Valuation-Indifferent Indexation as an Alternative to Cap-Weighting

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Abstract:

The common method of weighting an investment portfolio by the relative market capitalization of portfolio holdings is under heavy critique from a group of researchers claiming that under noisy market conditions capitalization-weighting produces inferior portfolio returns relative to valuation-indifferent weighting methods. The claim, dubbed "noisy market hypothesis", has received empirical support in academic studies covering a large range of markets. This study investigates the performance of valuation-indifferent indices relative to a capitalization-weighted benchmark using nearly 23 years of Finnish equity market data. The historical effectiveness of indexation methods is simulated by constructing eight valuation-indifferent portfolios, including equally weighted and fundamentally weighted portfolios, and measuring the performance against a capitalization-weighted portfolio. In addition to considering risk and liquidity characteristics, index performance is also analyzed in a Fama-French multi-factor framework. Evidence of valuation-indifferent indexation dominance over cap-weighting is found; the historical, annualized excess returns range from 3.35% to 4.48%, depending on the weighting metric used. After accounting for investment risk, valuation-indifferent weighting methods are found to produce more mean-variance efficient portfolios. However, the outperformance is not of a linear nature and a Fama-French multi-factor analysis reveals that the excess returns are closely associated with the value premium observed in financial markets.

Keywords: fundamental indexation, valuation-indifferent indexation, cap-weighting, value premium

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1 INTRODUCTION

One of the last bastions of rational market-based finance is the school of passive index investing. This elegant strategy relies on the notion that buying and holding the market portfolio is a superior investment alternative for the average investor. Indexation as an investment strategy has not lost its appeal even as the foundations of capital asset pricing model (CAPM) have crumbled in academia and among practitioners. On the contrary, index investing has become increasingly popular in recent years as more private and institutional funds have been allocated to different indexed investment vehicles, such as index mutual funds and exchange traded funds (ETFs). In a survey by Investment Company Institute (2011: 32-33), in the United States alone, net assets invested in index funds totaled $1 trillion at year-end 2010 and index funds' share of equity mutual fund total net assets has risen from 4.0% in 1995 to 14.5% in 2010. The beauty of index investing lies in its conceptual simplicity and compliance with classical finance theory as well as its characteristic low-cost portfolio construction.

In a 2005 article "Fundamental Indexation" Robert D. Arnott, Jason Hsu, and Philip Moore come forth with the conclusion that the common practice of weighting portfolios by market capitalization is inherently flawed. They argue that in a noisy[1] market environment capitalization-weighting[2] produces portfolios that allocate more weight to overvalued securities and less weight to undervalued securities, which leads to a persistent performance drag against a valuation-indifferent indexation method. Since the seminal article by Arnott et al. (2005), valuation-indifferent indexation has gained further acknowledgement from several finance heavyweights, including Jeremy Siegel, Harry Markowitz, Jack Treynor, and the late Peter Bernstein.[3]

As a solution, Arnott et al. (2005) propose a weighting scheme based on company fundamentals, indifferent of investors' subjective valuation that is subject to pricing error and noise created by speculative investors and momentum traders. This indexation method is claimed to eliminate the performance drag inherent in cap-weighted portfolios. Arnott, Hsu, and West (2008) demonstrate that during periods of

[1] *Noise* in the context of financial time series data refers to random fluctuations in price and trading volume that distort the intrinsic value of a security. Black (1986) defines noise as the opposite of information.

[2] Hereafter *capitalization-weighting* is simply referred as *cap-weighting*.

[3] Jeremy Siegel is a senior investment strategy adviser to WisdomTree Asset Management, Inc. a provider of fundamentally weighted exchange traded funds. The latter names are, or have been, members of the advisory panel in Robert D. Arnott's investment management firm, Research Affiliates®, offering investment solutions using the fundamental index methodology.

overvaluation fundamentally weighted portfolios place lower weight on high valuation multiple stocks than cap-weighted portfolios, making the investor less exposed to price bubbles and, consequently, delivering a more satisfying cyclically-adjusted performance.

The noisy market framework also adds another perspective to the academic discussion regarding the well documented size and value return premia in equity markets. On the other side of the argument there is the efficient market camp that presents rational, risk-based explanations to the apparent outperformance of small-cap and value stocks. The discussion regarding cap-weighting and valuation-indifferent indexation boils down to the same problem of investor rationality. Theoretical discussion regarding valuation-indifferent indexation has so far been polarized between proponents of the so called noisy and efficient market hypotheses. What is also noteworthy is that the most audible advocates of valuation-indifferent indexation (in published research papers) are closely associated with investment management companies offering fundamental index funds to individual and institutional clients. Whether these papers are a marketing gimmick or further manifestation of the claimed superiority of valuation-indifferent indexation is yet inconclusive.

Empirical research based on backtesting of historical data supports the view that fundamental indexation, and valuation-indifferent indexation in general, produces more mean-variance efficient portfolios than cap-weighting, but research on the causality of these excess returns is still lacking. What are the value drivers of the reported outperformance? Do they stem from pricing errors in the market, as claimed in Arnott et al. (2005), or is a valuation-indifferent indexation strategy subject to hidden risks not captured by simple return analysis? Going forward, that is the most significant research question for investors considering adopting a valuation-indifferent indexation strategy instead of a passive, cap-weighted indexation strategy.

This thesis' contribution to the growing body of research on valuation-indifferent indexation is in further extending the scope to the Finnish equity market. The Finnish economy is a relatively mixed economy from a "Main Street" perspective with a tilt toward services and heavy industries, such as metals, pulp, energy and manufacturing. However, during the equity market boom in early 2000's, a cap-weighted portfolio of Finnish listed equities exhibited a significant sector tilt toward information technology stocks. The last couple of decades have been a particularly volatile time period in the Finnish equity market. It is of great interest to investigate which indexation method delivers a more satisfying performance with less feelings of anxiety along the way.

1.1. Purpose of the study

The purpose of this study is to investigate whether a cap-weighted portfolio exhibits a performance drag relative to a valuation-indifferent weighting method.

1.2. Scope of the study

The study comprises Finnish listed equities. The results and conclusions should be interpreted as specific to equities only since no other asset classes are investigated. In this study, valuation-indifferent indexation includes equal-weighting and fundamental weighting. The return data used in the study covers the time frame 31 March 1988 – 31 December 2010.

1.3. Structure of the thesis

The paper can be divided into two distinct parts—a theoretical and an empirical part. The theoretical part is organized as follows: Section two defines the concept of indexation as used in the context of this study and presents motivation for indexation as an investment strategy. Two different weighting disciplines are introduced, namely cap-weighting and valuation-indifferent weighting. The following two sections lay the theoretical foundations for replacing a cap-weighted indexation strategy for a valuation-indifferent investment strategy. A review of the development and principles of CAPM is presented in section three as well as its theoretical and empirical deficiencies and how these deficiencies can be addressed. Two relevant return anomalies, the size and value effects, are also discussed in section three. Section four investigates the effect of pricing error on cap-weighting and the justifications behind employing a valuation-indifferent weighting method. Concluding the theoretical part, section five contains a review of empirical studies on valuation-indifferent indexation.

The empirical part of the thesis consists of four sections. The data section provides a listing of the metrics selected for the valuation-indifferent portfolios and the rationale for each metric. A detailed overview of the data gathering process is also found in that section. The portfolio construction process is thoroughly described in the methodology section. Furthermore, the methodology section presents a number of performance metrics used to examine the portfolios' return, risk, and liquidity characteristics, as well as their sensitivity to the Fama-French risk factors. The results of these analyses are presented in the results section and, finally, section nine summarizes the main findings.

2 INDEXATION AS AN INVESTMENT STRATEGY

Research on equity mutual fund performance, such as Jensen (1968), Malkiel (1995) and Carhart (1997), and especially the relatively poor historical performance of actively managed funds versus common cap-weighted benchmark indices, has prompted a demand for index investing. The first passive index mutual funds for private and institutional investors were set up in 1970's, as documented in Bogle (2000). An argument commonly set forth by index fund providers is that actively managed funds seldom can consistently beat a cap-weighted market portfolio after adjusting for survivorship bias, management fees and trading costs. Bogle (2005: 23) offers an intuitive explanation for this finding: if we subtract index funds from the cap-weighted market portfolio, we're left with a market portfolio collectively owned by actively managed funds. Net of costs, an actively managed market portfolio cannot outperform itself.

2.1. The definition of index investing

In order to examine indexation from an investment perspective, a definition of index must be established. There seems to be no uniform definition for an index in a financial context, but for the purposes of this study, the following definition by Investopedia (2010) will apply: "In the case of financial markets, an index is an imaginary portfolio of securities representing a particular market or a portion of it." In other words, indexation is a method to construct a predetermined portfolio of assets and index investing means investing in those assets in the same proportion as they are in the index. What is critical is that the security selection criteria are defined ex ante so that the index composition is known before the results, as noted in Asness (2006: 1).

Arnott et al. (2008: 64) defines four key attributes a proper passive index portfolio should have: First, an index should be representative of a well specified investment opportunity set. If the objective is to represent the broad economy, the index should include enough companies from a diverse set of industries to correctly capture the distinct characteristics of the economy as a whole. An index could also be representative of a specific portion of the economy, such as a single industry or asset class. Second, an index should be replicable. This means that the securities included in the index are marketable and have reasonable liquidity so that a portfolio manager can with ease replicate the contents of the index through purchases and sales in the securities markets. Third, an index should be transparent and rules-based. Rules alone should determine which securities are included in the index portfolio and at what proportions. This excludes subjective security selection and allows historical analysis and comparison between indices. Finally, an index constructed for investment purposes should have a low portfolio turnover to ensure that the possible investment returns are not erased by transaction costs.

The terms 'active' and 'passive' may need further clarification. One consideration brought up by Blitz and Swinkels (2008: 267) is that a passive investment strategy does not involve rebalancing, or the purchase and sale of assets to arrive at the desired index weights. In other words, passive investment funds are pure buy-and-hold portfolios. In contrast, active strategies involve trading to maintain the target portfolio composition. Sinquefield (1995) provides another viewpoint where passive indexation does not involve subjective decisions and where portfolio selection is completely rules-based and objective whereas an active strategy relies on taking speculative trading positions on a continuous basis in order to profit from mispricing. Examples of this type of active investing include stock picking and market timing.

However, for the purpose of this study, the appropriate definition of active or passive indexation is considered purely semantic and irrelevant regarding the core research question of this paper. This study is primarily a performance comparison between investment portfolios based on the same investable opportunity set that differ only in the weighting method used.

2.2. Capitalization-weighting

In a capitalization-weighted index, each company in the index is weighted according to their market capitalization (i.e. share price times the number of shares outstanding) relative to the total market capitalization of all companies in the index. The main argument for cap-weighted index investing lies in the notion that the market portfolio is mean-variance efficient, as discussed later in section 3, and that a casual investor cannot consistently earn above average returns in an informationally efficient market. Consequently, the best alternative for a casual investor is to mimic the market portfolio while minimizing management fees and trading costs. Cap-weighting is a method to construct a currency-weighted portfolio of assets in a specified market and thus it corresponds well to the idea of a market proxy. A broad well-diversified cap-weighted index aims to replicate the market portfolio. In addition, a cap-weighted portfolio is a suitable market proxy also in the sense that it reflects the returns of the average investor. As exemplified by Estrada (2008: 95), though some investors may earn higher returns and some lower returns, on average investors collectively earn the return of a cap-weighted market portfolio.

Most of the widely quoted cap-weighted equity indices, such as the Standard & Poor's 500 or the Wilshire 5000, are float-adjusted meaning that the number of shares owned by company insiders and the government are not taken into account in the calculation of market capitalization. The holdings in the aforementioned two indices do not necessarily consist of the largest companies measured by market capitalization, but instead the portfolio selection is made by a committee[4]. As a side note, the S&P 500 index is not an index using the criteria set in Arnott et al. (2008: 64); the companies in the index are selected by a committee, the selection criteria are not fully transparent nor are the selection decisions historically replicable.

In a mutual fund context, Arnott et al. (2008: 51-54) identify several attractive structural features with cap-weighted index funds:

1) Cap-weighting is a convenient way to achieve broad diversification into all major sectors of the market. Because of its construction, the cap-weighted index serves as a suitable proxy for the market portfolio and the return on a cap-weighted index equals the currency-weighted return of an average investor.

2) Because stocks are subjectively valued by millions of investors worldwide, a cap-weighted portfolio represents the collective information and knowledge available to the market. The information comes without any analyst fees or time-consuming data gathering and security analysis, because the information is already incorporated in the share price. Letting markets do the work is convenient if one believes, in accordance with the efficient market hypothesis (see section 3), that the market more accurately evaluates the return and risk characteristics of an asset than an individual investor does.

3) Cap-weighted indexation is essentially a buy-and-hold strategy, which is often associated with a very low portfolio turnover. This practically eliminates trading costs, such as brokerage fees and taxes, bid-ask spread[5] and market impact[6].

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[4] According to Standard & Poor's (2010), the goal of the S&P 500 is "to ensure that the S&P 500 remains a leading indicator of U.S. equities, reflecting the risk and return characteristics of the broader large cap universe on an on-going basis." while taking into consideration other factors, such as financial viability, liquidity, sector representation and company type of its index constituents.

[5] Bid-ask spread is the difference in price between the highest price that a buyer is willing to pay for a security on the market and the lowest price for which a seller is willing to sell. The size of this spread may be considered as an additional cost to the buyer/seller, as the fair value estimate could be situated between the bid and ask prices

Portfolio holdings are automatically rebalanced as the market constantly recalibrates its expectations of the return and riskiness of securities. Rebalancing is required only when there are changes in the constituents in the underlying benchmark index due to corporate events such as mergers, acquisitions and bankruptcies or when changes are made in the benchmark itself. Additionally, an index fund can reduce the relative brokerage charges for fund investors by trading in larger blocks and by negotiating less costly brokerage fees than what applies for individual investors.

4) Large-cap stocks are usually among the most traded in the market. Because the majority of holdings in a cap-weighted portfolio are large-cap stocks, most of the trading takes place with highly liquid stocks. This means that an index fund can handle relatively large inflows and outflows of money without making a big impact on market prices and bid-ask spreads.

5) In contrast to most actively managed funds who liquidate their holdings once they've reached a target price, an index fund does not liquidate its holdings because the fund takes no active stance on valuation. Selling investments on profit may incur capital gains taxes for non-tax exempt investors. For these investors fund returns are tax deferred.

6) Largest equity index funds replicate well established benchmark indices, such as the S&P 500 index[7]. There is no need for a benchmark as the fund is essentially the benchmark. From a convenience standpoint, index investing allows an ease of monitoring and cost comparison between different fund alternatives.

The potential gains of cap-weighted index investing are impressive from a cost-efficiency and convenience standpoint. Yet there are several arguments that undermine the benefits that index investing offers:

1) Equity index returns have shown a tendency to be more volatile than movements in underlying fundamentals. Assuming investors are risk-averse, they value price stability over price instability. A study by Shiller (1981) shows that historical U.S. stock price movement seems to have been 5 to 13 times too volatile than what can be justified by the arrival of new information about future real dividends. Large price swings may occur because of changing investor risk preferences in the case that expectations about the future remain unchanged. Shiller's observations indicate that this is not the case as the variability in expected real interest rates far exceeds the variability in nominal interest rates over the same time period.

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[6] Closely related to the liquidity of a security, by market impact is meant the effect a market participant may have on the price when it buys or sells a security. Buying a large stake in a thinly traded security may increase the required bid price for subsequent purchases.

[7] According to MarketWatch (2010), two mutual funds that track the Standard & Poor's 500 index, the SPDR S&P 500 ETF from State Street Global Advisors and the Vanguard 500 Index Fund from The Vanguard Group, Inc., are both included in the top 25 list of largest mutual funds in the U.S.

2) According to Arnott (2008: 93), most of the trading in cap-weighted indices is concentrated near the bottom of the fund's holdings as smaller companies are added or removed from the index. These companies usually have low turnover, which may result in higher transaction costs. Furthermore, the inclusion of a company in a well known equity index may induce a positive trading effect and a temporary bounce in stock price.

3) Index funds may not be as objective and passive as claimed by index fund providers. Fuller, Han, and Tung (2010) point out that the construction of investable indices require a number of subjective decisions that must be made in order to satisfy practical requirements. For example, the scope and the number of companies in an index must be chosen arbitrarily. There are several cap-weighted benchmarks that index funds can replicate, but each index varies with regard to index objective, number of holdings, limitations, et cetera. Rebalancing rules and frequency must also be determined. Treatment of dividends is another matter: does the fund reinvest dividends or does it distribute them to shareholders; if it does, how frequently does the distribution occur? The above examples are to show that index investing may be seen as an active investment strategy in which the active decisions are made by an outside party instead of investors themselves.

4) A passive indexing strategy may be boring and unrewarding in a psychological sense. Indexation rules out extraordinary gains that are possible if one engages in stock picking or speculation. With indexation it becomes impossible to earn above average returns; something that may seem unattractive to individuals that are competitive by nature. Hardly any of the wealthiest investors in the world have made their fortune by pursuing an indexation strategy.

2.3. Valuation-indifferent indexation

Valuation-indifferent indexation differs from cap-weighting in that, instead of market capitalization, the weighting of securities in the index is based on a non-price related metric. The main idea is to break the link between security price and index weight. This thesis examines two different valuation-indifferent indexation methods: equal weighting and fundamental weighting. The bulk of the research on valuation-indifferent indexation methods is exclusively focused on fundamental indexation and likewise this study devotes a large part of the discussion on that method. A discussion on the practical and theoretical distinctions between the two valuation-indifferent indexation methods is offered in section 2.3.5.

2.3.1. Equally weighted indices

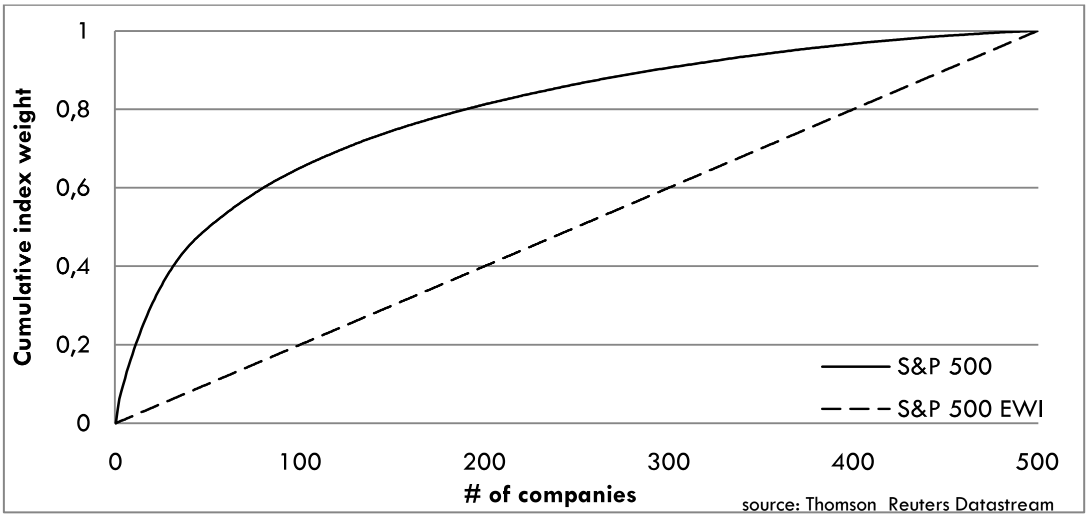
The first valuation-indifferent weighting scheme discussed here is equal-weighting. In this method of portfolio construction every index constituent is given the same index weight and the weight is directly determined by the inverse of the number of securities in the index. For instance, if a portfolio consists of n securities, each security will be given the weight 1/n in an equally weighted portfolio.[8] Index weights are strictly determined by the amount of securities in the index and are thus completely unrelated to individual security prices.

Another way of looking at equally weighted indices is that they are factor-indifferent. Following Dash, Guarino, and Zeng (2010: 2), all indices can be defined as variations of the following equation: $Weight_i = Factor_i^{Exponent} / \sum Factor_i^{Exponent}$, where the index weight for an individual asset *i* is the relative factor raised to a power. In a cap-weighted index the weighting factor is the market value of a company, but the factor could be any other measureable attribute. Overweighting or underweighting a certain attribute may lead to differences in index performance. Most indices do not use an exponent in determining index weights. However, the equal-weighted index differs from most index methodologies in that it is defined by the exponent rather than by the factor. The exponent in an equal-weighted index is zero. Dash et al. (2010: 3) explain that an equal-weighted index randomizes factor mispricing and can thus be perceived as a factor-indifferent index weighting method. It pertains to the view that mispricing does occur in the market, but that it is impossible to anticipate beforehand which factors outperform and which factors underperform in the market.

Another distinction between factor-weighted and equal-weighted indices is that equal-weighted indices are expected to have a lower stock concentration. In indices that weigh companies on the basis of a size factor, such as market capitalization, a relatively small number of large companies dominate the index. This attribute is expected to be reversed in an equally weighted index, because of its construction. An example of this feature can be seen in figure 1 depicting the stock concentration in cap-weighted and equally weighted S&P 500 indices.

[8] The total index weight in an equally-weighted portfolio is thus n*(1/n) = 1.

Figure 1 The cumulative weight distribution of the S&P 500 index and the S&P 500 equal-weighted index (EWI) on 22 February 2011



Continuing on the differences between factor-weighted and equal-weighted indices, Dash et al. (2010: 5) point out that relative industry weights between factor-weighted and equal-weighted indices are not determined in the same way. The industry weight in a factor-weighted portfolio is determined by the factor size of a particular industry relative to the market as a whole whereas in an equally weighted index the industry weight is determined by the relative number of companies. Using the S&P 500 index as an example Dash et al. (2010: 7) show that, historically, the variance of sector weights has been greater in the cap-weighted S&P 500 index than in the equal-weighted S&P 500 index. An intuitive explanation for this result is that the sector weights in a cap-weighted index vary with respect to both number of stocks in each sector and sector performance. In an equal-weighted index, sector weights vary only with respect to the number of stocks in each sector.

The downsides with equal-weighting are, according to Dash et al. (2010: 8-9), a relatively higher portfolio turnover versus a cap-weighted index and potential capacity constraints. An equally weighted portfolio must be periodically rebalanced, which results in a higher portfolio turnover and higher trading costs. Further, an equally weighted index has a higher proportion of holdings in relatively small stocks. Shares in small companies may be characterized by a lower liquidity and a higher bid-ask spread than large stocks. This could lead to potential liquidity issues. However, the problem is rather hypothetical and only becomes an issue when the fund is of substantial size and when the index includes stocks with a minuscule trading volume. An equally weighted index based on the S&P 500 index would hardly suffer from capacity constraints.

2.3.2. Fundamentally weighted indexes

Fundamental indexation is a relatively novel concept made known by Research Affiliates LLC, the investment management firm headed by Robert D. Arnott. Like cap-weighted portfolios, fundamentally indexed portfolios do not involve security analysis, but instead of market value the portfolio holdings are proportional to a suitable fundamental (i.e. non-price related) metric of company size. However, there is no definite measure of the relative size of a company in an economy. Fundamental indexation as such does not indicate which weighting metric is used. Portfolio managers following a fundamental index strategy usually measure a company's index weight using balance sheet data. As long as the weighting metric is unrelated to the market value of a company, fundamental indexation is a valuation-indifferent weighting method.

On a conceptual level, fundamental indexation is a step away from a market-centric approach where investors view their investment opportunity set relative to the stock market. A market-centric approach is supported by classical finance theory where, given the liberty of some simplifications, stock prices incorporate all available information concerning expected future cash flows of a business and the riskiness of these cash flows. In this approach, the securities traded in the market, at least in the long run, are priced correctly. Instead, Arnott et al. (2008: 137) prefer to view their indexation method as an economy-centric approach, where portfolio holdings are weighted relative to their economic footprint. Cap-weighting is a conceptually elegant weighting method in the sense that the stock market as a whole is cap-weighted. In mirroring the performance of the stock market in general, they argue, a cap-weighted market portfolio should be the preferred choice of measurement. But when composing a portfolio of the economy, cap-weighting may introduce a bias that is driven by subjective market forces.

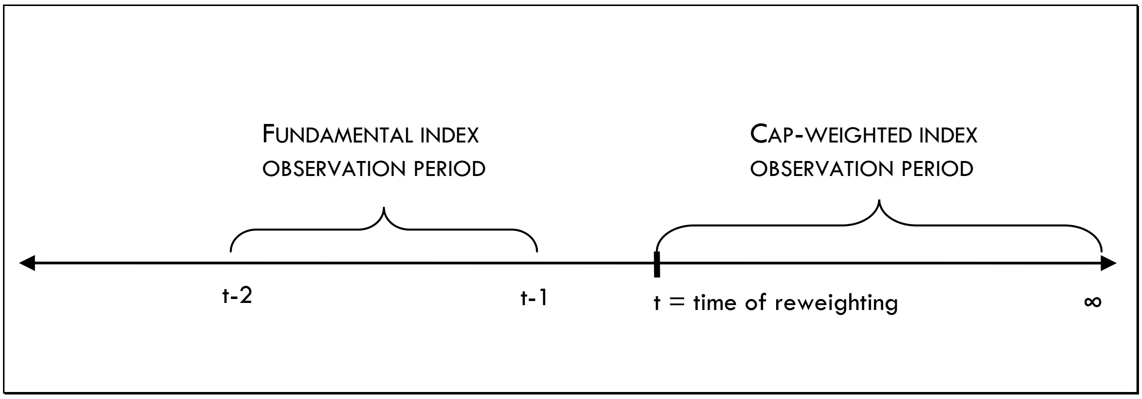
Another conceptual difference between the two indexation methods concerns the time perspective: Because the index weights in a fundamental portfolio are based on current accounting figures, the portfolio represents the broad economy of today[9] whereas in a cap-weighted portfolio current figures are largely irrelevant and the valuation of securities is based on an assessment of future unrealized dividends and capital gains. Recent accounting data are usually audited and thus, at least in general, objective and transparent whereas market valuation is subjective, uncertain and subject to behavioral

[9] Or, more specifically, the broad economy during the period of data gathering.

factors and time-varying investor preferences. However, Blitz and Swinkels (2008: 267) correctly remark that the weighting metric choice in fundamentally weighted indices is a subjective choice as well.

Figure 2 Fundamental vs. cap-weighted indexation: a difference of time perspectives

The index weights in a fundamentally weighted index are determined by company fundamental data from the time period t-2 to t-1, whereas the index weights in a cap-weighted index are based on a subjective assessment of the total cash flows from the reweighting time t (present day) to infinity.



This difference of time perspectives is also apparent in the composition of indices; if the expected growth rates of companies change, the cap-weighted index weights react instantly whereas a fundamentally weighted index adjusts once and if growth realizes. Differences between fundamentally and cap-weighted index compositions are widest during times when the expected relative growth rates of companies significantly deviate from their current fundamental values. Following the above reasoning, fundamentally indexed indices are neutral to growth expectations, which Arnott et al. (2008: 85) suggest is the reason for the method's inherent bias toward "value stocks". In practice, this means that fundamental indices contra-trade against companies whose growth prospects are largest. Jun and Malkiel (2007: 120) also note that fundamental indices overweight value stocks and underweight growth stocks as long as current values of earnings and book value are used instead of expected values. The connection between valuation-indifferent indexation and the value effect is more thoroughly discussed in section 4.3.

2.3.3. Individual and composite fundamental indices

There is no single correct fundamental measure to gauge the relative economic significance of a company. Commonly used fundamental measures include revenue or sales[10], earnings, cash flow, dividends, book value, and number of employees. These metrics can vary with respect to scope and depending if you use gross or net values. For instance, book value can mean gross assets, net assets, operating assets or even gross liabilities. Dividends can include stock buybacks in addition to cash dividends, and so on. It is important to note that each measure has distinct characteristics and result in differently weighted portfolios. As Arnott et al. (2008: 80-83) list, a fundamental index based on sales emphasizes companies with thin profit margins and large sales volume. Similarly, a dividend-based index overweights mature companies with stable cash flows, such as companies in the utilities and insurance sectors, and altogether excludes non-dividend paying growth companies from the opportunity set. A cash-flow-weighted index may favor or disfavor companies with highly cyclical incomes and a book value-weighted index may overweight capital intensive companies or companies with aggressive accounting practices. As a result, using a single fundamental weighting metric may introduce sector biases into the index. There is also the question of end user; a tax-exempt investor prioritizing income might prefer a dividend-weighted indexation method above others.

To smooth out the effect of sector biases, Arnott et al. (2008: 80-84) propose a composite index that combines several fundamental size metrics. They draw an analogy between different measures of company size and a footprint in the sand: a footprint can be measured in terms of length, width, depth, et cetera. Each metric tells us of different aspects of size, but combining them into composite measure gives a more complete picture of the footprint. Further benefits of a composite measure, according to Arnott et al. (2008: 84-85), include a reduced exposure to differences in accounting practices within an economy and internationally, in addition to reduced exposure to accounting fraud and data errors.

As mentioned earlier, there is no generally accepted definite measure of company size. Even financial media list companies in size order according to sales, market capitalization, number of employees, and other attributes. The selection of fundamental metrics is discretionary and varies between studies. The selection of metrics used in this study is discussed further in section 6.1.

[10] The difference between these two is often negligible; revenue is gross sales less discounts, returns and other allowances.

2.3.4. Valuation-indifferent indexation and costs

In contrast to cap-weighted portfolios, which rebalance automatically as security prices change, valuation-indifferent portfolios must be periodically rebalanced in order to properly track their benchmark. In practice, this means purchasing securities whose price have risen above their target index weight and selling securities whose price has dropped more than the index benchmark. Portfolio rebalancing generates trading costs, which depend on rebalancing frequency, portfolio size, liquidity factors and the maximum tracking error a portfolio manager is prepared to tolerate. However, trading costs have decreased substantially in recent decades complicating multi-year cost analyses.

Rebalancing frequency is an interesting question of optimization. An ideal valuation-indifferent index would be continuously rebalanced when security prices depart from their optimal index weights. However, this would greatly increase trading costs to levels close to actively managed funds and, as Blitz and Swinkels (2008: 267) point out, would also incur a negative exposure to the short-term momentum effect, which historically would have been damaging to returns. Ultimately, the decision of rebalancing frequency is a trade-off between performance benefits and transaction costs.

In the original study by Arnott et al. (2005: 87) the cost aspect is considered by taking into account the effect of simulated trading costs, which are not substantial enough to wipe out the excess returns achieved by a fundamentally weighted investment strategy. Other cost and liquidity-related attributes, such as portfolio turnover, holding concentration, and weighted trading volume are also examined, but the liquidity characteristics are not substantially worse than in the reference cap-weighted portfolio to entirely justify the return differential.

One alternative to gauge the costs of valuation-indifferent indexation strategies is to look at mutual funds and exchange traded funds that employ a periodic reweighting scheme. For example, the annually rebalanced PowerShares FTSE RAFI US 1000 exchange traded fund had an annualized total expense ratio (TER) of 0.45% as of 22 April 2011 and the TER's generally vary between 0.4% and 0.8% for valuation-indifferent ETF's; a price level that can be considered mid-range in the ETF universe.

2.3.5. *Fundamental indexation vs. equal-weighting*

In contrast to equal-weighting where the portfolio weight is unrelated to company size, fundamentally indexed portfolios offer a better representation of the economy as a whole and the index better adjusts to changes in the sector composition of the economy over time (Arnott et al. 2008: 68-70). Though differences exist in portfolio composition, fundamental indices do not substantially differ from the cap-weighted benchmark with regard to top holdings and sector distribution, as demonstrated in Arnott (2008: 86-88). As a matter of fact, the reported correlation coefficients and Fama-French market betas between the fundamentally weighted and cap-weighted portfolios are close to one in the Arnott et al. (2005: 87) study. Arnott et al. (2008: 88) also note that the majority of holdings in fundamentally indexed portfolios are in large, highly liquid stocks, which results in a lower portfolio turnover and lower trading costs —an attribute that is highly valued in index investing. In equally weighted portfolios, the trading costs are larger due to the inherent bias toward small-cap stocks.

Not considering the effect of trading costs, Arnott et al. (2005) present no theoretical justifications to expect fundamental indexation to perform differently from equal-weighting, or any valuation-indifferent weighting method for that matter, in noisy market conditions as both weighting methods supposedly avoid the performance drag due to pricing error in cap-weighted indices (see section 4).

2.3.6. *Investing in valuation-indifferent indices*

A valuation-indifferent indexation strategy is a viable investment strategy for a casual investor either through mutual funds or by manual portfolio construction. The latter method requires more manual labor but compared to most active strategies, an equally or a fundamentally weighted portfolio using a low rebalancing frequency is a quite straightforward approach and the required fundamental data is attainable at a low cost.

For the fund investor, a number of mutual and exchange traded fund providers offer valuation-indifferent investment alternatives to retail clients. These providers include Invesco PowerShares, WisdomTree, RevenueShares, Claymore investments, Schwab funds, and First Trust Portfolios. One estimate (Scully, 2010) of the total amount of assets managed using fundamental indexation strategies is $50 billion in 2010.

3 THE RISE AND FALL OF CAPM

To fully embrace the theoretical justification for the underperformance of cap-weighting, as suggested by the noisy market hypothesis[11], a brief review of the main developments in modern portfolio theory is offered below. The development of practical methods to measure the risk and return characteristics of portfolios essentially began in the 1950's. Markowitz (1952) showed that portfolio volatility can be reduced by adding non-perfectly correlated assets to a portfolio in a process known as mean-variance optimization. Essentially Markowitz's paper was a mathematical proof demonstrating the importance of diversification—an age-old wisdom in investing. Investors can through portfolio optimization calculate an efficient frontier; a set of unique combinations of assets that give the highest expected risk-adjusted return for all levels of riskiness[12]. Using this method, investors can eliminate the idiosyncratic risk of all assets in the portfolio and only be left with the systematic risk of the market.

Another cornerstone of modern financial theory that later became known as the efficient market hypothesis (EMH) was being developed in the 1960's. Fama (1965) and Samuelson (1965) showed that prices fluctuate in a random fashion indicating that an investor cannot outperform the market without the possession of unique information. This does not mean that mispricing does not occur, but that it is impossible to distinguish which securities are mispriced through security analysis. Fama (1970) presented empirical proof of efficient capital markets, further polished the theory and defined three forms of market efficiency; weak, semi-strong, and strong, which each differ regarding the magnitude of the information set available to investors.[13]

Markowitz's method of portfolio optimization in capital market equilibrium, under the assumption that EMH holds, leads to a pricing model known as capital asset pricing model (CAPM). The model was developed independently and simultaneously by Treynor (1962), Sharpe (1964), Lintner (1965), and Mossin (1966). CAPM draws an intuitive parallel between the expected risk and the expected return of an asset. According to CAPM, the return of an asset is dependent upon the asset's beta[14], i.e. the

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[11] See section 4. The term *noisy market hypothesis* was coined by Jeremy Siegel (2006).

[12] Riskiness is here determined by the expected portfolio variance.

[13] In the weak form market efficiency only historical public data is included in the information set, in the semi-strong form all public data is included and in the strong form all data, public and private, is included in the information set.

[14] The CAPM formula: $E(R_i) = R_f + \beta_i(E(R_m) - R_f)$ where $E(R_i)$ is the expected return of an asset, R_f is the risk-free rate of interest, β is the covariance between asset returns and market returns relative to market

covariance between the return of an asset and the return of the market as a whole. This implies that all variance that is not related to the market can be diversified away. If one diversifies away all asset-specific variance by combining different assets into a portfolio, the resulting portfolio will be the market portfolio. Thus, in a rationally priced market, it turns out that the market portfolio is mean-variance efficient.

3.1. Theoretical gaps in CAPM

Later theoretical considerations and empirical studies have discovered gaps in the validity of CAPM. From a theoretical standpoint, the model assumes that investors have a quadratic utility function or that asset returns are normally distributed random variables—assumptions that are not very realistic. For example, Mandelbrot (1963) and Fama (1965) find that financial time series do not follow a normal distribution pattern, but instead the return distributions tend to be fat-tailed and leptokurtic when compared to a normal distribution. This means that asset returns show a disproportionally high probability of very small and very high price movements. A quadratic utility function implies that individuals have an increasing absolute risk aversion[15]; in other words, they are willing to invest less in a risky asset, in absolute terms, the more wealth they possess. For certain ranges of wealth, the quadratic utility function may indicate a preference to reduce wealth, demonstrate Cremers, Kritzman, and Page (2003: 5).

Markowitz (2005) argues that real world constraints make the market portfolio mean-variance inefficient; if CAPM holds, investors would have homogenous expectations and access to information, investment decisions are made only in a mean-variance framework, transaction costs would be nonexistent, and every investor would be able to lend or borrow at the risk-free rate. CAPM is also a one-period model meaning that investment decisions are assumed to be made at the beginning of the time period and that the final wealth is consumed at the end of the period. Investments are not rebalanced or consumed in the mean time. The time period is assumed to be same for all investors. This assumption can be relaxed if one assumes a dynamic market model[16].

Another issue arises when one tries to construct a market portfolio. Mayers (1976) shows that, theoretically, the CAPM market portfolio should include all capital assets,

variance, and R_m is the expected return of the market. $E(R_m) - R_f$ is also called the expected market risk premium.

[15] Increasing absolute risk aversion also implies increasing relative risk aversion.

[16] A more detailed description of the Intertemporal CAPM is offered in section 3.4.

non-marketable assets included, that are in positive net supply. Roll (1977) points out the equivalence between the validity of the CAPM equation and the mean-variance efficiency of the all-asset market portfolio. Considering the above tautology, it follows that it is not possible to empirically test the CAPM if one cannot observe the whole investment opportunity set in the economy. Therefore, a market portfolio merely based on traded equities can be seen as an unfit proxy for the market portfolio.

3.2. Empirical tests of CAPM

Though the first empirical tests on CAPM are promising, further tests on asset return data show that the historical relationship between asset returns and variance has not been as strong as predicted by CAPM, conclude Black, Jensen, and Scholes (1972) and Fama and French (1992). In other words, equity owners have not been compensated in full, considering the systematic risk that they've carried. The above finding suggests that portfolios that overweight low-beta stocks have historically earned above average risk-adjusted returns.

What's more, a number of return anomalies have been documented that contradict with the assumed mean-variance efficiency of the CAPM market portfolio; most notably the size and value effects. Performance analysis on historical stock market data shows that small cap and value stocks persistently outperform the cap-weighted indices on a risk-adjusted basis. The size effect was identified by Banz (1981) on NYSE common stocks. The main finding is that companies with a very small market value have had significantly higher risk-adjusted returns relative to the market during the time period 1936-1975. This superior performance cannot be rationalized by the standard CAPM equation. Furthermore, the size effect is not found to be linear; the effect is more powerful in the smallest of stocks. The previous result could mean that the relative performance is higher for small cap stocks than what is anticipated by equity investors or that small size is a proxy for some hidden risk not captured by the standard CAPM equation. Upon further examination of the size effect Keim (1983) detects that for NYSE and AMEX stocks over the period 1963-1979 the relationship between excess returns and company size is negative for every month of the year, but the effect is particularly strong in January. Later research shows that the size premium has been significant and long-running. In a study by Credit Suisse Research Institute (2009) the CRSP[17] low-cap index was found to outperform the total U.S. equity market by 1.4%

[17]Center for Research in Security Prices at the University of Chicago.

annually over the period 1926-2008 and in the UK the small-cap premium was 2.3% annually for the HGSC[18] low-cap index over the period 1955-2008.

Further evidence against the CAPM market model was provided in a study by Basu (1977) where he finds that stocks listed on NYSE with a low price-to-earnings ratio, on average, yielded higher risk-adjusted returns between April 1957 and March 1971 than a cap-weighted market portfolio even after adjusting for tax effects, information processing and transaction costs. Basu takes the view that security prices are biased and that the price-to-earnings ratio is an indicator of this bias and that an investor can exploit this anomaly to earn higher risk-adjusted returns.

Another well researched valuation metric is the price-to-book metric. Fama and French (1992) analyze the cross section of expected stock returns in the U.S for the period 1963–1990 and find a positive connection between average realized returns and book-to-price ratios both in a univariate and multivariate framework. Further, they note that the value effect has historically been significantly stronger than the size effect.

Bernstein and Damodaran (1998: 203) describe the process of stock screening in which the return anomalies described above have been found. In constructing a portfolio only stocks that satisfy certain predetermined characteristics are included in the portfolio. The actual return of the resulting portfolio is then measured against the expected return on the same portfolio. To find out the expected return of a portfolio one must measure the risk on that portfolio and determine the return that corresponds to the risk, usually determined by the CAPM beta. If the risk-adjusted returns of these screened portfolios exceed the return of a cap-weighted market portfolio, a return anomaly has been detected. However, there is no generally accepted measure of risk and the excess return that is registered could be the result of a faulty model for risk and return.

Fama and French (2004: 40-44) state that the empirical problems with CAPM could be due to overly simplistic assumptions underlying the theory or because researchers are having difficulties in implementing valid tests of the model—either way, they conclude that most applications of CAPM are not valid as such.

[18]Hoare Govett Smaller Companies index.

3.3. Possible explanations for the size and value anomalies

Theories that offer explanations for the noted asset return anomalies can roughly be divided into two categories; theories that pertain to investor irrationality as the source of return anomalies and theories that offer rational, risk-based explanations to the observed anomalies. In the first case the market is assumed to misprice assets, which suggests that it is possible for investors to pocket arbitrage profits simply by exploiting these pricing inefficiencies. In the latter case the pricing mechanism of the market is efficient but simple pricing models that are used in valuing assets do not capture all the risks associated with asset returns. It follows that more sophisticated pricing models are necessary in order to better take these hidden risk factors into consideration.

3.3.1. Irrational asset pricing explanations

One behavioral explanation for the observed anomalies is that investors tend to overreact to unexpected news. This alternative is brought up in the first value effect study by Basu (1977) and is further researched in De Bondt and Thaler (1987) who find that portfolios of prior "losers" generally outperformed prior "winners" over time periods of 1 to 5 years. De Bondt and Thaler study comprise monthly return data for NYSE common stocks in the period 1926-1982. The results imply that investors consistently exaggerate the effect of good news in portfolio selection and vice versa in case of bad news. In a somewhat similar line of reasoning, Lakonishok, Shleifer, and Vishny (1994) propose that value-oriented strategies generate excess returns because these strategies exploit the irrational behavior of a typical investor. They find likely that investors constantly overestimate the growth prospects of so-called "glamour stocks" relative to "value stocks". As a possible reason for this behavior, they propose that investor expectations are excessively tied to past growth even though future growth tends to be mean reverting. In other words, investors are prone to extrapolating past performance when valuing assets instead of objectively assessing future growth prospects.

Another contributing factor to the irrationality story could be the disparity of time horizons between investors and investments. Shleifer and Vishny (1990) suggest that most investors could have shorter time horizons than what is required for a value strategy to generate excess returns and are thus more focused on investments that are likely to earn excess returns in the short term than in the long term. Likewise, money managers cannot underperform their peers or a benchmark index for long periods of time or they risk losing their job. This could explain why money managers are more inclined to invest in growth stocks instead of employing a value strategy that includes more career risk. Another agency-related explanation considered by Lakonishok, Shleifer, and Vishny (1994) is that fund managers prefer growth stocks because they may appear more prudent investments than value stocks and are more justifiable to existing and potential clients. This practice is commonly known as "window dressing". Furthermore, they mention that many institutional investors exclude companies in financial distress from their investment opportunity set. Companies in financial distress often have low valuation multiples and are regarded as value stocks.

3.3.2. Rational asset pricing explanations

Efficient market theorists recognize the existence of return anomalies and adhere to the view that small-cap and value strategies are fundamentally riskier investment strategies; the excess return from these strategies is simply the result of additional exposure to hidden risk factors. Single-factor CAPM may not be the correct model to measure the risk and return of a portfolio and betas could thus underestimate the true risk of small-cap and value stocks.

The added riskiness of small-cap stocks may come from a number of sources. Smaller companies usually get less coverage from stock analysts and financial media when compared to larger companies. Bernstein and Damodaran (1998: 207) suggest that the smaller quantity of relevant information may result in added estimation risk, of which the small-cap premium could partly be compensation for. Furthermore, small-cap stocks usually have a smaller trading volume than large-cap stocks. Small volume usually translates into relatively higher bid-ask spreads and other transaction costs. Amihud and Mendelson (1986) show that investors put more weight on the liquidity of an asset when the expected holding period is relatively short. Highly liquid assets may thus appear more attractive than cheaper, illiquid assets. Accentuated liquidity risk may be another contributing factor to the small-cap premium.

Companies with a low price-to-book ratio could, according to Fama and French (1996: 76-81), indicate additional risk because companies that have a low valuation are more likely to be in financial distress and are thus more sensitive to economic shocks. Following this logic, the higher observed average returns of value stocks are compensation for a relatively higher probability of financial distress. Researchers may also be fixated on finding patterns in historical average returns that are inconsistent with asset pricing models, according to Black (1993). This kind of data snooping may lead to results that are specific to the sample used. Another explanation to the value premium, suggested by Kothari, Shanken, and Sloan (1995), is that the average returns for value stocks are overstated because of survivorship bias; data samples may more likely include firms that survive periods of financial distress than firms that don't. Lettau and Wachter (2007) propose that value stocks are more sensitive to fluctuations in cash flows whereas growth stocks are more sensitive to changes in discount rate. They make the assumption that changes in discount rate are less feared by investors than changes in cash flows. Using a time-variable model of the stochastic discount factor, which is related to the time-varying risk preference of investors, they find a risk-based explanation to the outperformance of value stocks in a CAPM-framework.

3.4. CAPM extensions

In a response to the apparent failure of the single-factor CAPM, Fama and French (1992) suggest that both size and value could be proxies to hidden dimensions of risk not captured by a single-factor CAPM equation. They find that adding variables that measure stock size and book-to-market equity most effectively characterize the cross-section of average historical stock returns. This augmented form of the classical CAPM is commonly known as the Fama-French three-factor model.

Other extensions to CAPM include the Arbitrage Pricing Theory (APT), Intertemporal CAPM (ICAPM) and the consumption based CAPM (CCAPM). Formulated in Ross (1976), the APT pricing model suggests that the expected return of an asset is a linear function of an unspecified number of systematic risk factors, instead of being explicitly dependent on the market risk factor[19] in CAPM. These systematic risk factors may include economic variables, such as inflation and shifts in the yield curve, as well as asset specific variables. The ICAPM and CCAPM factor in expectations about future consumption in the pricing model. Merton (1973) presents a model that adds additional state variables in the standard CAPM equation. These state variables incorporate the eagerness of investors to hedge against uncertainties regarding future consumption and investment opportunities. The CCAPM replaces the beta term, or the measure of covariance between asset return and market return, with a measure of covariance between market return and aggregate consumption growth. The consumption beta thus relates movements of the stock market relative to the ability to consume. If an

[19] i.e. sensitivity to the market risk premium $E(R_m) - R_f$

appropriate measure of consumption is found, one can infer a pricing model for risky assets. The development of CCAPM can be attributed to Lucas (1978) and Breeden (1979).

The previous models better explain the historical average returns of stocks by relaxing some CAPM constraints. They don't, however, justify some of the theoretical gaps in CAPM, on which the philosophy of passive indexation strategy is based on; in particular, the underlying expectation of a rational market that effectively drives prices toward their fundamental values because of arbitrage profit-seeking behavior.

4 THE "NOISY" MARKET HYPOTHESIS

Taking into consideration the shortcomings of CAPM, it is rather questionable that a large quantity of investment advisors and investment literature promote a passive, low-cost indexation strategy based on replicating the returns of a broad well-diversified equity index.[20] If the CAPM assumptions are not theoretically nor empirically robust, an investment strategy based on the CAPM market portfolio may not the best possible investment alternative for the casual investor.

Amenc, Goltz, and Le Sourd (2008: 6) list three reasons for why an alternatively constructed index may outperform a cap-weighted market index:

1) The indexation method uses a better allocation technique;

2) or produces portfolios with additional exposure to risk premia;

3) or overweights undervalued securities, i.e. exploits market inefficiencies

Being in direct opposition to the efficient market hypothesis, the noisy market hypothesis makes the claim that the observed market price is not always the best unbiased estimate of the fair market value of a security. Siegel (2006) argues that price formation in the market is subject to real-world structural constraints, such as taxes and liquidity, as well as speculative behavior on part of insiders, momentum traders and other speculative market participants. These unpredictable and temporal shocks, dubbed as "noise", obscure the intrinsic value of securities. If individual share prices are noisy, the index weights in cap-weighted indices are also affected by this pricing error.

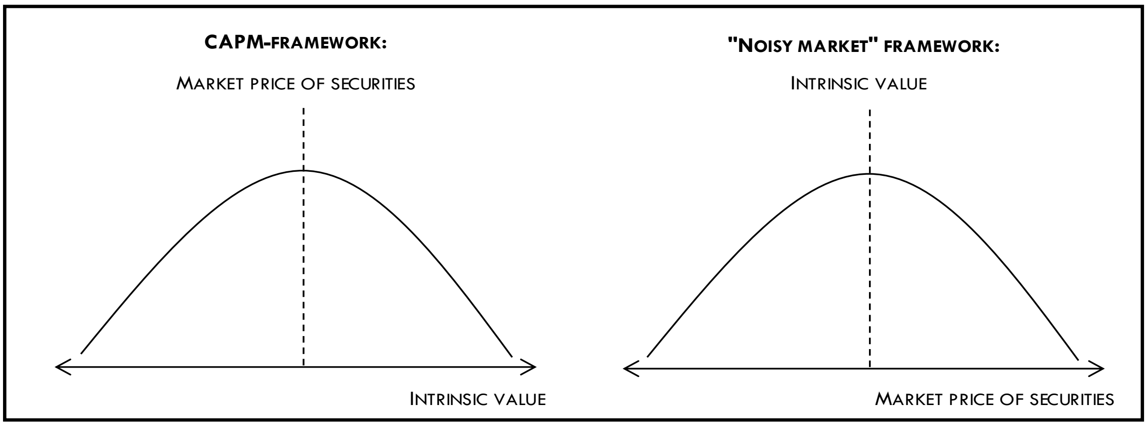
The intuition of Arnott et al. (2005) argument is this: suppose market prices are randomly distributed around the intrinsic values of stocks and not the other way around. In other words, the equity market provides a "best guess" of the fair value of an enterprise. This human, subjective assessment of fair value is bound to contain at least some pricing error. In a valuation-indifferent portfolio, portfolio weights are unaffected by the emergence of pricing error in equity prices. In a reasonably large valuation-indifferent portfolio, the net impact of pricing errors is negligible as portfolio holdings are evenly distributed among overvalued and undervalued securities. But in a cap-weighted portfolio, portfolio weights have a positive correlation with pricing error as

[20] See e.g. *A Random Walk Down Wall Street* by Malkiel, Burton G., W. W. Norton & Company, 2007.

overvalued securities get a larger relative share of the portfolio. If share prices ultimately revert to their intrinsic value, cap-weighted portfolios suffer a performance drag due to this positive correlation. In other words, the adherents of noisy market hypothesis make the assumption that fair value is a key driver of price movement.

Figure 3 Two different views on the relationship between market value and intrinsic value

In a CAPM-framework (left) the intrinsic values of securities are randomly distributed around the market prices of securities making market price, on average, a reasonable estimate of fair value. The "noisy market" framework (right) is based on the foundation that market prices are randomly distributed around the intrinsic values of securities.



However, Kaplan (2008: 35) points out that a problem with the above intuition is that pricing errors in capital markets is not an easy subject to investigate, because the intrinsic values of assets are not observable. Furthermore, there is no assurance that asset prices ultimately regress toward intrinsic value. On the contrary, pricing errors can increase benefiting the cap-weighted investor. Indeed, Arnott et al. (2008: 103) document that cap-weighted portfolios usually outperform valuation-indifferent portfolios during periods of increasing valuation multiples, such as during the market boom in the late 1990's.

How does the claimed underperformance of cap-weighting present itself in a CAPM framework? It doesn't, according to noisy market adherents. Arnott et al. (2008: 132) assert there is a logical fallacy with measuring performance against the market portfolio: In CAPM context the risk-adjusted excess return of a security or a portfolio of securities over market return is denoted by alpha[21]. Because the excess return is often measured against a cap-weighted market portfolio, a cap-weighted index cannot show negative alpha, implying that there exists no performance drag. However, if one rejects a market-centric view of the economy and measures excess return relative to the whole

[21] $\alpha_i = R_i - [R_f + \beta_i(R_m - R_f)]$ Also known as Jensen's alpha as defined in Jensen (1968).

opportunity set available to investors, a cap-weighted market portfolio supposedly exhibits a negative alpha.

4.1. Formal mathematical proof of noisy market hypothesis

In the presence of noise, capitalization-weighted portfolios offer inferior risk-adjusted returns relative to valuation-indifferent portfolios, according to proponents of noisy market hypothesis. Treynor (2005) and Hsu (2006) offer formal demonstrations of the underperformance of cap-weighted portfolios relative to valuation-indifferent portfolios in a noisy market framework. The fundamental assumption behind the model is that there exist both securities whose market values exceed their theoretical intrinsic values and securities whose market values are less than their intrinsic values.

What follows is an example given in Treynor (2005: 67). Consider a portfolio of two securities. The distribution of overvalued and undervalued securities is allowed to vary, but in order to better illustrate the effect, Treynor assumes that the positive and negative mispricing is symmetrical around the intrinsic value. Let the intrinsic values of both securities be v, and let the aggregate positive and negative pricing errors be $+e$ and $-e$, respectively. A cap-weighted investor spends $v + e$ monetary units on the overvalued security and $v - e$ monetary units on the undervalued security. The total investment is $(v + e) + (v - e) = 2v$ monetary units and the investor gets

$$(v + e)\left(\frac{v}{v + e}\right) + (v - e)\left(\frac{v}{v - e}\right) = 2v \tag{1}$$

worth of intrinsic value.

In contrast, an investor using a valuation-indifferent weighting scheme will allocate the same amount of monetary units on the overvalued and on the undervalued security. But a same sized investment on the overvalued security buys less of the intrinsic value than a corresponding investment on the underpriced security. In other words, a monetary unit spent on a security whose intrinsic value is v and market value $v + e$ buys $v/(v + e)$ worth of the intrinsic value and a similar investment on a security with a market value of $v - e$ buys $v/(v - e)$ of the intrinsic value. If the valuation-indifferent investor spends the same amount v on both securities, as does the cap-weighted investor in equation (1), the valuation-indifferent investor gets

$$v\left(\frac{v}{v + e}\right) + v\left(\frac{v}{v - e}\right)$$

worth of intrinsic value, or, stated otherwise

$$v\left[\frac{v(v-e)+v(v+e)}{v^2-e^2}\right]=v^2\left(\frac{2v}{v^2-e^2}\right)=\left(\frac{v^2}{v^2-e^2}\right)2v=\left[\frac{1}{1-\left(\frac{e}{v}\right)^2}\right]2v \qquad (2)$$

In equation (2) above, the expression inside the brackets is always greater than zero. The valuation-indifferent investor thus gets more intrinsic value than the cap-weighted investor with an investment of equal size. Treynor (2005: 67) observes that the size of the advantage is dependent on $(e/v)^2$, or the relative size of the pricing error squared[22]. Further, he notes that valuation-indifferent investors realize the excess return even if the mispriced securities do not revert to their intrinsic values. However, the gain is amplified if reversion to true value occurs. In the case that securities are correctly priced, the valuation-indifferent portfolio shows no benefit relative to the cap-weighted portfolio.

4.2. Theoretical fallacies with noisy market hypothesis

Perold (2007) examined the arguments made by Arnott et al. (2005), Treynor (2005) Hsu (2006) regarding the inferiority of capitalization-weighting and dismissed them as logically inconsistent. One problem is the presupposition that market prices are randomly distributed around the intrinsic value of a stock. Doing this, one implicitly assumes negative autocorrelation of stock prices, i.e. that prices systematically revert to their intrinsic value. This is a false assumption if one instead assumes that the direction of price movement is random. If price movement is random mispricing could become more severe, which is beneficial to a cap-weighted strategy. Perold (2007: 35) notes that the empirical evidence on autocorrelation of stock returns is inconclusive; therefore the conclusion that a valuation-indifferent weighting scheme is superior to cap-weighting may not be valid.

Another problem that Perold (2007) brings up with the noisy market model is the claim that cap-weighted indexation must overweight overvalued securities and underweight undervalued securities when market prices are subject to pricing error. However,

[22] The cumulative benefit of a valuation-indifferent weighting scheme for the whole range of securities in the market can be expressed with a frequency function $f(e/v)$ as

$$\int_{-\infty}^{\infty}\frac{f(e/v)d(e/v)}{1-(e/v)^2} \qquad (3)$$

market capitalization by itself does not reveal whether a security is overvalued or undervalued. The valuation-indifferent argument requires that both overvalued and undervalued securities exists in the market.[23]

Furthermore, in formulating the expected return of the cap-weighted portfolio in a noisy market framework, fundamental index theorists include the intrinsic value of a security in the information set for investors suggesting that investors know the fair value of a security. Using a Bayesian analysis under the assumption that one does not possess information about the intrinsic value of a security, Perold (2007) demonstrates that the expected return of cap-weighting is not negatively biased. The previous result can be stated in terms of correlation of the pricing error with intrinsic value and with market value: If the correlation between pricing error and the intrinsic value of a security is weak or nonexistent, as claimed by adherents of fundamental indexation, the correlation between pricing error and the market value of a stock must also be weak or nonexistent. The lack of correlation between the conditional market value and pricing error explains why capitalization-weighted index returns should not *by itself* exhibit a performance drag.

Kaplan (2008) continues on the same line of reasoning and formulates a boundary condition for the superiority of the two different weighting methods: if fundamentally weighted indices are to outperform cap-weighted indices, the correlation between a fundamental size metric and intrinsic value should be greater than the correlation between market value and intrinsic value. In other words, fundamental measures of company size should contain more information about the intrinsic value of companies than what market values do. Furthermore, Kaplan (2008: 35) states that because the intrinsic values of companies are not observable, one cannot perform empirical tests, other than on historical data, to determine the superior weighting method.

Kaplan (2008: 36-37) goes on to suggest a composite approach to portfolio weighting. If both market capitalization and fundamental data contain information regarding intrinsic values, the weighting methods can be combined to form portfolios that include both sets of information.

[23] In an example, Perold (2007: 32) considers two stocks with a fair value of $10. If both stocks trade at $12, they are both equally overvalued and the resulting cap-weighted portfolio is an equally-weighted portfolio. A cap-weighted portfolio does not, in this case, exhibit a return drag relative to a valuation-indifferent portfolio if prices revert back to fair value.

4.3. Noise and return anomalies

The well documented size and value return anomalies were briefly discussed in sections 3.2. and 3.3. The reason these anomalies are in focus here is because many empirical studies on fundamental indexation (see section 5) conclude that the performance advantage of fundamentally weighted indices can be attributed to a higher exposure to Fama-French size and value factors.

An often found argument against valuation-indifferent indexation is that the weighting method simply produces portfolios that are heavily tilted toward value stocks. Asness (2006) and Blitz and Swinkels (2008), in their critique of fundamental indexation, make the case that fundamental indexation is an active investment strategy that rides on the well-documented value effect. They assert that fundamental index proponents make the same discoveries that academics and practitioners made decades earlier with value investing and without recognizing that they are observing the same phenomenon. As possible reasons for the historic outperformance of value investing, Asness mentions added riskiness, investor irrationality, and data mining, or some combination of them. Thus he does not exclude the possibility that investor irrationality is behind the historic outperformance; only that fundamental index proponents have not presented any compelling evidence that support their case.

Can the historic performance of growth versus value strategies be explained by historic trends in investing styles? Bogle and Malkiel (2006) note that value stocks in general have outperformed growth stocks since the late 1960s and that this historical development may explain the outstanding performance of fundamental indexation and other value strategies. At the same time they remind that during the period 1937-1968 growth stocks outperformed value stocks. Bogle and Malkiel are convinced that a mean reversion effect in security returns exists and that an investor never can know with certainty when such trend reversion will occur. In a rising valuation environment, investment strategies that rely on the value factor would suffer relative to growth strategies, even if security prices are noisy.

Taking another view, Arnott, Hsu, Liu, and Markowitz (2009) maintain that size and value are not systematic risk factors at all, but instead can be used to predict future returns. According to them, the size and value anomalies are driven by the same market imperfection – noise. These anomalies arise naturally when security prices are not fully informationally efficient. But if pricing errors become smaller, the size and value effects diminish accordingly. However, limits to arbitrage could make noise in market prices persistent. They assert that a market model with time-variable and mean-reverting noise better explains the empirical shortcomings in CAPM literature. Arnott and Hsu (2008) construct a market model showing the above conclusions in a one risk factor framework with mean-reverting pricing errors.

On the issue of alternating periods of growth and value dominance, as brought up in Bogle and Malkiel (2006), Arnott et al. (2009) propose that these cyclical periods may merely be a manifestation of the noise variance expanding and contracting. Although noise in security prices is unobservable, they claim that noise can be inferred from security prices. According to the logic in Arnott et al. (2009), large cap and high valuation multiple securities are more likely to have positive pricing errors and are thus more likely to have a lower expected return. Conversely, securities with a small market value or a low valuation multiple are more likely to have a negative pricing error indicating a higher expected return.

Siegel (2006) presents the above conclusion in an intuitive example: If a stock price falls because of noise, i.e. without a change in the company fundamentals, overweighting that stock will probably yield a positive excess return. Conversely, if a stock price appreciates without a change in fundamentals, that stock will probably underperform. Stocks whose price exceeds their fundamental value become large-cap and high-valuation multiple stocks and are therefore more likely to underperform.

4.4. The valuation-indifferent indexation puzzle in a nutshell

The ongoing debate regarding the origin and cause of the size and value anomalies is also at the core of the discussion regarding valuation-indifferent indexation. This dispute arises from differences of belief about market rationality and cannot be resolved with current knowledge of security market behavior. Assuming that the noisy market camp is correct and there exists a pricing bias causing a value-tilted portfolio to outperform a cap-weighted portfolio on a consistent basis, the same type of investor irrationality and pricing errors must persist in the future in order to reap excess rewards from following a valuation-indifferent indexation strategy. This fact is also acknowledged in Arnott et al. (2008: 232).

The behavioral biases of individuals may be of a persistent nature, but if they can be identified, what prevents well-informed investment professionals, such as hedge fund managers, from exploiting this apparent error? Thus, another requirement for the valuation-indifferent indexation strategy to generate above-average returns is that the indexation method is not adopted by the investment community, or that the adjustment does not happen instantly, so that the obtainable excess returns are not arbitraged away. In that case a cap-weighted portfolio turns into a carbon copy of a valuation-indifferent index eradicating the performance differences between the two.

What is the prospect of pricing errors in securities markets in the future? The hedge fund industry has in recent years grown into a substantial presence in the securities markets with influence on the pricing of securities. Estimates of hedge fund assets under management vary from $2.5 to $4.0 trillion in June 2008, in a survey by Alternative Investment Management Association (2008). Investment activity carried out by hedge funds typically is not burdened by regulatory constraints and other restricting guidelines, such as excluding short positions from the investment opportunity set. Furthermore, hedge funds can easily amplify their active bets by taking on large amounts of debt to leverage the investment returns. The whole existence of the hedge fund industry relies on identifying and exploiting pricing errors in the market.

Another factor that could diminish the potential excess returns from valuation-indifferent indexation is an increased amount of published information and more advanced methods to dissect the information. It should be fair to assume that company disclosure of financial information and the tools used by analysts to process that information is in a constant state of improvement due to developments in computerized data processing. Factors that could counteract developments in information flow and processing are a lagging legislature and weak regulatory oversight as well as more opaque disclosure practices in companies.

If one accepts the view that a valuation-indifferent indexation strategy obtains most of its performance benefits because of the value effect, the next logical step is to investigate whether a value strategy is a fundamentally riskier investment strategy than a buy-and-hold cap-weighted indexation strategy. This can be achieved by a thorough analysis of the shape and dynamics of the probability distribution of actual index returns.

5 REVIEW OF PREVIOUS EMPIRICAL RESEARCH

The findings and the methodology in Arnott et al. (2005) were highly influential and form a basis for further research on the subject. Empirical research has since expanded into international equity markets (see section 5.2) and, quite recently, into other asset classes (section 5.3). The methodological focus has shifted from simple performance analysis to multi-factor regression models and especially to a more detailed examination of the link between excess return and Fama-French risk factors.

5.1. U.S. evidence

In the seminal article on fundamental indexation Arnott et al. (2005) construct six fundamental portfolios for different metrics of company size. The metrics are: sales, revenue, cash flow, gross dividends, book value, and total employment. Trailing five-year averages are used for the first four metrics[24]. For each measure, they select the 1000 largest companies to be included in the respective portfolios. The companies in the resulting indices are then reweighted at their relative metric weight. The indices are rebalanced yearly on the last trading day of each year using the most recent financial statement data on that day. In addition to the six individual fundamental indices, a composite index is constructed where the index weight for every company is determined as the equal average of four size metrics (sales, cash flow, gross dividends, and book value). The other two metrics are dismissed due to data availability issues (employment) and similarity between metrics (sales and revenues). A 1000-stock cap-weighted benchmark portfolio is constructed in a similar fashion as the individual fundamental portfolios.

Arnott et al. (2005) sample includes stock market and financial data for U.S. companies for the time period 1962-2004. A return regression on sample data shows that all fundamental indices, individual and composite, produce a statistically significant geometric excess return versus the cap-weighted benchmark index with approximately the same risk level. The return advantages range from 1.66% to 2.56% a year for the individual metrics and 2.12% for the composite index. Higher Sharpe ratios and

[24] The motivation for five-year averaging, according to Arnott et al. (2005), is that it minimizes the business cycle component of variables and reduces portfolio turnover without any material effect on performance and volatility.

information ratios[25] also indicate a higher risk-adjusted return for the fundamental indices. Using a one-factor CAPM market model, fundamental indices generate a statistically significant positive alpha compared with the benchmark cap-weighted index and with less systematic risk. However, in a Fama-French three-factor CAPM model the authors find significant exposure in fundamentally weighted portfolios to the value factor and, to a smaller degree, to the size factor. Net of these factor loadings, fundamental indices show a CAPM alpha of -0.1. Unfortunately, the authors do not thoroughly discuss the implications of the above result, which implies that the majority, if not all, excess performance are linked to a higher Fama-French risk factor exposure.

Jun and Malkiel (2007) anchor on the results Arnott et al. (2005) obtained from their multi-factor analysis. They perform a Fama-French three factor regression to measure the performance of the FTSE RAFI US 1000 fundamental index[26] against the cap-weighted S&P 500 index and find with statistical significance that for the time period January 1967 – March 2007 the fundamental composite index alpha is zero with a very high R^2. According to Jun and Malkiel, the historical outperformance of fundamental indexation relative to cap-weighted indexation relies entirely on added exposure on the size and value factors and refer to evidence showing that the excess returns from following size and value strategies is simply compensation for accepting additional risk. As further evidence for this claim, they show that it is possible to construct portfolios of ETFs and benchmark indices with similar factor loadings and risk-adjusted performance. As a word of caution, Jun and Malkiel warn that size and value-based strategies may not continue to outperform a cap-weighted strategy in the future.

If one assumes that the observed market price is a noisy representation of the intrinsic value of a company and that the intrinsic value changes slowly over time, one can estimate the intrinsic value of a company using a moving average of past prices. This is the underlying idea in the approach taken by Chen, Chen, and Bassett (2007). In other words, one can obtain a better estimate of the fundamental value of a company without using accounting data. Echoing the intuition in Arnott et al. (2005), the harmful effects of noise on portfolio weighting is expected to be dampened using smoothed values of market value as a weighting metric.

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[25] Sharpe ratio: excess return over the risk free rate of return/volatility; Information ratio: value added relative to benchmark/tracking error.

[26] A fundamentally-weighted stock index provided by Arnott's Research Affiliates. The index is a 1000-stock composite index based on four fundamental metrics.

The obtained results in Chen et al. provide support for the smoothed cap approach. Using market price and return data for U.S. stocks from 1962 to 2003, the smoothed cap indices outperform the reference index by approximately 1% annually for different rebalancing dates and estimation windows. They find that the outperformance is greater with longer estimation periods and that the smoothed indices have a significantly lower return volatility. Similar to other studies reported here, the smoothed cap indices lagged the benchmark portfolio during the late 1990's market boom. Chen et al. conclude that using averaged values of market capitalization serves as an adequate alternative to accounting figures in estimating the intrinsic value of a company.

Expanding the research further into the commercial realm, Amenc, Goltz, and Le Sourd (2009) assess the performance of fourteen fundamentally weighted U.S. stock market indices from seven index providers. The performance of fundamental indices is compared against capitalization, equal and value-weighted S&P 500 and CRSP NYSE total market indices as well as against twelve value-weighted U.S. sector indices. A monthly data frequency is selected and the time period for the study is 1962 to 2006[27]. The results indicate that fundamental indices outperform value-weighted indices, although the outperformance is not statistically significant for most fundamental indices. On another note, most fundamental indices fail to outperform equal-weighted indices with sufficient statistical significance indicating that there are no meaningful performance differences between the two indexation methods, which is consistent with the theoretical motivation presented in section 2.3.5. Furthermore, fundamentally weighted indices tend to underperform minimum-variance portfolios constructed from style and industry indices when measured by mean-variance efficiency.

In a multi-factor analysis, the fundamental indices in Amenc et al. (2009) exhibit statistically significant positive alphas, but when the model is adjusted for small-cap, value and momentum factors the excess returns are greatly reduced and in most cases do not significantly differ from zero. The average monthly alphas are reduced from 31 basis points to only 9 basis points. Furthermore, it turns out that the fundamentally weighted indices have a notable exposure to the value factor and this is even confirmed by a sector bias toward typical value industries, such as utilities whereas sectors that typically exhibit higher valuation multiples are underweighted. They also note that

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[27] Commercial indices were not available in the 1960's, but some index providers have constructed track records for their indexation methodology as far back as 1962. For some indices, the observation period starts as late as 1998.

fundamental index providers are not willing to provide performance comparison against equal-weighted or multi-factor benchmarks thus ignoring additional risk factors present in the cross section of stock returns. Their main conclusion is that the lion's share of the outperformance in a fundamental indexation strategy can be attributed to an added exposure to the value factor. The main benefit from investing in a fundamentally weighted index is that it is a relatively cheap, liquid and convenient way to construct a value-weighted portfolio.

Empirical research on the performance of equal-weighting is relatively scarce. However, equal-weighted indices have existed for years, most notably the S&P 500 equal-weighted index (S&P 500 EWI), as well as investment products using the equal-weighting methodology. Dash et al. (2010) look at the historical performance of the equally weighted S&P 500 index fund relative to the cap-weighted S&P 500 index. They find that the equal-weighted weighted index has since December 1989 outperformed the cap-weighted index by an annual rate of return of 1.8%[28], although the performance has varied during different market conditions. However, an equal-weighted index has been somewhat more volatile than its cap-weighted equivalent. Even so, the correlation between the two indices has remained on a high level, mostly between 93% and 96% on a rolling 36-month period, with the exception to the time period around the turn of the millennium and the subsequent correction when the correlation fell to as low as 84%. As expected, the S&P 500 EWI is also tilted toward small-cap and value stocks, but the size and style bias is found to vary with time.

5.2. International evidence

The launching of country index funds and ETF's has allowed investors to diversify their wealth internationally in an easy, cost-efficient way. What is the best weighting method in constructing a globally diversified portfolio? This is the research question in Estrada (2008) whose sample covers 16 developed country benchmark indices for the time period 1973–2005. Dividend per share is selected as the fundamental metric because it is "objective, transparent, and independent of accounting principles", according to Estrada (2008: 98). The dividend portfolio is weighted according to the relative dividend per share and the cap-weighted benchmark according to the relative market capitalization of each country. The annual geometric return in the dividend-weighted index is 1.9 percentage points greater than in the cap-weighted benchmark, but this

[28] The time period for the study is December 1989 – June 2010.

excess return is achieved with a 1.4 percentage point higher annualized standard deviation, higher negative skewness, and higher kurtosis. Despite the somewhat higher riskiness, Estrada states that the performance of a dividend-weighted portfolio is more satisfying on a risk-adjusted basis. The outperformance of dividend-weighted portfolios is not consistent over time; the dividend-weighted index outperforms the benchmark in four of six non-overlapping 5-year sample periods. However, over 10-year periods the dividend-weighted index outperforms in all three sub periods. The dividend-weighted index has a significant tilt toward countries with small relative market capitalization and high dividend yield. The author attributes the superior performance of the dividend-weighted portfolio partly to the higher exposure to the value factor and, to a smaller degree, to the size factor. Surprisingly, when the performance of the dividend-weighted portfolio is compared against an equal-weighted and a dividend-yield-weighted portfolio, the latter two strategies deliver notably higher returns with somewhat similar volatility and beta as the dividend-weighted portfolio. Estrada concludes that fundamental indexation outperforms cap-weighted indexation, but still loses to a simple value strategy. However, the relationship between portfolio returns and size and value premia is not discussed in great detail.

The first published empirical study on fundamental indexation using strictly European data was conducted by Hemminki and Puttonen (2008). The authors take the Dow Jones Euro Stoxx 50 index, a broad cap-weighted blue-chip index of Eurozone stocks, and reweight the index using five fundamental measures[29] and also construct an equally weighted composite fundamental portfolio. During the period 1996–2006, they find that all fundamentally weighted portfolios yielded higher risk-adjusted geometric returns than the cap-weighted benchmark. The excess returns average 1.76% per year. However, the result is not statistically significant for all fundamental portfolios, which the authors explain is due to a relatively short observation period. The authors conclude that it is possible to generate higher risk-adjusted returns by reweighting a cap-weighted portfolio using fundamental metrics of company size.

Hemminki and Puttonen's study differs from most comparable studies in the way that the authors do not construct fundamental portfolios from a large sample of companies, but instead merely reweight an existing cap-weighted index. This portfolio construction method introduces a selection bias into the sample as the same companies may not be included in the portfolio if securities were selected from a larger sample of companies.

[29] The metrics used are book value of equity, total employment, sales, cash flow, and gross dividends.

Another weakness with the study is that the data is not tested in a multi-factor framework leaving the source of the observed excess returns open to speculation.

Stotz, Döhnert, and Wanzenried (2010) applied the fundamental indexation concept on the European equity market also by reweighting an existing cap-weighted index. Their data sample covers the Dow Jones Stoxx 600 index for years 1993–2007. Their main contribution compared to Hemminki and Puttonen's (2008) study is a more meticulous risk analysis. In the risk analysis they examine risk in fundamentals (e.g. the volatility of dividends and cash flows), exposure to Fama-French risk factors and a momentum factor, and lastly, intertemporal risk. Fundamentally weighted portfolios produced an annual geometric excess return of just below 2 percentage points on average with a somewhat similar volatility as in the cap-weighted benchmark. The authors observe that the source of excess returns in a fundamental indexation strategy is closely related to the value factor, but the extensive risk analysis does not present evidence that the return difference is driven by at least the risk factors considered in the study. In light of the results, Stotz et al. conclude that a fundamentally weighted indexation method better reflects the intrinsic values of companies than cap-weighting.

Andersson (2009) examines the fundamental indexation concept on the Swedish equity market covering the years 1979–2007. The fundamental metrics considered are sales, earnings, book value, and employees. Andersson's study is of interest due the similarities with this study in what comes to scope, sample size, and the relatively similar economic environments in Finland and Sweden.

However, the methodological approach is somewhat unconventional: Andersson investigates a set of hypotheses regarding the performance and structural factors of fundamentally weighted portfolios relative to a cap-weighted portfolio. First the historical returns of the four fundamental indices are measured against the benchmark index. The results show a positive excess return and a positive CAPM alpha for each fundamental index in the data sample with varying degrees of statistical certainty. Next the author tests whether the fundamental indices are small-cap and value biased relative to the cap-weighted benchmark and whether there exists small-cap and value premia in Sweden. The author finds that the Swedish stock market does exhibit a value premium and, with a somewhat lower statistical significance, a small-cap premium. Furthermore, the fundamental indices have a noticeable exposure to the size and value factors, which the author interprets as evidence that the excess return from following a fundamental indexation strategy stems from exposure to these two risk factors.

However, the logical process of how the above conclusion was reached is not consistent. The conclusion is an example of a deductive fallacy; even if the size and value factors partially may explain the return differential, the methodology does not reveal to what extent these factors contribute to the observed excess return as a multi-factor model would show. In addition, even though fundamental index portfolios are biased toward size and value factors, the author does not examine whether exposure to these factors increases portfolio risk.

The most comprehensive study of fundamental indexation in an international context is conducted by Lobe and Walkshäusl (2010). The study encompasses 50 developed and emerging markets with over 26 years of data from June 1982 to July 2008. In addition to country-specific indices, the performance of fundamentally weighted global portfolios is compared against corresponding cap-weighted benchmark portfolios. The following fundamental metrics are considered: sales, income, book value, cash flow, net payout, and number of employees. In addition to individual fundamental portfolios, Lobe and Walkshäusl calculate a composite index as the average of the weights in sales, book value, cash flow, and net payout portfolios.

On a global scale, the first performance test results are promising with regard to the hypothesis that fundamental indexation beats cap-weighting. All individual fundamental indices show an excess return relative to the reference index with annual excess returns ranging from 2.53% (book value) to 3.94% (net payout). The standard deviation of monthly returns is lower for all fundamental indices than for the reference index, but the liquidity measures[30] are somewhat lower for the fundamental indices. In addition, the country and sector weightings turn out to be less volatile in fundamentally weighted indices over the examination period more accurately reflecting the evolution of the general economy. Further risk analysis shows that fundamental indices exhibit relatively higher negative skewness and higher excess kurtosis, which implies that the lower standard deviation measure of fundamental indices does not capture the riskiness of the strategy to the full extent. However, the added downside risk does not seem to be of a long-term character as all fundamental indices have higher minimum 12-month trailing returns than the benchmark market index.

Scaling down to country-level, the regressions yield similar results: all but four country-specific fundamental composite indices show superior monthly average returns relative

[30] Here measured by the average market capitalization and the fraction of total market capitalization belonging to the 100 largest stocks in each index.

to cap-weighting. The average annualized excess return for the sample is 2.46%. The fundamental indices for 25 countries have a lower annualized volatility than the cap-weighted benchmark index and in 43 countries the fundamental indices produce a higher Sharpe ratio.

Lobe and Walkshäusl examine the statistical significance of the returns in a single-factor and in a multi-factor framework[31]. The single factor model shows statistically significant alphas for all global fundamental indices, but only for 14 countries out of 50. The multi-factor model reveals that fundamental indices are significantly tilted toward the value factor and, to a lesser extent, to the size factor. However, the momentum factor does not seem to be a plausible explanation for the return differentials. After adjusting for the value and size tilts, 2 out of 8 global indices and 9 out of 50 country-specific indices exhibit a positive alpha. Thus Lobe and Walkshäusl conclude that in a global context and in certain countries, the excess return from following a fundamental indexation strategy cannot be explained by an added exposure to size, value or momentum factors[32].

5.3. Evidence from other instruments

Empirical research on valuation-indifferent indexation has recently been extended onto other asset classes than equities. Arnott et al. (2010) apply a valuation-indifferent weighting approach on investment-grade and high-yield U.S. corporate bonds as well as on emerging market bonds and establish that all individual and composite valuation-indifferent portfolios outperform their respective cap-weighted benchmark portfolios. After adjusting for duration and default risk factors, in addition to Fama-French risk factors, the valuation-indifferent bond portfolios generally exhibit statistically significant alphas. The result provides further support to the hypothesis that valuation-indifferent indexation adds value relative to cap-weighting irrespective of exposure to

[31] The multi-factor model used in the model includes Fama-French risk factors and a momentum factor (see Carhart (1997)).

[32] Analyzing Finnish equity data, Lobe and Walkshäusl (2010) obtain an annual excess return of 2.88% for the fundamentally-weighted index and a significantly lower volatility than the cap-weighted index. The monthly CAPM alpha is a statistically insignificant 0.34% and the CAPM beta is 0.69 on a 1% significance level. The three-factor CAPM alpha is 0.29% significant at the 10% level, and a beta of 0.79 at the 1% significance level. The factor loading to the size factor is an insignificant -0.03 and to the value factor 0.25 with a statistical significance at the 1% level. The momentum factor is a statistically insignificant 0.00.

size and value factor loadings as other risk factors are at play in the fixed income arena[33].

Hsu, Li, and Kalesnik (2010) find similar results in the U.S. real estate market. They construct a composite portfolio consisting of commercial real estate holding and investment companies and real estate investment trusts (REITs) and weight the portfolio using an equal average of four size metrics: sales, book value, dividends, and cash flow. The composite valuation-indifferent portfolio outperforms the cap-weighted benchmark with statistically significant excess return and with borderline significant positive alpha in a multi-factor model. With a global sample Hsu et al. aren't able to produce statistically significant results.

In conclusion, research on valuation-indifferent indexation in alternative markets is very limited, but the results so far indicate that fundamental index outperformance can be found in other asset classes as well. Of course, other asset classes may be affected by other risk factors than those typical for equities.

5.4. Summary of empirical literature

Virtually all empirical studies share the same observation: a fundamentally weighted indexation method produces higher risk-adjusted returns relative to a cap-weighted market index using historical data. The excess returns are for some metrics substantial; up to several percentage points on an annual basis. However, some risk measures indicate that the excess returns come at a cost; either a higher return volatility, lower portfolio liquidity or an added risk for outliers. Also, the observed excess performance is seldom constant, but varies closely with trends in valuation.

Furthermore, nearly all studies observe an added exposure to size and value factors. This observation is even acknowledged by foremost advocates of valuation-indifferent indexation. There is, however, a lack of consensus among researchers in that a small-cap or a value-tilted strategy is a fundamentally riskier investment strategy that would justify the observed historical outperformance of valuation-indifferent portfolios. As far as proponents of valuation-indifferent indexation (e.g. Arnott et al. 2008: 148) are concerned, the value effect is merely a manifestation, not a cause, of the flawed capitalization-based weighting mechanism.

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33 As examples, Arnott et al. (2010: 119) list maturity, term structure, collateral quality and default probability.

In light of the above observations, further research on the subject should put more emphasis on measuring investment risk. There are compelling arguments for the higher riskiness of small-cap and low valuation multiple stocks, but if these risks do not manifest themselves fully in historical return data, the underlying arguments become subject to reconsideration. In this sense the meticulous risk analysis in Stotz et al. (2010) is a step in the right direction in assessing the risk-adjusted performance of valuation-indifferent indexation.

6 DATA

This section provides a listing of the fundamental metrics used in the study, an overview of the data gathering process, and a review of the modifications that have been made to the data.

6.1. Selection of fundamental metrics

In order to gauge the economic significance of a company in line with the theoretic rationale set forth in Arnott et al. (2005), a number of appropriate fundamental measures of company size are selected as proxies for economic significance. Different fundamentals measure different aspects of company size and there may be several calculation alternatives within one metric. Also, as noted in Fuller et al. (2010), the decision regarding weighting criteria involves a subjective decision and this may include a selection bias in the results. In order to obtain a broad and balanced view of fundamental indexation, a diverse set of metrics are examined and the motivation for the inclusion of each measure is given in the listing below. Empirical literature gives reasonable pointers to where to begin, but there is no reason to exclude previously non-researched metrics from the study. However, data availability considerably narrows down the alternatives to a few well-known measures of company size. The following fundamental metrics are chosen for this study:

1) **Sales**: A metric similar to revenue, sales is usually at the top of the income statement and represents the volume of transactions multiplied by the price of the products or services sold. Variants of this measure are included in virtually all empirical studies of fundamental indexation. A sales-weighted index may be biased toward sectors with a low profit margin overweighting companies in mature, heavily competitive industries and companies that produce relatively homogenous products or services.

2) **Net earnings**: Net earnings are usually the bottom line in an income statement and depict the amount that can either be reinvested into the business or distributed to shareholders as dividends. Since the goal of virtually all businesses is to produce funds to either of the aforementioned purposes, maximizing earnings can be said to be of greater importance to a company and its owners than sales alone. Earnings can be a volatile figure and this characteristic may overweight or underweight highly cyclical industries in a particular year. Also, earnings can be subject to manipulation by companies with aggressive accounting practices. Earnings are a commonly used measure in fundamental indexation studies.

3) **Total assets**: Total assets are the sum of all tangible and intangible assets owned or controlled by a company. Likewise, total assets can be defined as the sum of the total liabilities and total shareholder's equity[34] of a company. It is the bottom line in a balance sheet. Most empirical studies use the shareholder's equity part to measure company size in fundamentally weighted indices. However, one motivation for using total assets instead of net assets is that total assets better describe the total magnitude of a company's operations irrespective of its capital structure. This measure of company size may overstate highly leveraged firms and capital-intensive firms.

4) **Free cash flow**: While net earnings represent the amount available for investment or distributions to shareholders, free cash flow is the amount available for distribution among all the securities holders of a company[35]. Free cash flow can be calculated as earnings before interest and taxes (EBIT) adjusted with depreciation, amortization, and changes in working capital and fixed assets. Much like earnings, free cash flow can be a volatile figure and is dependent on the management's willingness to spend on capital investments. A free cash flow-weighted index may emphasize stocks of mature companies with weak growth prospects.

5) **Paid cash dividends**: Equity owner's investment in the company is usually returned back in the form of cash distributions. Finnish listed companies generally follow a dividend policy with yearly distributions. A company may distribute its earnings to its shareholders as dividends or direct the funds into new investments. Dividend policy varies greatly between industries and between companies; the policy is largely dependent of the internal growth opportunities that the business faces. In the growth phase, companies generally do not pay dividends to shareholders as new investments are expected to be more lucrative. This measure of company size tends to exclude a significant part of companies from the index; namely, growth stocks. Also, companies in financial distress may choose not to distribute dividends. Approximately one fifth of listed Finnish companies did not pay dividend in 2010. Siegel (2009: A.14) considers dividends as the most appropriate weighting metric, because "dividends are the only fundamental variable that is completely objective, transparent and unable to be manipulated by managers who tinker with accounting assumptions".

   Another alternative instead of dividends would be to use the net payout measure, such as in Walkshäusl and Lobe (2010). Net payout takes into consideration share repurchases, which boost the stock price and thus can be regarded as an additional distribution to shareholders. However, as Arnott (2008: 223) notes, executives may prefer repurchases because executive compensation may be tied to specific share price or earnings per share targets, which both are positively affected by share repurchases. This makes the net payout measure somewhat unreliable. Also, executive compensation varies greatly between companies and repurchase

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[34] Also known as *net assets* or *book value of equity*.
[35] I.e. debt and equity holders

programs are a relatively new practice, whereas dividends are a more comparable measure when investigating long-term data.

6) **Number of employees**: The employee figure is the only non-financial metric in this study. The rationale for using employees as a size metric is that the number of employees can be used as a proxy for the amount of labor done in a company, as suggested in Andersson (2009: 37). But in the capital and knowledge-based economy of today, the employee number alone may not be that accurate measure of total labor or value creation done in businesses. Nevertheless, the amount of employees measures one aspect of company size. An employee-weighted index may allocate a higher weight on companies that favor temporary workers and require a lower degree of specialization from its employees over capital intensive and knowledge intensive companies.

6.2. Company fundamentals and return data

Financial statements are disclosed on an annual and on a quarterly basis by Finnish publicly listed companies. In this study, annual financial statements data are needed in the portfolio construction process. Using quarterly data would mean more frequent rebalancing, which is not in the best interests of fund investors, unless there are clear performance benefits that outweigh the increased trading costs. Annual data is used in the original study by Arnott et al. (2005) and a model with quarterly rebalancing is not found to affect the results in a material way in their study. In addition to company fundamentals, market capitalization data is needed to construct a benchmark portfolio.

Company fundamentals and market capitalization data are retrieved from the Worldscope database. The time series data depict the situation at year-end, except for market capitalization, for which data is obtained for the day of portfolio reweighting at the end of March. In some rare cases where the financial year of a company ended mid-year, that figure is used as the year-end data point. Occasionally, some data points are missing from the Worldscope time series, in which case the relevant information is acquired directly from companies' yearly annual reviews. This may indicate that the data in Worldscope is somewhat inaccurate and subject to errors. In addition, data for some delisted companies is missing entirely. These companies are excluded from the sample.

Return data are acquired from the Thomson Reuters Datastream database. Return data represents the total return of a stock, which takes into consideration price appreciation/depreciation, annual dividends, and special dividends on a pre-tax basis. It is equal to the gross investment return a private investor gets on a stock and the net investment return for a tax-exempt investor. Return data is given as the adjusted, indexed[36] closing price of a security and is measured on a monthly basis, which is a reasonable observation frequency for a non-professional investor. The nominal return data is adjusted for inflation using Finnish consumer price index data provided by Statistics Finland (2011) as a deflator. Real returns are preferred as they better reflect the actual surplus an investor gets for invested capital.

Total return data are available from 25.3.1988 onwards. Because monthly data are used in the study, the time period of the study is 31.3.1988 – 31.12.2010; a total of 273 months or 22 years and 9 months. Earlier data exist for the year-end fundamental metrics used in the study, but these data are needed only from 1987 to 2009. There is, however, one exception; year-end free cash flow figures are available from 1994 to 2009. The difference in sample time periods should be noted in the interpretation of results.

In addition to stock returns, the linear regression models used in the study require an estimate of the risk-free rate of interest. As a proxy for the risk-free rate, the historical monthly average of the 3-month Helibor/Euribor rate is used. Interest rate data is acquired from the Thomson Reuters Datastream database. Data on Helibor rates is available for the time period March 1987 – December 1998, after which the interest rate proxy is switched to the pan-eurozone Euribor reference rate.

The sample covers all Finnish publicly traded companies on the NASDAQ OMX Helsinki exchange at year-end 2010. In addition to current listings, the sample includes delisted companies taken from a list provided by Kauppalehti (2010). After these inclusions, the total number companies amounts to 181. However, due to data availability issues, the number of companies in the sample is reduced to 162. This means that the results suffer from a survivorship bias whose effect is difficult to determine. However, the magnitude of the bias should be tolerable, as most omitted companies are from diverse industries and would have a relatively small index weight, both on a market cap and valuation-indifferent basis. Furthermore, the list of delisted companies in Kauppalehti (2010) may be incomplete, since the earliest notations are from 1996.

[36] In this context *indexed* means that the first observation in a time series is given a starting value of 100, regardless of the nominal share price.

Corporate events, such as mergers, acquisitions, and bankruptcies, are taken into consideration in the return calculation. Companies that expire during the investigation period remain in the sample until they are delisted. Cross-listed companies are included in the sample only if the corporate headquarters is located in Finland. If there are data for several share series, the most liquid series is selected. No further restrictive measures on the sample are selected, as a close inspection of the return and fundamental data does not reveal any peculiar outliers.

The sample aims to replicate the full set of investment alternatives available to Finnish equity investors during the investigated time period. This is why the inclusion of delisted companies is of significant importance. Arnott et al. (2005) and Chen et al. (2007) limit the number of companies to 1000 largest by each measure, which may mean that the companies in the indices differ between different measures of company size. In addition, a great number of smaller companies are excluded from their indices, which contradicts the aim of mirroring the relative weights of the whole economy. A subset of a larger sample may thus introduce a selection bias in the results. Hemminki and Puttonen (2008) use another sampling method in their study. They select a cap-weighted index and reweight the index components using fundamental measures. This sampling procedure is also affected by selection bias as the index components weighted by capitalization are not necessarily the same as in a fundamentally weighted index. Selection bias can be avoided by using a sample that covers all stocks in a particular market when constructing the portfolios. The sampling method in this study differs from the aforementioned studies in the way that the sample size is dynamic. The number of companies varies yearly as new stocks enter the sample and deceased stocks exit the sample. The number of stocks in the sample is somewhat steadily growing and peaks at 128 stocks at year-end 2007. In total, the sample in this study covers 2079 firm-years.

The data used in the study may be subject to errors in the databases from which the return data and company fundamentals are retrieved. Other possible error sources include human mistakes during data gathering and data processing. Also, Arnott et al. (2008: 192) mention that company fundamentals may be subject to accounting fraud, which would falsely reflect the companies' significance in the economy. The magnitude of these errors on the results is difficult to evaluate.

7 METHODOLOGY

This section presents the methodology used to conduct the empirical study. First, the portfolio construction and reweighting process is explained in detail. Next, the relevant performance metrics in order to compare the performance of valuation-indifferent indexation methods against the cap-weighted benchmark method are presented. Portfolio performance is assessed with respect to three aspects, in particular: total return, riskiness, and liquidity. In addition, single-factor and multi-factor regression models are used to dissect the total return of the different indexation strategies into alpha, beta, and Fama-French size and value factors. Finally, the set of tested hypotheses is defined.

7.1. Portfolio construction

Three different weighting methods are investigated: cap-weighting, equal-weighting, and fundamental-weighting, of which the two latter represent valuation-indifferent weighting methods. Altogether, nine portfolios are constructed: one cap-weighted, one equally weighted, six fundamentally weighted, and one fundamentally weighted composite portfolio. The fundamentally weighted portfolios are weighted according to the following metrics: sales, earnings, assets, dividends, number of employees, and cash flow. The composite portfolio comprises all the aforementioned fundamental metrics less cash flow[37].

A manually constructed cap-weighted benchmark portfolio is preferred over an established cap-weighted index, such as the NASDAQ OMX Helsinki All Share Growth Index, because the set of companies in the established index may not fully correspond with the sample used in the study. The subject of study is the performance of indexation methods, not the performance of sampling methods. Also, there could be other inconsistencies in the index construction with regard to entry and exit of index constituents and in the calculation of market capitalization[38].

The portfolio weighting procedure is straightforward: The weight w of an individual stock i in a cap-weighted index is $w_{i,t}^{MCAP} = MCAP_{i,t} / \sum_{j=1}^{N} MCAP_{j,t}$, where MCAP denotes

[37] The cash flow measure is excluded from the composite portfolio due to time period incompatibility; cash flow data is available from 1994 whereas data for the other five metrics exist from 1987. Including cash flow in the composite index would mean a change in portfolio construction methodology during the investigation period, potentially inducing a bias in the results.

[38] E.g. whether a company's market capitalization is float-adjusted or not.

the market capitalization of a stock *i* at time *t* and *N* is the total number of stocks in the index. In a fundamentally weighted index the weight of stock i is $w_{i,t}^{F} = F_{i,t-1}/\sum_{j=1}^{N} F_{t-1}$, where $F_{i,t-1}$ is the fundamental measure of a company at the end of fiscal year t-1 closest to t. The index weight in an equally weighted index is $w_{i,t}^{EQ} = 1/N_t$. The composite fundamental portfolio weight is the average of five fundamental metrics, $w_{i,t}^{COMP} = 1/5(w_{i,t}^{SALES} + w_{i,t}^{EARNINGS} + w_{i,t}^{ASSETS} + w_{i,t}^{DIVIDENDS} + w_{i,t}^{EMPLOYEES})$. The sum of index weights in all indices is 1. Index return between t and t + 1 is calculated as the product of individual stock returns: $R_{t+1}^{INDEX} = \sum_{i=1}^{N} w_{i,t}(1 + R_{i,t+1})$.

Index reweighing takes place at the end of the last trading day of March each year. Similar to the conceptual timeline in figure 2 (p. 15), market capitalization data is instantly available on the day of reweighting, but the fundamental metrics have a lag of three months, which should cover the time it takes for companies to compile and publish the financial statements from the latest fiscal year.

In line with Arnott (2005) and Lobe and Walkshäusl (2010), if a company has negative earnings or negative cash flow in a single year, the data point is set to zero. This means that the portfolios cannot take short positions in stocks. The reason for restricting short sales is based on economic intuition; the aim of fundamental indexation is to measure the economic weight of a company and allowing companies to have a negative economic weight would be peculiar.

In contrast to Arnott et al. (2005), the fundamental measures are not averaged over several years, but represent the latest disclosed year-end figures. The reason for this choice is mainly practical; since the sample size is considerable smaller in this study, shortening the investigation period for averaging purposes may hurt the robustness of the results. Another reason is congruence; if averaged values of company fundamentals are used, the corresponding procedure should be applied on the market value-weighted index as well. In that case the cap-weighted index would not be based on current market assessment.

While the portfolio construction and the performed calculations are not conceptually hard to grasp, the data processing is cumbersome and time-consuming. Despite meticulous attention to details one cannot exclude the possibility of mistakes in data processing. Furthermore, it is in order to consider two possible methodological issues that could weaken the relevance of the used models; namely data mining and the disparity between statistical and economic significance. Data mining relates to the selection of inputs used in the model. There is a possibility that certain input variables, in this case company fundamentals, are favored ahead of others in order to obtain satisfying results. The second issue refers to the possibility that a fixation for statistical significance makes the selected econometric model less applicable in a practical context. The aforementioned problems are addressed in part through using same variables and econometric models as in previous research, limiting the selected data inputs to well-known and easily obtainable corporate fundamentals, preferring simplicity ahead of explanatory power in model construction, and through determining a set of expected hypotheses beforehand (see section 7.4).

7.2. Performance evaluation

Once the test portfolios are constructed, the next step is to analyze three aspects of portfolio performance: total return, risk, and liquidity. A number of nominal and risk-adjusted return measures are calculated in order to assess the returns of valuation-indifferent portfolios relative to the cap-weighted benchmark portfolio. Portfolio returns are calculated on a yearly, compounded, and rolling basis. The risk-adjusted measures used in the study include CAPM-beta, Sharpe ratio, and Treynor measure.[39] To test whether or not the medians of the differences between valuation indifferent and cap-weighted index returns equal zero, a matched pairs test is used. The Wilcoxon matched-pairs signed-ranks test (Wilcoxon, 1945) is preferred over a sign test or a student-t test for paired samples, as the Wilcoxon test is non-parametric and suitable for dependent samples[40]. In addition to difference direction, the magnitude of the difference is also taken into consideration. The null hypothesis in the Wilcoxon test is that the difference between the observations of each pair has a median value of zero. The absolute differences of each pair are ranked from 1 to N, where N denotes the number of pairs in the sample. Pairs with a zero difference are omitted[41]. Next, the original signs are affixed to the ranked numbers and the positive and negative ranks are summed; W_+ and W_-, respectively. For large samples, an approximation of the level of

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[39] Sharpe ratio is calculated as the (ex-post) return of an asset earned above the risk-free rate divided by the realized volatility for the same time period. The calculation for the Treynor measure is the same, except volatility is replaced by the CAPM-beta. On how to determine the CAPM-beta, see section 7.3.

[40] The Jarque-Bera statistic for the variables implies that the return differences between valuation-indifferent and cap-weighted indices are not normally distributed; hence a non-parametric test is preferred. Further, variable dependency (e.g. time-dependence) in financial time series cannot be ruled out.

[41] Such pairs are not found in the data sample used in this study.

significance is obtained by calculating a normally distributed Z-statistic $Z = (W_{max} - 0.5 - \frac{N(N+1)}{4})/\sqrt{N(N+1)(2N+1)/24)}$.

Portfolio risk is a multi-faceted concept that cannot be compressed into a single measure. The volatility of portfolio returns is a key risk measure in a CAPM-framework, but a thorough analysis of the shape and dynamics of the historical distribution of returns provides a more complete picture of investment risk. Outlier risk, or the frequency and severity of extreme return variation, is of particular interest. Metrics that measure outlier risk include minimum and maximum return range, as well as the skewness and kurtosis of the return distribution.

The costs associated with pursuing an investment strategy are often omitted from academic studies. However, this aspect is of importance in performance evaluation studies, because much of the claimed benefits of "superior" investment strategies disappear when trading costs and management fees are added into the picture. The actual costs of following an investment strategy that involves buying and selling securities is difficult to determine due to factors such as fund size and time-variable transaction fees. For the aforementioned reasons, a direct cost analysis is omitted from this study, but a number of liquidity measures are calculated in order to get a rough assessment of the indices' holding concentration and liquidity risk. These include portfolio turnover, cap ratio, concentration ratio, and the Herfindahl Index.

Portfolio turnover measures the total share of assets bought and sold in a portfolio relative to the total market capitalization of the portfolio. Cap ratio is a measure of relative investment capacity of an index. It is acquired by dividing the average market capitalization of each valuation-indifferent index with the average market capitalization of the benchmark cap-weighted portfolio. A cap ratio of .7 for a valuation-indifferent index means that the weighted-average market capitalization is 30% lower than in the market portfolio. The concentration ratio gives the relative share of a given number of largest companies in the index. The ratio is calculated as $CR_m = \sum_{i=1}^{m} w_i$ where w is the percent weight of security i and m is the number of largest companies used in the calculation. In this study the concentration ratio is calculated as the relative share of the 10 largest companies in the index. Another concentration measure is the Herfindahl Index. Originally used to measure the relative size of firms in an industry (Herfindahl 1950), the metric is also suitable to measure the concentration of an index or a portfolio. The calculation formula for the index is $H = \sum_{i=1}^{N} w_i^2$ where w is the percent weight of security i and N is the number of index constituents. Because the weights of index constituents are squared, the Herfindahl index gives a relatively larger weight to large companies than when using the concentration ratio.

7.3. Multi-factor analysis

To further examine the risk-adjusted performance of the investigated indices, portfolio returns are evaluated in a Fama-French three-factor framework. A starting point for the evaluation is the classical single-factor CAPM model[42], which decomposes portfolio return into a number of factors. The factors can be estimated through a linear regression model. The intercept of the regression, α, or *Jensen's alpha*, can be interpreted as a measure of relative out or underperformance against the benchmark market portfolio.

Previous research on valuation-indifferent indexation has found convincing evidence of a possible size and value effect in valuation-indifferent portfolio returns. In order to determine the significance of these effects on historical Finnish equity data, the classical CAPM model is augmented by two additional explanatory variables, the SMB and HML factors[43], in accordance with the methodology in Fama and French (1993). As noted in Fama and French (1992), the CAPM expanded with a size and a value factor manages to explain relatively well the average price variation in U.S. stocks. The single-factor (eq. 4) and multi-factor (eq. 5) regression models are presented below:

$$r_{i,t} - r_{f,t} = a_i + b_i(r_{m,t} - r_{f,t}) + \varepsilon_{i,t} \quad (4)$$

$$r_{i,t} - r_{f,t} = a_i + b_i(r_{m,t} - r_{f,t}) + s_i SMB_t + h_i HML_t + \varepsilon_{i,t} \quad (5)$$

Where $r_{i,t}$ is the return of the valuation-indifferent portfolio i in month t, $r_{f,t}$ is the risk-free rate in month t, and $r_{m,t}$ is the return of the benchmark cap-weighted market portfolio in month t. SMB and HML denote the risk factors associated with company size and book-to-market ratio. The regression intercept is a_i and the factor loadings are b_i, s_i, and h_i. Finally, $\varepsilon_{i,t}$ denotes the error term. The regressions are estimated using the ordinary least squares (OLS) estimation method.

In the multi-factor model, stocks are first ranked and then divided into two groups at the end of March according to their market value. If the market value of a stock is below

[42] described in e.g. Sharpe (1964).
[43] ”Small minus big” and ”high minus low”, respectively.

the sample median it is be placed to the Small category (S) and if it is above the median market value it is placed in the Big category (B). Similarly, at the end of March stocks are divided into three groups according to their book-to-market ratio. The first category (L) holds the lowest 30%, the middle category (M) the next 40%, and the top category (H) the highest 30% of stocks ranked by their book-to-market ratio. The latest yearly company financial reports are used to calculate the book-to-market ratio. Negative book-to-market ratios are set to zero. Six portfolio combinations (S/L, S/M, S/H, B/L, B/M, and B/H) are then formed at the intersections of the two size and three book-to-market groups. The returns on these portfolios are calculated on a monthly basis and the six portfolios are reweighted each year at the end of the last trading day in March.

The SMB premium, which corresponds to the size factor and is included in equation (5), is the difference between the mean returns of the three Small portfolios and the mean returns of the three Big portfolios. It is calculated as R(S/L + S/M + S/H)/3 – R(B/L + B/M + B/H)/3. Similarly, the HML premium, which is meant to capture the effect of the value factor, is the mean returns of the two high book-to-market portfolios less the mean return of the two low book-two-market portfolios. The calculation is R(S/H + B/H)/2 – R(S/L + B/L)/2. The decision to group stocks into two size and three value categories is arbitrary and follows the same procedure as, for example, in Fama and French (1993) and in Lobe and Walkshäusl (2010). Monthly return data on the SMB and HML variables reveal that a value-tilted portfolio has yielded a positive monthly return difference of 0.40%. Conversely, there is no convincing evidence of a notable size premium in the Finnish equity market as the SMG factor is merely 0.03%, on average.

Several studies[44] also include a fourth factor, momentum, in the multi-factor analysis, but the factor is excluded from this study due to lacking theoretical foundations and empirical evidence.

Preliminary regression tests show signs of autocorrelation and heteroskedasticity in the regression residuals. To address these issues, Newey and West (1987) heteroskedasticity and autocorrelation consistent (HAC) standard errors are used in all subsequent regressions.

[44] e.g. Amenc et al. (2009), Stotz et al. (2010), and Lobe and Walkshäusl (2010).

7.4. Hypotheses

The following hypotheses are investigated in the performance tests (* denotes the expected outcome):

Hypothesis #1:

H_0: Valuation-indifferent indices do not outperform the cap-weighted benchmark

H_1: Valuation-indifferent indices outperform the cap-weighted benchmark *

Hypothesis #2:

H_0: No performance difference between equally weighted and fundamentally weighted portfolios *

H_1: Performance difference between equally weighted and fundamentally weighted portfolios

Hypothesis #3:

H_0: Valuation-indifferent indices do not exhibit positive alpha in single-factor CAPM

H_1: Valuation-indifferent indices exhibit positive alpha in single-factor CAPM *

Hypothesis #4:

H_0: Valuation-indifferent indices do not exhibit positive alpha in Fama-French three-factor CAPM *

H_1: Valuation-indifferent indices exhibit positive alpha in Fama-French three-factor CAPM

In addition, a significant exposure to the value factor (HML) is expected in the three-factor regression model. The expectations are in line with the justifications set forth in the theoretical part of the thesis and with empirical literature discussed in detail in section 5.

8 RESULTS

The next three subsections analyze portfolio performance with respect to three characteristics: portfolio return, portfolio risk, and portfolio liquidity. The results of the Fama-French three-factor analysis are given in section 8.4.

8.1. Performance evaluation

The historic performance of the cap-weighted index and the valuation-indifferent indices is given both on an aggregate and on a yearly basis in table 1 below.

Table 1 Performance data on the investigated indices

The cap-weighted benchmark index is on the far left followed by the equal-weighted, the fundamental composite, and the six individual fundamental indices. The fundamental composite index is an equally weighted average of the individual fundamental indices, less cash flow. Return data (adjusted for inflation) are given both on a cumulative and on an annual basis. The return data cover the time period from 31.3.1988 to 31.12.2011; year 1988 thus only covers nine months. Below the return figures, a number of risk measures are given for each index.

#	Year	R(MCAP)	R(EQUAL)	R(COMP)	R(SALES)	R(ASSETS)	R(EARN)	R(DIV)	R(EMPL)	R(CASH)*
1	1988	1.87%	-1.85%	5.53%	0.89%	17.17%	6.24%	6.93%	-2.93%	
2	1989	-13.20%	-9.28%	-11.36%	-5.12%	-14.27%	-11.14%	-14.73%	-11.40%	
3	1990	-37.10%	-31.62%	-36.23%	-35.08%	-34.37%	-36.46%	-37.21%	-38.30%	
4	1991	-10.90%	-2.51%	-9.74%	-7.38%	-12.80%	-16.29%	-5.50%	-6.65%	
5	1992	9.84%	17.89%	11.54%	13.72%	-11.60%	27.11%	5.61%	26.64%	
6	1993	78.25%	56.44%	89.76%	84.42%	100.26%	82.98%	87.85%	92.29%	
7	1994	17.19%	5.80%	11.41%	14.57%	1.94%	6.47%	15.81%	18.28%	
8	1995	-4.55%	-7.85%	-5.21%	-6.13%	-8.65%	-5.21%	0.64%	-7.35%	5.21%
9	1996	49.01%	66.60%	46.64%	46.20%	49.19%	36.86%	49.61%	50.61%	34.73%
10	1997	32.60%	38.61%	31.34%	26.01%	44.90%	35.43%	23.04%	27.44%	20.42%
11	1998	51.67%	-2.29%	20.70%	14.30%	12.70%	39.85%	28.05%	10.52%	40.74%
12	1999	141.59%	36.40%	76.60%	69.08%	53.59%	102.56%	96.16%	65.06%	102.37%
13	2000	-20.84%	-3.05%	-9.99%	-11.39%	-7.65%	-6.18%	-11.51%	-13.30%	-16.94%
14	2001	-30.48%	-1.63%	1.62%	2.98%	4.83%	-5.51%	-2.17%	6.40%	-3.54%
15	2002	-37.39%	-11.38%	-13.50%	-11.13%	-8.05%	-20.01%	-20.16%	-7.83%	-20.64%
16	2003	3.82%	51.84%	16.98%	18.01%	19.46%	7.41%	13.47%	26.97%	10.02%
17	2004	6.78%	17.83%	18.33%	18.66%	24.16%	9.89%	18.24%	19.72%	11.04%
18	2005	32.51%	31.05%	34.03%	33.29%	34.89%	34.62%	31.70%	35.53%	33.48%
19	2006	17.58%	23.01%	22.93%	22.65%	27.27%	20.26%	18.24%	26.31%	19.21%
20	2007	18.69%	0.04%	9.56%	9.33%	1.87%	22.18%	16.31%	-0.50%	15.20%
21	2008	-50.44%	-44.22%	-49.97%	-51.74%	-45.34%	-52.23%	-48.88%	-51.68%	-48.86%
22	2009	24.40%	56.68%	38.36%	37.73%	35.78%	26.89%	37.57%	53.98%	19.88%
23	2010	22.85%	17.63%	23.61%	22.15%	25.04%	28.74%	17.86%	24.20%	27.60%
Cumulative 22,75 year return		331.71%	720.11%	756.32%	675.31%	690.16%	720.17%	729.35%	852.38%	441.60%
Geometric mean return p.a.		**5.41%**	**9.07%**	**9.30%**	**8.76%**	**8.86%**	**9.07%**	**9.13%**	**9.88%**	**9.89%**
Geometric mean excess return p.a.**			3.65%	3.89%	3.35%	3.45%	3.65%	3.71%	4.46%	4.48%
Correlation		1.00	0.74	0.91	0.89	0.82	0.95	0.94	0.85	0.92
Standard deviation		28.17%	18.83%	22.64%	22.22%	23.00%	25.22%	23.21%	22.39%	23.97%
Beta		-	0.73	0.86	0.84	0.82	0.92	0.88	0.83	0.81
Treynor		-	0.08	0.07	0.07	0.07	0.06	0.07	0.08	0.08
Sharpe		0.08	0.31	0.27	0.25	0.25	0.23	0.26	0.30	0.28
Maximum monthly return		32.29%	24.79%	30.64%	31.99%	32.66%	30.51%	29.26%	32.84%	28.17%
Minimum monthly return		-30.09%	-15.66%	-17.89%	-17.59%	-18.16%	-21.15%	-17.72%	-18.64%	-17.38%
Maximum 12 month return		144.91%	79.67%	123.17%	114.47%	137.70%	132.39%	114.94%	128.61%	102.37%
Minimum 12 month return		-60.22%	-45.71%	-53.94%	-55.58%	-52.20%	-57.60%	-52.49%	-52.94%	-54.50%
Skewness (monthly returns)		0.19	0.37	0.41	0.39	0.60	0.43	0.33	0.36	0.26
Excess kurtosis (monthly returns)		2.30	1.91	1.76	2.07	2.22	2.01	1.20	2.23	1.29

Gray = Index underperforms benchmark index MCAP
White = Index overperforms benchmark index MCAP

* Data from 4/1995
** R(index) - R(MCAP)

The results show that equally and fundamentally weighted indices generate, by a clear margin, an excess return relative to the cap-weighted benchmark index. The equally weighted index produces an excess real return of 3.65% annually and the corresponding figure for the composite fundamental index is 3.89%. The annual excess returns range from 3.35% (sales) to 4.48% (cash flow) for the individual fundamental indices, although the shorter investigation period makes the results of the cash flow-weighted index not directly comparable with the other indices.

Table 1 also highlights the individual years when valuation-indifferent indices underperform the reference index; the years are denoted by a grey background. A year-to-year comparison reveals interesting patterns: most valuation-indifferent indices underperform the cap-weighted index during years 1994-1999 and again in 2007. In 1998-1999 all valuation-indifferent indices performed worse than the cap-weighted market portfolio. The result is not surprising considering the fact that late 1990's and 2007 was characterized by rising valuation levels in the stock market driven by growth stocks in the IT sector. The same observation is made in Arnott et al. (2008: 103) in their study of the U.S. stock market.

Figure 4 Long-horizon performance of the three main indexation methods

This figure shows the cumulative geometric total return for the cap-weighted, the equally weighted, and the composite fundamentally weighted portfolios on an inflation-adjusted basis. The fundamental composite index is an equally weighted average of the individual fundamental indices, less cash flow. The return data in the figure cover the time frame from 31.3.1988 to 31.12.2010.

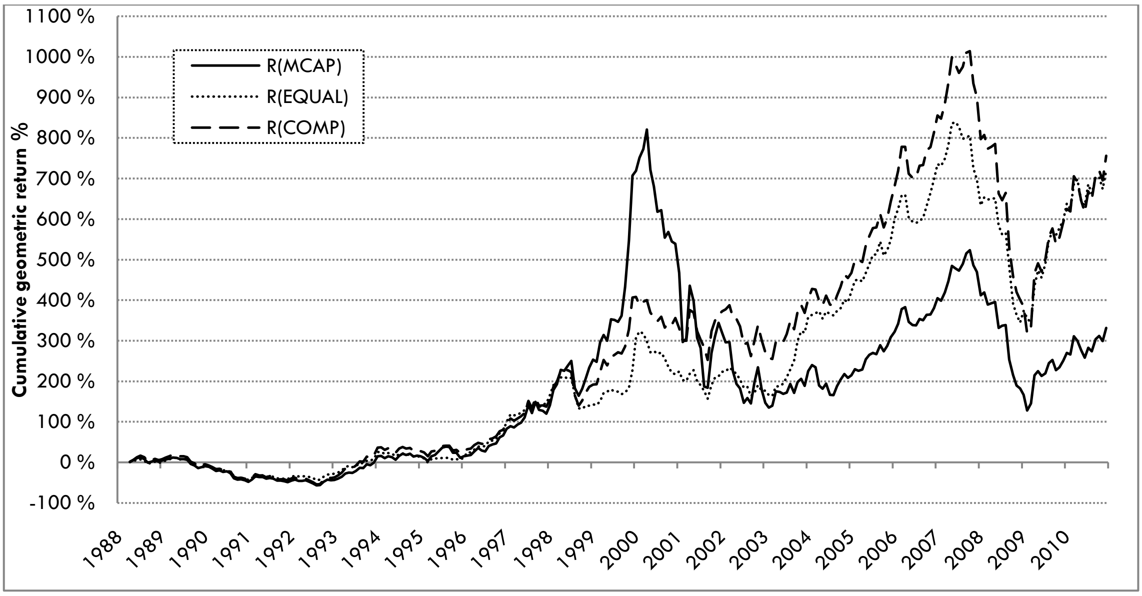


Figure 4 illustrates the long-horizon performance of the market cap-weighted, equally weighted, and composite fundamentally weighted indices. The time period after the implosion of the 2000 market peak largely explains why valuation-indifferent indexation schemes have achieved such notable positive return difference relative to the cap-weighted portfolio. The market downturn violently brought the market values in the cap-weighted portfolio below pre-bubble levels while valuation-indifferent portfolios were largely in a sideways market during the 2000-2002 time period. The subsequent recovery of market values was an exceptionally favorable time period for both equally and fundamentally weighted portfolios whereas the cap-weighted benchmark portfolio did not even reach the market peak of 2000 before the downturn of 2007-2008 occurred. During the downturn valuation-indifferent indices suffered severe losses and the losses for some indices even surpassed those of the cap-weighted benchmark. Interestingly, the valuation-indifferent indices did not offer protection from a market crash as they did in the downturn of 2000-2002. The reasons for the inconsistent behavior during these two market downturns are unclear. However, the corresponding recessions can be said to have had different origins: the 2000-2002 recession is closely associated with the overheating of the IT sector while the 2008-2009 recession began as a credit crisis and had a profound impact on the general economy. The ongoing recovery period since March 2009 has so far been considerably better for valuation-indifferent indices. The cumulative return differentials between valuation-indifferent portfolios and the cap-weighted benchmark are approximately 400% during the sample time period.

Figure 5 Total returns of the three main indexation methods in a rolling 36-month window

This figure shows the 36-month rolling total return for the cap-weighted, the equally weighted, and the composite fundamentally weighted portfolios on an inflation-adjusted basis. The fundamental composite index is an equally weighted average of the individual fundamental indices, less cash flow. The figure covers the time frame from 31.3.1991 to 31.12.2010.

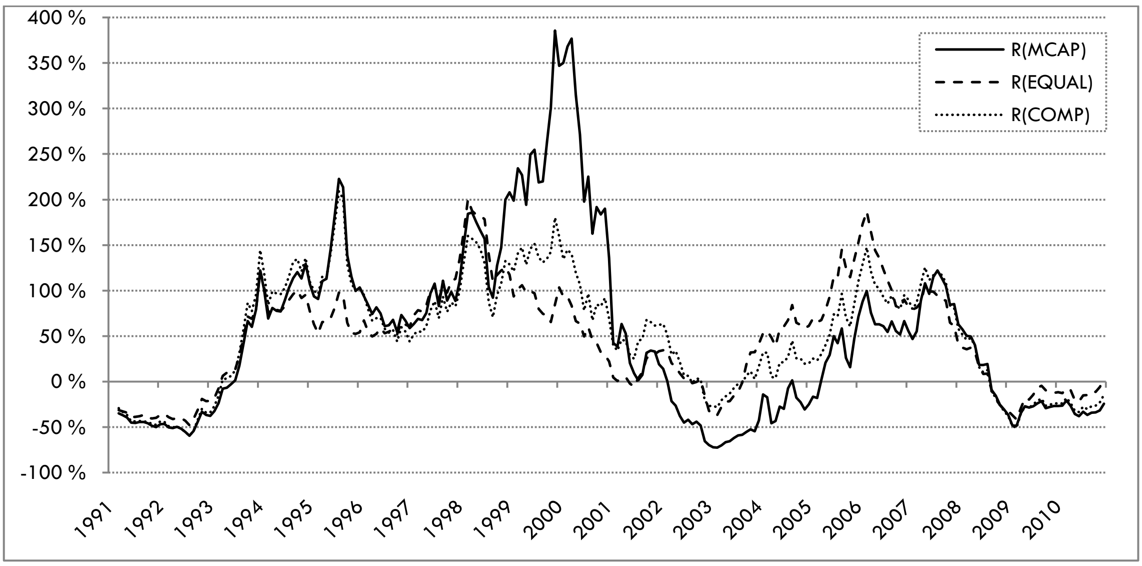
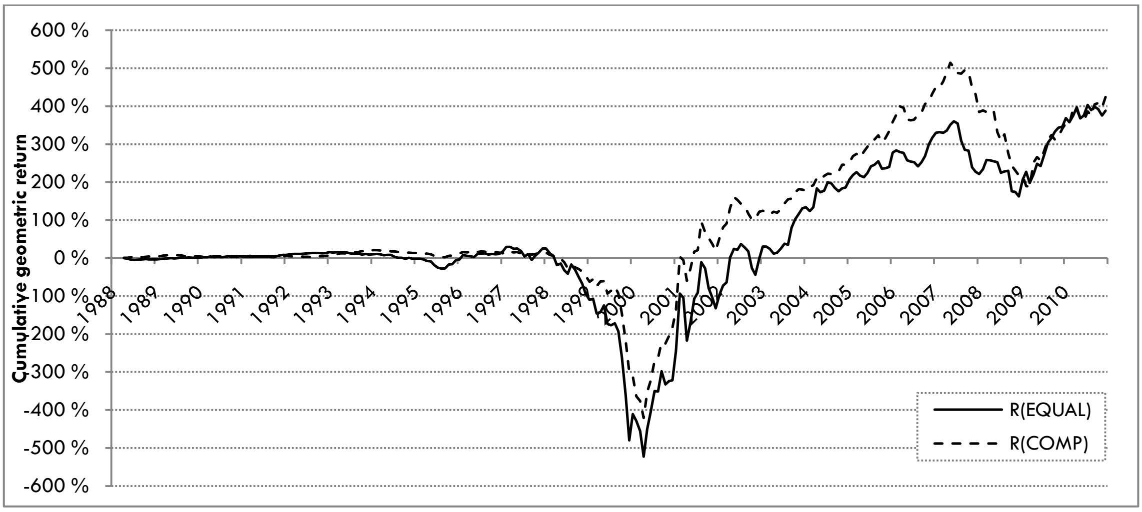


Figure 6 Cumulative annual growth rate difference versus the cap-weighted benchmark index R(MCAP)

The figure below shows the cumulative geometric return difference between the cap-weighted benchmark portfolio and the equally and the composite fundamentally weighted portfolios on an inflation-adjusted basis. The fundamental composite index is an equally weighted average of the individual fundamental indices, less cash flow. The figure covers the time frame from 31.3.1988 to 31.12.2010.



The comparative performance of the equally weighted and the fundamentally weighted composite portfolios relative to the cap-weighted market portfolio are illustrated above. Figure 5 shows the rolling 36-month returns for the three indexation methods and figure 6 shows the cumulative annual return difference against the benchmark index.

Figure 7 Historical performance of the investigated indices in return-volatility space

This figure shows the historical mean-variance efficiency of all the investigated portfolios. Mean-variance optimization involves maximizing returns (vertical scale) and minimizing return variance (horizontal scale); accordingly the portfolio that is located in the upper-leftmost part of the graph is assumed to deliver the best risk-adjusted returns. Asset returns are observed here on an aggregate basis and the figure below may thus give an overly simplified depiction of mean-variance efficiency. The fundamental composite index is an equally weighted average of the individual fundamental indices, less cash flow.

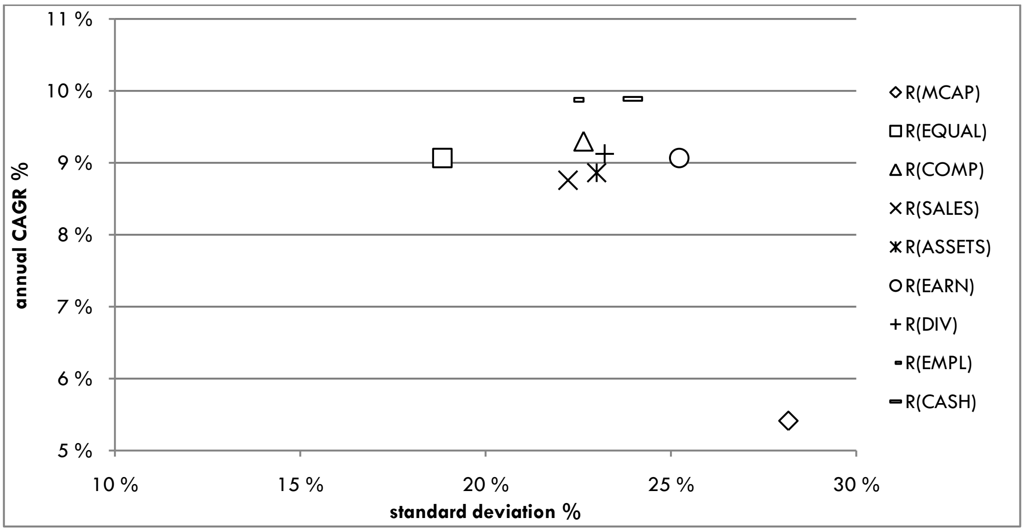


Figure 7 shows the performance of all the investigated indices in a return-volatility space. With the exception of the cash flow and employee-weighted portfolios, the valuation-indifferent indices' geometric annual mean returns fall within a single percentage point. The cash-flow and employee-weighted indices exhibit the highest returns in the whole set and the equally weighted index is the least volatile. The underperformance of the cap-weighted index relative to valuation-indifferent indices is apparent. The higher risk-adjusted performance of valuation-indifferent portfolios is also illustrated by positive Treynor measures and relatively higher Sharpe ratios. Again, the results of the cash flow-weighted index are not directly comparable with the other indices due to a substantially shorter observation period.

Table 2 Results of the Wilcoxon matched-pairs and single-factor CAPM regression tests

A matched-pairs test is used to determine whether differences between groups of paired data significantly differ from zero; in this case whether the differences of the monthly median returns between the cap-weighted and the valuation-indifferent indices significantly differ from zero. The calculation for the Z-statistic is Z=(W(max)-0.5-N(N+1)/4)/√(N(N+1)(2N+1)/24)). Furthermore, the single-factor CAPM regression variables are estimated by ordinary least squares (OLS) using Newey-West heteroskedasticity and autocorrelation consistent standard errors. The regression model is r(i,t)-r(f,t)=a(i)+b(i)(r(m,t)-r(f,t))+ε(i,t). The regression R^2's are adjusted for degrees of freedom. The fundamental composite index is an equally weighted average of the individual fundamental indices, less cash flow. Monthly return data from 4/1988 to 12/2010 are included in the sample.

	R(EQUAL)	R(COMP)	R(SALES)	R(ASSETS)	R(EARN)	R(DIV)	R(EMPL)	R(CASH)
Wilcoxon matched-pairs signed-ranks test:								
W+	20599	20528	20692	20674	20468	20767	20863	10301
W-	16802	16873	16709	16727	16933	16634	16538	7654
Wmax	20599	20528	20692	20674	20468	20767	20863	10301
N	273	273	273	273	273	273	273	189
Z-stat.	1.454	1.399	1.525	1.511	1.353	1.582	1.656	1.757
P-value (two tailed)	0.146	0.162	0.127	0.131	0.176	0.114	0.098	0.079
Single-factor CAPM regression test:								
a	0.0046	0.0035	0.0033	0.0038	0.0028	0.0032	0.0042	0.0035
	(0.1833)	(0.1891)	(0.2497)	(0.2651)	(0.146)	(0.1697)	(0.1995)	(0.2426)
b	0.7295	0.8576	0.8400	0.8204	0.9211	0.8767	0.8300	0.8078
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
R^2 (adj.)	0.7270	0.8951	0.8733	0.8088	0.9367	0.9211	0.8286	0.8845
N	273	273	273	273	273	273	273	189
Prob(F)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

The Wilcoxon matched-pairs signed-ranks test results mostly fail to confirm the statistical significance of the observed excess returns. Cash-flow and number of employees are the only two metrics passing the 10% significance threshold. The excess returns for the dividend-weighted and sales-weighted indices are borderline significant. For the equal, earnings, and composite fundamental-weighted indices, the null hypothesis clearly cannot be rejected. A closer inspection reveals that the prominent outperformance of the cap-weighted index relative to the valuation-indifferent indices during the volatile months in the late 1990's pulls the test results heavily toward statistical insignificance.

In table 2, just below the results for the Wilcoxon test, the results for the single-factor CAPM regression tests are displayed. The regression model does not provide assurance to the supposition of valuation-indifferent outperformance. The alphas for all valuation-indifferent indices are positive, but not adequately so. Thus, the expected outcomes for hypotheses #1 and #3 (see section 7.4.) cannot be confirmed with reasonable statistical certainty. The monthly alphas range from 0.28% to 0.46%. The CAPM-betas are 0.73 for the equal-weighted and between 0.81 and 0.92 for the fundamentals-weighted indices. All observed betas are highly significant. The high R-squared and F-statistics indicate that the regression model is a reasonably good fit for the data. The R-squared figures are corrected for degrees of freedom.

The regression results fall close to those reported in Lobe and Walkshäusl (2010), who obtained a statistically insignificant alpha value of 0.34% and a highly significant beta value of 0.69 for Finnish equities. Most fundamental indexation studies have acquired positive alphas with varying degrees of statistical significance. Further regressions are performed to examine the sensitivity of the results. A yearly return comparison (see table 1) indicates that the performance of valuation-indifferent indices relative to the cap-weighted index may be dynamic, with alternating periods of outperformance and underperformance. To test whether the results are affected by the considered time frame, the regressions are performed again, this time excluding the time period January 1998 – April 2001. The excluded time period is associated with strongly rising stock valuations during the early 2000's stock market boom. The results for these regressions show that all valuation-indifferent have statistically significant (5% threshold) monthly alphas ranging from 0.42% to 0.75%.[45] The previous results suggest that 1) regression results are highly dependent on the time frame considered, 2) the relative outperformance of valuation-indifferent weighting methods against cap-weighting is dynamic, and 3) a linear regression model may not be suitable to capture non-linear performance differences.

Hypothesis #2 is to investigate whether there is a performance difference between equal-weighted and fundamentally weighted indexation methods. The hypothesis is

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[45] The results for the supplementary regressions are presented in Appendix 2.

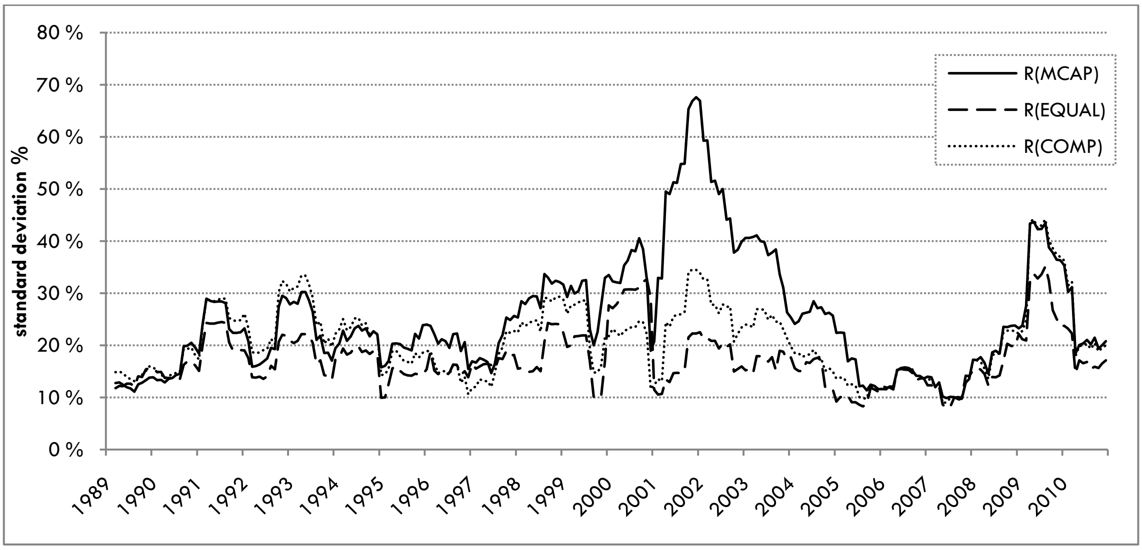
tested using a regression model similar to equation (4), except where instead of market risk premium the return difference between the equal-weighted index and the 3-month risk-free rate is used. No statistical significant deviations from zero are found; the null hypothesis cannot be rejected.[46] As expected, the behavior of the equally weighted portfolio does not seem to significantly differ from fundamentally weighted portfolios over longer-term horizons.

8.2. Risk analysis

Sample standard deviations at first seem abnormally high for all portfolios; the standard deviation range from 18.83% to 28.17%. Interestingly, and contrary to a priori expectations, the standard deviation for the cap-weighted index is notably higher than for the equally or for the fundamentally weighted portfolios. The above result indicates that a cap-weighted indexation strategy is not only underperforming, but is also a riskier strategy if one uses standard deviation as measure of investment risk. The reported standard deviations also vary between the valuation-indifferent indices. The equally weighted index stands out as a particularly low-risk alternative with an annualized standard deviation as low as 18.83%.

Figure 8 Annualized standard deviation of the cap-weighted, equally weighted, and composite fundamentally weighted indices in a 12-month rolling window

This figure shows the return variability of the three main indexation methods as measured by standard deviation. Specifically, standard deviation depicts the dispersion from mean and can be regarded as a measure of investment risk. Here the standard deviation, calculated from monthly portfolio returns, is shown on a 12-month rolling basis starting from 3/1989 to 12/2010. The fundamental composite index is an equally weighted average of the individual fundamental indices, less cash flow.

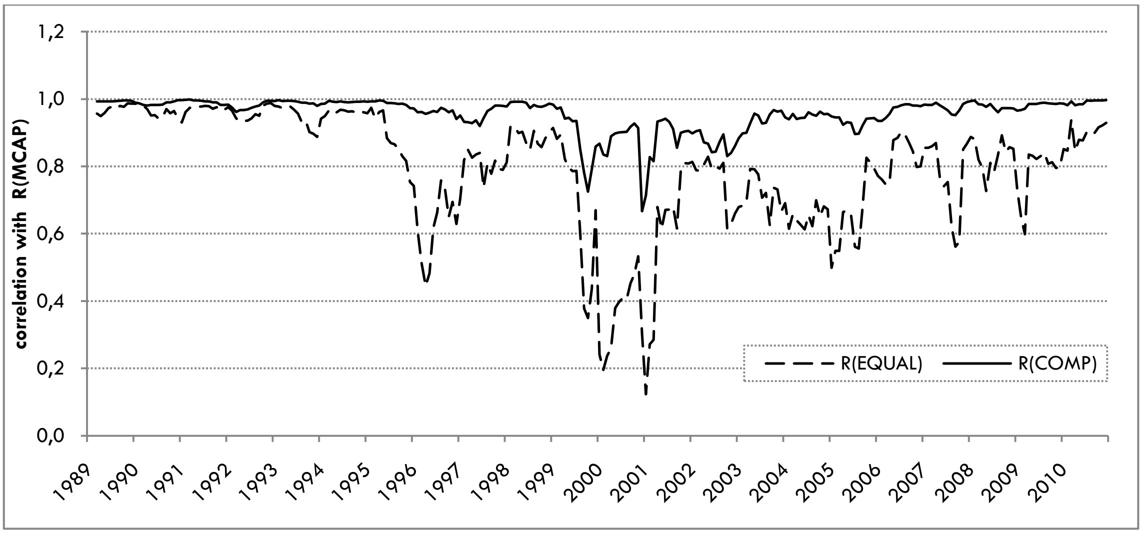


46 See appendix 2 for the regression results in detail.

A closer inspection reveals that standard deviation is highly dependent on the time frame used in the study. In the Finnish equity market, the time period 2000-2003 was exceptionally volatile. This volatile period particularly affects the results of the cap-weighted index, visible in figure 8 displaying the rolling 12-month volatility for the three main weighting methods.

Figure 9 Monthly correlation of the valuation-indifferent indices with the cap-weighted benchmark index in a 12-month rolling window

The figure below shows the correlation coefficients of the cap-weighted benchmark portfolio with the two main valuation-indifferent portfolios: the equally weighted and the composite fundamentally weighted portfolios. Correlation is a measure of linear dependence between two time series. However, a high correlation does not necessarily imply causation between the two variables nor does it imply a strictly linear relationship. The correlation coefficients are calculated from monthly portfolio returns on a 12-month rolling basis for the time period 4/1989 – 12/2010. The fundamental composite index is an equally weighted average of the individual fundamental indices, less cash flow.

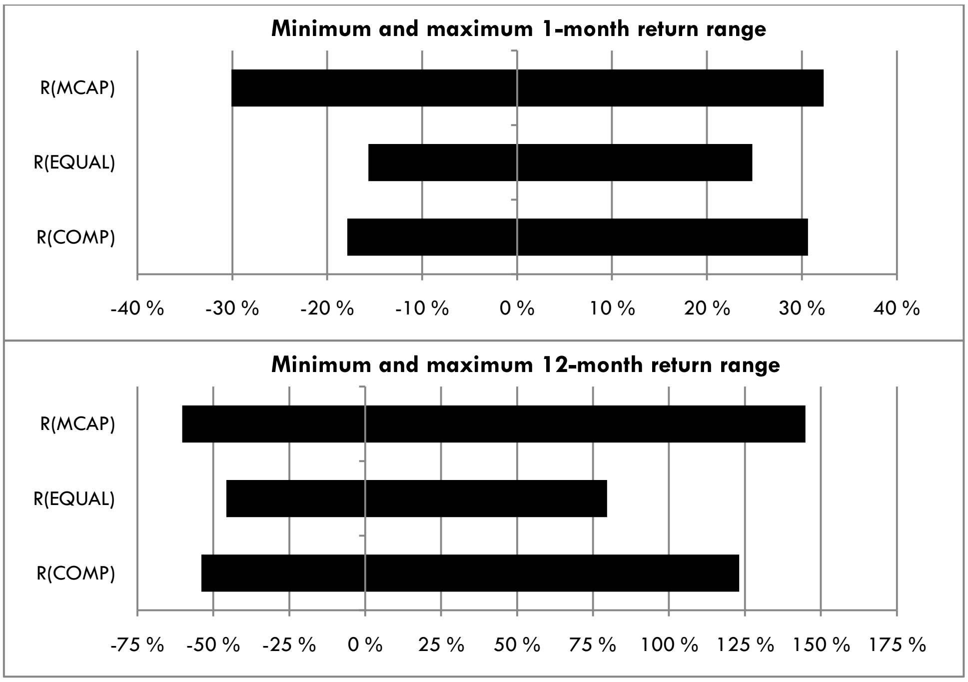


Arnott et al. (2005: 87) find in their study of the U.S. market that correlations between the fundamental portfolios and the reference cap-weighted benchmark portfolio are quite close to unity; the correlations range from .94 to .97. Correlations between the valuation-indifferent portfolios and the benchmark are somewhat lower in this study; .82 to .95 for the fundamentally weighted portfolios and .74 for the equal-weighted portfolio. The difference may arise from the fact that the Arnott et al. study covered several market cycles whereas this study only includes data from one, possibly two, market cycles. Further, the Finnish equity market during the sample time period has been considerably more volatile than the U.S. equity market. Visible in figure 9, correlations depart noticeably from unity during the run-up and the subsequent unwinding of the market bubble in early 2000's. In less volatile market conditions, the correlations between valuation-indifferent indices and the cap-weighted index are fairly close to one. Especially the correlation is high between fundamental and cap-weighted indices, as expected, since both indices aim to represent the companies' relative significance in economy whereas the equal-weighted index gives a more crude depiction of the broad economy.

Based on the results, it seems that a cap-weighted indexation strategy is, not only worse performing, but also a riskier strategy than valuation-indifferent indexation strategies as measured by standard deviation. Standard deviation, however, renders an incomplete picture of the risks involved for an investor. A more informative approach is to study the shape of the distribution of realized returns and especially the outlier risks. A number of outlier risk measures are examined. First, the range of minimum and maximum returns is wider for the cap-weighted benchmark portfolio than for any of the valuation-indifferent portfolios both for 1-month and 12-month periods. Figure 10 displays the return ranges for the cap-weighted, equally weighted, and fundamentally weighted composite indices.

Figure 10 The minimum and maximum 1-month (above) and 12-month (below) return ranges of the three indexation methods

In the figure below, the above horizontal bar graph shows the best and worst single month returns for the three main indexation methods during the observation period. The graph below shows the range of best and worst returns during a 12-month period. A wide return range may be indicative of outlier risk. The return data in the graphs cover the time frame from 31.3.1988 to 31.12.2010. The fundamental composite index is an equally weighted average of the individual fundamental indices, less cash flow.



Skewness is a measure of how symmetrically observations are spread around the mean. Zero skewness indicates a perfectly symmetrical distribution. A positive skewness means that the median observation is lower than the average value and a negative skewness indicates that the median observation is higher than the average value. In assessing investment performance, a negative skewness is generally considered an unwanted trait. Negative skewness is indicative of the possibility of extremely negative outliers, also known as skewness risk. Based on results, all valuation-indifferent portfolios exhibit positive skewness whereas the cap-weighted benchmark index return has a somewhat lower, yet still positive, skewness. Stated differently, the realized returns of the market portfolio conform better to a normal distribution, but valuation-indifferent portfolios exhibit relatively more abnormally high positive monthly outcomes.

Kurtosis denotes how dispersed the observations are around the mean. A low kurtosis indicates that observations are tightly clustered around the average value and a high kurtosis means a larger spread of observations. Positive excess kurtosis means that observations are more dispersed around the mean than what is predicted by the typical bell shaped curve of the normal distribution. This feature is known as kurtosis risk, or “fat tail” risk. The return distribution of the cap-weighted market portfolio shows a higher excess kurtosis than in any of the valuation-indifferent portfolios. The previous result implies a higher outlier risk in the cap-weighted portfolio.

8.3. Liquidity analysis

The liquidity measures given in table 3 should not strictly be interpreted as proxies for portfolio trading costs. In the context of this study, liquidity (or the lack thereof) should also be considered another aspect of portfolio risk. In a market where buyers and sellers are abundant and where information flows promptly from security issuers to market participants, an investor should be able to liquidate his or her trading positions with ease. Liquidity may become a problem if the size of the portfolio is substantial relative to the total size of the market as trading in large blocks may have a significant effect on market prices.

Table 3 Key liquidity measures for the examined indices (average values per annum, 1988 – 2010)

Liquidity measures may be used to gauge rebalancing costs, dispersion of portfolio holdings, and risks arising from potential liquidity issues. Portfolio turnover shows the share of the portfolio that is reweighted at the annual reweighting day at the end of March. CAP ratio is the average market capitalization of portfolio assets relative to the cap-weighted portfolio. Concentration ratio gives the share of the 10 largest holdings in the portfolio relative to the whole portfolio and Herfindahl index measures the dispersion of assets. The calculations for the measures are provided in section 7.2. All measures are given as a simple average of the yearly figures covering the years 1988-2010 (1994-2010 for the cash flow-weighted index). The fundamental composite index is an equally weighted average of the individual fundamental indices, less cash flow.

	Portfolio turnover	CAP ratio	Concentration ratio	Herfindahl Index
R(MCAP)	5.18 %	1	74.54 %	18.2
R(EQUAL)	18.55 %	0.16	14.70 %	1.5
R(COMP)	23.93 %	0.67	66.99 %	7.4
R(SALES)	18.55 %	0.64	67.85 %	7.5
R(ASSETS)	21.57 %	0.58	76.68 %	11.7
R(EARN)	66.52 %	0.86	79.64 %	13.9
R(DIV)	36.72 %	0.77	74.95 %	10.3
R(EMPL)	19.31 %	0.52	59.00 %	5.3
R(CASH)	53.37 %	0.67	78.77 %	13.5

The liquidity measures reveal several interesting observations. As expected, the yearly portfolio turnover figure is the lowest for the cap-weighted index portfolio, in which trading occurs only when new securities enter or delisted securities exit the index. IPO's in Finland peaked in the late 1990's, which increases the average figure for the cap-weighted index, but the turnover remained even lower than the corresponding figure for U.S. stocks in the time period 1962-2004[47]. However, valuation-indifferent portfolios require significantly more maintenance and the proportion of assets traded relative to portfolio size varies greatly between indices. Indices with the most volatile holdings are the earnings-weighted and cash flow-weighted indices, while the sales and equal-weighted indices have the second smallest figure of all; 18.55%. The composite fundamental index has an annual turnover rate of 23.93%.

The remaining three measures depict holding concentration. The index with the least concentrated holdings is the equally weighted index. Such a low concentration may be indicative of potential liquidity issues as the majority of holdings are in stocks with a relatively low market capitalization and trading volume. Weighting a portfolio by the number of employees also produced an index with a relatively low holding concentration. In other fundamental indices, the concentration ratios remain close to that of the cap-weighted benchmark portfolio. The lower CAP-ratios and lower Herfindahl numbers indicate that the holding distribution in fundamentally weighted

[47] For U.S. stocks, the portfolio turnover in the cap-weighted index is 6.30% and between 10.55% and 14.56% in the fundamental indices in Arnott et al. (2005).

portfolios is more balanced whereas the cap-weighted index places a larger share of portfolio assets in large cap stocks. In a nutshell, the liquidity characteristics are somewhat weaker for valuation-indifferent portfolios and notably so for the equal-weighted index. The results are for the most part in line with ex ante expectations.

8.4. Multi-factor analysis

The results from the Fama-French three-factor regressions shed light on whether the performance difference of valuation-indifferent portfolios relative to the cap-weighted benchmark portfolio can be attributed to additional exposure to size (SMB) and value (HML) factors, indicated in Table 4 by the factor loadings s and h, respectively.

Table 4 Fama-French three-factor regression results

The Fama-French tree-factor CAPM regression variables are estimated by ordinary least squares (OLS) using Newey-West heteroskedasticity and autocorrelation consistent standard errors. The regression model is r(i,t)-r(f,t)=a(i)+b(i)(r(m,t)-r(f,t))+s(i)SMB(t)+h(i)HML(t)+ε(i,t). The regression R^2's are adjusted for degrees of freedom. The fundamental composite index is an equally weighted average of the individual fundamental indices, less cash flow. The sample includes monthly return data from 4/1988 to 12/2010.

	R(EQUAL)	R(COMP)	R(SALES)	R(ASSETS)	R(EARN)	R(DIV)	R(EMPL)	R(CASH)
Fama-French three-factor CAPM regression test:								
a	0.0022	0.0019	0.0015	0.0016	0.0022	0.0018	0.0025	0.0013
	(0.4777)	(0.2998)	(0.4625)	(0.5125)	(0.1525)	(0.2803)	(0.3140)	(0.5764)
b	0.7983	0.8764	0.8633	0.8485	0.9260	0.8946	0.8496	0.8560
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
s	0.4499	-0.0446	-0.0340	-0.0424	-0.0523	-0.0283	-0.0661	-0.0204
	(0.0001)	(0.4823)	(0.5998)	(0.6109)	(0.2868)	(0.5672)	(0.4345)	(0.7028)
h	0.3008	0.3173	0.3637	0.4412	0.1391	0.2834	0.3593	0.3106
	(0.0001)	(0.0000)	(0.0000)	(0.0000)	(0.0200)	(0.0000)	(0.0000)	(0.0000)
R^2 (adj.)	0.7669	0.9199	0.9053	0.8545	0.9418	0.9400	0.8611	0.9104
N	273	273	273	273	273	273	273	189
Prob(F)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)

The alpha values acquired in the multi-factor regressions are lower, yet positive, than those obtained in the single-factor regressions. However, all alphas are statistically insignificant implying that the excess performance is not of a linear nature. The beta coefficients are slightly higher than the corresponding figures in the single-factor regression model indicating a relatively high co-movement with the market premium.

The main points of interest in the multi-factor analysis are the factor loadings for the SMB and HML factors. Only the equally weighted index has a statistically significant loading to the size factor, but whether this loading produced an excess return relative a market value-weighted indexation method is not evident as the size premium is found to be close to zero in Finland (see section 7.3). The other valuation-indifferent indices do not show a significant linear dependency with the small-cap premium.

As expected, the HML factor captures well the return differential between cap-weighted and valuation-indifferent indexation methods. The factor loadings for the valuation factor are positive and statistically significant on a 2% significance level for all the investigated indices. With the exception of the equal-weighted index, the factor loadings are higher for the value factor than for the size factor. As reported in section 7.3, a highly positive value premium has existed in Finland during the sample time period. In short, the value premium seems to explain the return differentials between valuation-indifferent and cap-weighted indices reasonably well, whereas the size factor does not. The results are similar to the corresponding findings in e.g. Arnott et al. (2005) and Lobe and Walkshäusl (2010). However, Lobe and Walkshäusl (2010) also acquired a positive alpha for their composite fundamental index on a 10% significance level using Finnish equity data. The obtained results for the multi-factor model correspond well with the expectations determined in hypothesis #4. As in the single-factor regressions, the high R-squared and F-statistics in the performed regressions indicate a reasonably good fit to the data.

9 CONCLUSION

The main assertion by noisy market theorists is that weighting a portfolio by relative market capitalization incorporates a structural flaw resulting in lower total returns against valuation-indifferent weighting methods. As index investing is gaining wider acceptance among private and institutional wealth managers, such claim may change one's perception of what is considered a good starting point for constructing an investment portfolio. The motive for this study was to investigate whether the hypothesis holds in the Finnish equity market. A historical backtest of nearly 23 years of Finnish equity return data reveals that cap-weighting has been an inferior indexation method relative to valuation-indifferent weighting methods, if one considers historical investment performance as a measure of success. Based on the results, the hypothesis offered in Arnott et al. (2005), Treynor (2005), and Hsu (2006) cannot be rejected. The excess performance of valuation-indifferent indices is notable both on an average and on an aggregate basis.

However, the behavior of the outperformance is much more complicated than at the first glance. A matched-pairs statistical hypothesis test and a linear regression model fail to capture the observed outperformance with satisfactory statistical certainty. This is the case when one considers the data sample as a whole, but it is possible to obtain statistically significant results with subsamples of various sizes. This suggests that the observed phenomenon is not of a linear nature, but that the outperformance varies under different market conditions. For example, the relative return difference behaves differently during the market downturns in 2000-2002 and in 2008-2009. Although not investigated here, it also seems that the outperformance is not uniform across geographical regions, as observed in Lobe and Walkshäusl (2010). These conflicting results warrant the use of more sophisticated models that better capture dynamic market phenomena. A linear estimation model may not be the best approach to investigate the performance of indexation methods.

Some researchers argue that the higher historical returns from unorthodox investment strategies may derive from additional exposure to risk factors and that these risk factors are not always plainly visible[48]. Investment risk in this study was measured from a number of angles. Valuation-indifferent indices have not only outperformed the

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[48] Among the main proponents of this line of thought may be mentioned Eugene Fama and Kenneth French (see e.g. Fama and French (1996)) .

cap-weighted benchmark, but have carried less investment risk whether considering return variability or tail risk. However, the holdings in valuation-indifferent indices are more dispersed implying potentially larger liquidity risk. In a fringe market such as Finland, where a large number of listed stocks are relatively thinly traded, indirect costs arising from illiquidity could be sizable for an index fund. Nevertheless, a higher liquidity risk is unlikely to fully justify yearly return differentials in excess of 3%.

Perold (2007) and Kaplan (2008) propose that the indexation conundrum may be described as a battle between two data sets; fundamental metrics and the market value of companies contain different information regarding the fair value of companies and the superiority of indexation methods is dependent on the quality of information contained in the underlying measures. This view is not supported by the results in this study. The equal-weighted index, where the index weight is simply determined by the number of companies and not by a company-specific metric, shows similar return behavior as its valuation-indifferent brethren indicating that the performance difference is not dependent on the weighting metric, but rather on the weighting method.

The time period of the study covers almost 23 years; however, one cannot help but to notice that the data sample is dominated by one market cycle where prices peaked around the turn of the millennium. A large portion of the outperformance of valuation-indifferent indices can be attributed to the 2000–2007 time period and the conclusions drawn from the results may be specific to that time period only. In addition, the financial markets in Finland have been in a rapid state of development and increased liberalization beginning in the late 1980's. In this sense, the study cannot be considered as a long-horizon study and it would be unwise to extrapolate the acquired results into the future.

As in many other studies on the subject, the three-factor model shows that the excess performance of valuation-indifferent indices relative to the cap-weighted benchmark can largely be attributed to the value factor. The comments that valuation-indifferent indexation is simply a method to construct value-weighted portfolios are justified, in this sense. However, this study (or studies by other researchers, for that matter) does not offer definite answers to whether pursuing a value strategy is a fundamentally riskier investment strategy than simply buying and holding the market portfolio. With regard to the risk metrics considered in this study, the results rather point to the opposite.

The dominance of value-tilted portfolios is a widely observed and a seemingly persistent phenomenon in equity markets. Its origins and causes are a much debated issue in finance and, as Jun and Malkiel (2007) caution, factor dominance may turn upside down as it may take several decades for market trends to revert. Growth stock outperformance would likely be poisonous to valuation-indifferent investors. Furthermore, market anomalies have a tendency to disappear once discovered.

Supposing that a valuation-indifferent indexation delivers real benefits, the continued outperformance requires that irrational behavior by market participants persists in the future. One argument for why pricing irrationality may endure is the herding behavior of money managers, described in e.g. Lakonishok et al. (1994). Money managers constantly seek higher risk-adjusted returns for the assets they manage, but at the same time they are concerned about their employment. Following a valuation-indifferent investment strategy implies taking an opposing view relative to the rest of the market. Time-variable outperformance, as observed in this study, may subject a money manager to significant short-term career-risk. Cap-weighting, or taking the same investment position as your peers on average, may seem like a rational investment choice career-wise.

For professional money managers the effectiveness of the portfolio weighting method is at the core of business operations. But what is the bottom line for private investors without the luxury of necessary tools and resources to venture unconventional weighting methods? The first lesson to be learned is that indexation method matters. Investors often are concerned with what investments to include in a portfolio, but one fundamental question is seldom considered: in what proportions should the investments be held? The common advice is to invest in the market portfolio and simply leave the weighting decision to the market forces to determine. That leads to the second lesson, which is to question prevalent ideas of portfolio management. Although the indexation debate is far from resolved, research on valuation-indifferent indexation has sparked interest in seeking information about alternative methods of indexation.

SVENSK SAMMANFATTNING

Indexering har blivit alltmer populärare placeringsstrategi inom portföljförvaltning. Som ett exempel på detta, så var 14,5 % av amerikanska fondtillgångar i olika typer av indexfonder i slutet av år 2010 (Investment Company Institute (2011: 32-33) och andelen har ökat stadigt under de senaste åren. Indexering som en portföljstrategi baserar sig på antagandet att aktiemarknaden allokerar kapital effektivt och att indexering i genomsnitt erbjuder den bästa riskjusterade avkastningen för en enskild placerare. Bevisen på prissättningseffektivitet på marknaderna är dock motstridiga.

I placeringsportföljer som baserar sig på att replikera ett aktieindex är placeringarna i allmänhet viktade enligt relativt marknadsvärde. Men detta sätt har kommit under skarp kritik från ett antal forskare som förespråkar för ett marknadsvärdeneutralt indexeringssätt. De anser att den allmänna kutymen att väga ett index på basis av relativt marknadsvärde leder till mindre effektiva portföljer än portföljer som vägs enligt marknadsvärdeneutrala faktorer. I främsta leden av detta tankesätt står bland annat Robert Arnott, Harry Markowitz och Jack Treynor, vilka i stället föreslår att väga en placeringsportfölj med marknadsvärdeneutrala faktorer, till exempel olika bokslutsmått som omsättning, vinst och utbetalda dividender. Tidigare studier antyder att marknadsvärdeneutrala index har, på basis av historiskt data, erhållit högre riskjusterad avkastning än motsvarande marknadsvärdeviktade index. Syftet med denna avhandling är att undersöka hur marknadsvärdeneutrala index har presterat i jämförelse till ett marknadsvärdeviktat indexeringssätt på den finska aktiemarknaden. Undersökningen innefattar nästan 23 år av finskt aktiedata.

INDEXERING SOM EN PLACERINGSSTRATEGI

Det finns flera olika definitioner på ett index, men i denna studie definieras ett index som en imaginär värdepapperssportfölj som har till syfte att representera en marknad eller en specifik delmarknad; i detta fall den finska aktiemarknaden. Indexering innebär en placeringsstrategi där man strävar efter att replikera innehållet i en index.

De första passiva indexfonderna inrättades i USA på 1970-talet (Bogle 2000) som respons till studier som visar att aktivt förvaltade fonder i allmänhet inte lyckas slå ett marknadsvärdeviktat referensindex efter att courtage och förvaltningskostnader tas i beaktande (se t.ex. Jensen 1968, Malkiel 1995 och Carhart 1997). Den vanligaste metoden att vikta ett index är enligt relativt marknadsvärde. Denna indexeringsmetod har flera förmånliga egenskaper: för det första så motsvarar den resulterande portföljen väl med idén om en universell marknadsportfölj. En indexplacerare erhåller en väl diversifierad portfölj över alla viktigaste sektorerna i ekonomin och erhåller, utan att ta hänsyn till kostnader, den genomsnittliga avkastningen av alla placerare i ekonomin. För det andra så kan en marknadsvärdeviktat index antas innehålla den kollektiva informationen gällande värden på alla tillgångar som handlas på marknaden. Detta är behändigt, ifall man tror på att marknaden mer effektivt kan utvärdera tillgångarnas risk- och avkastningsegenskaper än vad en enskild placerare kan göra. Vidare, så underlättas placerarens övervakande av portföljen eftersom de mest kända inhemska och utländska referensindexen är marknadsvärdeviktade. Ytterligare, så är en marknadsvärdeviktad portfölj en självjusterande portfölj, dvs. placeraren behöver inte själv justera portföljvikterna genom uppköp och försäljning av tillgångar, eftersom vikterna justeras automatiskt när tillgångspriser förändras. Detta medför klart lägre kostnader jämfört med en aktivt förvaltat portfölj. Den enda situationen där aktiv justering av placeringsportföljen behövs är när värdepapper inträder i eller utträder från själva indexet. Tillgångarna i ett marknadsvärdeviktat index är ofta bland de mest handlade och mest likvida på marknaden, vilket betyder att en fond eller en portfölj relativt lätt kan klara av stora tillflöden eller utflöden av kapital.

Det finns dock vissa egenskaper med marknadsvärdeviktade index som kan räknas som nackdelar. Marknadens subjektiva värderingsprocess kan vara mer volatil än vad man kunde tänka sig. Till exempel argumenterar Shiller (1981) att prisrörelser på aktiemarknaden inte kan fullständigt motiveras med motsvarande nyheter gällande reella dividender. Enligt Shiller kan aktiepriser också påverkas av förändringar i placerarnas riskpreferenser. Indexering kan också anses vara ett tråkigt sätt att placera, åtminstone för ambitiösa och tävlingslystna placerare. En index-placerare kan inte heller aldrig nå en avkastningsnivå som överstiger marknadens medelavkastning.

Ett marknadsvärdeneutralt index skiljer sig från ett marknadsvärdeviktat index på det sätt att, istället för marknadsvärde, så används en annan faktor för att bestämma de relativa vikterna av värdepappren i indexet. Ett exempel på ett marknadsvärdeneutralt index är det likaviktade indexet. I ett likaviktat index får alla tillgångar samma indexvikt och indexvikten bestäms enbart av antalet tillgångar i indexet. Likaviktade index vanligtvis har en större koncentration av tillgångar i mindre värdepapper, eller s.k. ”small-cap” aktier. En annan typ av marknadsvärdeneutrala index är ”fundamentala index”, i vilka värdepappren i indexet viktas enligt ett icke-prisrelaterat estimat av företagets relativa storlek. Som estimat används vanligtvis redovisningsbaserade mått som omsättning, vinst, kassaflöde eller utdelning. Ibland används en kombination av flera mått för att bli av med sektorspecifika viktskillnader. Redovisningsmått skiljer sig från marknadsvärde med anseende på tidsperspektiv; redovisningstal inte är i praktiken fullständigt aktuella och de måste samlas under en längre tidsperiod medan marknadsvärde är baserat på marknadens nuvarande värdering av en tillgång. Vidare kan redovisningsmått kunna anses vara objektiva, eftersom de har sin bas i aktuella historiska data. Däremot är marknadsvärde en subjektiv mått som bestäms fritt av marknadskrafterna. Marknadsvärdeneutrala index måste periodiskt ombalanseras, vilket gör denna indexeringsmetod ett dyrare alternativ jämfört med en vanlig marknadsvärdebaserad indexeringsmetod. Ombalanseringsfrekvensen är ett subjektivt beslut och beror på den avvikelse från referensindexet som en placerare tolererar. Dock finner inte Arnott et al. (2008: 87) att förvaltningskostnaderna i fundamentalt viktade index med årlig ombalansering markant skiljer sig från passiva, marknadsvärdeviktade index. I kommersiella fonder som använder en marknadsvärdeneutral indexeringsmetod ligger de årliga kostnaderna i stort sett mellan 0,4 % och 0,8 % av fondens totala tillgångar. Däremot är kostnaderna i aktivt förvaltade fonder generellt sett högre.

UPPGÅNGEN OCH NEDGÅNGEN AV CAPM

Motiveringen för en marknadsvärdebaserad indexeringsstrategi är starkt kopplat med antagandet om informationellt effektiva marknader och hållbarheten av CAPM-prissättningsmodellen. Det är i synnerhet här var de största teoretiska skillnader mellan förespråkare av marknadsvärdebaserad och marknadsvärdeneutral indexering finns. Utvecklingen mot en teori om informationellt effektiva marknader har sina rötter i 1960-talet då man föreslår att priserna på värdepapper fluktuerar slumpmässigt, vilket tyder på att placerare inte kan slå en s.k. marknadsportfölj utan tillgång till unik information gällande det verkliga marknadsvärdet på en tillgång. Ett årtionde tidigare hade Markowitz (1952) skapat grunderna för vad numera kallas för den moderna portföljteorin. Markowitz metod av portföljoptimering, under antagandet att marknaderna är informationellt effektiva leder till en prissättningsmodell (CAPM) som intuitivt förklarar kopplingen mellan den förväntade avkastningen och den förväntade risken av en tillgång (se t.ex. Sharpe 1964). Enligt CAPM är en tillgångs icke-diversifierbara risk, vanligtvis betecknat beta, i direkt relation till tillgångsprisets samvariation med marknadens prisvariation. De första empiriska undersökningarna av CAPM ger lovande resultat.

Senare studier visar dock brister med det teoretiska fotfäste som CAPM står på samt avslöjar ett antal avkastningsanomalier som inte kan förklaras med CAPM i dess enklaste form. För att CAPM skulle hålla krävs att endera av följande antaganden gäller: att tillgångarnas avkastningar är normalfördelade eller att marknadsaktörer har en kvadratisk nyttofunktion. Ingendera av dessa antaganden har fått övertygande bevis i empiriska undersökningar. Markowitz (2005) påpekar att restriktioner i finansiella marknader gör det i praktiken omöjligt för tillgångspriser att vara informationellt effektiva estimat av verkligt värde. Empiriska tester på historisk avkastningsdata visar ett antal avkastningsanomalier som står i direkt strid med CAPM. Bland de mest betydande kan nämnas storleks- och värdepremierna, enligt vilka aktier av småföretag och företag med en låg värderingsmultipel avkastar i genomsnitt mera än vad som kan motiveras med CAPM. Dessa två anomalier har i stort sett existerat till denna dag (se t.ex. studierna av Fama och French 2004 samt Credit Suisse Research Institute 2009) även om andra avkastningsanomalier har i regel försvunnit snart efter att de har upptäckts. Teorier som förklarar dessa anomalier kan grovt indelas i två grupper: rationella och irrationella förklaringar. Enligt rationella förklaringar kan överprestation av vissa portföljstrategier förklaras av riskfaktorer som CAPM i den enklaste form inte lyckas fånga. Till exempel kan den högre historiska avkastningen av småföretag och värdeföretag förklaras av en högre risk för finansiellt trångmål eller högre likviditetsrisk. Irrationella förklaringar associerar överprestationen till beteendemässiga och institutionella faktorer som leder till irrationellt beteende av marknadskrafterna. Man har försökt förbättra CAPM modellens empiriska egenskaper genom att komplettera modellen med tilläggsvariabler. Bland dessa utvidgade CAPM-modeller kan nämnas Arbitrage Pricing Theory (Ross 1976), Intertemporal CAPM (Merton 1973) och Consumption CAPM (Lucas 1978 och Breeden 1979). Även om utvidgade CAPM modeller bättre lyckas förklara historiska avkastningar, kan de inte täppa till några av de större teoretiska gapen med CAPM, på vilken den passiva marknadsvärdeviktade indexeringsstrategin är baserat på.

”NOISY MARKET” HYPOTESEN

Noisy market hypotesen (se t.ex. Siegel 2006) är i direkt opposition med synsättet där en marknadsvärdeviktad indexeringsstrategi är den bästa möjliga alternativet för en enskild placerare. Enligt hypotesen innehåller tillgångspriserna ett prissättningsfel, vilket också påverkar indexvikterna i ett marknadsvärdeviktat index. Den effektiva marknadshypotesen anser inte att tillgångspriserna alltid motsvarar de verkliga värden, men att marknadspriserna i genomsnitt är korrekt prissatta. Detta medför att det är omöjligt att förespå riktningen av prissättningsfelet och således ger detta inte möjligheter att erhålla arbitragevinster. I stället anser anhängare av noisy market hypotesen att tillgångspriserna är slumpmässigt distribuerade kring verkliga värden på tillgångar. Detta anses leda till en positiv korrelation mellan prissättningsfel och indexvikt i marknadsvärdebaserade index; dvs. kommer övervärderade tillgångar att ha en proportionellt för stor vikt i en index och på motsvarande sätt kommer undervärderade tillgångar att ha en för liten indexvikt. Däremot lider inte marknadsvärdeneutrala indexeringssätt av detta problem. Detta skulle betyda att marknadsvärdeviktning presterar sämre i relation till ett marknadsvärdeneutralt indexeringssätt. Distributionen av övervärderade och undervärderade tillgångar tillåts variera, men ett viktigt antagande är att det finns både över- och undervärderade tillgångar på marknaden. Treynor (2005) och Hsu (2006) uttrycker konklusionerna ovan i en matematisk form.

Noisy market hypotesen har kommit under skarp kritik från akademiker sedan huvudpoängen introducerades i Arnott et al. (2005). Perold (2007) påpekar att hypotesen innehåller ett implicit antagande om negativ autokorrelation i tillgångspriser, av vilket det inte finns definitiva bevis på. Ett annat problem är antagandet om att det finns både över- och undervärderade tillgångar på marknaden. Kaplan (2008) formulerar ett gränsvillkor till den relativa överprestationen mellan olika indexeringsmetoder: För att marknadsvärdeneutrala indexeringsmetoder skulle slå ett marknadsvärdeviktat index, borde den valda viktningsfaktorn innehålla mer information gällande det verkliga värdet på en tillgång än vad marknadens estimat av tillgångens värde (dvs. marknadsvärdet) innehåller.

Empiriska undersökningar gällande fundamental indexering finner ofta en koppling mellan överprestationen och värdepremiet. Vissa kritiker, som Asness (2006) samt Blitz och Swinkels (2008), anser att fundamental indexering är endast ett kostnadseffektivt sätt att konstruera en portfölj som drar nytta av värdepremiet medan Arnott, Hsu, Liu och Markowitz (2009) hävdar att värdering inte är en riskfaktor alls och att värdepremiet endast är en symptom av informationellt ineffektiva marknader. Debatten kring fundamental indexering och avkastningsanomalier är således en kamp mellan två olika synsätt på marknadens förmåga att prissätta tillgångar. Om man accepterar uppfattningen att ett marknadsvärdeneutralt indexeringssätt har en prestationsfördel, så måste felprissättning fortsätta existera i framtiden för att fortsättningsvis dra nytta av effekten.

EMPIRISKA STUDIER

Empiriska undersökningar inom problemområdet har genomförts på olika geografiska områden samt med olika tillgångsklasser. Fundamentalt viktade portföljer granskas med anseende på avkastning, riskkarakteristika samt avkastningens anslutning till storleks-, värde- och momentumpremierna. Kännetecknande för en klar majoritet av studierna är att fundamentalt viktade index har funnits överprestera jämfört med en marknadsvärdeviktat referensindex och att denna överprestation inte fullständigt kan förklaras med en högre risknivå. Däremot finner studierna sällan en statistiskt signifikant Fama-French trefaktor alfa, men dock en signifikant koppling till värdefaktorn. Den mest omfattande studien är utförd av Lobe och Walkshäusl (2010) och undersöker prestationen av fundamental indexering i 50 olika länder.

Slutsatserna av resultaten skiljer sig mellan olika studier. Medan vissa studier, som t.ex. Arnott et al. (2005), Hemminki och Puttonen (2008) samt Stotz, Döhnert och Wanzenried (2010), konkluderar att fundamental indexering erbjuder signifikanta fördelar jämfört med marknadsvärdeviktad indexering, kommer Jun och Malkiel (2007) och Amenc, Goltz och Le Sourd (2009) fram till att fundamental indexering är endast en enkel metod att konstruera en portfölj som drar nytta av värdepremiet. Förutom aktiemarknaden, har fundamental indexering undersökts inom skuldebrevsmarknaden (Arnott et al. 2010) och inom fastighetsmarknaden (Hsu et al. 2010) med likartade fynd som inom aktiemarknaden.

DATA OCH METODOLOGI

Empiriska undersökningen omfattar den finska aktiemarknaden (nuvarande NASDAQ OMX Helsinki) från och med mars 1987 till december 2010; dvs. består samplet av 22 år och 9 månader av avkastningsdata. För att minimera survivorship bias i samplet kompletteras listan av noterade bolag i slutet av år 2010 med bolag vars notering har upphört tidigare. Samplet omfattar totalt 162 noterade bolag, varav 126 existerade i slutet av år 2010. Totalt 19 aktier utesluts på grund av bristfällig data. Förutom avkastningsdata så används redovisningsdata i studien för att konstruera fundamentalt viktade index. De valda redovisningsbaserade viktningsfaktorerna är omsättning, nettovinst, balansomslut, fri kassaflöde (Obs: data tillgängligt ända från år 1994), utdelning och antalet anställda. Samtliga data är hämtade från Thomson Reuters Datastream och Worldscope databaser.

Totalt konstrueras 9 olika portföljer: en marknadsvärdeviktad, en likviktad, sex fundamentalt viktade och en fundamentalt viktad sammansatt portfölj (ett likaviktat genomsnitt av alla fundamentala portföljer förutom kassaflöde). Aktierna i de olika portföljerna är viktade enligt deras relativ faktorandel. Om ett bolag har negativ nettovinst eller kassaflöde under ett år, får aktien vikten noll. Portföljerna omviktas årligen i slutet av mars, eftersom relevant redovisningsdata för samtliga företag antas då vara allmänt tillgängligt.

Portföljernas prestation mäts med anseende på tre egenskaper: avkastning, risk och likviditet. Riskjusterade avkastningsmått innefattar CAPM-beta, Sharpe-kvoten och Treynor-kvoten. För att undersöka ifall avkastningsskillnaderna mellan marknadsvärdeviktade och marknadsvärdeneutrala portföljer skiljer betydligt från noll så används Wilcoxon matchade par test som lämpar sig för icke-parametriska och beroende sampel. Vidare analyseras portföljavkastning utgående från en CAPM faktormodell och en Fama-French trefaktormodell. Trefaktormodellen används för att undersöka om avkastningsskillnaderna kan förklaras med storleks- och värdepremierna. Regressionskoefficienterna erhålls med OLS metoden. Förutom avkastningsvolatilitet, undersöks portföljernas risk för prischocker genom olika mått (minimi- och maximiavkastning under 1 och 12 månader samt avkastningsdistributionens skevhet och kurtosis). De undersökta likviditetsmåtten är portföljomsättning och olika mått på koncentration (cap-kvot, koncentrationskvot och Herfindahl index).

RESULTAT OCH KONKLUSIONER

Marknadsvärdeneutrala index har genererat en årlig reell överskottsavkastning mellan 3,35 % och 4,48 % under tidsperioden från mars 1988 till december 2010. Prisbeteendet och avkastningsskillnaderna är relativt små mellan de olika marknadsvärdeneutrala index, vilket indikerar att skillnaden inte i första hand beror på viktningsfaktorn, utan av viktningsmetoden. Marknadsvärdeneutrala index avkastade ungefär dubbelt så mycket som en börsvärdeviktat index på en kumulativ basis. Men denna överavkastning har inte varit kontinuerligt; under vissa perioder, t.ex. mellan åren 1994-1999, avkastade den marknadsvärdeviktade indexet betydligt mera. En linjär regression visar inte ett statistiskt signifikant avkastningsskillnad. Av detta kan man härleda att relationen mellan avkastningarna av dessa två indexeringsmetoder är dynamisk. Fama-French trefaktorregressionerna antyder att avkastningsskillnaderna är starkt beroende av värderingsfaktorn. Ett signifikant beroende till storleksfaktorn beträffas endast med det likviktade indexet. Interceptet alfa är positivt men statistiskt icke-signifikant i alla utförda regressioner.

Förutom en högre genomsnittlig avkastning, hade de marknadsvärdeneutrala index en lägre volatilitet under tidsperioden. Likaså var indexen mindre utsatta för prischocker på 1 och 12 månaders tidsperspektiv. Således hade de marknadsvärdeneutrala indexeringssätten en klart bättre riskjusterad avkastning än det traditionella marknadsvärdevägda indexeringssättet. Likviditetsmåtten visar att marknadsvärdeneutrala index i allmänhet har en högre portföljomsättning och en mer utspridd innehavsstruktur, vilket indikerar högre ombalanseringskostnader och högre likviditetsrisk. Dock anses inte dessa egenskaper fullständigt förklara de avsevärt stora avkastningsskillnaderna mellan indexeringssätten.

För det första så tyder resultaten på att hypotesen framfört av bland annat Arnott et al. (2005) inte kan förkastas med finsk aktiemarknadsdata och för det andra är relationen av avkastningsskillnaderna mellan en marknadsvärdeviktat och marknadsvärdeneutrala indexeringssätten mycket invecklat och starkt kopplat med värdepremiegåtan. Fenomenet borde granskas vidare med hjälp av icke-linjära undersökningsmodeller. Ur en placerares synvinkel har ett marknadsvärdevägt indexeringssätt varit ett klart bättre alternativ, men kan man anta att denna prestationsfördel fortsätter i framtiden? Iakttagelsen att överprestationen inte är linjär kan hindra kortsiktiga placerare eller placerare utsatta för karriärrisk (t.ex. institutionella fondförvaltare) att dra nytta av denna möjliga avvikelse. Vidare visar studien att det finns konkreta prestationsskillnader mellan olika indexeringssätt och att det möjligen är lönande att ifrågasätta den allmänna metoden att vikta tillgångar enligt marknadsvärde.

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APPENDIX 1 LIST OF COMPANIES INCLUDED IN THE STUDY

No	Stock	Name changes and corporate events	Data from	Data to
1	Affecto Oyj	Formerly: Affecto Genimap	31.5.2005	
2	Ahlstrom Oyj		31.3.2006	
3	Aktia Oyj		30.9.2009	
4	Ålandsbanken Abp		31.3.1988	
5	Aldata Solution Oyj		29.10.1999	
6	Alma Media Oyj	Formerly: Aamulehti-Yhtymä, Almanova	30.6.1994	
7	Amanda Capital Oyj	Formerly: Finvest	31.3.1988	
8	Amer Sports Oyj	Formerly: Amer-Yhtymä	31.3.1988	
9	Aspo Oyj		29.10.1999	
10	Aspocomp Group Oyj		29.10.1999	
11	Atria Oyj	Formerly: Atria Yhtymä	30.11.1998	
12	AvestaPolarit Oyj	Delisted - acquisition: Outokumpu	31.1.2001	31.3.2003
13	Basware Oyj		29.2.2000	
14	Birka Line Abp	Delisted - acquisition: Eckerö (not listed)	31.5.1989	29.5.2008
15	Biohit Oyj		30.6.1999	
16	Biotie Therapies Oyj		30.6.2000	
17	Capman Oyj		30.4.2001	
18	Cargotec Oyj		30.6.2005	
19	Castrum Oyj	Delisted - acquisition: Sponda	30.12.1988	31.7.2001
20	Chips Oyj	Delisted - acquisition: Orkla	31.8.1990	31.3.2005
21	Cencorp Oyj	Formerly: PMJ Automec	29.5.1998	
22	Citycon Oyj		31.8.1990	
23	Componenta Oyj		29.7.1994	
24	Comptel Oyj		31.12.1999	
25	Conventum Oyj	Formerly: Arctos Capital, Delisted - acq.: Pohjola	31.3.1999	27.2.2002
26	Cramo Oyj	Formerly: Rakentajain Konevuokraamo	29.7.1994	
27	Cultor Oyj	Delisted - acquisition: Danisco	31.3.1988	30.9.1999
28	Digia Oyj	Formerly: SysOpen	30.9.1999	
29	Efore Oyj	Formerly: Finlandia Interface	29.7.1994	
30	Elecster Oyj		31.5.1996	
31	Elektrobit Oyj	Formerly: JOT Automation	30.9.1998	
32	Elisa Oyj	Formerly: HPY Holding	30.7.1999	
33	Etteplan Oyj		28.4.2000	
34	eQ Oyj	Formerly: eQ Online, Delisted - acq.: Straumur	28.4.2000	31.12.2007
35	Evia Oyj	Formerly: Markkinointi Viherjuuri, Bankruptcy	29.7.1994	30.4.2009
36	Evox Rifa Group Oyj	Delisted - acquisition: Kemet Electronics	30.11.2000	30.3.2007
37	Exel Composites Oyj	Formerly: Exel	30.10.1998	
38	F-Secure Oyj		30.11.1999	
39	FIM Group Oyj	Delisted - acquisition: Glitnir	28.4.2006	31.7.2007
40	Finnair Oyj		31.8.1990	
41	Finnlines Oyj		30.11.1992	
42	Fiskars Oyj		31.3.1988	
43	Fortum Oyj		30.12.1994	
44	Geosentric Oyj	Formerly: Benefon	31.5.1994	
45	Glaston Oyj	Formerly: Kyro	30.6.1997	
46	Hartwall Oyj	Delisted - acquisition: Scottish Courage Ltd	30.4.1991	31.12.2002
47	HKScan Oyj	Formerly: HK Ruokatalo	30.5.1997	
48	Honkarakenne Oyj		31.7.1996	
49	Huhtamäki Oyj	Formerly: Huhtamäki Van Leer	31.3.1988	
50	Ilkka Yhtymä Oyj		29.7.1994	
51	Incap Oyj		31.3.1998	
52	Innofactor Oyj	Formerly: TJ Group, Westend ICT	30.4.1999	
53	Instrumentarium Oyj	Delisted - acquisition: GE	31.3.1988	30.1.2004
54	Interavanti Oyj		29.12.1989	
55	Isko Oyj	Delisted - acquisition: Nokian Renkaat	30.9.1994	30.6.2000
56	Ixonos Oyj	Formerly: Tieto-X	30.9.1999	

57	Julius Tallberg-Kiinteistöt Oyj		30.11.1992	31.3.2010
58	Kauppakaari Oyj	Delisted - acquisition: Talentum	30.9.1996	31.5.2000
59	Kemira Oyj		30.11.1994	
60	Kekkilä Oyj	Delisted - acquisition: Vapo	29.7.1994	30.11.2006
61	Kemira GrowHow Oyj	Delisted - acquisition: Yara International	29.10.2004	30.4.2008
62	Keskisuomalainen Oyj		30.4.1999	
63	Kesko Oyj		31.3.1988	
64	Kesla Oyj		29.7.1994	
65	Kone Oyj		31.3.1988	
66	Konecranes Oyj	Formerly: KCI Konecranes	30.4.1996	
67	Kymmene Oyj		31.3.1988	30.11.1998
68	Kylpyläkasino Oyj	Delisted - acquisition: Restel	31.8.1994	30.4.2007
69	Lännen Tehtaat Oyj		29.9.1989	
70	Larox Oyj	Delisted - acquisition: Outotec	29.7.1994	31.5.2010
71	Lassila & Tikanoja Oyj		31.3.1988	
72	Lemminkainen Oyj		29.4.1994	
73	Länsivoima Oyj	Delisted - acquisition: Fortum	31.5.1994	29.9.2000
74	M-Real Oyj	Formerly: Metsä-Serla	31.8.1989	
75	Mandatum Pankki Oyj	Formerly: Interbank Op., Delisted - acq.: Sampo	31.8.1998	29.6.2001
76	Marimekko Oyj		31.3.1999	
77	Martela Oyj		31.7.1996	
78	Merita Oyj	Delisted - acquisition: Nordic Baltic Holding	31.3.1988	31.3.2000
79	Metso Oyj		31.8.1990	
80	Metsä Tissue Oyj	Delisted - acquisition: M-Real	31.12.1997	31.1.2003
81	Neo Industrial Oyj	Formerly: Metsämarkka, Neomarkka	30.11.1998	
82	Neste Oil Oyj		29.4.2005	
83	Nokia Oyj Oyj		31.3.1988	
84	Nokian Renkaat Oyj		30.6.1995	
85	Nordic Aluminium Oyj		30.4.1997	
86	Norvestia Oyj		31.3.1988	
87	Nurminen Logistics Oyj	Formerly: Kasola	29.7.1994	
88	Okmetic Oyj		31.7.2000	
89	Olvi Oyj		30.9.1994	
90	Oral Hammaslääkärit Oyj	Formerly: Endero	30.6.1999	
91	Oriola-KD Oyj		31.7.2006	
92	Orion Oyj		29.1.1993	
93	Outokumpu Oyj		29.12.1989	
94	Outotec Oyj		31.10.2006	
95	Panostaja Oyj		30.9.1994	
96	Partek Oyj	Delisted - acquisition: Kone	31.3.1988	30.9.2002
97	PI-Consulting Oyj	Delisted - acquisition: PI Management	28.2.1997	31.1.2000
98	PKC Group Oyj	Formerly: PK-Cables	30.4.1997	
99	Pohjois-Karjalan Kirjapaino Oyj		29.7.1994	
100	Pohjola Pankki Oyj	Formerly: OKO Pankki	31.7.1989	
101	Pohjolan Sanomat Oyj		31.7.1996	30.11.1999
102	Polar Kiinteistöt Oyj	Delisted - acquisition: IVG Immobiliére SAS	29.11.1996	30.6.2004
103	Ponsse Oyj		31.7.1996	
104	Pöyry Oyj	Formerly: Jaakko Pöyry	31.12.1997	
105	Proha Oyj		29.10.1999	
106	QPR Software Oyj		29.3.2002	
107	Raisio Oyj		29.1.1993	
108	Ramirent Oyj	Formerly: A-Rakennusmies	30.6.1998	
109	Rapala VMC Oyj		31.12.1998	
110	Rautaruukki Oyj		31.10.1989	
111	Raute Oyj		28.2.1995	
112	Repola Oyj		31.3.1988	31.12.1998
113	Revenio Group Oyj	Formerly: Done, Done Solutions	30.6.2000	
114	Ruukki Group Oyj	Formerly: A Company, Balansor	31.7.1996	
115	Salcomp Oyj		31.3.2006	

116	Sampo Oyj		30.6.1989	
117	Sanoma Oyj	Formerly: SanomaWSOY	31.3.1988	
118	Saunatec Oyj	Delisted	30.9.1996	29.12.2000
119	Scanfil Oyj	Formerly: Wecan Electronics	31.5.2000	
120	Solteq Oyj	Formerly: TH Tiedonhallinta	30.9.1999	
121	Sonera Oyj	Delisted - acquisition: Telia	30.11.1998	31.3.2003
122	Suomen Spar Oyj	Delisted - acquisition: SOK	30.9.1994	31.1.2006
123	Soprano Oyj		30.9.2004	
124	Sponda Oyj		30.6.1998	
125	SRV Group Oyj		29.6.2007	
126	Suomen Saastajien Kiinteistot Oyj		29.7.1994	
127	Stockmann Oyj		30.6.1989	
128	Stonesoft Oyj		30.4.1999	
129	Stora Enso Oyj		31.3.1988	
130	Suominen Yhtymä Oyj	Formerly: J.W. Suominen Yhtymä	31.10.2001	
131	Takoma Oyj		31.7.1996	
132	Talentum Oyj		31.5.1996	
133	Talvivaara kaivososakeyhtiö Oyj		29.5.2009	
134	Tamfelt Oyj	Delisted - acquisition: Metso	31.3.1988	31.5.2010
135	Tamrock Oyj	Delisted - acquisition: Sandvik	31.3.1988	30.11.1998
136	Technopolis Oyj		30.6.1999	
137	Tecnotree Oyj	Formerly: Tecnomen	30.4.2001	
138	Tectia Oyj	Formerly: SSH Communications Security	29.12.2000	
139	Tekla Oyj		31.5.2000	
140	Teleste Oyj		31.3.1999	
141	Tieto Oyj	Formerly: TietoEnator	31.3.1988	
142	Tiimari PLC	Formerly: Leo Longlife	31.5.1994	
143	Tikkurila Oyj		31.3.2010	
144	Trainers House Oyj	Formerly: Satama	31.3.2000	
145	Tulikivi Oyj		30.9.1994	
146	Turkistuottajat Oyj		29.7.1994	
147	Turun Arvokiinteistöt Oyj	Delisted - acquisition: Nordea	30.9.1994	28.2.2005
148	Turvatiimi Oyj	Formerly: Menire	29.7.1994	
149	UPM-Kymmene Oyj		31.1.1991	
150	Uponor Oyj	Formerly: Asko	30.6.1988	
151	Vaahto Group Oyj		29.7.1994	
152	Vacon Oyj		29.12.2000	
153	Vaisala Oyj		29.1.1993	
154	Valtameri Oyj	Delisted - merger: Rautaruukki	29.9.1995	31.8.1999
155	Viking Line Abp		31.7.1996	
156	Wärtsila Oyj	Formerly: Metra	31.3.1988	
157	WM-Data Novo Oyj	Delisted - acquisition: WM-data AB	28.11.1997	30.4.2004
158	Wulff-Group Oyj	Formerly: Beltton-Yhtiöt, Wulff-Yhtiöt	31.10.2000	
159	YIT Oyj		29.7.1994	
160	Yleiselektroniikka Oyj		31.1.1995	
161	Yomi Oyj	Delisted - merger: Elisa	27.2.1998	31.12.2004
162	Yrityspankki Skop Oyj	Delisted – liquidation	31.7.1996	31.3.2004

APPENDIX 2 RESULTS FOR SUPPLEMENTARY REGRESSIONS

Table 5 Single-factor CAPM regression test results, excluding the time period 1/1998 – 4/2000

See section 8.1. The single-factor CAPM regression variables are estimated by ordinary least squares (OLS) using Newey-West heteroskedasticity and autocorrelation consistent standard errors. The regression model is r(i,t)-r(f,t)=a(i)+b(i)(r(m,t)-r(f,t))+ε(i,t). The regression R^2's are adjusted for degrees of freedom. The sample includes montly return data from 4/1988 to 12/1997 and from 5/2000 to 12/2010.

	R(EQUAL)	R(COMP)	R(SALES)	R(ASSETS)	R(EARN)	R(DIV)	R(EMPL)	R(CASH)
a	0.0075	0.0060	0.0061	0.0071	0.0042	0.0051	0.0074	0.0055
	(0.0228)	(0.0122	(0.0157)	(0.0237)	(0.0279)	(0.0149)	(0.0149)	(0.0422)
b	0.7395	0.8633	0.8473	0.8310	0.9229	0.8777	0.8376	0.7911
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
R^2 (adj.)	0.7737	0.9075	0.8898	0.8274	0.9387	0.9305	0.8442	0.9020
N	245	245	245	245	245	245	245	161
Prob(F)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)

Table 6 Single-factor CAPM regression results with the return premium of equal-weighted index as the dependent variable

See section 8.1. The single-factor CAPM regression variables are estimated by ordinary least squares (OLS) using Newey-West heteroskedasticity and autocorrelation consistent standard errors. The regression model is r[equal](i,t)-r(f,t)=a(i)+b(i)(r(m,t)-r(f,t))+ε(i,t). The regression R^2's are adjusted for degrees of freedom. The sample includes montly return data from 4/1988 to 12/2010.

	R(COMP)	R(SALES)	R(ASSETS)	R(EARN)	R(DIV)	R(EMPL)	R(CASH)
a	0.00096	0.000607	0.000899	0.00125	0.001066	0.000979	0.000663
	(0.5815)	(0.7116)	(0.6671)	(0.6167)	(0.5982)	(0.5297)	(0.8279)
b	0.989524	0.983856	0.977523	0.992853	0.982322	1.011067	0.899524
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
R^2 (adj.)	0.8708	0.8757	0.8395	0.7948	0.8450	0.8990	0.7248
N	273	273	273	273	273	273	189
Prob(F)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)