

TALLINN UNIVERSITY OF TECHNOLOGY

School of Business and Governance

Department of Economics and Finance

Anton Savolainen

**PERFORMANCE EVALUATION OF FUNDAMENTAL
INDEXATION ON THE FINNISH STOCK MARKET**

Bachelor's thesis

International Business Administration, Finance and Accounting

Supervisor: Associate Professor, PhD, Karin Jõeveer

Tallinn 2018

I declare that I have compiled the paper independently.

All works, important standpoints and data by other authors have been properly referenced and the same paper has not been previously presented for grading.

The document length is 10,356 words from the introduction to the end of the summary.

Author: Anton Savolainen

(signature, date)

Student's code: 156127

Student's e-mail address: anton.savolainen@hotmail.com

Supervisor: Associate Professor, PhD, Karin Jõeveer

(signature, date)

Chairman of the Defence Committee: asdasdad

Permitted to the defence

(name, signature, date)

TABLE OF CONTENTS

ABSTRACT.....	3
INTRODUCTION.....	4
1. LITERATURE REVIEW	7
1.1. Indices and index weighting schemes.....	7
1.2. Theoretical background of indexation	10
1.3. Passive portfolio strategies.....	11
1.4. Fundamental indexation.....	12
1.5. Earlier studies of fundamental indexation.....	14
2. METHODOLOGY	17
2.1. Data.....	17
2.2. Index construction.....	17
2.3. Formulas for measuring the performance	20
2.4. Market condition and risk factor analysis	22
3. RESULTS	24
3.1. Performance of the fundamental indices.....	24
3.1.1. Period by period analysis.....	27
3.1.2. Market condition analysis.....	28
3.1.2. Risk factor analysis	29
3.2. Discussion of the results obtained	31
3.3. Limitations of the research and suggestions for future research	33
CONCLUSION	34
REFERENCES.....	36

ABSTRACT

This bachelor's thesis examines the performance of fundamental indexation on the Finnish stock market (Nasdaq Helsinki). Fundamental indexation is an index weighting method based on fundamental factors of companies such as book value, dividends and revenue. The assumption is that fundamental factors offer a better estimation of stocks' fair value than market capitalization. Previous studies of fundamental indexation on different stock markets have shown that fundamental indexation provides superior performance compared to the commonly used capitalization-weighted indexation. The aim of this research is to evaluate the performance of fundamental indexation on the Finnish stock market and analyze if it outperforms the capitalization-weighted indexing. Fundamental factors used in the research are book value, employees, cash flow, dividends, EBITDA and revenue. In addition, a composite index combining cash flow, dividends, EBITDA and revenue is constructed. The research covers years 2005-2018, a period which contains multiple declining and rising markets. The results show that every fundamental index, except the one weighted with cash flow, provide both higher absolute returns, 1.12% on average, and risk-adjusted returns compared to the capitalization-weighted reference index. However, no excess return is statistically significant. Regarding different market conditions, fundamental indices are able to provide significant excess returns when the market is rising but not during a decline. In addition, conducted Fama-French Three Factor Model analysis provides evidence that the overall outperformance of fundamental indices can be attributed to the market, value and size factors.

Key words: fundamental indexation, alternative weighting schemes, performance evaluation, stock market indices, the Finnish stock market

INTRODUCTION

Passive investing has become extremely popular among investors, and the market share of passive funds has grown rapidly during the last few years. Passive investing is usually executed by investing in index funds which offer an effective way to invest in a chosen market, sector or industry. It also offers a relatively easy way to have a broad diversification in one's investment portfolio. Most of the passive funds are tracking indices that are weighted by constituents' market capitalization. Capitalization-weighting means that the higher the capitalization of an underlying asset in the index is, the more it drives the overall value of the index. According to many different modern portfolio theories, such as the Capital Asset Pricing Model (CAPM), capitalization-weighted market portfolio should be the mean–variance optimal. This means that an average investor should not be able to get excess returns compared to holding the market portfolio. However, alternative weighting scheme called fundamental indexation has been proven to outperform capitalization-weighted market portfolios. Fundamental indexation weights index's constituents index based on companies' fundamentals, such as book value, cash flow and dividends. Fundamental factors are said to offer a better estimation of assets' fair value whereas capitalization-weighted indices overweight overpriced assets and underweight undervalued assets. Fundamental indexation is already a common and widespread weighting method but less known in Finland. There are no fundamental indices available for the Finnish stock market and no relevant research has been conducted.

The aim of this research is to evaluate the performance of fundamental indexation and analyze if it outperforms capitalization-weighted indexing on the Finnish stock market. The research also examines the risk characteristics, performance in different market conditions and risk factor exposures of the fundamental indices. In addition, the author discloses the theoretical background of index investing and fundamental indexation. The following research questions are used to examine fundamental indexation:

- 1) Does fundamental indexation offer excess returns compared to capitalization-weighted indexing on the Finnish stock market?

- 2) What are the return and risk characteristics of the fundamental indices?
- 3) How does fundamental indexation perform in different market conditions?
- 4) What are the risk factor exposures of the fundamental indices?

The research contributes to the field of research of fundamental indexation using the whole universe of companies that are listed on the Finnish stock market (Nasdaq Helsinki). The total amount equals to 126 companies. The research period covers a period of 01.03.2005-28.02.2018 which is 13 years in total and includes both multiple rising (bull) and declining (bear) markets. This time period can be considered long enough to receive definite results and suitable for testing the performance of the fundamental indices in different market conditions. The fundamentals of the companies are used to generate the fundamental indices. Six different fundamentals are used to generate the indices: book value, full-time employees, cash flow, total cash dividends paid, EBITDA and revenue. The fundamental indices are then compared to the capitalization-weighted reference index. In addition, a composite index combining four different fundamentals, cash flow, dividends, EBITDA and revenue, is constructed. The performance of the fundamental indices is evaluated using different measures, for example geometric average return and Sharpe ratio. Also, the performance in different market conditions and exposures to commonly known risk factors are examined.

In addition to the empirical evidence and quantitative analysis, a research method called literature review is used to discuss the theoretical background of indexation and fundamental indices. Literature review as a research method helps to develop theoretical and conceptual frameworks, discover the gaps in understanding and identify relevant concepts, methods and facts (Ghauri, Grønhaug 2005, 52). Academic studies, journals, articles, books, investment companies' and stock exchange's materials are used as relevant references. To get access to the previously mentioned sources, library of Tallinn University of Technology and PRIMO: TTÜ e-resources portal are used.

First chapter covers the topic of indices, index weighting, theories behind indexation, passive portfolio management and fundamental indexation. It also discusses the earlier studies of fundamental indexation. Second chapter provides all the necessary information about the methodology, data, construction of the indices, formulas, market condition analysis and risk factor exposure analysis used for evaluating the performance of the fundamental indices Third chapter

presents the results of this research along with discussion of the results and limitations of the research. It also provides suggestions and advise for further research. In the end, there is a conclusion which summarizes the research's main results and findings.

The author would also like to thank a few people by name for the support and help they provided during the studies and the writing process of this thesis. Firstly, Associate Professor Karin Jõeveer, the supervisor of this bachelor's thesis, for her support and help during the whole writing process. Secondly, Jesper Hietanen, a co-student and a friend, who has been the right hand of the author throughout the studies. Thirdly, Reea Harjumäki, the woman behind author's great success in studies and life in general. Finally, author's family for their immeasurable support both mentally and financially throughout the studies and rest of the co-students and friends with whom the author has had the privilege and a great joy to study at Tallinn University of Technology.

1. LITERATURE REVIEW

1.1. Indices and index weighting schemes

An index is a group of securities chosen to track a particular investment theme such as a market, asset class, sector or industry (FTSE Russell 2018). Comparing the value of an index to its starting value tells how the index has performed over time. The reason for widely spread usage of indices in the financial markets is simply representation. Comparing different assets to the performance of different market indices gives market participants an idea how well the particular asset has performed compared to the market. Also, indices can be compared to other indices in order to see how different markets have performed in general. Markets and, in most cases, individual sectors of a market, such as small-cap stocks, can include thousands of securities. Market indices allow market participants to follow the trends and performance without having to track the entire available universe of securities. For the majority of market participants, following all of this would be too complicated, time-consuming and inefficient (Ibid.). This is where indices come in as useful tools for investors following the markets.

There are many indices generated for various different purposes and they do not always have to provide return or price information of different securities. For example, frequently quoted CBOE Volatility Index (VIX) formulates an expectation of stock market volatility in the near future. Widely and most commonly used indices for different assets are (Wealth Management Systems Inc. 2015):

- IBC's Money Fund Report Averages (money market funds),
- Barclays Aggregate Bond Index (bond funds),
- 10-Year U.S. Treasury Bond (treasury bond funds),
- Standard & Poor's Composite Index of 500 Stocks (large-cap stocks),
- Nasdaq Composite Index (certain technology and sector funds),
- Morgan Stanley Capital International's Europe, Australasia, Far East (EAFE) Index (international funds),
- Russell 2000 Index (small-cap stocks).

Index weighting schemes can be divided to three different approaches: capitalization-weighting, equal weighting and fundamental weighting (see Figure 1).

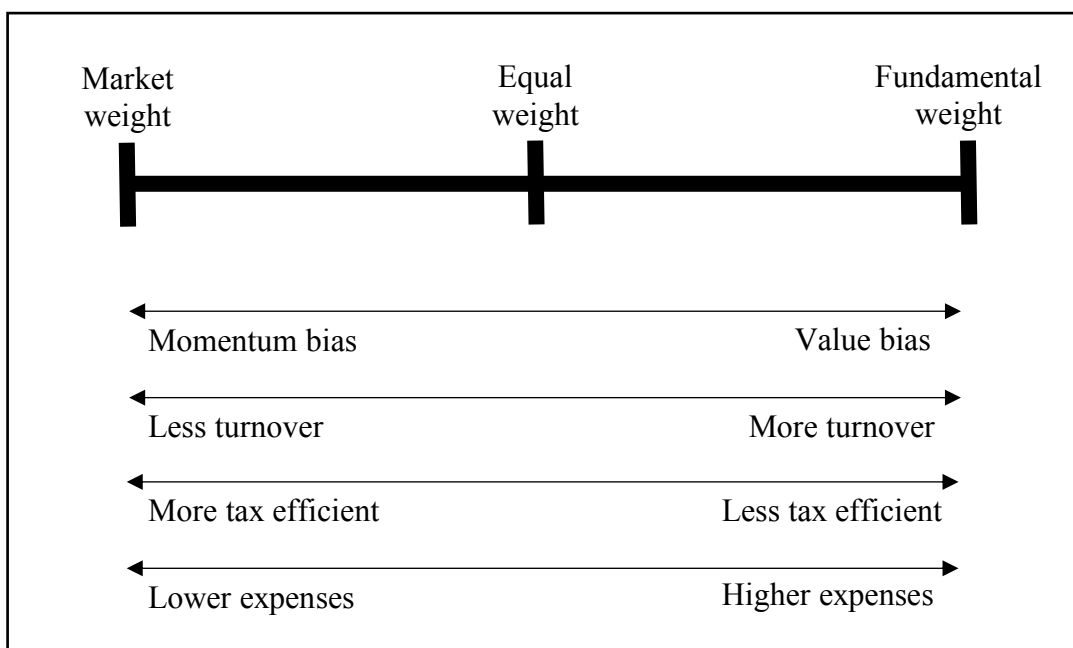


Figure 1. Three approaches to indexing
Source: Shaw (2008)

Capitalization-weighting is the most common and most used method of index weighting. For example, commonly known and widely used S&P 500 and Euro Stoxx 50 -indices are capitalization-weighted. This weighting scheme means that the constituents of the index are weighted in the proportion that their free-float market capitalization has to the sum of free-float market capitalization of all the constituents underlying in the index (Shaw 2008). Companies with high market capitalization account for a greater portion of the stock index. For example, if company's market capitalization is \$40,000,000 and the sum of all companies' market capitalization is \$100,000,000, this single company would be worth 40% of the index at that moment. The advantage of using market capitalization as an index weighting method is that it reflects the actual behaviour of the market (FTSE Russell 2018). It is also a self-rebalancing methodology because, if company's share price or outstanding amount of shares changes, the proportions of stocks in the index change accordingly. This leads to low turnover and low costs when maintaining capitalization-weighted portfolio. However, capitalization-weighting leads to momentum bias which means that the method systematically overweights overvalued stocks and underweights undervalued stocks (Shaw 2008). Figure 2 shows a graphical representation of the previously mentioned situation.

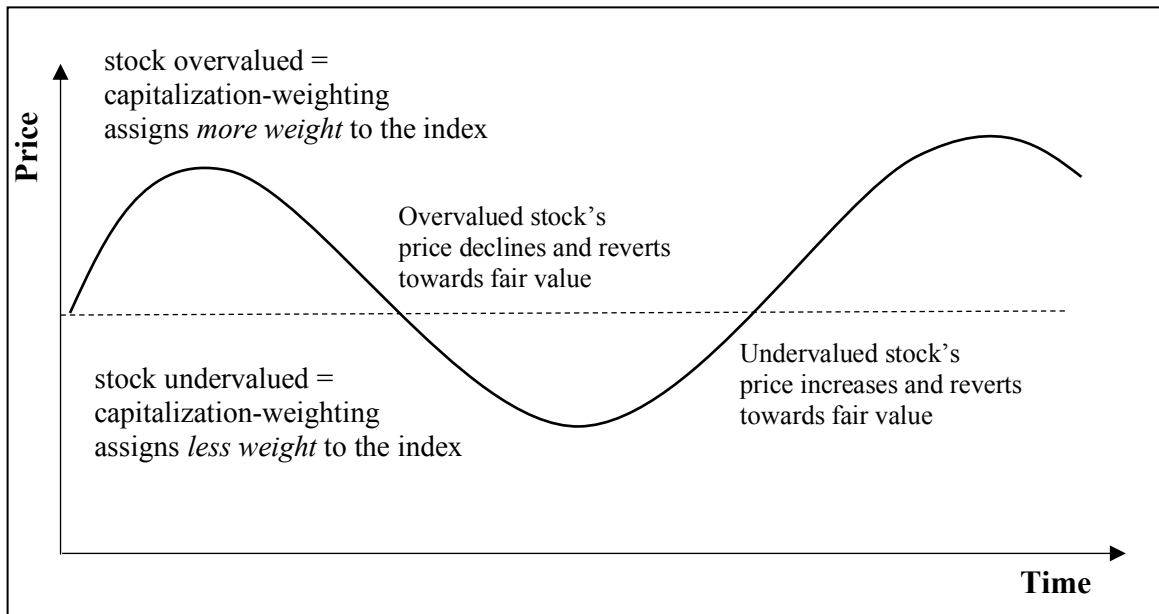


Figure 2. Graphical representation of the concept of capitalization-weighting
Source: Shaw (2008)

Equal weighting is an alternative for capitalization-weighting but it is less used weighting method. This weighting scheme is very simple: each constituent of the index is represented in equal weights and each constituent contributes equally to the index's performance. This alternative method removes the systematic overweighting and underweighting features of the market cap approach. It is neither momentum nor value biased (Shaw 2008). The negative aspect of it is the fact that it leads to higher turnover and therefore lower tax efficiency, higher expenses and typically higher volatility due to the greater role of small-cap stocks (Ibid.). There are only a few commonly known indices on the market that are equally weighted. The S&P 500 Equal Weight -index is an example of an equally weighted index.

Fundamental weighting is a weighting method based on the fundamental factors of companies such as book value, dividends and cash flow. The assumption is that fundamental factors offer a better estimation of a company's fair value than market capitalization (FTSE Russell 2018). In addition, it could possibly prevent participation in bubbles and subsequent crashes, especially to those that are driven by extremely high stock valuations. Fundamental weighting has the same downsides that the previously mentioned equal weighting has. It leads to higher costs compared to the capitalization-weighting because of the higher turnover and it is also value biased. (Shaw 2008). An example of fundamental index is the FTSE RAFI US 1000 -index which is based on the largest 1,000 fundamentally ranked companies on the US market (FTSE Russell 2018). It uses

dividends, book value, sales and cash flow as fundamental factors. Fundamental indexation as a weighting method is discussed more thoroughly in chapter 1.4.

1.2. Theoretical background of indexation

Capitalization-weighted indexing is considered to form an optimal mean-variance portfolio. This portfolio can also be called as the market portfolio. It is based on many financial theories along with the belief that no active strategy is capable of outperforming the mean-variance portfolio. The origin of equity indices come from Markowitz's (1952) findings. Mathematically constructing the mean-variance portfolio, which took into account explicit views on expected return and risk of every stock, he derived a portfolio of stocks that maximized diversification possibilities and minimized the variance (Ibid.). Kaplan (2014) argues that today's capitalization-weighted indices are still based on a technique similar to Markowitz's.

The Capital Asset Pricing Model (CAPM) was the next advancement towards the creation of indices available nowadays. The model was developed by Sharpe (1964) and Lintner (1965) who published their studies related to asset pricing. The CAPM is an economic model which explains stock returns as a function of market return (Blanco 2014, 61). More precisely, it calculates asset's rate of return based on its built-in risk and rates of risk free and market returns. It extended the limited possibilities of Markowitz's portfolio, by leaving out explicit expectations and introducing a factor called systematic risk. The CAPM also included short selling as a possibility which is closer to today's set of investment possibilities. It can be considered as the foundation of capitalization-weighted indexing (Kaplan 2014). In the 1960s, many researchers understood that, if investors create mean-variance portfolios using the same components and expectations, they should end up with the same market portfolio. Investors are only rewarded with a return dependent on an asset's systematic risk, beta (β), which cannot be diversified away (Ibid.). The relationship between return and volatility is what makes the indexation strategies work the way they do. Eugene Fama, with Kenneth French, have been trying to improve the CAPM and invent more advanced and better asset-pricing models. For example, Fama and French (1993) created the Three Factor Model which added size and value to stock valuation. They have later extended it to the Five Factor Model which added company's profitability and investment measures to the factors (Fama, French 2015).

The Efficient Market Hypothesis (EMH) proposed by Fama (1970) asserts that public information gets reflected in the prices without a delay and securities' current prices reflect all the available information. This gave a rationale of investing in market indices and made investors believe that obtaining information would not generate excess returns. The hypothesis implies that passive capitalization-weighted indexing develops the market portfolio and adjusts itself efficiently to all information available for market equilibrium. Any active strategy should not be able to outperform it because prices reflect all the available information immediately. However, Reilly and Brown claim that the overall evidence on capital market efficiency is best described as mixed; some studies support the efficient market hypothesis and others do not (2012, 140).

1.3. Passive portfolio strategies

Passive portfolio strategies can be viewed as the opposite to active strategies. Generally, passive strategies are based on the belief that it is difficult or even impossible to gain extraordinary returns in the market and outperform the market. The reason for this is often explained by the theories of the mean-variance portfolio, the Capital Asset Pricing Model and the Efficient Market Hypothesis (see chapter 1.2.). Passive strategies are content to reflect the market or market sectors as a whole. Thus, the fund is not dependent on the manager making the right decisions or spending too much resources on the market research and trading the holdings.

Often passive strategy is referring to the index tracking strategy. Index tracking has a simple and precise objective to match a specific index or market. It does not try to instead of trying to outperform the market. Indexing does not offer the ability to outperform a benchmark, but, because of its substantially lower expenses, the strategy has outperformed many active managers over time (Philips *et al.* 2014, 13). The popularity of mutual funds and Exchange-Traded Funds (ETFs) based on indices during the recent years is partly attributable to the fact that many actively managed mutual funds have had difficulties outperforming the market. When transaction costs and higher fees, which are related to active fund management, are taken into account, the task is even more difficult. This makes the trend of money flowing to passive funds easier to explain. In Europe during 2017, passive funds enjoyed higher growth rates than actively managed funds which has been the trend during the last few years (Masarwah 2018). The combined inflows to open-end index funds and exchange-traded funds reached an organic growth rate of 14.7% While actively managed funds took higher inflows in absolute terms, it only amounted to a growth rate of 8.5%

which is significantly lower growth rate compared to the passive funds. Passive funds increased their market share from 15.2% in 2016 to 16.0% when the year 2017 ended (Ibid.).

Most of the passive funds are tracking indices that are capitalization-weighted. Efficient market hypothesis (EMH) asserts that public information gets reflected in the prices without a delay. Current prices of securities should reflect all the available information about the security (Malkiel 2011, 4-6). If the market really is efficient, opportunities for extraordinary risk-adjusted gains should not simply persist which makes the capitalization-weighted index an optimal market portfolio. However, empirical evidence from different markets shows that the capitalization-weighted portfolio is not optimal. Hsu (2006) showed that, if the stock prices are inefficient in the sense that they do not fully reflect firm fundamentals, capitalization-weighted portfolios are only sub-optimal. Arnott *et al.* (2005) demonstrated in their article that investors can do much better than just holding capitalization-weighted market indices. Also, Haugen and Baker (1991) argued that the markets are not efficient. They concluded that matching the market is an inefficient investment strategy and also proved that even if all investors would be rational and the capital market informationally efficient, investing in capitalization-weighted portfolios is inefficient and portfolios with lower volatility exist in the market. They stated that four assumptions must hold for capitalization-weighted portfolios to be efficient (Ibid.):

- 1) All investors must have the same expectations of risk and return for every stock;
- 2) Short-selling is available for all investors and for each security;
- 3) The income from investment returns is not taxed;
- 4) All alternative investments should be included in the efficient portfolio.

Haugen and Baker (1991) also showed that none of these assumptions hold in the financial markets. Instead, they found evidence that there existed portfolios providing larger or the same return but with lower volatility compared to the capitalization-weighted portfolio. More empirical evidence about beating of the capitalization-weighted portfolio is provided in chapter 1.5. which covers earlier studies of fundamental indexation on different markets.

1.4. Fundamental indexation

Fundamental indexation is sometimes referred to as alternative beta, strategy beta or smart beta strategies because they provide broad-based market exposure (Davidow 2014, 4). Fundamental indexation weights the index constituents based on fundamental factors such as revenue, cash flow

and dividends rather than only providing the biggest weights to the largest companies. Basically, any fundamentals of companies can be used. Fundamentally weighted index screens securities in a way that is similar to many actively managed mutual funds and ETFs. However, fundamental indexation follows a strict rule-based discipline and rebalances the index at predetermined intervals. This removes the emotions and human errors that hurt often managers of active funds (Ibid., 4). Capitalization-weighted indices instead are different compared to fundamental indices in a way of adjusting portfolio weights only when securities are added or deleted from the index. The price changes of individual stocks change the capitalization-weighted index's value and weights accordingly.

Fundamental strategies represent an evolutionary step in indexing. They are moving beyond traditional capitalization-weighting by applying logic and intelligence to the index construction (Davidow 2014, 5). While fundamental and capitalization-weighted indices may begin with the same basket of suitable and available securities, the difference in construction can lead to dramatically different results. Fundamental indices are able to capture the positive attributes of both traditional passive strategies and active strategies. Their unique construction process may provide investment opportunities different from those of capitalization-weighted counterparts. The following findings can be attributed to fundamental indexation (Ibid.):

- Weighting securities based on economic factors, rather than merely on market cap, leads to a more sophisticated allocation of capital;
- Fundamentally weighted index strategies have delivered better risk-adjusted returns than their market-cap equivalents since inception;
- Fundamentally weighted index strategies have been able to outperform many actively managed mutual funds.

Fundamental indexation is said to be based on a new paradigm in which market prices of stocks deviate from their fair value. This new paradigm is called the noisy market hypothesis (Kaplan 2008, 32). It contrasts the Efficient Market Hypothesis by claiming that the prices of securities are not always the best estimate of the true underlying value. Treynor (2005) showed that prices are noisy and do not fully reflect firm fundamentals which is why the traditional capitalization-weighting schemes are quite probably only sub-optimal. Indices weighted with fundamentals represent the fair market values better than capitalization-weighted indices. By re-weighting capitalization-weighted indices by certain fundamental values, it is possible to produce consistently higher returns and higher risk-adjusted returns (Hemminki, Puttonen 2008).

1.5. Earlier studies of fundamental indexation

A number of studies have shown that fundamental indexation is able to provide significantly higher returns than indices based on capitalization-weighting. Table 1 summarizes some of the most notable studies of fundamental indexation performed on different universes.

Table 1. Summary of previous studies of fundamental indexation on different universes

Authors	Arnott, Hsu, Moore (2005)	Hemminki, Puttonen (2008)	Clare, Motson, Thomas (2013)	Basu, Forbes (2014)	Pelys, Lenickaite (2016)
Period	1962 - 2004	1996 - 2006	1969 - 2011	1985 - 2010	2003 - 2015
Universe (index)	US (S&P 500)	Europe (DJ Euro Stoxx 50)	US	Australia	Central and Eastern Europe
Fundamentals	book value, cash flow, revenue, gross sales, gross dividends, employment, composite	book value, cash flow, sales, dividends, employment, composite	book value, cash flow, dividend, sales, composite	book value, sales, operating income, dividends, net pay-out, employees	book value, cash flow, revenue, dividends, composite
Average excess return over cap-weighted reference	2.15%	1.73%	1.55%	4.28%	3.24%
Average volatility vs reference	15.17% vs 15.20%	23.80% vs 24.00%	15.40% vs 15.30%	15.73% vs 16.72%	23.13% vs 22.16%
Average Sharpe ratio vs reference	0.44 vs 0.30	0.55 vs 0.48	0.41 vs 0.32	0.46 vs 0.19	0.35 vs 0.22
Best fundamental (return)	gross sales	dividends	sales	sales	revenue
Best fundamental (Sharpe ratio)	cash flow	dividends	sales, dividends	sales	revenue

Source: Arnott *et al.* (2005), Hemminki and Puttonen (2008), Basu and Forbes (2013), Clare *et al.* (2013), Pelys and Lenickaite (2016), compiled by the author

Arnott *et al.* (2005) provided evidence of the long-term performance of fundamental indexation. This was the first noticed work on the strategy of fundamental indexation and has been the foundation for later research. They used data of the 1,000 largest US companies over a 43-year research period from 1962 to 2004 to create six different fundamental indices. They found that the fundamental indices outperformed the capitalization-weighted S&P 500 -index 1.97% on average.

The best performing index by absolute return was the index constructed with gross sales. Measuring the performance with Sharpe ratio, the index constructed with cash flow as a fundamental factor was the best performing index. They also generated a composite index in which each of the fundamentals were included in equal shares. The composite index produced an average annual return of 12.47% compared to an average annual return of 10.53% of the S&P 500 -index over the same period. The volatility of the fundamental composite index was slightly lower than the volatility of the S&P 500 -index, 14.7% compared to 15.1%. If 1\$ had been invested in a fundamental composite index in 1962, it would have grown to 156.54\$ by the year 2005 but investing in the S&P500 -index would have made up only 73.98\$.

Research conducted by Clare *et al.* (2013) showed that even randomly constructed portfolios outperformed, also in risk-adjusted terms, the reference index constructed on the basis of the market capitalization on the US market during 1969-2011. They stated that the superior risk-adjusted performance cannot be attributed only to luck. Research by Hsu (2008) and Treynor (2005) showed that it is possible to outperform the standard capitalization-weighted indices, if only the portfolio is weighted with a non-price factor. They argue that fundamental indexation works well because of the noisiness of the markets. The noisier the market, the better is the performance of fundamental indexation. Hsu and Campollo (2006) published an article which stated the problem of stock undervaluation and overvaluation. They reported that capitalization-weighted portfolios can be outperformed by portfolios that are weighted on fundamentals.

Research of fundamental indexation on the European market is conducted by, for example, Hemminki and Puttonen (2008). They weighted the indices using book value, employees, sales, cash flow and dividends. As many others, they also generated a composite index. Their findings suggest that, by re-weighting capitalization-weighted market index by certain fundamental values, it is possible to produce consistently higher returns and higher risk-adjusted returns. Some of these fundamental portfolios produce consistent and significant benefits compared to the capitalization-weighted portfolio. They also tested the transaction costs impact on the results obtained but found that there was no effect regarding the excess returns. Houwer and Plantinga (2009) expanded the research by Hemminki and Puttonen and re-weighted the DJ Stoxx 600 -index constituents by different fundamental measures. The results showed that, during the period of 1993-2007, the excess returns of fundamental indices were 2.4% higher on average compared to the DJ Stoxx 600 -index. Furthermore, Pelys and Lenickaite (2016) examined fundamental indexation on Central and Eastern European markets. They created fundamental indices using net revenue, cash flow,

dividends and equity. The findings showed that almost all fundamental indices significantly outperformed the capitalization-weighted reference index, except the ones weighted with dividends. Transaction costs did not have a significant impact on the generated excess returns.

Basu and Forbes (2014) tested whether fundamental indexation outperforms capitalization-weighted indices on the Australian market. They weighted the fundamental indices by the following fundamentals: sales, book value, operating income, dividends, net pay-out and number of employees. Their findings are in line with other previous research and proved that fundamental indices outperform the capitalization-weighted ones. The outperformance persisted even after adjusting for slightly higher transaction costs related to higher turnover of the fundamental indices.

2. METHODOLOGY

2.1. Data

The research was performed using data of public companies traded on the Finnish stock market. More precisely, the stock had to be listed on Nasdaq Helsinki in March 2018, when all of the data was obtained, in order to be included in the universe. The total number of companies included was 126. The data was obtained using Thomson Reuters Datastream. Companies that were delisted during the research period of 2005-2018 were excluded because their fundamental data was not possible to obtain.

The data set included annual data of six different fundamentals: book value, full-time employees, cash flow, total cash dividends paid, EBITDA and revenue. The data was annual data and taken from the last day of each year. The data covered years 2002-2017 for the fundamentals of cash flow, dividends, EBITDA and revenue. Fundamentals using the latest single-year data as a data measure covered the years 2004-2017. Market capitalization data of the companies covered the years 2004-2017 and it was used to generate the capitalization-weighted index (hereafter, the *Reference* -index) for referencing purposes. Monthly closing prices of the stocks were obtained in order to calculate the returns throughout the research period of 01.03.2005-28.02.2018. In other words, the research period covered 13 years (156 months). This period can be considered long enough in order to receive definite and significant results. In addition, the period includes both economic growth and decline phases which allows testing of the performance in different market conditions.

2.2. Index construction

A back-testing method was used to find out the hypothetical returns of the fundamental indices and the capitalization-weighted reference index. To evaluate the performance of fundamental indices on the Finnish stock market, indices based on fundamental weighting were constructed and

back tested over the period of 01.03.2005-28.02.2018. The fundamentals and data measures were chosen in accordance with Arnott *et al.* (2005):

- book value (*Book*),
- full-time employees (*Employees*),
- trailing three-year average cash flow (*Cash Flow*),
- trailing three-year average total cash dividends paid (*Dividends*),
- trailing three-year average EBITDA (*EBITDA*),
- trailing three-year average revenue (*Revenue*).

Trailing three-year average was used when constructing the *Cash flow*, *Dividends*, *EBITDA* and *Revenue* -indices. This means that the index's weights, for example for the year 2010, were done according to an average of the fundamental values from years 2007, 2008 and 2009. The trailing three-year average aims to reduce the portfolio turnover and smoothen the volatility in the index weights which would result from using single-year data. A five-year trailing average was used by Arnott *et al.* (2005) but, for example, Pelys and Lenickaite (2016) showed that using three-year trailing average does not lead to different results compared to the five-year trailing average. The *Book* and *Employees* -indices were constructed using single-year data in order to account for the recent and major changes in the companies, such as mergers and acquisitions. For example, the weighting of these indices in 2010 was done according to the fundamental values of the last day in 2009. The *Reference* -index was also constructed based on the single-year data.

Two indices were constructed for each individual fundamental measure. The first index included 30 stocks and the second index included 10 stocks. This was done to find out if the number of companies affects the performance of the fundamental indices. All 126 stocks were ranked based on their fundamental value each year from largest to smallest. After that the top 30 and top 10 companies were assigned with the weights in accordance to their size:

(1)

$$W_{it} = FV_{it} / \sum_{i=1}^n FV_{it}$$

where

W_{it} – weight of the stock in the fundamental index on date t

MV_{it} – value of the fundamental of stock i on date t

Σ – “sum of”

The capitalization-weighted *Reference* -index was generated using the same principles as the fundamental indices but using market capitalization for weighting:

(2)

$$W_{it} = MV_{it} / \sum_{i=1}^n MV_{it}$$

where

W_{it} – weight of the stock in the reference index on date t

MV_{it} – market value of company i on date t

Σ – “sum of”

Table 2 shows the correlation of monthly returns between the *Reference* -index and the two most commonly used market indices on the Finnish stock market. OMXH25 consists of 25 most-traded stocks on the market and OMXHGI is an all-share gross index represents the overall state and changes in OMX Helsinki (Nasdaq OMX 2018). It is worth mentioning that OMXH25 is a cap restricted index which means that the weight of a single stock cannot exceed 10% of the index’s total market value. This could be the reason why the *Reference* -index is more similar to OMXHGI than OMXH25 when looking at the correlation of the monthly returns. Both the *Reference* -index and OMXHGI are not cap restricted. Generally, the *Reference* -index’s correlation with the most common market indices of the Finnish stock market is very strong which makes the *Reference* -index a valid benchmark for the fundamental indices examined in this research.

Table 2. Correlation of the monthly returns between the *Reference* -index (30 stocks) and OMXHGI and OMXH25 -indices

	Reference	OMXHGI	OMXH25
Reference	1		
OMXHGI	0.969	1	
OMXH25	0.945	0.958	1

Source: Compiled based on author’s calculations

A single composite fundamental index (hereafter, the *Composite* -index) was also constructed. The *Composite* -index was constructed using an average of four different fundamentals: cash flow, dividends, EBITDA and revenue. Arnott and West (2006) stated that the composite index is superior to individual indexing because it reduces the biasness that each individual fundamental index contains. For example, sales related fundamentals are often biased towards several sectors,

such as service and financial sectors (Ibid.). In addition, dividends exclude many companies that simply do not pay dividends. Using a composite measure and trailing three-year average reduces this kind of biasness.

All indices, both the fundamental indices and the *Reference* -index, were constructed on an annual basis on the first trading day of March. They were held for 12 months and then rebalanced. In addition, the constituents' weights were held constant inside the index throughout the year for the reason of comparability. Rebalancing was made 13 times including the initial weighting in March 2005. The reason for rebalancing at the beginning of March is the fact that the companies on the Finnish stock market publish their annual reports during January and February. Thus, the same indices could have been generated based using the same principles in the past and calculation of the indices can be continued in the future without making any changes to the principles. Moreover, rebalancing in March avoids the usage of lagged data as the most recent data is used as soon as it is available.

2.3. Formulas for measuring the performance

To calculate the annual average returns, geometric average was used. It accurately reflects the compounded investment returns, especially when the investment is highly volatile. The geometric average is the most appropriate for series that indicate serial correlation which is the case with investment portfolios. Annual average returns of the fundamental indices are represented in Table 3, 4, 5, 6 and 7.

Geometric average return: (3)

$$\bar{R}_i = \sqrt[n]{(1 + R_1) \times (1 + R_2) \times \dots \times (1 + R_n)} - 1$$

where

- R – return of an asset
- n – number of the period(s)

Standard deviation of the returns was used as a measurement of volatility. It is one of the key fundamental risk measures that is widely used in the financial markets. The higher the volatility, the riskier the security is. Divisor of $n-1$ was used to get an unbiased estimate of the variance. The annual volatility was derived from the monthly volatility. Volatility of the fundamental indices is represented in Table 3, 4, 6 and 7.

Standard deviation:

(4)

$$\sigma = \sqrt{\frac{\sum_{i=1}^n (x_i - \bar{x})^2}{n - 1}}$$

where

- σ – standard deviation
- \sum – “sum of”
- x – each value in the data set
- \bar{x} – mean of all values in the data set
- n – number of values in data set

Sharpe ratio is a way to examine the performance of an investment by adjusting it for the risk. The ratio measures the excess return or risk premium per unit of deviation in an investment asset or a trading strategy, typically referred to as risk (Sharpe 1966). Finnish 10-year government bond was used as a risk-free rate when calculating the Sharpe ratio for each index. Sharpe ratios of the fundamental indices are represented in Table 3 and Table 4.

Sharpe ratio:

(5)

$$S = \frac{\bar{R}_p - R_f}{\sigma_p}$$

where

- \bar{R}_p – expected return of the portfolio
- R_f – risk-free rate
- σ_p – standard deviation of portfolio returns

Tracking error is a measurement of the quality of the replication and shows how closely the portfolio follows the benchmark index. The higher the value of the tracking error, the less the portfolio follows the benchmark. It is defined as the standard deviation of the difference between the portfolio's and benchmark index's returns. Tracking errors of the fundamental indices are represented in Table 3 and Table 4.

Tracking error:

(6)

$$TE = \sqrt{\frac{\sum_{i=1}^n (R_p - R_b)^2}{n - 1}}$$

where

- Σ – “sum of”
- R_p – return of the portfolio
- R_b – return of the benchmark index
- n – number of values in data set

2.4. Market condition and risk factor analysis

The performance of the fundamental indices compared to the capitalization-weighted *Reference* -index was also evaluated in different market conditions. The results were tested both on rising (bull) and declining (bear) stock markets (Table 6 and Table 7). The market was considered to be in a bull market when the capitalization-weighted *Reference* -index gained at least 15 percent from the previous low and in a bear market when the decline was at least 15 percent from the previous high. Basu and Forbes (2014) showed in their research that the fundamental indices outperformed the capitalization-weighted indices in bear markets but the outperformance was either small or non-existent in bull markets. This can be considered as a good benchmark for this research.

More precise analysis of the performance of the fundamental indices is important because they promise to provide superior performance compared to the capitalization-weighted indices. In order to analyze the indices' characteristics and sources of excess returns, the Capital Asset Pricing Model and Fama-French Three Factor Model were used in this research. The CAPM asserts that the expected return of a security is explained by the risk-free rate and total risk premium. The total risk premium is attained by multiplying equity risk premium with beta. Beta and is a market movement measure and reflects the market risk. Market portfolio's beta is equal to one, riskier assets have beta higher than one and less risky asset lower than one. The *Reference* -index was used as a market portfolio in the regression. The CAPM regression analysis is represented in Table 8.

Beta of the portfolio:

(7)

$$\beta_p = \frac{Cov(R_p, R_m)}{Var(R_m)}$$

where

- Cov – covariance of the portfolio and market
- Var – variance of the market

Capital Asset Pricing Model (CAPM):

(8)

$$\bar{R}_p = R_f + \beta_p(\bar{R}_m - R_f)$$

where

\bar{R}_p – expected portfolio return

\bar{R}_m – expected market return

R_f – risk-free rate

β_p – beta of the portfolio

Although the CAPM remains as a benchmark model of risk and return, discontentment of the empirical performance has led to improvements and alternative models. Fama and French (1993) proposed that systematic returns were comprised of two additional factors: value and size. Many researchers before them had found that small cap stocks tended to outperform large cap stocks even though the identifiable market risk in the small cap stocks was lower than was evident in the large cap stocks (Clare *et al.* 2013). They concluded that there seemed to be a risk premium that could be earned from investing in small cap stocks that was independent. Fama and French (1993) suggested that book-to-market value was also an additional systematic risk factor. They argued that there is a risk premium that could be earned from passive exposure to stocks with a high book-to-market value. European monthly returns of SMB and HML -factors for the Fama French Three Factor Model analysis were obtained from French's website (2018). As a market risk premium, the author used the *Reference* -index adjusted with the risk-free rate. European factors were used instead of country specific ones because the author could not find the specific factors for Finland. However, the Finnish market correlates strongly with the European market. Finland is also one of the markets included in the European factors calculated by French. The results of the Fama-French Three Factor Model regression are represented in Table 9.

Fama-French Three Factor Model:

(9)

$$R_p - R_f = \alpha + \beta_1(R_m - R_f) + \beta_2SMB + \beta_3HML + \varepsilon$$

where

R_p – portfolio return

R_m – market return

R_f – risk-free rate

α – the average abnormal returns, Jensen's alpha

HML – difference in monthly returns between value stocks and growth stocks

SMB – difference in monthly returns between small versus big stocks

ε – error term

3. RESULTS

3.1. Performance of the fundamental indices

Table 3 shows the most important characteristics of the performance of the fundamental indices (consisting of 30 stocks). The ending value of the initial investment is calculated using 100€ as the initial amount invested. This illustrates what would have been investment's value at the end of February 2018 if one would have invested in these indices at the beginning of March 2005 (see Figure 3). Annual volatility shows the risk assigned to every index which is derived from the monthly standard deviation. Sharpe ratio provides a way to examine the risk-adjusted performance. Tracking error measures the replication and shows how closely each fundamental index follows the *Reference* -index. Excess return is calculated by subtracting the *Reference* -index's annual average from the fundamental index's one. T-statistics indicates the statistical significance of excess returns. More precise information about these previously mentioned measures is provided in chapter 2.3.

Table 3. Performance of the fundamental indices (30 stocks), 2005-2018

	Ending value of 100€	Annual average (%)	Volatility (%)	Sharpe ratio	Tracking error (%)	Excess return (%)	t-statistics of excess return
Book	168.59€	4.10%	18.97%	0.183	6.55%	1.32%	0.87
Employees	157.98€	3.58%	19.87%	0.148	7.54%	0.80%	0.50
Cash flow	137.65€	2.49%	18.06%	0.103	3.70%	-0.29%	-0.20
Dividends	177.69€	4.52%	18.48%	0.210	5.80%	1.74%	1.17
EBITDA	157.70€	3.47%	19.35%	0.151	5.90%	0.78%	0.51
Revenue	181.66€	4.70%	20.40%	0.199	6.80%	1.92%	1.17
Composite	174.59€	4.38%	19.82%	0.189	5.86%	1.60%	1.01
Reference							
Market cap	142.88€	2.78%	18.07%	0.119	-	-	-

Source: Compiled based on author's calculations

(***, ** and * indicate the statistical significance of excess return at one, five and ten percent levels respectively.)

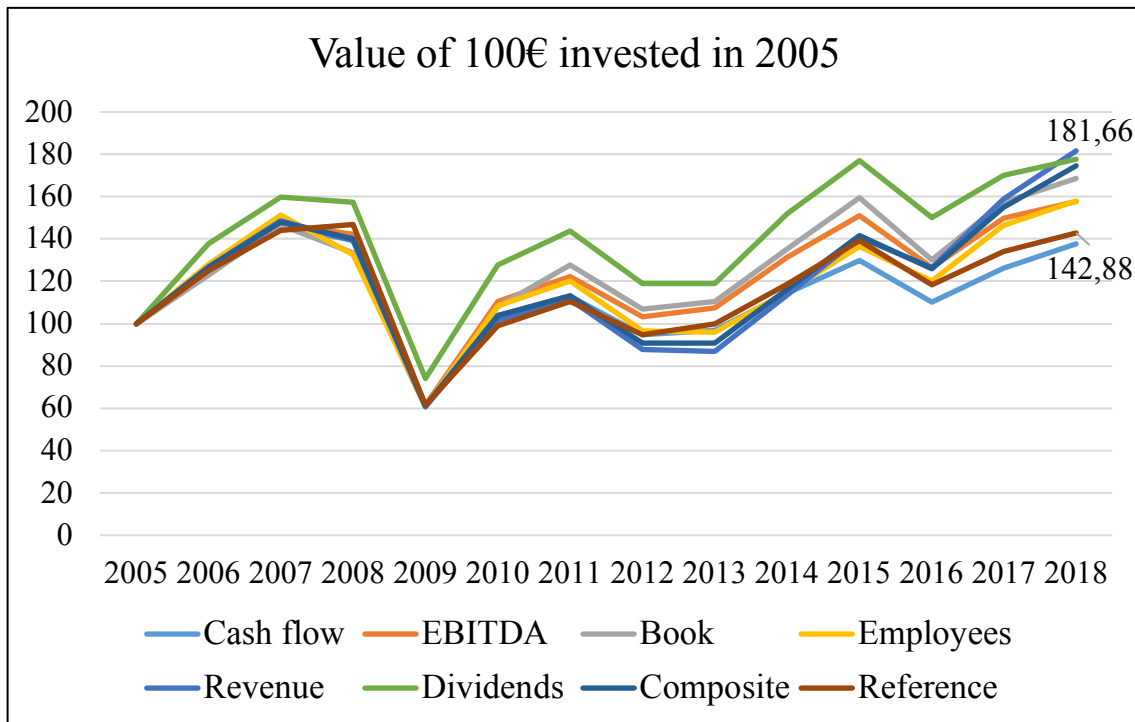


Figure 3. Value of 100€ invested in March 2005 (30 stocks)
Source: Compiled based on author's calculations

Seen in Table 3, every fundamental index, except the *Cash flow* -index, provide a higher average return than the capitalization-weighted *Reference* -index. The average excess return of all fundamental indices is 1.12% and the range of the positive excess returns is between 0.80% and 1.92%. The *Book*, *Dividends*, *Revenue* and *Composite* -indices all have excess returns over one percent. However, no excess return is statistically significant. The best performing index is the *Revenue* -index with an annual average return of 4.70%. If 100€ would have been invested in that index in March 2005, the investment would have had the ending value of 181.66€ at the end of February in 2018 (Figure 3). This is approximately 27% higher amount than the ending value if the investment would have been made to the capitalization-weighted *Reference* -index. The worst performing index is the *Cash flow* -index which yields only 2.49% on average. When looking at risk-adjusted performance, the best performing index is the *Dividends* -index (Sharpe ratio of 0.210 vs 0.199 of the *Revenue* -index's). This is due to the fact that the volatility of the *Dividends* -index is considerably lower compared to the *Revenue* -index. The results show that the volatility of the *Reference* -index is lower compared to the volatility of fundamental indices, except compared to the *Cash flow* -index. The *Revenue* -index carries the highest risk in terms of volatility but it also provides the highest return as mentioned above. The Sharpe ratio is always a positive number which means there is no index that would yield lower average return than the risk-free rate. The average tracking error of the fundamental indices is 6.02%. The *Cash flow* -index has the

lowest tracking error which means it is following the *Reference* -index most closely. This is confirmed by the very similar annual average return and volatility compared to the *Reference* -index. The *Employees* -index has the highest tracking error but that does not lead to the best performance. The *Dividends* -index has the second lowest tracking error but the second best annual average return which means that the good performance of the index was not obtained with higher risk by deviating heavily from the *Reference* -index. This is also confirmed by the Sharpe ratio of the index.

Table 4. Performance of the fundamental indices (10 stocks), 2005-2018

	Ending value of 100€	Annual average (%)	Volatility (%)	Sharpe ratio	Tracking error (%)	Excess return (%)	t-statistics of excess return
Book	151.26€	3.23%	19.34%	0.134	6.57%	0.90%	0.58
Employees	144.57€	2.88%	21.26%	0.105	8.34%	0.55%	0.32
Cash flow	121.00€	1.48%	18.50%	0.045	3.45%	-0.85%	-0.58
Dividends	176.15€	4.45%	19.22%	0.198	7.23%	2.12%	1.38*
EBITDA	141.45€	2.70%	19.88%	0.104	5.41%	0.37%	0.23
Revenue	161.30€	3.75%	21.97%	0.142	9.66%	1.42%	0.80
Composite	142.92€	2.79%	20.65%	0.104	6.97%	0.45%	0.28
Reference							
Market cap	134.91€	2.33%	18.47%	0.092	-	-	-

Source: Compiled based on author's calculations

(***, ** and * indicate the statistical significance of excess return at one, five and ten percent levels respectively.)

Fundamental indices consisting of 30 stocks provide higher average returns with lower volatility compared to the ones consisting of 10 stocks (Table 3 and Table 4). The average excess return of the smaller fundamental index portfolios is 0.71% compared to the 1.12% of the larger indices. The overall characteristics are very similar but the performance of larger portfolios is superior compared to the smaller portfolios. It is worth noticing that, even though the smaller portfolios are riskier in terms of volatility compared to their larger counterparts, the yields are lower. In addition, the *Dividends* -index is the best performing index in terms of both absolute return and risk-adjusted return when generating the fundamental indices using only 10 stocks. Its excess return is over two percent and statistically significant at ten percent level. The average tracking error is 6.80% which is a higher value compared to the average tracking error of the larger fundamental indices.

3.1.1. Period by period analysis

Table 5. Annual returns period by period (30 stocks)

	Book	Employees	Cash flow	Dividends	EBITDA	Revenue	Composite	Reference
2005-2006	22.94%	28.02%	23.73%	37.66%	25.39%	26.96%	26.38%	25.10%
2006-2007	19.09%	18.13%	17.55%	16.04%	17.35%	16.98%	17.14%	15.17%
2007-2008	-8.76%	-12.38%	-4.02%	-1.45%	-3.39%	-6.20%	-5.39%	1.92%
2008-2009	-54.33%	-54.27%	-56.07%	-52.95%	-56.72%	-56.45%	-56.34%	-58.15%
2009-2010	77.25%	78.63%	69.41%	72.28%	79.73%	67.51%	69.61%	61.00%
2010-2011	18.12%	10.89%	8.54%	12.55%	10.55%	9.58%	9.23%	11.55%
2011-2012	-16.42%	-19.61%	-15.94%	-17.24%	-15.68%	-21.09%	-19.93%	-14.27%
2012-2013	3.37%	-0.61%	2.20%	0.11%	4.20%	-1.07%	-0.05%	5.60%
2013-2014	22.67%	20.03%	18.01%	27.71%	22.30%	30.62%	28.29%	18.66%
2014-2015	17.80%	18.56%	13.58%	16.46%	14.91%	23.88%	21.88%	17.47%
2015-2016	-18.40%	-12.01%	-15.22%	-15.19%	-16.18%	-9.96%	-11.18%	-14.98%
2016-2017	20.97%	21.85%	14.61%	13.29%	18.39%	25.45%	22.98%	13.23%
2017-2018	7.10%	7.96%	9.10%	4.52%	5.28%	14.34%	12.77%	6.55%
Average returns								
2005-2018	4.10%	3.58%	2.49%	4.52%	3.57%	4.70%	4.38%	2.78%
2005-2012	0.94%	-0.51%	-0.76%	2.50%	0.43%	-1.83%	-1.38%	-0.78%
2012-2018	7.91%	8.56%	6.41%	6.93%	7.34%	12.87%	11.53%	7.11%

Source: Compiled based on author's calculations
(green color indicates the best performance and red color the worst performance)

Period by period analysis is presented in Table 5 above and it provides a more detailed picture about the performance of the indices. Even though the fundamental indices, except the *Cash flow* -index, outperformed the *Reference* -index, it can be clearly seen that during three annual periods (2007-2008, 2011-2012 and 2012-2013) the *Reference* -index was the best performing index. However, it was also the worst performing index during four periods (2006-2007, 2008-2009, 2009-2010 and 2016-2017). The *Book* -index was the best performer during two periods but also the worst performer during two periods. The *Employees* -index with the *Cash flow* -index provided the worst returns during one and three periods respectively. The *Dividends* -index was performing strongly at the beginning of the research period being two times the best performing index. However, it also provided the worst return during the last annual period of the research. The *EBITDA* -index provided the best annual return once in 2008-2009. The *Revenue* -index provided the worst returns two times in a row in 2011-2012 and 2012-2013 but it dominated the last five annual periods of the research. The *Composite* -index stand outs from its peers by not having any best or worst performances. It is worth noticing that, if the research period would have been from 2005 to 2012, the *Revenue* -index would have been the worst performing index instead of

providing the highest average return. Thus, it can be concluded that the excess returns of the fundamental indices are very dependent on the test period chosen. For example, the average excess return of fundamental indices, when looking at the whole research period, is 1.12% whereas during the periods of 2005-2012 and 2012-2018 it is 0.70% and 1.69% respectively.

3.1.2. Market condition analysis

Table 6. Performance of fundamental indices in bull market (30 stocks)

	Annual average (%)	Volatility (%)	Excess return (%)	t-statistics of excess return
Book	11.25%	14.27%	0.88%	0.69
Employees	11.15%	14.95%	0.79%	0.59
Cash flow	9.51%	13.70%	-0.85%	-0.69
Dividends	12.08%	14.50%	1.72%	1.32*
EBITDA	10.51%	14.38%	0.15%	0.11
Revenue	13.20%	15.69%	2.84%	2.02**
Composite	12.47%	15.13%	2.11%	1.55*
Reference				
Market cap	10.36%	13.44%	-	-

Source: Compiled based on author's calculations

(***, ** and * indicate the statistical significance of excess return at one, five and ten percent levels respectively.)

Table 7. Performance of fundamental indices in bear market (30 stocks)

	Annual average (%)	Volatility (%)	Excess return (%)	t-statistics of excess return
Book	-18.78%	30.64%	2.00%	0.37
Employees	-20.72%	32.05%	0.06%	0.01
Cash flow	-19.69%	28.87%	1.10%	0.22
Dividends	-19.01%	28.53%	1.77%	0.35
EBITDA	-18.76%	31.67%	2.02%	0.37
Revenue	-22.48%	31.99%	-1.70%	-0.30
Composite	-21.60%	31.39%	-0.82%	-0.15
Reference				
Market cap	-20.78%	29.24%	-	-

Source: Compiled based on author's calculations

(***, ** and * indicate the statistical significance of excess return at one, five and ten percent levels respectively.)

There are some differences in the performance of the fundamental indices when comparing the bull market results to the overall results. In bull market, the average excess return of the fundamental indices is 1.09%. In addition, the fundamental indices are able to provide significant excess returns in this market condition. The excess return is statistically significant at five percent level for the *Revenue* -index and at ten percent level for the *Dividends* and *Composite* -indices. In bull market, the *Composite* -index has higher average return compared to the *Dividends* -index which is a difference compared to the overall results seen in Table 3. The best performing fundamental index in bull market is the *Revenue* -index but it also carries the highest risk like it does in the overall results.

In bear market, the average excess return of the fundamental indices is 0.63%. The *EBITDA* -index is the best performing index with over two percent excess return. In this market condition, also the *Book* -index performed well having the excess return of exactly two percent. The *Revenue* and *Composite* -indices underperformed the capitalization-weighted *Reference* -index even though they provided the highest returns in bull market. Statistically significant excess returns are not achieved in bear market.

3.1.2. Risk factor analysis

Table 8. CAPM alpha and beta of fundamental indices (30 stocks)

	CAPM Alpha	CAPM Beta	R²
Book	0.0011	1.019***	0.942
Employees	0.0008	1.041***	0.897
Cash flow	-0.0002	0.990***	0.981
Dividends	0.0015	0.995***	0.946
EBITDA	0.0007	1.053***	0.966
Revenue	0.0018	1.070***	0.898
Composite	0.0015	1.058***	0.930

Source: Compiled based on author's calculations

(***, ** and * indicate the statistical significance at one, five and ten percent levels respectively.)

The dynamics of the fundamental indices are in line with the overall movement with *Reference* -index (Figure 3). This is also supported by CAPM betas seen above in Table 8, which range from 0.99 to 1.07 and, thus, are very close to one. The betas are mostly over one, expect for the *Cash*

flow and *Dividends* -indices, which means that most of the fundamental indices have a higher systematic risk compared to the market index. The CAPM beta is statistically significant at one percent level for each index. Moreover, the CAPM alpha is positive for all fundamental indices, except for the *Cash Flow* -index, but no alpha is statistically significant. It can be concluded that the characteristics of the fundamental indices are very similar to capitalization-weighted indices. This is due to the fact that fundamental indices lie somewhere between beta and alpha. Fundamental indices are passive indices similar to the capitalization-weighted ones with approximately the same market exposure. However, they are more efficient by improving the weighting scheme which leads to the outperformance.

Table 9. Fama-French Three Factor Model regression (30 stocks)

	Alpha	Rm-Rf	HML	SMB	R²
Book	0.0012	0.982***	0.217***	0.038	0.948
Employees	0.0004	1.029***	0.106	0.306***	0.907
Cash flow	-0.0002	0.979***	0.061**	0.004	0.981
Dividends	0.0015	0.985***	0.053	-0.029	0.947
EBITDA	0.0007	1.026***	0.161***	0.050	0.970
Revenue	0.0016	1.048***	0.142*	0.141*	0.902
Composite	0.0014	1.038***	0.130**	0.102	0.933

Source: Compiled based on author's calculations

(green ***, yellow ** and pink * indicate the significance of factors at one, five and ten percent levels respectively.)

Table 9 summarises the exposure of the fundamental indices to the market, value and size factors. The highest market exposure is shown by the *Revenue* -index, while the *Cash flow* -index is the least exposed to the market. The market factor exposure is statistically significant for every fundamental index at a very low, one percent, level. All of the fundamental indices have a positive value exposure (HML). The *Book* -index is the most exposed to the value factor and the *Dividends* -index the least. The *Revenue* -index's exposure to the value factor is significant at ten percent level, the *Cash flow* and *Composite* -indices at five percent level and the *Book* and *EBITDA* -indices at one percent level. Only the *Employees and Dividends* -indices do not have a statistically significant exposure to the value factor. All of the fundamental indices, except the *Dividends* -index, have a small-cap bias (SMB). The *Dividends* -index is tilted towards large cap stocks. The

highest exposure to size factor is shown by the *Employees* -index. The size factor exposures are statistically significant only for the *Employees* and *Revenue* -indices. Furthermore, the *Cash flow* -index is the only one that shows a negative alpha. Similar to CAPM alphas, no alpha is statistically significant.

3.2. Discussion of the results obtained

Table 10 summarizes the research similarly to Table 1. It provides an easy way to compare the results to some of the earlier studies of fundamental indexation.

Table 10. Summary of the research

Period	2005 – 2018
Universe (index)	Finland
Fundamentals	book value, employees, cash flow, dividends, EBITDA, revenue, composite
Average excess return	1.12%
Average volatility vs reference	19.28% vs 18.07%
Average Sharpe ratio vs reference	0.17 vs 0.12
Best fundamental index (return)	revenue
Best fundamental index (Sharpe ratio)	dividends

Source: Compiled based on author's research

The results from the Finnish stock market show that this market is not an exception when it comes to fundamental indexation. Higher returns compared to capitalization-weighted indexing are possible to achieve with this weighting method. The overall results are in line with the previous research performed on the US stock market (Arnott *et al.* 2005; Clare *et al.* 2013), Western Europe (Hemminki, Puttonen 2008; Houwer, Plantinga 2009), Australia (Basu, Forbes 2014) and Central and Eastern Europe (Pelys, Lenickaite 2016). Most of the previous studies have shown that

fundamental indices constructed with fundamental factors of revenue/sales and dividends have been the best performing (Table 1). The results of this research are in line with that because the *Revenue* -index provided the highest absolute return and the *Dividends* -index the highest risk-adjusted return. However, the average excess return of 1.12% is considerably lower when comparing it to the previously mentioned studies. Like Pelys and Lenickaite (2016), the author found out that larger fundamental index portfolios are superior compared to the smaller portfolios.

As mentioned in chapter 1.5., Hsu (2008) and Treynor (2005) stated that portfolios need only to be weighted with non-price factor to outperform the standard capitalization-weighted indices. However, the results of this research show that the *Cash flow* -index did not outperform the capitalization-weighted *Reference* -index on the Finnish stock market. Arnott and West (2006) concluded that the composite index is superior to indices weighted with individual fundamental factors because it reduces the biasness that each individual fundamental index contains. Yet, the *Composite* -index did not provide a superior performance on the Finnish stock market. It was only the third best index in the overall results, the second best in bull market and the second worst in bear market. Also, the performance of the fundamental indices in different market conditions is different compared to the research of Basu and Forbes (2014). They showed in their research that the fundamental indices outperformed the capitalization-weighted indices in bear markets and in bull markets the outperformance was either small or non-existent. This research's results show exactly the opposite.

The risk factors analysis showed that the alpha coefficient becomes insignificant when the market, value and size factors are added. This means that the fundamental indices can be related to already known and common risk factors. All of the fundamental indices had a positive exposure to the value factor which shows that they have a value premium and are tilted to that factor. The findings are consistent with the critique of fundamental indexation by Blitz and Swinkels (2008). They noted that fundamental indexation is biased towards value factor and the alpha becomes insignificant after controlling for more factors. All of the indices, except the *Dividends* -index, showed also a positive exposure to the size factor. The biasness towards small-cap stocks confirms the previous findings of Houwer and Plantinga (2009). The CAPM betas showed that the fundamental indices are very similar to the capitalization-weighted ones when it comes to the characteristics but they are able to provide better performance by improving the capitalization-weighting method.

3.3. Limitations of the research and suggestions for future research

Fundamental indexation as an index weighting method allows the usage of basically any fundamental factor of a company. The fundamentals used in this research were chosen in accordance with Arnott *et al.* (2005). Most of the previous studies of fundamental indexation have also used a similar set of fundamentals which allows the comparison of the results. However, different fundamentals and data measures would be worth examining. Some other combination could provide a superior performance compared to the fundamental indices constructed in this research.

The author used only the CAPM to analyze the indices' characteristics and the Fama-French Three Factor Model to examine the fundamental indices' exposure to commonly known risk factors. There are many different alternatives for analysis, such as Carhart's (1997) Four Factor Model, that could be used in order to examine the origin of the excess returns of the fundamental indices. It still remains to be analyzed whether the excess returns of the fundamental indices on the Finnish stock market are derived from an additional risk exposure, price inefficiencies of the market or some unidentified factor. In addition, the monthly returns of HML and SMB -factors obtained for the Fama French Three Factor model regression were European factors, not country specific factors. The factors specifically from the Finnish stock market could show different results when examining the risk factor exposures of the fundamental indices.

This research did not take into account portfolio turnover and transaction costs derived from it. Thus, the author advises that the future research should concentrate on the turnover characteristics of the fundamental indices. As represented in Figure 1 and discussed in chapter 1.1.1., fundamental indexation leads to higher turnover compared to the capitalization-weighted indices and, thus, to higher transaction costs. Excess returns obtained in this research were lower compared to other results obtained from different markets which could lead to the fact that the outperformance of fundamental indexation on the Finnish stock market might not hold when the excess returns are adjusted for transaction costs. The number of large cap stocks with high liquidity on the Finnish stock market is very limited which could lead to liquidity related issues. This is something that would be worth examining in addition to the effect of transaction costs. Future research could also use a longer research period in order to provide more definite conclusions of fundamental indexation's long-term performance on the Finnish stock market.

CONCLUSION

Even though the finance literature and multiple studies have rejected the mean–variance portfolio’s efficiency, the vast majority of passive investing strategies are still based on capitalization-weighted indexing. Fundamental indexation represents a step beyond traditional capitalization-weighting. Weighting stocks by market capitalization causes a drag on performance and suffers from market’s inherent mispricing of stocks. This is based on a paradigm of asset pricing called the “noisy market hypothesis” which argues that stocks’ market values differ from their fair values. It leads to capitalization-weighted portfolios being skewed towards overvalued stocks. As a result, fundamental factors act as better estimators of the fair stock values.

The aim of this bachelor’s thesis was to evaluate the performance of fundamental indexation and analyze if it outperforms capitalization-weighted indexing on the Finnish stock market. In order to achieve this aim, fundamental index portfolios were created for the period of 01.03.2005 - 28.02.2018. The fundamental indices were constructed using six different fundamentals: book value, employees, cash flow, dividends, EBITDA and revenue. Also, a composite index combining cash flow, dividends, EBITDA and revenue was constructed. The performance of these indices was compared to the capitalization-weighted reference index. In addition, the results were tested in different market conditions and, in order to analyze the index characteristics and sources of excess returns, the Capital Asset Pricing Model and the Fama-French Three Factor Model were used.

The results of this research showed that, in general, the fundamental indices outperformed the capitalization weighted *Reference* -index. This is in line with the previous studies of fundamental indexation. Even though the volatility of the *Reference* -index was lower compared to the volatility of the fundamental indices, risk-adjusted returns of the fundamental indices were still higher in addition to the absolute returns. However, the *Cash flow* -index was an exception because it did not outperform the *Reference* -index even though similar fundamental index has provided positive excess returns according to the previous research. The fundamental indices provided excess returns in the range of -0.29% - 1.92%, and the average volatility was 19.28% compared to the *Reference*

-index's volatility of 18.07% The best performing index by absolute return was the *Revenue* -index but, when adjusting the returns with risk, the best performing index was the *Dividends* -index. Both of these indices outperformed the *Reference* -index by almost two percent on average. However, no excess return was statistically significant even at ten percent level. Contrary to Arnott and West's (2006) findings, the composite index was not superior on the Finnish stock market. Larger portfolios consisting of 30 stocks were superior compared to the smaller portfolios consisting of 10 stocks even though the characteristics of them were very similar. The CAPM betas supported the fact that the dynamics of the fundamental indices are in line with the overall movement of the capitalization-weighted *Reference* -index. The betas were mostly over one which is a sign of higher market risk compared to the market index. The Fama-French Three Factor Model analysis showed statistically significant market factor exposure at a very low level and positive exposure to the value factor for all fundamental indices. However, the value factor exposure was not statistically significant for the *Employees* and *Dividends* -indices. The exposure to the size factor was positive for all indices, except for the *Dividends* -index, but only the *Employees* and *Revenue* -indices had statistically significant small-cap exposure. Both the CAPM and the Fama-French Three Factor Model alphas were not statistically significant.

Limitations of this research and suggestions for future research were discussed in chapter 3.3. Future research should definitely test the impact of transactions costs on fundamental indexation on the Finnish stock market. Fundamental indexation leads to higher transaction costs compared to the capitalization-weighting which could annihilate the outperformance. Some smaller and less traded stocks included in the fundamental indices might bring issues related to the liquidity. More in-depth factor analysis with multiple different models would provide information about the origin of the excess returns of the fundamental indices. Future research could also include a longer research period in order to provide more definite conclusions of fundamental indexation's long-term performance on the Finnish stock market. The author would also like to remind that the results are based on assumptions and they are strongly dependent on the inputs chosen by the author. For example, as mentioned in period by period analysis in chapter 3.1.1., the level of excess returns of the fundamental indices is very dependent on the chosen test period. It is worth warning that the past returns or outperformance provided by fundamental indexation do not guarantee future returns and provide a secure way to beat the market.

REFERENCES

- Arnott, R., Hsu, J., Moore, P. (2005). Fundamental Indexation. – *Financial Analysts Journal*, Vol. 61, No. 2, 83-99.
- Arnott, R., West, J. (2006). Fundamental indexes: current and future applications. – *ETFs and Indexing*, Vol. 1, 111-121.
- Basu, A., Forbes, B. (2014). Does fundamental indexation lead to better risk-adjusted returns? New evidence from Australian Securities Exchange. – *Accounting and Finance*, Vol. 54, 699-728.
- Blanco, B. (2012). The use of CAPM and Fama and French Three Factor Model: portfolios selection. - *Public and Municipal Finance*, Vol. 1, No. 6, 61-70.
- Blitz, D., Swinkels, L. (2008). Fundamental indexation: An active value strategy in disguise. – *Journal of Asset Management*, Vol. 9, No. 4, 246-269.
- Carhart, M. (1997). On Persistence in Mutual Fund Performance. – *Journal of Finance*, Vol. 52, No. 1, 57–82.
- Clare, A., Motson, N., Thomas, S. (2013). An Evaluation of Alternative Equity Indices. Part 2: Fundamental weighting schemes. – *Cass Business School*, March 2013, 1-27.
- Davidow, A. B. (2014). *Fundamentally weighted indexing: Weighing the difference*. Accessible: http://www.schwab.com/public/file/P-6353249/Fundamentally_Weighted_Indexing_-_Weighing_the_Difference_retail.pdf , 17 April 2018.
- Fama, E. (1970). Efficient Capital Markets: A Review of Theory and Empirical Work. – *The Journal of Finance*, Vol. 25, No. 2, 383-417.
- Fama, E., French, K. (1993). Common risk factors in the returns on stocks and bonds. – *Journal of Financial Economics*, Vol. 33, No. 1, 3-56.
- Fama, E., & French, K. (2015). A five-factor asset pricing model. – *Journal of Financial Economics*, Vol. 116, No. 1, 1-22.
- French, K. (2018). *Fama/French European 3 Factors*. Accessible: http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html#International , 23 April 2018

- FTSE RAFI Index Series Methodology overview*. FTSE Russell. Accessible: http://www.ftse.com/products/downloads/FTSE_RAFI_Indexes_Methodology_overview.pdf , 2 May 2018
- Ghauri P., Grønhaug K. (2005). *Research Methods in Business Studies: A Practical Guide*. 3rd ed. Harlow: Pearson Education Limited.
- Haugen, R., Baker, N. (1991). The Efficient Market Inefficiency of Capitalization-Weighted Stock Portfolios. – *Journal of Portfolio Management*, Vol. 17, No. 3, 35-40.
- Hemminki, J., Puttonen, V. (2008). Fundamental indexation in Europe. – *Journal of Asset Management*, Vol. 8, No. 6, 401-405.
- Houwer, R., Plantinga, A. (2009) *Fundamental Indexing: An Analysis of the Returns, Risks and Costs of Applying the Strategy*. Working Paper, University of Groningen.
- How are indexes weighted?* FTSE Russell. Accessible: <http://www.ftserussell.com/research-insights/education-center/how-are-indexes-weighted> , 10 April 2018.
- Hsu, J. (2006). Cap-Weighted Portfolios are Sub-Optimal Portfolios. – *Journal of Investment Management*, Vol. 4, No. 3, 1–10.
- Hsu, J., Campollo, C. (2006). New Frontiers in Index Investing: An examination of fundamental indexation. – *Journal of Indexes*, Vol. 58, 32-37.
- Hsu, J. (2008). “Why Fundamental Indexation Might—or Might Not—Work”: A Comment. – *Financial Analysts Journal*, Vol. 64, No. 2, 17-18.
- Kaplan, P. (2008). Why Fundamental Indexation Might-or Might Not-Work. – *Financial Analysts Journal*, Vol. 64, No. 1, 32-39.
- Lintner, J. (1965). The valuation of risk assets and the selection of risky investment in stock portfolios and capital budgeting. – *Review of Economics and Statistics*, Vol. 47, No. 1, 13-37.
- Malkiel, B. (2011). *The Efficient-Market Hypothesis and the Financial Crisis. Rethinking Finance: Perspectives on the Crisis (Proceedings of a Conference)*. Russel Sage Foundation.
- Markowitz, H. (1952). Portfolio Selection. – *The Journal of Finance*, Vol. 7, No. 1, 77-91.
- Masarwah, A. *Morningstar DirectSM Asset Flows Commentary: Europe*. Accessible: <https://corporate1.morningstar.com/ResearchLibrary/article/845401/morningstar-direct-asset-flows-commentary-europe--year-end-2017/> , 16 April 2018.
- NASDAQ OMX All-Share, Benchmark and Sector Indexes*. Nasdaq OMX. Accessible: https://indexes.nasdaqomx.com/docs/Methodology_NORDIC.pdf , 26 April 2018.
- Pelys, P., Lenickaite, I. (2016). *Fundamental Indexation: evidence from Central and Eastern Europe*. (Bachelor’s Thesis). Stockholm School of Economics, SSE Riga. Riga, Latvia.

Philips, C., Kinniry Jr., F., Walker D. (2014). The Active-Passive Debate: Market Cyclicity and Leadership Volatility. – *Vanguard Research*, July 2014, 1-13.

Reilly, F., Brown, K. (2012). *Analysis of Investments & Management of Portfolios*. 10th ed. s.l. South-Western, Cengage Learning.

Sharpe, W. (1964). Capital Asset Prices: A Theory of Market Equilibrium under Conditions of Risk. – *Journal of Finance*, Vol. 19, No. 3, 425-442.

Sharpe, W. (1966). Mutual Fund Performance. – *The Journal of Business*, Vol 39, No. 1, 119-1378.

Shaw, R. (2008). *Three Approaches to Index Weighting*. Accessible:
<https://seekingalpha.com/article/95466-three-approaches-to-index-weighting> , 10 April 2018.

Treynor, J. (2005). Why Market-Valuation-Indifferent Indexing Works. – *Financial Analysts Journal*, Vol. 61, No. 5, 65-69.

What is an index? FTSE Russell. Accessible:
<http://www.ftserussell.com/research-insights/education-center/what-index> , 10 April 2018.