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Norwegian Municipalities' Investments in Capital Markets

An Empirical Study of Norwegian Municipalities' Investment Portfolios

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NORWEGIAN SCHOOL OF ECONOMICS

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Abstract

Unfamiliar to many, Norwegian municipalities manage substantial investment portfolios totaling 35 billion NOK (3.7B USD). In this thesis we investigate what characterizes Norwegian municipalities' investments in capital markets as well as how they have performed in equity markets. We start by establishing a general overview consisting of assets under management and asset allocation for all municipalities. We observe that total investments in capital markets have increase by 30% since 2003, whereas the largest growth has been in stocks and shares. This paper reveals that investments in stocks and shares have doubled in the last 10 years. From a sample of 37 municipalities, we find that the most prominent drivers of municipal investment in capital markets are gross income per capita and population size.

Further, we find that the average portfolio consists of 70% fixed income and 30% equity, indicating that Norwegian municipalities generally are risk averse. However, we find that there are variations among them, whereas a municipality with higher-income population, higher assets under management-to-assets and income from power companies is less risk averse. When evaluating the municipalities' equity performance, we use the Carhart four-factor model. At a 5% significance level, 2 out of 27 municipalities are achieving positive excess returns, respectively Vennesla and Sokndal. In contrast, Volda is delivering negative abnormal excess returns. However, when applying a persistence analysis, we reveal that there seems to be no evidence of superior skill, implying that the positive (negative) abnormal returns are due to luck (bad luck).

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1 Introduction

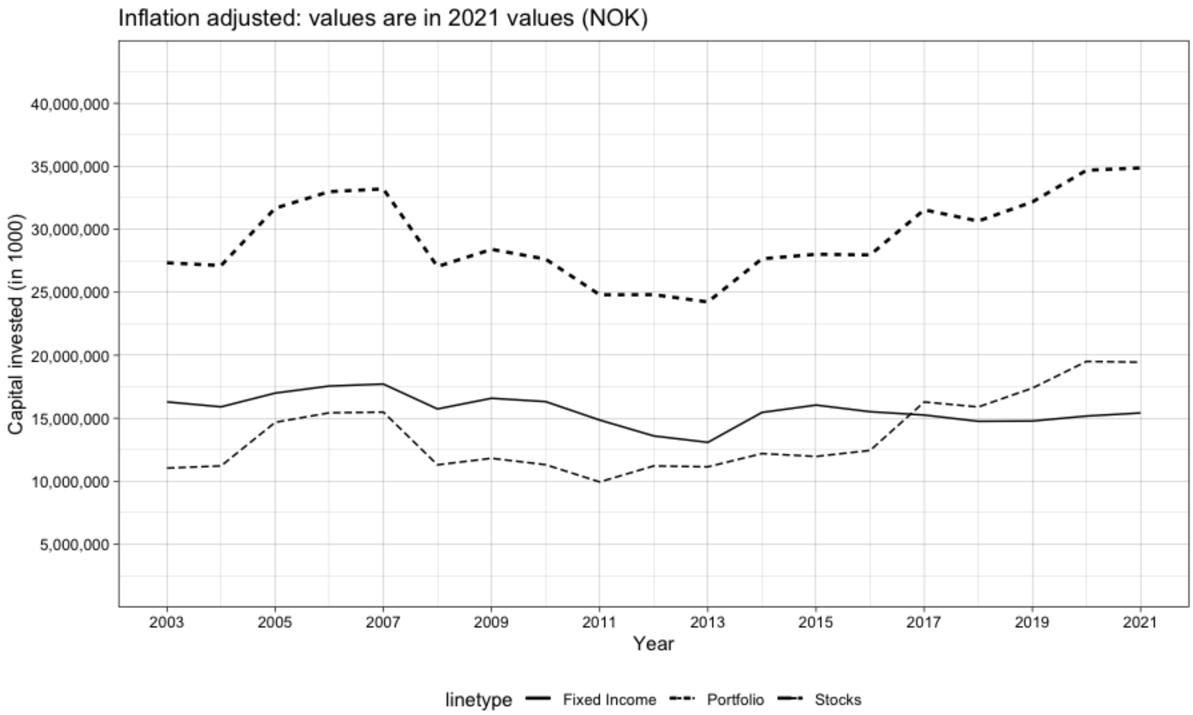
1.1 Relevance

Municipalities and their involvement in the capital market are uncharted waters, even though municipalities have increased their investments drastically for the last ten years. In 2021 Norwegian municipalities had invested a total amount of 35 billion NOK (3.7B USD) in capital markets (Statistisk Sentralbyrå, 2022a). Remarkably, almost no one has actually evaluated how the municipalities manage their investments, what they invest in, and what returns they make, other than the general financial overview given by the annual reports. We therefore consider this thesis to be an important contribution to public economics in Norway. The research topics we seek to investigate in this paper are:

1. *How does the Norwegian municipalities invest in capital markets, and what determines these investments?*
2. *How have the Norwegian municipalities performed in the equity market?*

Often referred to when speaking of Norwegian municipalities investments in capital markets is the "Terra scandal". The Terra scandal occurred as a consequence of the financial crisis in 2007-2008 and is named after the investment firm Terra Securities ASA, which intermediated the sale of financial securities that lead to the scandal (Truyen, 2008, p. 561). Although only eight municipalities were involved, in 2007 the total invested amount were 850 million NOK (90M USD) (E24, 2008). Moreover, the investments were financed with debt, which caused the gearing for municipalities to increase in the period before the scandal (VFF, 2007). In 2017, the municipalities involved had lost a sum of 1.4 billion NOK (148M USD) (NRK, 2017). The Terra scandal received a lot of media coverage, possibly due to the fact that the investments could be interpreted as a "gambling with the people's money".

Figure 1.1: Total Capital Invested, Stocks and Shares and Fixed Income



The figure is based on numbers from SSB.

By adjusting the investments in the capital market for inflation using the inflation calculator from SSB (Statistisk sentralbyrå, 2022), it is possible to compare the value of assets under management for the municipalities over time. Figure 1.1 displays the annual development from 2003 to 2021. The assets under management are higher than it was before the financial crisis and the Terra Scandal in 2007, in 2021-values. Before the financial crisis in 2007, the municipalities had investments worth approximately 32.5 billion NOK (3.4B USD) in 2021-values. Historically, Norwegian municipalities has invested most of their capital in fixed income. Indeed, this is one reason why they were hit hard under the CDO-scandal. But keep in mind that there may be fixed income investments placed in the "Stocks and Shares"-variable, but not vice versa. Thus, the investment in fixed income is, in reality, higher than what figure 1 illustrates, due to the KOSTRA-classifications including mutual funds and ETFs in stocks and shares, which can contain fixed income securities.

In 2021 the municipalities had 35 billion NOK (3.7B USD) under management, 20 billion NOK (2.1B USD) invested in stocks and share and 15 billion NOK (1.6B USD) in fixed income. Regarding the two asset classes, it is possible to deduce from figure 1 that investments in fixed income has stayed relatively stable, while the investments in stocks and shares are more volatile. Moreover, figure 1 indicates that the proportion of stocks and shares steadily increased over the last decade.

The capital that municipalities invest in the market originates from different sources. While some municipalities sold shares from their power companies, others used their excess liquidity to invest in the capital market (Regjeringen, 2008). Thus, there are various reasons why municipalities invest in the capital markets, but the most prominent source is realized return from sales of shares in power companies, like for instance Trondheim and Asker (Asker Kommune, 2020, p. 9; Kommunal Rapport, 2010).

1.2 Legal requirements

Due to variation in finance rules, municipal investments differ between municipalities. Some municipalities take on more risk than others because it is the local government that determines the finance rules. Our thesis will therefore investigate this difference, where we examine the proportion of risk the municipalities take. By looking at the riskiest municipalities, specified in section 3.1, this paper will develop an insight into how much risk the municipalities and the local government permits.

The municipalities are regulated by laws that restrict the exposure to risk. According to The Local Government Act section 14-1, Fundamental financial management requirements, municipalities cannot manage their financial assets in a way that entail significant financial risk, in order that payment obligations are sure to be fulfilled at maturity (The Local Government Act, 2018, §14-1). But, when investing in securities, there is no clear definition of significant risk, other than not fulfilling payment obligations at maturity. Thus, local governments, i.e., the municipalities themselves, have a mandate to determine what “significant financial risk” might be and where that line is crossed (The Local Government Act, 2018, §14-2e). Hence, the municipalities can set rules for how the capital should be allocated in the capital markets.

Local Government Act section 14-13, Financial and debt management, states that the finance rules shall contain provisions preventing the municipalities from taking significant financial risk in financial management (The Local Government Act, 2018, §14-13). Hereunder, return targets for the financial management must be specified by the respective municipalities. Return targets will, firstly, be limited by section 14-1, while, on an underlying level, the municipalities will have the rights to regulate themselves on what risk they are exposed to, given that it does not exceed the limitation of section 14-1. As a consequence of these rules, it is natural to assume variations in what is defined as a significant financial risk among municipalities, thus leading to different asset allocations.

To better understand the importance of researching municipal investments one can simply study the development of the amount invested. During the last decade, the increase in total capital invested has been significant, while research and attention paid to this growth has been minimal. We should perhaps ask to why this is the case. When we set out on this mission to gather information about the municipal investments, we found different types of obstacles. For instance, there was no central database on this topic, and we had to contact the municipalities in person to gather information about their funds. Even to find the development of the total value of the market-based investments we had to use several different databases provided by SSB. Consequently, we find that a systematic overview of the field is lacking. Our goal is to create a clearer overview of the municipal investments, while also investigating the performance of the municipalities and the rationale behind their investment behavior.

2 Literature Review

In the following section we present the theoretical framework of the thesis. The purpose is to lay the foundation and to explain the relevant theory for grasping the discussion.

2.1 Efficient Market Hypothesis

To better understand the purpose of this thesis, it is beneficial to first explain the efficient market hypothesis (EMH) and how it is related to our research. EMH is a theory about capital markets that states that all security prices should fully reflect all available information in order for the market to be efficient (Fama, 1970, p. 283). It should be further elaborated that the efficient market hypothesis commonly is divided into three subsets: Weak form, semi-strong form and strong form; these relates to the degree of information available to the market. In the weak form of market efficiency, a stock price today is reflected all historical information. The Semi-strong form claims that stock prices today reflect all publicly available information like annual reports and news. Finally, the strong form also accounts for information that is not available to the public, meaning that it is impossible to make a superior gain – even for investors with private information (Fama, 1970, p. 283). On this notion, the only force that is able to move stock prices are news.

Although the EMH has been widely recognized as one of the major contributions to modern finance, it has also been met by skepticism and academic debate. The opposition argues that investors behave irrationally, and that this irrationality is skewed, meaning that it does not cancel out. And while the EMH tells us that arbitrage investing removes the effect of irrational mispricing, the other side argues that arbitrage is both risky and costly, and therefore cannot fully offset mispricing (Shleifer, 2000, p. 2). The majority of empirical financial research show that the semi-strong form of market efficiency mostly holds (Fama, 1970, p. 283). To exemplify this, 95% of domestic equity funds underperformed measured against the S&P composite 1500 over the last 20 years (Coleman, 2022).

2.2 CAPM

A financial model that has been an essential to the modern financial literature, is the Capital Asset Pricing Model (CAPM). The model was developed by Sharpe, Treynor, Lintner and Mossin in the 1960s, and has since been a crucial building block for both further financial research and asset pricing in business (Perold, 2004, p.3). The model explains how to look at the relationship between risk and return in the stock market. The intuition is that higher risk in an asset should be compensated with higher expected return. Moreover, not all risk should affect the asset price. *Firm specific* (idiosyncratic) risk can be eliminated by having a diversified portfolio and will consequently not be compensated for in the CAPM. Systematic risk on the other hand, is not diversifiable, and will hence be considered in the CAPM and will affect the expected return for an asset. Thus, the expected return of an asset in the CAPM is driven only by its exposure to systematic market risk. Expected return and the risk coefficient "beta" will therefore have a linear relationship.

There are three assumptions underlying the CAPM (Berk & DeMarzo, 2017, p. 417-418):

1. Investors can buy and sell all securities at competitive market prices (without incurring taxes or transactions costs) and can borrow and lend at the risk-free rate.
2. Investors hold only efficient portfolios of traded securities - portfolios that yield the maximum expected return for a given level of volatility
3. Investors have homogenous expectations regarding the volatilities, correlations and expected returns of securities.

The CAPM is based on strong assumptions, and these assumptions do not fully describe investor behavior. Thus, the CAPMs conclusion will not be completely accurate (Berk & DeMarzo, 2017, p. 424). The CAPM can be written

$$E[R] = R_f + \beta(E[R_m] - R_f) \tag{2.1}$$

where expected return is denoted by E[R], R_f is the risk-free rate, beta measure how sensitive the stock price is to market volatility and lastly the market risk premium is denoted by $E[RM] - R_f$, which is the market return excess over the risk-free rate.

2.3 Fama-French three-factor model

Though the CAPM has been an important contribution to financial literature, the model has been criticized for being too simplistic, most famously by Eugene Fama and Kenneth French in 1993 (Fama and French, 1993, p.5). In their paper, they argue that expected return cannot be explained from exposure to systematic market risk alone, but rather that there are other risk factors driving the expected return as well. On this basis, they extended the CAPM with two additional factors. Fama and French created the *Fama-French three-factor model* which also considered a value factor and a size factor. Empirical research has provided strong evidence that including these factors increases the model's explanatory power (Perold, 2004, p.33). The Fama-French three-factor model is expressed as follows:

$$R_{it} = RF_t + \beta_{market_i}(Rm_t - RF_t) + \beta_{SMB_i}(SMB_t) + \beta_{HML_i}(HML_t) \tag{2.2}$$

This expression is the extension of the CAPM explained earlier. The additional factors are SMB (Small minus Big), which is a measure of size, and HML (High minus Low), which is a measure of value. The size factor is created using a portfolio of companies with low market capitalization and subtracting a portfolio of companies with high market capitalization. Fama and French find that investing long in "small" companies should yield higher return. The value factor is created in the same way, where they use a long-short portfolio of companies with high book-to-market value minus companies with low book-to-market value. Fama and French (1993) suggests that companies with high book-to-market level (value stocks) tends to yield higher returns than companies with low book-to-market level (growth stocks).

2.3.1 Alpha

The intercept in this model is alpha "α" and measures the ability of fund managers to obtain abnormal returns. If the alpha is significantly positive, then the fund has managed to create returns above investing passively in a portfolio conditioned on the three factors (market risk, size and value). If the alpha is significantly negative however, then the fund manager has performed worse than the market, realizing lower returns for a given investment strategy.

2.4 Carhart four-factor model

Jegadeesh and Titman's paper "Returns to Buying Winners and selling losers" from 1993 introduce a new factor called "momentum" and argues that expected stock return can largely be explained by this. The momentum strategy buys stocks that have been generating high returns over 3-12 months (winners) and sells stocks that have been generating low returns (losers). The rationale, according to Jegadeesh and Titman, is that people tend to overreact to information about the stock, typically earnings reports, driving the stock price even higher than what the news about fundamentals would indicate.

With basis in the research from Jegadeesh and Titman (1993), Carhart (1997) extended the Fama-French three-factor model to also include a momentum factor. He uses the momentum factor PR1YR which is constructed by looking at two portfolios of companies: One portfolio containing companies with the highest 30% returns in the past 11 months and subtracting the portfolio containing companies with the lowest 30% returns. He comes to the same conclusion as Titman and Jegadeesh, and points out that funds that have had high returns the previous year, will likely experience above average returns the next year as well. Furthermore, he finds that the strategy of buying last year's top performing firms and selling the poor performing ones, yields an 8% annual return. The Carhart four factor model can be written as follows:

$$R_{it} = RF_t + \beta_{market_i}(R_{Mt} - RF_t) + \beta_{SMB_i}(SMB_t) + \beta_{HML_i}(HML_t) + \beta_{PRY1R_i}(PR1YR_t) \quad (2.3)$$

On the other hand, Carhart (1997) argues that funds relying on the momentum strategy underperform compared to conventional mutual funds. The issue lies in the fact that the constructed factor portfolios do not consider transaction costs and management fees, which occur when using the momentum strategy in the real world. Consequently, funds using the momentum strategy reap no benefit because the gain from the strategy are consumed by costs, and this leads to a net negative performance. In contrast to non-momentum funds, the momentum strategy yields significantly lower returns after expenses. Carhart further suggests that momentum-funds that in fact do obtain high returns are not due to a momentum strategy, but rather chance (Carhart, 1997, p. 58). Hence, momentum cannot be a strategy that yields persistent returns. We will in this thesis use the Carhart four-factor model to measure stock performance for the municipalities, since this encompasses the more restricted models.

2.5 Active portfolio management

Since many of the municipalities use external management firms to manage their investments, we are looking into the effects of active portfolio management. Given that a passive investor always will hold every security in the market, the passive investor will have the same return as the market. An active investor, on the other hand, will act on perceptions of mispricing, and will therefore change which securities to hold given this perception (Sharpe, 1991, p. 7). Accordingly, Sharpe suggests the following:

1. Before costs, the return on the average actively managed portfolio will equal the average passively managed return.

2. After costs, the return on the average actively managed portfolio will be less than the average passively managed return.

Thus, pre-cost, the returns of actively managed funds will be a zero-sum game. The reasoning is that abnormal returns for one actively managed fund comes at the expense of another. On the other hand, after costs, the results will be a negative sum game. Of course, some managers "beat the market" and we want to know whether Norwegian municipalities chose those managers.

Actively managed portfolios have trading fees, as well as the fees the municipalities must pay to the management firms. This leads to extra costs, which lowers the total returns for the municipalities. There is little evidence, even before fees, that management firms produce aggregate superior returns (Busse, Goyal & Wahal, 2010, p. 788). Moreover, through the recent years, the fees paid to asset managers has increased (Malkiel, 2013, p. 101-102). The abnormal returns that the management firms might manage to acquire on the behalf the municipalities may be consumed by the fees paid.

2.6 Risk aversion

The topic of risk aversion is central to explain investing behavior. Risk aversion derives from expected utility maximization of a concave utility-of-wealth function (Rabin & Thaler, 2001, p. 221). Reformulated, this means that people want to maximize their perceived utility based on their individual preferences. A person with a high risk-aversion will demand more compensation for a given risk than someone with a lower risk-aversion, which can be called the risk premium. Thus, investments in riskier securities cause higher expected returns, since the investors are compensated for taking on a higher risk.

On the topic of risk aversion, it is natural to ask: How risk averse should municipalities be? One might argue that the most important task of the municipality is to ensure safe and stable investments in order to cover costs and is thus obligated to take on low risk. On the other hand, one might say that there is a more profitable approach that require taking on more risk and that ineffective investments are the same as wasting the "peoples' money". Moreover, should the municipalities' risk profile reflect the risk aversion of its citizen? Or is perhaps the Norwegian sovereign wealth fund a more suitable benchmark, considering that it is intended to represent the risk aversion of Norway (Regjeringen, 2021)? The average stock weight for Norwegian municipalities is approximately 30%, while it is 70% for the Norwegian sovereign wealth fund (Norges Bank, 2022).

We discussed before that municipalities cannot take on significant financial risk, as stated in the law. What may be significant for some municipalities can be insignificant for others, depending on its financial state. In addition, each municipality have other characteristics like share of educated citizen, age, wealthy people, etc. that can influence the risk aversion of the people. This might indicate that risk aversion should be different between municipalities.

On the other hand, it also seems reasonable to share the same risk profile as the Norwegian sovereign wealth fund as it is run by highly competent people who wish to maximize returns given a modest risk profile. In contrast, the citizen of a municipality does not have this knowledge and may not know what is best for themselves, suggesting that the municipality would benefit from following the Oil fund.

3 Data

In the following section, the method and process used in regards of the collection of data is described, in addition to the rationale behind the sample selection and variables chosen.

3.1 Sample selection

By looking at what the municipalities are required to report through "KOSTRA", we found information regarding investments in the capital market. KOSTRA is short for "kommune, stat and rapportering", which translates to municipality, state and reporting. Through KOSTRA and the data "financial balance sheet summary, by capital" (Statistisk Sentralbyrå, 2022a), we found how much each municipality has invested in financial assets, hereunder stocks, bonds and other forms of securities. It is important to note the difference between the terms "financial fixed assets" and "financial current assets". Financial fixed assets are financial assets intended for permanent ownership. Examples can be power plants and other assets that the municipality believes should be owned and held indefinitely. Financial current assets, on the other hand, is defined by SSB as assets that are not acquired for permanent ownership or use, which means investments in the capital market (Statistisk Sentralbyrå, 2020). Consequently, the relevant information for the thesis is financial current assets.

Using financial current assets, we selected the "Year" as 2020, while under "Capital" we selected "B.2 Financial current assets" and "B.2.1 Stocks and shares". Under region we chose municipalities 2020 and selected all the municipalities. Through this, we managed to get an overview of the investments in the capital market at the end of 2020, thereby selecting our sample. We chose "financial current assets" because we wanted to examine those municipalities that had the largest investments. Furthermore, we included "stocks and shares" because we wanted the sample of Norwegian municipalities to include those that took a certain amount of risk. Hence, we removed those that only invested in fixed income or other low risk securities. However, "stocks and shares" may include shares in Exchange Traded Funds (ETF) or mutual funds. This means that the stocks and shares under KOSTRA may contain ETF and mutual funds that invests only in fixed income.

The threshold we chose for inclusion in the sample was a minimum of 10 million NOK (1.1M USD) invested in stocks and shares. The rationale behind this was that many municipalities had large total investments, but were exposed to low risk due to small investments in stocks and shares. By adding a minimum of 10 million NOK investment in stocks and shares, we get a sample that includes the municipalities that takes on a certain amount of risk in the capital market. However, due to the fact that this also includes "shares", some of the municipalities hold shares only in fixed income funds and do not invest in stocks, again meaning that the sample included municipalities that only invested in fixed income.

Based on the criteria described above, the relevant sample consisted of 71 municipalities out of a possible 356 municipalities. The threshold of 10 million was set relatively low, because it was reasonable to assume that not every municipality would report the data we required, meaning that some municipalities that fulfill the criteria would not be included in the final dataset.

3.2 Data collection

The data collection process included first calling the municipalities personally to request the data we needed. Furthermore, we sent a formal and specific demand by email, which the municipalities were required to evaluate to decide whether they had the information requested.

3.2.1 Data requested from the municipalities

The data requested were monthly returns from their total portfolios and returns for different asset classes, as well as their respective weights. The reason for requesting monthly returns was to have a larger data set for which to make our performance analysis. Municipalities usually report their returns on a four-month basis, or yearly, and not monthly. Furthermore, the municipalities often only report their total portfolio investments. As a result, many municipalities did not have the monthly returns we requested. The choice of how much information is stored about the investments is under the control of each municipality, and thus varies greatly between the municipalities.

The monthly data requested were not publicly available, and to acquire the data we contacted all the 71 municipalities in the data sample by phone and requested the relevant data. Many municipalities had only parts of the information available and could therefore not forward all the data we requested.

3.2.2 Data collected from the municipalities

There were 41 municipalities that forwarded monthly returns for either all, some or one of the relevant asset classes. However, we chose to reduce the sample further to only include municipalities with at least 24 months of observations. We removed municipalities with less than 24 months of observations since we deemed less than two years to be too narrow of a sample to evaluate their performance. Consequently, the sample ended up consisting of 37 municipalities, where 36 reported portfolio returns 27 reported stock returns and fixed income returns.

Since the portfolio data consists of 36 municipalities, we have acquired portfolio data from 52% of the relevant municipalities. Stock data were both acquired from 27 municipalities and fixed income data were acquired from 26, meaning we have 38% of relevant municipalities' stock data. Thus, out of the relevant municipalities, the final dataset consists of 52% and 38% for portfolio and stock and shares, respectively.

By looking at the data collected as a share of total value invested by municipalities, we can get a better insight to how much data we gathered. In total portfolio value, the dataset consists of about 23 billion NOK (2.4B USD) invested in the capital markets by Norwegian municipalities. This is 70% of the total investments, where the total investment from the municipalities was 33 billion NOK (3.5B USD) in 2020. Stock and share investments acquired had a total value of 11,2 billion NOK (1.2B USD), while the total value that all municipalities invested in stocks and shares were 18,5 billion NOK (2B USD) in 2020. This means that the dataset includes 61% of all the stock and share investments. Below, we consider the possible problem of sample selection bias.

Even though the dataset consists of 38 out of 71 municipalities, we have managed to collect a substantial share of the capital invested at 70% of total invested capital from Norwegian municipalities. Hereunder, the dataset explains 61% of the investments in stocks and shares.

3.3 Sample selection analysis

Out of the 71 municipalities which satisfies the requirements we have received 37. 74% out of the top half of the sample provided data, sorting by absolute investments in the capital market in 2020. On the other hand, only 40% on the bottom half provided data from their investments. Furthermore, when investigating the different quartiles as in table 3.1, it is possible to highlight this occurrence.

	Q1	Q2	Q3	Q4
Data Recieved	76.47	72.22	44.44	38.89

Table 3.1: Data Received (%)

Following table 3.1, it is clear that the less a municipality invested, the lower the probability that the municipality had the requested information available.

The municipalities we received data from were those who had the highest amount of capital invested in the market, as illustrated by table 3.1. This trend can have many different answers and aspects, but one reason may be that the municipalities with a higher amount invested, need to have a better insight into their own investments, due to the risk of a substantial loss in absolute numbers being higher. Another reason may be that those municipalities with the largest holdings are more accustomed to dealing with large amounts of capital, and therefore have a better structure linked to capital management. For example, bigger municipalities, which are more accustomed to larger cash flows, can be assumed to have better competence with handling larger amounts of capital. However, some municipalities with smaller holdings also had excellent overview over their allocations and returns. Thus, there may be different explanations as to why there are considerable differences between the information available in the respective municipalities.

Throughout the data gathering process, we found that those municipalities that did not employ a professional management company had more of a problem in providing monthly reports than those who did. Those municipalities that used management companies, either for managing the municipalities' investment or only making reports, often had monthly reports or excel sheets with the desired data. In conclusion, those municipalities that handled the investments in-house had more challenges with providing the necessary data.

4 Methodology

In this chapter we explain the choices made for our analysis, along with describing what methods were used to measure the performance of the municipalities.

4.1 OLS

To measure whether the municipalities managed to create abnormal returns relative to the benchmark, we regressed monthly returns of the municipalities on the explanatory factors based on the Carhart four-factor model, the fixed income two-factor model and a constructed six-factor model.

$$Y = \alpha + \beta X + \mu \tag{4.1}$$

Where is the constant, β is the slope coefficient, and μ is the error term.

The OLS-estimator chooses a regression line based on minimizing the distance between the data points (Hanck, Arnold, Gerber, Schmelzer, 2020, p.104). The "distance" in this regard, refers to the squared error from the independent variable "X" made when predicting the dependent variable "Y". To better illustrate the operation, we can look at the equation we want to minimize:

$$\sum_{i=i}^{n} (y_i - b_0 - b_1 X_i)^2 \tag{4.2}$$

In the expression above, the OLS estimator minimizes the sum of the error squared, whereas the dependent variable is denoted by y, and the independent variable denoted by X. Furthermore, b0 and b1 denotes estimators for some coefficients $\beta 0$ and $\beta 1$.

4.2 Panel Data

Panel data is used because our data regarding characteristics and risk consists of repeated observations on the same cross-section of municipalities (Wooldridge, 2010, p. 6). Since this paper investigates both changes over time and variations across municipalities, we use pooled OLS and fixed effects panel model regressions to estimate whether there are some characteristics which may describe the risk-aversion of municipalities.

4.2.1 Pooled OLS

The pooled OLS takes the data-sample and makes one fitted regression. Pooled OLS can be formulated:

$$y_{it} = x_{it}\beta + v_{it} \tag{4.3}$$

Where $v_{it} = c_i + u_{it}$. The v_{it} is the sum of the unobserved effects and idiosyncratic error (error term) (Wooldridge, 2010, p. 256). The x_{it} is the observable variables that change across entity (i) and time (t). The c_i is the individual effect (or individual heterogeneity) in our case, since it indexes individual entities. The μ_{it} is the idiosyncratic errors, since it that changes across time and entity (Wooldridge, 2010, p. 251).

The pooled OLS does not utilize the time series and cross-sectional structure of the data. This regression model may, however, have some issues. For example, we assume that average risk aversion varies from municipality to municipality but remains relatively constant through time. The OLS will not capture the effect of differences in risk aversion between municipalities. OLS will therefore have omitted unobservable factors that differs between municipalities, but assumed to be constant over time. Consequently, OLS only investigate on a general level, but does not account for the changes for each group, which panel data does (Hanck. et. al., 2020, p. 285).

4.2.2 Random effects vs. fixed effects

There are often discussions of whether to use fixed effects or random effects. The main difference between these methods is how the individual effect (c_i) is treated. The individual effect is treated as a random effect in the random effect model, while treated as a parameter to be estimated for each cross-section observation (i) in a fixed effect (Wooldridge, 2010, p. 251). A random effect assumes zero correlations between the observed explanatory variables and the unobserved effect (Wooldridge, 2010, p. 252):

$$Cov(x_{it}, c_i) = 0 \tag{4.4}$$

In this paper we stick to the fixed effect, because we assume correlations between these variables due to the results in the Hausman tests (see table 5.8 and 5.9). The fixed effects method does not mean that c_i is being treated at non-random, but rather allowing for arbitrary correlations between the unobserved effects and the observed explanatory variables (Wooldridge, 2010, p. 252). The fixed effect method can be written as follows:

$$y_{it} = x_{it}\beta + c_i + u_{it} \tag{4.5}$$

The fixed effects take the constant to be a group-specific constant term, thus allowing for multiple constants. Followingly, each constant is treated as an unknown parameter to be estimated (Greene, 2008, p. 285; 287).

When using individual fixed effect, one sets dummies for each of the entities. For example, creating a dummy of 1 or 0 if the observation is Asker. For Asker the dummy will equal 1, while the other municipalities will equal zero. Therefrom, we can investigate whether an increase/decrease in independent variables affects the dependent variables in an entity. Time fixed effects are also included in this thesis. In time fixed effects we are creating dummies on year instead of entity, exploring time-specific effects that are constant across entities (Hanck, et. al., 2020, p. 291). According to Hanck. et. al (2020), the time effects can be expressed

$$y_{it} = \beta_0 + \beta_1 X_{it} + \delta_2 B2_t + ... + \delta_T BT_t + u_i t \tag{4.6}$$

where T is the last year in the sample, δ is the year coefficient and B is the dummy for each year. β_0 denotes aggregate time effects, while β_1 is the coefficient of an independent variable.

4.2.3 Tobit Regression

Tobit regression, or the censored regression model, is used when a variable has an upper or lower limit, for example a high quantity of observations at zero. In our case, the variable "stock weight" is characterized by upper limits decided by the individual municipalities. This makes the Tobit regression a fitting model. The regression is obtained by making the mean in the preceding correspond to a classical regression model. The Tobit model regression can be formulated as follows (Greene, 2008, p. 764):

$$y_{it}^* = x_{it}^{'}\beta + v_{it}$$
$$y_{it} = \begin{cases} 0 & \text{if } y_{it}^* \geq 0 \\ y_{it}^* & \text{if } y_{it}^* \leq 0 \end{cases} \tag{4.7}$$

y_{it}^* is the index variable. If the index variable is below zero or zero it will be censored in this expression. We interpret the results from the Tobit-regression as if it were no data-censoring. However, it is not informative to compare the Tobit coefficient with the OLS coefficient estimates (Wooldridge, 2010, p. 528). This is due to the different measures of the OLS and the Tobit regressions. Tobit regressions measure to maximize the Log-likelihood function, while OLS estimates the highest R-squared (Wooldridge, 2010, p. 529). Consequently, the marginal effects for a Tobit-regression are calculated differently (Greene, 2008, p. 764).

4.3 Benchmark

In order to understand the skill of an investor, we need to measure her performance against a suitable benchmark, which serves as a passive alternative to investing in the active portfolio. By doing this, performance can more easily be translated into a comparable measure that stakeholders can relate to. The challenge of choosing a benchmark relates to how well it carries the same characteristics as the investment portfolio made by the fund. In this thesis, we measure performance for equity returns.

The most common benchmark for mutual funds in Norway is the OSEFX reference index. OSEFX is an adjusted version of OSEBX, where it considers the fact that OSEBX is value weighted, and therefore skewed towards large-cap companies like Equinor or DNB, making the index less representative for performance measure. OSEFX adjusts for this by allowing maximum weight of 10% for each stock (Sørensen, 2009).

The OSEFX would normally have been a reasonable benchmark. However, since most of the stocks invested by the municipalities are in different global stock markets, we need to consider a global benchmark as well. In order to construct a suitable benchmark with similar characteristics as the municipalities, we investigate what underlying equity funds their portfolio consists of and compare them to the style box presented by Morningstar (2022). Our finding is that the municipalities are highly homogeneous in their strategies. Globally, they invest mostly in stocks that are large in terms of market capitalization and neutral in terms of growth/value strategy. Domestically, the majority invest in medium sized companies and neutral growth. On this basis, we construct a benchmark portfolio for the municipalities' equity returns consisting of 36% OSEFX and 64% Developed Markets Big Neutral portfolio due to the split between domestic and global stocks shown in table 5.1 below. The latter is a portfolio derived from Kenneth French' website which were meant to fit the global portfolios of the municipalities (French, 2022). Hence, all municipalities are measured against the same benchmark.

5 Analysis

5.1 Descriptive statistics

The following section will present the descriptive statistics for the data used in the thesis, where the purpose is to display the data in an orderly fashion. We will display averages for the variables in table 5.1 and look more thoroughly into the specific municipalities in table 5.2.

Table 5.1 shows the descriptive statistics of the variables included for the municipalities. We also include the Sharpe ratio, which states how much return an average municipality can expect for every unit of risk. A higher Sharpe ratio indicates a better investment, since the municipality gets a higher return for a given risk. The Sharpe ratio is a simple measure of performance, but it can be a valuable indicator.

	Obs.	Mean	Median	St.Dev	Sharpe ratio
Municipal Portfolio Return	36	5.77	4.72	4.95	1.24
Municipal Stock Return	27	9.76	9.55	13.11	0.76
Municipal Global Stock Return	19	10.26	10.42	12.97	0.82
Municipal Norwegian Stock Return	17	10.63	10.99	15.16	0.71
Municipal Fixed Income Return	26	2.31	2.15	2.13	1.22
Municipal Stock Weight	27	29.91	27.80		
Municipal Global Stock Weight	19	21.93	19.76		
Municipal Norwegian Stock Weight	17	10.88	8.71		
Municipal Fixed Income Weight	26	67.99	70.12		

Table 5.1: Descriptive Statistics

Annual average statistics based on different asset classes and total portfolio. Mean and standard deviation are shown in percentage. The mean returns are subtracted risk-free rate (i.e., excess return). St.Dev = Standard Deviation.

The mean represents the expected return for the different return categories, displaying what a representative municipality can expect to gain in a year. The standard deviation indicates the risk of the asset classes, where a higher standard deviation reflects higher risks.

The Sharpe ratio is calculated by finding the mean Sharpe ratio for the individual municipality, and then finding the overall mean Sharpe ratio for all municipalities. Note that this is different from finding the mean return and dividing it on the mean standard deviation for all municipalities together. Consequently, the mean divided by standard deviation in table 5.1 will not equal the Sharpe ratio.

Regarding the returns, the mean annual return and standard deviation is highest for stocks and lowest for fixed income. This indicates that a higher risk is associated with a higher average return, which is in line with the relationship between risk and return suggested by the CAPM. Table 5.1 also displays the percentage of capital invested invested in different asset classes. The majority of the investments are allocated in fixed income securities, which are a little under 68% of the portfolio. Stock investments are slightly under 30%. Out of the 30% placed in stocks, two-thirds are invested in global stocks, while one-third is invested in Norwegian stocks.

Figure 5.1: Historical Equally Weighted Aggregated Portfolio And Stock Return

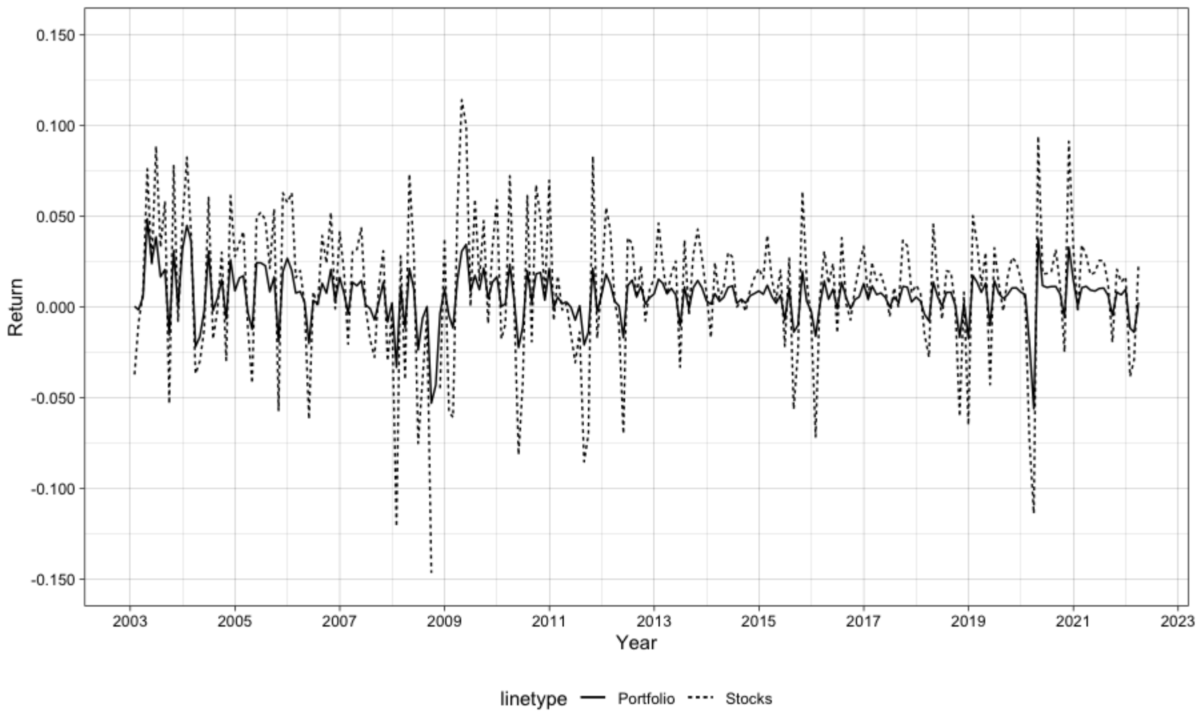
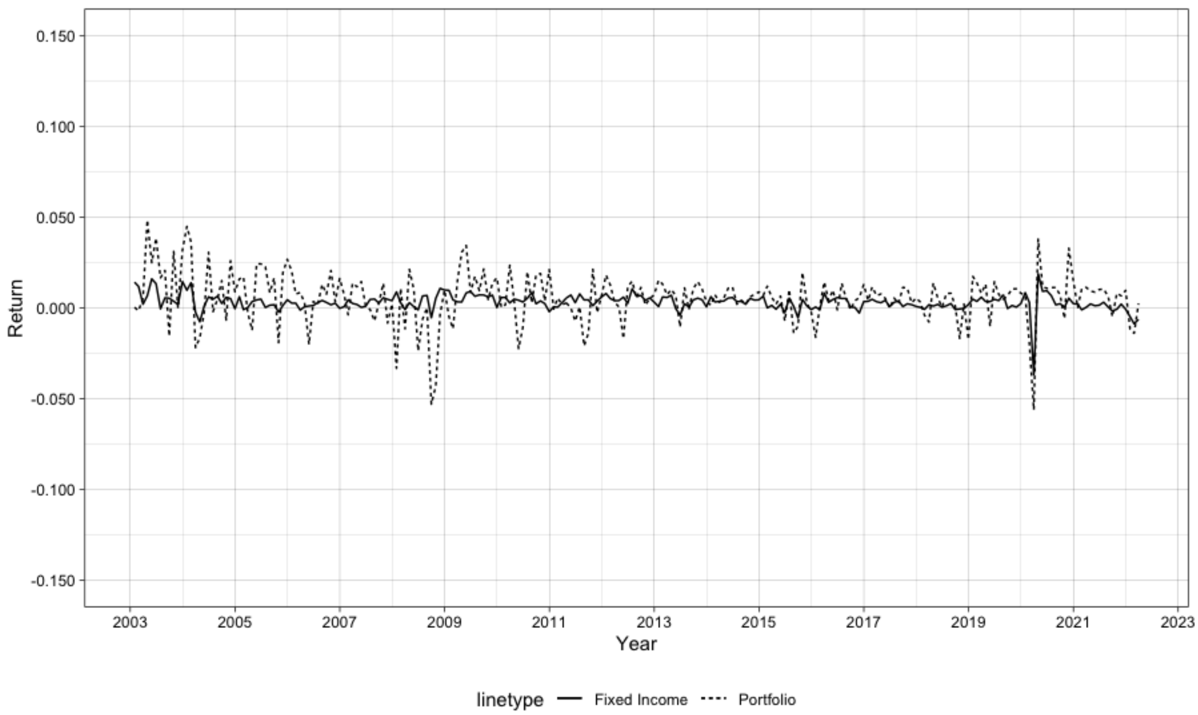


Figure 5.2: Historical Equally Weighted Aggregated Portfolio And Fixed Income Return



The most volatile return is in dotted lines, making it easier to view the figures. The figure is based on numbers from SSB.

The two figures above display the development in aggregated municipal returns in the period between 2003-2022 and illustrates clearly how total portfolio returns, stock returns and fixed income returns move and differ from each other. Figure 5.1 shows the relationship between portfolio return (solid line) and stock returns (dotted line), while figure 5.2 display the same for portfolio returns (dotted line) and fixed income returns (solid line). It should be mentioned that the graphs contain continuously more data as far ahead in time we get. As presented, we observe a difference in volatility between stocks and fixed income, which is expected. We note that total portfolio returns are mostly driven by the variations in fixed income due to a significantly larger share of fixed income and is thus characterized by limited volatility.

Furthermore, it is interesting to look at the impact of both the financial crisis in 2007-2008 and the Corona-crisis in 2020. The graphs showcase considerable losses for the municipalities, where we observe aggregated stock returns of approximately -18% in the deepest trough during the financial crisis in 2008. The losses were less during the

Corona-crisis, where we see an aggregated stock return of -11% in 2020. Both recessions, however, are followed by a significant bounce-back effect. What is notably different about the Corona-crisis regarding the municipal returns, is the loss in fixed income returns. This was relatively stable through the financial crisis in 2008 but seem to have dropped quite heavily in 2020.

By breaking down table 5.1 we get the summary for every individual municipality, as shown in table 5.2.

Municipality	Obs.	AUM	Port. Ret.	Port. SD	SR Port.	Stocks Ret.	Stock SD	SR Stocks	FI	FI SD	SR FI	Stock/FI	SR BM
Asker	97	2608475	6.25	6.99	0.89	10.03	11.75	0.85	3.33	3.07	1.08	1.06	0.79
Askøy	76	407811	9.35	12.70	0.74							.	
Aukra	51	553067	21.22	7.33	2.90								
Bamble	108	377798	5.07	3.56	1.42	9.95	11.88	0.84	3.94	2.61	1.51	0.27	0.93
Birkenes	96	88670	5.97	4.14	1.44								
Bjørnafjorden	204	503589	6.05	5.04	1.20	10.51	14.45	0.73	2.57	1.33	1.94	0.64	0.59
Bærum	245	2848547	4.28	5.09	0.84	5.70	15.22	0.37	3.20	1.93	1.66	0.53	0.63
Enebakk	72	80082	1.97	2.58	0.76				1.97	2.58	0.76		
Fredrikstad	72	1146528	3.59	2.48	1.45	11.34	10.25	1.11	1.45	1.45	1.00	0.24	0.95
Frøya	198	164275	4.30	4.58	0.94	8.93	14.14	0.63	2.80	2.00	1.40	0.42	0.58
Gjerdrum	211	135820	1.19	0.63	1.89								
Gjøvik	182	948689	3.12	2.50	1.25	7.94	14.90	0.53	2.28	1.46	1.56	0.20	0.50
Herøy	61	84141	4.08	4.56	0.90	9.44	14.38	0.66	0.81	1.86	0.44	0.37	0.87
Holmestrand	24	595148	0.87	3.24	0.27	4.95	10.78	0.46	0.27	0.85	0.32	0.42	0.68
Kristiansand	96	1198022	5.23	2.51	2.08	13.41	9.83	1.36	2.99	1.22	2.44	0.29	1.14
Kvinnherad	76	784997	6.88	6.27	1.10	7.95	11.26	0.71	1.87	7.77	0.24	2.52	0.88
Larvik	168	935534	3.99	4.28	0.93							0.27	
Lindesnes	48	68185	3.77	2.70	1.39	8.97	12.92	0.69	1.17	1.15	1.02	0.28	0.81
Midtre Gauldal	229	49460	5.39	4.80	1.12	11.44	14.78	0.77	3.00	2.12	1.42	0.40	0.61
Nannestad	24	182715	2.14	1.70	1.26	6.95	10.50	0.66	1.51	0.85	1.77	0.11	0.55
Notodden	26	59217	5.83	7.13	0.82	11.56	14.39	0.80	2.03	2.85	0.71	0.67	0.75
Porsgrunn	241	355808	3.72	4.05	0.92	6.91	14.64	0.47	3.01	1.88	1.60	0.40	0.61
Ringerike	79	169849	5.82	6.17	0.94	5.49	11.23	0.49	1.17	2.96	0.40	1.13	0.91
Sandnes	50	339717	12.48	11.20	1.11	12.46	11.43	1.09					0.86
Sigdal	132	24660				9.15	14.98	0.61					0.73
Sirdal	204	40909	7.27	8.72	0.83								
Skaun	202	45358	4.14	4.24	0.98	9.55	14.48	0.66	2.30	1.57	1.46	0.39	0.59
Sokndal	96	126115	3.83	3.69	1.04	12.52	12.66	0.99	1.55	2.20	0.70	0.25	0.78
Stad	144	119919	4.76	4.63	1.03	9.08	12.56	0.72	2.28	1.55	1.47	0.52	0.80
Sula	64	105469	4.83	4.93	0.98	11.86	11.76	1.01	1.03	1.53	0.67	0.54	0.89
Sunnfjord	255	116159	4.67	5.80	0.80	6.79	15.30	0.44	6.84	3.42	2.00	0.54	0.61
Trondheim	102	6499398	3.82	2.34	1.63	10.21	11.75	0.87	1.87	0.96	1.93	0.19	0.85
Vennesla	114	262735	6.44	4.04	1.60	14.33	12.27	1.17	3.43	2.45	1.40	0.37	0.74
Volda	61	169204	3.46	3.17	1.09	16.06	19.55	0.82	1.32	1.72	0.77	0.23	0.98
Øvre Eiker	131	101493	3.19	2.36	1.35								
Øygarden	24	276572	21.77	5.07	4.30								
Ålesund	265	663396	6.79	13.08	0.52								
Sum	4528	23237531											

Table 5.2: Municipality Descriptive Statistics

The observations are the number of monthly return and all returns and standard deviations are shown in percent. The number of observations is based on the total number of observations, and there may be differences between portfolio observations, stock observations and fixed income observations for a single municipality. The returns are in excess of risk-free rate.

AUM = Assets Under Management

SD = Standard Deviation

SR = Sharpe Ratio

BM = Benchmark

Sharpe ratio=(Average Portfolio Return)/(Portfolio SD)

Table 5.2 displays the statistics and variables for the individual municipalities. The number of observations are highly variable, ranging from 24 months at the lowest to 264 months at the highest. We sub-categorize assets in the portfolios into stocks and fixed income. The returns are the average excess returns, which means that they are average annual returns after subtracting risk-free rate. AUM stands for Assets Under management and is included in the table in order to show how much the municipalities had invested in the capital market in 2020. The Sharpe ratio for the benchmark is displayed in the far-right column. The Sharpe ratios of the benchmark differs between municipalities because it is adjusted for each municipalities' time period. Kristiansand has the highest stock Sharpe ratio of 1.36, yet the benchmark Sharpe ratio in the same period is 1.14. Consequently, the table reveal that the time period for Kristiansand was characterized by higher return relative to volatility, driving Kristiansand's Sharpe ratio upwards. The Sharpe ratio of the benchmark therefore functions as a good reference point when evaluating a municipality stock performance.

Stock/FI is the stock-fixed income-split and shows the average stock weight divided by the average fixed income weight. For example, a stock/FI-split value of 1 means that the portfolio allocation is 50/50 in stocks and fixed income, while a value of 0.5 shows a portfolio consisting of 33% in stocks and 66% in fixed income.

Table 5.3 displays the summary statistics for the Fama-French-factors. All the factors have 264 observations, going back to March 2003. Ålesund has data furthest back in time, which starts in March 2003, and the Fama-French factors have equal length.

	Obs.	Mean	St.Dev	Min	Max	SR
SMB	264	1.85	6.49	-8.64	8.37	0.29
HML	264	3.24	9.24	-10.15	12.24	0.35
MOM	264	4.39	14.34	-24.26	17.74	0.31

Table 5.3: Descriptive Statistics for Risk Factors

Time period is from January 2000 to December 2021. Mean and standard deviation are shown annually, while Min and Max are monthly.

All numbers except SR (Sharpe ratio) are in percent.

The highest expected return stems from the momentum strategi, with 4.39%. The lowest is small minus big, with an expected return of 1.85%. Corresponding, the momentum strategi has the highest standard deviation, while small minus big has the lowest, indicating the risk exposure of the strategies. However, the highest Sharpe ratio stems from the high minus low strategy.

In table 5.4 below we see the correlations matrix displaying the correlations between the factors used to measure equity performance. Momentum and the other factors are negatively correlated, while all the other factors have over 10% correlations.

	MKT	SMB	HML	MOM
MKT	1.0000			
SMB	0.1992	1.0000		
HML	0.1392	0.1427	1.0000	
MOM	-0.3487	-0.0723	-0.4460	1.0000

Table 5.4: Risk Factors Correlation Matrix

The correlation between SMB and market and HML and market are relatively high, respectively 20% and 14%. To assess whether the correlations give us problems with multicollinearity, we use *Variance Inflation Factor* (VIF). The variance inflation factor indicates how much correlation to accept, and a rule of thumb is that a VIF-value less than is 10 considered acceptable, meaning that multicollinearity is not a problem (Wooldridge, 2020, p. 92). The formula for VIF can be written as such:

$$VIF_j = \frac{1}{1 - R_j^2} \tag{5.1}$$

The "j" in the formula represents the coefficient for the variables, while R_j^2 represents the linear relation between the variables. Table 5.5 displays the VIF-values. We use an equally weighted stock return portfolio consisting of all municipalities as the dependent variable (same as stock return in figure 5.1) and the Fama-French Four Factor risk factors.

	VIF
Market	1.15
SMB	1.04
HML	1.26
MOM	1.37

Table 5.5: VIF Test

Variance Inflation Factor Test on Fama French Carhart Risk Factors.

As the table illustrates are all the variables well under 10, implying that there is no multicollinearity problem between the stock returns and risk factors.

Table 5.6 showcases the descriptive statistics for municipality characteristics. All the total values are written in thousands, which includes "gross income per capita", "population", "power income" and block grant". The table's purpose is to display the data used for assessing the characteristics that differentiate municipalities from one another, either economic or demographic. The data will be used to investigate whether certain characteristics have any effects on the risk aversion of a municipality.

	n	Mean	SD	Median	Min	Max
Higher Education (%)	337	16.36	3.89	16.02	8.00	25.39
Median Income PC	337	415773	41136	411110	282843	530728
Population	337	27640	38564	12267	1737	205163
Share over 67 Years (%)	337	14.48	2.65	14.81	8.27	21.20
Debt Ratio	337	73.71	10.79	75.11	15.74	96.80
Profit Margin	335	3.02	4.74	2.80	-27.20	27.20
AUM-to-Assets	328	7.66	5.20	6.92	0.00	28.11
Power Income	207	2571	8402	0.00	0.00	67299
Block Grant	320	612155	786606	315138	1628	4710005

Table 5.6: Descriptive Characteristics Summary Statistics

The table is based on numbers from SSB. PC stands for per capita. "Block Grant" and "Power Income" are in thousands of NOK. "Share over 67 years", "Higher Education" and "Median Income PC" investigates some characteristics of the citizens in a municipality. "Share over 67 years (%)" is the share of population over the age of 67 in per cent. "Higher Education (%)" is the percentage share of population which have obtained 120 credits or more at a tertiary level, regardless of obtaining a degree (SSB, 2021).

The age of 67 were chosen because it is the average retirement age in Norway, making it a reasonable variable to reflect elderly people within a municipality. Looking at median gross income makes it possible to investigate whether municipalities with a population consisting of higher income citizens take on more risk. We chose median gross income because there are some outliers with regard to mean gross income, where some high earners increase the mean. Consequently, these outliers disrupt the representativeness of the income level in the municipality.

"AUM-to-Assets" and "Profit Margin" are two variables that respectively examine the economic size and operations of the municipalities. AUM-to-Assets (Assets under Management-to-Assets) is a variable that aims is to capture the investment value relative to municipality size. By adjusting assets under management for assets, we get a variable that is more comparable between the municipalities. The variable "Profit Margin" is net operating surplus as a percentage of gross operating revenues (per cent). The profit margin is an indication of the how well the municipalities are being financially operated.

"Power Income" is the income from hydroelectric power plants in the municipalities that own and gain revenue from these. "Block Grant" is funding received from the central government. According to KS, the majority of funding the municipalities receive from the central government is in the form of block grants, which were 32% of total municipal income in 2018 (KS, 2019).

Table A1.1 (see appendix) is a broken-down version of the table 5.6, showing the descriptive statistics on a municipal level. The blanks are missing values where we do not have data. Furthermore, there are certain variables that have less observations than other. An example is power income, which has 207. Power income has fewer observations because the data go back only to 2014. Thus, the n (yearly observations) in table A1.1 is the maximum observations per municipality, and not complete observations.

Because of the mergers of numerous municipalities in 2020, we had to modify the data of characteristics of those that merged. If the differences in characteristics where too significant, we had to alter the municipalities to fit the characteristics of which we had the longest data sample. For example, Ålesund merged with Haram, who had a fund of 276 million NOK (29.2M USD) in 2019, adjusted for inflation. In contrast, Ålesund had only 7 million NOK (741K USD) invested in the capital market. Since the data for Haram goes back to 2001, while the merger happened in 2020, we used Harams characteristics. However, since we base our paper on today's municipalities (2022), we changed the name to "Ålesund", since Harams portfolio is called "Ålesund" in the data regarding returns. The same was done for Lindesnes, Sunnfjord and Øygarden, where it was Marnadal, Førde and Fjell respectively, that had the majority of the now merged investment funds. The differences between the before-merger characteristics and the after-merger characteristics were too big, meaning that it was necessary to use the before-merger characteristics.

Bjørnafjorden and Stad are newly established municipalities as a result of the merger, so we simply uses the characteristics of the old municipalities owning funds. These were Os and Eid for respectively Bjørnafjorden and Stad. For the rest of the municipalities in our dataset, we found no substantial changes in the characteristics, meaning we let these municipalities stay unchanged, using the characteristics after the merger after 2020 and the characteristics before the merger pre-2020.

Table A1.1 reveals a big difference in the number of observations between municipalities; the highest is 17 years, while the lowest is two years. The table shows the portfolio standard deviation, where Askøy has the highest standard deviation at 3.5% and Gjerdrum at 0.08% has the lowest. Kvinnherad has the highest stock-fixed income-split at 250%, meaning that they have more than 2.5 times the amount of stocks relative to fixed income. On the other side is Nannestad, having a stock-fixed income split at 11%, indicating that their portfolio consisting of approximately 10% in stocks. "Higher Edu." And "Share over 67" is the share of the population with higher education and are the age over 67 respectively. All the ratios and shares are in percent, and block grants and Power income are in thousands.

5.2 Assets under Managements and Municipality Characteristics

In this section, we investigate whether certain municipality characteristics affect the value of investments for municipalities. Together with the risk aversion analysis further in this chapter, the AUM analysis helps us understand what drives municipal investments in capital markets.

In order to analyze the relationship between AUM and the chosen independent variables, we use panel regressions. The panel data is unbalanced because some of the municipalities are not observed in every period. To test whether to use fixed effects or random effects, the Hausman test is conducted. In the Hausman test, the key consideration is whether individual effects and the observable explanatory variables, which changes across time but not by group, is correlated (Wooldridge, 2010, p. 288). The Hausman test can be expressed as follows:

$$H - Test = \frac{(\hat{\delta}_{FE} - \hat{\delta}_{RE})}{Var(\hat{\delta}_{FE}) + Var(\hat{\delta}_{RE})} \tag{5.2}$$

$\hat{\delta}_{FE}$ and $\hat{\delta}_{RE}$ denotes the vector of fixed effects and random effects estimates, respectively, without the coefficient on time-constraint or aggregate time variables.

A statistically significant difference between these two factors is interpreted as evidence against the random effect, since the random effect model assumes no correlation. The random effect will therefore be inconsistent if the difference is significant, while the fixed effect is consistent (Wooldridge, 2010, p. 288). The null hypothesis is that there is no correlation between the individual effects and explanatory variables (Wooldridge, 2010, p. 252). A standard level of rejecting the null hypothesis is at a five percent level. If the null hypothesis is rejected, we should use the fixed effects.

Regression	Chi-square	p-value	df	H1
AUM	48.08	0.0000	8	one model is inconsistent

Table 5.7: Hausman Test for AUM

Table 5.7 displays the Hausman test. With a p-value of zero, the Hausman test clearly states that there are correlations between the individual effects and explanatory variables. Thus, we will use the fixed effect.

The regressions for OLS, time fixed effects and fixed effects can be written as such (Time fixed effects and Fixed effects are expressed similar to Hanck et.al. 2020, p. 291):

Pooled OLS:

$$\begin{aligned} logAUM_{it} = \alpha_0 + \beta_1 Debt\ ratio_{it} + \beta_2 log(Median\ Gross\ Income)_{it} + \beta_3 log(Tax\ Income)_{it} \\ + \beta_4 (Profit\ Margin)_{it} + \beta_5 (Share\ Over\ 67\ Years)_{it} \\ + \beta_6 (Higher\ Education)_{it} + \beta_7 (Power\ Income)_{it} + v_t \end{aligned} \tag{5.3}$$

Time fixed effects:

$$\begin{aligned} logAUM_{it} = \beta + \beta_1 Debt\ ratio_{it} + \beta_2 log(Median\ Gross\ Income)_{it} + \beta_3 log(Tax\ Income)_{it} \\ + \beta_4 (Profit\ Margin)_{it} + \beta_5 (Share\ Over\ 67\ Years)_{it} \\ + \beta_6 (Higher\ Education)_{it} + \beta_7 (Power\ Income)_{it} \\ + Time\ \ Fixed\ \ Effects + c_i + u_{it} \end{aligned} \tag{5.4}$$

Fixed effects:

$$\begin{aligned} logAUM_{it} = \alpha_i + \beta_1 Debt\ ratio_{it} + \beta_2 log(Median\ Gross\ Income)_{it} + \beta_3 log(Tax\ Income)_{it} \\ + \beta_4 (Profit\ Margin)_{it} + \beta_5 (Share\ Over\ 67\ Years)_{it} \\ + \beta_6 (Higher\ Education)_{it} + \beta_7 (Power\ Income)_{it} \\ + Municipality\ \ Fixed\ \ Effects + c_i + u_{it} \end{aligned} \tag{5.5}$$

Table 5.8 shows the regression results, where AUM is used as the dependent variable in all three regressions. Regression 1 is a standard OLS, regression 2 is a fixed time effect (FTE) and regression 3 is an entity fixed effect regression (FE). Whether the variables have significant effect on the independent variable or not, is shown by the stars beside the coefficients. One star equals significance at a 10% level, two stars equals significance at a 5% level and three stars equals significance at a 1% level. Consequently, a higher number of stars means that the results are less likely to be merely due to chance (Hanck et al., 2020, p. 73). This applies for all the regressions we analyze in this chapter.

The logarithms used in the regressions are the natural logarithm (ln). We use logarithmic transformation because it enables us to maintain a non-linear relationship between the dependent variable and the independent variable, while still using a linear model. In addition, it also transforms a variable that may be highly skewed in one direction, to have a more normal distribution (Benoit, 2011, p. 2). Moreover, all the capital were adjusted for inflation to today's value.

The absolute value variables "Gross Income", "Population" and "Block Grant" were all set in natural logarithm (ln). The reasoning is that a minimal increase in a variable that is in high absolute numbers would be extremely low, and therefore have no effect on the dependent variable AUM. The results could be significant, but the coefficient would only show zero (or close to zero), and thus be meaningless to the reader. Hence, for the variables put in natural logarithms, we see a relative change in the independent variables to find an absolute change in the dependent variable (Zax, J., 2011, p.518-519).

Table 5.8: Results from Regression on AUM

	AUM		
	OLS	FTE	FE
	(1)	(2)	(3)
Higher Education (%)	0.039	0.050	0.029
	t = 0.768	t = 0.930	t = 0.663
Ln Gross Income	−0.875	−0.976	2.696***
	t = −0.462	t = −0.473	t = 2.984
Ln Population	1.264***	1.252***	0.648*
	t = 4.199	t = 3.969	t = 1.795
Share over 67 years (%)	0.046	0.063	−0.027
	t = 0.803	t = 1.008	t = −0.859
Debt Ratio	−0.017	−0.019	−0.0002
	t = −1.170	t = −1.293	t = −0.029
Profit Margin	0.021	0.024	0.001
	t = 0.971	t = 1.014	t = 0.214
Ln Block Grant	−0.371	−0.367	0.135**
	t = −1.244	t = −1.134	t = 2.301
Power.income	0.00002**	0.00002**	0.00001
	t = 1.975	t = 2.230	t = 0.976
Observations	199	199	199
Adjusted R^2	0.760	0.766	0.987

Note: *p<0.1; **p<0.05; ***p<0.01

From table 5.8 we observe several noteworthy results that we highlight in this section.

Further discussion and explanations will be elaborated on in the next chapter. The regression analysis delivers four significant variables that can explain higher investing in capital markets. The first result presented is that an increase the share of people with high gross income within a municipality's leads to an increase in its total amount of investments in capital markets. More specific, the fixed effects regression shows that a marginal increase in gross income increases AUM with 2.7%, emphasized by being significant at a 1% level.

Next, a higher population has a positive effect on AUM, which is displayed by all of the three regressions, whereas two of them are significant at a 1% level. Moreover, as the population grows bigger, total amount of capital invested increases, which is not a surprising result. Furthermore, the third characteristic that has significant positive effect on AUM, is block grant – only shown by the fixed effects regression. In other words, municipalities who receive more block grant from the Norwegian government tend to invest more in capital markets.

Finally, power income correlates positively with AUM, shown by the fact that a marginal increase (1000 NOK) in power income leads to an increase in total investments by 0.00002%. This result is significant at a 5% level for both the OLS regression and the fixed time-effects regression.

5.3 Risk and Municipality Characteristics

In this section we seek to understand what makes municipalities more willing to invest in risky assets, and what makes them risk averse. Since we cannot observe risk aversion directly, we use two factors that works as proxies, respectively share of stock in the portfolio (stock weight) and standard deviation. The former is a suitable measure because it looks at risk in the same way as the CAPM. In CAPM one adjusts risk by allocating capital in either risky assets or risk-free assets. In this case we measure risk aversion by how much they invest in stocks (risky), rather than fixed income (not risk-free, but less risky). In addition, standard deviation measures the *actual* volatility of their investments, and is thus a good proxy for municipalities' attitude towards risk.

For analyzing whether municipality characteristics influence the risk aversion (or risk appetite), we run five regressions. The dependent variables are standard deviation and the Stock weight. Since our sample is rather small, consisting of 36 municipalities in regard to standard deviation and 26 municipalities with stock weight, there is a trade-off between maintaining degrees of freedom and possible omitted variables bias (Hanck et.al., 2020, p.176). A high variance means that it becomes more difficult to precisely estimate the true value of the coefficients. We regress the whole sample on 9 characteristics.

Similar to section 5.2, we are using panel data regressions to explore a relationship using municipality characteristics. In this section, we are investigating whether these characteristics influence municipality risk aversion. Again, like section 5.2, we use a Hausman test to determine if we are using random effects or fixed effects.

Regression	Chi-square	p-value	df	H1
Standard Deviation	66.72	0.0000	9	one model is inconsistent

Table 5.9: Hausman Test for Standard Deviation

Our Hausman test reject the null hypothesis because the p-value equals zero for standard deviation, and we assume that there are correlations between the individual effects and explanatory variables. Consequently, we use the fixed effect model regression, in addition to the baseline pooled OLS and time fixed effect. In addition, a Tobit regression will be used to measure the effect of characteristics on stock weight, due to the upper limits set in the financial rules for each municipality.

The regressions can be expressed as follows:

Pooled OLS:

$$\begin{aligned}\widehat{Risk}_{it} = {} & \alpha_0 + \beta_1 Debt\ ratio_{it} + \beta_2 log(Median\ Gross\ Income)_{it} + \beta_3 log(Tax\ Income)_{it} \\ & + \beta_4(AUM{-}to{-}Assets)_{it} + \beta_5(Profit\ Margin)_{it} + \beta_6(Share\ Over\ 67\ Years)_{it} \\ & + \beta_7(Higher\ Education)_{it} + \beta_8(Power\ Income)_{it} + v_t\end{aligned} \tag{5.6}$$

Time fixed effects:

$$\begin{aligned}\widehat{Risk}_{it} = {} & \beta + \beta_1 Debt\ ratio_{it} + \beta_2 log(Median\ Gross\ Income)_{it} + \beta_3 log(Tax\ Income)_{it} \\ & + \beta_4(AUM - to - Assets)_{it} + \beta_5(Profit\ Margin)_{it} \\ & + \beta_6(Share\ Over\ 67\ Years)_{it} + \beta_7(Higher\ Education)_{it} \\ & + \beta_8(Power\ Income)_{it} + Time\ \ Fixed\ \ Effects + c_i + u_{it}\end{aligned} \tag{5.7}$$

Fixed effects:

$$\begin{aligned}\widehat{Risk}_{it} = {} & \alpha_i + \beta_1 Debt\ ratio_{it} + \beta_2 log(Median\ Gross\ Income)_{it} + \beta_3 log(Tax\ Income)_{it} \\ & + \beta_4(AUM - to - Assets)_{it} + \beta_5(Profit\ Margin)_{it} \\ & + \beta_6(Share\ Over\ 67\ Years)_{it} + \beta_7(Higher\ Education)_{it} \\ & + \beta_8(Power\ Income)_{it} + Municipality\ \ Fixed\ \ Effects + c_i + u_{it}\end{aligned} \tag{5.8}$$

Tobit Regression:

$$\begin{aligned}\widehat{Risk}_{it} = {} & \alpha_0 + \beta_1 Debt\ ratio_{it} + \beta_2 log(Median\ Gross\ Income)_{it} + \beta_3 log(Tax\ Income)_{it} \\ & + \beta_4(AUM{-}to{-}Assets)_{it} + \beta_5(Profit\ Margin)_{it} + \beta_6(Share\ Over\ 67\ Years)_{it} \\ & + \beta_7(Higher\ Education)_{it} + \beta_8(Power\ Income)_{it} + v_t\end{aligned}$$

$$\widehat{Risk}_{it} = \begin{cases} 0 & \text{if } \widehat{Risk}_{it} \geq Upper\ limit_i \\ y^*_{it} & \text{if } \widehat{Risk}_{it} \leq Upper\ limit_i \end{cases} \tag{5.9}$$

meaning that the stock weights (i.e., risk) above the upper limit decided in the financial rules are censored, given the individual municipality (i). $\widehat{Risk}$ is written because we use a proxied risk.

The rationale behind the regression below is to explain whether there are certain types of municipalities that are more risk averse than others. The table displays how much a minimal increase in the independent variables change the dependent variables (risk proxies) standard deviation and Stock Weight, where "Stock Weight" is the percentage of the whole portfolio invested in stocks.

Table 5.10: Results from Regression on Risk and Characteristics

	Dependent variable:				
	Standard Deviation			Stock Weight	Stock Weight
	OLS	FTE	FE	OLS	Tobit
	(1)	(2)	(3)	(4)	(5)
Higher Education (%)	−0.076*	−0.058	−0.159	−0.810	−0.118
	t = −1.846	t = −1.461	t = −1.087	t = −0.669	t = −0.219
Ln Gross Income	7.342**	3.853	17.162***	103.820**	7.177***
	t = 2.344	t = 1.542	t = 6.591	t = 2.418	t = 3.022
Ln Population	−0.606	−0.203	3.041*	3.164	9.157*
	t = −1.014	t = −0.655	t = 1.852	t = 0.532	t = 1.773
Share over 67 years (%)	0.129***	0.017	0.220*	0.062	−0.931
	t = 3.068	t = 0.311	t = 1.709	t = 0.057	t = −1.476
Debt Ratio	−0.009	−0.003	−0.050*	−0.038	−0.324*
	t = −0.513	t = −0.156	t = −1.853	t = −0.086	t = −1.935
Profit Margin	0.021	0.012	0.010	−0.079	0.029
	t = 1.392	t = 0.654	t = 0.704	t = −0.191	t = 0.063
AUM-to-Assets	−0.053**	−0.026	0.053	−1.560*	−1.574***
	t = −2.021	t = −0.853	t = 0.800	t = −1.835	t = −4.572
Ln Block Grant	0.912	0.391	0.747	−0.891	−7.831
	t = 1.326	t = 1.052	t = 1.576	t = −0.192	t = −1.490
Power.income	0.00001*	0.00001**	0.00000	0.001***	0.001***
	t = 1.738	t = 2.321	t = 0.282	t = 3.343	t = 4.343
Observations	189	189	189	146	
Adjusted R^2	0.139	0.489	0.592	0.282	

Note: *p<0.1; **p<0.05; ***p<0.01

Table 5.10 reveals several explanatory variables worth showcasing. in this section we look at the key statistical takeaways, whereas the explanations behind the coefficients will be further discussed in the next chapter “discussion”. We see from the table, that there are some differences between the dependent variables in terms of significant explanatory variables, even though both serve as proxies for risk-aversion. Furthermore, from the three regressions on the left-hand side, we note seven significant explanatory variables. On the right-hand side however, there are five significant variables.

The perhaps most prominent result is “gross income”. By looking at gross income, it is possible to investigate whether municipalities with a population consisting of higher income-citizens are more exposed to risk. OLS and fixed effects are significant for standard deviation, while both OLS and Tobit are significant for stock weight. The gross income per capita is significant in the fixed effect regression for standard deviation at a 1% level, indicated by the three stars. Moreover, the variable is also significant at a 1% level for the Stock weight, indicated by the three stars in the Tobit regression. An increase in Gross income of one unit leads to an increase in standard deviation by 17.32%. To better understand, a one per cent increase in gross income per capita lead to a 0.1732% increase in standard deviation. Moreover, the Tobit regression indicates that municipalities invest more of its portfolio in stocks when gross income per capita increases. In other words, higher income per capita leads to more exposure to risk.

Other demographic factors like population, share of people over 67 and education also show significant explanatory powers. The two formers show a positive correlation with the dependent variable, whereas population is significant at a 10% level for both risk proxies. Even though the significance is modest, significant results for both standard deviation and stock weight indicate that population has in fact an effect on risk aversion. Moreover, the variable “share over 67 years affects standard deviation with a significance level of 1% from the OLS and 10% for the fixed effects regression. In contrast, education is negatively correlated with standard deviation, meaning that a higher share of educated people within a municipality leads to lower standard deviation. It will, on the other hand, be given less weight considering it is significant only at 10% in the OLS regression and only for standard deviation.

Looking at economic explanatory variables, we observe that "AUM-to-assets" correlates negatively with both standard deviation and stock weight, revealing that a larger amount of investing in the capital markets leads to higher risk aversion measures by both proxies. This effect is especially emphasized by being significant at a 1% level towards the dependent variable stock weights. Furthermore, from the table we observe that also debt ratio has a negative effect on risk-taking. The results are significant at a 10% level for both standard deviation and stock weight. This means that a higher debt in a municipality leads to higher risk aversion, which is intuitive. More precise, a marginal increase in a municipality's debt ratio leads to a decrease in standard deviation by 0.05% and a decrease in stock weight by 0.3%.

Lastly, it is interesting to analyze the effect that power income has on risk aversion. From the table, we observe that an increase in power income increases both standard deviation and the stock weight. The effect is particularly powerful towards the latter with a coefficient of 0.001%. At first glance, these increases might not seem high, but it is important to emphasize that these variables are not written in natural logarithms, but in whole numbers. Consequently, a marginal increase of 1000 NOK leads to an increase of 0.001%. Thus, we find that there is a clear and positive relationship between power income and risk-taking.

5.4 Analysis of Equity Returns

In the following sections, we measure the equity performance of the municipalities through the use of three performance models introduced earlier, respectively the CAPM, the Fama-French three-factor model and the Carhart four-factor model. The reason for this is to first establish a base line where we consider only how the returns are explained by market exposure (CAPM). Thereafter, we expand the model by including a size factor and a value factor in order to better explain expected returns (FF3F). Lastly, we measure the equity performance by also considering a momentum factor for enhancing the ability to capture variations in the stock price (FF4F).

Furthermore, it should be emphasized that this is just one part of the portfolio for some municipalities, whereas for others, it comprises the entire portfolio. It is important to notice the constant, alpha, in each regression. Alpha represents the abnormal return (excess) over and above the risk factors and reveals whether or not the portfolio manages to create extra value. Whether the abnormal return alpha is significant or not, is shown by the stars beside the coefficients, as explained earlier in the section above. Furthermore, we define, for all the regressions, a null hypothesis for the market coefficients to equal 1 and another null hypothesis for the alpha estimate to equal 0.

5.4.1 CAPM

Table 5.11: CAPM Stock regression (1)

	Dependent variable:								
	Stock Return								
	Asker	Bamble	Bjørnafjorden	Bærum	Fredrikstad	Frøya	Gjøvik	Herøy	Holmestrand
Market	0.874***	0.874***	0.822***	0.839***	0.635***	0.802***	0.810***	0.964***	0.905***
	t = 25.278	t = 26.411	t = 28.790	t = 38.655	t = 11.949	t = 34.517	t = 29.372	t = 22.922	t = 12.537
Alpha	0.117	−0.017	0.122	−0.076	0.279	0.110	0.098	−0.166	−0.158
	t = 0.915	t = −0.132	t = 0.925	t = −0.738	t = 1.333	t = 0.990	t = 0.732	t = −0.947	t = −0.682
Observations	95	107	179	203	72	198	182	59	24
Adjusted R^2	0.872	0.868	0.823	0.881	0.666	0.858	0.826	0.900	0.872

Note: $^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$

Table 5.12: CAPM Stock Regression (2)

	Dependent variable:								
	Stock Return								
	Kristiansand	Kvinnherad	Lindesnes	Midtre Gauldal	Nannestad	Notodden	Porsgrunn	Ringerike	Sandnes
Market	0.741***	0.768***	0.795***	0.803***	0.890***	0.706***	0.824***	0.833***	0.679***
	t = 11.466	t = 19.476	t = 12.170	t = 32.164	t = 13.088	t = 10.671	t = 42.973	t = 18.513	t = 13.293
Alpha	0.367*	−0.081	0.211	0.143	0.125	0.140	−0.119	0.053	0.311
	t = 1.831	t = −0.515	t = 0.760	t = 1.205	t = 0.577	t = 0.394	t = −1.309	t = 0.325	t = 1.386
Observations	93	71	33	201	24	26	204	54	50
Adjusted R^2	0.586	0.844	0.821	0.838	0.881	0.819	0.901	0.866	0.782

Note: *p<0.1; **p<0.05; ***p<0.01

Table 5.13: CAPM Stock Regression (3)

	Dependent variable:								
	Stock Return								
	Sigdal	Skaun	Sokndal	Stad	Sula	Sunnfjord	Trondheim	Vennesla	Volda
Market	0.990***	0.829***	0.869***	0.786***	0.735***	0.780***	0.900***	0.775***	1.073***
	t = 30.507	t = 36.509	t = 16.640	t = 20.383	t = 12.872	t = 27.097	t = 37.973	t = 17.497	t = 27.110
Alpha	−0.096	0.126	0.327*	0.035	0.243	0.066	0.123	0.550***	−0.602***
	t = −0.708	t = 1.167	t = 1.684	t = 0.221	t = 1.052	t = 0.483	t = 1.396	t = 3.116	t = −2.825
Observations	132	199	94	144	64	204	95	113	26
Adjusted R^2	0.876	0.871	0.748	0.743	0.723	0.783	0.939	0.732	0.967

Note: *p<0.1; **p<0.05; ***p<0.01

The tables above showcase that 3 out of 27 municipalities maybe capturing positive abnormal returns. Moreover, Kristiansand's return and Sokndal's return is statistically significant on a 10% level, while Vennesla's abnormal return is significant at a 1% level. Volda on the other hand, yields a significant negative abnormal return at a 1% level. As mentioned earlier, the CAPM can only explain returns by considering exposure to market risk. The tables above clearly presents that all the municipalities are highly correlated with the market. One should also note that the model's explanatory power R2 is generally high, which means that most of the returns can be explained by the model (here, market exposure). In addition, we note that both the market coefficients are significantly different from 1. Consequently, we reject both null hypotheses (that portfolios are merely tracking the market, and that there are no excess returns).

5.4.2 Fama-French Three-Factor

Table 5.14: FF3F Stock regression (1)

	Dependent variable:								
	Stock Return								
	Asker	Bamble	Bjørnafjorden	Bærum	Fredrikstad	Frøya	Gjøvik	Herøy	Holmestrand
Market	0.886***	0.849***	0.820***	0.850***	0.658***	0.803***	0.805***	0.942***	0.901***
	t = 25.708	t = 25.544	t = 28.375	t = 38.537	t = 11.436	t = 34.020	t = 29.097	t = 22.588	t = 12.369
SMB	−0.011	0.176**	0.157*	−0.181**	−0.095	0.086	0.216**	0.053	0.105
	t = −0.134	t = 2.059	t = 1.655	t = −2.595	t = −0.634	t = 1.155	t = 2.412	t = 0.478	t = 0.518
HML	−0.123***	0.096*	−0.085	−0.006	−0.062	−0.093*	−0.085	0.160***	−0.125
	t = −2.891	t = 1.686	t = −1.108	t = −0.124	t = −0.841	t = −1.965	t = −1.540	t = 3.330	t = −1.055
Alpha	0.067	0.062	0.122	−0.093	0.216	0.104	0.102	−0.056	−0.196
	t = 0.531	t = 0.492	t = 0.925	t = −0.907	t = 0.993	t = 0.939	t = 0.764	t = −0.329	t = −0.703
Observations	95	107	179	203	72	198	182	59	24
Adjusted R^2	0.880	0.875	0.825	0.884	0.663	0.860	0.832	0.915	0.869
Note:									*p<0.1; **p<0.05; ***p<0.01

Table 5.15: FF3F Stock Regression (2)

	Dependent variable:								
	Stock Return								
	Kristiansand	Kvinnherad	Lindesnes	Midtre Gauldal	Nannestad	Notodden	Porsgrunn	Ringerike	Sandnes
Market	0.759***	0.753***	0.800***	0.803***	0.886***	0.724***	0.822***	0.893***	0.680***
	t = 12.138	t = 18.750	t = 9.964	t = 31.615	t = 15.285	t = 9.425	t = 43.043	t = 18.995	t = 12.453
SMB	0.117	0.181*	−0.110	0.111	−0.332**	−0.122	0.140**	−0.171	0.120
	t = 0.804	t = 1.748	t = −0.510	t = 1.372	t = −2.450	t = −0.603	t = 2.329	t = −1.366	t = 0.824
HML	−0.314***	−0.129***	0.114	−0.101*	−0.178*	0.020	−0.115***	−0.166**	−0.101
	t = −2.997	t = −2.835	t = 0.986	t = −1.965	t = −1.985	t = 0.251	t = −2.990	t = −2.359	t = −1.346
Alpha	0.315	−0.062	0.366	0.143	0.261	0.099	−0.121	−0.112	0.264
	t = 1.626	t = −0.406	t = 1.075	t = 1.211	t = 1.389	t = 0.261	t = −1.364	t = −0.685	t = 1.105
Observations	93	71	33	201	24	26	204	54	50
Adjusted R^2	0.617	0.861	0.816	0.841	0.915	0.806	0.906	0.882	0.783
Note:									*p<0.1; **p<0.05; ***p<0.01

Table 5.16: FF3F Stock Regression (3)

	Dependent variable:								
	Stock Return								
	Sigdal	Skaun	Sokndal	Stad	Sula	Sunnfjord	Trondheim	Vennesla	Volda
Market	0.970***	0.830***	0.844***	0.801***	0.757***	0.806***	0.910***	0.788***	1.018***
	t = 29.568	t = 36.419	t = 15.827	t = 20.572	t = 12.329	t = 28.688	t = 37.786	t = 18.107	t = 23.682
SMB	0.085	0.119	0.228*	0.124	−0.177	−0.174*	−0.122**	0.172	0.240*
	t = 0.905	t = 1.650	t = 1.802	t = 1.164	t = −1.103	t = −1.968	t = −2.147	t = 1.423	t = 1.953
HML	0.147**	−0.127***	0.029	−0.165**	0.014	−0.243***	0.016	−0.263***	0.054
	t = 2.258	t = −2.773	t = 0.432	t = −2.401	t = 0.205	t = −4.276	t = 0.534	t = −3.261	t = 0.976
Alpha	−0.016	0.118	0.399**	−0.021	0.174	0.015	0.108	0.444**	−0.473**
	t = −0.116	t = 1.103	t = 2.029	t = −0.134	t = 0.719	t = 0.116	t = 1.226	t = 2.543	t = −2.256
Observations	132	199	94	144	64	204	95	113	26
Adjusted R^2	0.881	0.876	0.752	0.751	0.720	0.804	0.940	0.753	0.972
Note:									*p<0.1; **p<0.05; ***p<0.01

The Fama-French three factor regression shows no surprising results. When we account for two additional factors, we find that Kristiansand no longer shows a positive alpha. Furthermore, we notice that the significance level of the returns of Vennesla and Volda drops to a 5% level, while it rises to 5% for Sokndal.

Volda still yields negative abnormal return while being exposed to both market risk and the size factor. According to the model, this return can be driven by holding companies with small market capitalization as well as Volda being the municipality with the highest market coefficient. This is surprising, considering Fama and French (1993) argue that betting on small companies should yield higher returns. But note that the sample size is small.

5.4.3 Carhart Four Factor Model

Table 5.17: FF4F Stock regression (1)

	Dependent variable:								
	Stock Return								
	Asker	Bamble	Bjørnafjorden	Bærum	Fredrikstad	Frøya	Gjøvik	Herøy	Holmestrand
Market	0.852***	0.861***	0.820***	0.836***	0.631***	0.803***	0.797***	0.957***	0.898***
	t = 22.734	t = 23.748	t = 27.300	t = 36.754	t = 10.229	t = 32.400	t = 27.175	t = 21.026	t = 10.409
SMB	−0.007	0.178**	0.157	−0.179**	−0.098	0.086	0.212**	0.054	0.105
	t = −0.093	t = 2.074	t = 1.650	t = −2.584	t = −0.656	t = 1.152	t = 2.370	t = 0.491	t = 0.503
HML	−0.199***	0.127*	−0.084	−0.057	−0.133	−0.094*	−0.108*	0.194***	−0.134
	t = −3.595	t = 1.835	t = −1.015	t = −1.075	t = −1.398	t = −1.775	t = −1.738	t = 3.072	t = −0.790
MOM	−0.126**	0.045	0.001	−0.077**	−0.114	−0.002	−0.036	0.063	−0.010
	t = −2.094	t = 0.793	t = 0.014	t = −2.252	t = −1.179	t = −0.040	t = −0.808	t = 0.824	t = −0.076
Alpha	0.108	0.042	0.122	−0.058	0.240	0.104	0.115	−0.078	−0.198
	t = 0.857	t = 0.325	t = 0.908	t = −0.563	t = 1.103	t = 0.932	t = 0.855	t = −0.453	t = −0.690
Observations	95	107	179	203	72	198	182	59	24
Adjusted R^2	0.884	0.875	0.824	0.886	0.665	0.859	0.831	0.914	0.862

Note: *p<0.1; **p<0.05; ***p<0.01

Table 5.18: FF4F Stock Regression (2)

	Dependent variable:								
	Stock Return								
	Kristiansand	Kvinnherad	Lindesnes	Midtre Gauldal	Nannestad	Notodden	Porsgrunn	Ringerike	Sandnes
Market	0.744***	0.762***	0.789***	0.806***	0.903***	0.706***	0.829***	0.883***	0.667***
	t = 10.821	t = 17.372	t = 9.553	t = 30.374	t = 12.256	t = 8.282	t = 41.578	t = 17.640	t = 11.100
SMB	0.115	0.183*	−0.121	0.111	−0.323**	−0.132	0.140**	−0.163	0.121
	t = 0.781	t = 1.761	t = −0.554	t = 1.365	t = −2.303	t = −0.638	t = 2.323	t = −1.284	t = 0.823
HML	−0.350***	−0.109*	0.051	−0.090	−0.128	−0.020	−0.095**	−0.201**	−0.136
	t = −2.762	t = −1.790	t = 0.348	t = −1.574	t = −0.827	t = −0.178	t = −2.211	t = −2.222	t = −1.355
MOM	−0.047	0.036	−0.107	0.018	0.048	−0.081	0.034	−0.050	−0.054
	t = −0.509	t = 0.513	t = −0.717	t = 0.453	t = 0.407	t = −0.509	t = 1.117	t = −0.619	t = −0.527
Alpha	0.345*	−0.073	0.403	0.135	0.229	0.131	−0.137	−0.105	0.273
	t = 1.697	t = −0.470	t = 1.161	t = 1.120	t = 1.103	t = 0.336	t = −1.526	t = −0.641	t = 1.131
Observations	93	71	33	201	24	26	204	54	50
Adjusted R^2	0.614	0.859	0.813	0.840	0.912	0.799	0.906	0.880	0.779

Note: *p<0.1; **p<0.05; ***p<0.01

Table 5.19: FF4F Stock Regression (3)

	Dependent variable:								
	Stock Return								
	Sigdal	Skaun	Sokndal	Stad	Sula	Sunnfjord	Trondheim	Vennesla	Volda
Market	0.981***	0.832***	0.832***	0.817***	0.735***	0.830***	0.925***	0.797***	1.044***
	t = 29.356	t = 34.811	t = 14.011	t = 20.636	t = 10.961	t = 28.894	t = 34.393	t = 17.156	t = 22.230
SMB	0.088	0.119	0.229*	0.125	−0.179	−0.176**	−0.126**	0.175	0.233*
	t = 0.938	t = 1.648	t = 1.804	t = 1.182	t = −1.115	t = −2.027	t = −2.219	t = 1.436	t = 1.930
HML	0.205***	−0.120**	0.001	−0.092	−0.036	−0.162***	0.047	−0.231**	0.129
	t = 2.743	t = −2.341	t = 0.007	t = −1.170	t = −0.393	t = −2.623	t = 1.186	t = −2.384	t = 1.628
MOM	0.090	0.011	−0.046	0.124*	−0.091	0.131***	0.053	0.046	0.108
	t = 1.557	t = 0.316	t = −0.487	t = 1.843	t = −0.828	t = 3.012	t = 1.199	t = 0.599	t = 1.305
Alpha	−0.054	0.113	0.415**	−0.079	0.203	−0.047	0.088	0.427**	−0.459**
	t = −0.388	t = 1.043	t = 2.072	t = −0.494	t = 0.826	t = −0.365	t = 0.986	t = 2.412	t = −2.220
Observations	132	199	94	144	64	204	95	113	26
Adjusted R^2	0.882	0.875	0.750	0.755	0.718	0.811	0.941	0.751	0.973

Note: *p<0.1; **p<0.05; ***p<0.01

As demonstrated in the tables above, 3 out of 27 municipalities have generated positive abnormal monthly returns that are statistically significant. This, however, contradicts what we normally believe about the result. We would usually expect that 95% do not beat the market, while 5% beat the market by chance due to random error. Thus, one would expect 1-2 significant alphas and not three which is the case here. The 1-2 abnormal returns in excess of what the expected result is might be a type 1 error. Type 1 error is rejecting the null hypothesis all though it is in fact true (Hanck et al., 2020, p. 81).

Furthermore, when we include the momentum factor into the model, Kristiansand receives significant abnormal returns. We observe that its t-stat increases from 1.626 in the FF3F to 1.697 in the FF4F, making it barely significant at a 10% level. It is however a surprising result considering that we include one additional risk factor.

The municipalities who have been performing the best according to the Carhart four-factor model are thus Kristiansand, Sokndal and Vennesla. Vennesla achieves the highest returns, which is 0.427% higher than its benchmark, adjusted for the appropriate risk factors. Their return is significant at a 5% level. Sokndal obtains the second highest abnormal returns of 0.415%, whereas the return is significant at a 5% level. Next is Kristiansand with an abnormal return of 0.345% which is statistically significant at a 10% level.

We note that both Vennesla's and Kristiansand's abnormal returns can be explained by exposure to market risk and investing in low-book-to market companies. Sokndal's and Volda's return, however, is likely driven by exposure to market risk, as well as investments in firms with small market capitalization.

It should also be mentioned that both Kristiansand's positive abnormal return has relatively low explanatory power, adjusted R2, which indicates that there are other explanations than the model as to why Kristiansand has achieved this. For the other municipalities who performed well, most of the returns can be explained by the factors in the model.

Volda however, is the only municipality generating significant negative returns. From our analysis they are under-performing relative to the market adjusted for risk by 0.459% monthly, and thus are destroying value. Their returns are statistically significant at a 5% level. Due to an R2 of 97.3%, the return can almost entirely be explained by the factors in model and consequently less by external factors.

From the table, it is clear that the municipalities share a common characteristic in the fact that they are all highly correlated with the market and are exclusively significant at a 1% level. It should be mentioned that a t-stat of 2 or above implies that the results in this analysis are statistically significant at a 1% level, and all the market coefficients for the municipalities are notably higher than 2.

Furthermore, according to our analysis, only four of the municipalities are correlating with the factor proposed by Carhart. Moreover, Stad and Sunnfjord is betting on companies who have been performing well in the past. In contrast, Asker and Bærum are holding companies who have been performing poorly in the past – shown by a negative correlation with the MOM-factor.

The size factor, denoted by SMB tells us whether the municipalities have bet on stocks with a small market cap or a big market cap. We observe that 6 out of 27 municipalities are betting on small while four municipalities are betting on stocks with a big market capitalization. For the value factor HML, we note from the overview that ten municipalities are betting on companies with low book-to-market companies and three municipalities are betting on high book-to-market companies.

In conclusion, all three models provide significant evidence for rejecting both out null hypothesis that the alpha estimate is equal to 0 and that the market beta is equal to 1. This will be further elaborated in "discussion".

5.4.4 Time-Adjusted Equity Performance

From the analysis done above, we find three municipalities who have received positive alphas. Because they share approximately similar number of observations, we test for whether this element has an explanatory effect on the alphas. Kristiansand has 93 observations, Sokndal has 94 and Vennesla has 113 observations. Since there might be specific factors within this period of time that can explain the positive abnormal returns, we look at equity performance for the period between 2014 and 2019. We include all municipalities that have reported returns within this period of time. With these adjustments, we make sure that all municipalities have the same preconditions as the best-performing municipalities from the last section. These regressions are shown in the tables below.

Table 5.20: Time-Adjusted Eqiuty Performance: FF4F Stock Regression (1)

	Dependent variable:							
	Stock Return							
	Asker	Bamble	Bærum	Bjørnafjorden	Frøya	Gjøvik	Kristiansand	Midtre Gauldal
Market	0.922***	0.930***	1.051***	0.790***	0.738***	0.731***	0.776***	0.730***
	t = 19.022	t = 21.912	t = 25.850	t = 10.229	t = 11.159	t = 12.255	t = 8.540	t = 9.446
SMB	−0.004	0.037	−0.206***	0.056	−0.019	0.098	0.151	0.045
	t = −0.044	t = 0.471	t = −2.685	t = 0.386	t = −0.153	t = 0.868	t = 0.870	t = 0.301
HML	−0.056	0.001	−0.124*	−0.244*	−0.135	−0.056	−0.412**	−0.186
	t = −0.652	t = 0.011	t = −1.691	t = −1.750	t = −1.130	t = −0.524	t = −2.472	t = −1.326
MOM	−0.101	0.033	−0.088	−0.046	0.014	−0.004	−0.103	0.011
	t = −1.473	t = 0.537	t = −1.493	t = −0.409	t = 0.151	t = −0.045	t = −0.786	t = 0.097
Alpha	0.130	−0.039	−0.124	0.244	0.270	0.178	0.303	0.316
	t = 1.033	t = −0.349	t = −1.147	t = 1.190	t = 1.540	t = 1.124	t = 1.256	t = 1.525
Observations	70	71	72	72	72	72	70	70
Adjusted R^2	0.875	0.891	0.925	0.647	0.676	0.717	0.591	0.604

Note: *p<0.1; **p<0.05; ***p<0.01

Table 5.21: Time Adjusted Eqiuty Performance: FF4F Stock Regression (2)

	Dependent variable:							
	Stock Return							
	Porsgrunn	Sigdal	Skaun	Sokndal	Stad	Sunnfjord	Trondheim	Vennesla
Market	0.923***	0.965***	0.758***	0.999***	0.938***	0.915***	0.951***	0.764***
	t = 27.436	t = 12.827	t = 11.400	t = 11.178	t = 11.869	t = 15.644	t = 25.205	t = 8.941
SMB	0.018	0.131	−0.022	0.147	0.106	−0.118	−0.055	0.020
	t = 0.282	t = 0.923	t = −0.172	t = 0.874	t = 0.714	t = −1.070	t = −0.762	t = 0.123
HML	−0.019	0.451***	−0.162	0.023	−0.137	−0.093	0.055	−0.449***
	t = −0.309	t = 3.317	t = −1.351	t = 0.148	t = −0.956	t = −0.879	t = 0.801	t = −2.905
MOM	0.036	0.292***	0.027	0.027	0.213*	0.202**	0.050	0.008
	t = 0.750	t = 2.689	t = 0.285	t = 0.211	t = 1.872	t = 2.391	t = 0.914	t = 0.067
Alpha	−0.055	0.047	0.275	0.309	−0.041	−0.088	0.067	0.453**
	t = −0.616	t = 0.236	t = 1.558	t = 1.314	t = −0.193	t = −0.568	t = 0.666	t = 1.999
Observations	72	72	72	69	72	72	70	72
Adjusted R^2	0.926	0.714	0.685	0.689	0.685	0.793	0.917	0.598

Note: *p<0.1; **p<0.05; ***p<0.01

Time period is from January 2014 to December 2019

As the tables present the alpha of both Kristiansand and Sokndal disappears when adjusting for time differences. Vennesla however, is the only municipality that still manages to deliver positive abnormal returns, here at a 5% significance level. The reason why the number of observations differs, is due to missing values within the period of time, but all municipalities share the same start date and end date. From the time-adjusted performance evaluation presented above, it is likely that the individual investment periods of Sokndal and Kristiansand had explanatory power as to why they achieved positive alphas.

5.5 Persistence Analysis

To know whether the municipalities perform consistently, we base our persistence analysis on Carhart's (1997) method to determine persistency in returns. In his article, he divided mutual funds into deciles were the best performing portfolios last year where in decile 1 and the worst performing portfolios were in decile 10. However, we divide our portfolios into five, instead of ten. Assuming that those who performed best last period performs best this period, we know that the municipalities are persistent and skillful rather than lucky. Given skilled portfolio managers, one can assume the following average return order, where P_1 are the top performing portfolios and P_5 are the worst performing:

$$P_1 > P_2 > P_3 > P_4 > P_5 \tag{5.10}$$

One would assume the order above to be true if skill were the decisive factor, since those portfolio managers with the best stock picking skills will consistently achieve superior returns.

Table 5.22 presents the different Carhart portfolios summarized. The data used for the Carhart portfolios is limited to the period between January 2009 and January 2022. Before 2009 is the dataset rather limited; for instance, in December 2008, the dataset consists of only 7 municipalities with stock returns. The observations in table 5.22 show that the division into quantiles is not equally distributed due to the different number of municipal observations for each month. The stock return and the standard deviation (St.Dev.) are annualized to show the annual expected return for each portfolio.

Portfolio 1 are those municipalities who had the highest returns a month prior, while Portfolio 5 are those who had the lowest returns. Consequently, we ranked the municipalities every month, dividing them into five different portfolios based on their stock returns one month prior. Then, we found the average equally weighted return for each of the five portfolios, and these are the ones summarized below.

Portfolio	Stock Return	St.Dev.	Obs.
Portfolio 1	10.21	12.23	550
Portfolio 2	10.61	11.39	463
Portfolio 3	10.81	12.04	514
Portfolio 4	10.36	12.16	470
Portfolio 5	11.92	13.47	580

Table 5.22: Carhart Portfolios Average Returns

As the table displays, there is no evidence for persistency as portfolio 5, which are the worst 20% performing municipalities on a month-to-month basis, in fact are delivering highest returns and portfolio 1, the best performers, delivers the lowest returns.

$$P_5 > P_3 > P_2 > P_4 > P_1 \tag{5.11}$$

As shown above, the order of portfolios who are performing the best is not persistent as one would expect portfolio 1 to deliver best results and portfolio 5 to deliver the worst results. Consequently, the true order implies that returns depend on luck more than skill.

Next, in order to investigate whether the portfolios have created significant positive abnormal returns, we run the Carhart four-factor regression on the five portfolios. Here, the null hypothesis is that alpha equals zero. If we cannot reject the null hypothesis, we can attribute the municipalities strong performance to skill, rather than luck. If we reject the null hypothesis however, we can conclude that the positive alphas displayed in the previous section is due to luck.

Table 5.23: FF4F Regression on Carhart Portfolios

	Dependent variable:				
	Stock Return				
	Portfolio 1	Portfolio 2	Portfolio 3	Portfolio 4	Portfolio 5
Market	0.803***	0.763***	0.763***	0.798***	0.880***
	t = 45.170	t = 40.239	t = 42.607	t = 41.844	t = 48.421
SMB	0.0003	0.038	0.026	0.054	0.082*
	t = 0.007	t = 0.807	t = 0.550	t = 1.114	t = 1.770
HML	−0.103***	−0.128***	−0.080***	−0.027	0.014
	t = −3.445	t = −3.932	t = −2.592	t = −0.836	t = 0.457
MOM	−0.072	−0.824	−0.771	−0.836	3.691
	t = −0.028	t = −0.294	t = −0.299	t = −0.293	t = 1.412
Alpha	0.038	0.061	0.109	0.071	0.097
	t = 0.554	t = 0.845	t = 1.552	t = 0.977	t = 1.376
Observations	550	463	514	470	580
Adjusted R^2	0.816	0.804	0.812	0.819	0.830
Note:					*p<0.1; **p<0.05; ***p<0.01

Table 5.23 presents the Carhart four-factor regressions on the five portfolios. As the table shows, there are no significant alphas, and consequently we cannot reject the null hypothesis. In other words, our analysis show that the abnormal returns achieved by Vennesla, Kristiansand, Sokndal and Volda is due to luck rather than skill.

6 Discussion

The purpose of this chapter is to dig deeper into the results on rates of returns on investments and the pattern of asset allocation. We will discuss possible relationships and explanations as to why we have attained the results presented in the previous chapter, in addition to suggest drivers. Most importantly, we seek to answer the research questions we posed in the beginning of the thesis:

1. *How does the Norwegian municipalities invest in capital markets, and what determines these investments?*

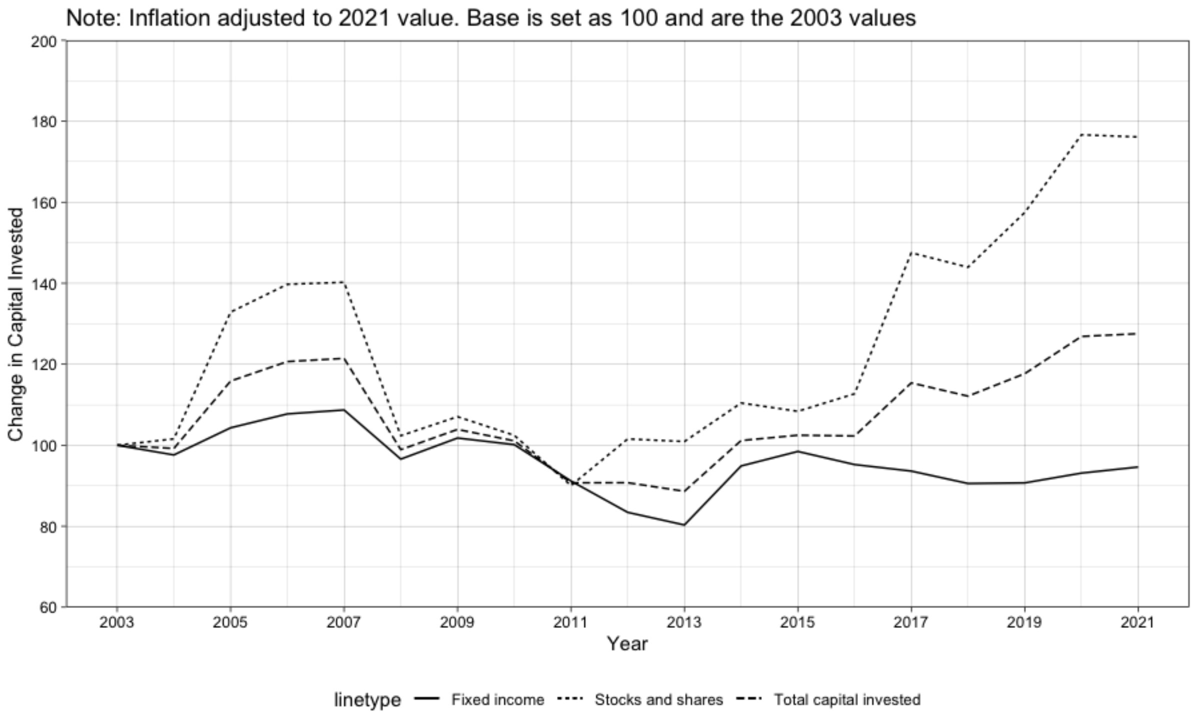
2. *How have the Norwegian municipalities performed in the equity market?*

6.1 The Variation in Pattern of Investments

The first topic to discuss is the variation in the pattern of municipal investments in capital markets. Moreover, we look closer at the development in AUM, as well as municipality characteristics that affect investing in capital markets.

In figure 6.1, the percentage change in the value of the asset classes is illustrated. The figure is indexed to 100, which means that the asset classes start at 100 and the y-axis shows the percentage change from the base.

Figure 6.1: Indexed Total Capital Invested, Stocks and Fixed Income



The figure is based on numbers from SSB.

Looking at the whole time series, figure 6.1 reveals that investments in stocks and shares has increased by a little under 80%, while investment in fixed income has been reduced by around 5%. Total capital invested has increased by approximately 30% since 2003. Moreover, in the last ten years alone (from 2011), the value of total capital invested has increased by 40%. The investments in stocks and shares have doubled in this ten-year period, increasing from 10 billion NOK to 20 billion NOK (see figure 1). Fixed income has been relatively stable in this time-period, with an increase of 4%.

For the last five years (from 2016), capital invested has increased by 25%. Stocks and shares have increased by 56%, while fixed income has been approximately constant. Consequently, the increase in assets under management is due to the increased investments in stocks and shares, which has had a substantial growth in the last decade. Figure 4 illustrates that the Norwegian municipalities have increased their investments in the capital market, and, as it stands now, it seems to be a trend that likely will continue.

As mentioned, it is the increased investments in stocks and shares that has driven the amount of invested capital upwards. The reasoning for this is uncertain, however, there may be some factors that can contribute to explain this phenomenon. With generally low interest rates and high liquidity around the world after the financial crisis, investments in fixed interest rates securities have yielded limited returns. Since fixed income securities yielded low returns, many municipalities may have raised their invested amount in stocks and shares. This is called the portfolio balance channel, and reflects the direct impact on asset prices of investors rebalancing their portfolios in response to the central banks quantitative easing-related asset purchases (Joyce, Lasaosa, Stevens, & Tong, 2020, p. 117). Quantitative easing is the central bank injecting money into the economy, such as buying assets from the private sector which pushes the prices up. Consequently, the quantitative easing and low rates may give some contribution to the explanation to why the investments in fixed income continued to fall even after the financial crisis. Municipalities may have rebalanced their portfolio due to the low returns on fixed income, thus increasing their investments in stocks.

Furthermore, from looking at the AUM-regression in table 5.8, we have identified the central drivers for what makes municipalities invest in the capital market. In particular, we find four characteristics that have an explanatory effect, respectively “gross income”, “population”, “block grant” and “power income”.

First, we find that an increase in population leads to an increase in AUM. This may not be a surprising finding, considering that AUM is measured in absolute numbers and that a larger population entails higher costs on a general basis. If we assume that the purpose of the fund is to cover foreseen and unforeseen costs, it seems natural that a larger population leads to more invested in the capital market. A natural growth in population may thus serve as an intuitive explanation for why we observe an increase in AUM, shown by figure 6.1.

The regression reveals that gross income per capita evidently has a significant effect on a municipality’s investment rate - higher gross income per capita leads to an increase in AUM. If we were to draw parallels between a municipality’s population and its investing practice, we assume that a higher-income population will be more accustomed to saving, hereunder investing in capital markets. This is in line with the findings of Dynan, Skinner & Zeldes (2004). This may be an explanation why municipalities with high-income citizens invest more in capital market. Moreover, a wealthy population might have less need for financial support, making capital markets a reasonable alternative for saving potential excess liquidity.

Municipalities that receive more block grant is shown to invest more in capital markets. This may be considered to be a conflicting event; even though block grant is unrestricted funding, it is also a mean to even out income differences between municipalities (Regjeringen, 2022). One would assume that most of this funding is intended to cover costs. This might be the case, but we reveal that a higher degree of block grant disbursement also leads to heavier investing in stock and fixed income.

Finally, we see the same effect of higher power income. Municipalities who receive income from power plants also increase their AUM. It is not trivial to determine that power income alone is leading to a higher degree of investing, but it might be indicative of certain dynamics. For instance, power income may represent a "bonus" revenue channel, where profits are transferred into the fund. Although the graph in figure 4 do not show development further than 2021, it can be reasonable to think that the substantial increase in power prices in 2022 will lead to a further increase in AUM because of the positive correlation between them.

6.2 Risk Aversion

In this section we provide possible explanations behind the relationships we found in the last chapter regarding risk aversion. Furthermore, we seek to discuss what the major drivers of risk aversion for Norwegian municipalities are.

Table 6.1 describes the asset allocation of the sample. "Global stocks" and "Norwegian stocks" will not equal "stocks", since the sample size for the subcategories are smaller than the stock sample size. The "Other assets" variable is other forms of securities, i.e., private equity or real estate funds. Some municipalities had securities that no other, or few other, municipalities had.

	Portfolio	Stocks	Global Stocks	Norwegian stocks	Fixed Income	Other assets
Average allocation	100	29.91	21.93	10.88	67.99	2.09
Standard Deviation		13.11	12.97	15.16	2.13	

Table 6.1: Average Allocation (%)

The table clearly shows a relatively high risk-aversion, where the municipalities invest mostly in fixed income, at 68% of the total portfolio. Furthermore, table 6.1 illustrates that fixed income is the asset class with the lowest standard deviation, and therefore the least risky investment. Approximately two-thirds of the funds are invested in fixed income, indicating that municipalities in general are risk averse. Civil servants have in general a higher risk aversion (Hartog, Ferrier-i-Carbonell & Jonker, 2002, p. 23). By drawing parallels to municipal investments, we know that civil servants are involved in constructing the finance rules upon which the investment risk is based. However, the risk established in the finance rules are politically determined, and our assumption is that the civil servants have influence on the decision-making. Moreover, politicians may be risk averse due to potentially high suffered loss in their portfolio while sitting on power, which will cause bad publicity. Consequently, by hedging against possible bad publicity, politicians may establish a low risk-profile in the finance rules.

Since some municipalities are more risk averse than others, we wanted to investigate whether there are some characteristics that may function as drivers of risk aversion. It is natural to assume that the purpose of the capital invested is to benefit the population at some point in time. By investigating the risk taken in these portfolios, we can get an overview of what types of municipality take on more risk than others. In the municipal finance rules, the politicians decide on the framework of the risk profiles for the portfolios.

6.2.1 Economic Factors

AUM-to-Assets are significant in two different regressions in regard to stock investment. Consequently, a higher AUM-to-assets increases the percentage of portfolio investments in stocks, indicating an inverse relationship between AUM-to-assets and risk aversion. This seems counter-intuitive, where municipalities that already invest a large share of their assets, additionally take higher risk. Thus, the municipalities take higher risk on accounts of both proportion of assets and on the risk exposure on the portfolio in itself. On the other hand, a high level of AUM-to-Assets means that the municipalities have a safety-net in the sense of for example unforeseen expenditures. Larger fluctuations in the portfolios have minor consequences, since the portfolio has the possibility to cover cost regardless of a reduction in value.

Power income seems to lead to both a higher risk exposure and a larger amount invested in stocks. The difference between the mean revenue and the maximum revenue gained by a municipality is rather big. Accordingly, a high power income is fairly constant, where for example Kvinnherad has significantly higher power income than the rest of the sample (as in table A1.1 in the appendix). The variations in power income are high (look at table 5.6), meaning that there are variations in income from power plant. This also holds for variations within the individual municipalities. Higher power income leads to a higher share of invested capital in stocks, rather than fixed income. A higher income from power plant will therefore lead to the municipality investing more in stocks. Consequently, it seems like power municipalities who earn higher returns from their power plants reinvest some of this capital in stocks. Ultimately, a higher power income leads to lower risk aversion, meaning that municipalities increase their risk exposure for a higher level of power income.

Even though the power of results regarding debt ratio is somewhat uncertain due to a lower significance (10%-level), it is valuable to discuss. A higher debt ratio leads to lower risk-taking, estimated with both standard deviation and stock investments, where an increased debt ratio indicates a more financially distressed municipality. Loan costs for municipalities are low because the possibility of default is zero. Hence, municipalities often have a high debt burden, with a mean of 73% total asset value (see table 5.6). A higher debt ratio will mean that the municipality relies heavily on debt to finance their operations.

Municipalities cannot go bankrupt, meaning the default rate equals zero. However, a financially distressed municipality will instead be put into the "ROBEK-list", which is a register for governmental approval for financial obligations. The consequences of inclusion in the list are, among others, that resolutions regarding loan, financial leasing and long-term contracts for renting buildings, installations or permanent operating equipment expensed over four years must be approved by either the County Governor or the Ministry (Regjeringen, 2007). Although municipalities cannot go bankrupt, we see that they receive consequences by increased regulations financially and decreased economic freedom. Following these lines, a municipality with a higher debt ratio may not risk the possibility of a decline in the market, resulting in losses and inclusion in the ROBEK-list. Thus, is seems reasonable for municipalities with a high debt ratio to take on less risk, to ensure rather liquid capital in case of, for example, increase in interest rates that would hit these municipalities hard.

6.2.2 Demographic Factors

A higher median gross income per capita leads to higher risk-taking, estimated with both standard deviation and stock weight (see table 5.10). There may be several different explanations why municipalities with higher income citizens have a more risk-exposed portfolio. Higher income citizens lead to higher tax income, therefrom generating steady revenues. Because our variable is median income, we know that these municipalities are not dependent on a few high earners for tax income, which would have been the case if the variable was the mean income per capita. A large proportion of municipal income originates from tax income, and in 2018 the tax on income and wealth stood for 40% of total income (KS, 2019). Consequently, a municipality with high earning citizens is assumed to have a steady tax income, where one can assume that they have enough to cover regular costs without having to use the capital in the investment portfolio for funding.

Riley and Chow find that higher income often leads to lower risk aversion (Riley & Chow, 1992, p. 37). That high earners are less risk averse seems intuitive. According to Prospect Theory, a loss of one dollar for an individual who earns 100.000 USD is perceived as less than a loss of one dollar for an individual who earns 50.000 USD. Consequently, the perceived risk of losing one dollar differ between individuals based on their income and wealth due to the disutility. This stems from the assumption that the gains and losses usually correspond to the current asset position (Kahneman & Tversky, 2013, p. 274). A municipality with high tax income may therefore perceive a given risk as smaller than municipalities with lower tax income, thus leading to lower risk aversion.

People usually become more risk averse with age (Palsson, 1996, p. 786). However, that does not seem to be the case for Norwegian municipalities. Municipalities seem to increase their investments in stocks as the share of citizens older than 67 grows higher. This is surprising because individuals over the age of 65 are more risk averse (Riley & Chow, 1992, p. 37). Given that many people in the municipalities are above the age of 67, one may question whether the population in these municipalities actually wants to take on more risk. A higher risk exposure may in such a case be contrary to the citizens wishes.

Our findings imply that municipalities with larger populations, to some degree, lead to higher risk both regarding standard deviation and investments in stocks. Similar to debt ratio, this finding is to some degree weak, but likewise relevant to note. A larger population generates higher tax income, due to an increased tax pool. Yet, on the other side, will a larger population generate higher expenditure. Given economies of scale, a larger municipality will have less costs per capita. The trade-off is lower locally adapted offers due to "one-size fits all" decisions in a more heterogeneous population (Hindriks & Myles, 2013, p. 641). Purely financially, a more centralized municipality will have a higher net income, and it may therefore be intuitive to hold riskier securities.

In summary, our findings show that municipalities with higher income citizens act less risk averse. Moreover, there is a weak indication that municipalities with higher population and an older population also act less risk averse. For the economic factors, we find that municipalities with higher power income exhibit increased risk aversion. On the other hand, an increased AUM-to-assets and a higher power income are associated with lower risk-aversion, due to decreased investments in stocks. Overall, we see that certain characteristics, both economic and demographic, cause differences in the chosen level of risk exposure. This is consistent with variation in risk aversion of municipalities.

6.3 Equity Return

The results from the Carhart four factor regression, in addition to the persistence analysis are presented in the chapter above. In the following, we investigate further what may be the underlying reasons for the results. Initially, we rank performance based on t-statistics rather than alpha estimates, which is suggested by Fama and French (2010). The reason for this is outlined by Sørensen (2009), who says that the precision of the alpha estimate varies across funds, due to both the length of the return history and the degree of diversification. Hence, it can be beneficial to consider the reliability of the alpha estimate, and rank municipalities with respect to t-statistics.

As revealed in the previous chapter, the three municipalities achieving positive abnormal returns are Sokndal, Kristiansand and Vennesla; Sokndal and Vennesla are significant at a 5% level, while Kristiansand is significant at a 10% level. Consequently, Vennesla and Sokndal are performing the best according to our model. Vennesla is also the municipality with the highest alpha estimate of 0.427%. Sokndal receives the second-best alpha of 0.415% and Kristiansand is third best, yielding an abnormal return of 0.345%. These are monthly returns, and will therefore amount to substantial annual returns when accumulated over 12 months.

On the other hand, after analyzing whether the well-performing municipalities were skillful or simply lucky through a persistent analysis, we found no evidence of persistence. Thus, we conclude that all the abnormal results presented above were due to luck. This, however, do not erase the fact that they managed to obtain abnormal results, but it can help to explain where they come from. Furthermore, when adjusting for investment-periods to only include observations between 2014 and 2019, only Vennesla receives abnormal returns.

We mentioned earlier that both Kristiansand and Vennesla are investing in low book-to-market companies, also called “growth stocks”. For Vennesla in particular, this exposure largely explains their abnormal return (as well as market exposure), generating an overall R2 is 0.75. This finding may be somewhat surprising in light of the arguments of Fama and French (1993) that high book-to-market companies should outperform low book-to-market companies. An explanation might be that growth stocks now, unlike 1993, comprise big technology companies like Apple, Google, Amazon, etc., which all have experienced significant growth over recent years. These are companies with relatively low book-to-market value. From the underlying equity portfolios of Kristiansand, Vennesla and Sokndal, it is clear that they have been investing heavily in the global technology sector (e.g., DNB Teknologi and KLP Aksjeglobal), which may also be the reason why being negatively correlated with HML is yielding abnormal returns. This can also be the reason why betting on growth stocks has proved to be the most common strategy used for the municipalities.

Another characteristic to consider is that the three best-performing municipalities are all located in the south of Norway. Both Kristiansand and Vennesla have been outsourcing their asset management to the same managers, initially Griff Kapital and later Gabler. Among the other municipalities, only Birkenes is using Gabler as their asset manager, which suggests that Gabler has been choosing favorable stocks on behalf of Kristiansand and Vennesla. In addition, they hold mostly the same underlying equity funds – both globally and domestically. Thus, it is no surprise that Kristiansand and Vennesla are performing similarly. Sokndal on the other hand, has been using DNB as their asset manager, but the characteristics of the underlying portfolio of stocks are in a large degree similar to that of Kristiansand and Vennesla. Note in particular, both Gabler and DNB are reporting monthly returns net of fees, meaning that the abnormal returns shown in our analysis belongs entirely to the municipalities.

Our analysis shows that Sokndal is significantly positively exposed to the size factor SMB, where they are betting on companies with a small market capitalization. This is in line with the predictions of Fama and French (1993), who states that companies with small market caps tend to yield higher return than companies larger in size. The authors argue that investors demand more compensation for holding small stocks, which again drives higher return due to higher risk. This may also be the reason why investing in companies with a small market capitalization has been one of the most preferred strategies for the municipalities.

The R2 of Kristiansand is only 0.61, which implies that a great part of its return is due to other factors than what is accounted for in the model. One partial explanation for their positive abnormal return may be due to the time period of the data. The data we received from Kristiansand started in 2012 and ended in December of 2019, meaning that both the financial crisis in 2008 and the Corona-crisis in 2020 is left out. This explanation seems to be likely because when we controlled for investment period-effects in table 5.20, Kristiansand's positive abnormal return disappears.

At the opposite end of the spectrum, Volda has a negative abnormal return of 0.459%. An immediate methodological explanation can simply be that Volda suffers from rather few observations (2019-2021), and the results can therefore be skewed by a few negative outliers. Moreover, it is natural to assume that the poor performance is heavily influenced by the Corona-crisis that started in March of 2020. The crisis may have been amplified by the fact that Volda has the highest market beta of the sample, leading to a larger fall. A beta of 1.044 is the only beta above 1 and implies that Volda's equity portfolio is slightly more volatile than the market returns. This is also emphasized in section 5.1 which shows that Volda has the highest standard deviation of all the municipalities.

It is interesting to note that none of the municipalities yielding abnormal return are taking advantage of the momentum strategy. By contrast, there are in fact four municipalities that have a significant MOM. This finding contradicts Sørensen (2009), who presents that the momentum factor is not significantly present in the Norwegian stock market. Furthermore, two municipalities, respectively Asker and Bærum, is apparently betting on companies who have performed poorly over the last 12 months. The reason may be due to a belief in that there is a chance of buying "cheap" stocks, and thus making a profit on a potentially large upside. It should be emphasized that investing in poor-performing stocks can be a completely random strategy which was not initially intended.

It is important to acknowledge that the vast majority of municipalities in our sample are not delivering positive abnormal returns. Sørensen (2009) concludes in his research about Norwegian equity mutual funds listed on the Oslo Stock Exchange, that there are no statistically significant risk-adjusted excess returns according to the Carhart four-factor model. Fama and French (1993), amongst other researchers, come to the same conclusion about market efficiency. On the basis of this, it might be appropriate to question the result of our analysis, considering that we find 3 out of 27 significant positive abnormal returns in our sample. As we discussed in the analysis, we would normally expect only 1-2 abnormal returns. A possible explanation why we have received additional 1-2 more may be that the sample we use is rather small and can thus cause abnormalities. However, if we allow for a significance level of 5%, only two municipalities are achieving abnormal returns, which is in line with the argument made above.

Lastly, we should draw attention to regulations regarding risk for municipalities in the capital markets - both from governmental regulations as well as their own municipal regulations. Ultimately, the returns depend greatly on the risk-frame set by the municipalities as well as the ability of the asset manager. Consequently, the restrictions set beforehand can be limiting for the asset managers in charge of the investments. A possible alternative may be to allow for more flexible portfolio weight in stocks, enabling the manager to seize opportunities that may present themselves in the stock market, in line with the strategy of the oil fund that allows for 60-80% weight in equity.

7 Conclusion

The purpose of this paper was to investigate a field lacking a systematic overview. The lack of an overview was stunning, considering municipalities had investments of 35 billion NOK (3.7B USD) placed in capital markets. In this paper, we created an overview of municipal investments and their typical characteristics, as well as investigating stock performance. Given the regulations that makes the individual municipality define "significant risk", we investigated the variations in risk between municipalities as well. In the following, we answer our two research questions on which our thesis is based upon.

Research question 1: How does the Norwegian municipalities invest in capital markets, and what determines these investments?

In order to answer this question, we look at development in total investments for Norwegian municipalities from 2003 to 2021. Furthermore, we investigate how certain municipality characteristics explain willingness to invest in capital markets and risk aversion. We find that inflation-adjusted investments have increased by 30% since 2003 and 40% in the last 10 years. This development is driven largely by investing in stocks and shares which have had an increase of 100%, while fixed income saw an increase of 4% in the last 10 years. Moreover, we find that the most prominent drivers of willingness to invest in capital markets to be median gross income of the population, size of population, block grant and income from municipal power companies. Norwegian municipalities' investments are characterized by having a low risk-profile, where the average share of capital is allocated approximately 30% in equity and 70% in fixed income.

Municipalities are in general risk averse, where most of their investments are in fixed income securities. However, a municipality is able to decide the level of risk exposed on their own portfolio. Consequently, we assumed that risk exposure would vary between municipalities. When investigating what determines risk aversion, we find that there are in fact different characteristics that have explanatory powers. The most prominent results are that risk-tolerant municipalities seem to have higher median gross income, high degree of AUM-to-assets and income from municipal power companies. The assumption regarding varying risk were therefore confirmed, where some types of municipalities are less risk averse than others.

Research question 2: How have the Norwegian municipalities performed in the equity market?

In the second research question posed, we evaluate the performance made in the equity markets by the Norwegian municipalities. We do this by applying the Carhart four-factor model, as well as test for robustness through a time period-adjusted performance analysis and a persistence analysis. We find that Vennesla and Sokndal outperforms a risk-adjusted benchmark, and thus achieves positive abnormal excess returns. These findings show to be statistically significant at a 5% level for both. Kristiansand achieves a positive alpha at a 10% significance level.

However, when adjusting for time period differences, we reveal that only Vennesla achieves positive abnormal excess returns, significant at a 5% level. When running a persistence analysis, we find no evidence of superior skill, so we conclude that the positive abnormal returns presented are due to luck. In addition, one municipality, Volda, is delivering negative abnormal excess returns, which is statistically significant at a 5% level. In conclusion, 3 out of 27 municipalities are achieving positive alphas, whereas the high performance is due to luck rather than skill.

8 Limitations and Future Research

In this chapter, we address the limitations we observe in our research. We find the two most prominent limitations to be variations regarding data from the municipalities and lacking performance evaluation of municipalities' total portfolio and fixed income. In addition, we provide suggestions for future research regarding the topic of municipal investments in capital markets.

8.1 Variations in the data

A significant limitation we experienced early on in the process of writing this thesis, were a great variety of both quality and quantity in the data we received from the municipalities. Moreover, some municipalities reported only total portfolio returns, while others reported both fixed income returns and stock returns. The respective weights of the asset classes were also reported only by some municipalities. Another issue regarding the data is how the municipalities differ in number of observations. Thus, the analysis regarding those municipalities that reported data further back in time is more precise than those with a short period. Municipalities with few observations will therefore be less precise. Having different time periods also makes it more difficult to compare municipality performance and we have therefore tried to refrain from comparing municipalities as much as possible.

We also encountered a problem regarding how representative the sample is. When collecting the data, a recurring issue were that the municipalities that managed their own investments usually did not store monthly data, which led to them being excluded from the analysis. Consequently, these municipalities are not well represented in our thesis. In addition, some large municipalities considering fund size, like Sandefjord and Skien, are missing, making the sample less representative. Moreover, many municipalities with larger investments, but only fixed income securities, are not included in our dataset. The representativeness of this paper may therefore be limited to those municipalities which for the most part invest in stocks.

8.2 Lack of Performance Evaluation for Total Portfolio and Fixed Income

The second central issue we want to address is that we evaluate only the performance of equity portfolio and not fixed income and total portfolio. When running the returns from the fixed income portfolios on the two-factor model (Fama and French, 1993; NBIM, 2020), we find that almost every municipality is delivering significant abnormal excess returns. We propose that there are risks within the bond markets that the model is unable to capture, and thus deliver an extremely high number of significant alphas. A possible explanation may be that parts of these markets are illiquid, and thus creates a risk which is not accounted for in the current two-factor model. This may be the case in this thesis, considering the uncertainty of whether municipalities hold bonds to maturity or not. Fama and French (1993) states that the two-factor model struggles with explaining variations in returns of low-grade corporate bonds. As a result, the significant alphas of fixed income drive total portfolio returns to be significant for almost every municipality. We have therefore not evaluated the total portfolio performance. Some municipalities may have been performing well in terms of total portfolio returns, but this will not be considered in this paper's performance evaluation.

8.3 Future Research

On basis of the limitations stated above, we propose suggestions for future research. Analyzing the investments and the performance of Norwegian municipalities has not been done before on this level. There is therefore a great potential for further research on this field. First, we suggest gathering a larger and more comparable data from the municipalities which may enhance the analysis. Second, including a quantitative analysis could be an insightful contribution to the quantitative analysis. This may be helpful to determine why the municipalities take on such low risk and to better explain their risk aversion, as well as what determines their willingness to invest in capital markets. Further, by doing a qualitative analysis, it will be possible to deduct where the realized returns are spent, as well as the long-term plan for a municipality.

We also note how the analysis would be improved by including performance evaluation for fixed income and total portfolio as well. We suggest experimenting with models that include risk factors that are able to price more risk (preferably liquidity risk) in the fixed income market. As a result, one would probably also be able to evaluate total portfolio performance. Other interesting research would be to elaborate on key drivers of municipal investment behavior. There are most likely other central characteristics that have explanatory powers.

Another research topic may be how the municipalities should "optimally" invest. By investigating specific municipality characteristics and the purposes of the capital investments, it can be possible to give insight and advice for better portfolio management. For example, finance rules may limit returns due to low upper limit for stock investments. Consequently, this is reducing the opportunity to increase exposure to the market when it may be reasonable to do so.

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Appendix

A1 Figure

Municipality	n	SD	Stock Weight	H. Educ.(%)	Gross Inc.	Popul.	Over 67(%)	Debt Ratio	Profit Marg.	AUM/Assets	Power Inc.	Block Grant
Ålesund	17	2.55		13.03	387695	8943	16.17	74.85	1.08	16.54	0	227433
Asker	7	1.61	42.07	24.39	498794	65098	13.79	65.69	6.00	10.92	0	1053209
Askøy	6	3.53		17.25	450036	28826	11.90	89.46	1.42	6.23	0	892640
Aukra	3	1.62		17.35	424927	3535	18.00	38.83	24.30	16.60	0	123042
Bærum	17	1.25	33.72	23.83	487621	115266	13.62	64.66	6.08	9.73	0	1260522
Bamble	9	0.84	18.26	15.07	410867	14125	16.37	74.60	2.30	9.02	29	386321
Birkenes	7	1.03		14.79	406007	5140	13.47	80.22	1.41	6.03	940	200124
Bjørnafjorden	16	1.34	36.26	16.26	416246	17605	10.97	75.47	3.47	8.28	0	315171
Enebakk	5	0.57		14.99	451081	10976	12.77	82.01	2.20	3.27	0	306114
Fredrikstad	5	0.67	19.59	18.90	398874	80844	16.12	83.25	1.62	5.74	18874	2302514
Frøya	16	1.14	28.50	11.44	373836	4512	16.19	73.98	5.07	10.55	0	111735
Gjerdrum	17	0.08		16.63	455430	5986	10.95	76.60	3.05	10.00	0	118094
Herøy	4	1.20	25.82	15.32	405888	8937	17.15	85.28	0.82	3.73	0	229606
Holmestrand	2	0.83	29.37	18.01	420189	14292	17.33	81.24	-3.35	6.97	4	414703
Kristiansand	8	0.67	21.50	21.01	413848	87823	12.86	75.08	2.49	2.94	113	2287298
Kvinnherad	5	1.72	41.45	16.09	411690	13180	18.80	76.29	3.92	15.78	46441	428820
Larvik	13	1.00	17.69	16.45	390205	43908	16.31	79.30	0.38	8.44	0	1162878
Lindesnes	4	0.65	18.68	13.73	407003	2305	14.61	52.50	-1.00	3.58	2797	108770
MidtreGauldal	17	1.19	28.38	10.97	370205	6100	16.82	68.31	1.55	11.17	3717	212009
Nannestad	2	0.49	9.60	13.88	439560	12074	11.62	92.46	5.10	4.94	10	341275
Notodden	2	2.90	41.00	17.81	404289	12866	18.80	84.12	1.40	1.50	9765	450308
ØvreEiker	10	0.49		15.50	419203	18235	14.42	84.00	1.15	3.46	0	493298
Porsgrunn	17	0.90	19.32	15.81	388758	35014	15.35	73.24	1.79	1.80	0	788639
Ringerike	6	1.55	53.00	17.21	409870	30152	17.33	92.09	2.80	2.38	1978	839829
Sandnes	4	3.01	99.23	18.44	456277	77152	10.68	62.73	2.83	0.72	3310	1909268
Sigdal	11			10.78	400837	3509	18.79	70.32	3.63	2.32	1	123261
Sirdal	16	2.28		14.59	420519	1800	16.15	47.36	7.17	2.68	4277	34737
Skaun	16	1.06	27.85	15.50	422046	7135	11.85	77.09	3.54	2.38	0	206680
Sokndal	7	0.94	20.00	11.50	416488	3308	16.66	71.94	2.63	12.46	45	130610
Stad	11	1.24	33.62	17.64	417080	6307	15.31	82.44	1.17	7.67	114	212942
Sula	5	1.23	34.80	18.60	428608	9134	13.69	82.58	0.74	4.64	0	319031
Sunnfjord	17	1.51	35.00	20.22	433688	12201	9.55	75.40	2.59	5.60	562	269633
Trondheim	8	0.52	14.92	22.59	447154	189916	12.09	70.61	3.42	10.58	143	4035215
Vennesla	10	1.01	25.79	12.62	391516	14142	12.58	76.10	3.76	7.33	9529	483429
Volda	5	0.59	17.73	24.78	401720	9399	16.60	80.83	0.52	3.40	2263	328103

Table A1.1: Descriptive Characteristics Statistics

n = Number of observations SD = Standard Deviation

H. Educ. = Higher Education

Popul. = Population

Over 67 (%) = Percentage of population over the age of 67

Marg. = Margin

Inc. = Income