THE ENTERPRISE MULTIPLE CAPITAL MARKET INVESTMENT STRATEGY: EFFECTS OF EQUALLY WEIGHTING LOW ENTERPRISE VALUE PORTFOLIOS BY INDUSTRIES ON TOTAL RETURN AND RISK

Thilo Alexander Bömke

Saint Petersburg State University, GSOM

Master in Corporate Finance

Supervisor: Dr. A. Y. Andrianov

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ЗАЯВЛЕНИЕ О САМОСТОЯТЕЛЬНОМ ХАРАКТЕРЕ ВЫПОЛНЕНИЯ ВЫПУСКНОЙ КВАЛИФИКАЦИОННОЙ РАБОТЫ

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I, Thilo Bömke, second year master student, program «Corporate Finance», state that my master thesis on the topic "The Enterprise Multiple Investment Strategy: Effects of Equally Weighting Portfolios by Industries on Total Return and Risk", which is presented to the Master Office to be submitted to the Official Defense Committee for the public defense, does not contain any elements of plagiarism.

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Аннотация

Автор	Тило Александр Бомке
Название магистерской диссертации	Инвестиционная стратегия на рынках капитала, основанная на мультипликаторах EV: влияние равного взвешивания отраслевых портфелей с низкими мультипликаторами EV на общую доходность и риск
Факультет	Высшая Школа Менеджмента (Санкт-Петербургский Государственный Университет)
Направление подготовки	Корпоративные Финансы
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Научный руководитель	Александр Юрьевич Андрианов, к.э.н.
Описание цели, задач и основных результатов	Предметом рассмотрения данной работы является вопрос улучшения показателей риска и доходности инвестиционной стратегии, основанной на мультипликаторах EV и равном взвешивании портфелей по отраслям. В основу работы легли как последние публикации в области стоимостного инвестирования, так и классические теории диверсификации и управления портфеля. Проведен анализ портфеля на основе выборки акций компаний из S&P 500 с самыми низкими значениями мультипликатора EV в каждой отрасли, при условии равного веса доли каждой отрасли в портфеле. Далее показатели последнего сравниваются с портфелем, состоящим из акций с самыми низкими значениями мультипликатора EV без учета их принадлежности к конкретным отраслям. На основании показателей риска и доходности, таких, как стандартное отклонение и полуотклонение, R^2, бета, периодическая доходность и коэффициент Шарпа, был сделан вывод о существенном превосходстве отраслевой стратегии, при этом, несмотря на более высокую корреляцию с доходностью S&P 500, данная стратегия характеризуется более низким уровнем системного и внесистемного риска.
Ключевые слова	Управление портфеля акций, инвестирование на фондовом рынке

Abstract

Author	Thilo Alexander Bömke
Master thesis title	The Enterprise Multiple Capital Market Investment Strategy: Effects of Equally Weighting low-Enterprise Multiple Portfolios by Industries on Total Return and Risk
Faculty	Graduate School of Management, Saint Petersburg State University
Major subject	Corporate Finance
Year	2021
Academic advisor	Alexander Yurevich Andrianov, Candidate of Sciences
Description of goal, methodology and results	This paper aims to improve the popular quantitative low-enterprise multiple investment strategy for capital market stock portfolio management by equally weighting the portfolio by industries. This represents a synthesis of recent publications in the field of value investing on the one hand and classic diversification and portfolio allocation theories on the other. The analysis consists of a portfolio simulation based on the S&P 500 in which the lowest EM-stocks of each industry, resulting in equally weighted industries in the portfolio, are selected. The benchmark portfolio consists of a portfolio consisting purely of the lowest EM-stocks, disregarding their industries. Based on various risk and return metrics, such as standard- and semi deviation, R^2, beta, periodical returns and the Sharpe ratio, it was concluded that the industry-adjusted EM strategy far outperforms the plain EM-strategy in terms of returns at a lower level of systemic and non-systemic risk despite a higher correlation with the S&P 500's returns.
Keywords	Portfolio management, stock market investing, enterprise multiple, value investing

Glossary

EBITDA	= Earnings before interest, taxes, depreciation and amortisation
EM	= Enterprise value multiple (Enterprise value / EBITDA)
ETF	= Exchange traded fund
Hypothesis portfolio	= Containing companies exhibiting the lowest EM in each industry
Benchmark portfolio	= Containing companies exhibiting the lowest EM not adjusted for industries
Total return	= Mixed approach of long and short strategy where undervalued stocks are bought while overvalued stocks are borrowed and sold

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CHAPTER 1: INTRODUCTION

This chapter provides a rough overview of what to expect in this paper and includes a short summary of the research gap and potential managerial implications.

1.1 Background of the research

The thesis explores the domain of modern stock portfolio management where factor-investing has become increasingly popular among asset managers. This development can be traced back to multiple reasons: Over the most recent decades, passive investing, essentially allocating one's portfolio according to an index, has steadily gained popularity among investors (Sushko & Turner, 2018). This development has been driven by a variety of empirical studies, almost unanimously proving that ETFs (exchange traded funds), aiming to reproduce the exact performance of a chosen index, tend to outperform actively managed funds in the long term (Prondzinski & Miller, 2018) (French K. R., 2008). Possible reasons for this include leaner cost structures of passive vehicles and the assumption that markets are (somewhat) efficient, making active investing a zero-sum game given a sufficiently large sample size and time horizon. Warren Buffet, one of the world's most renowned investors, is as convinced of the merit of this idea as to bet one million dollars on the prediction that a basket of actively managed funds will underperform their respective benchmark indices.

As active managers increasingly seem to come to terms with this idea, new approaches to investing are in development: More and more asset managers rely on so called factor-investing strategies, trying to combine the benefits of active and passive investing. Factor investing makes the armies of equity analysts of many traditional active funds redundant as the portfolio is constructed purely on quantitative data within a couple of clicks. This represents a fairly cost-efficient, rule-based approach while still aiming to outperform the purely passive ETF-strategy. Criteria on whose basis these portfolios are constructed are possibly endless, but only some of these strategies have been empirically proven. Going back two decades in time, Fama and French have developed a solid foundation for such a strategy: An empirically-driven factor investing strategy based on Fama and French's findings would only include the small (according to market capitalization) and undervalued (according to, e.g. price/book) companies in a certain index (French & Fama, 1993).

In more recent years, the enterprise value multiple has emerged as an empirically-verified indicator for undervalued companies as well and has been proven to generate additional excess returns intrinsic to the EM-multiple in comparison to other quantitative indicators of undervaluation. In factor-investing terms, it would make sense to construct a portfolio with companies exhibiting the lowest enterprise value multiples to generate excess returns in relation to the passive approach.

Furthermore, the effects of diversification are regarded as one of the fundamental truths of modern portfolio theory as postulated by Markowitz in 1952. In recent years, some studies have devoted further attention to diversification strategies, such as over countries or industries (Vardharaj & Fabozzi, 2007) (Wilmington Trust, 2015). This thesis evaluates the impact of combining both strategies: The EM-investment strategy and industry diversification.

1.2 Potential managerial implications

The findings could result in a new portfolio management strategy, possibly even new financial products that operate under the quantitative principles under investigation in this thesis. Since this strategy requires no qualitative analysis, even including the allocation of companies to industries since there are many different classification benchmarks, it is extremely cost-efficient for portfolio managers of any fund size. Rebalancing of the portfolio is projected to take place once every couple of years (for more information, see 3.4); the strategy would hence require only minimal effort. Moreover, since much of the data is available on the internet freely or for comparatively low fees, this strategy could potentially be implemented by private investors as well.

1.3 Main research question

What impact does equal industry allocation have on the risk-return profile of the enterprise multiple investing strategy?

Essentially, if the impact as described above is positive in terms of the risk-return profile, the general principles laid out in this thesis can be turned into a comprehensive and complete investment strategy. If this is not the case, the question will still grant interesting insights into the enterprise-multiple investing strategy. Negative results might, for example, imply that the outperformance generated by the enterprise multiple investment strategy could be attributed to inherent sector-rotation benefits which would be nullified by equal industry allocation in a portfolio. In order to further investigate such possibilities, a related sub-question will be raised in chapter 2.3.

1.4 Organisation of the thesis

This paper is divided into five major sections: The introduction, the extended literature review including a derivation of the research gap and focus, the methodology, the analysis and finally the conclusion including recommendations.

CHAPTER 2: THEORETICAL FRAMEWORK

The following chapter introduces the theoretical framework and models employed to investigate the problem.

2.1 Theoretical foundation

This section reviews some of the most fundamental publications in portfolio management and then dives into more recent discoveries. These papers stem from both renowned academic institutions and private-sector asset management companies to ensure practicability.

2.1.1 The evolution of value investing

In order to begin with the right foundation for the research, one needs to start at the crib of modern investing: The invention of value investing itself by Benjamin Graham and David Dodd in 1934 with the publication of their book "Security Analysis" which would be elevated to the gold standard in investment management in the following decades and repackaged as the timeless classic "The Intelligent Investor", considered the bible of value investing by most. The key postulate essentially boils down to purchasing a company well below its fair value based on indicators such as the value of its assets or its earnings power (Graham, 1949). Legendary investors like Warren Buffet have proven over extended periods of time that this investing style is not only a paper tiger but can generate real excess returns in comparison to respective markets; this approach to portfolio management has catapulted Buffet into the ranking of the worlds five richest individuals (Buffet, 1990) (Forbes Media, 2019).

Much later, in 1993, Professors Eugene Fama and Kenneth French formalised these findings in their so-called three-factor model. This model is essentially an evolution of the more basic capital asset pricing model in that it includes a value factor and a size factor. More concretely, the model empirically demonstrates that ninety percent of excess returns relative to respective markets can be explained by adjusting for companies with smaller market capitalisations and stocks which are relatively undervalued according to the current earnings power or value of their assets (French & Fama, 1993) (Fama & French, 1998).

In subsequent research published in the Journal of Quantitative Finance in 2010, T. Loughran proved low enterprise multiples can essentially serve as a substitute for most conventional value indicators, such as low price to book or low price to earnings. Loughran defines the enterprise multiple, or EM for short, as (*equity value + debt + preferred stock – cash) divided by EBITDA*, the operating income before depreciation and amortisation. Deviating definitions sometimes

replace the denominator by EBIT (Loughran & Wellman, 2010). In comparison to the traditional metrics, the EM yields several benefits: It takes into account items such as debt and cash, meaning it factors in leverage, leading to more comparable results between companies with different capital structures or even from different sectors. On the other hand, the EM does not reveal *how much* a given company relies on leverage, making it dangerous to rely on the EM method in isolation.

On the other hand, while EBITDA provides a useful approximation of operating performance, the EM does not take interest coverage or depreciation into account. Naturally, one could encounter companies with above-average yearly EBITDA, but negative net income, for example if the company is overleveraged and issued debt in high-interest currency environments, leading to a crippling interest burden. Furthermore, in very capital-intensive industries, EBITDA tends to be a suitable measure for operating performance but fails to account properly for required capital expenditures since it does not take depreciation into consideration. It is thus not a perfect valuation tool on its own, but much more holistic in comparison to traditional value metrics. (Bömke, 2019)

The primary goal of Loughran's and Wellman's research was to establish a relationship between expected returns and the enterprise value multiple. Due to an increasing popularity of the valuation technique with practitioners, the researchers speculated that there could be a return-premium based on this indicator that cannot be explained by existing asset-pricing theories. The duo was proven right in their assumption after controlling for various asset-pricing models. Consequently, the key contribution to this thesis is the basic concept that investment strategies based on low-EM valuations generate alpha in excess of other value-investing metrics.

2.1.2 Exploring the enterprise multiple effect and its potential pitfalls

"The Enterprise Multiple Investment Strategy: International Evidence" by Christian Walkshäusl and Sebastian Lobe, also published in the Journal of Quantitative Finance, builds on the key findings of the first article and empirically backs these claims up for almost all relevant developed and emerging markets. In that sense, it strengthens the foundation of the proposed research topic further. The contribution is hence similar: These two papers provide the basis on which the research is footed since the proposed topic investigates whether an adjustment for industries (which would mean clustering the stocks by their respective industries) will lead to higher or lower return- and risk metrics, ultimately indicating whether the risk-return profile of the enterprise multiple investment strategy can be enhanced by adjusting by industries.

This idea is footed on the fact that low enterprise multiples tend to capture certain industries, such as wholesale, retail and industrials, more often than high-growth industries such as

telecommunications and software engineering, which logically leads to two problems with this investment approach: Firstly, the excess returns could be driven by a temporary outperformance of these industries in comparison to industries with traditionally higher multiples, implying that these excess returns of the EM are possibly based on industry performance rather than some intrinsic driver of the EM itself. In other words, a low EM could just represent a proxy for companies operating in an industry which has hit the bottom of the business cycle and will thus generate excess returns in the short term during its cyclical rebound. Exhibit 2.1.2.1 illustrates this phenomenon and demonstrates what industries tend to outperform the general market at what point in the business cycle.

Secondly, due to the high relative weight of certain industries in the low EM portfolios, standard deviation of returns and thus risk might increase based on relative movements of entire industries. Proof of this phenomenon has been delivered repeatedly by various researchers; some of them even took it further and developed entire portfolio management approaches around it, for example "Sector Rotation and Monetary Conditions", published in the Journal of Investing. Essentially, the authors managed to establish that, based on 33 years of data, *"the rotation strategy earns consistent and economically significant excess returns while requiring only infrequent rebalancing*" (Conover, Jensen, Johnson, & Mercer, 2008).

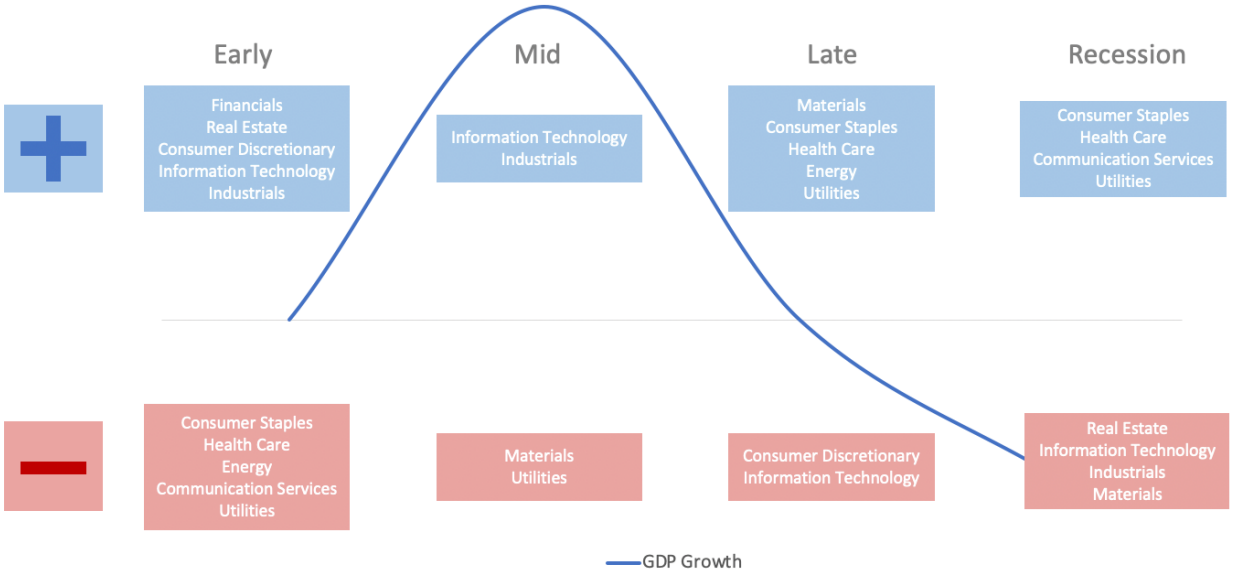


Figure 1- Exhibit 2.1.2.1: Performance of stocks by industry during the business cycle, own creation. Data taken from fidelity.com (An introduction to sector rotation strategies, 2016).

On the other hand, the paper "On The Use Of Enterprise Value Multiples As Indicators Of Intrinsic Value In Emerging Markets" by Bruce Payne, Roman Wong and Michael Tyler takes a different angle at the possible reasons causing low EM valuations. Published in Southwestern Economic Review, it is maybe not as well-known, but unique in its deviating approach to the excess returns

generated by the EM as it analyses underlying financial problems at the firm level that could lead to low valuations and how these could adversely affect the risk (-return) profile. In other words, the goal was to establish the average financial profile of a low EM-company. The researchers tried to explain the respective low or high EMs with the following independent variables:

"X1 - Total Market Capitalization X2 - Share Price Liquidity X3 - The Two Year Growth Rate in Sales X4 - Hamada's Unlevered Beta (Operating Risk) X5 - Long Term Debt to Total Capital (Financial Risk) X6 - Coeffcient of Variation in Operating Income X7 - Institutional Investor Buying Activity" (Payne, Wong, & Tyler, 2018). The results of the regressions indicated that financial leverage had the largest negative impact on the EM, followed by operating leverage. All variables were significant and had an impact on the EM. While these findings do not directly contradict the hypothesis of sector-based undervaluation since these poor financial indicators could also be a result of respective sector underperformance due to the business cycle, it does strengthen the hypothesis that low EM usually come with weaker fundamentals in general.

Furthermore, "Why Do Enterprise Multiples Predict Expected Stock Returns?", published in the Journal of Portfolio management in November 2019 and authored by Steven S. Crawford, Wesley R. Gray and Jack Vogel, takes broader perspective on the topic. According to traditional models such as CAPM, higher returns of specific investments ought to be rooted in higher systemic risk (represented in the CAPM-model by the beta coefficient). It is this assumption that Crawford and alia wanted to investigate further in the case of the enterprise multiple. More concretely, the key research question was whether low EMs correlate with higher systemic risk.

The team managed to establish that the so called "EM-effect" is mainly attributable to mispricing and does thus not correlate with higher systemic risk. Moreover, the researchers clarified that the return premium generated by the EM-effect is stronger in times of bull markets and establish that "*the EM effect is primarily attributable to mispricing and cannot be explained by higher systematic risk*". However, it was also brought to light that "Over 80% of the alpha associated with the best EM portfolio is generated by the short leg" (Crawford, R. Gray, & Vogel, 2019). Consequently, long-only strategies are expected to fare worse in comparison to long-short (or *total return)* strategies.

Another significant drawback of value investing strategies unfortunately applies to the EM-investment strategy as well: The concept of value traps. Essentially, value traps describe the phenomenon of undervalued stocks according to conventional valuation metrics in which the low valuation is justified based on underlying issues within the company (Penman & Reggiani, 2018). This can be rooted, among other reasons, in low growth expectations due to diminishing or

stagnating market shares, questionable financing decisions, inherent cyclicality of the business' operations or poor capital expenditure decisions. When iterating the methodology in chapter 3, mitigating mechanisms for value traps are implemented to avoid retaining "dead weight", meaning non-performing, undervalued stocks, in the portfolio.

2.1.3 Practical view: factor investing and the enterprise multiple

The following section explores the basics of factor investing as the natural evolution of the empirical discoveries in the realm of finance in recent decades. The notion behind this approach is to harvest excess returns based on empirically-proven indicators for outperformance of stocks on purely quantitative grounds. Due to this fairly mechanical, research driven approach, it is also referred to as "smart beta investing". In this thesis, the topic is explored from a practical perspective as well, beginning with research by private financial institutions.

The following article has not been compiled by an academic institution, but by MSCI Inc. It is thus to be treated with caution as there are usually commercial interests at play, but it represents a thorough, rigorous and practice-oriented insight into modern factor investing and hence warrants further investigation. The paper "Foundations of Factor Investing" was written by Jennifer Bender, Remy Briand, Dimitris Melas and Raman Aylur Subramanian in December 2013 (Bender, Briand, Melas, & Subramanian, 2013). In the executive summary, it states that the research team could identify six equity risk premia factors: Value, low size, low volatility, high yield, quality and momentum, all of which are represented in MSCI's so-called factor-indexes. Firstly, contemporary portfolio theory is briefly reviewed and connected to the current product portfolio of MSCI. This represents a valuable insight into the applicability of recent academic findings in finance. The article then continues to dissect the different factors and how they are usually quantified and measured. While only the value-premium, in our case representative of the enterprise multiple, is relevant to the given research design, this paper nevertheless gives a good insight into general developments in factor investing and addresses the viability of such strategies in the future.

The paper aims to identify potential root causes driving excess returns by means of an extensive literature review. Researchers and practitioners are almost evenly split in two camps; essentially, one of them claims that these excess returns are a result of higher systemic risk attached to the outperforming groups of stocks while the other assumes mispricing. More concretely, in economic downturns, companies with questionable balance sheets (which could be associated with low valuations and hence the value factor) might be less likely to receive emergency funding. As for Fama and French's size factor, small-cap companies are usually less liquid, a factor that has been proven by Liu to have an impact on valuation (Liu, 2006). Furthermore, Frank Zhang demonstrated

that companies with higher information uncertainty, in other words less transparent stocks, tend to react stronger to newly published positive and negative information (Zhang F. , 2006). Thirdly, Chan and Chen as well as Dichev have determined that small-cap companies are also more likely to be financially distressed (Chan & Chen, 1991); (Dichev, 1998).

With regards to the value premium, Chen and Zhang (1998) established that value stocks come with a higher risk due to low flexibility and volatile earnings and Winkelmann et al. (2013) who alleged that small- and value firms are more susceptible to economic shocks than their larger, fairly priced counterparts (Zhang & Chen, 1998) (Winkelmann, Suryanarayanan, Hentschel, & Varga, 2013). The team concludes, based on its literature review, that „the premium to value can consequently be viewed as compensation for macro risk“ (Bender, Briand, Melas, & Subramanian, 2013).

However, as mentioned earlier already, another attempt to evaluate the systemic risk hypothesis specifically for the enterprise multiple has been conducted, among others, in “Why Do Enterprise Multiples Predict Expected Stock Returns?” by Crawford et alia who clearly state that the excess returns of the EM are not attributable to higher risk (Crawford, R. Gray, & Vogel, 2019). This would either imply that one of the papers is wrong or that the EM captures a unique phenomenon that is not purely attributable to the classic value premium.

Moreover, a contemporary alternative to this enterprise multiple strategy can be found in the free cash flow yield. Many valuation-theorists and practitioners have used discounted cash-flow models, often based on the free cash flow to the firm, which has been proven to be a formidable indicator of a company’s financial performance in recent years in different academic studies. The cashflow yield represents an incarnation that can be applied specifically for valuation as it divides the total free cash flow by the market capitalisation, thus turning it into a comparable metric among companies (Hackel, Livnat, & Rai, 2000). To account for debt, the author of this paper suggests slight adjustments, namely to divide the free cash flow to the firm by the enterprise value, essentially a full-fledged alternative to the traditional enterprise multiple. Existing research on free cash flows as a valuation metric point to similar results as with the enterprise multiple when it comes to generating excess returns based on relative stock undervaluation, possibly with even higher excess returns than the enterprise multiple itself as it captures actual, unmanipulable cashflows of the company. While these theoretical suggestions are very likely to apply in practice, comprehensive studies such as those of Loughran and Wellman on the merits of the enterprise multiple have yet to be conducted for the free cash flow yield as an investing strategy. Such a paper would make an excellent addition to the academic universe under consideration in this literature review, but is out of the scope of this research question. This paper will hence proceed

by employing the enterprise multiple as there are more studies confirming its predictive powers for excess returns.

2.1.4 Portfolio allocation and balancing

After having discussed the enterprise multiple-based value investing style at length, the following articles shed some light on contemporary theories regarding portfolio allocation – thus focusing on *how rather than what* to invest in – starting with the all-time classic "Portfolio Selection" by Harry Markowitz, published in 1952, the foundation for most modern portfolio theories.

As per textbooks on finance, there are two potential kinds of risks for investors: Systemic and non-systemic risks. While systemic risk cannot be efficiently mitigated (unless investors pursue a sophisticated total return strategy which can, in rare cases, produce positive returns in all market phases), non-systemic or individual risk can be "diversified away" by investing in a basket of lowly or negatively correlated securities. The revolutionary insight in Markowitz's paper revolves around exactly that idea; he demonstrated mathematically and statistically how to achieve the highest returns at given levels of risk (namely variance) by allocating certain proportions of the portfolios to certain securities. The resulting portfolios yielding maximised returns for a given level of risk are plotted along a so-called "efficient frontier" and represent the best historic returns for any given volatility (or variance) level (Markowitz, 1952).

Furthermore, just like Markowitz's paper, "Portfolio rebalancing in theory and practice" deals with the question of *how* to invest rather than *what* to invest in when constructing a portfolio. Vanguard's specialists were concerned with the question of when and how often to rebalance a portfolio. This question is discussed at length later in the methodology section when it comes to planning the model portfolios for the analysis. The article's three main approaches consisted of time horizon-based rebalancing, threshold-based rebalancing and a combination of the two.

In essence, the article elaborated that there is no optimal rebalancing strategy and that "the risk-adjusted returns are not meaningfully different whether a portfolio is rebalanced monthly, quarterly, or annually; however, the number of rebalancing events and resulting costs increase significantly" (Jaconetti, Zilbering, & Kinniry Jr., 2010). For our research model, this would imply rather long holding periods as short periods would make the research more tedious to conduct and remove it further from the needs of practitioners who need to keep an eye on transaction costs and workload.

However, one missing link that yet has to be supported by data is the idea that weighting stocks by sectors might improve the risk-return profile of a portfolio. While this could simply be inferred

by as an extension of the generally accepted concept of diversification and the preceding investigation of seasonal sector performance, there is some academic evidence to back up this claim, for example the paper "Sector, Style, Region: Explaining Stock Allocation Performance" by Raman Vardharaj and Frank Fabozzi, published in the Financial Analysts Journal in January 2019. The team describe their research as analysing the "importance of allocation by economic sector and by size and style in purely U.S. stock portfolios […]" (Vardharaj & Fabozzi, 2007) and reached, among others, the following conclusion: "first, allocation policy explains nearly 90 percent of the monthly or quarterly return variability over time".

The independent study "Sources of gains from international portfolio diversification" reaffirms the hypothesis that (the variability of) returns are driven by sector allocation. The scientists investigated whether portfolio diversification gains are mainly a result of country or sector allocation policies. As industries around the world keep integrating due to globalisation, the duo states, the "importance of industry factors in explaining returns [increases]". Furthermore, it is clarified that "country factors are smaller for countries integrated in world financial markets" (Campa & Fernandes, 2006). This implies that the gains from sector diversification are stronger for developed countries and thus even more relevant for conservative investors who seek to diversify their holdings in highly liquid, advanced economies rather than developing markets.

The idea that this effect could, to a significant extent, be driven by sector allocation is further backed up by "Constructing a more dynamic portfolio with equity sector allocation" by Wilmington Trust, one of the USA's largest financial service providers and asset managers. The topic comes very close to the core of the idea of this thesis by comparing conventional indicators of excess returns, such as value or size, with portfolios weighted by industries.

Wilmington takes a rather pragmatic approach by comparing respective factor indices (refer to 2.1.4), namely Russell 1000 Large Cap Value, Russell Mid Cap and Russell 2000 Small Cap, with factor indices. In terms of industry classification, the researchers employed the following methodology:

> *„In an effort to standardize categorization, Standard & Poor's spearheaded an initiative known as the Global Industry Classification Standard (GICS) that categorizes publicly owned U.S. companies by their business activities. It includes 59 industries within 10 sectors and we've grouped them into the following broader "super sector" categories"* (Wilmington Trust, 2015).

These “super sectors” consist of energy, materials, industrials, consumer discretionary, consumer staples, healthcare, financials, information technology, telecommunications and utilities. These sectors can often have massive deviations in return as they tend to move in cycles:

2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
56.7	3.3	–6.4	46.2	31.2	31.3	35.5	34.5	–16.1	61.7	27.6	19.2	28.9	43.2	28.7
36.7	1.0	–6.8	37.0	24.5	16.8	24.1	21.4	–23.1	46.9	26.8	13.9	24.0	41.1	25.4
24.7	–3.2	–14.2	36.4	19.6	6.6	21.1	19.1	–29.0	41.9	22.9	12.8	17.7	40.8	20.3
16.5	–6.8	–14.9	32.8	18.6	6.3	19.7	16.2	–30.4	21.6	20.5	6.1	17.3	35.3	15.5
5.8	–8.6	–19.2	30.9	13.8	4.7	19.5	13.8	–33.3	20.0	19.3	5.6	15.3	28.7	15.2
4.6	–9.5	–22.9	26.3	10.7	3.9	18.5	11.8	–34.6	19.5	14.3	5.0	14.9	26.2	10.0
–17.1	–11.9	–25.6	24.5	10.2	2.7	14.4	11.6	–40.0	14.9	12.4	2.5	14.6	25.8	9.7
–24.0	–12.6	–26.6	16.2	8.2	–0.5	13.2	7.2	–43.0	13.8	10.3	–0.3	10.4	25.3	7.2
–38.0	–24.8	–33.6	15.4	4.6	–5.3	7.9	–13.0	–44.6	11.7	5.8	–9.5	4.8	12.6	1.9
–38.4	–30.7	–36.8	7.1	1.5	–5.3	7.4	–18.5	–55.1	7.4	3.0	–17.0	1.5	12.4	–7.8
–9.1	–11.9	–22.1	28.7	10.9	4.9	15.8	5.5	–37.0	26.5	15.1	2.1	16.0	32.4	13.7

Consumer discretionary
Consumer staples
Energy
Financials
Healthcare
Industrials
Information technology
Materials
Telecommunication services
Utilities
S&P 500 Index

Figure 2 - Exhibit 2.1.3.1: Annual performance of various sectors (Wilmington Trust, 2015)

Just by looking at exhibit 2.1.3.1, one may infer that diversification across these sectors is likely to yield substantial benefits. This discrepancy in returns is also evident when calculating correlation coefficients for each sector:

	Energy	Materials	Industrials	Consumer discretionary	Consumer staples	Healthcare	Financials	Information Technology	Telecommunication Services	Utilities
Energy	1.00									
Materials	0.64	1.00								
Industrials	0.58	0.83	1.00							
Consumer discretionary	0.44	0.73	0.83	1.00						
Consumer staples	0.36	0.52	0.62	0.55	1.00					
Healthcare	0.34	0.43	0.56	0.50	0.68	1.00				
Financials	0.47	0.68	0.81	0.77	0.63	0.58	1.00			
Information Technology	0.38	0.53	0.65	0.74	0.34	0.43	0.52	1.00		
Telecommunication Services	0.31	0.40	0.48	0.55	0.43	0.40	0.47	0.51	1.00	
Utilities	0.51	0.32	0.40	0.27	0.41	0.40	0.41	0.16	0.32	1.00

Figure 3 - Exhibit 2.1.3.2: Correlation among returns of economic sectors (Wilmington Trust, 2015)

Among the regular indices mentioned earlier, the lowest correlation coefficient was 0.75. Consequently, much higher diversification benefits can be achieved by constructing portfolios based on relative sectors rather than factors such as value or size (alone). This paper, while not

academic, provides a valuable insight into the potentials that *could* arise by combining a sector-based allocation approach to low-EM stocks.

2.2 Limitations of selected theory

This section sheds light onto the limitations of the chosen literature. A crucial point, as raised earlier already, is the reliability or degree of scientific and academic rigor of the papers by private-sector companies. As these papers were employed to answer questions of more practical nature anyway (such as portfolio rebalancing from a practitioner's perspective or to demonstrate the foundations of factor investing), they ensure a delicate balance between scientific objectivity and reliability and practical relevance. This does, however, not apply to the paper by Wilmington Trust, which represents a fundamental cornerstone of this thesis as it delivers one of the most compelling cases for the diversification by sectors. In this sense, it has to be seen as a hint for this thesis: Wilmington Trust purports that allocating portfolios by industry *should* lead to more favourable Sharpe ratios in theory. This is not taken at face value, but verified in this of this thesis. As such, it is interesting and provides valuable input, but the theoretical foundation of this thesis does not dependent on the validity of Wilmington's findings.

2.3 Research gap, selection and justification of theory and formulation of sub-question

While it has already been determined that this thesis investigates the predictive power of the enterprise multiple, one might object why the focus of this paper is so limited in scope since the review of articles in factor investing clearly points towards the existence of a multitude of other factors. Firstly, the value factor is one of the best-documented and most-verified drivers of outperformance. Many new, empirically grounded factors are found by academics around the world every year, but their validity is often questionable. Researchers rely on extremely small sample sizes – at least in comparison to the size of the stock market as a whole – and often try to fit the data to a specific hypothesis. The traditional value factor, on the other hand, has been scrutinised by academics over and over again. With the enterprise multiple representing its newest peer-reviewed incarnation, it is no surprise that it is many corporate finance practitioners' favourite valuation tool; Block concluded more than a third of surveyed analysts preferred it to other valuation metrics in 2010 already (Block, 2010). By focusing on the enterprise-multiple value factor, this thesis is treading on theoretically solid ground.

With the same train of thought, one could argue that, next to the value factor, it should also include Fama and French's "High-Low Factor" since it has the same fundamental standing in academia and has, despite many attempts to prove the opposite, not been refuted so far. While this is valid

criticism, the idea behind this thesis is to establish whether two theories, strategic sector allocation and value investing, can be combined to achieve a superior risk-reward profile. By including another variable, the findings would be diluted: Both in the case of positive of negative results, one would not be able to establish which of the cross-interaction between the independent variables, namely the value factor and the sector allocation, between the sector allocation and the size factor or the size factor and the value factor have influenced the dependent variables (risk-return) the most. Next to the problem of needing to drastically increase the sample size since most indices only include the top of their respective markets to properly account for the size factor, the issue of cross-interaction would require a much more complex research design and is beyond the scope of this thesis.

In conclusion, the research gap identified in the literature review can be summarised as the effects of combining industry-based portfolio balancing with the enterprise multiple investing strategy. Both approaches have been proven to work individually, but it remains to be discovered if this holds true if one was to unite the two approaches or if there are any synergy effects. As mentioned earlier, there are indicators pointing towards a reciprocal neutralisation of the effects, for example by assuming that the EM-effect is largely based on industry rotation benefits since a low EM-strategy at a given point in a business cycle tends to overweight certain industries. If that assumption was false, the main research question of this paper would make little sense as there would always be a quasi-equal distribution of sectors in EM-portfolios. As a premise to the main research question as formulated in chapter 1.4, one thus needs to answer the following foundational sub-question beforehand:

Does the EM investment strategy lead to a disbalance in the industry allocation of a portfolio?

Most of the (private-sector) research in this chapter points towards an affirmative answer to the question but it is so essential to the research that it warrants its own research question.

Moreover, one could also assume that equal industry allocation results in a more favourable risk profile as the portfolio would not be subject to the volatility of a single, overweighted sector. We can thus speculate that the hypothesis portfolio, namely an industry-weighted EM-portfolio, would yield a more favourable risk-return profile. On the other hand, the null-hypothesis postulates that there is no significant effect.

CHAPTER 3: METHODOLOGY

The following chapter deals with the research methodology. The methodology and metrics are explained and justified; furthermore, this chapter explores possible ethical issues which could arise during the execution of the research.

3.1 Introduction

The nature of this thesis and finance as a discipline overall warrant a quantitative approach. In that sense, the *raw* data is non-manipulable and accessible for everyone which necessarily leads to increased transparency and accountability. The following sections provide a detailed account of how the data was retrieved, transformed, measured and interpreted in order to ensure full replicability. Each decision that was taken in the process is accompanied by an explanation and justification.

3.2 Sample choice and retrieval

Firstly, one needs to find a dataset which is large enough to provide some degree of statistical significance (despite the time and resource constraints of a master's thesis). Secondly, in order to provide findings that can possibly be applied to most developed markets, it needs to be representative of an average – or at least most – developed economies' stock universe, meaning it should be well balanced between sectors and locations. A somewhat balanced and representative sector composition is particularly relevant for this thesis to ensure the sector-weighted portfolios can be constructed later. Thirdly, it should be a stock universe that is widely accessible and provides not only enough, but also reliable historic data. In the light of the requirements above, the S&P 500 was deemed the most suitable sample as it aims to provide a representation of the US-economy while featuring highly liquid, accessible stocks with readily-available fundamental and price data.

All of the quantitative data was taken from Refinitiv Datastream (formerly Thomson Reuters). The database contains over 35 million individual instruments and indicators and 70 years of data from more than 170 countries (Refinitiv US Holdings Inc.). As such, it is regarded as one of the most exhaustive and reliable tools for financial and economic data and analysis and is trusted by many private-sector practitioners and researchers. Individual data points include the historic enterprise value of a stock, historic EBITDA, its industry classification and monthly prices at the individual stock level (as total return indices) for the observation period. The data was exported to Microsoft Excel through the following formulae:

=@Thomson.Reuters.AFOSpreadsheetFormulas.DSGRID("LS&PCOMP0192";"NAME;DWEE;ICBIN";"1992-01-01";"";"";"RowHeader=true;ColHeader=true;DispSeriesDescription=true;DispDatatypeDescription=true";"")

for the historic EM-multiples of historic S&P constituents at a specified historic date and

=@Thomson.Reuters.AFOSpreadsheetFormulas.DSGRID('1992'!$B$3:$B$502;"RI";"1992-01-01";"1995-12-01";"M";"RowHeader=true;TimeSeriesList=true;ColHeader=true;Transpose=true;DispSeriesDescription=false;YearlyTSFormat=false;QuarterlyTSFormat=false";"")

for the corresponding historic monthly total returns (adjusted for dividends) of each equity.

All formulae were checked for plausibility and accuracy by manually comparing some of the results to the entries in the Refinitiv databases via the desktop interface. In order to depict the total holding period return to the investor and to make it comparable with the S&P 500, dividends are included in the performance calculation by choosing Datastream's total return index (Clare, 2018). The whole data retrieval process took place remotely via Anydesk which added an extra layer of complexity to the process.

3.3 Methodological design and justification

This section explains and justifies the analysis procedure. In general, there are multiple possible approaches: Firstly, in quantitative research in finance, linear panel regressions enjoy enormous popularity. For the topic at hand, it would theoretically be possible to design a linear panel regression: Monthly returns as a variable dependent on the EM – with an expected inverse relationship according to the existing empirical research – and a binary dummy variable for each sector. If one was to split the data in equally-sized sets with a horizon of, say, three years, one should receive wildly different results for the coefficients of the binary dummy variables. However, this would only prove that there is indeed a cyclical component to the behaviour returns of individual sectors; it would not provide any meaningful insight into how to harvest that excess return potential in portfolio management. Furthermore, the cyclicality of sector returns is an established fact already and is hence no novelty (Vardharaj & Fabozzi, 2007) (Campa & Fernandes, 2006).

A further problem is the mismatch of dependent variables with independent variables. Namely, there are monthly returns (or even *more* granular returns) for stocks, but only yearly, or at best, quarterly estimates for the constituents of the EM, such as EBITDA, cash or debt. Arguably, the returns could be annualised, but this would imply the loss of relevant data for the calculation of

the coefficients and more importantly, it would distort the risk profile by smoothening monthly returns for stocks that might have an enormous variance throughout the year. A panel regression is thus not helpful to answering the research question itself, but it could provide helpful additional insights related to the topic.

Consequently, the researcher has decided to employ a portfolio-based approach: The (historic) stock universe of the S&P 500 is used to form portfolios with equal industry weights. These portfolios are rebalanced after certain time-periods (for the derivation of exact parameters, see 3.4) according to the lowest multiples in each industry. In terms of industry classification, the researchers employed Refinitiv's own industry classification system. The resulting portfolio is called the *hypothesis portfolio* in the following chapters.

Another crucial component is the decision of whether to include short-selling in the research design. Total return strategies, more specifically long-short approaches, have consistently produced higher Sharpe ratios than all major long-only strategies. In this specific case, Crawford, Gray and Vogel have demonstrated that most of the EM-premium can only be harvested through short sales (Crawford, R. Gray, & Vogel, 2019), meaning the natural inclination would be to construct total return portfolios. However, since this paper is intended for practical use, especially for retail investors who often face short-selling limitations, a long-only portfolio is deemed more appropriate. This is somewhat understandable as short-selling is generally more expensive than long positions due to, among other factors, the cost of borrowing (Banerjee & Graveline, 2012) and additional unique risk, such as the risk of prematurely recalled loans (Engelberg, Reed, & Ringgenberg, 2017).

As the goal of this paper is to examine the impact of applying an equal sector weighting to a low-EM investing approach on risk and return, one also needs to define the metrics to measure both indicators. Returns are presented as annualised and average monthly returns on a portfolio basis – annualising returns reduces the ability to deduce possible price volatility, but other, more insightful measures are employed to assess volatility. Annualised or monthly average returns are equivalent to the geometric mean defined as

$$r = \sqrt[t]{\frac{Holding\ period\ ending\ value}{Holding\ period\ beginning\ value}} - 1$$

where

$r =$ annual or monthly return

$t =$ number of years (for annualised) or months (for monthly) per holding period

Furthermore, the standard deviation of returns is used as an indicator for price volatility and hence portfolio risk. This metric is regarded as one of the most basic measurements for portfolio risk; its magnitude often determines whether certain investors want to or are allowed to (in case of some highly regulated pension funds etc.) invest in a financial instrument at all. Consequently, this indicator will not only be highly relevant to potential institutional investors who might be interested in applying the strategy but also to conservative private investors who plan to liquidate some of their assets in the near future (Clare, 2018). Furthermore, it also represents one of the necessary components to calculate the *Sharpe ratio*.

In conjunction with the conventional standard deviation, the semi-deviation is also taken into account. It is defined as the standard deviation of negative returns only, resulting in a more representative measure of downwards volatility and hence risk in comparison to the simple standard deviation. In other words, positive outliers – which are generally considered desirable in the context of portfolio returns and can thus hardly be regarded as a proxy for risk– may inflate the standard deviation, but not the semi-deviation. It is defined as

$$\sigma_B = \sqrt{\frac{1}{T} * \sum_{t=1}^{T} Min\{(r_t - B), 0\}^2}$$ (Estrada, 2004)

where

B = benchmark value; in the following calculations *zero*

$\sigma_B =$ semi-deviation with respect to B

$r_t =$ return of period *t*

T = total number below benchmark returns (as opposed to the total sample size).

After having established two independent metrics for risk and return, both will now be combined in the so-called Sharpe ratio which Sharpe himself plainly called *reward to variability ratio* in his original paper *Mutual Fund Performance* in 1966 (Sharpe, 1966). Essentially, it represents a measurement of how many units of return are generated by one unit of risk. In other words, it shows how much return can be harvested at a certain risk level. Consequently, a higher ratio indicates a more efficient portfolio in terms of its risk profile, subsequently solving the problem of comparability of portfolio returns with differing risk profiles. Sharpe defines the risk to variability ratio (henceforth known as *Sharpe Ratio*) as

$$\frac{A_i - p}{V_i}$$

where

A_i = average returns for asset i

p = risk-free rate

V_i = *variability* (or standard deviation) of asset i (Sharpe, 1966).

On top of that, by analysing the monthly beta of the EM-portfolios with the S&P 500, one can identify diversification potentials for the portfolio as a whole. A beta of below one (or, ideally, negative) will indicate that a portfolio based on the investment principles under investigation in this thesis is likely to yield diversification benefits when mixed with the market portfolio, for example an S&P 500 ETF. In principle, the lower the beta of the EM-portfolios, the higher the expected diversification benefits. In general, the beta coefficient shows the level of *systemic risk* associated with the EM-portfolios in comparison to the Sharpe ratio which covers both systemic and idiosyncratic risk (Clare, 2018).

Further, the coefficient of determination for a linear regression between S&P 500 returns and hypothesis portfolio returns will be calculated. This will provide an insight into the percentage of returns of the hypothesis portfolio which is driven by S&P 500 returns. The standard formula of R^2, namely one minus the sum of squares of the residuals divided by the total sum of squares, will be employed. The researcher will also look into the significance of the relationship to gauge whether hypothesis-portfolio returns can be expected to follow trends of the S&P 500 in the future. Just like the beta, R^2 is employed of a measure of *systemic risk* while standard deviation covers idiosyncratic risk as well.

Both the beta and the coefficient of determination will be obtained by means of ordinary least square linear regressions of monthly portfolio returns against the S&P 500 for the total observation period as well as all individual holding periods. More concretely, the coefficients of the regression are equivalent to the beta whereas the coefficient of determination is calculated according to the following formula:

$$R^2 = 1 - \frac{Sum\ of\ Squares\ of\ Residuals}{Total\ Sum\ of\ Squares}$$

The regression calculations as well as some basic descriptive analysis of the data is performed in R-Studio, a graphical user interface for the programming language R.

Lastly, the alpha will be calculated, essentially measuring the outperformance over the respective index. This indicator has been chosen last as it is more of a formality in portfolio management, all relevant information can be extracted from the aforementioned indicators already.

The following formula will be employed based on (Häcker & Ernst, 2017):

$$\alpha = R - R_f - \beta(R_m - R_f)$$

where

α = Alpha

β = Beta

R_m = Market return

R_f = Risk free rate

Even though the EM-investment strategy has been proven and verified many times, for the sake of completeness, a significance test of the hypothesis strategy will be included as well. Significance will be established by comparing the mean returns with the help of an independent two-sample t-test. This procedure implies that there is no overlap between the samples.

As the hypothesis portfolio is a subset of the S&P 500, one needs to calculate the S&P 500's returns excluding any stocks that are represented in the hypothesis portfolio to make the two sets of stocks comparable for the t-test. As the hypothesis portfolio contains 33 stocks at any given point, the returns of these 33 stocks need to be removed from the sample of the S&P 500. Once these stocks are removed, the remaining 467 stocks in the portfolio need to be assigned higher weight to make up for the shrinking portfolio due to the removal of 33 stocks.

Based on these considerations, the following formula has been derived:

$$R_{S\&P500\ adjusted} = \left(R_{S\&P\ 500} - R_{Hypothesis\ Portfolio} * \frac{33}{500}\right) * 500/467$$

33/500 represents the weight of the hypothesis portfolio returns of the total S&P 500 returns. 500/467 accounts for the missing 33/500 of the portfolio by increasing the weighting of the remaining stocks to a total of 100% again.

This equation makes two simplifying assumptions: That stocks in the S&P 500 are balanced equally (which is not the case) and that there are always 500 stocks in the S&P 500 (which, at times, can contain slightly more than 500 stocks). The results thus have to be seen as an approximation; a more accurate t-test would necessitate the manual construction of all S&P 500 portfolios excluding the 33 stocks in the hypothesis portfolio to account for the weighting of stocks.

3.4 Methodological design of sub-question

To verify whether there is a statistically significant disbalance in the industry allocation of a plain EM-strategy which is the underlying assumption for the main research question of this thesis, the chance of a stock belonging to a certain industry will be seen as a binomial probability: If there are 11 industries, there chance of any stock to belong to a certain industry is 1/11 while the chance is 10/11 that it belongs to another when implying an equal number of stocks per industry in the population of the S&P 500. Following that logic, one can deduce the standard deviation of stocks per industry based on the formula for the standard deviation of binomial distributions:

$$\sigma = \sqrt{n * P(x) * (1 - P(X))}$$

n = 33

P(x) = 1/11

μ = 3

In an equally-weighted portfolio, one would expect a standard deviation of 1.36 stocks per industry based on this formula. Consequently, based on the standard deviation, one can deduce the z-score (by dividing the number companies per industry by σ) and hence the p-value for each industry to analyse whether any disbalance in industries can be ascribed to random variation around the mean or to a systematic disbalance caused by the EM-strategy.

3.5 Portfolio specifications: Size, holding period and time horizon

This section reveals and justifies the details of the portfolio allocation strategy for the EM-portfolios. Firstly, as specified in the title, all industries are represented with an equal share. There are two possible alternatives to this approach: The first one is a dynamic approach in which the weighting of each industry changes in each rebalancing period according to the business cycle to harvest additional excess returns due to the industry-induced cyclicality of stock returns. This would, however, necessitate an assessment of the current phase of the business cycle when rebalancing the portfolio. In turn, the indicators to estimate the current state of the business cycle are far beyond the scope of this thesis in terms of complexity and warrant separate, extensive research on their own. A dynamic approach is hence rather ill-suited.

A second, more feasible approach would be a sector allocation based on Markowitz's efficient portfolio theorem. The industry weights could be calculated on the basis of average industry returns from a longer period *prior* to the first observation period of this thesis. However, while Markowitz's approach is certainly grounded in empirical reality, one of the key premises of his

theory – like most empirically grounded theories – is the prediction of future returns based on past performance. In the case of industry returns, this raises several concerns: Can one really expect the future performance of the energy sector to match its historic trend when taking into account a mounting climate regulatory burden? Is this burden expected to grow or shrink over the coming decades? Moreover, can one really expect the returns of the technology and communication sectors to follow their historic performance in times of exponentially accelerating digitalisation and after the onset of blockchain technology? In the light of concerns like these, the researcher has decided to employ a *zero-bias* perspective: Future industry returns are neither expected to match past returns nor to be driven by any other assumptions; the hypothesis portfolio is hence weighted equally by industries.

Moreover, one needs to determine the portfolio size and allocation between long and short for the total return portfolio. According to Statman, between thirty and forty stocks are required to reap the full benefits of diversification (Statman, 1987). Consequently, based on a categorisation scheme of ten industries, there are three stocks per industry. For the total return hypothesis portfolio, one additional short position in the highest-EM stock in each industry is simulated. This results in a 75% long to 25% short allocation of the total return portfolio which is indicative of the general expectation that stock prices will rise rather than fall in the long term. Furthermore, at 40 stocks in total, the portfolio fulfils Statman's diversification minimum and adding any further stocks would be superfluous.

The rebalancing period represents another parameter of the portfolio. According to the National Bureau of Economic Research, the average length of a business cycle in the post-war period constituted six years and three months from peak to peak (the National Bureau of Economic Research, 2020). On the one hand, since Fidelity Investments' model (see exhibit 2.1.2.1) postulates four cyclical phases, one would have to rebalance the portfolio every 18.75 months to capture all phases of the cycle. On the other hand, Vanguard's specialists have established that there is no significant difference in returns for frequently- and sparsely-rebalanced portfolios (Jaconetti, Zilbering, & Kinniry Jr., 2010). Additionally, while this research design neglects transaction and brokerage fees for practical purposes, rebalancing the portfolios approximately every 1.5 years would imply higher fees.

Taking both of these perspectives into account, a rebalancing period of three years appears reasonable: It still cuts the average business cycle into approximately two equal components. More importantly, the last four business cycles – which weigh heavily onto the results of this paper as they represent the majority of the total observation period – had significantly longer durations than the historic post-war average: 146 months for the current period, 81 months for the period from

2001 to 2007 and 128 months and 108 months for the preceding cycles respectively (the National Bureau of Economic Research, 2020). This also weighs on the decision of the total observation period (or time horizon).

While more data is usually desirable in all empirical studies, one also needs to take several limiting factors into account: Firstly, the further this study stretches into the past, the smaller the sample will be; naturally, data becomes sparser with age. Secondly, we need to take resource constraints into account; for example, the time frame and size of the research team. In the light of the extraordinary length of the last four business cycles, the total observation period commences in 1992 right after the trough in mid-1991 and spans 27 years until 2020 resulting in nine independent observational sub-periods of three years and one of 1,5 years covering the onset of the corona crisis. Historic constituents of the S&P 500 that were delisted, acquired or dropped from the index during the holding period will be regarded as cash (meaning the returns of these particular equities will be frozen at the time of its disappearance) until the next rebalancing period.

After having determined the portfolio parameters, only the question of suitable benchmark portfolios remains. The hypothesis portfolio will be compared with the S&P 500 as a representation for the average market returns and the passive investing approach in general and with a low-EM portfolio without any regard for industry weightings based on the same sample as our hypothetical portfolio. This is to reveal whether changes in risk and return in comparison to the market portfolio are based on the EM-effect or the sector diversification effect.

Lastly, it was decided to introduce an additional rule to the portfolio building approach: If a stock is selected by the EM-strategy for two periods in a row, it will be skipped in the second period in favour of the stock with the next-highest EM. This procedure helps avoid value traps, namely companies that consistently perform below average and thus retain a low valuation of extended periods of time. Note that this rule prohibits stocks from entering the portfolio for two consecutive periods, but not for two or more periods *in total* since one would otherwise rotate through almost all of the stocks of the index within ten periods.

3.6 Ethical considerations, biases and robustness testing

While an affirmation of the theory that sector-based allocation can improve the risk-return profile of the EM-investment strategy would certainly make this paper more valuable, the researcher has no bias towards the outcome: He neither intends to sell the findings nor utilise it in any other commercial way. As a full-time student at the time of writing, there are no affiliations with any stakeholders in this project besides the research supervisor and other supporting academic staff.

There is hence no evidence for a confirmation bias. Moreover, since the portfolio simulation is based on historic components, essentially simulating the returns an investor would have harvested with this strategy from 1992 until 2019, there is no survivorship bias. Many of the historic constituents under investigation in the study were delisted, acquired or dropped from the S&P 500 over the decades.

In terms of robustness, the previously mentioned value trap avoidance rule will also provide us with meaningful information about the robustness of the strategy. By excluding certain stocks from entering the portfolio in every period and hence heavily weighing on the results due to their overrepresentation, the results will be protected from distortion.

Another potential flaw of the methodological design is rooted in the portfolio-simulation approach itself: When constructing the portfolios, the researcher assumes that towards the beginning of each year, all fundamental data of the last year has been made public already. In reality, however, when implying that the accounting year of a firm equals an ordinary calendar year, in January of any given year, the EBITDA values for the preceding year are usually not available yet. Most annual reports are published in February, March or April of the following year. Essentially, this approach factors in data that cannot be known to the average investor at a certain point in time. To mitigate this inherent bias, the researchers shall pay special attention to any abnormal increases in returns in the first three months of each portfolio period. Such abnormal returns would not invalidate the initial hypothesis of this thesis in any case, but the findings would have little practical value if the excess returns cannot be harvested by investors due to information asymmetries.

3.7 Conclusion and interconnection of variables

Based on chapters two and three, the thesis employs an eclectic, deductive research approach: The researcher synthesises current state-of-the-art theories in portfolio management, namely

I. the benefits of diversification by sectors
II. smart beta investing as a combination of a "passive" investment approach with empirical quantitative factors
III. the value factor, represented by the enterprise multiple.

One can thus deduce that, since I., II. and III. are all individually true, they should also be true all *taken together.* The logical result would hence be a more favourable return profile or, at the least, a higher Sharpe ratio for the EM portfolios that combine all three factors. On the other hand, there might be interdependencies between the factors that neutralise one another – the alternative hypothesis. The dependent variable *Sharpe ratio* is determined by two other dependent, mediating

(as both are constituents of calculating the Sharpe ratio) variables – monthly returns and standard deviation. These two are both influenced by our independent variables *sector allocation* and *enterprise multiple*.

CHAPTER 4: DATA PRESENTATION AND ANALYSIS

After having presented the introduction, the theoretical framework including relevant literature and the methodology, this chapter covers the execution research plan.

4.1 Introduction

The retrieval processes worked as intended after some attempts. All of the data was collected according to the initial methodological design.

4.2 Summary of data

Overall, the researcher retrieved ten sets of historic S&P 500 constituents with the corresponding EM from the beginning of the period as well as the industry classification of each equity as a static Datastream request. This equals more than 4.500 EM-data items and industry classifications respectively. Afterwards, 162.000 monthly static returns for each equity were retrieved via a dynamic request, totalling more than 171.000 individual data points, excluding tickers and company names. As briefly mentioned in the methodology, the prices of individual stocks were retrieved as price indexes, meaning with cumulating returns over time. The return index for the S&P 500 as a whole was downloaded to serve as a benchmark.

4.3 Analysis of data

After the portfolios have been constructed according to the parameters, preliminary positive results indicate that the industry-allocation strategy seems to provide excess returns in comparison to a plain low EM-investing strategy. Before proceeding to a more granular analysis, one should have a closer look at one of the premises of the hypothesised strategy in this thesis: The assumption that in a plain low EM-portfolio (herein also referred to simply as "benchmark"), certain industries are overrepresented throughout the business cycle (* =*overrepresentation significant at* $\alpha = 0.05$).

Benchmark	1995	1998	1998	2001	2004	2007	2010	2013	2016	2019
Basic Materials	2	2	9*	2	0*	6*	1	1	4	2
Consumer Discretionary	4	3	6*	8*	5	2	5	6*	10*	8*
Consumer Staples	0*	2	3	0*	4	0*	1	1	0*	1
Energy	3	3	2	9*	6*	13*	2	11*	1	10*
Financials	4	1	0*	0*	3	4	4	3	2	6*
Healthcare	0*	2	1	0*	2	1	5	0*	1	1
Industrials	13*	10*	5	9*	3	2	4	2	6*	0*
Real Estate	0*	0*	0*	0*	0*	0*	0*	0*	0*	0*
Technology	5	6*	2	2	2	1	5	7*	4	4
Telecommunication	1	2	1	2	5	3	3	2	3	1
Utilities	1	2	4	1	3	1	3	0*	2	0*

Figure 4 - Exhibit 4.3.1: Industry allocation of stocks in the benchmark portfolio

Exhibit 4.3.1 illustrates this point well: While our hypothesis portfolio is equally weighted by industries (three stocks per industry), the breakdown in 4.3.1 clearly reveals a significant imbalance in sector allocations for the benchmark portfolio: In all periods but 2004 and 2010, the two most heavily-weighted sectors consistently make up more than 45% of the portfolio while they should only account for approximately 9% in an equally-weighted portfolio. In the extreme cases of 2007 and 1995, the top industry alone accounts for roughly 40% of the portfolio.

Based on the formula in chapter 3.4, the expected standard deviation amounts to 1,36. At a cut-off value $\alpha = 0{,}05$, one would expect 5.5 out of 110 observations in exhibit 4.3.1 to fall beyond the lower and upper boundary $\alpha = 0{,}05$. In this case, however, 42 out of 110 observations fall into these statistically significant tails. This is more than 7 times the expected number of outliers (42/5,5). The assumption that a plain low-EM strategy leads to a significant disbalance in industries can thus be confirmed by the findings and the foundational assumption of this thesis is hence confirmed.

4.3.1 Period returns

The following sections first present and describe the data and then proceed to analyse it, starting off with the total portfolio returns over the complete period and followed by individual holding period returns. The data is presented as graphs and figures and then followed by detailed tables with the respective values they are based on.

Grey: *S&P 500*

Orange: *Plain EM-investment strategy*

Blue: *Hypothesis portfolio, industry-weighted EM-investment strategy*

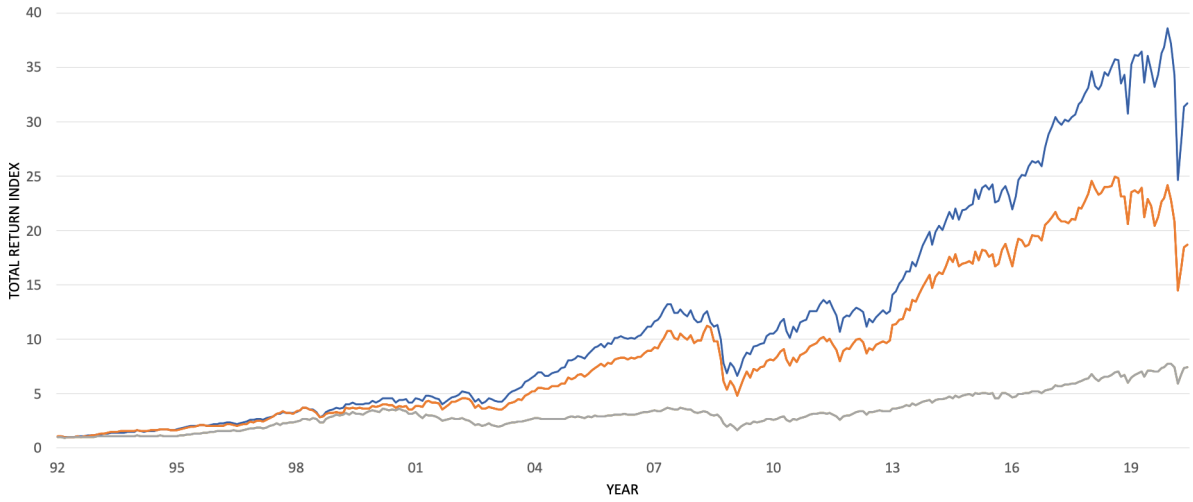


Figure 5 - Exhibit 4.3.1.1: Value of one dollar invested in 1992 according to each strategy, linear scale

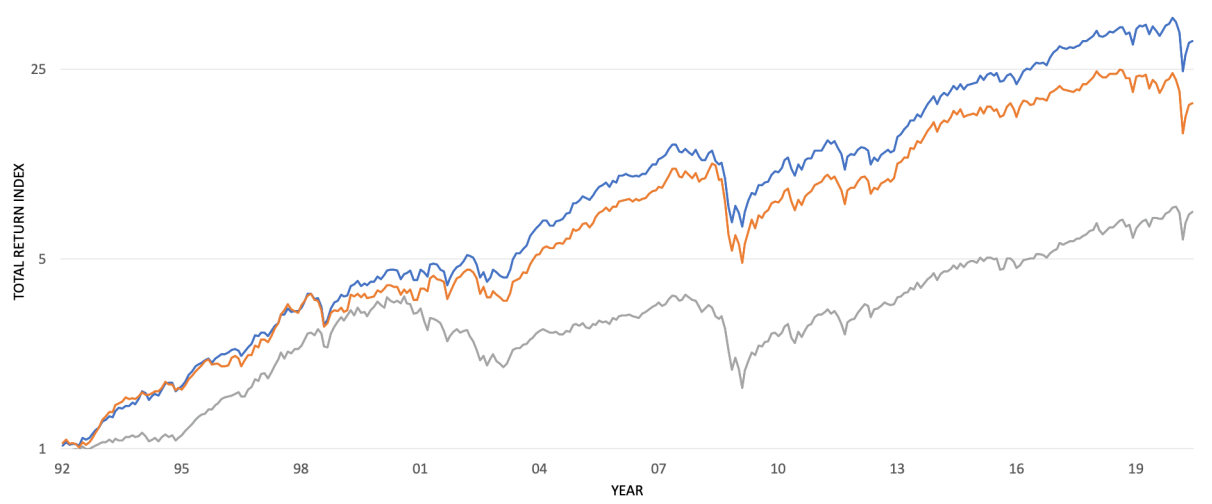


Figure 6 - Exhibit 4.3.1.2: Value of one dollar invested in 1992 according to each strategy, logarithmic scale

The following graphs depict the total return index for each holding period. The axis scaling is consistent throughout all periods to facilitate comparative analysis.

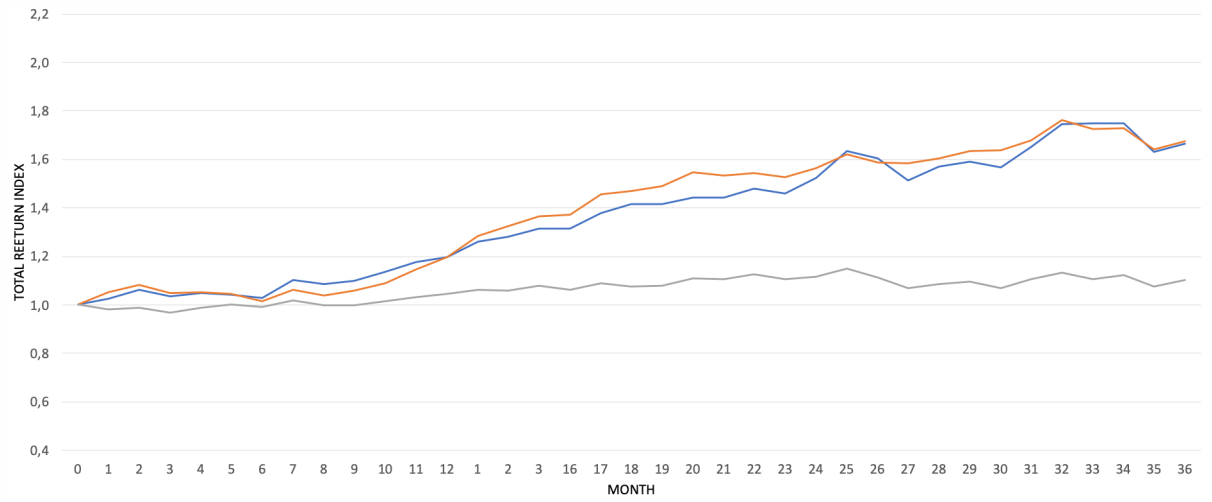


Figure 7 - Exhibit 4.3.1.3: Returns in 1992-1995

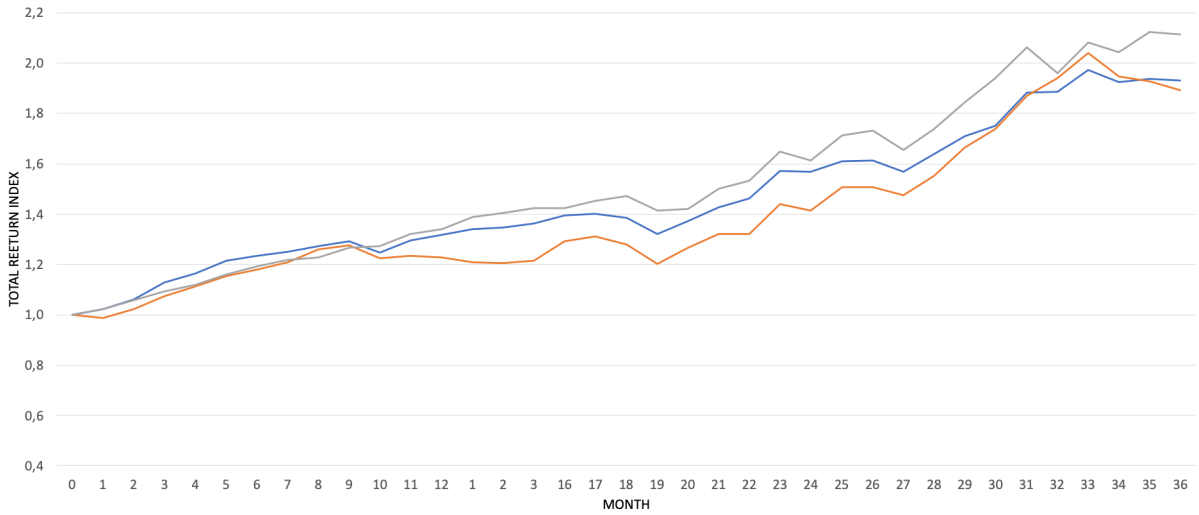


Figure 8 - Exhibit 4.3.1.4: Returns in 1995-1998

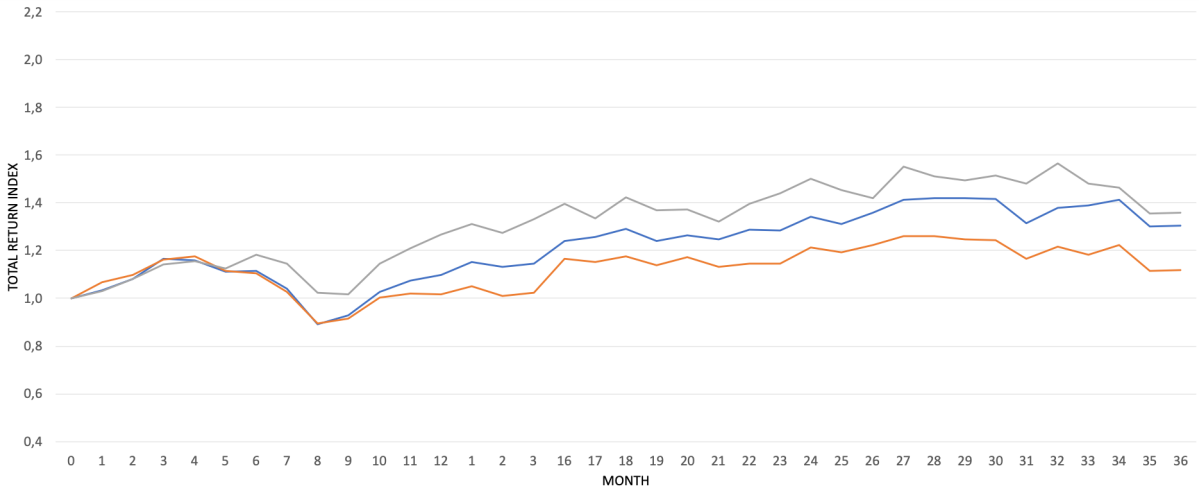


Figure 9 - Exhibit 4.3.1.5: Returns in 1998-2001

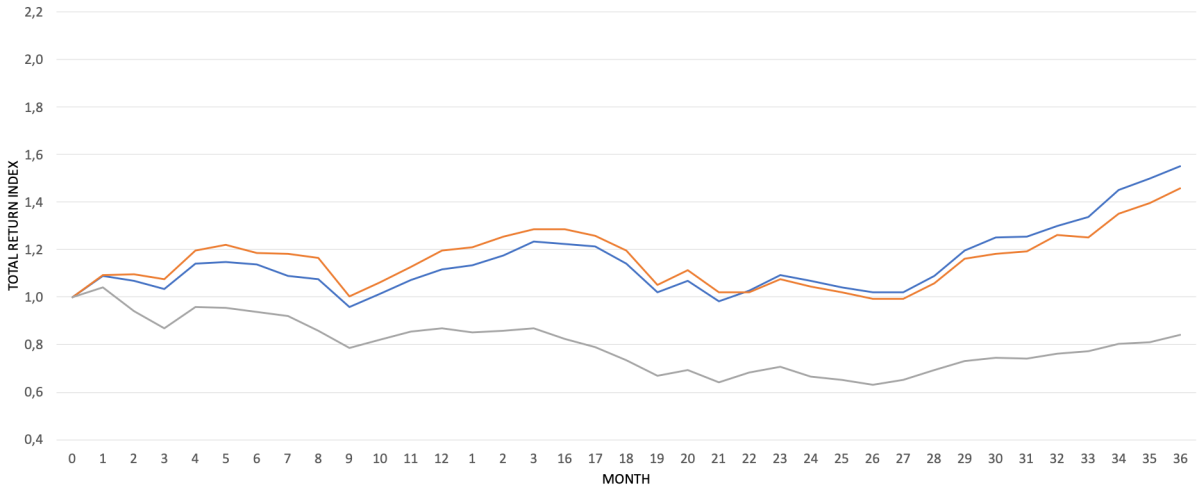


Figure 10 - Exhibit 4.3.1.6: Returns in 2001-2004

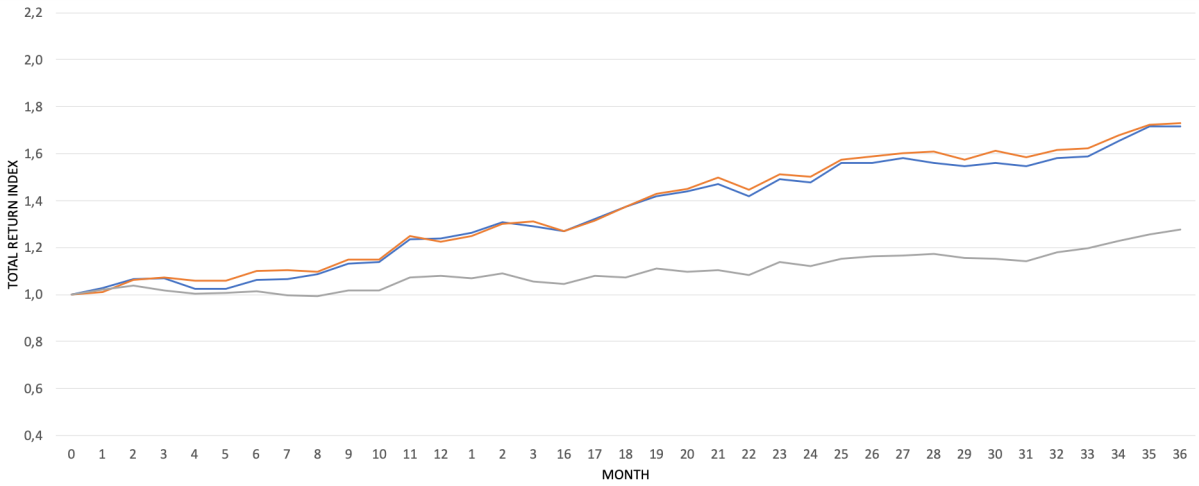


Figure 11 - Exhibit 4.3.1.7: Returns in 2004-2007

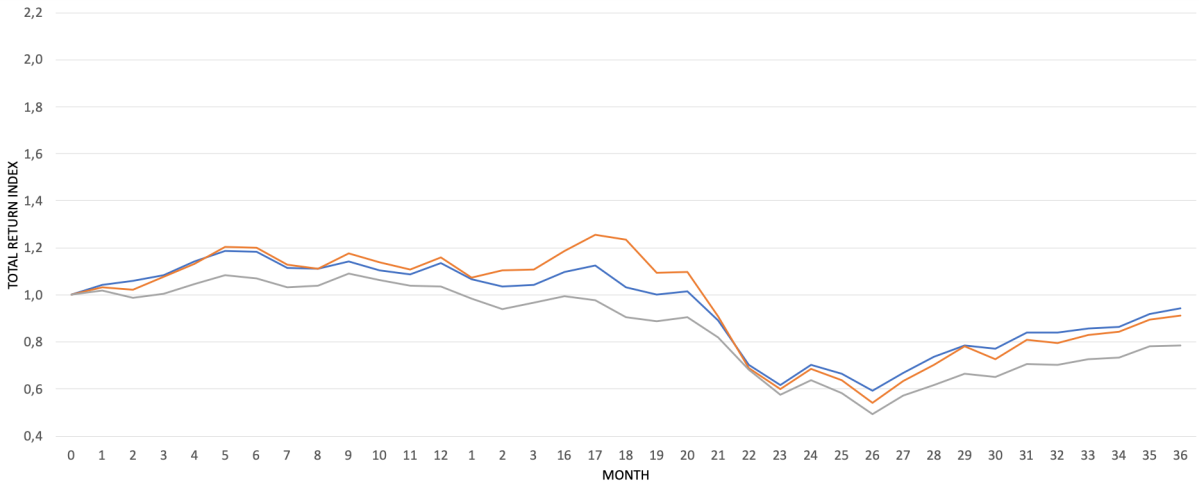


Figure 12 - Exhibit 4.3.1.8: Returns in 2007-2010

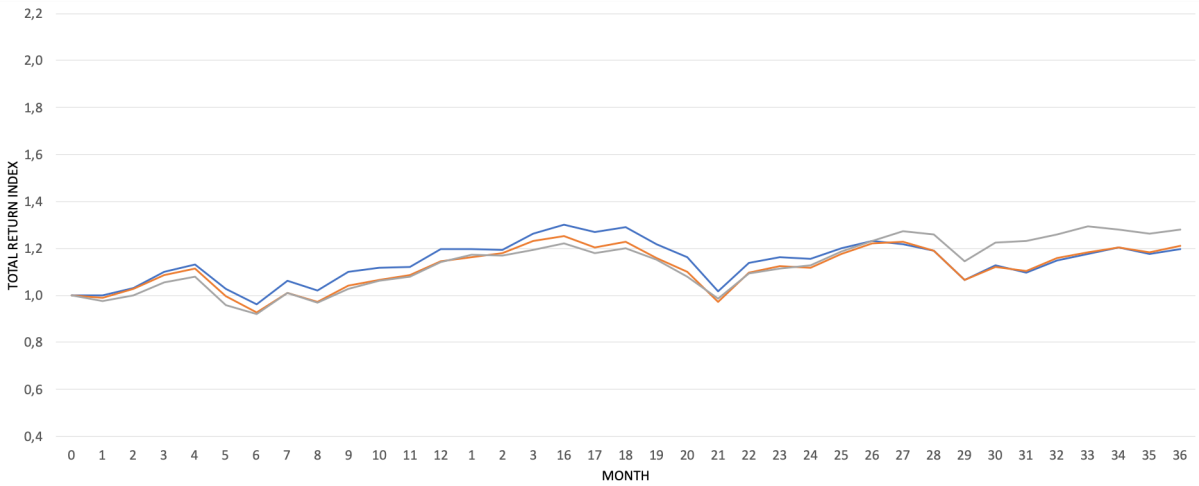


Figure 13 - Exhibit 4.3.1.9: Returns in 2010-2013

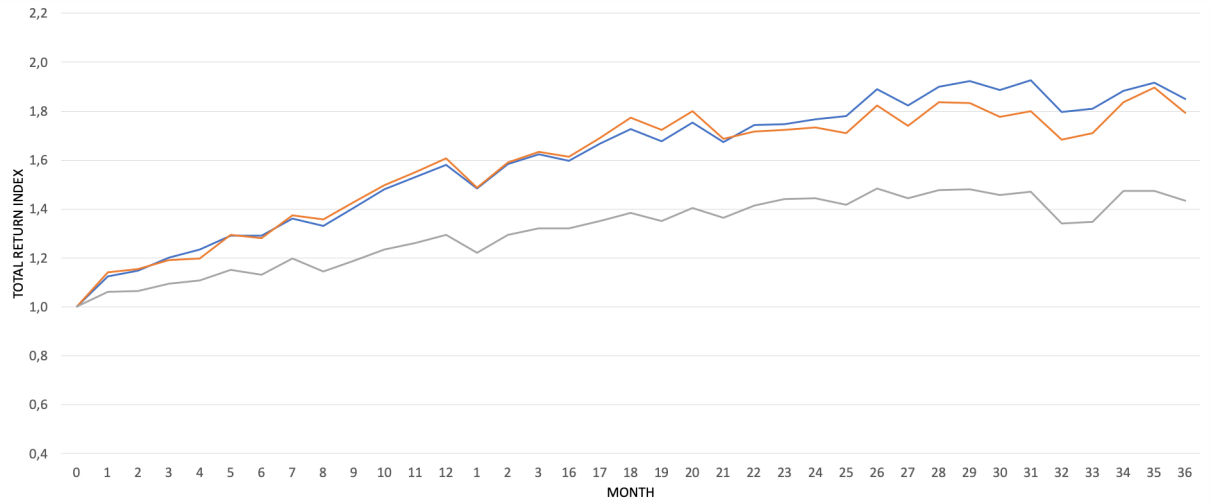


Figure 14 - Exhibit 4.3.1.10: Returns in 2013-2016

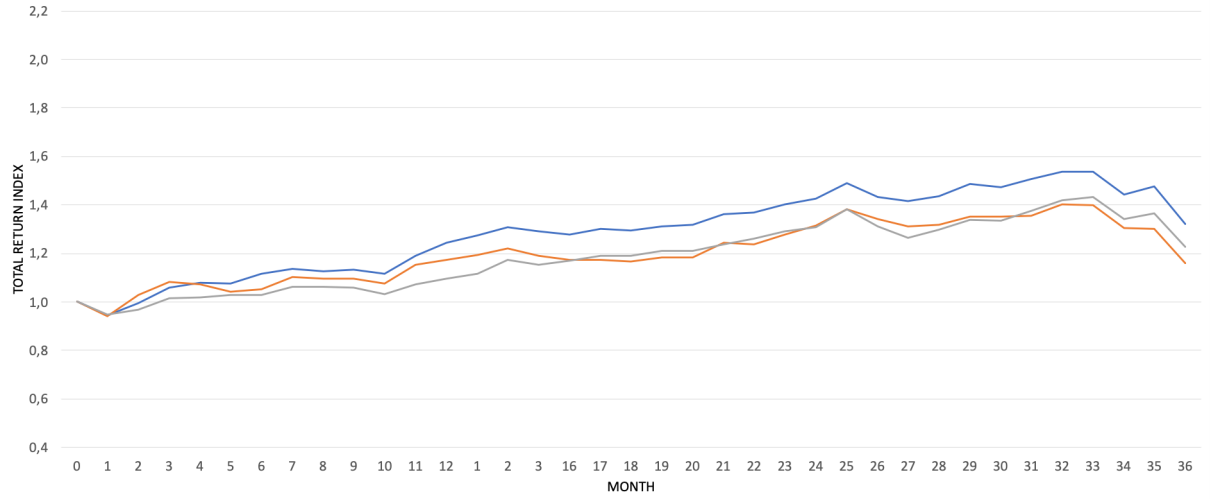


Figure 15 - Exhibit 4.3.1.11: Returns in 2016-2019

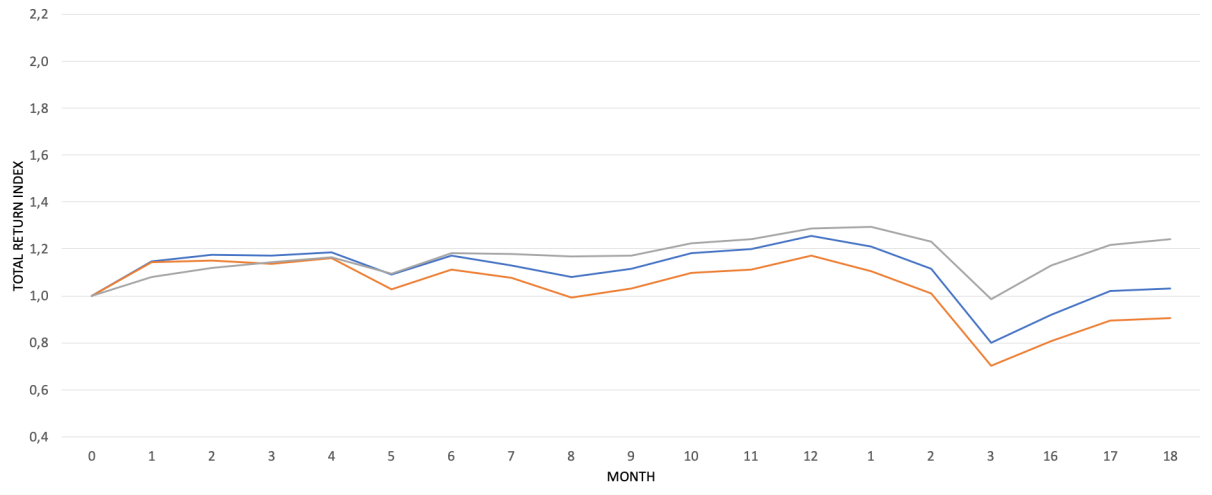


Figure 16 - Exhibit 4.3.1.12: Returns in 2019-2020

The following table shows the exact returns per period:

	Portfolio	Holding Period Return	Monthly Returns	Annual Returns
TOTAL	Hypothesis	3071,97%	1,01%	12,77%
	Benchmark	1770,74%	0,84%	10,61%
	S&P 500	647,05%	0,55%	6,77%
1992	Hypothesis	66,38%	1,42%	18,50%
	Benchmark	67,59%	1,44%	18,78%
	S&P 500	10,11%	0,27%	3,26%
1995	Hypothesis	93,07%	1,84%	24,52%
	Benchmark	89,17%	1,79%	23,68%
	S&P 500	111,30%	2,10%	28,32%
1998	Hypothesis	30,40%	0,74%	9,25%
	Benchmark	12,00%	0,32%	3,85%
	S&P 500	36,05%	0,86%	10,81%
2001	Hypothesis	55,11%	1,23%	15,76%
	Benchmark	45,78%	1,05%	13,39%
	S&P 500	-15,78%	-0,48%	-5,56%
2004	Hypothesis	71,58%	1,51%	19,72%
	Benchmark	73,01%	1,53%	20,05%
	S&P 500	27,55%	0,68%	8,45%
2007	Hypothesis	-5,81%	-0,17%	-1,98%
	Benchmark	-8,73%	-0,25%	-3,00%
	S&P 500	-21,38%	-0,67%	-7,70%
2010	Hypothesis	19,71%	0,50%	6,18%
	Benchmark	21,12%	0,53%	6,60%
	S&P 500	27,90%	0,69%	8,55%
2013	Hypothesis	84,90%	1,72%	22,74%
	Benchmark	79,49%	1,64%	21,53%
	S&P 500	43,31%	1,00%	12,74%
2016	Hypothesis	32,27%	0,78%	9,77%
	Benchmark	16,03%	0,41%	5,08%
	S&P 500	22,65%	0,57%	7,04%
2019	Hypothesis	3,17%	0,17%	2,11%
	Benchmark	-9,26%	-0,54%	-6,27%
	S&P 500	24,29%	1,22%	15,60%

Nominal portfolio returns for the total holding period, monthly and annual intervals

Figure 17 - Exhibit 4.3.1.11: Nominal portfolio returns for the total holding period, monthly and annual intervals

At first glance, it is evident that the hypothesis portfolio outperformed the S&P 500 and the benchmark by a significant margin. From 1992 to 2019, the funds invested in the industry-allocated EM strategy increased more than thirtyfold, almost twice as much as the benchmark portfolio returns and more than four times the returns of the S&P 500. In terms of monthly returns, the plain EM portfolio (the benchmark portfolio) performed 0.29 percentage points better than the

S&P 500 while the hypothesis portfolio beat it with 0.46 percentage points. This is slightly less than what Walkshäusl's and Lobe's findings would suggest as they duo found an outperformance of one percentage point per month when comparing high EM to low EM portfolios (Walkshäusl & Lobe, 2015).

As the S&P 500 consists of both low- and high-EM stocks, we could expect an outperformance of 0.5 percentage points a month (assuming that excess returns are linearly / normally distributed over the spectrum of low and high EM stocks). Next to random deviations, there are several explanations why returns fell slightly short of the expectations:

1. Walkshäusl and Lobe considered a vast sample of international stocks, not just the S&P 500. In other words, returns could have been distorted by geographic allocation as well as the composition of the S&P 500 which does not include smaller corporations.
2. Walkshäusl and Lobe shorted high-EM stocks. The approach in this thesis is long-only.
3. The assumption that excess returns based on EM-values are normally / linearly distributed in accordance with EM-values could be false.

Nevertheless, one can conclude that overall, the hypothesis approach to EM-investing seems to generate excess returns of around 0.17 percentage points a month or 2.16 points annually. While this does not seem like much, the total holding period returns illustrate very well how significantly this impacts the compound effect and consequently long-term returns. These excess returns are somewhat consistent throughout all periods, meaning they are not driven by extreme on-time price movements. This is supported by the fact that the hypothesis strategy outperformed the benchmark strategy in seven out of ten portfolio periods. In comparison with the S&P 500, this is true for six out of ten periods. However, it is worth mentioning that the period from 1992 until 1995 and the two periods from 2001 until 2007 account for the bulk of both the hypothesis and benchmark portfolios' outperformance; removing those periods would likely nullify most of the outperformance in comparison to the S&P 500.

Based on the period-return graphs, the hypothesis strategy – in comparison to the benchmark strategy – seems to be effective even in times of increased volatility and negative returns, in other words in crisis periods. This is illustrated well in exhibits 4.3.6 and 4.3.8 where the hypothesis strategy performance overtakes the benchmark strategy roughly at the trough of each crisis (in 2003 and 2008 respectively). In conjunction with the findings of Zhang et alia and Winkelmann et alia, these findings are of particular interest since both research teams established a positive correlation between (macro)-risk and low relative valuations (Zhang & Chen, 1998) (Winkelmann, Suryanarayanan, Hentschel, & Varga, 2013).

4.3.2 Total risk: Standard deviation and semi-deviation

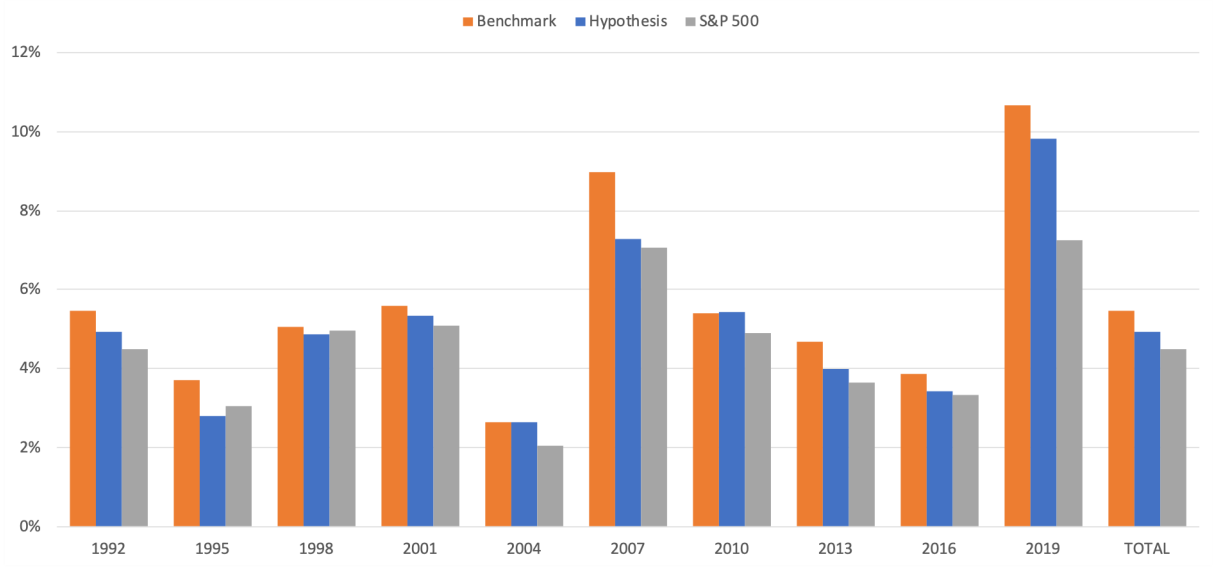


Figure 18 - Exhibit 4.3.2.1: Standard deviation of the hypothesis portfolio, benchmark portfolio and S&P 500

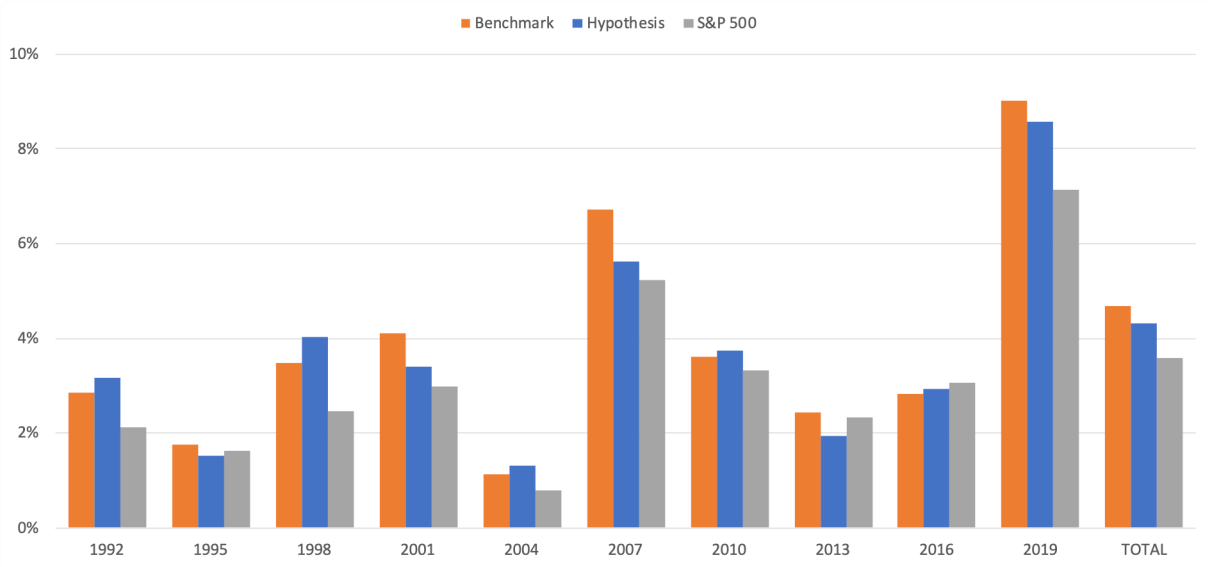


Figure 19 - Exhibit 4.3.2.2: Semi-deviation of the hypothesis portfolio, benchmark portfolio and S&P 500

As per the definition with the specific parameters determined in the methodology, the semi-deviation has been described as the standard deviation of negative returns. By looking at the total holding period in exhibits 4.3.2.1 and 4.3.2.2, it is evident that the hypothesis portfolio is characterised by lower standard- and semi-deviation than the benchmark portfolio. On the other hand, the semi-deviation of the hypothesis portfolio is noticeably higher in the period from 1998 (0,55 percentage points in comparison to the benchmark). However, in times of crises, for example 2001-2004 and 2007-2010, the hypothesis portfolio fared significantly better than the benchmark. When taking these thoughts and the overall results for the entire period into account, one can hence

deduce that an equally-weighted sector allocation of a low EM-portfolio indeed reduces volatility and hence risk of a portfolio. This is especially pronounced in times of crises.

The S&P 500, however, still shows even lower and hence favourable indicators in both cases. The hypothesis portfolio only exhibits a slightly lower semi-deviation than the S&P in three periods 1995-1998 and in the periods of 2013 until 2019, all timeframes of relative stability in the stock market. This is especially interesting in the case of semi-deviation. Choosing semi-deviation as a metric for risk and volatility rather than the conventional standard deviation lowers it by approximately one percentage point or, in relative terms, more than 20 percent. In comparison, when choosing the semi-deviation as a more accurate measure of risk, it decreases by (values taken from 4.3.2.1):

$$\Delta\%_{S\&P} = \frac{(3{,}58 - 4{,}5)}{4{,}5} = -20{,}4\%$$

$$\Delta\%_{Benchmark} = \frac{(4{,}69 - 5{,}46)}{5{,}46} = -14{,}1\%$$

$$\Delta\%_{Hypothesis} = \frac{(4{,}31 - 4{,}93)}{4{,}93} = -12{,}6\%$$

While the S&P 500 already exhibited the lowest risk in terms of standard deviation, the downwards adjusted semi-deviation clearly confirms that the S&P is the least volatile strategy. A possible explanation could be rooted in the presumption that systemic crises in the stock market impact low-EM portfolios more strongly than the overall market, tying in with the findings of Zhang and Chen (Zhang & Chen, 1998). These findings could also support the findings Bruce Payne, Roman Wong and Michael Tyler who claimed the EM-effect might be attributable to weaker fundamentals which usually come with higher risk. As a result, the hypothesis strategy reduces risk when compared to the benchmark portfolio, but still remains more volatile in comparison to the S&P 500.

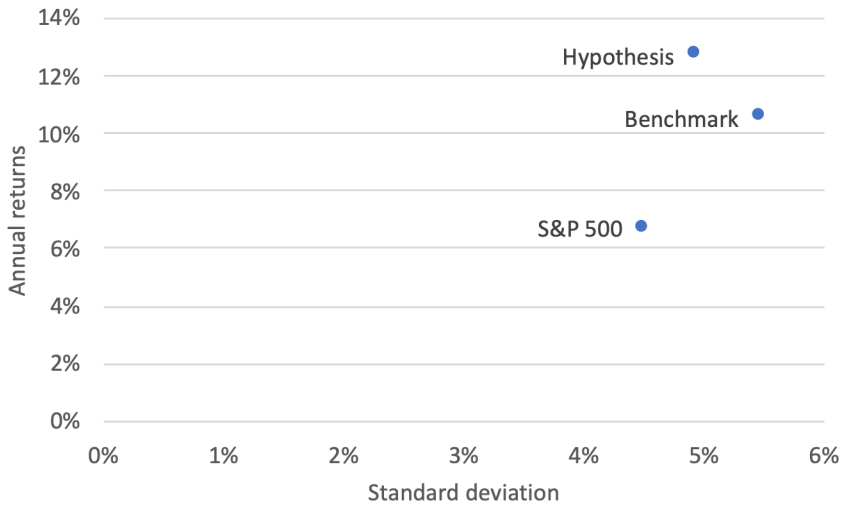
When taking only these findings into account in isolation by disregarding returns altogether, one can already establish that the risk-profile of the hypothesis strategy likely disqualifies it for a lot of institutional investors: Establishments like pension funds, sovereign wealth funds or other partly government-controlled funds tend to have strict requirements regarding the risk that managers may take on; often times, stock investments in general (as opposed to bonds or money market investments) are already seen as too risky (Clare, 2018). It can thus be classified as a high-risk, high-reward strategy; a more thorough analysis will follow in the next sub-chapter.

Standard deviation and semi-deviation for each holding period based on monthly returns

	Portfolio	Standard Deviation	Semi-deviation
TOTAL	Hypothesis	4,93%	4,31%
	Benchmark	5,46%	4,69%
	S&P 500	4,50%	3,58%
1992	Hypothesis	4,93%	3,15%
	Benchmark	5,46%	2,84%
	S&P 500	4,50%	2,12%
1995	Hypothesis	2,81%	1,52%
	Benchmark	3,70%	1,74%
	S&P 500	3,06%	1,63%
1998	Hypothesis	4,86%	4,02%
	Benchmark	5,04%	3,47%
	S&P 500	4,94%	2,45%
2001	Hypothesis	5,33%	3,40%
	Benchmark	5,58%	4,11%
	S&P 500	5,10%	2,98%
2004	Hypothesis	2,64%	1,30%
	Benchmark	2,64%	1,12%
	S&P 500	2,04%	0,79%
2007	Hypothesis	7,28%	5,62%
	Benchmark	8,98%	6,71%
	S&P 500	7,06%	5,22%
2010	Hypothesis	5,42%	3,74%
	Benchmark	5,40%	3,60%
	S&P 500	4,89%	3,33%
2013	Hypothesis	4,00%	1,94%
	Benchmark	4,68%	2,42%
	S&P 500	3,64%	2,34%
2016	Hypothesis	3,42%	2,93%
	Benchmark	3,87%	2,83%
	S&P 500	3,31%	3,07%
2019	Hypothesis	9,81%	8,56%
	Benchmark	10,65%	9,01%
	S&P 500	7,24%	7,15%

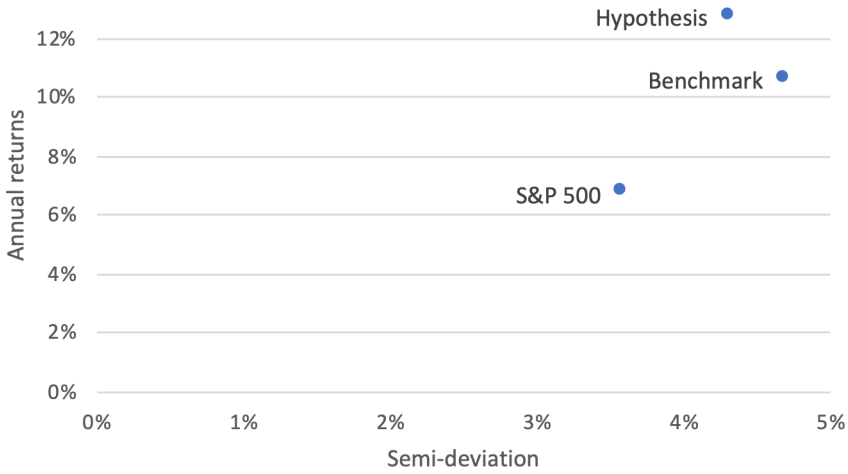
Figure 20 - Exhibit 4.3.2.3: Standard deviation and semi-deviation for each holding period based on monthly returns

4.3.3 Risk-return profile: Sharpe-ratio



Risk-return profile of portfolios based on standard deviation

Figure 21 - Exhibit 4.3.3.1: Risk-return profile of portfolios based on standard deviation



Adjusted risk-return profile of portfolios based on semi-deviation

Figure 22 - Exhibit 4.3.3.2: Adjusted risk-return profile of portfolios based on semi-deviation

Exhibits 4.3.3.1 and 4.3.3.2 represent risk-return charts with the annual returns on the y-axis and the standard and semi-deviation on the x-axis respectively; both exhibits only deviate marginally. At first glance, it is evident that the hypothesis portfolio provides superior returns at lower risk (when measured as overall volatility) when compared to the benchmark portfolio. Moreover, it can be deduced that only at slightly higher volatility, the hypothesis portfolio provides almost twice the returns of the S&P 500. In quantitative terms, for approximately 20% higher risk (measured in semi-deviation), the hypothesis portfolio provides 88% higher returns when compared to the S&P 500, meaning the excess risk is rewarded three times more than expected:

$$Excess\ Risk_{Hypothesis} = \frac{(4{,}31 - 3{,}58)}{3{,}58} = 20{,}4\%$$

$$Excess\ Returns_{Hypothesis} = \frac{(12{,}77 - 6{,}77)}{6{,}77} = 88{,}6\%$$

In other words: If one implies it was possibly to leverage the S&P 500 at no cost – a very optimistic assumption – to a degree where there is risk parity with the hypothesis portfolio, one would generate 1,204 * 6,77% = 8,15% of annual returns compared to the superior 12,77% that the hypothesis portfolio generates at the same level of risk.

The following table breaks down individual Sharpe ratios for each period:

	Portfolio	Annual Returns	Standard Deviation	Semi-deviation	3-year treasury yields	Sharpe Ratio Standard dev	**Sharpe Ratio Semi-dev**
TOTAL	Hypothesis	12,77%	4,93%	4,31%	3,68%	1,84	**2,11**
	Benchmark	10,61%	5,46%	4,69%	3,68%	1,27	**1,48**
	S&P 500	6,77%	4,50%	3,58%	3,68%	0,69	**0,86**
1992	Hypothesis	18,50%	4,93%	3,15%	5,13%	2,71	**4,24**
	Benchmark	18,78%	5,46%	2,84%	5,13%	2,50	**4,80**
	S&P 500	3,26%	4,50%	2,12%	5,13%	-0,42	**-0,88**
1995	Hypothesis	24,52%	2,81%	1,52%	7,84%	5,94	**10,97**
	Benchmark	23,68%	3,70%	1,74%	7,84%	4,28	**9,10**
	S&P 500	28,32%	3,06%	1,63%	7,84%	6,70	**12,55**
1998	Hypothesis	9,25%	4,86%	4,02%	5,62%	0,75	**0,90**
	Benchmark	3,85%	5,04%	3,47%	5,62%	-0,35	**-0,51**
	S&P 500	10,81%	4,94%	2,45%	5,62%	1,05	**2,12**
2001	Hypothesis	15,76%	5,33%	3,40%	4,82%	2,05	**3,22**
	Benchmark	13,39%	5,58%	4,11%	4,82%	1,53	**2,08**
	S&P 500	-5,56%	5,10%	2,98%	4,82%	-2,04	**-3,49**
2004	Hypothesis	19,72%	2,64%	1,30%	2,47%	6,54	**13,28**
	Benchmark	20,05%	2,64%	1,12%	2,47%	6,67	**15,73**
	S&P 500	8,45%	2,04%	0,79%	2,47%	2,93	**7,57**
2007	Hypothesis	-1,98%	7,28%	5,62%	4,71%	-0,92	**-1,19**
	Benchmark	-3,00%	8,98%	6,71%	4,71%	-0,86	**-1,15**
	S&P 500	-7,70%	7,06%	5,22%	4,71%	-1,76	**-2,38**
2010	Hypothesis	6,18%	5,42%	3,74%	1,66%	0,83	**1,21**
	Benchmark	6,60%	5,40%	3,60%	1,66%	0,91	**1,37**
	S&P 500	8,55%	4,89%	3,33%	1,66%	1,41	**2,07**
2013	Hypothesis	22,74%	4,00%	1,94%	0,76%	5,50	**11,32**
	Benchmark	21,53%	4,68%	2,42%	0,76%	4,43	**8,57**
	S&P 500	12,74%	3,64%	2,34%	0,76%	3,30	**5,13**
2016	Hypothesis	9,77%	3,42%	2,93%	1,31%	2,47	**2,89**
	Benchmark	5,08%	3,87%	2,83%	1,31%	0,98	**1,33**
	S&P 500	7,04%	3,31%	3,07%	1,31%	1,73	**1,87**
2019	Hypothesis	2,11%	9,81%	8,56%	2,47%	-0,04	**-0,04**
	Benchmark	-6,27%	10,65%	9,01%	2,47%	-0,82	**-0,97**
	S&P 500	15,60%	7,24%	7,15%	2,47%	1,81	**1,84**

Figure 23 - Exhibit 4.3.3.3: Sharpe Ratio for standard- and semi-deviation. Three-year treasury yields (first available day each year) were employed as risk free rates. (U.S. Department of The Treasury, 2021)

In the table above, based on the standard and semi-deviations in chapter 4.3.2, the Sharpe ratio for both indicators was calculated. As downside deviation is the main concern, the Sharpe ratio of the semi-deviation is visually emphasised. In both cases, the Sharpe ratio for the hypothesis portfolio is more than two times higher than the its value for the S&P and significantly higher than the

results for the benchmark. Verbally, the results imply that one unit of risk taken on by the investor, expressed as standard deviation or semi-deviation, is rewarded with 1,84 units (for the standard deviation) or 2,11 units (for the semi-deviation) of return, measured in annualised period returns. In comparison, the S&P 500 gratifies one unit of risk (as measured in percentage points of deviation) with only 0,69 or 0,86 units of return (measured in percentage points of returns) respectively.

In itself, this is already a preliminary answer to the research question posed in chapter one: Based on the sample employed in this thesis, the impact of constructing sector-weighted low-EM portfolios on risk and return is significantly positive; the semi-deviation-based Sharpe ratio is more than forty percent higher than its non-industry allocated benchmark. However, to analyse systemic risk and potential diversification benefits, the beta and the coefficient of determination need to be analysed as well to complete the risk analysis.

4.3.4 Systemic risk: Beta and coefficient of determination

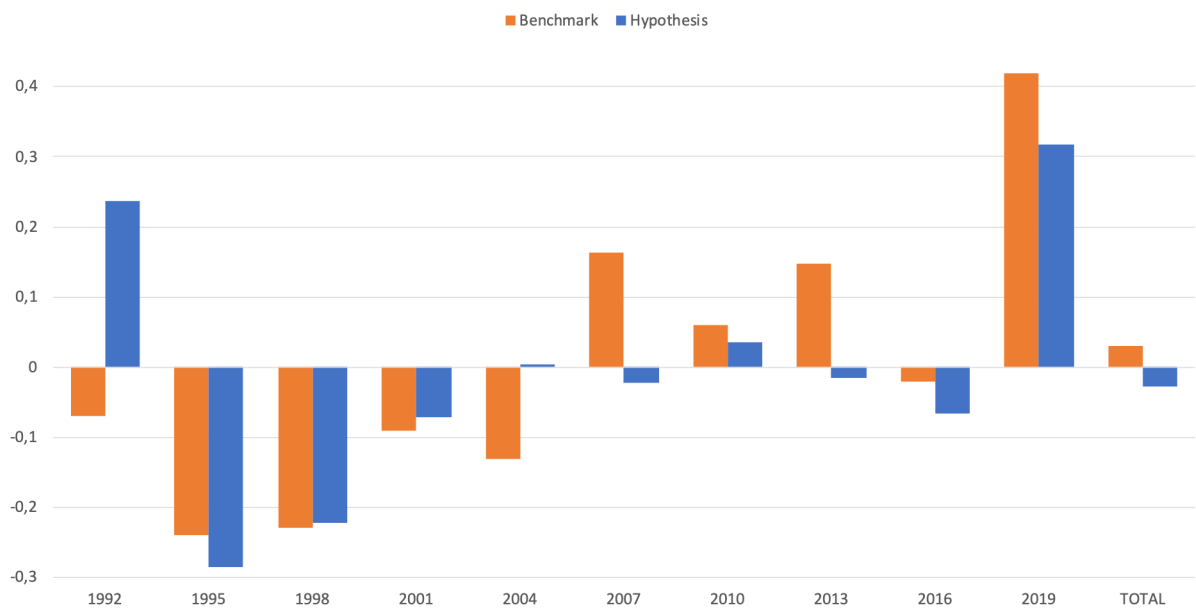


Figure 24 - Exhibit 4.3.4.1: Deviation of beta coefficient from its regressor (S&P 500)

The graph above depicts the deviation of the beta coefficient from the unit value of 1 of its benchmark, the S&P 500. When looking at the deviation of the beta coefficient from the S&P 500 over the whole observation period, the deviations are fairly insignificant at +0.03 for the benchmark portfolio and -0.03 for the hypothesis portfolio. This is to be expected when considering the fact that both portfolios are subsets of the S&P 500.

When looking at individual periods, the largest differences in beta between the benchmark and hypothesis portfolios can be observed in the periods beginning in 1992, 2007 and 2013. Removing

the first period of 1992 would significantly alter the results as it would decrease the total beta for the hypothesis portfolio remarkably. As for the systematic risk behaviour during crises, no final conclusion can be drawn based on the findings since the benchmark portfolio exhibited a slightly lower beta in the crisis of 2001 whereas the hypothesis portfolio performed significantly better in the period of 2008.

Regarding the discrepancies in standard- and semi-deviation as evident in 4.3.2, it is logically stringent that the benchmark strategy's total beta is more sensitive to changes in price of the S&P 500 than the hypothesis portfolio by around 0.06. While the difference is quite small, it can still be established that the hypothesis portfolio has a slightly lower exposure to systemic risk (when regarding the S&P 500 as a proxy for the overall stock market) as it reacts more lightly to price changes of the general market. Consequently, one can conclude that the lower total risk (see 4.3.2) of the hypothesis strategy in comparison to the benchmark portfolio is also reflected in and at least partly driven by lower systemic risk.

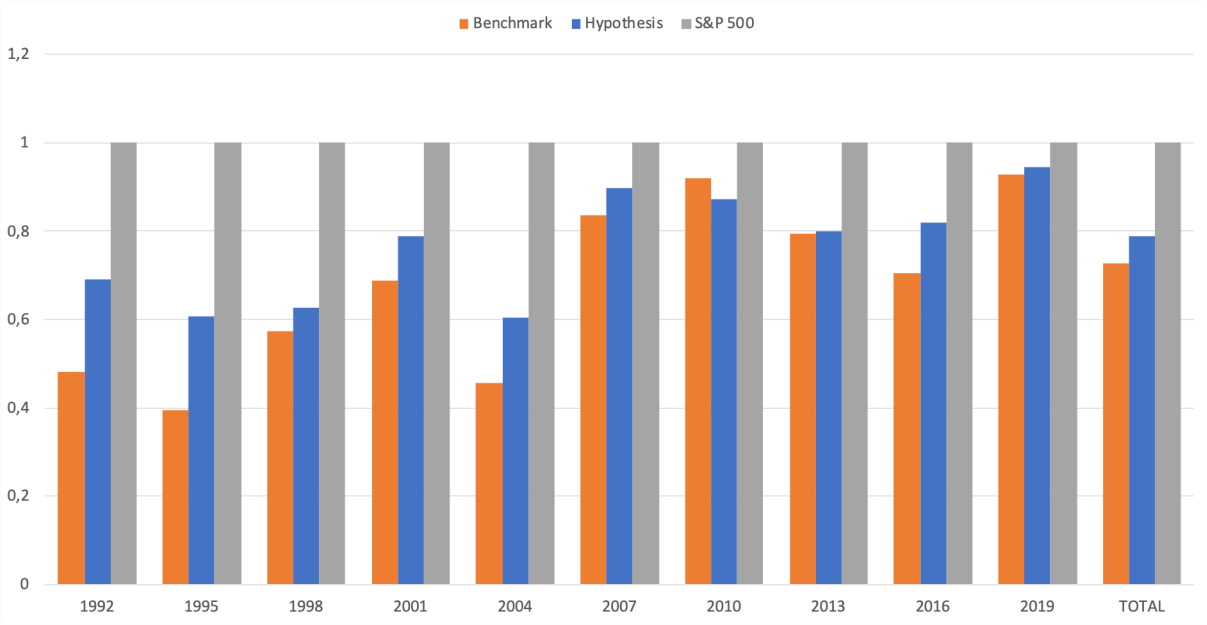


Figure 25 - Exhibit 4.3.4.1: Coefficient of determination

As for the last indicator, the coefficient of determination, exhibits 4.3.4.1 and 4.3.4.2 reveal that the returns of the S&P 500 are driving 79% of the returns of the hypothesis- but only 73% of the benchmark portfolio over the complete observation period. This is likely attributable to the industry composition of the hypothesis portfolio as it is closer to the industry distribution of the S&P500 rather than the skewed sector allocation of the benchmark portfolio as demonstrated in exhibit 4.3.1. These findings are consistent throughout all but one sub period, namely 2010 – 2013.

While this is not necessarily indicative for higher or lower risk, it is nonetheless of interest to portfolio managers and private investors alike: Those who would like to have a higher correlation

with the S&P 500 and thus traditional stock markets will likely fare better with the hypothesis strategy rather than the benchmark strategy.

	Portfolio	Monthly beta	Significance level of beta	Coefficient of determination
TOTAL	Hypothesis	0,97	0,00	0,79
	Benchmark	1,03	0,00	0,73
	S&P 500	1,00		1,00
1992	Hypothesis	1,24	0,00	0,69
	Benchmark	0,93	0,01	0,48
	S&P 500	1,00		1,00
1995	Hypothesis	0,71	0,00	0,61
	Benchmark	0,76	0,03	0,40
	S&P 500	1,00		1,00
1998	Hypothesis	0,78	0,00	0,63
	Benchmark	0,77	0,00	0,57
	S&P 500	1,00		1,00
2001	Hypothesis	0,93	0,00	0,79
	Benchmark	0,91	0,00	0,69
	S&P 500	1,00		1,00
2004	Hypothesis	1,00	0,00	0,60
	Benchmark	0,87	0,02	0,45
	S&P 500	1,00		1,00
2007	Hypothesis	0,98	0,00	0,90
	Benchmark	1,16	0,00	0,84
	S&P 500	1,00		1,00
2010	Hypothesis	1,04	0,00	0,87
	Benchmark	1,06	0,00	0,92
	S&P 500	1,00		1,00
2013	Hypothesis	0,98	0,00	0,80
	Benchmark	1,15	0,00	0,79
	S&P 500	1,00		1,00
2016	Hypothesis	0,93	0,00	0,82
	Benchmark	0,98	0,00	0,70
	S&P 500	1,00		1,00
2019	Hypothesis	1,32	0,00	0,94
	Benchmark	1,42	0,00	0,93
	S&P 500	1,00		1,00

Monthly beta, the corresponding p-value and coefficient of determination for each holding period.

Figure 26 - Exhibit 4.3.4.2: Monthly beta, the corresponding p-value and coefficient of determination for each holding period.

In summary of the table above, the benchmark strategy trumps with lower systemic risk (as measured by the beta with the S&P 500) while exhibiting a higher coefficient of determination than the benchmark portfolio. Taking both of these together, one can infer the following: The hypothesis portfolio is correlated more closely with the S&P 500 returns than the benchmark as

per R^2 while exhibiting lower volatility as per β - the only reason to prefer the benchmark portfolio of the hypothesis portfolio would be reduced correlation with the S&P 500.

4.4 Significance test: Independent two-sample t-test

The independent two-sample t-test for EM (hypothesis portfolio) and SP2 (adjusted S&P 500 returns) yielded the following results:

```
        Two Sample t-test

data:  YEM and YSP2
t = 1.4463, df = 54, p-value = 0.07694
alternative hypothesis: true difference in means is greater than 0
95 percent confidence interval:
 -1.071774       Inf
sample estimates:
mean of x mean of y
 15.44278   8.62359
```

Figure 27 - Exhibit 4.4.1: Independent two-sample t-test

With a p-value of 0,076, one can reject the null-hypothesis at a cut-off value of α = 10% and assume that the sample mean of the hypothesis portfolio (of the average annual returns) at 15,44% is higher than the sample mean of the adjusted S&P 500 annual returns at 8,62%. At a lower cut-off value of 5%, the results would be insignificant. This means there is moderate evidence to support the idea that average hypothesis portfolio returns are higher than adjusted S&P 500 returns.

However, since the EM effect has been proven in multiple studies prior to this, it is to be expected that the significance would further increase with sample size since the variance and mean of returns will likely stay at a similar level with an increasing sample size. A follow-up experiment with a much larger sample size could confirm this and would likely bring the p-value below 5% with a sufficient number of data points.

4.5 Summary and alpha calculation

Based on a transformation of the CAPM formula, the alpha for both portfolios has been calculated:

Portfolio	Annual Returns	R risk free	R Market (S&P 500)	Beta	Alpha
Hypothesis	12,77%	3,68%	6,77%	0,97	6,09%
Benchmark	10,61%	3,68%	6,77%	1,03	3,75%

Alpha calculation of the portfolios

Figure 28 - Exhibit 4.5.1: Alpha calculation of the portfolios

As the beta for both portfolios is around 1, the alpha is almost identical with subtracting the market returns (S&P 500) from the portfolio returns. One can observe that the alpha of the hypothesis portfolio is almost twice the annual market return, an enormous return premium.

Portfolio	Annual Returns	Semi dev.	Sharpe Ratio Semi dev.	R2	Beta	Alpha
Hypothesis	12,77%	4,31%	2,11	0,79	0,97	6,09%
Benchmark	10,61%	4,69%	1,48	0,73	1,03	3,75%
S&P	6,77%	3,58%	0,86	1	1	-

Summary of key metrics

Figure 29 - Exhibit 4.5.2: Summary of key metrics

Exhibit 4.4.2 contains a summary of the key portfolio metrics calculated in the analysis. It is clearly evident that the hypothesis portfolio generates superior returns as compared to the S&P 500 and the benchmark portfolio. Moreover, it excels through a lower standard deviation in comparison to the benchmark, which is also reflected in the much higher Sharpe ratio, while exhibiting slightly higher volatility than the S&P 500. This, however, is more than adequately rewarded by the excess returns: For only 20% higher volatility, the hypothesis portfolio generates almost 90% of additional returns.

In terms of systemic risk, the hypothesis portfolio exhibits a slightly lower beta and thus lower vulnerability to systemic shocks than the benchmark portfolio while still demonstrating a higher degree of correlation with the S&P 500 as measured by the coefficient of determination. This phenomenon is likely rooted in the higher similarity of the hypothesis portfolio to the S&P 500 – and thus the United States' stock market in general – due to the much more similar industry composition when comparing to the benchmark portfolio.

CHAPTER 5: CONCLUSIONS AND RECOMMENDATIONS

This chapter will draw a final conclusion and provide answers to the research questions based on the analysis in chapter 4 and discuss their managerial implications as well as further research gaps.

5.1 Conclusions

First off, as this whole thesis is based on the premise that a plain EM-investment strategy will lead to a disbalance in industries, the sub question

Does the EM investment strategy lead to a disbalance in the industry allocation of a portfolio?

is discussed (*see chapter 2.3*). It was brought to light that 42 of 110 observations, so approximately 40%, fell into the statistically significant tails at a p-value of 0,05.

H0 would imply that the EM investment strategy has no bearing on the industry allocation. In that scenario, we would expect around 5,5 outliers according to the properties of a normal distribution. As there are around 7 times as many outliers as expected at the 0,05 significance level, we can refute the null hypothesis and assume the opposite is true:

The low-EM investment strategy leads to a significant imbalance in the portfolio allocation.

Critics of this conclusion might object that the S&P 500 itself, the population the portfolios were drawn from, is not perfectly balanced by industries and that a certain skew was to be expected. While that superficially seems like a valid remark, a quick review of the data reveals that it is not grounded in the findings: The criticism would imply that certain industries are overrepresented all the time due to the makeup of the S&P 500. However, one can clearly observe that the overrepresented industries are not identical in every portfolio period, but change in accordance with the business cycle. Some examples: Industrials are overrepresented to an eyewatering extent in 1992 but not a single industrial company made it into the 2019 portfolio; basic materials rose from an underrepresentation in the 2004 portfolio to an overrepresentation in the 2007 portfolio and so on. This necessitates a further conclusion:

The industry imbalance is driven by the business cycle in recurring patterns.

With the underlying assumption proven, one can proceed with the main research question:

What impact does equal industry allocation have on the risk-return profile of the enterprise multiple investing strategy?

Based on the results of the quantitative analysis, it can be determined that the hypothesis strategy excels through lower total and systematic risk while providing higher returns than the plain

enterprise multiple strategy without allocation by industries. The industry-adjusted low-EM strategy is hence to be preferred in any case over the plain EM strategy.

In comparison to the S&P 500, the total volatility of the hypothesis strategy is higher, but this is rewarded more than adequately by excess returns as demonstrated in 4.4.

One might argue that this might render the hypothesis strategy unsuitable for risk averse investors. However, when taking modern portfolio theory into account and drawing a capital market line, it is evident that we can reproduce the lower risk level of the S&P 500 by adding the risk-free asset to the portfolio:

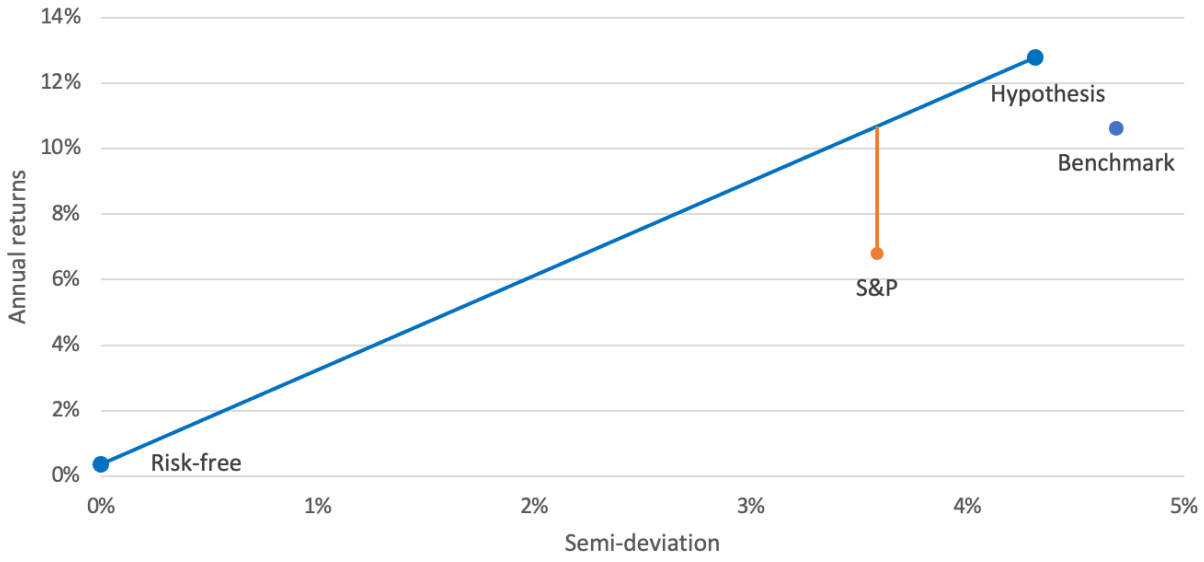


Figure 30 - Exhibit 5.1.1: Capital market line, based on January 2021 3-year treasury yields

By its very definition, the risk-free asset is assumed to have a volatility of 0. If we constructed a portfolio consisting of only the hypothesis portfolio and the risk-free asset, simple algebraic calculations reveal that a weight of around 83% hypothesis portfolio (3,58 / 4,31 = 0,831) and 17% risk free asset would lead to volatility parity with the S&P 500 at a semi-deviation of 3,58%. At that risk level, the S&P 500 generates a meager 6,77% annually compared to 10,67% that the hypothesis portfolio mixed with the risk-free asset generates at the same risk level (equal to the point of intersection of graphs in exhibit 5.1.1). It can hence be concluded that, based on the analysis of the historic data – which is not necessarily indicative of the future – that

The industry-weighted EM-investment strategy offers a much more attractive risk-return profile than the general market

When it comes to the benchmark portfolio,

The plain EM investment strategy offers lower returns at a higher total and systemic risk level

and is thus outmatched by the superior industry-adjusted hypothesis variant in all regards. The only tangible advantage is the decreased complexity: To construct the benchmark portfolio, the investor does not require any information on the industry, but only the EM of each company.

When taking a broader perspective, **one can also refute the assumption that the excess returns generated by the EM-effect are caused by sector cyclicality** as the equally-weighted portfolio performed significantly better despite mitigating any potential sector rotation effects.

5.2 Recommendations

The preceding conclusion is very clear in its implications: If investors have information on the respective industries of companies and want to pursue an EM-based strategy, they should use the industry information to construct an industry-weighted portfolio rather than the plain EM portfolio. Unless the information is unavailable, there is no reason not to do so in terms of potential risk and return.

Furthermore, the hypothesis strategy comes with higher risk which might make it unsuitable to certain kinds of risk-averse individuals and institutional investors such as governmental organisations, pension funds and so on. However, if the investment policy of the institution permits to do so, it is much more attractive to opt for a mix of risk-free assets and the hypothesis portfolio to approximate the risk level of the S&P 500 because historic returns were significantly higher than the general market (as represented by the S&P 500).

Furthermore, with a mix of the hypothesis strategy and the risk-free asset, one can even generate higher returns at lower levels of risk (as measured by semi-deviation) than the S&P 500, meaning that the strategy is even suitable for very risk-averse investors.

What should be taken into account by private investors are the higher transaction costs: Whereas shares in an ETF of the S&P 500 could be purchased for a couple of dollars, applying the hypothesis strategy would require investors to buy 33 independent stocks which implies a significantly higher cost burden for the investor. Especially for retail investors with a total portfolio value of less than 10.000 USD, fees could offset the entire alpha generated by the strategy. This is less of a concern for institutional investors and fund managers who will have to acquire independent stocks for their capital market funds (like ETFs) anyway.

It is, however, still highly recommended to not disregard the advantages of a portfolio that is-well diversified not only among industries and markets, but also across asset classes. If an investor wishes to invest in stocks, it is strongly encouraged to make use of the approach laid out in this

thesis, but this strategy does not act as a substitute for other asset classes. It is merely a modification and evolution of the well-known EM factor investing approach.

5.3 Limitations of research and future investigation potential

Even though it has been mentioned multiple times already, it can never be stressed enough: Past performance is not indicative of future performance and all empirical studies in portfolio management thus have to be taken with a grain of salt.

Moreover, the dataset of this thesis was entirely based on the S&P 500, essentially limiting it to US-American corporations with large market capitalisations. Even though the S&P 500 is generally a great proxy for the stock market of developed economies, it is still possible that the results of such an experiment would differ in other developed countries, not to mention developing economies. This also opens up a field of potential research: Reproducing this approach for a larger sample for other economies could help solidify the findings and increase their validity. Further, it is likely that returns would increase for a basket of small-cap stocks as Fama and French have established that companies with a lower market capitalisation tend to generate higher returns.

In addition, further research could cover potential synergy effects: This thesis has proven that a combination of equal industry allocation the EM-strategy outperforms a plain EM-strategy, but by how much? Is this merely an additive accumulation of benefits or do we see any potential synergy effects that go beyond the simple sum of expected benefits?

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List of figures

Appendix

Portfolio companies of benchmark portfolio

1992 – 1995

Code	Name	EM	Sector
904854	POLAROID DEAD - DELIST.19/12/03	1,39	Consumer Discretionary
912145	ALEXANDER & ALEX. DEAD - MERGER 922817	1,95	Financials
923024	ACME CLEVELAND DEAD - MERGER 912941	2,51	Industrials
932136	DATA GENERAL DEAD - MERGER 12/10/99	2,57	Technology
905809	NORTHROP GRUMMAN	3	Industrials
907652	GENERAL DYNAMICS	3,46	Industrials
519803	VARITY DEAD - MERGER 06/09/96	3,47	Industrials
998326	CA DEAD - DELIST.06/11/18	3,64	Technology
921697	GRUMMAN MERGER WITH 905809	3,71	Industrials
902233	ROCKWELL AUTOMATION	3,73	Industrials
906899	CRAY RESEARCH DEAD - MERGER 741342	3,77	Industrials
921293	MEREDITH	3,79	Consumer Discretionary
905102	OCCIDENTAL PTL.	3,81	Energy
906284	RYDER SYSTEM	3,84	Industrials
912812	M/A COMM. DEAD - MERGER 30/06/95	3,88	Industrials
902239	BANKAMERICA DEAD - MERGER 923937	3,99	Financials
902316	PEOPLES ENERGY DEAD - DELIST.05/03/07	4,06	Utilities
997329	INTERGRAPH DEAD - DELIST.30/11/06	4,17	Technology
921699	MCDONN.DOUGLAS DEAD - MERGER 904818	4,19	Industrials
906147	MAXUS ENERGY DEAD - MERGER 08/06/95	4,24	Energy
904899	LITTON INDS. DEAD - MERGER 905809	4,4	Industrials
905082	FMC	4,48	Basic Materials
902251	1ST.INTERSTATE BANCORP DEAD - MERGER - 905083	4,51	Financials
905018	LOCKHEED CORP DEAD - MERGER 15/03/95	4,52	Industrials
904864	SPRINT NEXTEL DEAD - DELIST.11/07/13	4,55	Telecommunications
901666	CONOCOPHILLIPS	4,56	Energy
907677	JOHNSON CONTROLS DEAD - DELIST.06/09/16	4,56	Consumer Discretionary
929813	AHMANSON HF DEAD - MERGER 702406	4,59	Financials
904262	PHELPS DODGE DEAD - DELIST.02/04/07	4,6	Basic Materials
904818	BOEING	4,65	Industrials
936365	ADVANCED MICRO DEVICES	4,66	Technology
922726	INTEL	4,69	Technology
741346	PREMARK DEAD - MERGER 905052	4,76	Consumer Discretionary

1995-1998

Code	Name	EM	Sector
921146	SPRINGS INDS. DEAD - DELIST 16/01/03	5,15	Basic Materials
930480	1ST.MISSISSIPPI DEAD - MERGER 133384	4,98	Basic Materials
912060	CLARK EQUIPMENT DEAD - MERGER 25/05/95	3,66	Consumer Discretionary
904803	CHRYSLER DEAD - MERGER 689057	3,96	Consumer Discretionary
906512	OUTBOARD MARINE DEAD - MERGER 30/09/97	5,09	Consumer Discretionary
905997	MOLSON COORS BEVERAGE COMPANY B	3,2	Consumer Staples
921917	AMER.STORES DEAD - MERGER 23/06/99	4,86	Consumer Staples
905791	PENNZENERGY (NYS) DEAD - MERGER 271980	5,38	Energy
906184	MOBIL DEAD - MERGER 905039	5,61	Energy
905255	SUNOCO DEAD - DELIST.05/10/12	5,05	Energy
930857	BARNETT BANKS DEAD - MERGER 09/01/98	4,84	Financials
981683	ST.JUDE MEDICAL DEAD - DELIST.05/01/17	5,58	Health Care
912969	TENET HEALTHCARE	4,74	Health Care
921463	NAVISTAR INTL.	5,17	Industrials
945627	SANTA FE PACIFIC	5,34	Industrials
951606	TANDEM COMPUTERS DEAD - MERGER 945551	5,42	Industrials
912151	CALIBER SYS. DEAD - MERGER 27/01/98	5,43	Industrials
951022	AMDAHL DEAD - MERGER 133227	3,24	Industrials
905343	BRIGGS & STRATTON	3,78	Industrials
916137	SPX	4,09	Industrials
905140	CON-WAY DEAD - DELIST.30/10/15	4,8	Industrials
905368	YRC WORLDWIDE	4,88	Industrials
951849	FEDEX	5,06	Industrials
905274	UNISYS	3,95	Technology
905061	TEXAS INSTRUMENTS	4,25	Technology
912374	NATIONAL SEMICON. DEAD - DELIST.26/09/11	4,29	Technology
999506	MICRON TECHNOLOGY	4,61	Technology
992816	APPLE	4,75	Technology
719563	SUN MICROSYSTEMS DEAD - ACQD.BY 719618	4,85	Technology
905609	HANDLEMAN DEAD - DELIST.16/01/13	5,14	Telecommunications
905409	L3HARRIS TECHNOLOGIES	5,62	Telecommunications
906149	SONAT DEAD - MERGER 325308	5,16	Utilities
902198	COLUMBIA ENERGY GP. DEAD - MERGER 01/11/00	4	Utilities

1998-2001

Code	Name	EM	Sector
902338	BETHLEHEM STEEL DEAD - DELIST.07/01/04	3,51	Basic Materials
544683	UNITED STATES STEEL	3,57	Basic Materials
904261	ASARCO DEAD - MERGER 18/11/99	3,75	Basic Materials
912227	RYERSON DEAD - MERGER	4,01	Basic Materials
904262	PHELPS DODGE DEAD - DELIST.02/04/07	4,97	Basic Materials
951020	CYPRUS AMAX MINERALS DEAD - MERGER 03/12/99	5,31	Basic Materials
905342	ASHLAND GLOBAL HDG.	5,48	Basic Materials
952192	ALCAN (NYS) DEAD - MERGER	5,88	Basic Materials
903720	TIMKEN	5,94	Basic Materials
905516	KING WORLD PRODUCTION DEAD - MERGER 902170	4,05	Consumer Discretionary
937343	L BRANDS	4,65	Consumer Discretionary
912138	FLEETWOOD ENTS. DEAD - DELIST.24/08/10	4,72	Consumer Discretionary
902230	FORD MOTOR	5,41	Consumer Discretionary
902272	FOOT LOCKER	5,6	Consumer Discretionary
916839	KNIGHT-RIDDER DEAD - DELIST.21/07/06	5,91	Consumer Discretionary
905119	SUPERVALU DEAD - DELIST.23/10/18	6,09	Consumer Staples
902260	GT.ATL.& PAC.TEA CO. DEAD - DELIST.14/03/12	5,23	Consumer Staples
912808	LONGS DRUG STRS. DEAD - DELIST.14/11/08	5,7	Consumer Staples
901666	CONOCOPHILLIPS	6,07	Energy
905142	KERR-MCGEE DEAD - DELIST.28/08/06	6,08	Energy
921284	MALLINCKRODT DEAD - MERGER 545615	5,4	Health Care
906284	RYDER SYSTEM	4,69	Industrials
905113	HOWMET AEROSPACE	5,76	Industrials
740337	MOORE WALLACE (NYS) DEAD - MERGER 905047	5,81	Industrials
916382	DIGITAL EQUP. DEAD - MERGER 945551	5,85	Industrials
518436	SEAGRAM (NYS) DEAD - MERGER 152866	5,85	Industrials
944276	LSI DEAD - ACQD.BY 54332K	6,06	Technology
997963	SEAGATE TECH. DEAD - MERGER 322081	4,59	Technology
945389	US.WEST NEW DEAD - MERGER 894076	6,09	Telecommunications
902324	EDISON INTL.	5,54	Utilities
905214	DTE ENERGY	5,71	Utilities
902314	PG&E	5,94	Utilities
902107	PPL	6,01	Utilities

2001 – 2004

Code	Name	EM	Sector
921482	NUCOR	4,42	Basic Materials
515133	INTERNATIONAL NICKEL (OTC)	4,67	Basic Materials
905491	OFFICEMAX DEAD - DELIST.06/11/13	5,23	Consumer Discretionary
904146	TOYS R US HOLDINGS DEAD - DELIST.08/08/05	5,4	Consumer Discretionary
694597	DELPHI DEAD - DELIST.07/10/09	3,23	Consumer Discretionary
904869	WHIRLPOOL	4,11	Consumer Discretionary
907677	JOHNSON CONTROLS DEAD - DELIST.06/09/16	4,27	Consumer Discretionary
921264	COOPER TIRE & RUB.	4,33	Consumer Discretionary
916604	CENTEX DEAD - DELIST.19/08/09	4,53	Consumer Discretionary
921855	TJX	4,78	Consumer Discretionary
904263	UNOCAL DEAD - MERGER W/905024	5,51	Energy
905802	HESS	3,39	Energy
905255	SUNOCO DEAD - DELIST.05/10/12	3,74	Energy
905102	OCCIDENTAL PTL.	3,76	Energy
544682	MARATHON OIL	4,41	Energy
683342	CONOCOPHILLIPS HOLDING DEAD - MERGER 901666	4,65	Energy
271980	DEVON ENERGY	4,76	Energy
905024	CHEVRON	4,88	Energy
952170	TOSCO DEAD - MERGER 901666	4,92	Energy
905343	BRIGGS & STRATTON	3,23	Industrials
921436	BRUNSWICK	3,86	Industrials
902233	ROCKWELL AUTOMATION	4,56	Industrials
905047	R R DONNELLEY & SONS	4,65	Industrials
905809	NORTHROP GRUMMAN	4,75	Industrials
905625	NAT.SERVICE INDS. DEAD - MERGER 13/06/03	4,98	Industrials
951849	FEDEX	5,1	Industrials
745176	ALLEGHENY TECHS.	5,18	Industrials
916704	DELUXE	5,18	Industrials
936365	ADVANCED MICRO DEVICES	2,3	Technology
992816	APPLE	4,17	Technology
904864	SPRINT NEXTEL DEAD - DELIST.11/07/13	4,52	Telecommunications
916311	ALLTEL DEAD - MERGER	5,22	Telecommunications
902103	SEMPRA EN.	5,51	Utilities

2004 – 2007

Code	Name	EM	Sector
945251	AVIS BUDGET GROUP	6,2	Consumer Discretionary
951018	GAP	6,24	Consumer Discretionary
912781	PENNEY JC	6,3	Consumer Discretionary
546814	MACY'S	6,39	Consumer Discretionary
937343	L BRANDS	5,42	Consumer Discretionary
905997	MOLSON COORS BEVERAGE COMPANY B	6,46	Consumer Staples
912134	KROGER	6,31	Consumer Staples
923116	ALBERTSONS DEAD - DELIST.07/07/06	5,21	Consumer Staples
905119	SUPERVALU DEAD - DELIST.23/10/18	5,81	Consumer Staples
921983	APACHE	4,98	Energy
905142	KERR-MCGEE DEAD - DELIST.28/08/06	4,99	Energy
741076	ANADARKO PETROLEUM DEAD - DELIST.09/08/19	5,13	Energy
777011	BURLINGTON RES. DEAD - MERGER 901666	5,14	Energy
901666	CONOCOPHILLIPS	5,32	Energy
500373	EOG RES.	5,72	Energy
923418	PROVIDIAN FINL. DEAD - DELIST.20/10/05	2,13	Financials
292731	JANUS CAPITAL GP. DEAD - DELIST.30/05/17	3,64	Financials
922817	AON CLASS A	5,66	Financials
327706	WELLPOINT HLTH.NET. DEAD - MERGER 14737P	4,14	Health Care
255956	AETNA DEAD - DELIST.29/11/18	6,01	Health Care
687141	CONVERGYS DEAD - DELIST.06/10/18	6,26	Industrials
929799	LOUISIANA PACIFIC	2,69	Industrials
906284	RYDER SYSTEM	4,14	Industrials
906930	ELECTRONIC DATA SYSTEMS DEAD - DELIST.05/09/08	6,44	Technology
916091	DXC TECHNOLOGY	6,2	Technology
906838	LUMEN TECHNOLOGIES	6,3	Telecommunications
922301	FRONTIER COMMUNICATIONS	6,54	Telecommunications
905261	AT & T DEAD - DELIST.21/11/05	3	Telecommunications
945388	AT&T	5,93	Telecommunications
945385	BELLSOUTH DEAD - DELIST.16/01/07	6	Telecommunications
902314	PG&E	3,41	Utilities
904842	CENTERPOINT EN.	6,13	Utilities
902324	EDISON INTL.	6,17	Utilities

2007 – 2010

Code	Name	EM	Sector
544683	UNITED STATES STEEL	3,77	Basic Materials
152594	FREEPORT-MCMORAN	3,86	Basic Materials
904262	PHELPS DODGE DEAD - DELIST.02/04/07	4,07	Basic Materials
904069	INTERNATIONAL PAPER	4,26	Basic Materials
921482	NUCOR	4,65	Basic Materials
357922	EASTMAN CHEMICAL	5,68	Basic Materials
923731	DILLARDS 'A'	6,05	Consumer Discretionary
904869	WHIRLPOOL	6,27	Consumer Discretionary
544682	MARATHON OIL	3,29	Energy
905802	HESS	3,61	Energy
982852	VALERO ENERGY	3,62	Energy
905102	OCCIDENTAL PTL.	4,34	Energy
905024	CHEVRON	4,41	Energy
327747	CHESAPEAKE ENERGY	4,46	Energy
905255	SUNOCO DEAD - DELIST.05/10/12	4,69	Energy
328723	XTO EN. DEAD - DELIST.08/07/10	4,94	Energy
271980	DEVON ENERGY	5,26	Energy
905039	EXXON MOBIL	5,69	Energy
921431	BAKER HUGHES A	5,71	Energy
916532	NABORS INDUSTRIES	5,83	Energy
992520	VALARIS A	5,9	Energy
951545	CINCINNATI FINL.	5,97	Financials
933974	TRAVELERS COS.	6,1	Financials
916028	SAFECO DEAD - DELIST.03/10/08	5,51	Financials
322677	ALLSTATE ORD SHS	5,76	Financials
683363	KING PHARMS. DEAD - DELIST.01/03/11	5,62	Health Care
921436	BRUNSWICK	6,39	Industrials
905966	CUMMINS	4,64	Industrials
999506	MICRON TECHNOLOGY	5,79	Technology
904864	SPRINT NEXTEL DEAD - DELIST.11/07/13	5,93	Telecommunications
35781K	EMBARQ DEAD - DELIST.13/07/09	5,52	Telecommunications
945384	VERIZON COMMUNICATIONS	5,91	Telecommunications
902103	SEMPRA EN.	5,92	Utilities

2010 – 2013

Code	Name	EM	Sector
702108	BIG LOTS	5,5	Consumer Discretionary
951018	GAP	5,5	Consumer Discretionary
981550	COMCAST A	5,51	Telecommunications
905809	NORTHROP GRUMMAN	5,53	Industrials
912633	RAYTHEON 'B' DEAD - DELIST.03/04/20	5,55	Industrials
904332	CONSTELLATION EN. DEAD - AQCD.BY 902317	0,96	Utilities
755741	CHARLES SCHWAB	3,18	Financials
28179N	NRG ENERGY	3,28	Utilities
867344	LEXMARK INTL. DEAD - DELIST.29/11/16	3,51	Technology
14737P	ANTHEM	3,55	Health Care
28341F	ASSURANT	3,58	Financials
906284	RYDER SYSTEM	3,78	Industrials
916860	HUMANA	4,04	Health Care
31676F	LEIDOS HOLDINGS	4,1	Technology
907620	ROWAN COMPANIES CL.A DEAD - DELIST.11/04/19	4,1	Energy
992854	TELLABS DEAD - DELIST.04/12/13	4,37	Telecommunications
916091	DXC TECHNOLOGY	4,43	Technology
894076	QWEST COMMS.INTL. DEAD - DELIST.01/04/11	4,44	Telecommunications
31109K	CF INDUSTRIES HDG.	4,45	Basic Materials
255272	FLUOR	4,45	Industrials
25735K	NASDAQ	4,68	Financials
916312	RS LEGACY DEAD - DELIST.09/10/15	4,73	Consumer Discretionary
906404	MURPHY OIL	4,73	Energy
543349	SAFEWAY DEAD - DELIST.30/01/15	4,84	Consumer Staples
912278	CIGNA	4,85	Health Care
936365	ADVANCED MICRO DEVICES	4,95	Technology
15168M	GAMESTOP 'A'	5,03	Consumer Discretionary
905596	H&R BLOCK	5,06	Consumer Discretionary
544665	COVENTRY HEALTH CARE DEAD - ACQD.BY 255956	5,11	Health Care
702635	UNITEDHEALTH GROUP	5,11	Health Care
906785	WESTERN DIGITAL	5,19	Technology
31604H	AMERIPRISE FINL.	5,26	Financials
902317	EXELON	5,46	Utilities

2013 – 2016

Code	Name	EM	Sector
152594	FREEPORT-MCMORAN	5,26	Basic Materials
923465	INTERPUBLIC GROUP	5,17	Consumer Discretionary
149387	APOLLO EDUCATION GP.'A' DEAD - DELIST.02/02/17	1,38	Consumer Discretionary
15303X	NETFLIX	2,76	Consumer Discretionary
929302	BEST BUY	2,78	Consumer Discretionary
904837	GOODYEAR TIRE & RUB.	4,56	Consumer Discretionary
905647	SOUTHWEST AIRLINES	4,59	Consumer Discretionary
906643	TYSON FOODS 'A'	5,1	Consumer Staples
905039	EXXON MOBIL	4,97	Energy
77229W	MARATHON PETROLEUM	3,15	Energy
544682	MARATHON OIL	3,29	Energy
912052	ANDEAVOR DEAD - DELIST.01/10/18	3,57	Energy
905802	HESS	3,61	Energy
921983	APACHE	3,63	Energy
905024	CHEVRON	3,82	Energy
916532	NABORS INDUSTRIES	4,18	Energy
901666	CONOCOPHILLIPS	4,22	Energy
982852	VALERO ENERGY	4,31	Energy
921049	HELMERICH & PAYNE	4,45	Energy
905840	BANK OF NEW YORK MELLON	-7,21	Financials
912402	LINCOLN NATIONAL	4,57	Financials
921925	JEFFERIES FINANCIAL GROUP	4,65	Financials
41195M	WESTERN UNION	4,96	Industrials
951849	FEDEX	5,23	Industrials
998326	CA DEAD - DELIST.06/11/18	4,72	Technology
541900	NORTONLIFELOCK	5	Technology
905284	XEROX HOLDINGS	5,17	Technology
26599V	SEAGATE TECH.	2,65	Technology
772203	DELL DEAD - DELIST.30/10/13	3,11	Technology
922726	INTEL	4,21	Technology
328576	JABIL	4,56	Technology
50394K	T-MOBILE US	3,77	Telecommunications
542868	CISCO SYSTEMS	4,58	Telecommunications

2016 – 2019

Code	Name	EM	Sector
912160	NEWMONT	6,29	Basic Materials
905114	DOW CHEMICAL DEAD - DELIST.01/09/17	5,66	Basic Materials
69264X	LYONDELLBASELL INDS.CL.A	5,92	Basic Materials
771767	MOSAIC	6,24	Basic Materials
32730D	UNITED AIRLINES HOLDINGS	4,12	Consumer Discretionary
50469N	DELTA AIR LINES	4,47	Consumer Discretionary
31196R	DISCOVERY SERIES A	4,77	Consumer Discretionary
54099E	DISCOVERY SERIES C	4,77	Consumer Discretionary
86532T	CAPRI HOLDINGS	4,89	Consumer Discretionary
951018	GAP	5,09	Consumer Discretionary
325849	KOHL'S	5,57	Consumer Discretionary
93801Q	AMERICAN AIRLINES GROUP	5,67	Consumer Discretionary
325972	BED BATH & BEYOND	5,92	Consumer Discretionary
15168M	GAMESTOP 'A'	6,15	Consumer Discretionary
322668	TRANSOCEAN	4,39	Energy
938076	FRANKLIN RESOURCES	5,37	Financials
933185	AFLAC	6,21	Financials
546697	GILEAD SCIENCES	6,48	Health Care
921757	PACCAR	6,43	Industrials
912669	AUTOMATIC DATA PROC.	3,16	Industrials
906284	RYDER SYSTEM	4,64	Industrials
670778	UNITED RENTALS	5,28	Industrials
87524M	ADT DEAD - DELIST.02/05/16	5,64	Industrials
255272	FLUOR	5,75	Industrials
999506	MICRON TECHNOLOGY	4,24	Technology
906785	WESTERN DIGITAL	4,62	Technology
8660JC	HEWLETT PACKARD ENTER.	6,08	Technology
905277	HP	6,09	Technology
906838	LUMEN TECHNOLOGIES	4,96	Telecommunications
922301	FRONTIER COMMUNICATIONS	5,79	Telecommunications
945384	VERIZON COMMUNICATIONS	5,99	Telecommunications
902321	PUB.SER.ENTER.GP.	6,43	Utilities
902317	EXELON	5,43	Utilities

2019 – 2020

Code	Name	EM	Sector
152594	FREEPORT-MCMORAN	4,54	Basic Materials
921482	NUCOR	4,74	Basic Materials
902230	FORD MOTOR	6,26	Consumer Discretionary
905647	SOUTHWEST AIRLINES	5,69	Consumer Discretionary
904837	GOODYEAR TIRE & RUB.	4,69	Consumer Discretionary
29739U	TWENTY FIRST CENTURY FOX A	5,08	Consumer Discretionary
29739V	TWENTY-FIRST CENTURY FOX B	5,08	Consumer Discretionary
329709	BORGWARNER	5,33	Consumer Discretionary
68470T	GENERAL MOTORS	5,42	Consumer Discretionary
546814	MACY'S	5,47	Consumer Discretionary
912134	KROGER	5,97	Consumer Staples
741076	ANADARKO PETROLEUM DEAD - DELIST.09/08/19	5,81	Energy
26276P	CIMAREX EN.	3,91	Energy
544682	MARATHON OIL	3,99	Energy
271980	DEVON ENERGY	4,53	Energy
921983	APACHE	5,03	Energy
921934	HOLLYFRONTIER	5,06	Energy
901666	CONOCOPHILLIPS	5,1	Energy
982852	VALERO ENERGY	5,18	Energy
50463C	CONCHO RESOURCES	5,41	Energy
905102	OCCIDENTAL PTL.	5,5	Energy
921925	JEFFERIES FINANCIAL GROUP	2,39	Financials
905840	BANK OF NEW YORK MELLON	3,29	Financials
31604H	AMERIPRISE FINL.	4,32	Financials
883488	E TRADE FINANCIAL DEAD - DELIST.05/10/20	5,25	Financials
777844	RAYMOND JAMES FINL.	5,26	Financials
518628	SVB FINANCIAL GROUP	5,54	Financials
131402	NEKTAR THERAPEUTICS	6,29	Health Care
905296	APPLIED MATS.	6,05	Technology
916091	DXC TECHNOLOGY	4,66	Technology
946387	LAM RESEARCH	5,29	Technology
26599V	SEAGATE TECH.	5,52	Technology
945388	AT&T	6,34	Telecommunications

Portfolio companies of hypothesis portfolio

1992 – 1995

Industry	Code	Name	EM
Basic Materials	905082	FMC	4,48
Basic Materials	904262	PHELPS DODGE DEAD - DELIST.02/04/07	4,6
Basic Materials	921146	SPRINGS INDS. DEAD - DELIST 16/01/03	5,3
Consumer Discretionary	904854	POLAROID DEAD - DELIST.19/12/03	1,39
Consumer Discretionary	921293	MEREDITH	3,79
Consumer Discretionary	907677	JOHNSON CONTROLS DEAD - DELIST.06/09/16	4,56
Consumer Staples	921917	AMER.STORES DEAD - MERGER 23/06/99	4,83
Consumer Staples	902260	GT.ATL.& PAC.TEA CO. DEAD - DELIST.14/03/12	5,16
Consumer Staples	912808	LONGS DRUG STRS. DEAD - DELIST.14/11/08	5,71
Energy	905102	OCCIDENTAL PTL.	3,81
Energy	906147	MAXUS ENERGY DEAD - MERGER 08/06/95	4,24
Energy	901666	CONOCOPHILLIPS	4,56
Financials	912145	ALEXANDER & ALEX. DEAD - MERGER 922817	1,95
Financials	902239	BANKAMERICA DEAD - MERGER 923937	3,99
Financials	902251	1ST.INTERSTATE BANCORP DEAD - MERGER - 905083	4,51
Healthcare	912969	TENET HEALTHCARE	6,48
Healthcare	916860	HUMANA	6,51
Healthcare	923643	BEVERLY ENTERPRISE DEAD - DELIST.14/03/06	6,85
Industrials	923024	ACME CLEVELAND DEAD - MERGER 912941	2,51
Industrials	905809	NORTHROP GRUMMAN	3
Industrials	907652	GENERAL DYNAMICS	3,46
Real Estate	912588	HOST HOTELS & RESORTS REIT	9,03
Real Estate	907624	POTLATCHDELTIC	7,83
Real Estate	905818	WEYERHAEUSER	14,43
Technology	932136	DATA GENERAL DEAD - MERGER 12/10/99	2,57
Technology	998326	CA DEAD - DELIST.06/11/18	3,64
Technology	997329	INTERGRAPH DEAD - DELIST.30/11/06	4,17
Telecommunication	904864	SPRINT NEXTEL DEAD - DELIST.11/07/13	4,55
Telecommunication	992814	ANDREW DEAD - DELIST.07/01/08	5,56
Telecommunication	945383	AMERITECH DEAD - MERGER 945388	5,75
Utilities	902316	PEOPLES ENERGY DEAD - DELIST.05/03/07	4,06
Utilities	902315	PANENERGY DEAD - MERGER 904383	5,88
Utilities	904820	PROGRESS ENERGY DEAD - ACQD.BY 904383	6,11

1995 – 1998

Industry	Code	Name	EM
Basic Materials	930480	1ST.MISSISSIPPI DEAD - MERGER 133384	4,98
Basic Materials	904464	NICOR DEAD - AQCD.BY 906820	6,14
Basic Materials	905342	ASHLAND GLOBAL HDG.	5,84
Consumer Discretionary	912060	CLARK EQUIPMENT DEAD - MERGER 25/05/95	3,66
Consumer Discretionary	904803	CHRYSLER DEAD - MERGER 689057	3,96
Consumer Discretionary	906512	OUTBOARD MARINE DEAD - MERGER 30/09/97	5,09
Consumer Staples	905997	MOLSON COORS BEVERAGE COMPANY B	3,2
Consumer Staples	921875	GIANT FOOD A DEAD - MERGER 30/10/98	5,72
Consumer Staples	912635	CVS HEALTH	5,86
Energy	905255	SUNOCO DEAD - DELIST.05/10/12	5,05
Energy	905791	PENNZENERGY (NYS) DEAD - MERGER 271980	5,38
Energy	906184	MOBIL DEAD - MERGER 905039	5,61
Financials	930857	BARNETT BANKS DEAD - MERGER 09/01/98	4,84
Financials	923443	FIRST FIDELITY BANCORP. DEAD - MERGER 29/12/95	6,01
Financials	933189	MELLON FINL. DEAD - MERGER.02/07/07	6,4
Healthcare	981683	ST.JUDE MEDICAL DEAD - DELIST.05/01/17	5,58
Healthcare	912157	PERKINELMER	6,05
Healthcare	902221	PHARMACIA DEAD - MERGER 904030	6,97
Industrials	906899	CRAY RESEARCH DEAD - MERGER 741342	3,2
Industrials	951022	AMDAHL DEAD - MERGER 133227	3,24
Industrials	905343	BRIGGS & STRATTON	3,78
Real Estate	907624	POTLATCHDELTIC	8,79
Real Estate	905818	WEYERHAEUSER	7,71
Real Estate	NA		
Technology	936365	ADVANCED MICRO DEVICES	3,07
Technology	905274	UNISYS	3,95
Technology	905061	TEXAS INSTRUMENTS	4,25
Telecommunication	905609	HANDLEMAN DEAD - DELIST.16/01/13	5,14
Telecommunication	905409	L3HARRIS TECHNOLOGIES	5,62
Telecommunication	945384	VERIZON COMMUNICATIONS	6,61
Utilities	902198	COLUMBIA ENERGY GP. DEAD - MERGER 01/11/00	4
Utilities	906149	SONAT DEAD - MERGER 325308	5,16
Utilities	905214	DTE ENERGY	5,73

1998 – 2001

Industry	Code	Name	EM
Basic Materials	902338	BETHLEHEM STEEL DEAD - DELIST.07/01/04	3,51
Basic Materials	544683	UNITED STATES STEEL	3,57
Basic Materials	904261	ASARCO DEAD - MERGER 18/11/99	3,75
Consumer Discretionary	905516	KING WORLD PRODUCTION DEAD - MERGER 902170	4,05
Consumer Discretionary	937343	L BRANDS	4,65
Consumer Discretionary	912138	FLEETWOOD ENTS. DEAD - DELIST.24/08/10	4,72
Consumer Staples	902260	GT.ATL.& PAC.TEA CO. DEAD - DELIST.14/03/12	5,23
Consumer Staples	912808	LONGS DRUG STRS. DEAD - DELIST.14/11/08	5,7
Consumer Staples	905119	SUPERVALU DEAD - DELIST.23/10/18	6,09
Energy	901666	CONOCOPHILLIPS	6,07
Energy	905142	KERR-MCGEE DEAD - DELIST.28/08/06	6,08
Energy	759710	ORYX EN. DEAD - MERGER 905142	6,19
Financials	912251	GEN.SIGNAL DEAD - MERGER 916137	6,74
Financials	131508	LEHMAN BROS.HDG. DEAD - DELIST.06/03/12	6,76
Financials	944260	GREEN TREE FINL. DEAD - MERGER 937102	6,81
Healthcare	921284	MALLINCKRODT DEAD - MERGER 545615	5,4
Healthcare	916860	HUMANA	9,21
Healthcare	541863	ALLERGAN DEAD - DELIST.17/03/15	9,51
Industrials	906284	RYDER SYSTEM	4,69
Industrials	951849	FEDEX	4,94
Industrials	921463	NAVISTAR INTL.	5,72
Real Estate	907624	POTLATCHDELTIC	7,8
Real Estate	905818	WEYERHAEUSER	9,83
Real Estate	NA		
Technology	997963	SEAGATE TECH. DEAD - MERGER 322081	4,59
Technology	944276	LSI DEAD - ACQD.BY 54332K	6,06
Technology	932136	DATA GENERAL DEAD - MERGER 12/10/99	6,4
Telecommunication	945389	US.WEST NEW DEAD - MERGER 894076	6,09
Telecommunication	945385	BELLSOUTH DEAD - DELIST.16/01/07	6,23
Telecommunication	904864	SPRINT NEXTEL DEAD - DELIST.11/07/13	6,63
Utilities	902324	EDISON INTL.	5,54
Utilities	902107	PPL	6,01
Utilities	902314	PG&E	5,94

2001 – 2004

Industry	Code	Name	EM
Basic Materials	921482	NUCOR	4,42
Basic Materials	515133	INTERNATIONAL NICKEL (OTC)	4,67
Basic Materials	903720	TIMKEN	5,56
Consumer Discretionary	694597	DELPHI DEAD - DELIST.07/10/09	3,23
Consumer Discretionary	904869	WHIRLPOOL	4,11
Consumer Discretionary	907677	JOHNSON CONTROLS DEAD - DELIST.06/09/16	4,27
Consumer Staples	921153	UST DEAD - DELIST.20/01/09	6,64
Consumer Staples	921249	AMER.GREETINGS 'A' DEAD - DELIST.09/08/13	6,7
Consumer Staples	904853	ALTRIA GROUP	7,44
Energy	905802	HESS	3,39
Energy	905255	SUNOCO DEAD - DELIST.05/10/12	3,74
Energy	905102	OCCIDENTAL PTL.	3,76
Financials	327998	MORGAN STANLEY	6,23
Financials	292731	JANUS CAPITAL GP. DEAD - DELIST.30/05/17	7
Financials	916036	COUNTRYWIDE FINL. DEAD - DELIST.11/07/08	7,43
Healthcare	327706	WELLPOINT HLTH.NET. DEAD - MERGER 14737P	5,99
Healthcare	905439	BAUSCH & LOMB DEAD - MERGER	6,74
Healthcare	325824	BOSTON SCIENTIFIC	8,03
Industrials	905343	BRIGGS & STRATTON	3,23
Industrials	921436	BRUNSWICK	3,86
Industrials	902233	ROCKWELL AUTOMATION	4,56
Real Estate	907624	POTLATCHDELTIC	10,44
Real Estate	905818	WEYERHAEUSER	7,03
Real Estate	NA		
Technology	936365	ADVANCED MICRO DEVICES	2,3
Technology	992816	APPLE	4,17
Technology	905274	UNISYS	6,85
Telecommunication	916311	ALLTEL DEAD - MERGER	5,22
Telecommunication	945384	VERIZON COMMUNICATIONS	6,49
Telecommunication	981550	COMCAST A	6,62
Utilities	902103	SEMPRA EN.	5,51
Utilities	905159	FIRSTENERGY	5,81
Utilities	902607	PINNACLE WEST CAP.	5,94

2004 – 2007

Industry	Code	Name	EM
Basic Materials	905129	HERCULES DEAD - DELIST.24/11/08	7,91
Basic Materials	152594	FREEPORT-MCMORAN	9,59
Basic Materials	997471	ENGELHARD DEAD - MERGER W/511398	9,91
Consumer Discretionary	937343	L BRANDS	5,42
Consumer Discretionary	904146	TOYS R US HOLDINGS DEAD - DELIST.08/08/05	6,11
Consumer Discretionary	945251	AVIS BUDGET GROUP	6,2
Consumer Staples	923116	ALBERTSONS DEAD - DELIST.07/07/06	5,21
Consumer Staples	905119	SUPERVALU DEAD - DELIST.23/10/18	5,81
Consumer Staples	912134	KROGER	6,31
Energy	544682	MARATHON OIL	4,64
Energy	271980	DEVON ENERGY	4,69
Energy	921983	APACHE	4,98
Financials	923418	PROVIDIAN FINL. DEAD - DELIST.20/10/05	2,13
Financials	922817	AON CLASS A	5,66
Financials	510110	CONCORD EFS DEAD - MERGER 325518	8,08
Healthcare	255956	AETNA DEAD - DELIST.29/11/18	6,01
Healthcare	14737P	ANTHEM	7,47
Healthcare	916860	HUMANA	7,83
Industrials	929799	LOUISIANA PACIFIC	2,69
Industrials	906284	RYDER SYSTEM	4,14
Industrials	687141	CONVERGYS DEAD - DELIST.06/10/18	6,26
Real Estate	894876	EQUITY OFFE.PROPS.TST. DEAD - DELIST.22/02/07	12,27
Real Estate	132808	APARTMENT INV.& MAN.'A'	12,8
Real Estate	357834	SIMON PROPERTY GROUP	13,83
Technology	916091	DXC TECHNOLOGY	6,2
Technology	906930	ELECTRONIC DATA SYSTEMS DEAD - DELIST.05/09/08	6,44
Technology	877072	NCR	8,03
Telecommunication	905261	AT & T DEAD - DELIST.21/11/05	3
Telecommunication	904864	SPRINT NEXTEL DEAD - DELIST.11/07/13	5,03
Telecommunication	945388	AT&T	5,93
Utilities	902314	PG&E	3,41
Utilities	904842	CENTERPOINT EN.	6,13
Utilities	902324	EDISON INTL.	6,17

2007 – 2010

Industry	Code	Name	EM
Basic Materials	544683	UNITED STATES STEEL	3,77
Basic Materials	904262	PHELPS DODGE DEAD - DELIST.02/04/07	4,07
Basic Materials	904069	INTERNATIONAL PAPER	4,26
Consumer Discretionary	923731	DILLARDS 'A'	6,05
Consumer Discretionary	904869	WHIRLPOOL	6,27
Consumer Discretionary	998171	HOME DEPOT	6,95
Consumer Staples	134784	MCKESSON	7,93
Consumer Staples	696324	PEPSI BOTTLING GP. DEAD - DELIST.11/03/10	7,34
Consumer Staples	921093	ARCHER DANIELS MIDLAND	7,87
Energy	905802	HESS	3,61
Energy	982852	VALERO ENERGY	3,62
Energy	905102	OCCIDENTAL PTL.	4,34
Financials	916028	SAFECO DEAD - DELIST.03/10/08	5,51
Financials	322677	ALLSTATE ORD SHS	5,76
Financials	951545	CINCINNATI FINL.	5,97
Healthcare	683363	KING PHARMS. DEAD - DELIST.01/03/11	5,62
Healthcare	912278	CIGNA	6,49
Healthcare	544665	COVENTRY HEALTH CARE DEAD - ACQD.BY 255956	7,18
Industrials	921757	PACCAR	6,51
Industrials	905966	CUMMINS	4,64
Industrials	921757	PACCAR	6,51
Real Estate	905818	WEYERHAEUSER	9,58
Real Estate	36269J	REALOGY DEAD - DELIST.23/04/07	10,99
Real Estate	894371	BOSTON PROPERTIES	11,78
Technology	999506	MICRON TECHNOLOGY	5,79
Technology	912744	TERADYNE (XSC)	7,02
Technology	905061	TEXAS INSTRUMENTS	7,85
Telecommunication	35781K	EMBARQ DEAD - DELIST.13/07/09	5,52
Telecommunication	906838	LUMEN TECHNOLOGIES	5,74
Telecommunication	945384	VERIZON COMMUNICATIONS	5,91
Utilities	902103	SEMPRA EN.	5,92
Utilities	902329	TXU DEAD - MERGER	6,85
Utilities	902316	PEOPLES ENERGY DEAD - DELIST.05/03/07	7,2

2010 – 2013

Industry	Code	Name	EM
Basic Materials	31109K	CF INDUSTRIES HDG.	4,45
Basic Materials	152594	FREEPORT-MCMORAN	5,67
Basic Materials	912160	NEWMONT	6,92
Consumer Discretionary	916312	RS LEGACY DEAD - DELIST.09/10/15	4,73
Consumer Discretionary	15168M	GAMESTOP 'A'	5,03
Consumer Discretionary	905596	H&R BLOCK	5,06
Consumer Staples	543349	SAFEWAY DEAD - DELIST.30/01/15	4,84
Consumer Staples	905119	SUPERVALU DEAD - DELIST.23/10/18	5,91
Consumer Staples	15162T	LORILLARD DEAD - DELIST.12/06/15	6,6
Energy	907620	ROWAN COMPANIES CL.A DEAD - DELIST.11/04/19	4,1
Energy	906404	MURPHY OIL	4,73
Energy	544682	MARATHON OIL	4,9
Financials	755741	CHARLES SCHWAB	3,18
Financials	28341F	ASSURANT	3,58
Financials	25735K	NASDAQ	4,68
Healthcare	14737P	ANTHEM	3,55
Healthcare	916860	HUMANA	4,04
Healthcare	702635	UNITEDHEALTH GROUP	5,11
Industrials	906284	RYDER SYSTEM	3,78
Industrials	255272	FLUOR	4,45
Industrials	905809	NORTHROP GRUMMAN	5,53
Real Estate	894720	IRON MOUNTAIN	8,43
Real Estate	132808	APARTMENT INV.& MAN.'A'	14,72
Real Estate	912588	HOST HOTELS & RESORTS REIT	15,2
Technology	867344	LEXMARK INTL. DEAD - DELIST.29/11/16	3,51
Technology	31676F	LEIDOS HOLDINGS	4,1
Technology	916091	DXC TECHNOLOGY	4,43
Telecommunication	992854	TELLABS DEAD - DELIST.04/12/13	4,37
Telecommunication	894076	QWEST COMMS.INTL. DEAD - DELIST.01/04/11	4,44
Telecommunication	904864	SPRINT NEXTEL DEAD - DELIST.11/07/13	4,54
Utilities	904332	CONSTELLATION EN. DEAD - AQCD.BY 902317	0,96
Utilities	28179N	NRG ENERGY	3,28
Utilities	902317	EXELON	5,46

2013 – 2016

Industry	Code	Name	EM
Basic Materials	771767	MOSAIC	5,58
Basic Materials	69264X	LYONDELLBASELL INDS.CL.A	6,12
Basic Materials	921161	AVERY DENNISON	8,06
Consumer Discretionary	149387	APOLLO EDUCATION GP.'A' DEAD - DELIST.02/02/17	1,38
Consumer Discretionary	15303X	NETFLIX	2,76
Consumer Discretionary	929302	BEST BUY	2,78
Consumer Staples	906643	TYSON FOODS 'A'	5,1
Consumer Staples	912134	KROGER	6,71
Consumer Staples	154680	AMERISOURCEBERGEN	7,42
Energy	77229W	MARATHON PETROLEUM	3,15
Energy	905802	HESS	3,61
Energy	912052	ANDEAVOR DEAD - DELIST.01/10/18	3,57
Financials	912402	LINCOLN NATIONAL	4,57
Financials	921925	JEFFERIES FINANCIAL GROUP	4,65
Financials	28367U	GENWORTH FINANCIAL CL.A	5,36
Healthcare	944704	CARDINAL HEALTH	6,51
Healthcare	255956	AETNA DEAD - DELIST.29/11/18	5,84
Healthcare	544665	COVENTRY HEALTH CARE DEAD - ACQD.BY 255956	6
Industrials	41195M	WESTERN UNION	4,96
Industrials	951849	FEDEX	5,23
Industrials	13950L	JOY GLOBAL DEAD - DELIST.06/04/17	5,72
Real Estate	28513N	CBRE GROUP CLASS A	11,87
Real Estate	905818	WEYERHAEUSER	14,9
Real Estate	357834	SIMON PROPERTY GROUP	17,96
Technology	906785	WESTERN DIGITAL	2,32
Technology	26599V	SEAGATE TECH.	2,65
Technology	772203	DELL DEAD - DELIST.30/10/13	3,11
Telecommunication	50394K	T-MOBILE US	3,77
Telecommunication	542868	CISCO SYSTEMS	4,58
Telecommunication	922301	FRONTIER COMMUNICATIONS	5,44
Utilities	902607	PINNACLE WEST CAP.	6,79
Utilities	902324	EDISON INTL.	6,41
Utilities	902321	PUB.SER.ENTER.GP.	6,66

2016 – 2019

Industry	Code	Name	EM
Basic Materials	905114	DOW CHEMICAL DEAD - DELIST.01/09/17	5,66
Basic Materials	912160	NEWMONT	6,29
Basic Materials	904069	INTERNATIONAL PAPER	7,44
Consumer Discretionary	32730D	UNITED AIRLINES HOLDINGS	4,12
Consumer Discretionary	50469N	DELTA AIR LINES	4,47
Consumer Discretionary	31196R	DISCOVERY SERIES A	4,77
Consumer Staples	699577	REYNOLDS AMERICAN DEAD - DELIST.25/07/17	11,36
Consumer Staples	13967E	MONDELEZ INTERNATIONAL CL.A	8,23
Consumer Staples	921093	ARCHER DANIELS MIDLAND	8,3
Energy	322668	TRANSOCEAN	4,39
Energy	982852	VALERO ENERGY	4,55
Energy	921049	HELMERICH & PAYNE	5,44
Financials	938076	FRANKLIN RESOURCES	5,37
Financials	933185	AFLAC	6,21
Financials	14861V	PRUDENTIAL FINL.	6,49
Healthcare	546697	GILEAD SCIENCES	6,48
Healthcare	749688	HCA HEALTHCARE	7,79
Healthcare	14737P	ANTHEM	7,81
Industrials	912669	AUTOMATIC DATA PROC.	3,16
Industrials	906284	RYDER SYSTEM	4,64
Industrials	670778	UNITED RENTALS	5,28
Real Estate	912588	HOST HOTELS & RESORTS REIT	10,57
Real Estate	894720	IRON MOUNTAIN	13,31
Real Estate	687197	CROWN CASTLE INTL.	13,93
Technology	999506	MICRON TECHNOLOGY	4,24
Technology	906785	WESTERN DIGITAL	4,62
Technology	8660JC	HEWLETT PACKARD ENTER.	6,08
Telecommunication	906838	LUMEN TECHNOLOGIES	4,96
Telecommunication	945388	AT&T	7,13
Telecommunication	945384	VERIZON COMMUNICATIONS	5,99
Utilities	902317	EXELON	5,43
Utilities	545101	AES	7,73
Utilities	904842	CENTERPOINT EN.	8,06

2019 – 2020

Industry	Code	Name	EM
Basic Materials	152594	FREEPORT-MCMORAN	4,54
Basic Materials	921482	NUCOR	4,74
Basic Materials	69264X	LYONDELLBASELL INDS.CL.A	5,88
Consumer Discretionary	904837	GOODYEAR TIRE & RUB.	4,69
Consumer Discretionary	29739U	TWENTY FIRST CENTURY FOX A	5,08
Consumer Discretionary	329709	BORGWARNER	5,33
Consumer Staples	912134	KROGER	5,97
Consumer Staples	906643	TYSON FOODS 'A'	7,87
Consumer Staples	905997	MOLSON COORS BEVERAGE COMPANY B	8,63
Energy	26276P	CIMAREX EN.	3,91
Energy	544682	MARATHON OIL	3,99
Energy	271980	DEVON ENERGY	4,53
Financials	921925	JEFFERIES FINANCIAL GROUP	2,39
Financials	905840	BANK OF NEW YORK MELLON	3,29
Financials	31604H	AMERIPRISE FINL.	4,32
Healthcare	131402	NEKTAR THERAPEUTICS	6,29
Healthcare	152533	LABORATORY CORP.OF AM. HDG.	8,84
Healthcare	992953	UNIVERSAL HEALTH SVS.'B'	8,86
Industrials	670778	UNITED RENTALS	5,48
Industrials	255272	FLUOR	5,64
Industrials	921757	PACCAR	6,22
Real Estate	945589	HEALTHPEAK PROPERTIES	10,32
Real Estate	132808	APARTMENT INV.& MAN.'A'	8,45
Real Estate	28513N	CBRE GROUP CLASS A	9,79
Technology	916091	DXC TECHNOLOGY	4,66
Technology	946387	LAM RESEARCH	5,29
Technology	26599V	SEAGATE TECH.	5,52
Telecommunication	135448	DISH NETWORK 'A'	8,61
Telecommunication	981550	COMCAST A	8,76
Telecommunication	68470X	CHARTER COMMS.CL.A	9,25
Utilities	902107	PPL	9,47
Utilities	905016	NEXTERA ENERGY	9,82
Utilities	902607	PINNACLE WEST CAP.	10,05