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Quality Investing in the Nordics

An empirical analysis of the QMJ factor in the Nordic countries, excluding Iceland

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Abstract

This master thesis provides empirical evidence that quality investing in the Nordics, excluding Iceland, produces abnormal returns. Even though investors are willing to pay a premium for quality, the QMJ factor introduced by Asness, Frazzini, and Pedersen (2013) generates abnormal returns for Nordic countries. As we examine the QMJ factor by the individual country and the Nordics as a region, we find that the QMJ generates positive returns across all countries when having a sufficiently large investment universe. Our results suggest that high-quality firms generate higher returns than low-quality firms while being less risky, confirming the existence of the quality puzzle in the Nordics.

Contents

1. Introduction

The introduction of the quality (QMJ) factor by Asness et al. (2013) presents investors and academics with a pricing puzzle. In a financial world where risk and reward are linked as a law of nature, such as for gravity in physics, it is hard to explain the existence of a quality factor yielding abnormal returns. Asness et al. (2013) find that high-quality firms outperform low-quality firms, measured by profitability, growth, and safety. Though it might not be a surprise that high-quality assets are attractive investments in general, it is surprising that high-quality stocks generate risk-adjusted abnormal returns. Explanations using the risk-reward framework imply that high-quality stocks are more risky investments than low-quality stocks. Even though there is no universally correct measurement for the actual risk of an investment, traditional measurements, such as market beta or volatility, indicate that high-quality stocks are in fact less risky investments. The quality pricing puzzle remains unsolved though possible explanations are imperfect risk measurements and market inefficiencies leading to high-quality stocks being undervalued, low-quality stocks being overvalued, or both.

Academics within finance have been on a quest to explain asset returns for many decades. The results have been the identification of numerous risk factors. Even though no factor can explain all asset returns, the risk factors provide valuable insight into evaluating and decomposing the asset returns. Many actively managed funds claim to be investing in high-quality companies to generate abnormal returns. The quality (QMJ) factor provides investors with a valuable tool to evaluate if this is true.

This paper aims to study the relationship between quality and asset returns in - Nordic countries. Examining a region and individual countries provides interesting insight into the performance of quality investing in the individual Nordic countries and the Nordic region, but also in general. We refer to Denmark, Finland, Sweden, and Norway as the Nordic countries, excluding Iceland due to Iceland simply being insignificant in terms of sample size. To investigate this, we will examine whether investing in high-quality companies outperforms low-quality companies in Nordic countries, as defined by Asness et al. (2013). We also want to investigate whether investors are willing to pay for quality, all else equal. Through our sample, which goes from 1987-2022, the economy and financial markets have experienced broadly different conditions, such as the dot-com bubble, the financial crisis, and most recently, COVID-19. For this reason, we find it interesting to examine the price of quality over time. Furthermore, we want to investigate the performance of portfolios sorted on quality and the QMJ which goes long high-quality stocks and short low-quality stocks.

To answer these issues, we have formulated the following research questions:

1. **Are investors willing to pay a price for quality?**
2. **How has the price of quality changed over time?**
3. **How have portfolios sorted on quality performed?**
4. **How has the QMJ factor performed?**

To answer research question 1, we construct profitability, growth, and safety measures. By combining these measures, we construct the quality score. We run cross-sectional regressions of the price-to-book ratio on the quality score to investigate the relationship between the company's quality and its price. The objective of the analysis is to examine whether investors are willing to pay a premium for quality. Further, we run the same regressions but yearly to find the change in the price of quality over time and answer research question 2. We also run cross-sectional regressions of the price-to-book ratio and the individual quality measures to support the selection of quality measures and decompose the price of quality.

To answer research question 3, we construct portfolios based on quality scores. The returns of the quality portfolios are analysed by running regressions of the returns on different systematic risk factors. Furthermore, we construct portfolios that are long high-quality stocks and short low-quality stocks. We hypothesize that high-quality companies outperform low-quality companies, and if we find evidence that supports our hypothesis, we will construct the QMJ factor to answer research question 4. We analyse the issue from the perspective of both local investors in each Nordic country and the perspective of an US investor investing in the Nordics as an region.

The paper is structured as follows. Section 2 presents relevant theories and literature for exploring our research questions. Section 3 is a literature review and section 4 describe data gathering, cleaning, and the sample. Section 5 outlines the chosen factor construction and methodology for analysing our research questions. Section 6 presents and discusses the results of our empirical analysis. Section 7 examines the robustness of the results. Finally, section 8 concludes the thesis.

2. Theory

When investing based on a factor, such as "Quality Minus Junk" (QMJ), the investor takes an active approach and believes it is possible to outperform the market. This contradicts the notion of efficient capital markets.

Fama (1970) introduced The Efficient Market Hypothesis (EMH), which has become fundamental for capital management. An efficient market is defined as a market in which prices always entirely reflect the available information. This implies that it is impossible to generate abnormal returns by investing based on available information. Only by investing based on unavailable information can an investor generate abnormal returns. The market price will reflect that information when the information becomes available.

Fama (1970) splits EMH into three categories; weak, semi-strong, and strong. The weak form states that all prior stock price history is reflected in the market price, which excludes investing based on technical analysis (using geometric models in price and volume charts to predict future price movements) as an investing strategy to achieve abnormal returns. The semi-strong form states that all official information, such as financial reporting, is reflected in the market price. Thus, investing based on fundamental analysis of company prospects should not be able to generate abnormal returns, according to the semi-strong form of EMH. The QMJ factor violates the semi-strong form in terms of being based on official accounting and stock price information. The strong form states that all information is reflected in market prices, including private information. Thus, actively investing in the market should not yield abnormal returns. Investing in a factor such as QMJ, should not generate abnormal returns in the long run because all information is reflected in the marked prices.

Grossman and Stiglitz (1980) introduced the idea that market efficiency creates a paradox that makes efficient markets impossible. If all information is reflected in the market price, investors would have no incentive to gather and analyse information. In turn, no information is gathered, and trading stops as there is no new information to be reflected in the stock price. An alternative approach is that the degree of market inefficiency determines the value of information. The value of information in this context constitutes the abnormal returns generated using the information.

Suppose the value of information is marginally decreasing and the price of new information is marginally increasing with the information efficiency of the market. Eventually, the market will reach an equilibrium where the marginal cost of new information equals the marginal value of new information. Any deviation from this equilibrium represents an opportunity that investors can exploit.

An active investor that buys high-quality companies and short low-quality companies, a strategy like QMJ, can be viewed as an effective investor with access to high-quality, cheap information, which generates positive abnormal returns. On the flip side, active investors with low-quality, expensive information invests in low-quality companies that generate negative abnormal returns.

A fundamental principle within finance is that investors are risk averse, meaning that the investor requires higher expected returns when risk increases. Assets get risk premiums due to their exposure to risk factors, such as market risk. Consequently, assets carry a basket of risk factors that investors can bet on. Factor investing theory sees not stock as an actual physical investment but as a set of risk factors. Investors should thus analyse the underlying risk factors when evaluating investment assets.

Factors as an approach to explain asset returns have been studied for many decades, with new factor variables and strategies emerging regularly. Even though factor models have successfully explained some asset returns, much of the return variation remains unexplained. However, there is a lot to learn from the partially explained return variation when analysing the return and risk of an asset.

Valuation theory states that the value of an asset is the present value of its future cash flows. Dividend discount models (DDM) discount the future cash distributions from the company to the shareholders. The Gordon Growth formula is a version of a dividend discount model where growth and discount rate are constant, and can be formulated as:

$$(1)\quad V_0 = \frac{Div_1}{r - g}$$

Where Div_1 is the dividend to be paid in the next period, r is the cost of equity, and g is the growth rate.

The growth rate can be expressed mathematically as the reinvestment rates times the return on equity:

$$(2) \quad g = b \times ROE$$

All else equal, a higher growth rate increases the asset's value. The same is true for the return on equity. If the discount rate increases, all else equal, the value decreases. The discount rate reflects the risk, or safety, of the investment. Specifically, increases in profitability and growth increase value. On the other hand, an increase in safety, or a decrease in risk, also increases value. Asness et al. (2013) rewrite the Gordon Growth formula to express the price-to-book value for a stock as:

$$(3) \quad \frac{P}{B} = \frac{Profitability \times (1-b)}{Required\ return - Growth}$$

Where (1 – b) is the pay-out ratio and b is the reinvestment rate.

The formula highlights the fundamental drivers of value: profitability, growth, and safety. In terms of the book value of equity, required return, and growth, two identical firms with different profitability should trade at different price-to-book ratios**.** According to the formula, the firm with the highest profitability should trade at a higher price-to-book ratio. The formula suggests that high-quality firms, meaning profitable, growing, and safe firms, should trade at a higher price-to-book ratio, all else equal. If this is true and all assets are priced correctly, all assets should have the same expected risk-adjusted returns. Deviations represent arbitrage opportunities for investors that can be exploited to generate abnormal returns.

Thus, assets with quality characteristics should trade at higher price-to-book ratios and have the same risk-adjusted returns as other assets.

3. Literature review

In the following section, we outline relevant literature for answering our research questions. Asness et al. (2013) argue that investors should be willing to pay a higher price for quality, all else equal. This section starts by looking at valuation theory and proceeds into empirical research on quality measures. Quality characteristics and asset returns have been evaluated on a standalone basis for a prolonged period.

The first characteristic of quality is profitability. All else equal, companies with higher profitability should be more valuable and thus have a higher price. Novy-Marx (2012,2013) finds that companies with high profitability outperform those with low profitability and argues that gross profit to assets is the purest form of measuring profitability. The reasoning is that the gross margin better represents the company's underlying earnings. Using the dividend discount model, Fama and French (2006) conclude that profitable firms have higher expected returns. Chan et al. (2006) investigate earnings quality and find that high accruals are a proxy for low earnings quality, which is linked to low future returns. There are numerous studies on the relationship between profitability and asset returns.

The second characteristic of quality is growth. Mohanram (2005) did a study where he created an index (G_SCORE) based on a combination of standard fundamentals such as cash flows, earnings, R&D intensity, capital expenditures, and marketing. The strategy involves buying high G_SCORE firms and shorting low G_SCORE firms. Mohanram (2005) concludes that the strategy consistently earns a significant excess return, and the results are robust across partitions based on size, stock price, analyst following, exchange listing, and prior performance. He argues that the strategy's advantage is in which stocks to avoid rather than which ones to buy. Mohanram (2005) points out that this basic growth-oriented strategy can broadly distinguish future winners from losers. Further, the abnormal returns remain significant after controlling for systematic risk factors such as book-to-market, size, momentum, and accruals. Mohanram (2005) concludes that high-growth firms outperform low-growth firms. The findings support the financial intuition that increased growth increases value, and thus investors should pay and demand higher prices for high-growth stocks. When constructing the growth measure, we use the same approach as Assnes et al. (2013) by calculating the 5-year growth for each profitability variable except accruals.

The third characteristic of quality is safety. The beta (BAB) variable is based on findings done by Black. et al (1972) and Frazzini & Pedersen (2014). They conclude that low-beta assets outperform high-beta stocks. Penman et al. (2007) decompose the book-to-market ratio (B/M) into two parts: the enterprise, reflecting operational risk, and the equity, reflecting both operational and financial risk. The purpose of the breakdown is to capture the risks an investor faces. Their study found empirical evidence that the operational component positively affects returns while the leverage variable negatively correlates with future returns. In other words, the researchers concluded that, on average, companies with low levels of leverage generated higher excess returns than companies with high levels of leverage. George and Hwang (2010) document that firms with low leverage and low financial distress experience higher risk-adjusted returns. Their explanation for the results is based on varying costs associated with financial distress across firms. They argue that companies with high costs related to financial distress choose to have lower leverage which decreases the probability of experiencing financial distress. Further, firms with high credit risk tend to underperform (Altman 1968; Ohlson 1980; Campbell et al. 2008) and firms with high accruals are more likely to suffer subsequent earnings disappointments, and their stocks tend to underperform peers with low accruals (Sloan 1996; Richardson et al. 2005). Although these papers are distinct and seem disjointed, they all have something in common: all these findings examine the performance of quality variables on a standalone basis.

Asness et al. (2013) combine the knowledge and empirical research of the individual quality components and introduce quality as a risk factor through the Quality Minus Junk (QMJ) factor, which is long high-quality firms ("Quality") and short low-quality firms ("Junk"). Quality is proxied by three measures: profitability, growth, and safety. These three quality measures appear robust based on financial intuition and empirical research. Asness et al. (2013) find that quality firms generate positive abnormal returns when controlling for systematic risk factors in the market. These findings represent an asset pricing puzzle that is hard to explain using risk-based theory, which argues that higher return is directly related to higher risk. Profitable, growing, and safe firms are perceived to be investments of lower, not higher, risk and should thus experience lower, not higher, returns. The quality puzzle remains unsolved, but Asness et al. (2013) argue that the puzzle is either a result of an undefined risk factor, a pricing anomaly, or data mining.

4. Data description

This section describes the data material used to answer our research questions. The data set covers most of the stocks trading on stock exchanges in Denmark, Finland, Norway, and Sweden from 1987-07 to 2022-10. Our primary data sources are stock price data and annual accounting data, both coming from Compustat Global. Additionally, we gather data for risk-free rates, consumer price indices, and exchange rates. The data sources are presented below:

Table 1: Data sources

Description	Source	Short	Time frame
Accounting Data	Compustat Global – Fundamentals Annual	CGFA	1987/06 – 2022/06
Stock Price Data	Compustat Global – Security Daily	CGSD	1987/06 – 2022/06
Risk-free Rates	OECD – Short-term interest rates	OSRF	1987/06 – 2022/06
CPI	OECD – Consumer price indices (CPIs)	OCPI	1986 – 2021
Exchange Rates	Federal Reserve – Foreign Exchange Rates	ERFR	1986 – 2022/06

The table shows the data sources gathered to answer the research questions.

The start of our data is determined by the first available data for fundamentals annual (CGFA) on 1987/06. CGFA is updated continuously, but we set the end of our data set to 2022/06. This way, companies that reported their annual reports in the first half of 2022 are included in our sample. CGFA provides detailed accounting data for companies trading globally (excluding the US and Canada). Asness et al. (2013) use quarterly data when available, whereas we exclusively use annual data. Due to occurrences of multiple annual data points for one company identifier (GVKEY), we only keep the accounting information that was first made available for each fiscal year and company. Only keeping the oldest accounting information is an additional measure to ensure that the accounting information is already available when constructing portfolios and provides us with only one data point for each period for each company. Due to the quality measure *growth,* which is based on 5-year growth rates and data availability in general, we argue that the start of the quality sample should be in January 1995. The main reason for this is that no firms have growth scores before the calendar year of 1994 and the generally small sample for the period 1987-1994.

Some firms report financial information in currencies other than the currency on which the primary issue of common equity is trading. There are multiple examples of this, such as some Norwegian stocks reporting in USD due to USD being the most relevant currency for their business. The most critical group affected is Finnish firms pre-January 1999, when the country started using EUR. To adjust for the switch from FIM to EUR in Finland, we use exchange rates from 1986 to 1999. In January 1999, the fixed exchange rate became official, and the transition from FIM to EUR was carried out. Thus, from January 1999 onwards, we use the official fixed exchange rate of the FIM/EUR. The quality variables themselves are unaffected due to them being ratios or non-accounting metrics, such as market beta. However, the price-to-book ratio requires adjustments so that the market value and the book value of debt are stated in the same currency. Consequently, we adjust the book value for each month by using exchange rates.

The stock price data (CGSA) contains daily trading information for companies outside the US and Canada. We use this data to determine what companies to include in our sample. Specifically, we only look at the primary issue of common equity. To assign a stock to a country, we first look at what stock exchange the primary issue of common equity is trading, and then we look at what country the stock exchange is located in. Additionally, we only keep stocks trading with the local currency of the country. Due to Finland changing the national currency from FIM to EUR in the late 1990s, we use historical exchange rates to adjust for the change in national currency. Specifically, we use the historical floating exchange rates for FIM and EUR until the official switch in January 1999. Since January 1999, we use the official fixed exchange rate.

When calculating returns, we adjust for both dividends and stock splits. To calculate stock returns, we look at the arithmetic change in adjusted close price. To calculate monthly returns, we define the last trading day for each stock and month. We use the adjusted close price on this date to calculate monthly returns. Additionally, we require the stock to be traded to at least the 20^{th} of each month to prevent faulty return values. We find the market value by multiplying the close price by the number of outstanding shares. To account for delisting, we make certain adjustments. Since our data set does not contain delisting returns, we estimate delisting returns by the reason for delisting. Expressly, we set delisting returns to -100% at bankruptcy and 0% in the case of acquisition, merger, or leveraged buyout. If the reason for delisting is something other than this, we set the delisting return to be -30% which is in line with Asness et al. (2013) treatment of delisting returns for other reasons. The delisting returns only affect a marginal part of the sample. The return calculations do not include any currency hedging which is in line with Asness et al. (2013).

We take certain measures to ensure that the fundamental data used to construct portfolios was available at the time of portfolio construction, we take certain measures. For the calendar year t, we use accounting data for t – 1 and align it with stock price data going from June in year t to June in year t + 1. The method creates a conservative time lag of 6 to 12 months from fiscal year end to portfolio construction that, to a great length, ensures that the accounting data was available at the time of portfolio construction. The alignment method is the same methodology used by Asness et al. (2013).

The risk-free rates are gathered from OECD and are the short-term interest rate by country for 1987/06 to 2022/10. Specifically, the short-term interest rate is the annualized monthly average of the 3-month treasury bill rate. Some of the quality variables use the consumer price index. For the consumer price index, we use data from OECD, and the values are annual and indexed at 2015 = 100.

Table 3 shows the descriptive statistics for the sample. There are differences across the countries in terms of sample size and characteristics. Denmark and Finland are the smallest samples, with only 346 and 264 firms for the whole period, respectively. Sweden has the largest sample, with 1069 firms for the period. Figure 5 in Appendix D shows each country's yearly number of stocks in the whole sample. The sample starts off small in 1995 but has grown considerably throughout the period. The lowest number of firms in a single year was 59, 47, 47, and 70 for Denmark, Finland, Norway, and Sweden, respectively. Figure 5 in Appendix D shows the development of the sample by country from 1995 - 2022. Additionally, table 23 and 24 in Appendix C shows more detailed statistics for both the quality score and its sub-components scores and the quality characteristics.

Additionally, we construct four risk factor portfolios: the market portfolio (MKT), small-minus-big (SMB), high-minus-low (HML), and momentum (UMD). The portfolio construction methods and data sets are similar across all portfolios, including the QMJ, which causes the degree of consistency we desire. In the next paragraphs, we briefly explain the construction of the risk factor portfolios.

The market portfolio (MKT) is simply the return of the overall market using market value weights. We find market value weights by dividing an individual firm's market value by the market's aggregated market value. The monthly market returns are calculated as:

$$(4)\quad MKT_t = \sum_t w_{t-1}^i \times r_t^i$$

Where MKT_t is the market return in month t. w_{t-1}^i is the lagged market value of the individual stock divided by the lagged market value of the whole market. Lagged market values are necessary for consistency. r_t^i is the excess return for the individual stock at month *t*.

SMB and HML are constructed following the methodology of Fama & French (1998). The Small-Minus-Big (SMB), or size, risk factor and the High-Minus-Low (HML), or value, risk factor is constructed using six portfolios formed on the intersection of size and book-to-market ratios (BE/ME):

Table 2: Portfolios sorted on size and value

Value / Size	**Small**	**Big**
Growth	Small Growth (SG)	Big Growth (BG)
Neutral	Small Neutral (SN)	Big Neutral (BN)
Value	Small Value (SV)	Big Value (BV)

The table shows six portfolios formed on the intersection of size (market value of equity) and value (book value of equity).

$$(5)\quad SMB = \frac{SG + SN + SV}{3} - \frac{BG + BN + BV}{3}$$

$$(6)\quad HML = \frac{SV + BV}{2} - \frac{SG + BG}{2}$$

The portfolios are updated and rebalanced monthly based on market value weights. We use the 50th percentile when sorting on size and sort conditionally, meaning we first sort by size and then by value. The portfolios construction method is consistent with the construction of QMJ.

The momentum risk factor is constructed following the methodology of Carhart (1997). The momentum risk factor, or UMD ("Up-Minus-Down"), is sorted into two portfolios on the 70th and 30th percentile based on past returns, where "Up" is the high performers and "Down" are the low performers. We sort by using the 1-year return leading up to the last month, from t-12 to t-1:

$$(7) \quad UMD_{SORT} = \frac{r_{t-1}}{r_{t-12}} - 1$$

$$(8) \quad UMD = Up - Down$$

The momentum risk factor portfolio is updated monthly using equal weights.

Due to our risk factors being constructed by us, there might be deviations from the risk factors used by Asness et al. (2013). Using internal versus external risk factors is a trade-off between consistency and replication accuracy, where we prioritize consistency.

Table 3: Descriptive Statistics of Sample

	Denmark	Finland	Norway	Sweden
Total stocks				
Stock price data	390	284	661	1140
Accounting data	346	264	600	1069
Whole sample	346	264	600	1069
Average stocks				
Stock price data	161	119	194	356
Accounting data	164	133	223	443
Whole sample	164	133	223	442
Min. stocks in a single year	59	47	47	70
Average market value	4836	744	6637	7478
Median market value	580	120	858	588
Currency	DKK	EUR	NOK	SEK
Time frame	1995/06 - 2022/06	1995/06 - 2022/06	1995/06 - 2022/06	1995/06 - 2022/06

The table shows the data sample from both the stock price data and the accounting data after cleaning. “Total stocks” is the total number of stocks in the time frame. “Average stocks” is the yearly average number of stocks. The stock price data contains stock prices for the primary issue of common equity for each company and is assigned to a country by which the stock exchange that the security is trading on is located. The “Whole sample” is the combined sample of the match between the stock price data and the accounting data.

5. Factor Construction and Methodology

The following section presents the methodology used in constructing portfolios based on quality. The section starts **by** looking at the estimation of the quality score, followed by portfolio construction based on quality. Even though the methodology follows Asness et al. (2018), we make independent decisions about methodology where we find it necessary.

The quality measure is calculated using the three individual measures for quality: profitability, growth, and safety. The quality measures are composed of six profitability variables, five growth variables, and four safety variables. Variable definitions and preparation can be found in Appendix A and B.

Firstly, we rank the firm's quality characteristics relative to other firms at time t. Accruals (ACC), beta (BAB), leverage (LEV), Ohlson's O-score, and standard deviation of ROE (EVOL) are ranked in descending order, while we rank the rest in ascending order. For each variable, x, and company, i, the variable is ranked in order:

$$(9)\quad r_i = rank(x_i)$$

The z-scores, or standardized value, of the ranks:

$$(10)\quad z = \frac{x - \bar{x}}{\sigma}$$

Profitability is measured by calculating z-scores for Gross Profit on Assets (GPOA), Return on Equity (ROE), Return on Invested Capital (ROA), Cash Flow on Assets (CFOA), Gross Margin (GMAR), and Accruals (ACC).

The profitability score is the z-score of the profitability sub-components:

$$(11)\quad Proftiability = z(z_{GPOA} + z_{ROE} + z_{CFOA} + z_{GMAR} + z_{ACC})$$

Growth is estimated by the z-scores of 5-year growth in the profitability measures, excluding accruals (ACC).

$$(12)\quad Growth = z(z_{\Delta GPOA} + z_{\Delta ROE} + z_{\Delta CFOA} + z_{\Delta GMAR})$$

The growth is calculated using the change in the numerator divided by the lagged value in the denominator. To exemplify, we write the formula for 5-year growth for ROE:

$$(13) \quad \Delta ROE_t = \frac{NI_t - NI_{t-5}}{BE_{t-5}}$$

Where NI is net income and BE is the book value of equity.

Safety is estimated by the z-scores for Beta (BAB), Leverage (LEV), Altman's Z-Score (Z-Score), and Ohlson's O-Score (O-Score) bankruptcy risk and ROE Volatility (EVOL):

$$(14) \quad Safety = z(z_{BAB} + z_{LEV} + z_Z + z_O + z_{EVOL})$$

BAB, or β, is calculated as follows:

$$(15) \quad \beta_i = \rho(r_i, r_m) \times \frac{\sigma_i}{\sigma_m}$$

Where the correlation, ρ, is calculated using 3-day returns for a period of 5 years. Three-day returns are used to account for nonsynchronous trading and a 5-year period due to correlations being more stable than volatilities. The standard deviations, σ, are calculated using daily stock returns for a period of 1 year. This method of estimating beta is as in Frazzini and Pedersen (2013) which is the same method used by Asness et al. (2013).

Due to missing data, we allow some data to be missing by averaging the existing data points. Specifically, we require one variable to be present within the individual quality variables. For example, the cost of goods sold (COGS) has a significant amount of missing data which impacts gross-profit-over-assets (GPOA) and gross margin (GMAR).

For the quality measures; profitability, growth, and safety, we allow for up to one measure to be missing. The growth measure is calculated over five years and thus has missing data for many young firms, which we want to keep in the sample. Even though some data is missing, we give the firms quality scores to obtain a sizable sample. It is unclear whether our methodology deviates from that of Asness et al. (2013).

The quality portfolios are created using the quality score of the individual company. Companies are sorted into portfolios based on the relative quality score. We use five percentiles to sort the quality portfolios, which deviates from Asness et al. (2013), who use ten. The reason for this is the size of our sample and to have more diversified portfolios. The portfolios are value-weighted and rebalanced every month to maintain market value weights, equivalent to the rebalancing method used by Asness et al. (2013).

The QMJ portfolio, or factor, is constructed using the intersection of six value-weighted portfolios formed on size and quality. Each month, the firms in the sample are assigned to two portfolios sorted by size, small or big. The size breakpoint we use is the 50th and 80th percentile independent by country, whereas Asness et al. (2013) use the 80th percentile for the international sample. Our reasoning is to get more diversified portfolios in terms of preventing a few stocks from dominating the portfolio throughout the period. Then, we assign the firms within each size portfolio into quality portfolios by the 30th and 70th percentile of the quality score. The 30th percentile of firms sorted on quality is the "junk" stocks, while the 70th percentile is the "quality" stocks. This conditional sorting, first sorting on size and then quality, is also used by Asness et al. (2013).

Table 4: Portfolios sorted on quality and size

Quality / Size	**Small**	**Big**
Quality	Small Quality	Big Quality
Neutral	Small Neutral	Big Neutral
Junk	Small Junk	Big Junk

This table shows six portfolios formed on the intersection of quality (quality score) and size (market value of equity).

Thereafter, we construct the QMJ portfolio return by calculating the average return of the two quality portfolios minus the average returns of the two junk portfolios:

$$(16)\quad QMJ = \frac{1}{2} \times (Small\ Quality + Big\ Quality) - \frac{1}{2} \times (Small\ Junk + Big\ Junk)$$

The QMJ can be rewritten to illustrate the split between QMJ in small and big stocks:

$$(17)\quad QMJ = \frac{1}{2} \times (Small\ Quality - Small\ Junk) + \frac{1}{2} \times (Big\ Quality - Big\ Junk)$$

Where *(Small Quality – Small Junk)* is the QMJ in small stocks, and *(Big Quality – Big Junk)* is the QMJ in big stocks. All portfolios are updated and rebalanced monthly using market value weights.

6. Results and discussion

First, we answer research question 1 by conducting Fama-Macbeth's (1973) cross-sectional regressions of the standardized price-to-book value (P/B) on the standardized quality score, as defined in the methodology section.

$$(18)\quad P_t^i = z(P/B)_t^i$$

Where z-score is the standardized value of the price-to-book ratio.

The cross-sectional regression can be expressed as:

$$(19)\quad \mathrm{P}_t^i = a + b \times Quality_t^i + Controls_t + \varepsilon_t^i$$

The regression should provide insight into whether the high quality is associated with a high price in the cross-section. The dependent variable, price-to-book ratio, and the independent variable, quality, are standardized for more straightforward interpretation. The interpretation is as follows, one increase in the standard deviation of quality leads to the price-to-book ratio increasing with b standard deviations.

We also include control variables for size and 1-year return. Size is the logarithmic value of the market cap, and 1-year return is the 12-month return. The control variables are also scaled for consistency and interpretation purposes.

Asness et al. (2013) also include these control variables. Large companies typically have stocks with higher liquidity and thus lower liquidity risk, which should lead to higher valuations. The 1-year captures the financial development during the last year, as the book values are only updated yearly. This time lag in the book values is adjusted by including the 1-year return as a control variable. Profitable firms with growing shareholder equity will have high price-to-book ratios simply because the book value of equity is not updated as frequently, so a high and positive coefficient for the 1-year returns can solely be due to the outdated book value of equity. Thus, it is interesting to include both the size and 1-year return as control variables.

Table 5: Price of Quality
Nordic countries (excluding Iceland) 1995-2022

	Dependent variable:							
	z(Price-to-Book)							
	Norway		Denmark		Sweden		Finland	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Quality	**0.21**	**0.07**	**0.22**	**0.11**	**0.22**	**0.13**	**0.37**	**0.30**
	(29.21)	(10.54)	(22.18)	(10.86)	(29.18)	(16.55)	(55.84)	(46.11)
Size		**0.29**		**0.39**		**0.18**		**0.16**
		(60.94)		(78.25)		(33.40)		(31.84)
1-year return		**0.28**		**0.21**		**0.21**		**0.21**
		(30.57)		(22.31)		(29.53)		(22.82)
R^2	0.04	0.24	0.05	0.31	0.04	0.12	0.12	0.22

The table shows the coefficients from cross-sectional regressions with standardized price-to-book as the dependent variable and the quality score as the main independent variable. All variables are monthly values for individual firms. The reported coefficients are the average over the whole period for each country. Size and 1-year return is standardized and used as control variables. Size is the logarithm of the market value, and 1-year returns are the past 12-month return. T-values are presented in parenthesis beneath the coefficients, and highlighted coefficients are significant on the 5% significance level.

Table 5 shows the results from the cross-sectional regressions for the price-to-book on quality and control variables. Column (1), (3), (5), and (7) shows that the quality of the firm positively impacts the price. The results indicate that higher-quality companies trade at a higher price, or premium, relative to lower-quality companies. All the coefficients are statistically significant at the 5% confidence level. When controlling for size and 1-year returns in columns (2), (4), (6), and (8), the coefficients stay positive and statistically significant but decrease in terms of both coefficient value and significance. The explanatory power is low at 4-12%, which is consistent with the findings of Asness et al. (2013).

The coefficients for size are all positive and statistically significant, indicating that larger firms trade at a higher price than smaller firms. The premium for larger size could be due to lower liquidity risk. The coefficients for a 1-year return are also positive and statistically significant, indicating that the stock return in the last 12 months affects the stock price. The 1-year return captures the intra-year development of the book value of equity and thus adjusts for the book value of equity being updated yearly. The explanatory power increases yo 13-31% when including the control variables.

To further investigate the price of quality, we run the same cross-sectional regressions for the price-to-book ratio on the quality sub-components: profitability, growth, and safety. The regressions can be formulated as:

$$(20)\quad P_t^i = a + b_1 Profitability + b_2 Growth + b_3 Safety + \varepsilon_t^i$$

Table 6 shows the results of the cross-sectional regressions for the quality sub-components. All the individual quality components show positive and statistically significant coefficients. The results indicate that profitable, growing, and safe firms are priced higher than their counterparts. Investors are willing to pay a higher price for firms with these characteristics, which is in line with our expectations. High profitability tells us about a firm's operational efficiency and ability to compete in the market. Firms that are expected to generate a return on equity higher than the cost of equity should trade at a higher price-to-book ratio than firms that are expected to generate a return on equity at or below the cost of equity, all else equal. The results support this notion of profitable firms demanding a higher price. Growing firms have higher expected earnings in the future, which increases the value of the assets, all else equal. Finally, safe firms should have a relatively lower cost of capital and thus higher value than more risky firms. Two companies with the same return on equity but with different costs of equity due to the risk of the firm should trade at different price-to-book ratios, all else equal. In the presented scenario, the safer firm should trade at a higher price-to-book than the riskier firm. The results support this notion and indicate that safer firms trade at higher prices

Table 6: Price of Quality Sub-Components

	Dependent variable:															
	z(Price-to-Book)															
	Norway				Denmark				Sweden				Finland			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Profitability	**0.13**			0.005	**0.24**			**0.25**	**0.15**			**0.05**	**0.36**			**0.26**
	(22.15)			(0.40)	(24.71)			(19.84)	(19.77)			(3.78)	(65.22)			(32.68)
Growth		**0.19**		**0.14**		**0.26**		**0.15**		**0.16**		**0.13**		**0.19**		**0.04**
		(28.37)		(14.51)		(25.92)		(16.31)		(21.16)		(14.83)		(19.32)		(4.16)
Safety			**0.26**	**0.28**			**0.03**	**-0.10**			**0.28**	**0.13**			**0.30**	**0.13**
			(19.76)	(15.42)			(4.04)	(-10.39)			(29.58)	(11.18)			(34.72)	(15.65)
R^2	0.02	0.04	0.05	0.10	0.06	0.07	0.01	0.11	0.03	0.03	0.03	0.06	0.12	0.07	0.06	0.15

The table shows the coefficients from cross-sectional regressions with standardized price-to-book as the dependent variable and the quality sub-components as independent variables. All variables are monthly values for individual firms. The reported coefficients are the average over the whole period for each country. Size and 1-year return is standardized and used as control variables. Size is the logarithm of the market value, and 1-year returns are the past 12-month return. T-values are presented in parenthesis beneath the coefficients, and highlighted coefficients are significant on the 5% significance level.

The cross-sectional regression coefficients show that the price for quality is positive and statistically significant on average from 1995-06 to 2022-06. To further investigate the development of the price of quality over time, we look at the yearly coefficients on a standalone basis and plot the price of quality over time. Asness et al. (2013) argue that there is a “flight to quality”, which means that investors value quality higher when financial markets experience downturns. We want to assess this argument by looking at the price of quality across different periods.

Figure 1 shows both the equally weighted average and the market value-weighted values of the yearly cross-sectional regression coefficients for each country. The intuitive interpretation is that in “good” times, where markets perform well and investors are optimistic, the price of quality should be low as investors are opportunistic. In “bad” times, where markets are performing poorly, and investors are pessimistic, the price of quality should be higher as investors value profitable, growing, and safe firms higher.

In the years before 2000, the markets were optimistic and performing well. The dot-com bubble in the year 2000 was a crisis where markets experienced major declines. In this period the price of quality was high, with a coefficient of about 0.35. The market decline stopped in about 2002/2003, and markets started climbing. The price of quality bottomed out in 2004 when markets had experienced one year of considerable growth since bottoming out in 2003. From this point, the markets increased until the financial crisis in 2007/2008. The price of quality increased from 2004 to 2007/2008. The development partly contradicts the notion that investors are willing to pay a lower price for quality in “good” times, but even though the price of quality increased, the price of quality was still relatively low in the range of 0.1 to 0.2. The period after the financial crisis, from 2008 to 2015, was a period of recovery after the major financial crisis. The price of quality increased in this period, indicating that investors were still looking for high-quality firms after the crisis. This growth could be due to structural changes in investor behaviour after the crisis due to the realization of the risk associated with investing in stocks. From 2016 until 2021, the price of quality declined rapidly. The period is characterised by record-low interest rates, expansionary fiscal policy from governments worldwide, and booming markets, which could have resulted in structural changes in investor behaviour as the cost of capital plummeted. The low interest rates could make lower-quality, younger firms with high expected growth more attractive to investors than profitable, growing, and safe firms. High-quality companies have a more extended accounting history and thus are more mature than young, fast-growing firms early in the life cycle.

To conclude about the phenomena called "flight to quality," we find it hard to interpret Figure 1 and thus make confident statements about the phenomena of "flight to quality." The intuition that investors should look to profitable, growing, and safe firms in uncertain times is reasonable and plausible. We find it challenging to quantitatively analyse both the short-term and long-term changes in investor behaviour due to market events and thus leave the question about "flight to quality" unanswered.

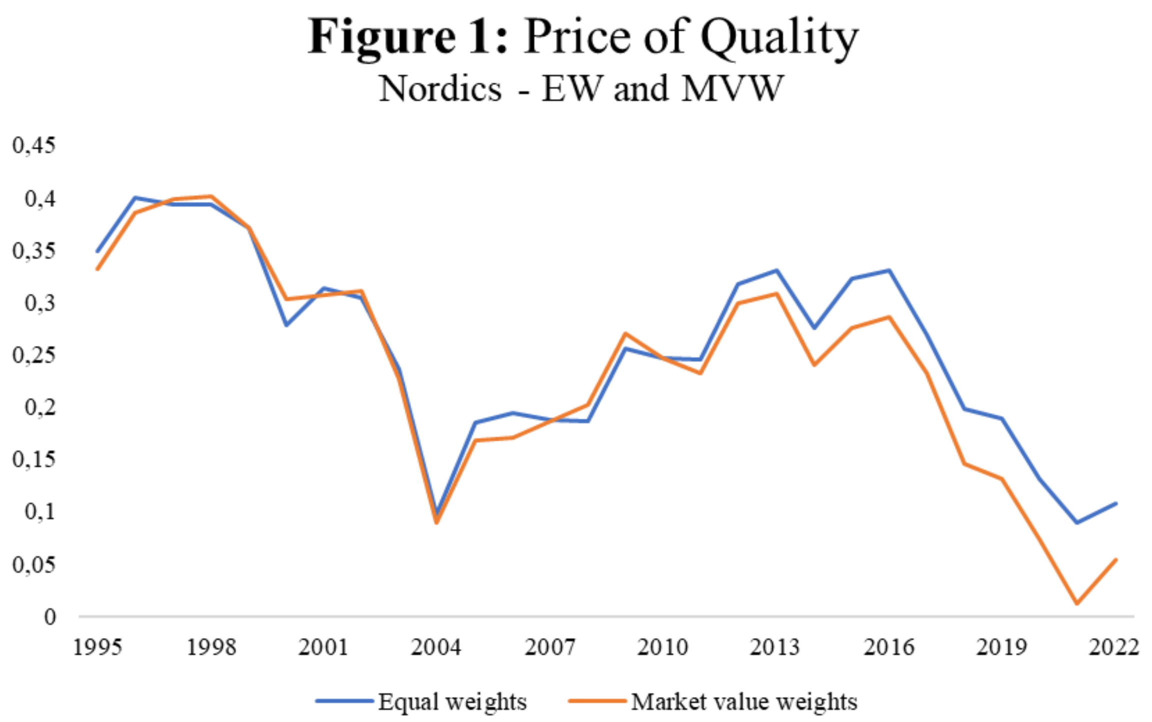

Figure 1: Price of Quality over time - Equally Weighted Average of Nordic countries (excluding Iceland)

Research question 1 was formulated to investigate the relationship between the quality of a firm and the pricing of its stock. The goal of research question 2 was to investigate the price of quality over time. The conclusion to research questions 1 and 2, we find evidence that higher quality demands higher prices and that the price of quality fluctuates over time. We are unable to prove the phenomena of "flight to quality" but find its intuition to be both reasonable and plausible. There are arguments to be made that investors find high-quality firms more attractive in times of uncertainty, but we cannot conclude definitively. Asness et al. (2013) discuss possible explanations for the quality premium, such as the market defining quality differently, omitted risk variables, and limited market efficiency. Assuming that markets are not fully efficient, the issue of assessing whether high-quality firms generate positive abnormal returns becomes interesting to investigate.

To determine whether investing based on quality yields positive abnormal returns and thus to answer research question 3, we construct five portfolios sorted on quality. Specifically, firms are sorted into five portfolios based on percentiles of the quality scores. Portfolio 1 is the bottom 20 percent of firms based on quality, and Portfolio 5 is the top 20 percent of firms based on quality. Additionally, a long-short portfolio called “H-L” is included, which shorts Portfolio 1 (lowest quality) and goes long Portfolio 5 (highest quality). This portfolio construction is done for each country, and the returns are analysed using risk factors. Table 7 to table 10 presents the results by country. We run regressions on the portfolio returns and control for common risk factors in the market. Specifically, we control for the market, size, value, and momentum factor.

The CAPM regression can be written as:

$$(21)\quad r_t - rf = \alpha + \beta_1 \times MKT_t + \varepsilon_t$$

Where the portfolio excess return is the dependent variable and the excess return of the market is the independent variable. The intercept is the CAPM alpha.

The 3-factor regression can be written as:

$$(22)\quad r_t - rf = \alpha + \beta_1 \times MKT_t + \beta_2 \times SMB_t + \beta_3 \times HML_t + \varepsilon_t$$

Where SMB (“small minus big”) is the size factor and HML (“high minus low”) is the value factor.

Finally, the 4-factor regression can be written as:

$$(23)\quad r_t - rf = \alpha + \beta_1 \times MKT_t + \beta_2 \times SMB_t + \beta_3 \times HML_t + \beta_4 \times UMD_t + \varepsilon_t$$

Where UMD is the momentum factor, or up-minus-down, based on past returns.

Across all countries, the “H-L” portfolios have positive excess returns, CAPM alpha, Fama & French (1993) 3-factor alpha, and Carhart (1997) 4-factor alpha. The “H-L” portfolios have excess returns of 1.50, 0.13, 0.84, and 0.74 percent monthly for Norway, Denmark, Sweden, and Finland, respectively. The CAPM alphas are 1.89, 0.32, 1.08, and 0.53 percent monthly for Norway, Denmark, Sweden, and Finland, respectively. Although the coefficients are only statistically significant for Norway and Sweden, we interpret the results as preliminary evidence that an investing strategy based on going long "Quality" companies and short "Junk" can yield positive abnormal returns, and we proceed to construct the QMJ-factor to investigate further.

Generally, the excess returns are increasing from the low-quality portfolios moving up to the high-quality portfolios. For Norway, the excess returns for the portfolios range from -0.43 to 1.07 percent, while the excess returns for Denmark range from 0.76 to 1.04 percent. Meanwhile, the excess returns range from 0.24 to 1.08 and 0.59 to 1.33 for Sweden and Finland, respectively. Except for Finland, all countries have negative market beta values, indicating that going long high-quality firms and short low-quality firms is a strategy with negative market beta.

Table 7: 5 Quality Portfolios for Norway

Portfolio	P1 (Low)	P2	P3	P4	P5 (High)	H-L
Excess Returns	-0.43	0.82	0.75	0.69	**1.07**	**1.50**
	(-0.78)	(1.88)	(2.03)	(1.81)	(3.11)	(3.60)
CAPM alpha	**-1.47**	-0.02	0.07	-0.01	**0.42**	**1.89**
	(-4.67)	(-0.09)	(0.33)	(-0.06)	(2.15)	(4.95)
3-factor alpha	**-1.38**	0.04	0.07	-0.01	**0.43**	**1.81**
	(-4.62)	(0.16)	(0.33)	(-0.04)	(2.31)	(5.06)
4-factor alpha	**-1.21**	0.03	0.12	0.10	**0.35**	**1.56**
	(-4.03)	(0.13)	(0.54)	(0.44)	(1.88)	(4.38)
Beta	1.48	1.19	0.96	1.00	0.92	-0.56
Sharpe Ratio	-0.15	0.36	0.39	0.35	0.60	0.69

The table presents five portfolios sorted solely on quality scores. The stocks are assigned to five portfolios, where portfolio 1 consists of the lowest quality stocks and portfolio 5 consists of the highest quality stocks. The portfolios are updated and rebalanced monthly using market value weights. Excess returns are monthly returns minus the risk-free rate. CAPM alpha is the intercept of regressions with portfolio excess returns as the dependent variable and market excess returns (MKT) as the independent variable. 3-factor alpha is the intercept of regressions with portfolio excess returns as the dependent variable and MKT, SMB, and HML as independent variables. 4-factor alpha is the intercept of regressions with portfolio excess returns as the dependent variable and MKT, SMB, HML, and UMD as independent variables. T-values are reported in parenthesis, and values are highlighted at the 5% significance level. The "H-L" portfolio is a portfolio going long the high-quality firms, P5, and short the low-quality firms, P1. The alphas and excess returns are in monthly returns. Sharpe ratio is the excess returns divided by the standard deviation of the excess returns and reported in yearly values. Beta is the market loading of the portfolio. The stock prices are in local currencies and well the risk-free rates used are also local.

Table 8: 5 Quality Portfolios for Denmark

Portfolio	P1 (Low)	P2	P3	P4	P5 (High)	H-L
Excess Returns	0.76	**1.04**	**0.75**	**0.86**	**0.89**	0.13
	(1.84)	(2.88)	(2.32)	(2.71)	(2.96)	(0.33)
CAPM alpha	-0.13	0.20	-0.05	0.04	0.19	0.32
	(-0.43)	(0.84)	(-0.25)	(0.23)	(0.96)	(0.83)
3-factor alpha	-0.06	0.12	-0.06	0.03	0.31	0.38
	(-0.21)	(0.53)	(-0.33)	(0.21)	(1.66)	(0.98)
4-factor alpha	0.03	0.11	0.01	0.05	0.27	0.24
	(0.09)	(0.46)	(0.05)	(0.32)	(1.39)	(0.61)
Beta	1.08	1.02	0.97	0.99	0.85	-0.23
Sharpe Ratio	0.35	0.55	0.45	0.52	0.57	0.06

The table presents five portfolios sorted solely on quality scores. The stocks are assigned to five portfolios, where portfolio 1 consists of the lowest quality stocks and portfolio 5 consists of the highest quality stocks. The portfolios are updated and rebalanced monthly using market value weights. Excess returns are monthly returns minus the risk-free rate. CAPM alpha is the intercept of regressions with portfolio excess returns as the dependent variable and market excess returns (MKT) as the independent variable. 3-factor alpha is the intercept of regressions with portfolio excess returns as the dependent variable and MKT, SMB, and HML as independent variables. 4-factor alpha is the intercept of regressions with portfolio excess returns as the dependent variable and MKT, SMB, HML, and UMD as independent variables. T-values are reported in parenthesis, and values are highlighted at the 5% significance level. The "H-L" portfolio is a portfolio going long the high-quality firms, P5, and short the low-quality firms, P1. The alphas and excess returns are in monthly returns. Sharpe ratio is the excess returns divided by the standard deviation of the excess returns and reported in yearly values. Beta is the market loading of the portfolio. The stock prices are in local currencies and well the risk-free rates used are also local.

Table 9: 5 Quality Portfolios for Sweden

Portfolio	P1 (Low)	P2	P3	P4	P5 (High)	H-L
Excess Returns	0.24	**0.73**	**0.99**	**0.93**	**1.08**	**0.84**
	(0.53)	(2.01)	(3.38)	(2.84)	(3.40)	(2.33)
CAPM alpha	**-0.89**	-0.32	0.16	-0.01	0.19	**1.08**
	(-3.05)	(-1.82)	(1.05)	(-0.07)	(1.14)	(3.01)
3-factor alpha	**-0.70**	**-0.35**	0.10	0.06	0.24	**0.94**
	(-2.52)	(-2.12)	(0.71)	(0.39)	(1.54)	(2.75)
4-factor alpha	**-0.62**	-0.26	0.11	0.03	0.24	**0.86**
	(-2.20)	(-1.59)	(0.76)	(0.18)	(1.53)	(2.49)
Beta	1.19	1.10	0.88	1.00	0.93	-0.25
Sharpe Ratio	0.10	0.39	0.65	0.55	0.65	0.45

The table presents five portfolios sorted solely on quality scores. The stocks are assigned to five portfolios, where portfolio 1 consists of the lowest quality stocks and portfolio 5 consists of the highest quality stocks. The portfolios are updated and rebalanced monthly using market value weights. Excess returns are monthly returns minus the risk-free rate. CAPM alpha is the intercept of regressions with portfolio excess returns as the dependent variable and market excess returns (MKT) as the independent variable. 3-factor alpha is the intercept of regressions with portfolio excess returns as the dependent variable and MKT, SMB, and HML as independent variables. 4-factor alpha is the intercept of regressions with portfolio excess returns as the dependent variable and MKT, SMB, HML, and UMD as independent variables. T-values are reported in parenthesis, and values are highlighted at the 5% significance level. The "H-L" portfolio is a portfolio going long the high-quality firms, P5, and short the low-quality firms, P1. The alphas and excess returns are in monthly returns. Sharpe ratio is the excess returns divided by the standard deviation of the excess returns and reported in yearly values. Beta is the market loading of the portfolio. The stock prices are in local currencies and well the risk-free rates used are also local.

Table 10: 5 Quality Portfolios for Finland

Portfolio	P1 (Low)	P2	P3	P4	P5 (High)	H-L
Excess Returns	0.59	**0.99**	**0.84**	0.77	**1.33**	0.74
	(1.47)	(2.79)	(2.27)	(1.88)	(3.30)	(1.89)
CAPM alpha	-0.22	0.22	-0.04	-0.31	0.31	0.53
	(-0.75)	(0.88)	(-0.19)	(-1.59)	(1.42)	(1.36)
3-factor alpha	-0.18	0.24	-0.03	-0.29	0.27	0.45
	(-0.63)	(1.07)	(-0.13)	(-1.50)	(1.40)	(1.29)
4-factor alpha	-0.09	0.19	0.09	-0.34	0.29	0.38
	(-0.30)	(0.83)	(0.40)	(-1.73)	(1.50)	(1.07)
Beta	0.81	0.77	0.88	1.08	1.02	0.21
Sharpe Ratio	0.28	0.54	0.44	0.36	0.63	0.36

The table presents five portfolios sorted solely on quality scores. The stocks are assigned to five portfolios, where portfolio 1 consists of the lowest quality stocks and portfolio 5 consists of the highest quality stocks. The portfolios are updated and rebalanced monthly using market value weights. Excess returns are monthly returns minus the risk-free rate. CAPM alpha is the intercept of regressions with portfolio excess returns as the dependent variable and market excess returns (MKT) as the independent variable. 3-factor alpha is the intercept of regressions with portfolio excess returns as the dependent variable and MKT, SMB, and HML as independent variables. 4-factor alpha is the intercept of regressions with portfolio excess returns as the dependent variable and MKT, SMB, HML, and UMD as independent variables. T-values are reported in parenthesis, and values are highlighted at the 5% significance level. The "H-L" portfolio is a portfolio going long the high-quality firms, P5, and short the low-quality firms, P1. The alphas and excess returns are in monthly returns. Sharpe ratio is the excess returns divided by the standard deviation of the excess returns and reported in yearly values. Beta is the market loading of the portfolio. The stock prices are in local currencies and well the risk-free rates used are also local.

To investigate whether going long high-quality firms and short low-quality firms generate abnormal returns and thus answer research question 4, we construct the QMJ factor introduced by Asness et al. (2013). The QMJ factor goes long "quality" firms and short "junk" stocks by using the intersection of six portfolios sorted on size and quality, as described in the methodology section. We construct the QMJ factor for each country and present the results in table 15. Due to concerns about the sample size and diversification of the portfolios, we construct the QMJ factor with a 50th percentile breakpoint as well. We analyse the performance of QMJ by running regressions on the excess returns while controlling for risk factors to determine if the strategy yields positive abnormal returns. To analyse the relationship between the different sub-components of quality, we also construct portfolios based on the quality subcomponents and estimate the correlation.

The correlation between the QMJ, Profitability, Growth, and Safety portfolios are reported in Tables 11 to 14. All the correlations are positive, indicating that not only is the QMJ correlated with the individual quality sub-components but also the sub-components themselves. This is true despite the sub-components being constructed using different variables.

The positive correlations indicate that profitable firms also typically are growing and safe. This is in line with basic financial theory and intuition. As we showed in the theory section, growth can be calculated using profitability, or return on equity in this particular case, and the reinvestment rate:

$$(24) \quad g = ROE \times b$$

Where b is the reinvestment rate, which is the portion of earnings reinvested back into the firm, and ROE is the return on capital. The fundamental idea is that companies with the ability to allocate capital at a positive rate of return, preferably above the cost of capital to create value, will grow. As this might be true, eventually every firm can end up in a position where all profitable investments have been made. At this point, the firm should pay out nearly all the earnings, which will stagnate growth. The company might still be profitable but unable to grow due to few or no investment opportunities. For this reason alone, firms can be profitable but not growing. This is supported in the correlation matrix for profitability and growth, as the values range from 0.417 to 0.717.

Profitability and safety are positively correlated, ranging from 0.220 to 0.368. Profitable firms have more secure cash flows and a proven business model that generates profits. On the other hand, secure cash flows enable higher leverage to increase the return on equity while also increasing the firm's risk. This can result in profitable firms becoming risky investments, especially for equity investors.

Asness et al. (2013) argue that investors should be willing to pay for the quality sub-components, or firm characteristics, on a standalone basis but that the sub-components are only sometimes connected. Thus, to truly measure quality, the measure must include multiple attractive firm characteristics.

Table 11: Correlation Matrix - Quality Measures - Norway

	QMJ	Profitability	Growth	Safety
QMJ	1			
Profitability	0.820	1		
Growth	0.868	0.717	1	
Safety	0.639	0.368	0.490	1

The table shows the correlations between portfolios sorted on quality (QMJ), profitability, growth, and safety. The portfolios are constructed using the intersection of six portfolios conditionally sorted on first the size of the firm and then the measure. The portfolios go long the firm with high values for the measure and short the firms with a low value for the measure. All portfolios are constructed in the same manner.

Table 12: Correlation Matrix – Quality Measures – Denmark

	QMJ	Profitability	Growth	Safety
QMJ	1			
Profitability	0.723	1		
Growth	0.737	0.417	1	
Safety	0.678	0.326	0.568	1

The table shows the correlations between portfolios sorted on quality (QMJ), profitability, growth, and safety. The portfolios are constructed using the intersection of six portfolios conditionally sorted on first the size of the firm and then the measure. The portfolios go long the firm with high values for the measure and short the firms with a low value for the measure. All portfolios are constructed in the same manner.

Table 13: Correlation Matrix - Quality Measures - Sweden

	QMJ	Profitability	Growth	Safety
QMJ	1			
Profitability	0.813	1		
Growth	0.902	0.713	1	
Safety	0.464	0.220	0.294	1

The table shows the correlations between portfolios sorted on quality (QMJ), profitability, growth, and safety. The portfolios are constructed using the intersection of six portfolios conditionally sorted on first the size of the firm and then the measure. The portfolios go long the firm with high values for the measure and short the firms with a low value for the measure. All portfolios are constructed in the same manner.

Table 14: Correlation Matrix - Quality Measures - Finland

	QMJ	Profitability	Growth	Safety
QMJ	1			
Profitability	0.785	1		
Growth	0.782	0.569	1	
Safety	0.629	0.335	0.416	1

The table shows the correlations between portfolios sorted on quality (QMJ), profitability, growth, and safety. The portfolios are constructed using the intersection of six portfolios conditionally sorted on first the size of the firm and then the measure. The portfolios go long the firm with high values for the measure and short the firms with a low value for the measure. All portfolios are constructed in the same manner.

To evaluate the performance of the QMJ factor we run regressions on the excess returns generated by the strategy. The results from the regressions are reported in table 15. All the QMJ portfolios generate positive excess returns, CAPM alphas, 3-factor alphas, and 4-factor alphas. The coefficients are statistically significant for Norway and Sweden while being insignificant for Denmark and Finland. The size of the excess returns and alphas are considerably lower for Denmark and Finland as well with excess returns of 0.05 and 0.32 percent respectively. For Norway and Sweden, the table shows excess returns of 0.67 and 0.58, and CAPM alphas of 0.95 and 0.78 percent monthly, respectively.

Denmark and Finland are the countries with the lowest sample sizes which results in less diversified portfolios. Specifically, conditional sorting on the 80^{th} percentile of size and then sorting on the 30^{th} and 70^{th} percentiles for quality leaves portfolios with only a few stocks for certain months. To adjust for the small sample size of Denmark and Finland, we construct new portfolios using the 50^{th} percentile size breakpoint. In addition to adjusting for the small sample size in both Denmark and Finland, the new QMJ portfolios can be used to assess the robustness of the original QMJ portfolios reported in table 15. Asness et al. (2013) use the 50^{th} percentile size breakpoint for the US sample and the 80^{th} percentile size breakpoint for the international sample. We do the same analysis on the performance of the 50^{th} percentile size breakpoint QMJ portfolios and report the findings in table 16.

Table 16 shows the excess returns, alphas, and factor loading of the QMJ portfolios by country using the 50^{th} percentile as the size breakpoint. All countries report positive excess return, CAPM alpha, 3-factor alpha, and 4-factor alpha. In addition, with the exception of Finland's 4-factor alpha, all the coefficients are statistically significant, leading us to believe that a certain degree of diversification is required to properly assess an investing strategy like QMJ. Nevertheless, table 16 shows QMJ in Norway generated excess returns, CAPM alpha, 3-factor alpha, and 4-factor alpha of 0.92, 1.21, 1.15, and 1.04 percent monthly respectively. For Denmark, the QMJ delivered excess returns, CAPM alpha, 3-factor alpha, and 4-factor alpha of 0.57, 0.77, 0.74, and 0.63 percent monthly respectively. For Sweden, the QMJ delivered excess returns, CAPM alpha, 3-factor alpha, and 4-factor alpha of 0.58, 0.78, 0.71, and 0.47 percent monthly respectively. Finally, the QMJ for Finland generated excess returns, CAPM alpha, 3-factor alpha, and 4-factor alpha of 0.61, 0.54, 0.47, and 0.37. The QMJ factors generate statistically significant abnormal returns for all countries.

Table 16 also reports the factor loadings of the QMJ portfolios. The QMJ portfolios all have negative market (MKT) loadings except for Finland, which has an insignificant but positive coefficient. Norway, Denmark, and Sweden all have negative market loadings with statistically significant coefficients. The negative market loading indicates that the QMJ portfolios are long low-beta stocks and short high-beta stocks. For size (SMB), all QMJ portfolios except Denmark report negative loadings, meaning the QMJ is long big companies and short small companies. The SMB coefficients can be interpreted as quality companies typically being big companies. For the value (HML), all portfolios show statistically significant negative loadings. The QMJ portfolios are long low book-to-market stocks, so-called growth stocks, and short high book-to-market stocks, so-called value stocks. The negative value loading is natural, as high-quality companies should be priced higher than low-quality companies. HML is long cheap stocks and short expensive stocks, which is not the case for QMJ, which is buying quality firms at a price premium, as explained when examining the price of quality. Thus, negative HML loadings are to be expected.

The momentum (UMD) loadings are all positive and statistically significant. The coefficients can be interpreted as QMJ being long stocks that have performed well in the last year and short stocks that have performed poorly. These results surprise us but might be explained by the accounting data being updated yearly. By this, we suspect that stocks that report financial information above expectations quarterly might experience increases in their stock price before the yearly accounting data is used to construct portfolios in June. The time lag we use to ensure that the accounting data was available during portfolio construction ranges from 6 to 12 months depending on the fiscal year-end. The time lag could lead the UMD to reflect positive stock gains around the time of reporting financials that exceed expectations. An alternative explanation is that high-quality companies typically have high historical stock returns.

The Sharpe ratio for the country QMJ portfolios is 0.60, 0.49, 0.48, and 0.52 for Norway, Denmark, Sweden, and Finland, respectively. The Sharpe ratios are relatively consistent across the countries, which is interesting considering QMJ in Norway generated excess returns of 0.92 percent monthly which is considerably higher than the rest. The high standard deviation leads us to conclude that the QMJ for Norway has been more volatile historically, which we can confirm visually by looking at figure 2. We find the performance across the Nordic countries exciting and decide to continue analysing and decomposing the returns of QMJ. We want to examine why QMJ for Norway differs from the rest.

Table 15: QMJ - Performance across Nordic countries

80^{th} percentile size breakpoint

Country	Norway	Denmark	Sweden	Finland
Portfolio	QMJ	QMJ	QMJ	QMJ
Excess Returns	**0.67**	0.05	**0.58**	0.32
	(2.42)	(0.21)	(2.77)	(1.19)
CAPM alpha	**0.95**	0.23	**0.78**	0.08
	(3.78)	(1.04)	(3.80)	(0.30)
3-factor alpha	**0.93**	0.26	**0.81**	0.11
	(3.97)	(1.19)	(4.15)	(0.50)
4-factor alpha	**0.78**	0.18	**0.59**	0.01
	(3.33)	(0.83)	(3.27)	(0.06)
MKT	**-0.40**	**-0.23**	**-0.21**	**0.24**
	(-8.83)	(-4.99)	(-5.37)	(5.67)
SMB	**-0.25**	0.12	-0.06	**-0.30**
	(-3.38)	(1.55)	(-0.93)	(-3.56)
HML	**-0.37**	**-0.33**	**-0.36**	**-0.50**
	(-7.73)	(-6.85)	(-6.90)	(-10.52)
UMD	**0.29**	**0.20**	**0.26**	**0.12**
	(7.32)	(4.06)	(8.92)	(2.47)
Sharpe Ratio	0.46	0.04	0.53	0.23

The table shows the results from a series of regressions on the monthly excess returns of the QMJ factors across the Nordic countries (excluding Iceland). The Quality-Minus-Junk (QMJ) factor is constructed by using the intersection of six portfolios sorted on size and quality. The portfolios are updated and rebalanced monthly using market value weights. The portfolios are conditionally sorted and first sorted by size, followed by quality. Size is the market value of the firm and quality is the standardized quality score. The size breakpoints we use are the 80^{th} percentile which is the size breakpoints Asness et al. (2013) use for the international sample. The quality breakpoints are the 30^{th} and 70^{th} percentile. The top 30 percent of firms by the quality score are the "quality" firms, and the bottom 30 percent by the quality score are the "junk" firms. The return of the QMJ is the average return of two high-quality portfolios ("quality") minus the average return of two low-quality ("junk") portfolios. The reported alphas are the intercepts of regressions on the excess returns while controlling for the market (MKT), size (SMB), value (HML), and momentum (UMD) factor. The factor loadings, or betas, are reported as MKT, SMB, HML, and UMD. The alphas and excess returns are in monthly returns. T-values are reported in parenthesis, and statistically significant coefficients on the 5% confidence interval are highlighted. The Sharpe ratio is the excess returns divided by the standard deviation of the excess returns, and the values are annualized. The stock prices are in local currencies and well the risk-free rates used are also local.

Table 16: QMJ - Performance across Nordic countries
50th percentile size breakpoint

Country	Norway	Denmark	Sweden	Finland
Portfolio	QMJ	QMJ	QMJ	QMJ
Excess Returns	**0.92**	**0.57**	**0.58**	**0.61**
	(3.15)	(2.57)	(2.49)	(2.73)
CAPM	**1.21**	**0.77**	**0.78**	**0.54**
	(4.54)	(3.57)	(3.37)	(2.40)
3-factor alpha	**1.15**	**0.74**	**0.71**	**0.47**
	(4.64)	(3.44)	(3.31)	(2.38)
4-factor alpha	**1.04**	**0.63**	**0.47**	0.37
	(4.13)	(2.89)	(2.40)	(1.89)
MKT	**-0.41**	**-0.24**	**-0.20**	0.07
	(-8.59)	(-5.55)	(-4.68)	(1.84)
SMB	**-0.26**	0.12	**-0.16**	**-0.31**
	(-3.89)	(1.81)	(-2.68)	(-5.47)
HML	**-0.31**	**-0.16**	**-0.44**	**-0.42**
	(-6.67)	(-3.35)	(-7.33)	(-9.39)
UMD	**0.30**	**0.22**	**0.34**	**0.18**
	(7.18)	(4.64)	(11.18)	(4.39)
Sharpe Ratio	0.60	0.49	0.48	0.52

The table shows the results from a series of regressions on the monthly excess returns of the QMJ factors across the Nordic countries (excluding Iceland). The Quality-Minus-Junk (QMJ) factor is constructed by using the intersection of six portfolios sorted on size and quality. The portfolios are updated and rebalanced monthly using market value weights. The portfolios are conditionally sorted and first sorted by size, followed by quality. Size is the market value of the firm and quality is the standardized quality score. The size breakpoints used are the 50th percentile which is the size breakpoint Asness et al. (2013) use for the US sample. The quality breakpoints are the 30th and 70th percentile. The top 30 percent of firms by the quality score are the “quality” firms, and the bottom 30 percent by the quality score are the “junk” firms. The return of the QMJ is the average return of two high-quality portfolios (“quality”) minus the average return of two low-quality (“junk”) portfolios. The reported alphas are the intercepts of regressions on the excess returns while controlling for the market (MKT), size (SMB), value (HML), and momentum (UMD) factor. The factor loadings, or betas, are reported as MKT, SMB, HML, and UMD. The alphas and excess returns are in monthly returns T-values are reported in parenthesis, and statistically significant coefficients on the 5% confidence interval are highlighted. The Sharpe ratio is the excess returns divided by the standard deviation of the excess returns, and the values are annualized.

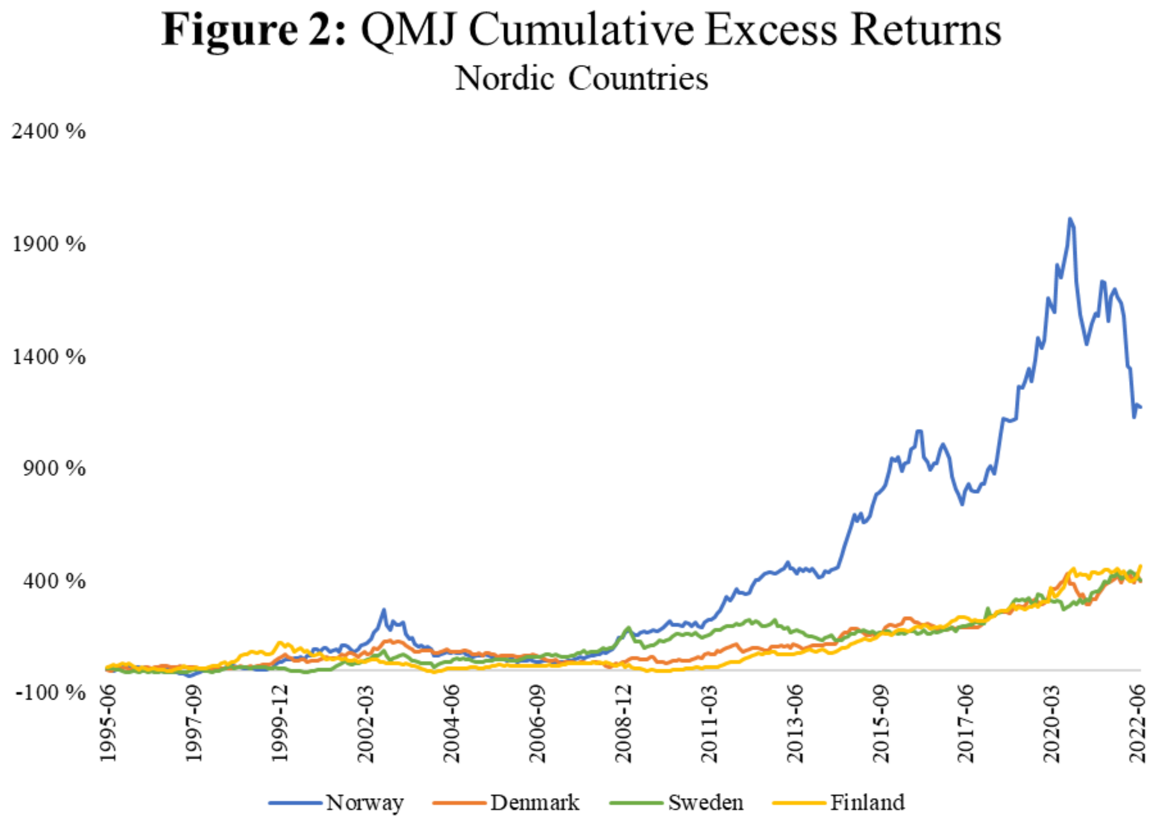

Figure 2: The figure shows the cumulative return of QMJ portfolios for the Nordic countries for the period 1995/06 – 2022/06.

We find the correlation of the QMJ country portfolios and report the results in table 17. We find that all the portfolios are positively correlated within a range of 0.067 to 0.314. Clearly, there are possibilities to get more diversified quality portfolios by combining the QMJ portfolios of the different countries. Considering the potential benefits of diversification, we construct combined QMJ portfolios for the Nordic countries using equal and market-value weights.

Additionally, we decompose the QMJ returns for each country further by splitting the 4-factor alpha into the long, which is small "quality" plus big "quality," and short portfolio, which is small "junk" plus big "junk." Norway and Denmark stand out with 48% and 47%, respectively, of the 4-factor alpha coming from the long portfolio and the remaining 52% and 53% coming from shorting. For Sweden and Finland, 88% and 93% of the 4-factor alpha are generated through going long and 12% and 7% through shorting, respectively. We find these results interesting and a possible explanation for the higher 4-factor alphas generated in Norway and Sweden compared to Denmark and Finland. Table 18 also shows that both the long- and short-side of QMJ contributes positively to the 4-factor alpha of QMJ.

To analyse the QMJ further, we estimate the 4-factor alpha contributions from both the small and the big sides of QMJ. Table 19 shows the results: small quality companies dominate the QMJ 4-factor alpha by 76% to 91%. The results are both surprising and interesting. To conclude, the abnormal returns, in terms of 4-factor alpha, mainly come from going long small high-quality companies and short small low-quality companies. We interpret this as for Sweden and Finland, the abnormal returns of QMJ, in terms of 4-factor alpha, mainly coming from going long small high-quality companies. For Norway and Denmark, we interpret the results as abnormal returns, in terms of 4-factor alpha, coming from both shorting and going long small high-quality companies. In general, both the long, short, small, and big sides generate abnormal returns, but the magnitude of the contributions differs. We are unable to explain why QMJ for Norway differs definitively within our thesis, but we discuss future research possibilities into the QMJ for Norway in section 7.

Table 17: Correlation Matrix - Country QMJ portfolios

	Finland	Denmark	Sweden	Norway
Finland	1			
Denmark	0.133	1		
Sweden	0.188	0.180	1	
Norway	0.067	0.314	0.312	1

The table shows the correlations of the QMJ portfolios by country. The correlations are calculated using monthly excess returns.

Table 18: QMJ Long/Short 4-factor alpha contributions by country

Country	Norway	Denmark	Sweden	Finland
4-factor alpha	100%	100%	100%	100%
Long	48%	47%	88%	93%
Short	52%	53%	12%	7%

The table shows the portions of the 4-factor alpha generated from the short- and long-side of the QMJ portfolio for each country. The long and short portfolios are constructed the same way as QMJ.

Table 19: Small/Big 4-factor Alpha contributions by country

Country	Norway	Denmark	Sweden	Finland
4-factor alpha	100%	100%	100%	100%
Small	87%	91%	76%	83%
Big	13%	9%	24%	17%

The table shows the portion of the 4-factor alpha generated from the small and big sides of the QMJ portfolio for each country. The small and big portfolios are constructed the same way as QMJ.

Further, we construct the equally weighted portfolio (EWP) using the QMJ portfolios for each Nordic country. The country QMJ portfolios are in local currencies and thus we assume a perfect cost-free hedge. The performance of the EWP QMJ is analysed by controlling for risk factors. The results are presented in table 20.

The EWP QMJ generated 0.67%, 0.85%, 0.75%, and 0.58% monthly excess returns, CAPM alpha, 3-factor alpha, and 4-factor alpha, respectively. All the coefficients are monthly and statistically significant at the 5% confidence level. The annual Sharpe ratio is 0.83, considerably higher than for the individual countries. We interpret this as the effect of diversification and that a combined, equally weighted portfolio generates higher risk-adjusted returns. The risk factor loadings are as follows: negative market (MKT), negative size (SMB), negative (HML), and positive momentum (UMD) loadings. All the risk factor loadings are statistically significant. The risk factor loadings can be interpreted as the EWP QMJ being long low-beta, large, expensive, and high-performing stocks.

Figure 3 shows the cumulative return of the equally weighted QMJ portfolio for the Nordic countries.

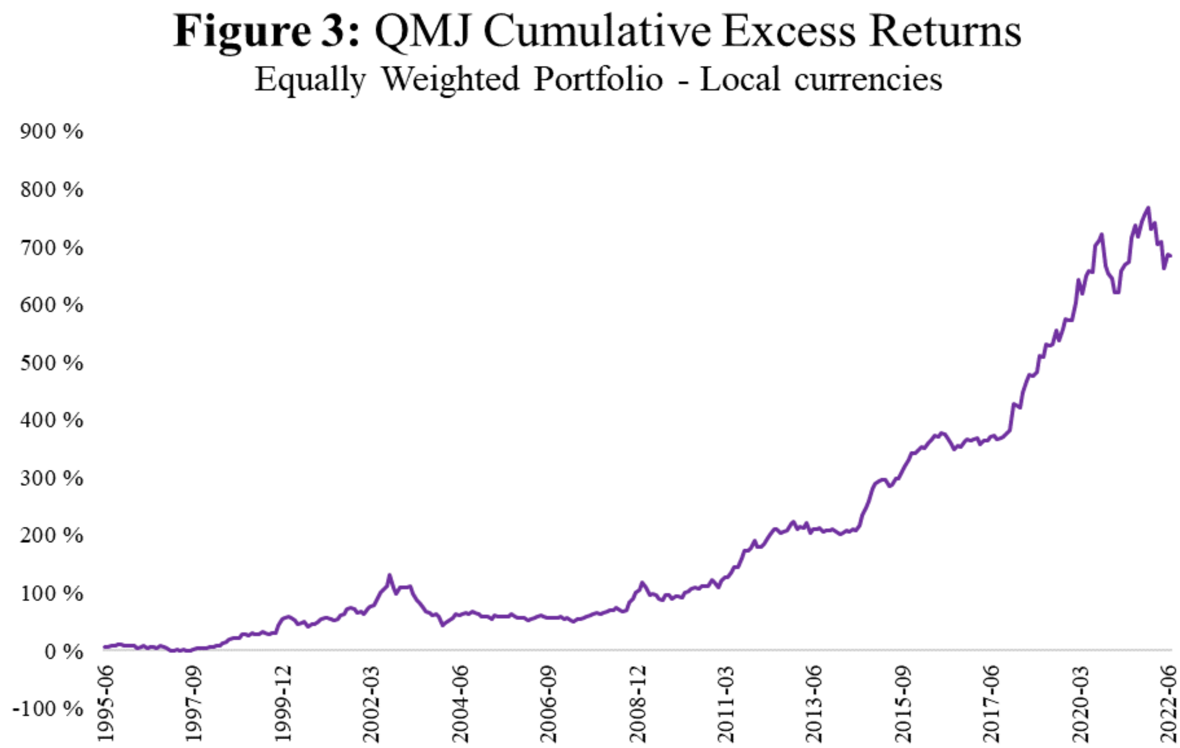

Figure 3: Cumulative return for the equally weighted QMJ portfolio for the Nordics (excluding Iceland) for 1995/06 - 2022/06

Table 20: QMJ Nordics

Region	Nordic countries
Portfolio	EWP - QMJ
Excess Returns	**0.67**
	(4.34)
CAPM alpha	**0.85**
	(5.78)
3-factor alpha	**0.75**
	(5.86)
4-factor alpha	**0.58**
	(4.58)
MKT	**-0.21**
	(-6.83)
SMB	**-0.22**
	(-3.63)
HML	**-0.43**
	(-9.31)
UMD	**0.35**
	(11.01)
Sharpe Ratio	0.83

The table shows the results from a series of regressions on the monthly excess returns of the QMJ factors across the Nordic countries (excluding Iceland). The Quality-Minus-Junk (QMJ) factor is constructed by using the intersection of six portfolios sorted on size and quality. The QMJ portfolios are updated and rebalanced monthly using market value weights. The combined Nordic QMJ is constructed using equal weights and local currencies, which assumes perfect cost-free hedge. The portfolios are conditionally sorted and first sorted by size, followed by quality. Size is the market value of the firm, and quality is the standardized quality score. The size breakpoints used are the 50^{th} percentile which is the size breakpoint Asness et al. (2013) used for the US sample. The quality breakpoints are the 30^{th} and 70^{th} percentile. The top 30 percent of firms by the quality score are the “quality” firms, and the bottom 30 percent by the quality score are the “junk” firms. The return of the QMJ is the average return of two high-quality portfolios (“quality”) minus the average return of two low-quality (“junk”) portfolios. The reported alphas are the intercepts of regressions on the excess returns while controlling for the market (MKT), size (SMB), value (HML), and momentum (UMD) factor. The factor loadings, or betas, are reported as MKT, SMB, HML, and UMD. The alphas and excess returns are in monthly returns. T-values are reported in parenthesis, and statistically significant coefficients on the 5% confidence interval are highlighted. The Sharpe ratio is the excess returns divided by the standard deviation of the excess returns, and the values are annualized.

Finally, we construct the QMJ for the Nordics using market value weights (MVW) and USD as the common currency. Figure 4 shows the cumulative excess return and table 21 shows the analysed performance of the QMJ with market value weights. Again, the QMJ reports significant and positive alphas with beta loadings indicating that QMJ bets on low-beta firms with large size, high value, and with well-performing stocks.

The MVW QMJ generated 0.61%, 0.77%, 0.64%, and 0.46% excess returns, CAPM alpha, 3-factor alpha, and 4-factor alpha, respectively which is somewhat lower than for the EWP QMJ. All the coefficients are monthly and statistically significant at the 5% confidence level. The annual Sharpe ratio is 0.71, still considerably higher than for the individual countries. The risk factor loadings interpretations remain the same as for the EWP QM and are as follows: negative market (MKT), negative size (SMB), negative (HML), and positive momentum (UMD) loadings. All the risk factor loadings are statistically significant. The risk factor loadings can be interpreted as the MVW QMJ being long low-beta, large, expensive, and high-performing stocks.

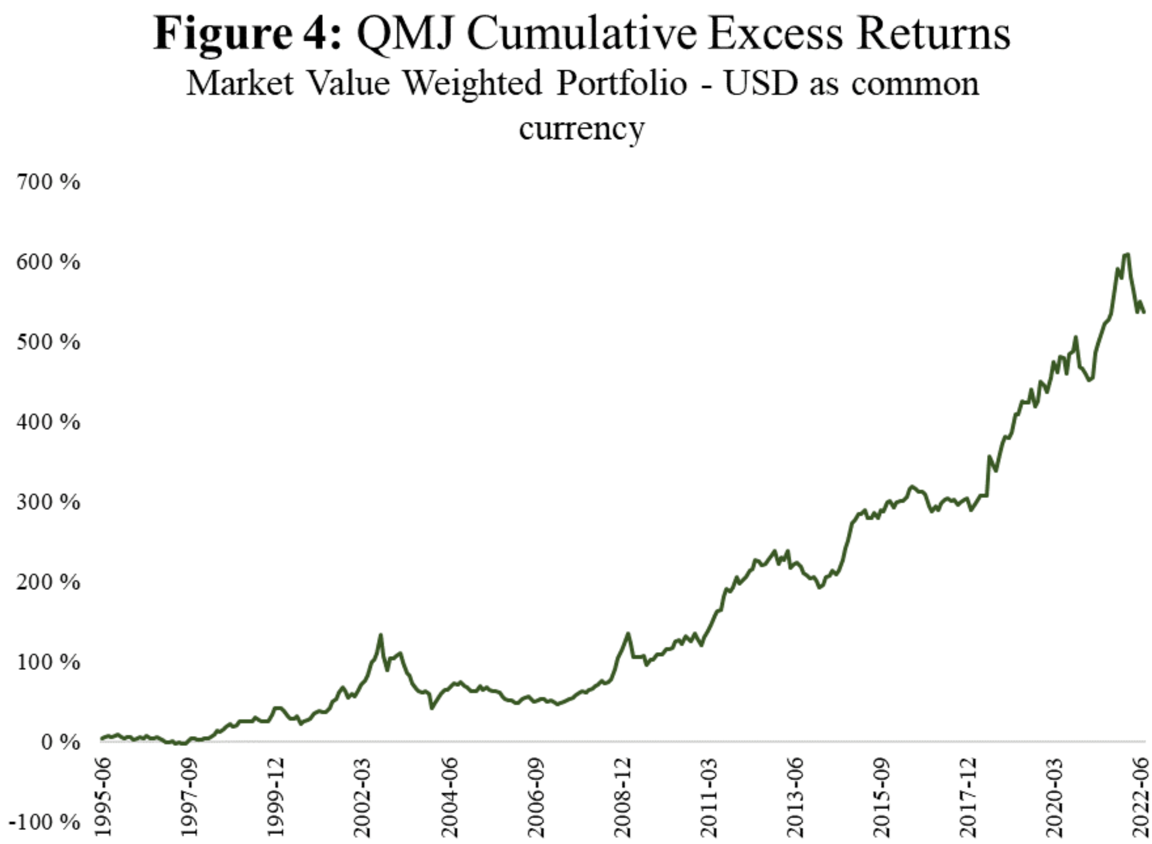

Figure 4: Cumulative return for the market value-weighted QMJ portfolio for the Nordics (excluding Iceland) for 1995/06 - 2022/06 using USD as the common currency.

Table 21: QMJ Nordics

Region	Nordics
Portfolio	QMJ - Market value weights
Common currency	USD
Excess returns	**0.61**
	(3.68)
CAPM alpha	**0.77**
	(4.88)
3-factor alpha	**0.64**
	(4.57)
4-factor alpha	**0.46**
	(3.46)
MKT	**-0.19**
	(-6.77)
SMB	**-0.26**
	(-4.38)
HML	**-0.43**
	(-7.87)
UMD	**0.37**
	(12.44)
Sharpe Ratio	0.71

The table shows the results from a series of regressions on the monthly excess returns of the QMJ factors across the Nordic countries (excluding Iceland). All stock prices have been converted to USD and the risk-free rate is that of the US. The Quality-Minus-Junk (QMJ) factor is constructed by using the intersection of six portfolios sorted on size and quality. The portfolios are updated and rebalanced monthly using market value weights. The combined Nordic QMJ is constructed using market value weights. The portfolios are conditionally sorted and first sorted by size, followed by quality. Size is the market value of the firm, and quality is the standardized quality score. The size breakpoints used are the 50th percentile which is the size breakpoint Asness et al. (2013) used for the US sample. The quality breakpoints are the 30th and 70th percentile. The top 30 percent of firms by the quality score are the "quality" firms, and the bottom 30 percent by the quality score are the "junk" firms. The return of the QMJ is the average return of two high-quality portfolios ("quality") minus the average return of two low-quality ("junk") portfolios. The reported alphas are the intercepts of regressions on the excess returns while controlling for the market (MKT), size (SMB), value (HML), and momentum (UMD) factor. The factor loadings, or betas, are reported as MKT, SMB, HML, and UMD. The alphas and excess returns are in monthly returns. T-values are reported in parenthesis, and statistically significant coefficients on the 5% confidence interval are highlighted. The Sharpe ratio is the excess returns divided by the standard deviation of the excess returns, and the values are annualized.

7. Robustness and further research

Considering the robustness of our findings and analysis, one of our primary motivations behind analysing a region instead of a single country is to test the robustness of the methodology and results. The data preparation and methodology are the same for all countries, preventing data mining for the individual country. Considering data quality and sample size, the period analysed is the longest we could use reliably. Additionally, all the portfolios included in this paper are constructed using the same sample and methodology. This includes the quality portfolios, the quality sub-component portfolios, and the risk factor portfolios. The Nordic countries have limited sample sizes, and some large companies dominate the country's share of total market value. These dominant firms might affect the results depending on what portfolio they are assigned to.

To test whether the chosen period is robust, we split the 27-year period, from 1995/06 to 2022/06, into three separate time periods. The results are shown in Appendix E. Even though the first period with the smallest sample, from 1995/06 to 2004/06, has insignificant 4-factor alpha, we interpret the results as the QMJ consistently generating abnormal returns over the whole period.

Transaction costs are ignored when we analyse QMJ, which is in line with Asness et al. (2013). Nevertheless, transaction costs are most real when implementing an investment strategy. We estimate the annual average turnover to be 117.79% for the QMJ with market value weights. We estimate turnover from both selling and buying, not just one side. Further, the market value-weighted QMJ for the Nordics return 7.32% and 9.24% for yearly excess returns and CAPM alpha, respectively. For the expected returns to be 0%, the total transaction cost would have to be 6.60% and 8.28% for excess returns and CAPM alpha, respectively, assuming an annual average turnover of 117.79%. For the excess returns and CAPM alpha to be statistically insignificant at the 5% confidence level, the transaction cost would have to exceed 3.09% and 4.77% for excess returns and CAPM alpha, respectively, assuming an annual average turnover of 117.79%. To conclude, the transaction costs do not change our interpretation of the QMJ returns.

Future research could further investigate the differences in the QMJ performance between Nordic countries. It is especially interesting to examine why investing in quality in Norway generates higher returns that are more volatile. Norway is a company where oil and gas, or energy, is a dominating industry. Oil and gas are a highly cyclical sector and could thus account for structural differences for Norway compared to the other Nordic countries. Firms with both high operational and financial leverage in a cyclical market could be priced on the optionality of the cyclical market going into a "boom". If these options have expired "out of the money" in our sample period and QMJ was shorting said stocks, then the effect could have generated significant alpha. To test the hypothesis of how cyclical sectors in the country affects the QMJ, a possible test would be to exclude said sectors and see if the differences remain. This was outside the scope of our thesis. Another interesting issue is to investigate long/short and small/big contributions to the QMJ abnormal returns further, as we observe differences. Additionally, Asness et al. (2013) argue that the low explanatory power of the QMJ factor on stock returns could come from the market using other quality definitions. Thus, including better and more accurate quality measures should increase the explanatory power of the QMJ factor.

8. Conclusion

This master thesis examines whether quality investing in Nordic countries is an investment strategy that generates positive abnormal returns. To investigate this question, we follow the methodology and framework introduced by Asness et al. (2013) on "Quality-Minus-Junk" (QMJ). Quality is defined as firm characteristics that investors find attractive and thus are willing to pay a premium for, all else equal. Profitability, growth, and safety are the three quality characteristics combined to assign firms a relative quality score for each period. Having a quantitative value for quality enables us to analyse the price of quality, on average, over the whole period and the price of quality over time. Furthermore, the quality score permits us to construct quality portfolios and evaluate the performance of portfolios going long high-quality stocks and short low-quality stocks.

First, we find that investors are willing to pay a higher price, or premium, for quality, all else equal. High-quality firms trade, on average higher price-to-book ratios than low-quality firms. The price of quality has changed over the period, and there are qualitative arguments for investors flocking to quality around periods of crisis. However, we cannot conclude definitively about the "flight to quality" phenomenon. On the other hand, the explanatory power of quality on the price-to-book ratio is low, and the vast majority of the variation remains unexplained.

Secondly, we construct five quality portfolios based on percentiles on the quality score. We find that high-quality portfolios outperform low-quality portfolios with and without adjustments for risk factors. These findings present a pricing puzzle, as the fundamental financial theory states that higher returns come with higher risk. The notion that high-quality stocks are riskier than low-quality ones is hard to accept, considering safety is a part of the quality measure and low market betas for high-quality portfolios. Alternative explanations include inadequate market efficiency or failure to measure the true risk. Our findings suggest that markets either underestimate "quality" stocks, overestimate "junk" stocks, or both. For the QMJ to be evidence of market inefficiency depends on whether QMJ captures a risk premium. We struggle to find both rational and behavioural explanations supporting the notion that high-quality stocks are inherently more risky than low-quality stocks thus confirming the pricing puzzle.

Lastly, we construct the “Quality-Minus-Junk” (QMJ) factor using the intersection of six portfolios conditionally sorted first on size and then quality. The QMJ factor can provide valuable insight when deconstructing asset returns to evaluate the underlying risk factors. We evaluate the performance of the QMJ across Nordic countries and find that QMJ generates statistically significant positive abnormal returns for all Nordic countries, although with different characteristics. This leads us to the conclusion that quality investing in the Nordics generates positive abnormal returns.

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Appendix

Appendix A: Variable definition

Depreciation = DP

Beta = beta

Book Value of Equity = BE

Equity = EQ

Working Capital = WC = Current Assets – Current Liabilities = act – lct

Change Working Capital = ΔWC = $WC_t - WC_{t-1}$

Debt = Long-Term Debt + Debt in Current Liabilities + Non-Controlling Interest + Preferred Stock

Property and Equipment = P&E

Capital expenditures = CAPEX = $P\&E_t - P\&T_{t-1} + Depr._t$

Consumer Price Index = CPI (2015=100)

Market Value = ME

Total Revenue = REV

Total Assets = TA

Net Income = NI

Cost of Goods Sold = COGS

Gross Profit = GP = REV – COGS

Cash Flow = CF = NI + Depr. – ΔWC - CAPEX

Appendix B: Variables calculations

Profitability:

$$(24)\ \ GPOA = \frac{Gross\ profit}{Total\ Assets} = \frac{GP}{TA}$$

$$(25)\ \ ROE = \frac{Net\ Income}{Book\ Value\ of\ Equity} = \frac{NI}{BE}$$

$$(26)\ \ ROA = \frac{Net\ Income}{Total\ Assets} = \frac{NI}{TA}$$

$$(27)\ \ CFOA = \frac{Cash\ Flow}{Total\ Assets} = \frac{CF}{TA}$$

$$(28)\ \ GMAR = \frac{Gross\ Profit}{Total\ Revenue} = \frac{GP}{REV}$$

$$(29)\ \ ACC = \frac{DP - \Delta WC}{AT}$$

Growth:

$$(30)\ \ \Delta GPOA_t = \frac{GP_t - GP_{t-5}}{TA_{t-5}}$$

$$(31)\ \ \Delta ROE_t = \frac{NI_t - NI_{t-5}}{BE_{t-5}}$$

$$(32)\ \ \Delta ROA_t = \frac{NI_t - NI_{t-5}}{TA_{t-5}}$$

$$(33)\ \ \Delta CFOA_t = \frac{CF_t - CF_{t-5}}{TA_{t-5}}$$

$$(34)\ \ \Delta GMAR = \frac{GP_t - GP_{t-5}}{REV_{t-5}}$$

Safety:

$$(35)\ Beta = \beta_i = \rho_{i,m} \times \frac{\sigma_i}{\sigma_m}$$

Where $\rho_{i,m}$ is the correlation between the stock i and the market m using 3-day returns over 5 years. The standard deviation of the stock i and the market m, σ_i and σ_m, is calculated using 1-day returns over 1 year.

$$(36)\ Leverage = LEV = \frac{Debt}{Total\ Assets} = \frac{Debt}{TA}$$

$$(37)\ Ohlsons'O\ score = -(-1.32 \times 0.407 \times \log\left(\frac{ADJA}{CPI}\right) + 6.03 \times TLTA - 1.42 \times WCTA + 0.076 \times CLCA - 1.72 \times OENEG - 2.37 \times NITA - 1.83 \times FUTL + 0.285 \times INTWO - 0.521 \times CHIN$$

Where

$$(38)\ ADJA = Adjusted\ Assets = TA + 0.1 \times (ME - BE)$$

$$(39)\ TLTA = \frac{Debt}{ADJA}$$

$$(40)\ WCTA = \frac{Current\ Assets - Current\ Liabilities}{ADJA}$$

$$(41)\ CLCA = \frac{Current\ Liabilities}{Current\ Assets}$$

$$(42)\ OENEG = Dummy\ that\ is\ 1\ if\ Total\ Liabilities > Total\ Assets$$

$$(43)\ NITA = \frac{Net\ Income}{Total\ Assets} = \frac{NI}{TA}$$

$$(44)\ FUTL = \frac{Pre\ Tax\ Income}{Debt}$$

$$(45)\ INTWO = Dummy\ that\ is\ 1\ if\ Net\ Income\ is\ negative\ for\ year\ 1\ and\ t-1$$

$$(46)\ CHIN = \frac{NI_t - NI_{t-1}}{|NI_t| - |NI_{t-1}|}$$

$$(47)\ Altman\ Z\ score = (1.2 \times WC + 1.4 \times RE + 3.3 \times EBIT \times 0.6 \times ME + 1 \times REV)/TA$$

$$(48)\ EVOL = Standard\ of\ ROE\ for\ the\ last\ 5\ years$$

Where:

RE = Retained Earnings (from Balance Sheet)

EBIT = Earnings Before Interest and Tax

$$(48)\ EVOL = Yearly\ Standard\ Deviation\ of\ ROE\ last\ 5\ years$$

Table 22 shows the detailed variable preparation. The method can be replicated using the same data sources with the same data variable codes.

Table 22: Detailed variable description

Variable	Description
Revenue	REV, if unavailable we proxy with SALE.
Cost of goods sold	COGS, if unavailable XOPR – XSGA (Operating expenses – Cost SG&A), if unavailable REV – EBITDA + XSGA
Gross profit	Revenue – Cost of goods sold
Total assets	AT
Total liabilities	DLTT + DLC + MIBT + PSTK, or LT
Preferred stock	PSTKR, PSTKN, and PSTK based on availability. Due to missing data, we set it to 0 if all are unavailable
Book value of equity	SEQ – PSTK, CEQ, and AT – LT – MIBT based on availability
Net income	NICON, CSHOI (Outstanding shares) * EPSINCON (Consolidated EPS), EBIT – XINT (Interest expenses) – TXT (Tax expenses), and IB (Net income before extraordinary items). Based on availability. IB as a proxy for net income affects a marginal part of the sample
Working capital	WCAP, and ACT – LCT based on availability. It seems like WCAP is calculated using ACT and LCT, so ACT – LCT as proxy saves marginal data.
Depreciation	DEPR, and EBITDA – EBIT based on availability.
Capital expenditures	CAPX, and PPENT – lag(PPENT) + depreciation. PPENT is the Property and Equipment. We take the current PPENT minus the PPENT for the last period and add the depreciation as a proxy for capital expenditures.
Cash flow	CF as described above, or OANCF (Operational cash flow) + INVCF (Cash flow from investing activities).
Minority interest	MIBT, if unavailable set to 0 due to data quality.
Book value of debt	DLC + DLTT

This table shows the detailed variable calculations and prioritization of different data variables.

Appendix C: Variable statistics

Table 23: Additional variable statistics

	n	Median	25th perc.	75th perc.
Profitability				
GPOA	26,461	16.2%	5.3%	36.5%
ROE	28,030	6.5%	-10.8%	16.2%
ROA	28,035	1.6%	-5.4%	6.3%
CFOA	22,546	1.0%	-11.6%	7.6%
GMAR	25,377	32.9%	13.6%	59.4%
ACC	22,505	3.6%	-3.4%	11.1%
Growth				
ΔGPOA	16,116	6.8%	-2.6%	32.7%
ΔROE	17,154	4.5%	-12.8%	24.5%
ΔROA	17,463	1.2%	-5.4%	9.3%
ΔCFOA	13,833	-65.4%	-166.2%	101.4%
ΔGMAR	15,986	12.0%	-4.3%	53.1%
Safety				
BAB (Beta)	22,264	0.667	0.381	0.967
LEV	28,033	23.1%	5.3%	44.2%
O-score	17,236	1.396	-0.486	2.993
Z-score	18,124	1.622	0.597	2.496
EVOL	19,215	9.6%	4.4%	25.0%

The table shows additional, more detailed variable statistics. Due to the QMJ construction being based on the relative performance of this bundle of variables, the absolute values are less informative on a standalone basis. Nevertheless, the table reports median and quartile values for each variable. *n* is the number of total observations for each variable.

Table 23: Descriptive statistics quality and quality sub-components

	n	Average	Min.	Max.	25th perc.	75th perc.
Quality	26,972	0	-3.295	3.681	-0.699	0.700
Profitability	28,091	0	-2.831	3.406	-0.693	0.725
Growth	17,465	0	-2.458	2.646	-0.751	0.736
Safety	28,057	0	-3.061	4.087	-0.663	0.562

The table shows descriptive statistics for the quality score and the quality sub-components. All the values are standardized values, or z-scores, and thus provide insight into the relative performance of the individual firm. The table reports median and quartile values for each variable. *n* is the number of total observations for each variable.

Appendix D: Sample size graph

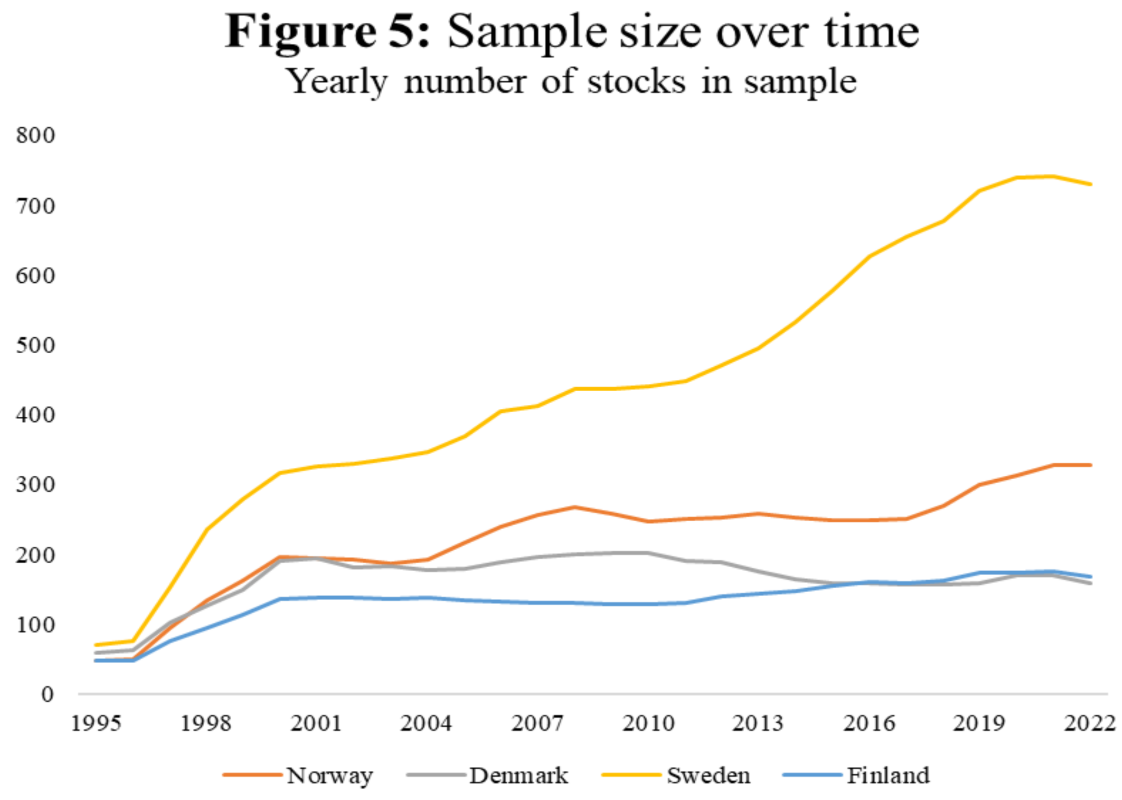

Figure 5: The graph shows the yearly whole sample for each country for 1995 - 2022

Appendix E: Robustness over time

Table 24: Robustness over three periods - QMJ Nordics

Region	Nordics	Nordics	Nordics
Portfolio	EWP - QMJ	EWP - QMJ	EWP - QMJ
Period	1995/06-2004/06	2004/07-2013/06	2013/07-2022/06
Excess returns	0.49	**0.65**	**0.88**
	(1.54)	(2.70)	(3.63)
CAPM alpha	**0.63**	**0.84**	**1.05**
	(2.04)	(4.18)	(4.22)
3-factor alpha	**0.65**	**0.52**	**1.03**
	(2.28)	(3.10)	(4.96)
4-factor alpha	0.43	**0.53**	**0.58**
	(1.61)	(3.11)	(2.65)
MKT	**-0.18**	**-0.26**	**-0.15**
	(-3.06)	(-7.07)	(-2.25)
SMB	**-0.36**	-0.03	**-0.26**
	(-3.39)	(-0.39)	(-2.27)
HML	**-0.32**	**-0.53**	**-0.45**
	(-3.15)	(-8.53)	(-6.34)
UMD	**0.34**	**0.29**	**0.45**
	(6.64)	(5.06)	(7.31)
Sharpe ratio	0.51	0.96	1.30

The table shows the results from a series of regressions on the monthly excess returns of the QMJ factors across the Nordic countries (excluding Iceland). The 27-year period, from 1996/06 to 2022/06, is split into three 9-year periods to test the robustness of the results. The Quality-Minus-Junk (QMJ) factor is constructed by using the intersection of six portfolios sorted on size and quality. The portfolios are updated and rebalanced monthly using market value weights. The portfolios are conditionally sorted and first sorted by size, followed by quality. Size is the market value of the firm and quality is the standardized quality score. The size breakpoints we use are the 50th percentile which is the size breakpoint Asness et al. (2013) use for the US sample. The quality breakpoints are the 30th and 70th percentile. The top 30 percent of firms by the quality score are the "quality" firms, and the bottom 30 percent by the quality score are the "junk" firms. The return of the QMJ is the average return of two high-quality portfolios ("quality") minus the average return of two low-quality ("junk") portfolios. The equally weighted QMJ is the QMJ for the Nordics using equal weights, local currencies, and local risk-free rates. The reported alphas are the intercepts of regressions on the excess returns while controlling for the market (MKT), size (SMB), value (HML), and momentum (UMD) factor. The factor loadings, or betas, are reported as MKT, SMB, HML, and UMD. The alphas and excess returns are in monthly returns. T-values are reported in parenthesis, and statistically significant coefficients on the 5% confidence interval are highlighted. The Sharpe ratio is the excess returns divided by the standard deviation of the excess returns, and the values are annualized.

Appendix F: Yearly turnover

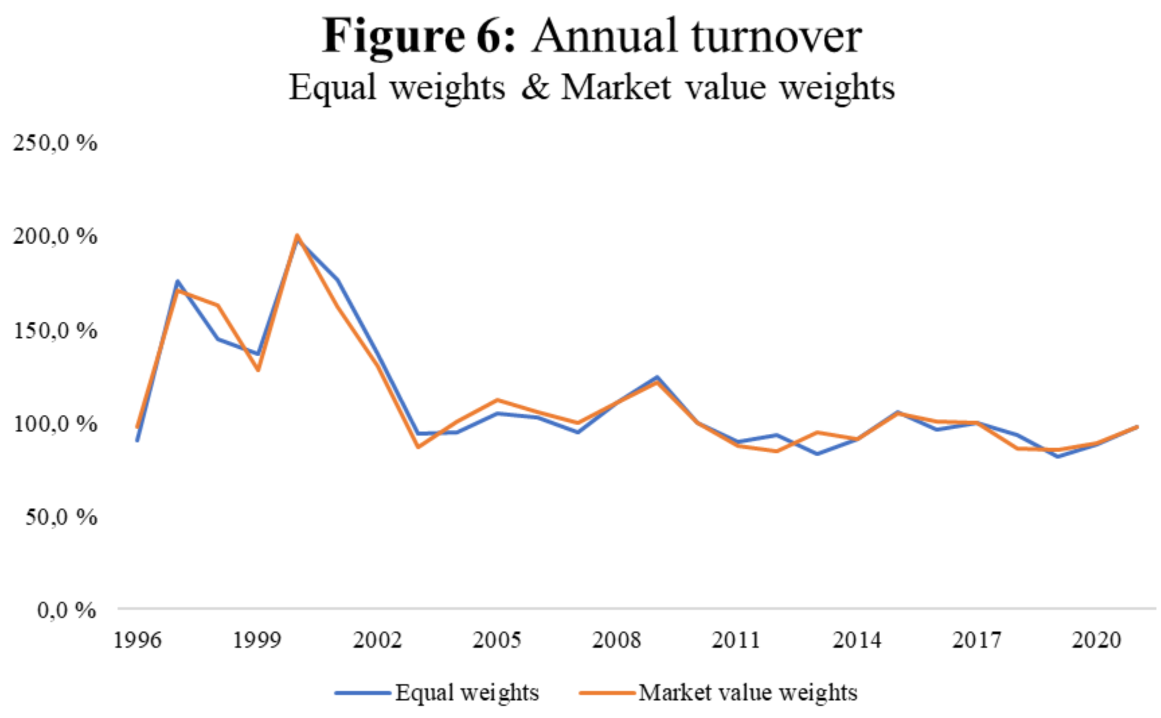

Figure 6: The figure shows the yearly turnover of both the market value-weighted and equally weighted QMJ for the Nordics for the period 1996 - 2021