial cost component, and export most of their production. The control group consists of industrial companies that also import raw materials for production and export their finished products. This setup allows us to distinctly assess the economic impacts specific to the aquaculture industry by comparing it with sectors with similar trade and supply chain dynamics.

Difference-in-Difference Methodology

Difference-in-Differences (DiD) estimators are analytical tools used to evaluate the impact of significant shifts in economic policies, government interventions, or changes in the institutional setting. These estimators are particularly effective in contexts resembling natural or quasi-experiments triggered by these abrupt changes (Roberts & Whited, 2013).

The DiD method, also known as the Double Difference Estimator, integrates two distinct approaches: cross-sectional and time series comparisons. The cross-sectional analysis helps mitigate the issue of omitted variable bias by comparing two distinct groups during the same time period, while the time series approach addresses unseen disparities between the two groups by examining the same entities before and after the policy shift. By merging these two approaches, the DiD estimator leverages the strengths of both, providing a robust measure of the treatment effect due to the policy or environmental change (Roberts & Whited, 2013).

The DiD approach is chosen because of its robustness in identifying causal effects. It leverages variations in exposure to the intervention over time and between the treatment- and control group. This methodology effectively controls for unobserved, time-invariant differences between the groups, as well as common trends affecting all units, thus isolating the causal impact of the policy change or intervention. Today, the DiD approach is one of the most frequently used methods in empirical research design to estimate the effects of policy interventions or changes that do not affect everybody (Lechner, 2011). By combining the use of before-after and treatment-control group comparisons, the method gives an intuitive appeal and has found broad application in economics and other fields (Fredriksson & Oliveira, 2019).

The fundamental structure of DiD involves two groups observed over two time periods, estimating the policy's effect pre- and post-implementation. One group is exposed to the policy during the second period, the treatments group, while the other group remains untreated, the control group (Imbens & Wooldridge, 2007). We observe the groups in both time periods and subtract the average change in the control group from the average change treatment group. This approach removes biases in the second period, which may arise from permanent differences between the groups. Additionally, it addresses biases from comparisons over time in the treatment group, which could stem from ongoing trends (Imbens & Wooldridge, 2007).

Our DiD study has data from two groups and two time periods. Fredriksson and Oliveira (2019), illustrates that a DiD estimation of a policy impact with two groups and periods can be written as:

$$DiD = \left(\bar{y}_{s=Treatment,t=After} - \bar{y}_{s=Treatment,t=Before}\right) - \left(\bar{y}_{s=Control,t=After} - \bar{y}_{s=Control,t=Before}\right) \quad (4.8)$$

Here y is used as the outcome variable, and the bar represents the average value. With before and after data for the treatment- and control group, the data will be divided into four groups (Fredriksson & Oliveira, 2019).

5. Testable Hypotheses

This section outlines our testable hypotheses. First, we introduce the hypotheses concerning the immediate stock price reactions on the days of the resource rent tax announcement and agreement. Next, we present the hypotheses for our factor models that examine abnormal returns for our treatment group across three distinct periods. Finally, we present the hypothesis to evaluate a change in ROA for aquaculture companies post-2014.

5.1 Initial Market Reaction

This analysis is based on the assumption that policy shocks significantly influence share prices, as investors immediately react to new information regarding governmental policies and other political events.

This event study aims to address the initial part of our research question: “How did the resource rent tax proposal and subsequent agreement affect the stock prices of Norwegian salmon farming companies?”

To address the question, we will test the following hypotheses:

Hypothesis 1: On the announcement day, the CAR for the treatment group was zero and equal to the CAR for the control group.

Hypothesis 2: On the agreement day, the CAR for the treatment group was zero and equal to the CAR for the control group.

Our study examines the stock price reactions of salmon farming companies to the resource rent tax on both the announcement and agreement days. We employ the event study methodology outlined by MacKinlay (1997), as detailed in subsection 4.1. Specifically, we test whether the cumulative abnormal return (CAR) for the treatment group (salmon companies affected by the tax) was zero and whether it was equal to that of the control group, which consists of salmon companies unaffected by the tax.

This analysis is interesting as it may uncover how investors think the resource rent tax will impact the future cash flows and valuations of Norwegian salmon farming companies.

By rejecting these hypotheses, we can conclude that the policy changes had a significant impact on the expected future cash flows and valuations of the salmon companies in our treatment group.

5.2 Fama-French 3-Factors

The debate surrounding the resource rent tax originates from discussions about exceptionally high returns in the salmon farming industry. We explore these claims of high returns during the periods around the tax announcement and agreement.

Hypotheses three and four seek to determine if companies in our treatment group, consisting of five salmon stocks impacted by the tax, experienced abnormal returns during three distinct periods: one year before the announcement, the interval between the announcement and the agreement, and ten months after the agreement.

To analyze this, we employ the Fama-French 3-Factors to assess alphas over these three periods. Initially, we perform a regression with constant betas, subsequently extending the model to include changing risk exposures with variable betas and interaction terms. To do this we apply the methodology outlined in subsection 4.2.

These analyses are interesting as they provide insights into how investor returns were impacted during the periods surrounding the resource rent tax announcement and agreement. Positive alphas indicate that the salmon stocks generated positive abnormal returns, while negative alphas suggest negative abnormal returns. In cases of negative alpha values, the investment performance is considered poor from an investor's perspective, as the returns fell below the required rate of return.

These analyses may determine whether the tax announcement and agreement have changed the risk characteristics of the stocks.

Constant Beta Approach

In our initial regression model, we employ the Fama-French 3-Factors using constant stock betas throughout the estimation period. We test the following hypothesis:

Hypothesis 3: The abnormal return for the treatment group was zero during the pre-announcement, intermediate, and post-agreement periods.

To investigate Hypothesis 3, we utilize the regression equation:

$$R_{i,t} = \alpha_1 + \alpha_3 + \alpha_3 + \beta_1 \times (Rm - Rf) + \beta_2 \times SMB + \beta_3 \times HML \qquad (5.1)$$

The Fama-French 3-Factor variables are thoroughly described in subsection 4.2. In this equation, α_1, α_2, and α_3 serve as intercepts corresponding to the pre-announcement, intermediate, and post-agreement periods, respectively.

α_1 quantifies the abnormal return for the treatment group in the one-year period before the announcement. α_2 measures the abnormal return during the period between the announcement and the agreement day. α_3 assesses the abnormal return in the ten-month period following the tax agreement. α_1, α_2, and α_3 are all benchmarked relative to the Fama-French 3-Factors.

Moving Beta Approach

Building on the constant beta approach, we now extend our regression model to include varying exposure to risk factors through moving betas and interaction terms over the sample period. This modification enables us to assess if the risk factors have changed over time. We explore this through the following hypothesis:

Hypothesis 4: With moving betas and interaction terms, the abnormal return for the treatment group was zero during the pre-announcement, intermediate, and post-agreement periods.

To test Hypothesis 4, we employ the following regression equation:

$$
\begin{aligned}
R_{i,t} = {} & \alpha_1 + \alpha_3 + \alpha_3 \\
& + \beta_1 \times (Rm - Rf) + \beta_2 \times d(pre) \times (Rm - Rf) \\
& + \beta_3 \times \ d(intermediate) \times (Rm - Rf) + \beta_4 \times d(after) \times (Rm - Rf) \\
& + \beta_5 \times SMB + \ \beta_6 \times d(pre) \times SMB \qquad (5.2) \\
& + \beta_7 \times d(intermediate) \times SMB + \beta_8 \times d(after) \times SMB \\
& + \beta_9 \times HML + \beta_{10} \times d(pre) \times HML \\
& + \beta_{11} \times d(intermediate) \times HML + \beta_{12} \times d(after) \times HML
\end{aligned}
$$

Here, "$d(pre)$", "$d(intermediate)$", and "$d(after)$" are dummy variables representing the pre-announcement, intermediate, and post-agreement periods, respectively. This equation allows us to analyze the influence of market conditions across these distinct phases.

5.3 Change in ROA Over Time, a Difference-in-Difference Approach

The aquaculture industry in Norway has reportedly experienced a significant rise in resource rent since around 2013-2014, with an additional increase starting in 2016 (Greaker & Lindholt, 2022). This analysis seeks to examine these claims of high industry returns.

Our aim in this analysis is to address the concluding part of our research question: "Was the resource rent tax economically justified?"

To address this question, we will explore the following hypothesis:

Hypothesis 5: The ROA did not change after 2014 relative to the control group.

We employ a difference-in-difference regression model based on the methodology outlined in subsection 4.3. This model examines changes in the ROA for the treatment group (Norwegian aquaculture companies) post-2014, relative to a control group consisting of Norwegian industrial companies with similar trade and supply chain dynamics. The period of study spans from 2009 to 2022.

To test Hypothesis 5, we use the following regression equation:

$$\begin{aligned} \mathrm{ROA_{i,t}} = \alpha_{i,t} + \beta_1 \times \mathrm{Treatment} + \beta_2 \times \mathrm{After\_2014} \\ + \beta_3 \times \mathrm{Treatment} \times \mathrm{After\_2014} + \varepsilon_{i,t} \end{aligned} \quad (5.3)$$

Here, $\mathrm{ROA_{i,t}}$ represents return on assets for company i at time t. Treatment is a dummy variable where 1 indicates companies in the treatment group and 0 denotes those in the control group. After_2014 is a dummy variable that is 1 for observations from 2014 and 0 for those prior. The interaction term Treatment × After_2014 captures the differential effect on ROA between the groups post-2014.

The focus is primarily on the coefficient β_3, which quantifies the causal effect of the change in ROA following 2014. The causal effect is determined by comparing the difference in ROA between the two groups pre- and post-2014. In other words, β_3 serves as the difference-in-difference estimator. A positive (negative) β_3

suggests that the treatment group performed better (worse) after 2014 relative to the control group, based on ROA.

This analysis is interesting because a positive β_3 would indicate an increase in profitability after 2014 relative to the control group. If this proves to be true, the public and governmental claims about high resource rent might be well-grounded. Consequently, a positive β_3 may provide economic justification for the implementation of the resource rent tax.

6. Data

This section provides an overview of the data used for the analyses. Subsection 6.1 explains the process of data selection and organization. Following this, subsection 6.2 presents and analyzes the descriptive statistics of the salmon stocks.

6.1 Data Selection

In this subsection we describe the process of data collection for the salmon stocks, stock index, CCGR data, and Fama-French 3-Factors.

Salmon Stocks and Stock Index Return

Our data sample consists of daily stock prices for ten salmon farming companies listed in Norway, collected during the winter and spring of 2024 from Yahoo Finance (Yahoo Finance, 2024). To evaluate the impact of the resource rent tax announcement and subsequent agreement on the Norwegian salmon farming industry, we divided these companies into two groups. The treatment group includes five companies affected by the tax: SalMar, Mowi, Grieg Seafood, Lerøy, and Måsøval. The control group consists of five companies not affected by the tax: Bakkafrost, Atlantic Sapphire, Arctic Fish Holding, Ice Fish Farm, and Icelandic Salmon.

For our analysis, we utilized the daily adjusted close price (Adj. Close), which reflects stock prices adjusted for corporate actions such as stock splits, dividends, and capital gains distributions. Additionally, we downloaded the OSEAX index (Oslo Børs All-share Index) from Refinitiv Eikon to benchmark the performance of the salmon stocks. This index includes all shares listed on the Oslo Stock Exchange and is adjusted daily for corporate actions, including dividend payments.

Given the limited number of salmon farming companies on the Oslo Stock Exchange, our sample also includes four stocks from Euronext Growth Oslo, Måsøval, Arctic Fish Holding, Ice Fish Farm, and Icelandic Salmon. All ten companies in our sample primarily engage in salmon farming. We excluded Austevoll Seafood ASA from our sample as it holds majority ownership in Lerøy Seafood Group ASA, which is already included in our analysis (Austevoll Seafood ASA, 2024).

CCGR Data Collection and Filtering

The data was obtained from the Centre for Corporate Governance Research (CCGR), which is affiliated with the Department of Finance at BI Norwegian Business School. The CCGR database is highly reliable as all limited liability companies registered in Norway are mandated to report accounting data to the state agency, The Brønnøysund Register Centre.

Our analysis focuses on three variables: net income (item_15039), total fixed assets (item_15063), and total current assets (item_15078), which are used to calculate the ROA over time for both a treatment group and a control group. This approach provides a solid foundation for our research. Additionally, we included revenue (item_15009) as a criterion for filtering purposes in the data. All data is consolidated numbers.

The initial phase of the research involved manually filtering out irrelevant or unwanted data. We defined the treatment group as aquaculture companies in Norway, which primarily import feed, their most significant cost component, and export the majority of their production. Conversely, our control group comprises industrial companies that import raw materials and export finished products, allowing us to clearly assess the economic impacts specific to the aquaculture industry by comparing it with companies exhibiting similar trade and supply chain dynamics.

Following the initial data curation, we implemented automated quantitative filtering using R-Studio. After processing data from the CCGR database, we compiled a dataset comprising 4,441 thousand observations spanning from 2009 to 2022 for our regression analysis. To ensure the integrity of our analysis, we first omitted observations with missing values. We also established a minimum revenue threshold of 10 million NOK for any given year to filter out inactive and very small firms. Additionally, we excluded data points where ROA was either below -80% or above 80% in any given year to eliminate outliers.

Fama-French 3-Factors

We downloaded monthly data on the Fama-French 3-Factors from the Kenneth R. French website. The dataset used in our regression analysis spans from September 2021 to March 2024 (French, 2024).

6.2 Descriptive Statistics

The descriptive statistics presented in Table 6.1, covering our sample of ten stocks from August 2, 2022, to June 30, 2023, offer interesting insights into the dynamics of the treatment and control groups. Stocks labeled with Treat = 1 are categorized as the treatment group, indicating their exposure to the resource rent tax, while those marked as Treat = 0 constitute the control group, used as a comparison to gauge the effect of the treatment (i.e., the resource rent tax). All stocks recorded an equal number of observations (231), ensuring a balanced evaluation between the stocks.

Table 6.1: Descriptive Statistics of Daily Returns
Notes: This table presents the descriptive statistics of daily returns for stocks categorized into the treatment and control groups over the sample period from August 2, 2022, to June 30, 2023.

Name	Ticker	Treat	Observations	Minimum	Average	Maximum	Std. Dev.	Skewness	Kurtosis
Måsøval	MAS	1	231	-22,619 %	-0,090 %	11,333 %	2,911 %	- 1,418	16,304
Mowi	MOWI	1	231	-18,906 %	-0,076 %	6,280 %	0,139 %	- 2,865	27,126
Lerøy Seafood Group	LSG	1	231	-27,519 %	-0,197 %	10,258 %	2,954 %	- 3,157	31,952
Grieg Seafood	GSF	1	231	-26,653 %	-0,224 %	9,058 %	3,125 %	- 2,484	21,885
SalMar	SALM	1	231	-30,312 %	-0,130 %	10,873 %	3,200 %	- 3,370	34,657
Icelandic Salmon	ISLAX	0	231	-6,627 %	-0,009 %	11,409 %	2,381 %	0,673	3,533
Ice Fish Farm	IFISH	0	231	-11,667 %	0,076 %	23,077 %	4,311 %	0,863	3,664
Arctic Fish Holding	AFISH	0	231	-12,234 %	0,041 %	25,287 %	3,934 %	1,587	8,820
Atlantic Sapphire	ASA	0	231	-45,814 %	-0,328 %	34,172 %	6,222 %	- 1,443	18,642
Bakkafrost	BAKKA	0	231	-12,826 %	0,014 %	8,641 %	2,252 %	- 0,640	4,926

The minimum and maximum values of daily return for the stocks vary significantly. When comparing the treatment- and control group it's clear that both groups exhibit stock returns with wide ranges between their minimum and maximum values, suggesting that volatility is not exclusive to the treatment group.

The standard deviation of return varies between the stocks in both groups, but on average the stocks in the treatment group have lower standard deviation compared to the control group. That may suggest that while the treatment group experiences volatility, it's within a narrower range compared to at least some of the stocks in the control group. It is also worth noting that companies in the treatment group are, on average, significantly larger than those in the control group, which may contribute to at least some of the observed differences in standard deviation.

The average returns for all stocks in the treatment group are negative, indicating an overall negative return on average over the sample period. Conversely, the control group's stocks present a mix of positive and negative averages, suggesting a varied but generally less negative performance.

Skewness and kurtosis serve as measures of distribution shape and tail weight, respectively. Stocks in the treatment group all show negative skewness, indicating an asymmetric distribution with longer left tails. This suggests that small gains occur more frequently than losses, yet extreme losses are more common than extreme gains. Additionally, a high positive kurtosis in the treatment group indicates a prevalence of more extreme values, whether gains or losses, compared to a normal distribution. In contrast, the control group stocks exhibit less extreme skewness and kurtosis, with distributions closer to normal, except for Atlantic Sapphire, which exhibits high kurtosis, pointing to a heavy-tailed distribution. It is noteworthy that Atlantic Sapphire has experienced operational and financial challenges, therefore the results are not surprising.

These results suggest that the treatment group experienced more extreme negative returns, relative to the control group. This indicates that the announcement and agreement of the resource rent tax had an impact on the returns. However, this is only a preliminary observation derived from descriptive statistics.

7. Results and Analysis

In this section, we will present the results of our empirical analyses. Subsection 7.1 features several graphs to illustrate the performance of salmon stocks over time, particularly focusing on the sample period. Additionally, we will share findings from our event study to address hypotheses 1 and 2. Following this, subsection 7.2 will delve into the Fama-French regression results concerning abnormal returns, where we will respond to hypotheses 3 and 4. In subsection 7.3, we will examine the results from our difference-in-difference analysis concerning the development of ROA post-2014, and address hypothesis 5. Finally, in subsection 7.4, we present the results of econometric tests conducted to ensure the validity of our findings.

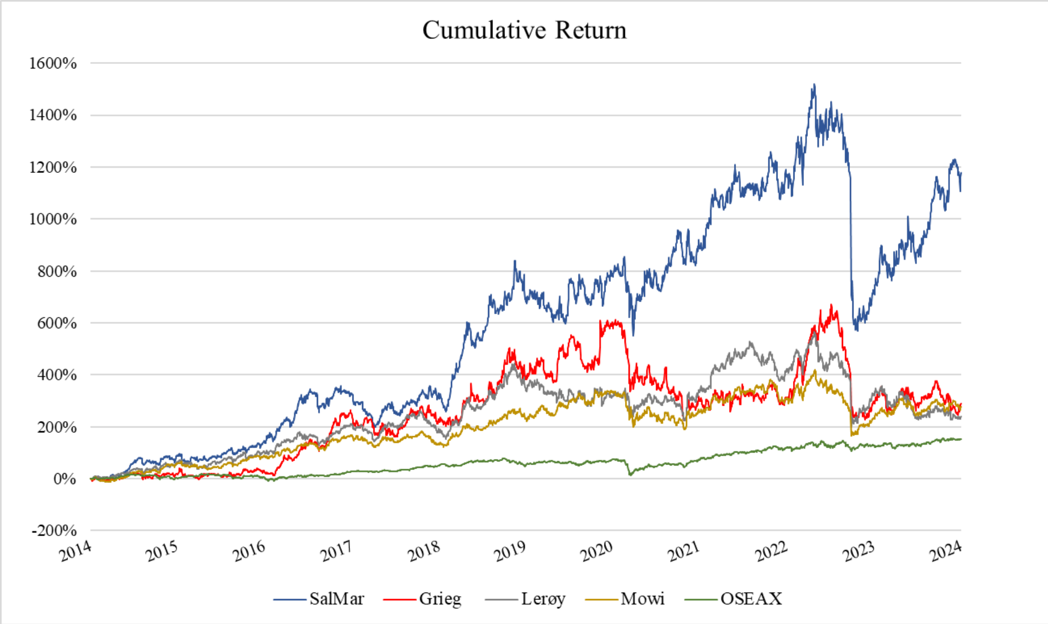
7.1 Event Study and Salmon Stock Return

In this subsection, we delve into the findings from our event study, which examines the stock market's response to the announcement and agreement of the resource rent tax. We thoroughly analyze how these key events influenced the stock prices of the salmon companies included in our study. To provide a clear visualization of the market dynamics at play, we include detailed graphs showcasing the cumulative returns and cumulative abnormal returns (CAR) for the salmon stocks.

7.1.1 Cumulative Return

Figure 7.1 below displays the cumulative stock returns for the treatment group companies SalMar, Grieg Seafood, Lerøy Seafood Group, and Mowi, along with the OSEAX stock index, spanning from 2014 to 2024. Måsøval is omitted from this graph as it was not listed throughout the entire period.

Figure 7.1: Cumulative Returns for Selected Salmon Stocks and OSEAX
Notes: This chart displays the cumulative returns for SalMar, Grieg, Lerøy, Mowi, and OSEAX from January 1, 2014, to December 29, 2023.



The graph clearly demonstrates higher returns for these salmon stocks compared to the broader market index from 2014 until September 28, 2022. Throughout this period, each of the four stocks demonstrated a substantial upward trajectory, with SalMar's performance being especially remarkable, potentially reflecting effective strategic management. The beta values for these stocks (SalMar 0.62, Grieg 0.80, Lerøy 0.74, Mowi 0.67) suggest that they not only outperformed the market but did so with their beta values all being below one. The beta values were regressed against the OSEAX using five years of daily returns from September 19, 2017, to September 19, 2022.

A pivotal moment is highlighted on September 28, 2022, when the stocks experienced a sharp decline following the announcement of the resource rent tax. This decline was followed by a partial recovery in the subsequent months, which may indicate an initial overreaction to the tax announcement news.

Figures 7.2 and 7.3 below illustrate the cumulative returns for the stocks in the treatment- and control group, respectively, over the sample period from August 26, 2022, to June 26, 2023.

Figure 7.2: Cumulative Returns for the Treatment Group
Notes: This chart displays the cumulative returns for the treatment group from August 26, 2022, to June 26, 2023. The green vertical line indicates the announcement day, and the black vertical line denotes the agreement day.

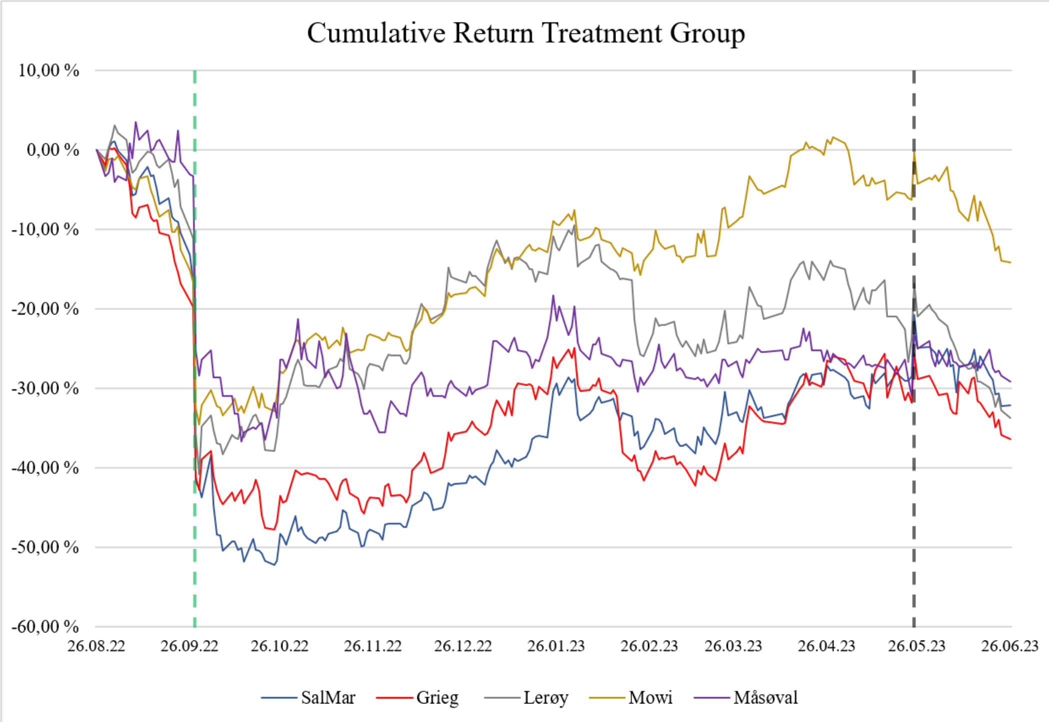
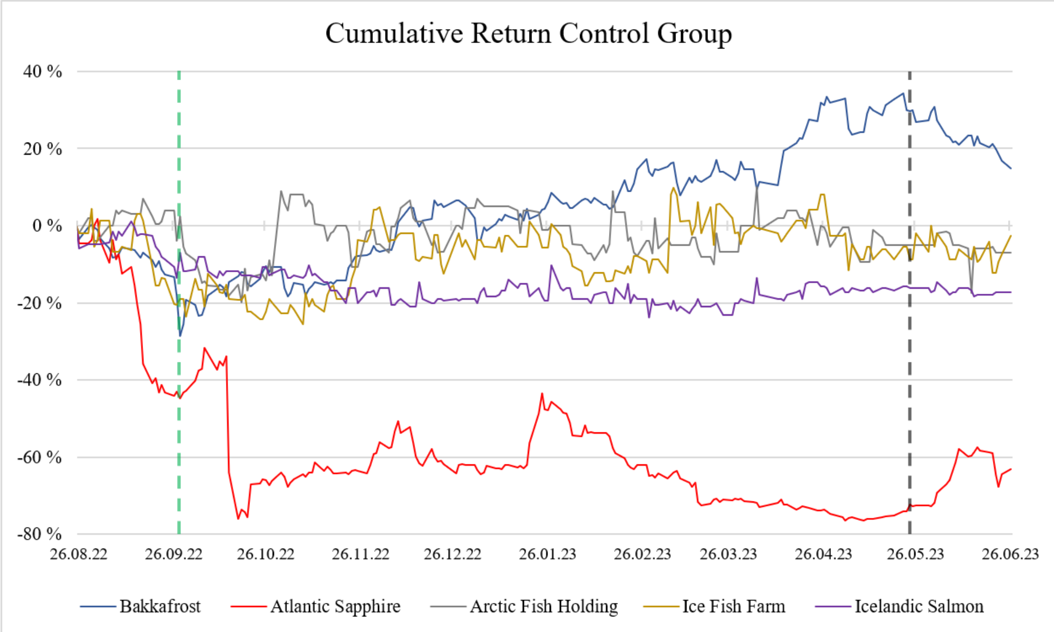


Figure 7.3: Cumulative Returns for the Control Group
Notes: This chart displays the cumulative returns for the control group from August 26, 2022, to June 26, 2023. The green vertical line indicates the announcement day, and the black vertical line denotes the agreement day.



There was a steep decline in stock prices for the treatment group on the announcement day, September 28, 2022, as illustrated by a dashed vertical green line in Figure 7.2. However, the treatment group displayed an upward trend in stock prices in the months following the announcement, suggesting a potential initial overreaction to the news.

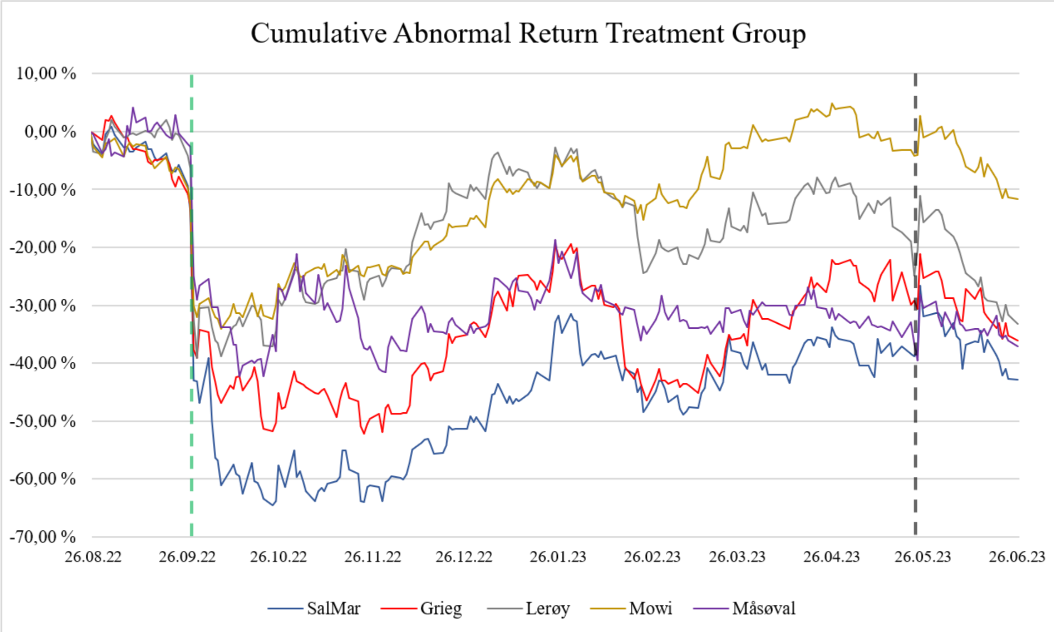
Some stocks in the control group also showed a moderate decline on the announcement day, possibly due to market uncertainties. Notably, Bakkafrost issued a statement on September 28, 2022, reassuring investors that they would not be affected by the tax (Bakkafrost, 2022). However, in the control group the trend is less clear, and the companies seem to be less affected.

On the agreement date, May 25, 2023, we observe an increase in stock prices within the treatment group, possibly reflecting a positive investor response to the agreement of a 25% tax rate, which is lower than the initially proposed 40%. For the control group, we cannot see a significant change in returns on the agreement day.

7.1.2 Cumulative Abnormal Return

Figures 7.4 and 7.5 below plot the cumulative abnormal return for the treatment and control group respectively over the sample period.

Figure 7.4: Cumulative Abnormal Returns for the Treatment Group
Notes: This chart displays the cumulative abnormal returns for the treatment group from August 26, 2022, to June 26, 2023. The green vertical line indicates the announcement day, and the black vertical line denotes the agreement day.



From an asset pricing perspective, we observe that the stock prices in Figure 7.4 initially decreased on the announcement day but began to rise shortly thereafter. The tax proposal introduced significant uncertainty within the industry, potentially elevating the risks associated with these stocks. Typically, higher risk is compensated by higher expected returns, which could explain the subsequent increase in cumulative abnormal returns for the treatment group following the initial price drop. Additionally, the upward moving trend in stock prices after the announcement may suggest a reversal effect, possibly due to an initial overreaction to the news.

Figure 7.5: Cumulative Abnormal Returns for the Control Group
Notes: This chart displays the cumulative abnormal returns for the control group from August 26, 2022, to June 26, 2023. The green vertical line indicates the announcement day, and the black vertical line denotes the agreement day.

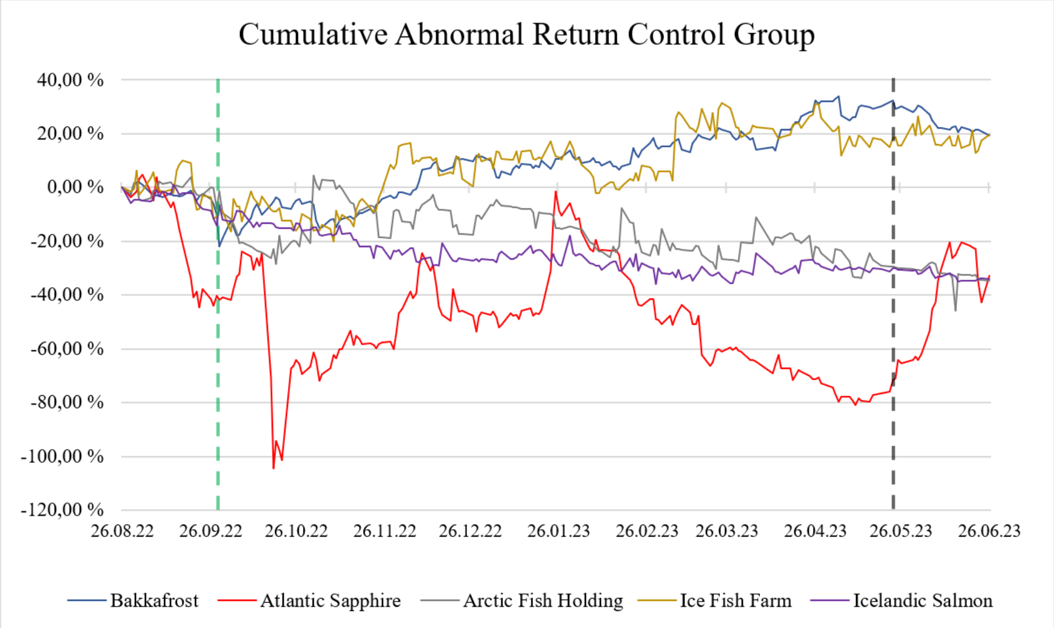


Figure 7.2 depicts the cumulative returns for the stocks in the treatment group, showing a notable downward trend in stock prices also prior to the announcement day, while the corresponding Figure 7.4 for cumulative abnormal returns shows this trend to be less pronounced. This suggests that the negative returns observed in the period prior to the announcement day in Figure 7.2 are at least partially attributable to general market movements. Notably, in Figure 7.4 there is a sharp decline in stock prices for the treatment group stocks on the announcement day followed by a positive rebound on the agreement day. In contrast, Figure 7.5 depicting the cumulative abnormal return for the stocks in the control group exhibited a more subdued response on both the announcement and agreement day.

7.1.3 Market Reaction to the Resource Rent Tax Announcement

Table 7.1 displays the cumulative abnormal returns (CAR) for the tax announcement day (September 28, 2022) and during three event windows surrounding the event. In addition, we have included pre- and post-event windows. The methodology employed for this event study follows MacKinlay's (1997) framework, as detailed in subsection 4.1.

Table 7.1: CAR on the Announcement Day Estimated With the Market Model
Notes: This table presents the Cumulative Abnormal Return (CAR) for the announcement day ([0]), September 28, 2022, and for additional event windows extending +/- 3 trading days around the event. T-values are reported in parentheses. Statistical significance at the 10%, 5%, and 1% levels are denoted by *, **, and ***, respectively.

Event Window	CAR
[0]	-0.2387***
	(-12.350)
[-1, 1]	-0.2911***
	(-12.582)
[-2, 2]	-0.2919***
	(-9.555)
[-3, 3]	-0.2739***
	(-16.711)
Pre-Event	
[-3, -1]	-0.0553***
	(-8.631)
Post-Event	
[1, 3]	0.0202**
	(2.554)
Observations (df)	5 (4)

The CAR of -23.87% on the announcement day revealed a significant negative market reaction with high magnitude, suggesting that the resource rent tax was perceived negatively by the market, leading to a decline in the stock prices of the companies affected by the proposed tax. The CAR decreases further through the extended event windows [-1, 1] and [-2, 2], before the CAR slightly increases in window [3, 3], indicating a continued adverse market response around the event date.

The significant negative CAR of -5.53% in the pre-event window, [-3, -1], in the days leading up to the announcement suggests that there might have been information leaks and possibly insider trading before the event, but this will remain speculation and we cannot say anything certain about this. Conversely, a positive CAR of 2.02% in the post-event window, [1, 3], indicates a mild recovery or positive correction following the initial drop. This positive response could indicate that the market has adapted to the news, possibly reassessing the initial reaction as excessive, or responding to additional positive information or clarifications that emerged after the event.

In conclusion, there was a significant negative reaction with high magnitude to the announcement of the resource rent tax, suggesting significant market disapproval. The negative returns observed in the days leading up to the announcement could indicate potential information leakage. Conversely, the positive returns following the announcement suggest that the initial market response may have been an overreaction.

Table 7.2 below displays the CAR for the treatment group relative to the control group for the tax announcement day and during three event windows surrounding the event. In addition, we have included pre- and post-event windows.

Table 7.2: Difference in CAR between the Treated and Control Group on the Announcement Day Estimated With the Market Model

Notes: This table presents the differences in Cumulative Abnormal Returns (CAR) between the treated and control groups on the announcement day ([0]), September 28, 2022, and for additional event windows extending +/- 3 trading days around the event. T-values are reported in parentheses. Statistical significance at the 10%, 5%, and 1% levels are denoted by *, **, and ***, respectively.

Event Window	CAR
[0]	-0.2190*** (-6.715)
[-1, 1]	-0.2504*** (-12.239)
[-2, 2]	-0.2213*** (-6.351)
[-3, 3]	-0.2190*** (-13.766)
Pre-Event	
[-3, -1]	-0.0414** (-3.540)
Post-Event	
[1, 3]	0.0414* (2.425)
Observations (df)	5 (4)

When examining the CAR in comparison to the control group, we can draw the same conclusions as in Table 7.1, but the magnitude of these effects is slightly less pronounced. This indicates that the control group also reacted negatively to the resource rent tax announcement, pointing to a potential industry-wide impact driven by uncertainties and information asymmetry related to potential tax changes.

Interestingly, the post-event CAR of 4.14% in the window [1, 3], significant at the 10% level, exceeds the figures reported in Table 7.1. This suggests that the treatment group outperformed the control group in the days following the tax announcement. The increase in the post-event CAR indicates that while the treatment group experienced a positive adjustment, the control group's returns declined in the subsequent days. Despite an investigation for news related to the companies in the control group within three days after the announcement, we could not identify any clear reasons for the observed decline in their prices during the post-event window.

In summary, the findings from this analysis are consistent with those presented in Table 7.1, though the effects on the announcement day are less pronounced. This indicates that the control group also responded slightly negative to the resource rent tax announcement, but to a lesser degree. The subsequent higher post-event returns indicate a favorable performance for the treatment group relative to the control group in the post-event period.

The results from the two event studies on the announcement day clearly show a negative CAR. Consequently, we can confidently reject Hypothesis 1.

7.1.4 Market Reaction to the Resource Rent Tax Agreement

Table 7.3 displays the cumulative abnormal returns (CAR) for the tax agreement day (May 25, 2023) and during three event windows surrounding the event. In addition, we have included pre- and post-event windows. The methodology employed for this event study follows MacKinlay's (1997) framework, as detailed in section 4.1.

Table 7.3: CAR on the Agreement Day Estimated With the Market Model
Notes: This table presents the Cumulative Abnormal Return (CAR) for the agreement day ([0]), May 25, 2023, and for additional event windows extending +/- 3 trading days around the event. T-values are reported in parentheses. Statistical significance at the 10%, 5%, and 1% levels are denoted by *, **, and ***, respectively.

Event Window	CAR
[0]	0.0972***
	(11.442)
[-1, 1]	0.0598***
	(5.394)
[-2, 2]	0.0523***
	(7.114)
[-3, 3]	0.0372**
	(3.807)
Pre-Event	
[-3, -1]	-0.0290*
	(-2.764)
Post-Event	
[1, 3]	-0.0311***
	(-7.569)
Observations (df)	5 (4)

The CAR of 9.72% on the agreement day disclosed a significant positive market reaction, suggesting that the terms of the resource rent tax agreed on were more favorable than expected, resulting in a positive stock price reaction of the affected companies. In fact, the agreed-on tax rate was lower than the tax rate initially proposed on the announcement day. As the event window expands from [-1, 1], to [-2, 2], and further to [-3, 3], the CAR decreases progressively to 5.98%, 5.23%, and 3.72%, respectively, indicating a diminishing positive response as the window widens.

In the pre-event window, the significant negative CAR of -2.90% might imply that some investors were acting on anticipatory information prior to the announcement day. The negative CAR of -3.11% in the post-event window may indicate that the market reassesses the initial positive surge as excessive. This adjustment may suggest a recalibration of investor expectations following a deeper analysis of the agreement's implications.

In summary, the observation of a significantly positive CAR on the agreement day suggests that the tax was lower than anticipated. The negative CAR leading up to the agreement suggests that investors may have braced for unfavorable news, whereas the negative CAR following the agreement likely indicates an initial overreaction.

Table 7.4 below displays the CAR for the treatment group relative to the control group for the resource ren tax agreement day.

Table 7.4: Difference in CAR between the Treated and Control Group on the Agreement Day Estimated With the Market Model
Notes: This table presents the differences in Cumulative Abnormal Returns (CAR) between the treated and control groups on the agreement day ([0]), May 25, 2023, and for additional event windows extending +/- 3 trading days around the event. T-values are reported in parentheses. Statistical significance at the 10%, 5%, and 1% levels are denoted by *, **, and ***, respectively.

Event Window	CAR
[0]	0.0904**
	(4.588)
[-1, 1]	0.0581*
	(2.408)
[-2, 2]	0.0181
	(0.746)
[-3, 3]	0.0095
	(0.279)
Pre-Event	
[-3, -1]	-0.0409*
	(-2.171)
Post-Event	
[1, 3]	-0.0400**
	(-3.620)
Observations (df)	5 (4)

On the event day, the CAR of 9.04% is nearly identical to that presented in Table 7.3, though slightly lower, indicating that the control group also experienced a modest positive CAR on the event day. As the event window expands from [-1, 1] to [-3, 3], the differences in CAR between the two groups decrease significantly, with the [-2, 2] and [-3, 3] windows showing no significant difference in CAR.

In the pre-event window, the CAR is -4.09%, suggesting that the treated group underperformed relative to the control group. This could imply that investors anticipated unfavorable news regarding the tax before the agreement was announced. In the post-event window, the CAR is -4.00%, indicating that the treated group continued to underperform. This underperformance suggests that investors may have initially overreacted on the agreement day. Moreover, the post-event CAR being lower than in Table 7.3 might imply that the market interpreted the tax announcement as relatively favorable for the control group compared to the treated group. This further suggests that the initial positive response of the treated group faded.

In conclusion, the primary findings are consistent with those in Table 7.3. We observed a significant positive CAR on the agreement day, along with significant negative CARs both pre- and post-event window. Notably, the extent of the negative CARs before and after the event exceeds those in Table 7.3, indicating a somewhat positive reaction from the control group.

The results from the two event studies conducted on the agreement day clearly demonstrate a positive CAR, leading us to reject Hypothesis 2.

7.2 Risk Factor Analyses Using the Fama-French 3-Factors

In this subsection, we present the findings from our two Fama-French 3-Factor analyses, examining the abnormal returns of our treatment group (SalMar, Mowi, Grieg Seafood, Lerøy, and Måsøval) during three specific periods: one year prior to the tax announcement, between the tax announcement and the tax agreement, and ten months after the tax agreement.

7.2.1 Fama-French Regression With Constant Beta

In Table 7.5 below, we present the results of our regression analysis with constant betas, which was conducted to evaluate the alphas across the three specified periods.

Table 7.5: Fama-French 3-Factor Regression on Treatment Group Returns
Notes: This table presents estimates from a pooled regression of salmon stocks in the treatment group on the Fama-French 3-Factors from September 2021 to March 2024. The dependent variable is returns ($R_{i,t}$), and the independent variables include the Fama-French factors market risk premium (Rm-Rf), small-minus-big (SMB), and high-minus-low (HML). Alphas 1, 2, and 3 represent abnormal returns across three distinct periods: one year pre-announcement, between the announcement and agreement, and ten months post-agreement, respectively. T-values are reported in parentheses, with statistical significance at the 10%, 5%, and 1% levels denoted by *, **, and ***, respectively.

	Dependent variable: Returns ($R_{i,t}$)
Alpha1	-0.00659*
	(-1.818)
Alpha2	-0.01143**
	(-2.518)
Alpha3	-0.01147***
	(-3.030)
Rm-Rf	-0.00064
	(-1.645)
SMB	-0.00083*
	(-1.671)
HML	0.00170***
	(5.395)
R^2	0.3555
Adjusted R^2	0.2911
F-statistic	9.1939

Alpha1, Alpha2, and Alpha3 are each significantly negative at the 10%, 5%, and 1% levels, respectively, suggesting that the stocks consistently underperformed before the announcement, between the announcement and the agreement, and after the agreement. Interestingly, the alpha becomes increasingly negative over time, indicating a trend of deteriorating performance. This pattern of negative alpha values suggests structural changes in stock returns occurred during these periods.

Additionally, the analysis reveals that the salmon stocks exhibit a slight negative correlation with the SMB (small firms) factor and a positive correlation with the HML (value firms) factor.

Based on the results of this regression, we can reject Hypothesis 3, as there is evidence of negative alpha in the one-year period prior to the announcement, between the announcement and the agreement, and ten months after the agreement.

The negative alphas indicate that, from an investor's perspective, the returns were lower than the expected (required) rate of return. Therefore, the salmon stocks have underperformed during the sample period from September 2021 to March 2024.

7.2.2 Fama-French Regression With Moving Beta and Interaction Terms

In Table 7.6 below we extend our analysis and display the results from our enhanced Fama-French 3-Factor regression model, which includes changing betas and interaction terms. This approach allows us to capture potential changing exposure to risk factors over time.

Table 7.6: Fama-French 3-Factor Regression With Moving Beta and Interaction Terms on Treatment Group Returns

Notes: This table presents pooled regression estimates of salmon stocks in the treatment group using the Fama-French 3-Factors, including moving betas and interaction terms, covering September 2021 to March 2024. The dependent variable is returns ($R_{i,t}$), and the independent variables include the Fama-French factors market risk premium (Rm-Rf), small-minus-big (SMB), and high-minus-low (HML). The dummy variables 'd(pre)', 'd(intermediate)', and 'd(after)' correspond to three distinct periods: one year pre-announcement, between the announcement and agreement, and ten months post-agreement, respectively. Alphas 1, 2, and 3 denote abnormal returns for these periods. T-values are reported in parentheses, with statistical significance at the 10%, 5%, and 1% levels denoted by *, **, and ***, respectively.

	Dependent variable: Returns ($R_{i.t}$)
Alpha1	-0.00353 (-1.007)
Alpha2	-0.00313 (-0.541)
Alpha3	-0.00918** (-2.215)
Rm-Rf	0.00269*** (2.874)
pre * (Rm-Rf)	-0.00285*** (-2.912)
intermediate * (Rm-Rf)	-0.00328** (-2.380)
after * (Rm-Rf)	-0.00322*** (-3.022)
SMB	-0.00013 (-0.115)
pre * SMB	0.00117 (0.756)
intermediate * SMB	0.00336 (1.448)
after * SMB	-0.00218 (-1.588)
HML	0.00151*** (3.439)
pre * HML	0.00137* (1.807)
intermediate * HML	-0.00154 (-1.535)
after * HML	0.00095 (1.062)
R^2	0.5281
Adjusted R^2	0.4296
F-statistic	6.7895

When we expand our analysis to incorporate shifting risk factors, Alpha1 and Alpha2 are no longer statistically significant, suggesting that our treatment group did not experience any abnormal returns during the pre- and intermediate periods. However, Alpha3 remains significantly negative, indicating a consistent negative abnormal return following the tax agreement. This may imply that the tax had a lasting adverse impact on returns.

Additionally, the regression reveals a positive correlation with the HML factor, and we may also interpret the Rm-Rf factor to decrease over time.

The regression results reveal that we also can reject Hypothesis 4, since there is evidence of a negative alpha in the ten months following the agreement. However, the level of significance is lower compared to the results presented in Table 7.5, with only Alpha3 demonstrating a statistically significant value.

In subsection 7.4, we present the results of econometric tests used to validate the regression results. For this model we identified evidence of multicollinearity. To address this, we ran a new model excluding the variables pre*(Rm-Rf), pre*SMB, and pre*HML, maintaining all other aspects of the model. This adjustment effectively resolved the multicollinearity issues. The outcomes of this revised regression are documented in the appendix, Table A1. Although these results show slight variations from those in Table 7.6, the modifications did not alter our interpretation of the alphas: Alpha1 and Alpha2 remained insignificant, whereas Alpha3 continued to be significantly negative, with a statistically significant value of -0.01156 at the 1% level.

Furthermore, it is important to note that the variables incorporating the market risk premium (Rm-Rf, intermediate*(Rm-Rf), after*(Rm-Rf)) are no longer statistically significant in the adjusted model, Table A1. This suggests that the multicollinearity previously affected these variables. The adjusted R^2 has decreased to 0.3620, although this is a reduction, it remains higher than the adjusted R^2 seen in our constant beta model (Table 7.5).

In conclusion, the findings in Table 7.6, and those from the adjusted model (Table A1) where we excluded three variables to address the multicollinearity issue, lead to the same conclusion. The negative alpha in the 10-month period following the tax agreement suggests that the salmon stocks underperformed the market from an investor's perspective, indicating that they have not been a favorable investment after the tax agreement day.

Referring back to the literature review, the results from the Fama-French models may support the concerns raised by Tveterås et al. (2019) about the impact of imposing taxes beyond the standard taxes and fees paid by all industries. They highlighted that a resource rent tax in Norway could potentially reduce profits and affect the prioritization of projects for international salmon enterprises. Furthermore, these findings may also support the views of Folkvord et al. (2019), who emphasized the need for careful consideration when developing a tax framework for aquaculture to avoid jeopardizing the industry's prospects for sustainable development. On the other hand, the results may challenge the views of Nøstbakken & Selle (2020), who supported the taxation framework, arguing that it would decrease economic inefficiencies, enhance competitiveness, and contribute to the funding of Norway's welfare state.

7.3 ROA Before and After 2014, a Difference-in-Difference Analysis

In this subsection, we present the findings from our difference-in-difference analysis, which investigates whether there were any changes in the ROA within the aquaculture industry after 2014 relative to a control group.

The treatment group comprises Norwegian aquaculture companies that primarily import feed, their largest cost component, and export the majority of their salmon production. Conversely, the control group consists of industrial companies that import raw materials for production and export finished goods. Therefore, the control group is not subject to the resource rent tax.

Table 7.7: Difference-in-Differences Analysis of ROA Between Aquaculture Companies and the Control Group

Notes: This table provides estimates from a pooled difference-in-difference regression analysis of aquaculture companies (treatment group) and industrial exporting companies that import input factors (control group), spanning from 2009 to 2022. The dependent variable is $ROA_{i,t}$. 'Treatment' is a dummy variable representing the treatment group, and 'After_2014' is a dummy variable for observations from 2014 onward. The interaction term 'Treat * After_2014' examines the differential impact on ROA between the groups post-2014. T-values are reported in parentheses, with statistical significance at the 10%, 5%, and 1% levels denoted by *, **, and ***, respectively.

	Dependent variable: $ROA_{i.t}$
Alpha	0.03738***
	(12.833)
Treat	0.04450***
	(6.485)
After_2014	-0.00410
	(-1.115)
Treat * After_2014	0.02936***
	(3.364)
R^2	0.0492
Adjusted R^2	0.0486
F-statistic	76.58

The regression analysis explains the impact on ROA across two distinct periods: before and after 2014. By comparing a treatment group with a control group, this analysis offers insights into the financial performance of these groups over time.

The intercept indicates that the baseline ROA for the control group before 2014 was approximately 3.74%. The 'Treat' coefficient shows that the treatment group's ROA was approximately 4.45% higher than that of the control group prior to 2014, indicating that the treatment group was already outperforming the control group before 2014 based on ROA. The 'After_2014' coefficient suggests no significant change in ROA across the control group after 2014. However, the 'Treat*After_2014' term, our primary term of interest, reveals an additional increase of approximately 2.94% in ROA for the treatment group compared to the control group post-2014. This result demonstrates a significant positive impact on the treatment group after 2014.

These findings suggest that the aquaculture industry in Norway has experienced a significant increase in ROA after 2014 compared to the control group. Consequently, we can reject Hypothesis 5.

In conclusion, this finding offers strong empirical evidence of a positive effect on aquaculture companies post-2014, potentially corroborating governmental assertions about the justification for the resource rent tax.

Returning to the literature review, the findings from the difference-in-difference analysis seem to support Boadway and Flatters (1993), who argued that the optimal tax on natural resources should capture the economic rents generated by these resources, effectively claiming the unearned income that ideally belongs to the public. Additionally, the results may corroborate Greaker and Lindholt (2021), who noted a significant increase in resource rent after 2012 in the Norwegian aquaculture sector. However, these findings may challenge the perspectives of Folkvord et al. (2019), who warned that a resource rent tax could distort the market and that exceptionally high profit margins might not be sustainable long-term due to global influences. Furthermore, the results might also contradict the views of Tveterås et al. (2019), who argued that a resource rent tax, similar to that applied in the hydropower industry, could deter financially sound projects, and impede sustainable growth in the aquaculture sector.

7.4 Validity of Regression Results Using Econometric Tests

To ensure the validity of our findings, we performed several econometric tests by following the theory from Brooks (2019) and using statistical packages in R-Studio (Brooks, 2019). We conducted testing for autocorrelation, heteroscedasticity, and multicollinearity. We applied the tests for the Fama-French regression with constant beta (Table 7.5), the Fama-French regression with changing betas and interaction terms (Table 7.6), and the difference-in-difference model on change in ROA (Table 7.7).

The test for autocorrelation by the use of the Durbin-Watson Test, suggests that there is no significant issue with autocorrelation in the residuals for any of the three regression models, and it's reasonable to proceed with the analysis without adjustments for autocorrelation.

The Breusch-Pagan test results from the analysis indicate that there is no significant evidence of heteroscedasticity in either of the three regression models. These results suggest that the models do not suffer from heteroscedasticity, meaning that the variance of the residuals does not vary significantly across different levels of the independent variables.

The test for multicollinearity by the use of the Variance Inflation Factor (VIF) model suggest that multicollinearity is not a concern in the Fama-French regression with constant beta (Table 7.5) or in the difference-in-difference model on change in ROA (Table 7.7). Hence it appears safe to proceed with interpreting the models without concerns about multicollinearity distorting the coefficient estimates. However, we have evidence of multicollinearity in the Fama-French regression with changing betas and interaction terms (Table 7.6). We obtain VIF value above 10 for the Rm-Rf factor and the interaction term Pre*(Rm-Rf), in addition we obtain VIF values above 5 (but below 10) for the factors after*(Rm-Rf), SMB, and intermediate*SMB.

By examining a correlation matrix and visual plots, it's clear that there are significant correlations between some of the variables, particularly among the interaction terms involving Rm-Rf. This is consistent with the high VIF scores observed, reinforcing concerns about multicollinearity within the model and suggests that these interaction terms share a lot of variances with the market risk factor itself. This is not surprising, because these interaction terms inherently include the Rm-Rf component, which directly contributes to their variance. It could also be mentioned that the presence of near multicollinearity will not have an effect on the BLUE properties of the OLS estimator. Despite some variables exhibit high VIF values, our analysis suggests that the overall model remains well-specified.

To address the multicollinearity issues identified in Table 7.6, we removed the variables pre*(Rm-Rf), pre*SMB, and pre*HML from the regression model, keeping all other variables as before. The revised regression is detailed in the appendix, Table A1. This modification successfully resolved the multicollinearity concerns. While the results slightly differed from those in Table 7.6, this adjustment did not affect our interpretation of the alphas: Alpha1 and Alpha2 continued to be insignificant, while Alpha3 remained significantly negative.

8. Discussion

8.1 General Discussion

In this subsection, we will begin by discussing the findings from our empirical analysis. Following that, we will explore critical arguments related to the design of the resource rent tax and delve into questions concerning its economic rationale. Additionally, we will discuss the political process surrounding the tax, from its proposal through to its finalized agreement.

Our event study, which examines the market's immediate reaction to the tax announcement and subsequent agreement, reveals that investors anticipate an impact on future cash flows due to the tax. The negative (positive) abnormal return on the tax announcement (agreement) day suggests negative (positive) investor sentiments of the tax news. While the immediate market response lends support to the efficient market hypothesis, the partial reversal observed following the initial reactions suggests an initial overreaction. This overreaction could indicate that the market is not fully efficient. Moreover, the swift market reactions underscore the profound effect that fiscal changes can have on investor expectations and the financial dynamics of the industry.

Our Fama-French regression in subsection 7.2 with constant betas reveal a negative alpha for the pre-event, intermediate, and post-event periods. However, when we expand the model to include interaction terms and adjust for changing exposure to risk factors, the alphas for the pre-event and intermediate periods are not statistically different from zero. In contrast, the post-event alpha remains significantly negative. This finding is in support of the industry stakeholders who have argued against the implementation of a resource rent tax.

Furthermore, the analysis employing a difference-in-differences approach in subsection 7.3, revealed a significant increase in ROA for the aquaculture companies after 2014 compared to the control group. This result provides empirical evidence supporting governmental assertions that implementing a resource rent tax is justified.

The analysis suggests that both the government and the owners of the salmon companies were right when they made arguments for and against the tax respectively. The difference-in-difference analysis shows that aquaculture companies have seen an increase in profitability, as reflected by the rise in ROA. However, the Fama-French regressions indicate that abnormal returns are either negative or zero. This suggests that despite the high ROA, future returns for investors may not be as favorable, particularly if stock valuations are already high. This finding could support the industry's view that future returns might be moderate, and that major shareholders are already subject to wealth tax on previously high returns.

Despite the last decade's high profitability in the aquaculture industry, profitability may not be permanent. Key reasons for high profitability include regulations and biological problems that limit production. The historical calculation of "resource rent" incorporates a mix of regulatory rents, inframarginal rents, and quasi-rents. Quasi-rents are temporarily extraordinary profitability that do not provide a stable foundation for taxation. According to Misund & Tveterås (2023), relying on such a volatile base could lead to the adoption of a complex tax model that only yields temporary revenue.

Extraordinary profits in the aquaculture industry may also arise from cost differences between companies, which stem from human structural factors such as talent, competence, and innovations protected by patents. These benefits are known as "inframarginal rent," a term that encompasses various forms of economic rent created by cost differences. The underlying causes of these differences vary, and companies demonstrating greater efficiency or higher levels of expertise can generate what is referred to as "skill rent" or "entrepreneurial rent" (Misund & Tveterås, 2023).

Additionally, societal inputs, including R&D funding from entities like The Research Council of Norway (Forskingsrådet), regulatory oversight, infrastructure development, and access to prime locations, play vital roles in the industry. Therefore, the extraordinary returns observed cannot be attributed solely to the exploitation of natural resources but rather represent a combination of corporate efforts and societal contributions (Misund & Tveterås, 2023).

Neither the studies by Greaker and Lindholt (2019, 2021, 2022) nor the report NOU 2019:18 have thoroughly analyzed the drivers of high profitability or its variability among companies. While it is often argued that the exploitation of scarce natural resources creates "resource rent," this claim lacks empirical support and is undocumented. In fact, current research suggests that the scarcity of aquaculture locations and the limitations on permits are primarily the result of environmental regulations, leading to what is more accurately described as regulatory rents rather than resource rents. Under these conditions, the academic justification for implementing a resource rent tax is debatable. Academic consensus generally asserts that market failures, such as those caused by pollution, should be addressed with environmental taxes designed to improve efficiency, rather than through taxes on resource rent (Misund & Tveterås, 2023; NOU 2019: 18, 2019).

Throughout our research, we conducted a thorough review of public and governmental documents related to taxation in the Norwegian salmon industry. A common justification for implementing a resource rent tax frequently references the work of Greaker and Lindholt from Statistics Norway, who have conducted detailed calculations of the resource rent in the industry (Greaker & Lindholt, 2019, 2021, 2022). While their analyses are extensive, relying exclusively on their methodology to establish a new tax may be considered narrow, especially given the array of available methodologies for calculating resource rent and the various definitions that could be applied.

It is notable that the analysis of resource rent has not been conducted from a broader range of perspectives. For example, Misund and Tveterås (2023) have examined economic profitability by incorporating capital costs, revealing considerable fluctuations in economic profit over time. Their findings offer a conservative estimate of resource rent and present a significant challenge to the rationale behind the proposed tax. This finding aligns with the conclusion from Boadway and Flatters (1993), who argue that resource taxes often overestimate resource rents in practice.

Interestingly, the tax rate was set arbitrarily, without any grounding in socio-economic analyses. Initially proposed at 40%, it was subsequently reduced to 35%, and eventually established at 25%. This rate was not evaluated in context with the overall tax burden, raising concerns that the aquaculture industry might become less profitable post-taxation compared to other sectors, potentially limiting its access to capital (Furuset, 2023b; Misund & Tveterås, 2023; NOU 2019: 18, 2019; Office of the Prime Minister & Ministry of Finance, 2023).

The aquaculture industry is already subject to multiple taxes, including a corporate tax, auctioned production permits, per kilo production fees, and export taxes. To make informed decisions about investments and employment in aquaculture, it is essential to understand how the complete array of taxes and fees impacts the industry's net cash flow, including R&D fees, payroll tax, dividend tax, wealth tax, and resource rent tax. The profitability of aquaculture after all taxes has not been examined, marking a critical oversight in both the resource rent tax consultation document and the NOU 2019:18 report (Ministry of Finance, 2022a; Misund & Tveterås, 2023; NOU 2019: 18, 2019).

The implementation of the resource rent tax was motivated by the principle that the sea and fjords, as natural resources, belong to the society at large. While it is argued that the salmon industry has achieved extraordinary profitability through the exploitation of these resources, the rationale for a basic deduction is questionable, as even smaller companies utilize the natural resources. This deduction contradicts the recommendations of both NOU 2019:18 and NOU 2022:20 and lacks an economic foundation. It introduces distortions by favoring smaller companies, complicating the competitive dynamics for larger companies in production permit auctions, and promotes the creation of complex, opaque ownership structures designed to minimize tax liability rather than to enhance the production efficiency of salmon (NOU 2019:18, 2019; NOU 2022:20, 2022).

Moreover, the basic deduction creates undesirable incentives that are economically unjustifiable and problematic for several reasons. It violates the principle of equality set forth by the Tax Reform of 1992 by valuing identical assets differently based on the size of the company. Additionally, it can lead to a lower tax burden for less productive companies compared to their more productive counterparts, which is undesirable from an efficiency standpoint (Misund & Tveterås, 2023).

Since 2002, aquaculture permits have been issued in exchange for payment, initially at fixed fees and later increasingly through state-conducted auctions. However, claims made in NOU 2018:19 and NOU 2022:20 that these permits were sold at heavily discounted prices are undocumented and misleading. The Aquaculture Tax

Committee's assertion that permits usually have been granted for free or far below market price is not backed by any supporting calculations or documentation (Misund & Tveterås, 2023).

In this context, companies acquire the right to use natural resources by winning auctions. This raises a question: If companies are paying market-based prices for permits through competitive auctions, are they truly generating a resource rent, or are they merely covering the actual cost of resource utilization in a competitive market?

The implementation of the resource rent tax could become a case study in economics and finance on how politics should not be conducted. The process seems rushed and incomplete, with indications that the tax was pushed through by top political leaders without sufficient regard for public inquiries or industry perspectives. The salmon tax took effect on January 1, 2023, and was applied retroactively before a political agreement was reached on May 25, 2023. Traditionally, Norway has enacted major tax reforms through long-term agreements involving parties from both wings in the parliament. Unfortunately, such a consensus was absent in this instance, which led to criticism of the process from other political parties and industry stakeholders (Furuset, 2023a, 2023b).

The resource rent tax is not truly neutral, despite the Aquaculture Tax Committee's recommendations resting on a central premise that the tax is "neutral," meaning that the tax does not affect the companies' operational and investment decisions. While this neutrality can be easily shown in a theoretical simplified economic model, real-world application shows that taxes influence corporate strategies. The specific structure and magnitude of this tax create distortionary incentives, potentially leading to unintended effects on tax revenue collection, corporate structure, and operations. Additionally, elements of the tax proposal, such as basic deductions, norm pricing, and the differential treatment of positive and negative resource rent income, further contribute to its non-neutral character (Misund & Tveterås, 2023).

We will not reach a definitive conclusion on whether the tax is justified. The thesis provides strong arguments both supporting and opposing it, revealing disagreements among experts and administrative agencies over its justification and potential for improvement. While theoretical models of optimal taxation offer valuable insights, the real-world implementation must also consider political, social, and practical realities that the theory may not fully capture (Mankiw et al., 2009). Taxes are essential for funding public welfare, and Norway has a well-established history of resource rent tax on hydro production and significant taxes on the petroleum industry, which have broadly benefited the society. However, it is evident that the implementation process of the resource rent tax could have been managed better. Setting a consultation deadline for feedback on the resource rent tax three days after its scheduled introduction is, at the very least, unconventional.

8.2 Critical Assessments and Limitations

Our study faces limitations due to a small sample size. The salmon farming industry is largely comprised of privately owned companies, with relatively few publicly listed companies. This scarcity may compromise the precision of our estimates for population parameters, potentially leading to increased sampling errors and reduced reliability of our findings. However, our treatment group includes the largest salmon companies, and the structure of the tax includes a basic deduction, meaning that relatively few companies are subject to the resource rent tax. Consequently, our selection of five stocks in the treatment group captures a significant portion of the market implications stemming from the announcement and subsequent agreement of the tax.

Additionally, within the control group, four companies are relatively small, characterized by low market capitalizations and low salmon production volumes. Moreover, some companies in this group also experience low trading volumes, resulting in decreased market liquidity. Particularly, Atlantic Sapphire has faced challenges with low production levels and operational difficulties.

Given the limited number of salmon farming companies listed on the Oslo Stock Exchange, our sample has been expanded to include four stocks from Euronext Growth Oslo: Måsøval, Arctic Fish Holding, Ice Fish Farm, and Icelandic Salmon. The remaining six stocks are listed on the Oslo Stock Exchange. The distinct rules and regulations governing these two markets could lead to varying investor responses to new information and policy changes, with the Oslo Stock Exchange generally subject to more stringent regulations than Euronext Growth Oslo.

In our second Fama-French regression, when we included interaction terms and adjusted for changes in risk factors, the alphas for the pre-announcement and intermediate periods were no longer significant. This suggests that our estimation of abnormal returns may be sensitive to the model specifications.

A continuation of our research could be to explore the long-term effects of the tax, focusing specifically on its impact on industry investment, growth, and global competitiveness.

9. Conclusion

This thesis has addressed the research question *"How did the resource rent tax proposal and subsequent agreement affect the stock prices of Norwegian salmon farming companies, and was the resource rent tax economically justified?"* Through three primary analyses, an event study, a Fama-French 3-Factor analysis, and a difference-in-difference analysis, this thesis has provided insights on the financial performance of the salmon aquaculture industry over time and examined how the announcement and agreement of the resource rent tax influenced stock prices. Additionally, reflections on the literature review reveal conflicting views regarding the long-term economic impacts of such taxation on the salmon farming industry.

Our event study analyzed market reactions on two pivotal dates: the initial tax proposal on September 28, 2022, and the eventual agreement on May 25, 2023. The findings revealed a significant negative impact on stock returns for companies affected by the tax on the announcement day, with an abnormal return of -23.87%. Conversely, the agreement day marked a positive adjustment with an abnormal return of 9.72%, indicating that the market responded favorably to a finalized tax rate that was lower than expected. These results demonstrate the salmon aquaculture industry's sensitivity to regulatory changes and highlight the substantial influence of government policies on economic outcomes.

The second analysis employs the Fama-French 3-Factors to explore abnormal returns for salmon companies from September 2021 to March 2024, assessing investor returns during a period surrounding the tax announcement and agreement. Utilizing constant betas, we observe negative alphas during the pre-announcement, intermediate, and post-agreement phases. However, when the model is expanded to incorporate interaction terms and adjust for changing exposure to risk factors, the alphas for both the pre-announcement and intermediate periods are not statistically significantly different from zero. In contrast, the alpha for the post-agreement period remains significantly negative. This pattern suggests that the alpha becomes increasingly negative over time, indicating a trend of deteriorating performance.

The third analysis employs a difference-in-difference estimation, taking a long-term perspective to evaluate claims of elevated industry returns since around 2014. The findings reveal that the aquaculture industry in Norway has experienced a significant increase in ROA, with an improvement of approximately 2.94% after 2014 compared to before, relative to a control group.

This thesis underscores the importance for governments to thoroughly evaluate the impact on stock markets before formulating and announcing significant policy changes. Although the Norwegian salmon farming industry has experienced considerable profitability in recent years, this trend may not be permanent. Factors such as regulatory interventions and biological constraints that limit production have been key drivers to this profitability.

The findings reveal that public discussions and statements from prominent politicians can lead to significant fluctuations in stock prices, increasing political uncertainty and diminishing company valuations. It is essential for politicians to consider the repercussions of their public statements on issues that could influence the stock market, as the market's reaction underscores the ramifications of incautious political rhetoric on financial stability.

It is a balance between providing fair compensation for societal resources and sustaining a competitive, viable aquaculture industry. While the immediate adverse effects on stock prices are evident, the long-term consequences of the resource rent tax are still uncertain.

In conclusion, this research has brought to light the significant immediate financial impacts and ongoing market adjustments caused by the resource rent tax, yet the broader economic justifications and the tax's future sustainability demand continual and careful evaluation. Policymakers must consider these aspects alongside the industry’s critical role in Norway's economy and its potential for future growth and innovation. This complex equilibrium will ultimately determine the long-term efficacy of the tax policy in harmonizing economic growth with social equity.

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Appendix

Table A1: Fama-French 3-Factor Regression With Moving Beta and Interaction Terms on Treatment Group Returns

Notes: This table presents pooled regression estimates of salmon stocks in the treatment group using the Fama-French 3-Factors, including moving betas and interaction terms, covering September 2021 to March 2024. The dependent variable is returns ($R_{i,t}$), and the independent variables include the Fama-French factors market risk premium (Rm-Rf), small-minus-big (SMB), and high-minus-low (HML). Alphas 1, 2, and 3 denote abnormal returns for to three distinct periods: one year pre-announcement, between the announcement and agreement, and ten months post-agreement, respectively. The dummy variables 'd(intermediate)', and 'd(after)' correspond to two distinct periods: between the announcement and agreement, and ten months post-agreement, respectively. T-values are reported in parentheses, with statistical significance at the 10%, 5%, and 1% levels denoted by *, **, and ***, respectively.

	Dependent variable: Returns ($R_{i,t}$)
Alpha1	-0.00582 (-1.660)
Alpha2	-0.00552 (-0.922)
Alpha3	-0.01156*** (-2.768)
Rm-Rf	-0.00004 (-0.145)
intermediate * (Rm-Rf)	-0.00048 (-0.494)
after * (Rm-Rf)	-0.00049 (-0.800)
SMB	-0.00004 (-0.045)
intermediate * SMB	0.00327 (1.418)
after * SMB	-0.00227* (-1.914)
HML	0.00184*** (4.946)
intermediate * HML	-0.00187* (-1.827)
after * HML	0.00062 (0.687)
R^2	0.4548
Adjusted R^2	0.3620
F-stat	6.5355