MASTER THESIS, BUSINESS ANALYTICS

Planting the SEEDS

Backtesting the Graham–Munger Investment Style for 2006–2020

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Bergen, Spring 2021

Abstract

Despite having many critics disputing value investing's relevance today, several of the world's best value investors continue to deliver market-beating results almost every year. This thesis attempts to participate in this discussion by studying two of the most prevalent value investing philosophies. Specifically, the thesis studies whether the quality-specific investment criteria for the defensive investor—as proposed by Benjamin Graham in The Intelligent Investor—can deliver risk-adjusted excess returns during the investment period from 2006 to 2020. Additionally, the thesis studies whether an improved performance can be observed by creating an investment style that blends the abovementioned, quality-specific criteria of Benjamin Graham with Charlie Munger's investment philosophies regarding purchasing price and holding duration.

By identifying all 36 companies that respect Graham's quality criteria as per December 31st 2005, 11 portfolio constructions that blend Graham's and Munger's investment philosophies are explored. All portfolio constructions produce consistent risk-adjusted excess returns when compared against a commonly accepted global benchmark. In particular, the proposed strategy—which blends Graham's and Munger's investing philosophies—produces substantial excess returns at a lower risk than the market provides. Nevertheless, while the results are promising, more research must be performed on additional investment periods before a firm response can be given to the current discussion.

Keywords Value investing, Benjamin Graham, The Intelligent Investor, The SEEDS criteria

Acknowledgements

I want to express gratitude to my supervisor Professor Bjerksund. His valuable guidance, especially when I was still in the idea-generating phase, helped me realize a research endeavor that I have been passionate about exploring further since the second semester of my master's degree. In addition, I am very thankful for Professor Bjerksund's offer to extend his thesis supervision for another semester.

I am beyond thankful to NHH for offering me the opportunity to pursue two master's programs —specializing in Business Analytics and International Management (CEMS). The extensive learning curve gained while training my coding and data analytics skills has been pivotal to manage the data collection, cleaning, and analysis of this thesis successfully.

I thank the libraries at NHH and the National University of Singapore for offering me access to the Bloomberg Terminal. Without accessing the Bloomberg database, tackling this research focus would not have been possible. I am very thankful for their generosity.

Thank you, Christian, for lending me a copy of Ben Graham's *The Intelligent Investor* that was filled to the brink with squiggles and notes of investment ideas at a time in which I was looking for a suitable master thesis topic that would enhance my investment knowledge and data analytics skills. So, a mix of Graham and Munger's investment styles it was!

A huge thank you goes to my beloved family, who has supported me throughout the good and the challenging times. From an early age on, I remember my dad emphasizing the power education can have on my life. He encouraged me in educating myself and challenged my assumptions about personal investing. His beliefs and mindset shaped me and are probably the driving force for this work. This work is for you, dad.

Lastly, I thank the reader for spending your precious time reading my thesis. I hope you enjoy reading it.

Lisa Hellweger

Bergen, May 2021

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Chapter 1

Introduction

About one hundred years ago, *value investing* was initially developed, bringing the investor's attention towards buying primarily stocks in quality companies at a price below their intrinsic value. However, the investment style was popularized after Benjamin Graham published his book *The Intelligent Investor* in 1949, which is today considered as the stock market "bible". Hence, Graham is considered by many to be the father of value investing (Cornell, 2021; Graham and Zweig, 2006).

Since Graham popularized the field, value investing has been among the most popular, applied, and analyzed investment styles. However, its popularity is also largely caused by Warren Buffet and Charlie Munger's devoted teachings—CEO and vice-chairman of Berkshire Hathaway—for almost five decades (Klerck, 2020; Munger, 1994).

While the value investing style follows certain tenets regarding the price and quality of investments, various investment philosophies have emerged, of which Graham has developed multiple. Specifically, he refined and re-defined his investment philosophy ever since he published his first philosophy in Security Analysis in 1934 (Benjamin Graham, 1934). For instance, in the latest edition of the Intelligent Investor—published in 1973 and modified in 2006 with commentary chapters by Jason Zweig—Graham published one investing philosophy for the active, "enterprising" investor and another for the "defensive" investor (Graham & Zweig, 2006).

In the last decades, the investment philosophy for the defensive investor has caught particular attention among laypeople and researchers alike. The philosophy involves identifying companies whose stocks meet seven criteria and then invest in any of these that fit the investor's preferences (Israel, Laursen, and Richardson, 2020; Soloviova, 2020).

Five of these criteria involve the quality of the company and imposes quantifiable thresholds for the (1) size of the enterprise, (2) earnings stability, (3) earnings growth, (4) dividend record, and (5) strong financial condition (Graham & Zweig, 2006). These quality criteria form the acronym SEEDS and form the foundation of the analysis in this thesis.

The following two criteria relate to the pricing, require a (6) moderate price-to-earnings ratio, and a (7) moderate price-to-book ratio, or a trade-off between these under certain thresholds (Graham & Zweig, 2006).

Despite delivering above-market returns in his day, Graham's investment philosophies and effectiveness have been under scrutiny in the last decades (Israel et al., 2020; Lev and Srivastava, 2019). On the one hand, researchers and analysts find evidence both for and against Graham's philosophy in delivering returns that outperform certain markets and periods. But, on the other hand, investors are branching out from Graham's fundamental philosophy in the belief that a modification to Graham's philosophy will continue to perform better than the market (Berge Larsen, Braathen, Gran, and Hundhammer, 2016; Sareewiwatthana, 2011; Zakaria and Hashim, 2017).

One such philosophy is Munger's "Sit On Your Ass" investing philosophy that he presented at the Berkshire Hathaway annual meeting back in 2000. This philosophy largely discards Graham's pricing criterion as the process is more heavily focused on finding some high-quality companies, buying them regardless of whether you get a discount on the intrinsic value or not, and holding these investments indefinitely. Munger reasons that the compounding effect of annual returns will dilute the extra returns earned on discounts on the intrinsic value over a long time (Munger, 1994).

This philosophy holds some merit. Specifically, Warren Buffett is today considered by many as the greatest investor of all time. However, he accredits a large part of his and Berkshire Hathaway's success to Charlie Munger's perspectives as Munger shifted his efforts away from the "buy low, sell high" philosophy that Graham was also accustomed to, towards a larger focus on the "buy quality and hold indefinitely" philosophy (Buffett, 1984; Greenwald, Kahn, Bellissimo, Cooper, and Santos, 2020a).

However, Buffett still follows (a large part of) Graham's philosophy and has decribed The Intelligent Investor as "By far the best book on investing ever written" (Graham and Zweig, 2006, front page). Yet, despite the Intelligent Investor being a best-selling, critically acclaimed investment book providing easy-to-follow investment principles for the defensive investor, and despite the fact that arguably the greatest investor of all time shifted his investment philosophy more towards that of Charlie Munger's, there is barely any literature that studies which performs the best or if there are any superior performance effects when merging the two philosophies.

Hence, to fill this research gap, I intend to study the SEEDS criteria of Graham as a starting point and compare how Graham's and Munger's philosophies regarding price and holding duration perform—what I will jointly refer to as the "Graham–Munger investment styles". Additionally, I intend to study if any of the analyzed portfolios that are constructed from this investing style outperform the market at large. Therefore, my research question is:

> Are companies that meet Graham's SEEDS criteria delivering a risk-adjusted excess return, and does a Graham–Munger investment style produce any improved performance?

To date, only one non-peer-reviewed study from 2016 (Berge Larsen et al., 2016) provides insights that contribute to answering this research question, albeit not entirely. Besides adding a second study to the discussion on the effectiveness of the Graham–Munger investing style, this thesis also contributes to the literature by extending upon the work of Berge Larsen et al. (2016) with a more detailed analysis of a longer time period and a more holistic approach to the investing process. Such an approach includes jointly analyzing the effects of portfolio filtering, holding strategies, reinvestment strategies, and rebalancing strategies, in addition to studying the effects caused by currency and benchmark choices.

The thesis is structured as follows. First, the relevant literature and theory are explored and described. Second, a methodology chapter covering numerous considerations, modifications, and additions to the theory and analysis process is provided. Third, the data analysis is provided, split into chapters of data considerations, descriptive analysis, and exploration of the Graham–Munger investment style. And fourth, the thesis concludes by describing its main findings, limitations, and future work.

Chapter 2

Literature Review & Theoretical Background

This chapter gives the reader a review of the academic literature and an overview of relevant theoretical concepts. I start by first introducing value investing—the key characteristics and diverging value investing approaches—and highlighting the empirical findings of the academic literature. Second, I provide an overview of relevant concepts from the modern portfolio theory, and third, I discuss various performance measures to be considered for the empirical analysis of this thesis.

2.1 Value Investing

While the origins of value investing date back to the late 1920s, value investing became well known in 1949 through Benjamin Graham's book The Intelligent Investor (Browne, 2006). Since then, Graham is known as the father of value investing. Other well-known value investors are David Dodd, Warren Buffett—who himself was a student of Graham—and Charlie Munger (Greenwald, Kahn, Bellissimo, Cooper, and Santos, 2020b; Cornell, 2021).

Value investors aim to maximize stock returns by selecting stocks that appear to be trading below their intrinsic value or book value and are, therefore, considered to be underestimated by the stock market. These stocks are also referred to as *value stocks*—characterized through a low price-to-earnings ratio, low price-to-book ratio, and high dividend yield (An, Cheh, and Kim, 2017; Cornell, 2021). As value investors usually hold their stocks for a long-term investment horizon, they conduct a thorough financial analysis before stock selection occurs (Asness, Frazzini, Israel, and Moskowitz, 2015; Greenwald et al., 2020b).

However, successful value investors such as Graham and Munger also have partially deviating investment philosophies (Graham and Zweig, 2006; Griffin, 2015). Hence, to understand better Graham and Munger's investment styles, their main differences are discussed next.

2.1.1 Graham's Investing Philosophy

Graham recommends his *seven stock selection criteria* to the defensive investor, who is unwilling to invest a lot of time and effort into her investment decisions and seeks conservative investments that do not require much time and effort and is yet inexperienced with stock investing (Graham & Zweig, 2006).

The seven stock selection criteria are (1) adequate size of the enterprise, (2) sufficiently strong financial condition, (3) earnings stability, (4) dividend record, (5) earnings growth, (6) a moderate price-to-earnings ratio, and lastly (7) a moderate price-to-assets ratio. After the defensive investor successfully identified and purchased value stocks, Graham advises keeping an asset portfolio of around 10 to 30 stocks (Graham & Zweig, 2006).

In Graham's eyes, investment risk represents the long-term loss of capital and not the stock price fluctuations. Therefore, it is an intelligent investor's responsibility to lose as little of the money invested as possible by purchasing low-quality stocks far above their tangible value (Klerck, 2020). Hence, Graham's *margin of safety* principle—the difference between a stock's intrinsic value and market value—serves to analyze whether a stock is traded below or above its intrinsic value, which overall increases the chance of earning a pleasant return on the stock (Graham and Zweig, 2006; Scott, 1996).

If a company's intrinsic value is lower (higher) than its stock price, the company is undervalued (overvalued), respectively. However, Graham never fully explained how to determine the intrinsic value of a company and confessed that it requires substantial investment knowledge (Graham & Zweig, 2006).

Being an intelligent investor also requires developing the emotional discipline to focus on the fundamental characteristics of an asset and not on one's emotions. Therefore, Graham's stock selection criteria help the defensive investor to train discipline, patience and develop intellectually (Graham & Zweig, 2006).

2.1.2 Munger's Investing Philosophy

Charlie Munger—Berkshire Hathaway's vice chairman—shared his value investing philosophy at the Berkshire Hathaway annual meeting in 2000. Compared to Graham's value investing approach, Munger focuses on identifying a few outstanding companies, invests a considerable amount of money, and then holds them preferably forever. Therefore, Munger defined his investing philosophy as "sit on your ass investing"—beliefs that do not align with Graham's approach of buying undervalued stocks at a low price (Griffin, 2015; Munger, 1994).

On a talk to the students at USC Business School in 1994, Munger (1994) gave the now infamous speech "A Lesson on Elementary, Worldly Wisdom As It Relates To Investment Management & Business" in which he explained why price should not be a decisive factor:

> If the business earns 6 % on capital over 40 years and you hold it for that 40 years, you're not going to make much different than a 6 % return—even if you originally buy it at a huge discount. Conversely, if a business earns 18 % on capital over 20 or 30 years, even if you pay an expensive looking price, you'll end up with a fine result.

Overall, Munger's "sit on your ass investing" strategy is driven by a company's ability to successfully compound the shareholders' equity for an attractive rate over a long investment time (Griffin, 2015).

While the focus of this thesis is to investigate Graham's stock selection philosophy, Munger's investing approach will be explored in practice in the results chapter of this thesis to draw some comparisons between the two super investors.

2.2 Graham's Stock Selection Framework

In The Intelligent Investor, Graham defines seven stock selection criteria for the defensive investor, which have the objective to identify undervalued stocks that can produce higher returns than the market (Graham & Zweig, 2006).

Graham's stock selection criteria can be divided into two categories. The first concerns the size of the enterprise, earnings stability, earnings growth, dividend record, and strong financial conditions. These five criteria form the acronym SEEDS , and I will continue referring to these criteria as the "SEEDS criteria". Additionally, the second category consists of Graham's price criterion, which is the product of a low price-to-earnings ratio and a low price-to-tangible-book-value ratio (Graham & Zweig, 2006). Both categories are described in the following pages to give the reader a better understanding of an intelligent investor's stock selection preferences.

2.2.1 Size of the Enterprise

According to Graham and Zweig (2006), the first stock selection criterion *adequate size of the enterprise*, requires a minimum of $100 million in annual sales for an industrial company and a minimum of $50 million in total assets for public utilities.

2.2.2 Earnings Stability

The *earnings stability* criterion requires positive earnings for the common stock over the last ten years. If, for instance, a company did not deliver positive earnings once, throughout the past ten years, the company violated the criterion (Graham & Zweig, 2006).

2.2.3 Earnings Growth

A company would pass Graham's *earnings growth* criterion if the business managed to increase its earnings per share (EPS) by at least one-third over the past ten consecutive years. To calculate the earnings growth, the intelligent investor uses a three-year average at the start and end of the investment horizon (Graham & Zweig, 2006). A simple way to calculate the EPS, according to Bodie, Kane, and Marcus (2014) is as follows.

$$EPS = \frac{\text{net income}}{\text{average outstanding shares}} \tag{2.1}$$

2.2.4 Dividend Record

Graham's *dividend record* criterion demands dividend payments to the shareholders for 20 consecutive years. As value stocks often pay dividends, there is typically a large amount of the value companies that have been stock-listed for at least two decades that meet this criterion (Graham & Zweig, 2006).

2.2.5 Strong Financial Conditions

The *strong financial conditions* criterion requires industrial companies to have a current ratio of at least two, meaning that the firm's current assets are at least twice the size of the current liabilities. Also, the long-term debt should not surpass the net current assets, of which net current assets is defined as current assets minus current liabilities. For public utilities, however, the debt should not be higher than twice the stock equity (Graham & Zweig, 2006).

2.2.6 The Price Criterion

The intelligent investor's sixth and seventh stock selection criteria are a *moderate price-to-earnings ratio* and a *moderate price-to-book ratio*. Graham and Zweig (2006) consider the price-to-earnings ratio as moderate if the price does not exceed 15 times the average earnings per share of the last three years. In addition, the price-to-book ratio is approved to be moderate if the stock price is below 1.5 times the last reported tangible book value. Graham preferred to use the tangible book value to avoid companies with a considerable number of intangible assets, whose value is harder to measure.

However, Graham also allows some trade-off between these two criteria if, for instance, an earnings multiplier below 15 justifies a consequently higher asset multiplier. If the multiplier times the price-to-book ratio does not exceed 22.5, which equals 15 times the earnings and 1.5 times the tangible book value, then Graham lets a company pass these two criteria (Graham & Zweig, 2006).

$$\text{Price criterion} = \frac{P}{E} \cdot \frac{P}{tBV} = 15 \cdot 1.5 \leq 22.5 \tag{2.2}$$

2.3 Empirical Findings on Value Investing

Even though various studies, among them Rani (2019) and Ye (2013), show that value investing still delivers promising results, disbelief emerged over the years criticizing its effectiveness (Israel et al., 2020). Lev and Srivastava (2019), for instance, argue in their paper that value investing lost its attractiveness already 30 years ago.

According to Lev and Srivastava (2019), the two reasons that negatively affected value investing in recent years are as follows. First, accounting deficiencies led to systematically misidentifying the value of a stock. And second, the economic developments over the last decades favored the rise of growth stocks—stocks with high price-to-earnings ratios—over value stocks (Beneda, 2002).

Oppenheimer and Schlarbaum (1981) pointed out that there is a limited amount of studies on Graham's value investing approach. Those available and well-researched focus on testing Graham's investing philosophy on stock markets in developed countries like the UK or the US. Xiao and Arnold (2008), among others, tested Graham's value strategy on the London Stock Exchange from 1981 to 2005 and found that significantly positive market-adjusted returns—annualized returns of up to 19.7 %—were achieved and explained this outcome with irrational pricing.

Additional studies argue that ignoring or adjusting Graham's price criterion shows promising results. One of these studies, for instance, argues that Graham's stock selection criteria—excluding the price-to-book ratio—delivered significant results in recent years (Tilley, 2016). The other concludes that Graham's investment strategy—when adjusting the price criterion to a range between 70 and 300—delivers above-market annual returns of 5.5–7.7 % over eleven years (Berge Larsen et al., 2016).

Studies on the performance of Graham's stock selection criteria in developing countries are somewhat limited, but those available show promising results. The main findings are summarized in the following paragraphs.

The first study to highlight was conducted by Chang (2011) and emphasized that most screening criteria proposed by Graham generated returns significantly higher than the returns of the stock exchange in Malaysia during the years from 2000 to 2009.

The second study performed by Zakaria and Hashim (2017) investigated and tested the relevance of Graham's stock selection criteria on the Saudi Arabia stock market. This study also identified abnormal returns in the respective stock market.

Third, Rachmattulah and Faturohman (2016) tested the validity of Graham's stock selection criteria on the Indonesian Stock Exchange from 2006 to 2015. They conclude that applying Graham's stock selection criteria delivered excess returns. Interestingly, stocks meeting a minimum of two Graham criteria delivered excess returns already with a minimum holding period of two years.

Fourth, Sareewiwatthana (2011) studied a stock portfolio over 15 years to identify if following Graham's value investing strategy—by focusing on three stock selection rules—outperforms the market in Thailand. Results showed that the portfolio significantly outperformed the respective stock market. Additionally, the findings show that the value stock portfolio delivered higher returns than the portfolio consisting of growth stocks.

Fifth, Ye (2013) studied the effectiveness of value investing in the Shanghai Stock Exchange from 2006 to 2011 by applying, among others, three stock selection criteria from Graham—considering Graham's price-to-earnings ratio, dividend yield, and current ratio. Results show that the stock portfolio delivered higher returns than the market in five out of the six years studied.

2.4 Modern Portfolio Theory

In 1952 Markowitz pioneered the modern portfolio theory, which focuses on how risk-averse investors can build well-diversified asset portfolios to maximize the expected return based on a certain level of market risk (Bodie et al., 2014; Rubinstein, 2002).

2.4.1 Beta

The beta coefficient is used in the CAPM model to measure the systematic risk of an investment or asset portfolio compared to the entire stock market. Knowing the volatility of an investment relatively to the market helps an investor decide whether it is worth taking the risk (Karačić and Bukvić, 2014; Tofallis, 2008). An asset's beta β_i is calculated as follows:

$$\beta_i = \frac{Covariance(r_i, r_M)}{Variance(r_M)} \tag{2.3}$$

The covariance measures the relationship of the movement between a stock's return, r_i, and the market's return, r_M. While a positive covariance implies that the returns move together, a negative covariance shows that the assets move reversely. The variance measures how the market's return, r_M, moves relatively to its mean (Bodie et al., 2014).

An absolute beta value of one shows that the asset is equally volatile as the market. A beta with an absolute value greater than one means that the stock is more volatile than the market, and a beta with an absolute value below one implies that the stock is less volatile than the market. Conversely, if a beta with an absolute value is negative, then the stock fluctuates opposite the market (Bodie et al.; Hasler and Martineau, 2019).

After calculating the asset's beta, the next question is how to construct a *portfolio's* beta. The most common approach to calculate the portfolio beta, β_p, is as a weighted average of the individual assets' beta:

$$\beta_p = \sum_{i=1}^{N} w_i \beta_i; \tag{2.4}$$

Where N is the number of investments, and w_i the investment weight of asset i.

This method, however, is problematic for portfolios that do not attempt to maintain fixed weights of the investments. As this thesis explores many alternatives of holding and rebalancing strategies, the weights will be modified over time, and therefore, a less common approach to calculating the beta is relevant, namely, calculating the beta based on the portfolio returns. For instance, Damodaran (2002, p. 120) writes

> [The beta is estimated], either by taking the [weighted] average of the betas of the individual stocks in the portfolio or *by regressing the portfolio's returns against market returns* over a prior time period...

This approach is also suggested by Chincarini and Kim (2006) and Radcliffe (1997), in which Radcliffe (1997) defines the weighted average and the portfolio approach as beta calculations on the *component security level* and the *portfolio level*, respectively. The portfolio level beta can therefore be calculated as follows:

$$\beta_p = \frac{Covariance(r_p, r_M)}{Variance(r_M)} \tag{2.5}$$

A benefit of the component security level approach is that the alpha will not be artificially inflated. Specifically, the component security level disregards the correlation between the returns as the asset betas are calculated without considering the other asset returns. However, the portfolio beta studies the returns of the whole portfolio and will therefore include this correlation effect. Hence, the volatility may present itself as higher than in the portfolio level approach when ignoring the correlation effect in the component security level approach. Which, in turn, increases the expected return from the investment because of a higher beta. When calculating the Jensen's alpha—presented in the performance measures section—against this return, the alpha will be smaller than in the portfolio level approach (Damodaran, 2002).

Despite wanting to avoid artificially inflated results, I still choose to follow the portfolio approach for two main reasons. First, the various holding and rebalancing strategies presented in this thesis change the weights of the investments substantially throughout the holding period. Second, the holding strategies may trigger a reinvestment from the 2006 cohort into the local benchmark. Therefore, investments into the index that reach a zero weighting will eventually present themselves into the portfolio with a much higher weighting. Thus, my portfolio studies the invested amounts in the 2006 cohort and the reinvested amounts into relevant indices. I, therefore, consider the portfolio level calculation of beta more appropriate.

2.4.2 The Capital Asset Pricing Models

The capital asset pricing model (CAPM), introduced by Sharpe and Lintner in the 1960s, represents the emergence of the asset pricing theory and calculates the acceptable rate of return for an investment (Bodie et al., 2014; Fama and French, 2004). The academic literature distinguishes between three main geographical models–the traditional (local), global, and international CAPM (Ejara, Krapl, O'Brien, & Ruiz de Vargas, 2020).

The Traditional CAPM

The traditional CAPM compares the asset return against the local market and is therefore also known as the local CAPM (Ejara et al., 2020). Risk-averse investors hold diversified portfolios to minimize their risk. While unsystematic risk has a negligible impact on the return of a well-diversified portfolio, the relevant risk of such a portfolio is the systematic risk. As investors expect a reward for waiting and taking on systematic risk through their asset investments, the CAPM describes the relationship between the expected return of an asset and its systematic risk. According to the CAPM, this relationship provides an evaluation of whether a stock is valued reasonably (Bodie et al., 2014; Blitz, Falkenstein, and Van Vliet, 2014; Hasler and Martineau, 2019).

The formula to calculate the expected return of an asset $\mathbb{E}[r_i]$ is as follows.

$$\mathbb{E}[r_i] = r_f + \beta_i(\mathbb{E}[r_M] - r_f) \tag{2.6}$$

The risk-free rate of return, r_f, accounts for the time value of money invested in risk-free assets. The beta of investment, β_i, is a volatility measure and expresses the systematic risk relative to the market. Moreover, the market risk premium, $\mathbb{E}[r_M] - r_f$, is the difference between the expected rate of return on a market portfolio $E[r_M]$ and the risk-free rate, r_f (Blitz et al., 2014; Bodie et al., 2014; Hasler and Martineau, 2019).

The expected return-beta relationship in figure 2.1 is a graphical representation of the CAPM. The market risk premium is observed by where the asset is plotted relative to the security market line (SML) (Bodie et al., 2014).

If a portfolio provides a return above the SML, it outperforms the market on a risk-adjusted basis, giving a positive alpha. If the return is below the SML, the portfolio underperforms the market, giving a negative alpha. If the portfolio is along the line—and alpha is therefore zero—then the portfolio performs as expected given the volatility level, beta. Given the risk of an investment, the SML provides the required rate of return, which is necessary to compensate the investor for the risk taken and the time value of money. Therefore, the SML is used as a benchmark to evaluate the performance of investments. For example, if a portfolio lies above the SML, meaning it provides a higher return than expected for a certain level of volatility, then it outperforms the market. Similarly, if a portfolio is under the SML for a given level of beta, then the portfolio is underperforming the market (Bodie et al., 2014; Hasler and Martineau, 2019).

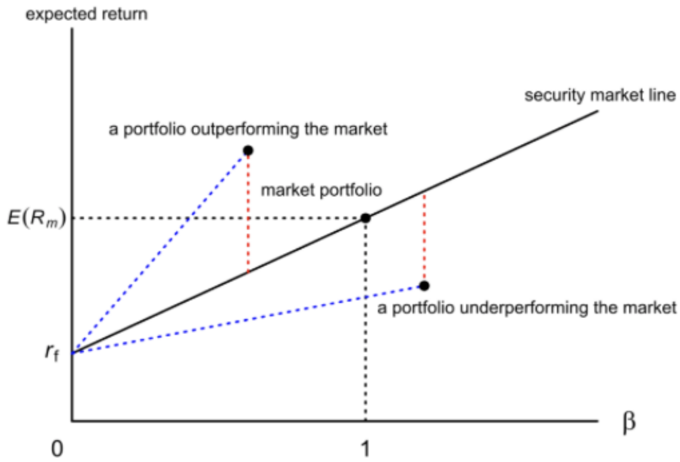

Figure 2.1: The capital asset pricing model (Tamplin, 2021).

The Global CAPM

While the traditional CAPM analyses the expected return-beta relationship based on a local market index, the global CAPM bases its analysis on the global market index such as the MSCI World Index. The global CAPM also uses a global risk-free rate such as the 10-year US treasury bond (Ejara et al., 2020; Villarreal, 2012). The formula for the global CAPM is as follows.

$$\mathbb{E}[r_i^G] = r_f^G + \beta_i^G(\mathbb{E}[r_M^G] - r_f^G) \tag{2.7}$$

In the formula, r_f^G represents the global risk-free rate, β_i^G measures the asset's volatility relative to the global market, and $E[r_M^G]$ is the expected rate of return on a global market portfolio.

The International CAPM

In comparison to the global CAPM, the international CAPM includes currency risk in the analysis and is considered to be conceptually superior to the global CAPM. However, the international CAPM is also considered harder to implement, which is also the reason why the global CAPM is used more frequently (Ejara et al., 2020). The formula for the international CAPM is as follows.

$$\mathbb{E}[r_i^I] = r_f^G + \beta_i^G(\mathbb{E}[r_M^G] - r_f^G) + \gamma_i(\mathbb{E}[r_X] - r_f^G] \tag{2.8}$$

$\mathbb{E}[r_X] - r_f^G]$ represents the risk premium of the foreign currency index, whereas $\gamma_i(\mathbb{E}[r_X] - r_f^G)$

represents the asset's foreign currency risk.

2.4.3 The Efficient Frontier

The efficient frontier is known as a cornerstone of the modern portfolio theory (Buttell, 2010). Visually, the efficient frontier draws a line through the portfolios that deliver the highest level of return given a certain risk level (as measured by standard deviation). Hence, a rational, risk-averse investor should only prefer portfolios along this frontier because every point below the frontier delivers a lower return than another portfolio alternative for a given risk level (Bodie et al., 2014; Feldman and Reisman, 2003).

Two points along the efficient frontier are particularly interesting. First is the *minimum-variance portfolio*, which is the left-most portfolio on the frontier that delivers the lowest level of risk. Second is the *optimal risky portfolio*, which is the portfolio that delivers the highest excess return (as measured against the risk-free rate) per unit of risk. In other words, the optimal risky portfolio delivers the highest Sharpe ratio. A line can be drawn from the graph's intersect in the risk-free rate through the optimal risky portfolio. This line is called the best possible Capital Allocation Line (CAL), and its slope equals the Sharpe Ratio. The steeper this line is, the higher is the "reward-to-variability" ratio, and it can, for instance, help investors in choosing how much to invest in the optimal risky portfolio and how much to invest in the risk-free asset (Bodie et al., 2014; Feldman and Reisman, 2003).

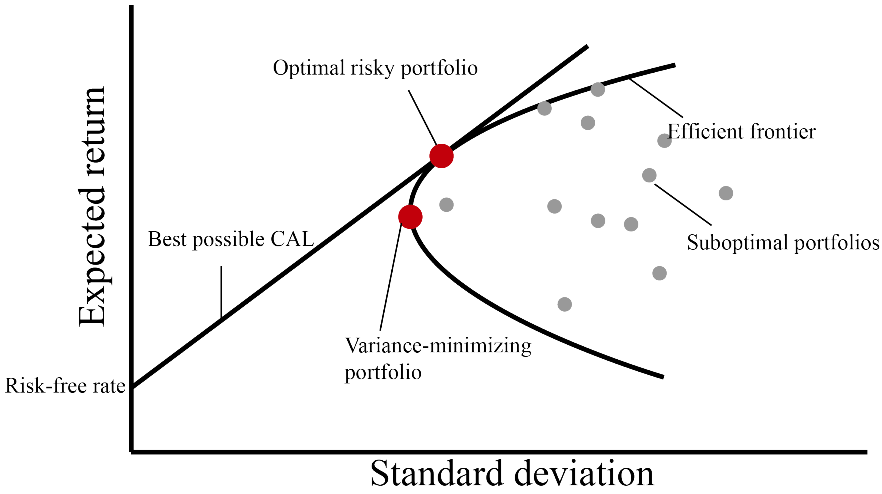

Figure 2.2: The efficient frontier

2.4.4 Portfolio Diversification

According to modern portfolio theory, stocks face two forms of risk—systematic and unsystematic risk. While the former refers to the market's risk and is also known as non-diversifiable risk, the latter describes the company-specific risk. Even when a stock is considered reasonably priced, it still poses an unsystematic risk, which the investor can reduce by well-diversifying the portfolio. Hence, a well-diversified portfolio is a portfolio where each asset weight is small enough so that the unsystematic risk becomes negligible. However, the systematic risk can not be diversified, and investors do not get compensated for bearing (Bodie et al., 2014; Biswas, 2015; Sukrianingrum and Manda, 2020).

2.4.5 Rebalancing Strategies

As mentioned in portfolio diversification, well-diversifying an asset portfolio makes unsystematic risk minor. While allocating diversified assets to one's portfolio is one step, the other is to decide on a suitable asset holding strategy for the investment period. Generally, a fund manager or investor chooses between holding the asset portfolio or rebalancing the portfolio. The former consideration—holding the originally allocated set of assets—is referred to as *buy-and-hold strategy* or no-rebalancing. The latter consideration—rebalancing—is known as *active rebalancing strategy* (Dayanandan and Lam, 2015; Guastaroba, Mansini, and Speranza, 2009; Qian, 2018).

The process of buying and selling investments of a portfolio to adjust the asset's weighting back to the target allocation of the portfolio is known as rebalancing (Dayanandan and Lam, 2015; Kitces, 2015). The potential and power of rebalancing to improve portfolio returns and reduce unsystematic risk is generally acknowledged in the academic literature (Harjoto and Jones, 2006; Tsai, 2001; Zilbering, Jaconetti, and Kinniry Jr, 2015).

The literature discusses a variety of rebalancing strategies, such as periodic rebalancing and threshold rebalancing (Dichtl, Drobetz, and Wambach, 2016; Qian, 2018). Nevertheless, while some empirical findings show that only quarterly or semi-annual rebalancing results in statistically significant results compared to a buy-and-hold strategy, others identified the return difference between periodic rebalancing, such as monthly and quarterly rebalancing, and a buy-and-hold strategy to be only marginal (Dayanandan and Lam, 2015; Rattray, Granger, Harvey, and Van Hemert, 2020; Yu and Lee, 2011).

Dichtl et al. (2016), on the other hand, conclude that frequent rebalancing significantly advances the risk-adjusted portfolio performance in all studied markets after studying several financial markets for 30-years. Also, Graham emphasizes in The Intelligent Investor the importance of following a periodic rebalancing approach, which, according to Graham, requires an asset weight reallocation approximately every six months (Graham & Zweig, 2006).

Moreover, there is little focus on the optimal rebalancing strategy when considering transaction costs as well as the optimal asset portfolio based on the asset's risk characteristics (Masters, 2003). When considering transaction cost, as well as taxes on capital gains—which occur when applying a rebalancing strategy—it is argued that the buy-and-hold strategy appears to be the best way to manage one's asset portfolio (Dayanandan and Lam, 2015; Yu, Chiou, Lee, and Lin, 2020).

Following a buy-and-hold strategy implies holding the asset portfolio from the beginning until the end of the investment period without adjusting any asset weights. However, a buy-and-hold strategy can result in an asset portfolio that deviates considerably from an investor's asset allocation considerations and is highly concentrated and limited to a few assets (Tsai, 2001). Hence, it might negatively affect the overall portfolio performance (Hu, Chang, & Chou, 2014).

2.5 The Efficient Market Hypothesis

In the 1970s, Fama developed the efficient market hypothesis (EMH), which claims that the stock price already reflects all information and assumes that stocks trade at their fair value (Fama, 2021).

According to the theory, there are three variations of the EMH—the weak, semi-strong, and strong EMH—all claiming to a certain degree that stock prices should reflect available information (Bodie et al., 2014). The first variation, the weak EMH, affirms that stock prices already reflect all information by studying market data such as historical stock prices or the trading volume. The weak EMH assumes that the technical analysis is ineffective for investor's investment decisions. However, the second variation, the semi-strong EMH, asserts that stock prices also reflect publicly available information concerning a company's prospects. Such information includes historical stock prices, the quality of the management, earning forecasts, and the balance sheet composition. Therefore, if investors have access to such information from publicly available sources, the stock prices will reflect such information. The third variation, the strong EMH, predicates that stock prices reflect all information relevant to the firm, even including information available only to company insiders (Bodie et al., 2014).

As information is considered as the most valuable commodity (Bodie et al., 2014), investors have an incentive to analyze and identify new information to generate higher investment returns than expected—what is otherwise known as outperforming the market (Grossman & Stiglitz, 1980).

However, only a few investors manage to consistently outperform the market, with Warren Buffett being one of them (Buffett, 1984). Also, other super investors such as Graham and Dodd have proven that the market is inefficient by taking advantage of the disparity between the stock's price and value (Coval, Hirshleifer, and Shumway, 2005; Price and Kelly, 2004). Buffet, for instance, stated in his article *The Superinvestors of Graham-and-Doddsville*, that different investors—which he studied for almost three decades—managed to achieve excess returns, independently from each other, by simply focusing on the differences between a stock's market price and its intrinsic value (Buffett, 1984). Overall, there are opposing views in the academic literature about the EMH and its effectiveness, particularly in the context of excess returns (Basu, 1977; Fama, 2021; Malkiel, 2005; Sewell, 2011).

2.6 Performance Measures

The academic literature presents several ratios that serve to measure the performance of a portfolio, both adjusted and unadjusted for risk (Bodie et al., 2014). Although which metrics to study may vary based on the investor's objective and preferences, the metrics I consider to be the most important to answer the research question are presented below.

2.6.1 Holding Period Return

The holding period return (HPR) is the total return earned during the investment period and calculated as follows.

$$HPR = \frac{p_E - p_B + c_D}{p_B} \tag{2.9}$$

Where p_E is the share's ending price, p_B is the share's beginning price, and c_D is the share's cash dividend (Bodie et al., 2014).

2.6.2 Compounded Annual Growth Rate

The compounded annual growth rate (CAGR) is a standard measure to compare different investments by calculating each investment's average growth. By average growth, theory means that a fixed annual rate is calculated that will compound every time period and result in the HPR in the final time period. The CAGR is considered the most appropriate metric to use in this context because each period's return is weighted equally. The formula for calculating the CAGR is as follows (Bodie et al., 2014).

$$CAGR = (1 + HPR)^{\frac{1}{n}} - 1 \tag{2.10}$$

where n is the number of years of the investment period (Bodie et al., 2014).

2.6.3 Jensen's Alpha

An investor should preferably look both at the overall portfolio return and at the associated risk when evaluating an investment's performance, which Jensen's alpha helps describing. Specifically, Jensen's alpha α_p is the average annual, risk-adjusted excess return of the portfolio (Phuoc, 2018) and defined as:

$$\alpha_p = r_p - [r_f + \beta_p(r_M - r_f)] \tag{2.11}$$

Where r_p is the realized return of the portfolio, β_p is the beta of the portfolio, and r_M is the realized return of the selected market index. If alpha is positive, then the portfolio is delivering excess risk-adjusted returns (Bodie et al., 2014).

2.6.4 Risk Premium Measures

The *Sharpe ratio* is a reward-to-variability ratio and the most commonly used ratio of risk-adjusted returns. The Sharpe ratio divides the excess return $(r_p - r_f)$ by the standard deviation of returns σ_p over that period (Israelsen et al., 2005).

$$S_p = \frac{(r_p - r_f)}{\sigma_p}$$

Even though the Sharpe ratio is a standard risk-adjusted performance measure for a portfolio, it holds two drawbacks. First, the ratio compares against the risk-free rate of return, which is not necessarily a relevant benchmark when looking at market-beating portfolio performances. Second, the Sharpe ratio looks at both systematic and unsystematic risk as well as upside and downside volatility (Bodie et al., 2014).

The *Sortino ratio* is a modification of the Sharpe ratio and a better risk measure choice since the ratio uses the downside deviation over the standard deviation. As recognized by Markowitz, only downside deviation is relevant for the investor, which makes the use of downside deviation as a risk measure more relevant (Rollinger & Hoffman, 2013).

The formula for the Sortino ratio is

$$S = \frac{\bar{r_p} - \bar{r_f}}{\sigma_d}$$

Where σ_d is the standard deviation of the downside deviation. Moreover, two disadvantages of the Sortino and Sharpe ratio are worth emphasizing. First, both ratios look at systematic and unsystematic risk, ignoring that a well-diversified portfolio makes unsystematic risk negligible. Second, the excess return is calculated against the risk-free rate and not a reference index such as the S&P 500 (Israelsen et al., 2005; Rollinger and Hoffman, 2013).

The *Treynor ratio* handles the first of these two downsides of the Sortino ratio by measuring the excess return per unit of risk comparing only against systematic risk. According to Bodie et al. (2014), the formula to calculate the Treynor ratio is

$$T_p = \frac{(r_p - r_f)}{\beta_p}$$

Since the Treynor ratio does not focus on downside volatility and uses the risk-free rate instead of a benchmark return, these are two disadvantages to consider (Scholz & Wilkens, 2005).

2.6.5 Information Ratio

The Information ratio (IR) is another indicator for risk-adjusted returns. In comparison to the three previously mentioned metrics, IR considers excess return as the return above the chosen benchmark index such as the Standard & Poor's 500 Index. Also, William Sharpe recommends using the IR ratio instead of the Sharpe ratio precisely because of this point (Israelsen et al., 2005). According to Bodie et al. (2014), the IR is the expected excess return relatively to a benchmark divided by the standard deviation of the excess return:

$$IR = \frac{\mathbb{E}[r_p - r_b]}{\sigma[r_p - r_b]} \tag{2.12}$$

Where r_b is the benchmark return.

Although there are no definite answers on what makes a good IR, Goodwin (1998) and Israelsen et al. (2005) state that the higher the information ratio is, the better, while a negative IR means that the portfolio did not produce excess returns.

Precisely, an IR of 0 to 0.4 is often not a good investment as the portfolio did not produce excess returns consistently. However, an IR of 0.4 to 0.6 is a good investment, whereas an IR above 0.6 is a great investment (Goodwin, 1998).

Chapter 3

Methodology

3.1 Backtesting

Backtesting is a method that assesses how a particular investment strategy would have performed ex-post (Schumann, 2018). For example, simulating the historical performance of stocks through backtests is a common approach when studying the effectiveness of value investing (Jahan, Cheh, and Kim, 2016; Sak, 2017). I, therefore, run a backtest using data from the Bloomberg Terminal and its equity screener, first, to identify companies, which fulfill the SEEDS criteria, and second, to analyze how the Graham portfolio performs throughout the defined investment horizon. However, when backtesting, there are three key considerations to make.

First, it is crucial to avoid *cherry-picking*, which is deliberately selecting data points to help support particular hypotheses, because it would otherwise reduce the credibility of the findings (Schumann, 2018). By including *all* companies that match the SEEDS criteria per December 31^{st} 2005, containing the companies that were eventually unlisted, I have avoided cherry-picking companies for the investment strategy. For the same reason, I have deliberately chosen to study companies for an investment period that includes the Great Recession in addition to one of the largest "bull periods" in modern time to explore how the 2006 cohort performs both during periods when the market delivers high returns and during periods when the market does not.

Second, the main attributes of the investment strategy—such as to filter the SEEDS criteria and the investment period—should be selected before looking at the historical data set. Otherwise, there is a higher chance of *overfitting* to occur, which is defined as constructing a tailor-made model that fits well with the current data set but would not perform well with other data sets

(Bailey, Ger, de Prado, & Sim, 2015).

Third, while this thesis studies how well the 2006 cohort of Graham companies performs relative to the market, the intention is to identify how the whole investment strategy may perform against later cohorts. Hence, in the results chapter, I study and eventually choose a pricing-, holding-, and rebalancing strategy based on the considerations. Choosing these strategies is essential to identify those that may likely perform well in later cohorts as well.

3.2 Assumptions

I make the following five assumptions throughout the data analysis.

First, the Bloomberg Terminal's universe of equities is complete enough to provide the relevant financial data. Furthermore, for companies that stop trading for whatever reason—for instance, due to an acquisition or bankruptcy—I assume that their data is still available in the Bloomberg terminal's equity screener, which seems to be the case.

Second, both taxes on sales and losses as well as transaction fees are assumed to be zero. Again, this is a commonly made assumption in modern portfolio theory (Edwin J & Martin J, 1997).

Third, I assume that the stocks can be bought and sold at the respective day's closing price, except January 1^{st} 2006, in which I assume that I can buy stocks at the opening price.

Fourth, if the company stops trading for whatever reason, I assume that I can sell the stocks at the closing price of the last day of trading. This assumption does not hold for companies that went bankrupt because I may not sell these shares.

Fifth, I assume that the closing price on the final day of trading before a company was acquired and unlisted represents the investors' actual compensation as part of the acquisition. Specifically, using the closing price simplifies the analysis because an acquisition may involve cash and stock compensation in the acquirer's company, complicating the calculations.

3.3 The SEEDS Criteria

Graham's seven stock selection criteria, introduced in The Intelligent Investor, serve the defensive investor who seeks safety and does not actively monitor the stock prices of her investments (Graham & Zweig, 2006). Graham's stock selection criteria were introduced in the theory chapter and lay the foundation for this thesis. However, some of Graham's investing criteria need some modifications and considerations, which are explained in the following pages. Criteria that are not modified and need no further explanation are not covered in this section.

3.3.1 Terminology

First, companies that respect the SEEDS criteria are frequently called *Graham companies*. Additionally, the companies that respect the SEEDS criteria as of December 31st 2005 are referred to as the *2006 cohort* of Graham companies.

3.3.2 Size of the Enterprise

In the commentary chapter of The Intelligent Investor, Zweig advises the defensive investor to seek companies with a total market value of at least $2 billion in 2003 (Graham & Zweig, 2006). After inflation-adjusting the minimum requirement for 2006 by using the US inflation calculator (Coinnews Media Group LLC, 2021), I add a minimum requirement of $2.19 billion in annual revenues for 2006 when identifying potential Graham companies through the Bloomberg Terminal's equity screener. To further analyze if the 2006 cohort violates the revenue criterion, I use the last available annual inflation rate when a company's annual report was published. If the reported currency was in any other currency than USD, I converted the revenue using the reporting date's currency rate.

Additionally, Graham and Zweig (2006) distinguish between industrial companies and public utilities when evaluating the enterprise size, having different criteria for each. However, the Bloomberg Terminal's equity screener did not have a criterion to filter for public utilities, which complicated the data collection process. Hence, I decided to ignore the utility-specific criterion of the enterprise size and evaluated all companies by the previously stated revenue criterion. As a result, utility companies listed in the Bloomberg universe, which would have fulfilled all SEEDS criteria, except the more strictly imposed revenue criterion, could not be identified and are excluded from the analysis.

3.3.3 Earnings Growth

Graham's earnings growth criterion requires a minimum EPS increase of 1/3 over the past ten years. As Graham and Zweig (2006) suggests, I use a three-year average to calculate the EPS growth. I, therefore, need 12 years of financial data to calculate the EPS growth for year ten, which requires the last 12 annual reports published before December 31st 2005.

3.3.4 Dividend Record

While old dividend data is traceable in the financial statements in the Bloomberg Terminal, the equity screener does not provide data for reporting years older than a certain number of years. Hence, no companies with 20 years of dividends will be returned when adding this filter in the equity screener. However, although the data may exist in the Bloomberg database, reducing this criterion from 20 to 10 years leads to a list of companies. Hence, I decide to ease Graham's dividend criterion to 10 years of uninterrupted dividend payments to have any investment candidates to study.

3.4 Adjusted Closing Prices

When backtesting results, it is vital to make certain adjustments to make stock prices comparable over time. Precisely, the prices should be adjusted for normal and abnormal cash dividends, in addition to adjusting for spin-offs, stock splits/consolidations, stock dividends, and rights offerings/entitlements. These price adjustments are performed automatically by the Bloomberg L.P. (2021) by entering the *DPDF* command and ticking all checkboxes to account for the necessary changes mentioned above. All equity and benchmark prices throughout this thesis are therefore adjusted, although they may not necessarily be referred to as "adjusted prices".

3.5 Price Criterion Modification

Graham recommends using a three-year trailing EPS average in the calculations because the metric is easy to manipulate (Graham & Zweig, 2006). By the same reasoning, I would like to modify the price-to-tangible-book-value ratio to specify that the tangible book value should also be a three-year trailing average.

3.6 Portfolio Strategies

In the results chapter, I analyze different pricing-, holding-, and rebalancing strategies to identify a final portfolio strategy that may deliver risk-adjusted excess returns. However, it is also important to avoid overfitting so that the final investment strategy can be applied to later cohorts of Graham companies with hopefully similarly promising results. The following section describes the four pricing-, four holding-, and five rebalancing strategies that I will consider in the results chapter, in addition to currency and benchmark comparisons and how all these alternatives are classified.

3.6.1 The Strategy Nomenclature

With four, four, and five alternatives for the pricing-, holding-, and rebalancing strategies, respectively, in total, 80 strategies are produced. Additionally, I evaluate each strategy against six currencies and two benchmarks, which delivers 960 different results. Finally, a classifier code is made for each of these 960 alternatives to quickly get an overview of the different alternatives. The nomenclature has the structure "P#-H#-R#-#-#", in which each hashtag is replaced with the pricing, holding, rebalancing, currency, and benchmark identifier, respectively.

Table 3.1: The strategy nomenclature.

Price strategy		Holding strategy		Rebalancing strategy		Currency	Benchmark	
P1	Graham range	H1	Hold–index	R1	No rebalancing	LCY	L	Local
P2	All companies	H2	Hold–portfolio	R2	Annual	USD	G	Global
P3	All excluding tails	H3	Sell–index	R3	Monthly	NOK		
P4	Max returns	H4	Sell-portfolio	R4	15 % threshold	EUR		
				R5	Annual w/o low HPR	CHF		
						GBP		

An example of a name given by the strategy nomenclature is "P1–H2–R3–USD–G". This particular strategy represents the pricing strategy "buy only companies that meet Graham's price criterion limit of maximally 22.5", holding strategy "continue holding the stock when the respective company violates a SEEDS criteria, but reinvest into the portfolio if it stops trading", and rebalance *monthly*. Additionally, the results are produced by first converting them to *USD* as the base currency, and the returns are compared against the *global* benchmark. The currency "LCY" presented in table 3.1 represents the local currency, meaning no currency conversion is performed.

3.6.2 The Pricing Strategy

I consider four pricing strategies, and all selected companies will be invested in, considering equal weighting. Pricing strategy P1 invests only in the companies with a positive price criterion score but less than $\frac{P}{EPS} \cdot \frac{P}{tBV} \leq 22.5$. Pricing strategy P2 invests in all companies in the 2006 cohort, whereas pricing strategy P3 invests in companies with a price criterion score in the range $[10;200]$.

The motivation behind analyzing P3 is that some companies in the 2006 cohort have unnaturally low or high price criterion scores, as shown in the descriptive analysis. Underlying issues within the companies might cause these scores that are not captured by the SEEDS criteria. Hence, I want to analyze the 2006 cohort but excluding these potentially problematic companies.

Finally, pricing strategy P4 is a forward-looking strategy, identifying the price criterion range that maximizes nominal returns and then invests in these companies. However, when constructing the algorithm that identifies this range, it is necessary to define a minimum number of companies to be included in this portfolio because the algorithm would otherwise identify the single best-performing company and propose this price criterion score as the return-maximizing range. To ensure that the portfolio is somewhat diversified, I require to invest in at least 20 companies.

Moreover, when identifying P4's return-maximizing range of the 2006 cohort, I use the average HPR as the decision criterion. I do not adjust for currency fluctuations because I can only study the company's performance without any external factors affecting the results. Hence, the selection for P4 will identify the range of the price criterion score, including at least 20 companies in which all companies between a lower and upper price criterion threshold deliver a higher average HPR than any other pricing range containing at least 20 companies.

However, since this strategy is forward-looking, this strategy will be used for informative purposes only to provide some potential guidance for further testing in later cohorts of Graham companies. P4 will therefore not be chosen as the finally suggested investment strategy.

3.6.3 The Holding Strategy

Four holding strategies are then considered after the pool of companies to invest in is decided in the pricing strategy. These strategies depend on two primary considerations. First, what to do with an investment when the affiliated company violates any of the SEEDS criteria, and second, where to reinvest the amount if a company must be removed from the Graham portfolio.

Studying the different reinvestment strategies, selling to index versus selling to the portfolio, provides different insights.

First, reinvesting into the benchmark index makes it possible to "lock in" the excess return on a single stock investment. Hence, this reinvestment strategy holds the benefit that it shows how well the company's stock outperformed the index over the investment period.

However, this reinvestment strategy is primarily relevant for informative purposes because it is not practically relevant for a portfolio manager to reinvest funds into the benchmark index. Therefore, the second reinvestment strategy reinvests the amounts into the portfolio. However, the downside with this reinvestment strategy is that in this thesis, I study only one cohort of Graham companies. Hence, I have only a few companies to reinvest into, potentially leading the findings from this cohort of Graham companies to be highly dependent on a smaller number of remaining companies. This concern is particularly present for holding strategy H4. Hence, since both reinvestment strategies provide both advantages and disadvantages, I will study both and, most importantly, evaluate whether the evaluated portfolios perform well across both reinvestment strategies.

In holding strategy H1 (Hold–Index), all investments are held throughout the investment period, regardless of whether they violate any of the SEEDS criteria during the investment period. However, if any investments stop trading, for whatever reason, the investment amount is reinvested into the investment's corresponding benchmark index.

In comparison, holding strategy H2 (Hold–Portfolio) holds all investments throughout the investment period, but I put all reinvestments into the remaining portfolio. Since rebalancing strategies are studied separately, which change the portfolio weights, I will not modify the weights when reinvesting. Instead, I identify the weights of the remaining portfolio investments on the reinvestment date and then allocate the reinvestment amount correspondingly.

Contrary to the two previously defined holding strategies, holding strategy H3 (Sell–Index) sells the investment on the first date the company reports to have violated any SEEDS criteria. For the "sell" strategies, it is essential to highlight that I did not allow re-entry into the Graham portfolio even when a company that violates at a certain point in time fulfilled all SEEDS criteria at a later point in time. If reinvestments must be made, either because any SEEDS criteria were violated or if the stock stopped trading, then the remaining investment amount is reinvested into the corresponding benchmark index.

Finally, holding strategy H4 (Sell–Portfolio) sells the investment when the corresponding company violates any SEEDS criteria for the first time. Similarly to holding strategy H2, the reinvestment amounts are allocated to the portfolio and do not change the remaining portfolio's weights. However, if all investments are eventually sold during the investment period, then there are no more companies in the portfolio. If this situation occurs, then the investment amount is invested into the benchmark index.

3.6.4 Rebalancing

After the pool of investments is selected from the pricing strategy and a relevant holding strategy is picked, I then analyze the selected portfolio against five rebalancing strategies. To rebalance is essential because, without portfolio rebalancing, the risk profile at the end of the investment period may be markedly different from the risk profile at the start of the investment period (Beach & Rose, 2005). The five studied rebalancing strategies are defined as follows.

First, rebalancing strategy R1 involves no rebalancing to gain a further understanding of the rebalancing bonus. Then, I study three rebalancing strategies that are common in the literature

(Zilbering et al., 2015). These are annual (R2), monthly (R3), and threshold (R4) rebalancing. R2 is rebalanced on December 31st each year, R3 is rebalanced on the last day of the month, and R4 triggers a rebalancing whenever the sum of the remaining portfolio investments deviates from their pre-specified targets by at least 15%. Then on the date that this threshold rebalance is triggered, the remaining portfolio, potential reinvestments into the index, and the benchmark comparison are all reinvested.

Moreover, pricing strategy P3 was motivated because there may be some underlying problems with selected investments that the SEEDS criteria may not capture. By the same reasoning, it is relevant to rebalance all investments except for the worst-performing companies. That way, if any investments continuously perform poorly, then the rebalancing strategy R5 will not continue to pour money into these poor performers. Hence, rebalancing strategy R5 rebalances annually but excludes rebalancing the bottom quarter of investments that has delivered the worst HPR—including past reinvestments and rebalancing—on the rebalancing date.

If reinvestments in the index have previously occurred on the date of rebalancing—primarily because the holding strategy involves reinvesting into the index—then rebalancing will not move invested amounts from the index reinvestments back to the portfolio or vice versa. Instead, on the rebalancing date, I identify the benchmark of each company that was sold to decide the target weights among the index investments and then rebalances accordingly. For example, if two US companies and one Norwegian company have been sold and the sales proceeds were reinvested into the index, then the target weight should be 2/3 of the US companies' reference index and 1/3 of the Norwegian company's reference index.

3.7 Choice of Benchmarks and Risk-Free Rates

When evaluating the 2006 cohort against an alternative, two alternatives are particularly relevant. The first is to compare the portfolio performance against the risk-free rate, which I have calculated as the average risk-free rate over the whole investment period. Here, the Sharpe, Sortino, and Treynor ratios are three candidates. But, since a portfolio manager should rather be compared against an investment alternative with a similar risk profile, using a risk-free rate to evaluate the performance of the 2006 cohort is not advisable because this portfolio involves substantially more risk than a risk-free alternative. Hence, the Sharpe ratio will only be used to in relation to the efficient frontier, whereas the Sortino and Treynor ratio will not be reported at all.

Instead, it is common practice to compare a portfolio against a *reference index*, of which the traditional CAPM model may use a local stock exchange's benchmark index while the global

CAPM model uses a globally constructed stock index.

However, since the 2006 cohort includes companies from multiple countries, particular concerns must be made when constructing the index and the risk-free rate metrics for the traditional CAPM model. I chose to solve this by constructing a weighted average of the country representation, making it easier to compare the Graham portfolio against an investment's peers within the same economy while evaluating a whole portfolio's performance against one benchmark.

For instance, pricing strategy P2 involves investing in all 36 companies in the 2006 cohort. I gathered each of the ten countries' market returns and risk-free rates, and a weighting was based on how often companies in the investment portfolio represented countries on the first day of trading. Since the USA is represented 21 times, for example, then $^{21}/_{36}$ of the S&P 500 and 10-year Treasury bond performance will be used to calculate the market return and risk-free rate. I applied this process for all countries represented in the portfolio until the sum of the weights equal one.

These constructed weights will work as target weights that decide both the initial benchmark investments and the weights to achieve after rebalancing. Otherwise, market fluctuations may make the benchmark investments deviate from these target weights.

Compared to the traditional CAPM, calculating a benchmark and a reference index is more straightforward for the global CAPM model. Using the 10-year US Treasury rate is common when choosing the global risk-free rate. I, therefore, continue this practice.

When choosing a global benchmark, several candidates emerge as commonly used global benchmarks (Justin, 2021). These benchmarks are the MSCI ACWI Index, MSCI World Index, FTSE All-World Index, the S&P Global 100 Index, the S&P Global 1200 Index, and the Dow Jones Global Titans 50. Choosing the correct benchmark is critical because the maximal difference in HPR may differ substantially over time. For instance, figure 3.1 illustrates that the most considerable HPR difference across any pair of benchmarks is almost 30 percentage points by 2020.

While multiple global benchmarks are chosen, it is prevalent for mutual funds to compare themselves against either the MSCI ACWI Index or the MSCI World Index—both "all-world" indices that include and exclude emerging markets.

With a correlation of 99.8%, these markets fluctuate almost synchronously, and the differences in HPR are minor. As figure 3.2 illustrates, the MSCI ACWI Index outperforms the MSCI World Index by almost 500 basis points during the entire investment period, whereas the MSCI World Index outperforms the MSCI AWCI Index by at most about 650 basis points during the investment period.

Even though the MSCI ACWI Index appears to be more commonly used among mutual funds in recent years than the MSCI World Index, I still decide to use the MSCI World Index as a benchmark for two main reasons. First, the 2006 cohort, consisting of 36 Graham companies, has a low emerging-market exposure with only two companies from emerging market, namely Malaysia and Hong Kong. Hence, studying an index without emerging markets is more relevant. Second, the final HPR of the MSCI World Index is 515 basis points higher than that of MSCI ACWI. Hence, I avoid artificially inflating the excess return performance of the portfolio if I choose a higher-performing benchmark. Therefore, the MSCI World Index will also be referred to as the global benchmark throughout this thesis.

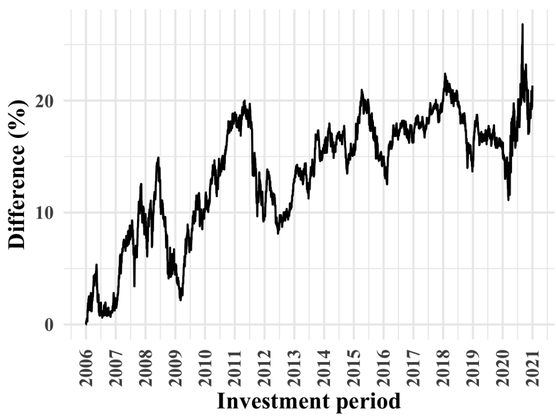

Figure 3.1: Largest absolute difference of global benchmarks.

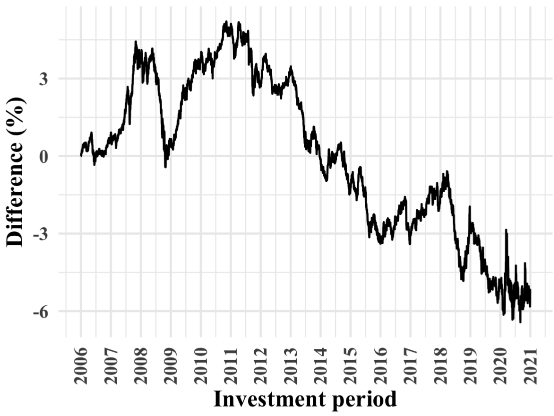

Figure 3.2: Cumulative difference between the MSCI ACWI and MSCI World indices.

3.8 Currency Choice

In the international CAPM model, currency risk is also implemented with a currency risk estimator γ_i. As I study an international portfolio, I consider it relevant to study how a choice of a base currency affects the performance of the final chosen portfolio strategy. This could, for instance, be relevant if I intend to establish a mutual fund in a selected country and need to convert stock values denominated in other currencies to the currency of the country I would be operating the mutual fund. However, instead of estimating the currency risk as the international CAPM model does, I will instead implement the currency rates directly into all calculations and then study how the nominal returns are affected by choice of a base currency. However, in the results chapter, I will only study the chosen pricing–holding–rebalancing strategy against different currencies.

3.9 Performance Evaluation

While every performance metric provides helpful information, none provides the complete picture of how well a portfolio performs. In the following chapters, I apply a range of these metrics to understand portfolio performance fully. While I defined some metrics in the theory chapter, the others I define in the following sections. Additionally, I present some considerations and modifications to the metrics described in the theory chapter.

3.9.1 Annual and Annualized Return

Throughout the next chapters, I often refer to the terms “annualized return” and “annual return”. By annualized return, I mean CAGR, whereas annual return means the value appreciation an investment or the portfolio had in a single year from January 1^{st} to December 31^{st} . The average annual return refers to the average annual returns over the full investment period from 2006 to 2020.

Furthermore, I only study nominal returns and discard real returns. The reason is twofold. First, to limit the scope of the thesis, and second, inflation numbers of all countries represented in the 2006 cohort were not available in the Bloomberg Terminal for the entire investment period.

3.9.2 Beta Considerations

When calculating the beta, a relevant question is whether to calculate the beta using daily, weekly, monthly, or annual returns. Daily returns are often not recommended because they may have a lot of noise (Gilbert, Hrdlicka, Kalodimos, & Siegel, 2014), whereas annual data may provide too few data points to provide a reasonable beta estimation. Therefore, weekly or monthly data is often preferred (Momcilovic, Begovic, & Tomasevic, 2014).

Another relevant question to ask when calculating the beta is the period the beta should be calculated over. If the time period is short, only a few data points may be used when estimating the beta. However, if the beta calculation is for a company, and if the time period is long, then the company may be markedly different from the beginning of this time period. This would consequently make the beta estimate inaccurate compared to today’s actual beta.

Moreover, because of a need to have a beta value that reflects an asset’s current actual beta, a third relevant question to ask is whether a *rolling beta* should be applied.

A beta calculation is based on historical volatility against the market. Since I invest only once on January 1^{st} 2006, it is relevant to study the estimated beta of this investment date. As I am more interested in the volatility of the investments during the investment period, I am more interested in studying the beta when I sell the investments on December 31^{st} 2020. Hence, I do not implement a rolling beta but rather study the beta estimate on the last date of the investment horizon.

Additionally, Pham et al. (2020) identified that using a medium-horizon time period of 12 years gave a better model fit and a lower standard deviation of the beta coefficient than a shorter time horizon of three years. I, therefore, apply this finding in the analysis. However, since the investment period in this thesis is 15 years, which is only 20 % longer than the horizon studied by Pham et al. (2020), I apply one beta calculation for the whole investment period of 15 years instead.

Furthermore, the literature discusses the importance of studying an *adjusted beta* because an asset is assumed to move closer towards the market's volatility over time, resulting in a beta of one. Because I choose to calculate the beta for the investment period, I consider the basic beta calculation sufficient. However, as mentioned in the theory chapter, I calculate the beta on a portfolio return level instead of on a component security level.

3.9.3 Information Ratio Considerations

I primarily focus on the information ratio instead of the Sharpe, Sortino, and Treynor ratios because they compare against a risk-free rate instead of a benchmark like the IR does. When calculating the IR, I use monthly returns of both the investments and the benchmark comparison.

3.9.4 Holding Period Return

In section 2.6.1 on page 17, theory defines HPR to include cash dividends c_d. However, since I use adjusted prices throughout the thesis, which accounts for cash dividends in the prices, I update the HPR formula to

$$HPR = \frac{p_e - p_b}{p_b}. \tag{3.1}$$

3.9.5 Holding Period Excess Return

When studying the portfolio results, the investment's holding period return is relevant and presented in the theory section. Similarly, how well the portfolio performed on an aggregate level against the benchmark is useful. Hence, the metric is beneficial for an investor to quickly see how well a portfolio performed over the entire investment period without compounding the annual differences. I define the holding period excess return as

$$HPER = HPR_P - HPR_M. \tag{3.2}$$

HPR_P is the portfolio's holding period return, and HPR_M is the benchmark's holding period return.

3.9.6 $\Delta CAGR$

A downside of using HPR and HPER, is that the results depend on the investment period. CAGR, which I presented in the theory chapter is a better approach. I define $\Delta CAGR$ as follows.

$$\Delta CAGR = CAGR_p - CAGR_M \tag{3.3}$$

Where $CAGR_p$ and $CAGR_M$ is the portfolio's and benchmark's annualized return, respectively.

3.9.7 Cumulative Outperformance Ratio

A downside of using the HPR is that it gives a valuable metric for one single day only. However, when evaluating mutual funds' past performance, the interested investor may also wish to study a graph illustrating day-by-day HPR and analyze by how much the portfolio outperforms the market to identify its performance consistency. This calls for a metric that allows the investor to quickly examine the ratio of days in the investment period in which the portfolio has delivered excess return—or the *cumulative outperformance ratio* (COR).

$$COR = \frac{\sum_{d=1}^{D} \mathbb{1}_{HPR_d^P > HPR_d^M}}{D} \tag{3.4}$$

In formula (3.4), HPR_d^P represents the portfolio's HPR on day d, HPR_d^M the benchmark's HPR on day d, and D the number of days in the investment period. Hence, $\mathbb{1}_{HPR_d^P > HPR_d^M}$ takes the value 1 if the portfolio's HPR outperforms the benchmark's HPR on a given day and 0 if it does not.

3.9.8 Annual Outperformance Ratio

When mutual funds, in particular, report their past performance, it is common to show a table with a year-by-year comparison of the fund's performance against the benchmark. Berkshire

Hathaway, for instance, always presents this table on the first page of their annual investor letters (Buffett, 2021).

The reader cares primarily about whether the fund's result is positive or negative, and then by how much and how often the fund is performing better than the benchmark. This need calls for an easily interpretable metric, which calculates for how many percent of the investment period years the portfolio's annual return was higher than the benchmark's annual return—or, the *annual outperformance ratio* (AOR). The formula for the AOR is as follows.

$$AOR = \frac{\sum_{t=1}^{n} \mathbb{1}_{a_t^P > a_t^M}}{n} \tag{3.5}$$

In formula (3.5), a_t^P represents the portfolio's annual return in year t, a_t^M the benchmark's annual return in year t, and n the number of years in the investment period. Hence, $\mathbb{1}_{a_t^P > a_t^M}$ takes the value 1 if the portfolio outperforms the benchmark in a given year and 0 if it does not.

3.9.9 Maximum and Minimum Asset Weight

To understand how exposed the portfolio is to the individual investments, I present the maximum and minimum asset weight in the results chapter. This metric shows the highest and lowest weight, respectively, that any investment had at any point during the investment period. This metric, however, studies only the investments made from the 2006 cohort and does not consider potential index reinvestments.

3.9.10 Rebalancing Bonus

Since I study rebalancing strategies, studying how much extra return rebalancing alone provides the portfolio is essential. Hence, I define the rebalancing bonus (RB) metric as follows.

$$RB_{p,h,r} = CAGR_{p,h,r} - CAGR_{p,h,R1} \tag{3.6}$$

In this context, $RB_{p,h,r}$ represents the rebalancing bonus for the portfolio following pricing strategy p, holding strategy h, and rebalancing strategy r. Similarly, $CAGR_{p,h,r}$ represents the CAGR, which is achieved for the exact pricing–holding–rebalancing strategy p, h, and r, whereas $CAGR_{p,h,R1}$ is the CAGR achieved for the exact pricing–holding strategy with no rebalancing.

Chapter 4

Data Considerations

4.1 Sample Period

This thesis aims to study the stock performance of the selected Graham companies over an investment period of 15 years. I made several considerations when selecting which time period to study. First, it is preferable to have a longer investment period to study because short-term returns are driven more by market psychology than by the company's fundamentals (Graham & Zweig, 2006). Second, it is preferable to have an investment period that includes both good- and poor-performing market periods, so-called bull and bear periods. I, therefore, included the Great Recession in the investment period. Third, the used database collects the relevant financial information to have sufficient data to identify companies respecting the SEEDS criteria. The database of the Bloomberg Terminal, which I used for the data collection, however, has substantial missing data in the years before, around 1995. Also, I needed to collect data for at least ten years before starting the investment period, in 2006, which was the earliest year that matched all three criteria. Berge Larsen et al. (2016) had similar reasoning and experience when choosing the starting date of their investment period in their analysis.

The investment horizon of 15 years starts on January 1^{st} 2006 and ends on December 31^{st} 2020. As the analysis of the Graham stocks starts on the first day of 2006, which is the day they are purchased at the opening price, it requires investigating the stocks the day before, on December 31^{st} 2005. The stocks are therefore purchased at the opening price on January 1^{st} 2006, which is equivalent to the closing price on December 31^{st} 2005.

4.2 Data Collection

This thesis analyzes the performance of Graham companies, which fulfill the SEEDS criteria at the beginning of 2006 and I define the set of Graham companies as the 2006 cohort. I decided to only analyze the 2006 cohort to limit the scope of the thesis. Potentially promising results from this thesis will, therefore, lay a foundation for future research in which more cohorts can be tested based on the findings from the 2006 cohort.

The financial data was collected using the Bloomberg Terminal. Since the Bloomberg database has a generous amount of stock information, this thesis uses the data from this source (Bloomberg L.P., 2021). However, since I only used the Bloomberg Terminal to identify companies respecting the SEEDS criteria, I may miss companies that would have qualified as Graham companies but are not listed in the Bloomberg universe.

The 2006 cohort was identified using the Bloomberg Terminal's equity screener (Bloomberg L.P., 2021). Even though it was not possible to add all of the SEEDS criteria to the screener, the screener allowed identifying a set of companies, which fulfilled a subset of the SEEDS criteria. Then further analysis was performed in R to identify which of the companies respected the remaining criteria.

After identifying the 2006 cohort, the next step was to gather the financial reports from the last available reporting year on December 31^{st} 2005 up until December 31^{st} 2020. For some companies, this involved starting with the FY2004 annual report, whereas other companies had already published their FY2005 annual report at the end of 2005 because they use a different accounting period than the Gregorian calendar. If multiple accounting styles and reports were available in the Bloomberg Terminal, the *mixed* accounting style of the consolidated annual report was always used when available.

If a company was listed on multiple stock exchanges, then the main listing and corresponding adjusted daily closing prices were collected using the Bloomberg Terminal's `GP` command and exported to Excel files. In addition, all prices were collected in the local currency (LCY) and then converted with daily currency prices in R if a strategy applied a specific currency.

Additionally, for every 2006 cohort company, the main stock listing and a relevant local benchmark were identified. Together with global benchmark prices, the closing prices of all local benchmarks were also collected with the `GP` prices and exported to Excel.

Finally, if companies stopped trading during the investment period, the dates on which they stopped trading were recorded manually by checking the company announcements in the Bloomberg Terminal. Then, the invested amounts were sold on the closing prices of their final trading dates. Although the closing price may not represent the final compensation the investors received on this final price, who may both have received a cash and stock compensation in another stock listing, I still consider the closing price a good approximation and easier to analyze.

4.3 Data Processing

After collecting the data from the Bloomberg Terminal, I processed the data of the actual 2006 cohort in R.

In total, over 6000 lines of code handle the entire process, from reading in the inputs from the Excel files that the Bloomberg Terminal produced to producing the results, tables, and different plots.

The code first structures benchmark, currency, and equity data by processing the data from Excel sheets to lists in R. Dates with missing prices due to closing dates are replaced with previous closing day's prices to have prices for every day of the investment period. It is also registered when a particular company stops trading if it is unlisted from the stock exchange during the investment period.

For equities, each annual report is then read from Excel files and converted into lists in R listing data points, which are used for further analysis. Examples of data points, in addition to numerical performance values, are the publication date of the annual report and logical True/False parameters whether each Graham criteria was preserved or violated.

4.3.1 Portfolio Analysis

I conduct the portfolio analysis through a function. I provide the function five arguments through equally many for-loops: the price strategy, the holding strategy, the rebalancing strategy, the currency, and the benchmark to use in the analysis. Since each argument has four, four, five, six, and two options, the loop runs in total 960 times.

Inside the portfolio analysis function, an initial investment pool of companies will be chosen based on the pricing strategy. Then a `for` loop is run across every day in the investment period from January 1^{st} 2006 until December 31^{st} 2020.

Which companies are still in the investment pool are identified for every day. A company may be eliminated from the pool either if it stops trading or because it violates the criteria set by the chosen holding strategy. Furthermore, the value of the investments is updated daily. This process includes updating the values of the remaining investments in the 2006 cohort for the total portfolio values. Moreover, if the holding strategy was to reinvest sales into the reference index, these values are also re-calculated and added to the total portfolio value. Finally, the benchmark values are updated. If any currency besides the local currency (LCY) is chosen in the strategy, then all values are also converted to the chosen currency, which may appreciate or depreciate the total values.

Selling the amounts invested into a company and reinvesting the amounts elsewhere may occur for any of the two following reasons. First, the company may stop trading on the date that is analyzed. Second, if the company violates any SEEDS criteria on the analyzed date and the holding strategy is to sell upon violation, then a reinvestment is triggered. As a result, the sales proceeds are reinvested either into the portfolio or the chosen index, depending on the analyzed holding strategy.

If a company is sold because it violates the SEEDS criteria, it is not accepted back into the portfolio even though it meets all SEEDS criteria again at a later point. Furthermore, if a reinvestment is triggered, the amount is reinvested into the corresponding index if the holding strategy involves reinvesting the amounts into the index. Additionally, if reinvestment is triggered, the holding strategy involves reinvesting into the portfolio, and if there are no remaining assets in the investment portfolio, then the total amount is invested into the index instead.

At the end of the day loop, the rebalancing rule is evaluated. If the rule is triggered, then the Graham investments, index investments, and benchmark investments are all rebalanced. However, the Graham and index investments are rebalanced separately, meaning that amounts will not be moved from the index investments to the remaining Graham companies or vice versa. The threshold rebalancing is triggered by the portfolio of Graham investments only, meaning that the portfolio, index, and benchmark are all rebalanced simultaneously if the portfolio triggers the threshold.

After the day loop has ended, the outputs are then finally produced for further analysis and to produce various plots and tables.

4.4 Further Data Cleaning and Considerations

After collecting the financial data from the Bloomberg Terminal, the next step is to clean the data set to lay the foundation for the data analysis. For the data cleaning process, the following considerations are important to highlight.

4.4.1 EPS

Adjusted EPS data were used wherever they are available because I believe removing extraordinary events will more closely reflect the company's EPS growth. If the adjusted EPS is not available from the Bloomberg Terminal's annual reports for certain years, then I use the basic EPS for those years instead.

4.4.2 Tangible Book Value

Although a positive tangible book value is not a requirement for any of the SEEDS criteria, Graham's price criterion works only for companies with a positive tangible book value. Hence, I excluded all companies with a negative tangible book value in the last annual report published before December 31^{st} 2005.

4.4.3 Trailing Averages for EPS and Tangible Book Value

To calculate the EPS growth over ten years—as required by one of the SEEDS criteria—twelve years of EPS data is needed. However, a few companies had financial data available for only ten or eleven annual periods before December 31^{st} 2005. Even though these companies met all other SEEDS criteria, they were disqualified because of missing EPS data for the 12^{th} year. To avoid excluding these companies from the Graham cohort, I allowed the three-year trailing average to be calculated only on the available data—regardless of whether one, two, or three data points were available. This choice was taken before studying the investment period performance of the affected companies to avoid cherry-picking investments. The same consideration was performed for the three-year trailing tangible book value calculation.

4.4.4 Updated Annual Reports

In the Bloomberg database, only the latest update date of an annual report was available. Thus, if companies made changes to an annual statement after the original publishing date, the latest update date will be the latest announcement date. If, for instance, the latest update has been made later than one year of the original announcement date, together with publishing the following annual report, then I end up with multiple annual statements showing the same year in their announcement date. This was the case with Hennes & Mauritz in 2006, for instance. Although there were only a few of these instances, the R code assumed that the latest update was the day and month of the original publishing date, and I then updated the year to the original year. By following this approach, I was able to preserve Graham companies in 2006 despite missing data points.

4.4.5 Exclusion of Companies Meeting the SEEDS Criteria

During the cleaning process, I identified that the Bloomberg Terminal's equity screener identified a few companies as Graham companies in 2006 even though they did not trade at the beginning of 2006. While they were stock listed after January 1^{st} 2006, their financial data for the previous ten years—from December 31^{st} 1995 to December 31^{st} 2005—however, was available in the Bloomberg universe. Therefore, the equity screener proposed these companies as potential candidates for the 2006 cohort. I excluded these companies from the cohort since it was not possible to invest in these companies on January 1^{st} 2006.

4.4.6 A Special Case on Sears

The companies' stock prices throughout the investment period have been gathered based on their primary stock listings. Usually, the stock prices of delisted companies are available in the Bloomberg database up until the unlisting date. However, one company of the 2006 cohort—Sears—was delisted from the Toronto Stock Exchange on July 28^{th} in 2017 BNN Bloomberg (2017), but for an unknown reason, the Bloomberg database did not offer any stock prices of Sears' main listing in Toronto any longer. As Sears' stock was still trading in the US market, the US stock prices have been used for the analysis and converted into Canadian dollar to represent the Sears listing. Although I could potentially have removed Sears from the 2006 cohort due to missing data, it was important to include Sears because it performed poorly throughout the investment period, and keeping it in the investment pool allowed me to avoid cherry-picking.

Chapter 5

Descriptive Analysis

This chapter seeks to describe and summarize the data set to gain valuable insights from the 2006 cohort and the SEEDS criteria.

5.1 The 2006 Cohort

After screening the companies' financial data, 36 companies passed the SEEDS criteria on December 31^{st} in 2005. This set of Graham companies, as table 5.1 shows represent the *cohort of 2006* as the individual stocks were purchased on January 1^{st} in 2006.

Table 5.1: The companies in the 2006 cohort of Graham companies.

ArcelorMittal Dofasco Inc. (Canada)	Nomura Research Institute Ltd. (Japan)
Barratt Developments PLC (United Kingdom)	Novo Nordisk A/S (Denmark)
Becton Dickinson and Co (USA)	Orkla ASA (Norway)
Brown-Forman Corp (USA)	Parker-Hannifin Corp (USA)
Centex LLC (USA)	Persimmon PLC (United Kingdom)
Cintas Corp (USA)	PPB Group Bhd (Malaysia)
Esprit Holdings Ltd. (Hong Kong)	PulteGroup Inc. (USA)
H & M Hennes & Mauritz AB (Sweden)	Reliance Steel & Aluminum Co (USA)
Harley-Davidson Inc. (USA)	Rohm Co Ltd. (Japan)
Illinois Tool Works Inc. (USA)	Sears Canada Inc. (Canada)
Intel Corp (USA)	SEB SA (France)
Kate Spade & Co LLC (USA)	Secom Co Ltd. (Japan)
Kellwood Co LLC (USA)	Taylor Wimpey PLC (United Kingdom)
Leggett & Platt Inc. (USA)	Thor Industries Inc. (USA)
MDC Holdings Inc. (USA)	UFP Industries Inc. (USA)
Medtronic PLC (USA)	Vulcan Materials Co (USA)
Molex LLC/US (USA)	Wilson Bowden Ltd. (United Kingdom)
NIKE Inc. (USA)	WW Grainger Inc. (USA)

As figure 5.1 shows below, the 2006 cohort can be split into two groups. The uppermost line represents the number of companies that are still listed and possible to buy and sell on the stock exchange each year. This line falls gradually from 36 companies in 2006 to 29 companies in 2020. However, the lowermost line represents the number of tradeable companies that still respect the SEEDS criteria each year. This number falls sharply during the Great Recession, and only two companies respect all SEEDS criteria between 2012 and 2015, with no companies respecting all criteria by the end of 2020. This observation is critical to keep in mind for the two holding strategies that involve selling the investments when the affiliated companies violate any SEEDS criteria.

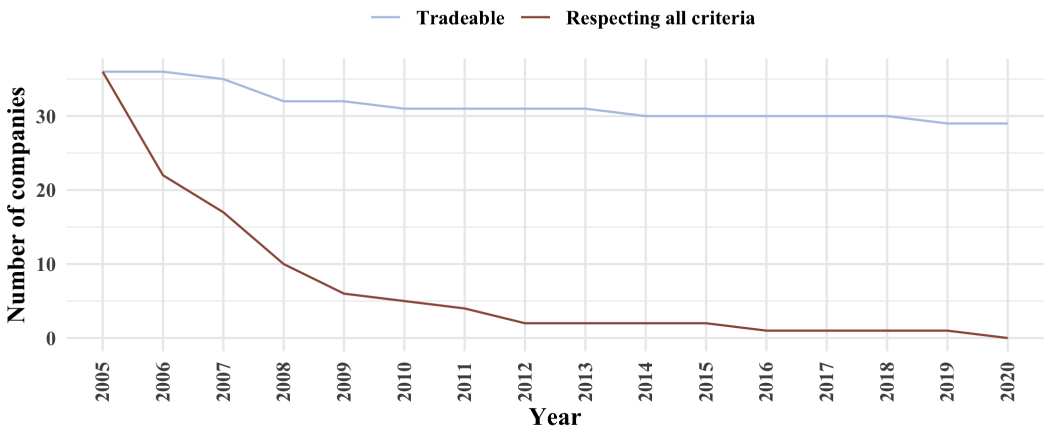

Figure 5.1: Tradeable and SEEDS -respecting companies per year.

Table 5.2 below provides a numerical representation of the number of Graham companies violating the SEEDS criteria for the first time. Most violating understandably occurred during the Great Recession. However, had readmission been allowed when respecting all SEEDS criteria again, the number of investments would have been higher as multiple companies re-met the criteria during the investment period.

Table 5.2: Number of first SEEDS violations per year.

2006	2007	2008	2009	2010–2011	2012	2013–15	2016	2017-19	2020
14	5	7	4	1	2	0	1	0	1

5.1.1 Country Exposure

The portfolio of Graham companies consists of 36 companies at the beginning of the investment period. Of these, 21 are stocks listed in the USA, which gives the 2006 cohort a considerable exposure towards the US stock market. The remaining 15 companies are stock listed across

UK (4), Japan (3), Canada (2), Denmark (1), France (1), Hong Kong (1), Malaysia (1), Norway (1), and Sweden (1). By the end of 2008, the number of companies reduced to 10, of which 7 were stock listed in the USA, and 1 company each in Norway, Sweden, and Hong Kong. By 2016, this list consisted only of one American company, which continued until 2020.

5.1.2 Sector Exposure

The sector classification of Morningstar (2011) divides the stock market into the three supersectors *cyclical*, *defensive*, and *sensitive*. While the cyclical supersector is strongly sensitive to the business cycles, the defensive supersector is generally not. The third supersector, sensitive, shows moderate correlations with the different business cycle phases (Morningstar, 2011).

When classifying the Graham portfolio into the three supersectors, figure 5.2 shows that the majority of Graham companies (21) is considered to be cyclical. Considering the cyclical supersector, 16 Graham companies are categorized as consumer cyclical, four as basic materials, and one as a real estate business. The second-highest number of Graham companies (9) is the sensitive supersector. Out of those nine Graham companies, six are industrial businesses and three tech businesses. The defensive supersector has the third-highest number of Graham companies (6). Of which, half are consumer defensive, and the other half are healthcare businesses. No financial services, utilities, communication services, and energy businesses were accepted into the 2006 cohort.

21 cyclical	6 defensive	9 sensitive
4 basic materials	3 consumer defensive	0 communication services
16 consumer cyclical	3 healthcare	0 energy
0 financial services	0 utilities	6 industrials
1 real estate		3 technology

Figure 5.2: Sector overview of Graham companies.

5.2 The SEEDS Criteria

This section first analyzes the reasons for violating the SEEDS criteria throughout the investment period, followed by analyzing the individual SEEDS criteria—the enterprise's size, earnings stability, earnings growth, dividend record, and a sufficiently strong financial condition. In addition, a short descriptive analysis is given to Graham's price criterion, which is taken out from the main analysis. Finally, for each criterion, the analysis counts the companies that re-respect a criterion after violating it.

5.2.1 Size of the Enterprise

A company fulfills Graham's first criterion, adequate size of the enterprise, if it generates annual sales of at least $2 billion (Graham & Zweig, 2006), inflation-adjusted from 2003. Table 5.3 shows that the 2006 cohort was largely unaffected in this criterion during the first part of the Great Recession but was more heavily affected in the later period. However, after the Great Recession, the number of companies meeting this criterion remained stable throughout the investment period.

Table 5.3: The number of companies meeting the revenue criterion, regardless of whether they have previously violated any SEEDS criteria or not.

2005	2006	2007	2008	2009	2010-2011	2012	2013-17	2018	2019	2020
36	35	34	26	21	20	19	18	19	20	22

Moreover, figure 5.3 examines the nominal revenue increase relative to each company's 2005 level. The figure shows that the companies that still respected all SEEDS criteria in a given year generally had a consistent increase in revenues. Additionally, in only two instances, any SEEDS criteria-respecting company delivered lower revenues than in 2005—Barratt Developments PLC in 2006 (97.9 % of the 2005 level) and Centex LLC in 2007 (93.4 % of the 2005 level).

For the companies that had already violated any SEEDS criteria, however, the variation in revenue is much greater, ranging from a substantially lower revenue compared to the 2005 level to a substantially higher level. Over the years, the median relative revenue level is generally higher for the remaining SEEDS -respecting companies than those who already violated any of these criteria. However, this comparison should not be emphasized too much since only two companies respected the SEEDS criteria from 2012 onwards. Nevertheless, the box plot indicates that it may typically be a revenue decrease rather than an increased inflation-adjusted revenue criterion that is the main reason why the revenue criterion was violated.

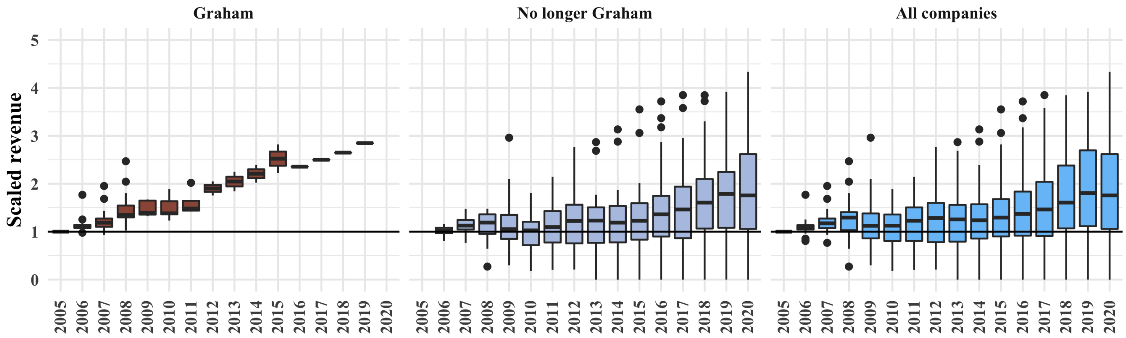

Figure 5.3: Scaled revenues per year.

5.2.2 Earnings Stability

The earnings stability criterion requires companies to deliver profits for at least ten consecutive years. Table 5.4 provides an overview of the Graham cohort of 2006 and how many companies fulfilled this criterion throughout the 15 years investment horizon.

Table 5.4: The earnings stability criterion.

	10	9	8	7	6	5	4	3	2	1	0	n	Mean	Min
2005	36											36	10.00	10
2006	35	1										36	9.97	9
2007	34	1	0									35	9.97	9
2008	26	6	0	0								32	9.81	9
2009	21	5	6	0	0							32	9.47	8
2010	20	6	2	3	0	0						31	9.39	7
2011	20	4	2	3	2	0	0					31	9.19	6
2012	19	5	0	4	1	2	0	0				31	9.00	5
2013	18	5	1	3	2	1	1	0	0			31	8.87	4
2014	18	4	1	3	2	1	1	0	0	0		30	8.87	4
2015	18	3	2	3	2	1	1	0	0	0	0	30	8.83	4
2016	18	3	2	3	2	1	1	0	0	0	0	30	8.83	4
2017	18	3	2	3	2	1	1	0	0	0	0	30	8.83	4
2018	19	2	2	4	3	0	0	0	0	0	0	30	9.00	6
2019	20	2	4	2	1	0	0	0	0	0	0	29	9.31	6
2020	22	1	4	1	0	1	0	0	0	0	0	29	9.41	5

Interestingly, the weighted mean ranged from 8.83 to 10 years of profits in the last ten years throughout the entire investment period. This high average means that the companies in general performed consistently well in delivering profits, also during the years of the Great Recession. For instance, the year with the highest frequency of companies with less than eight years of profits was 2012–2018, with only seven companies. Thus, while over half of the companies deliver profits in ten out of the last ten years throughout the investment period, the other half that delivers occasional losses do so mostly once or twice in ten years.

5.2.3 Earnings Growth

Graham's earnings criterion requires an EPS growth of one-third over the past ten years. Figure 5.4 differentiates between the companies fulfilling the SEEDS criteria in the left box plot, the companies previously violated any of the SEEDS criteria in the middle box plot, and all companies in the right box plot.

In the left plot, the companies show a continued increase in EPS growth over time until 2012, from which there were only two companies left in the portfolio. However, the companies that had violated any of the Graham criteria generally delivered a gradually worse EPS growth over time. However, it is essential to highlight that the median EPS growth is higher than one-third every year, meaning that the median company still meets the EPS growth criterion. Nevertheless, a substantial difference in EPS growth is observed for the companies that continue to meet the SEEDS criteria compared to those that do not, although statistical tests should be conducted to say if this difference is statistically significant.

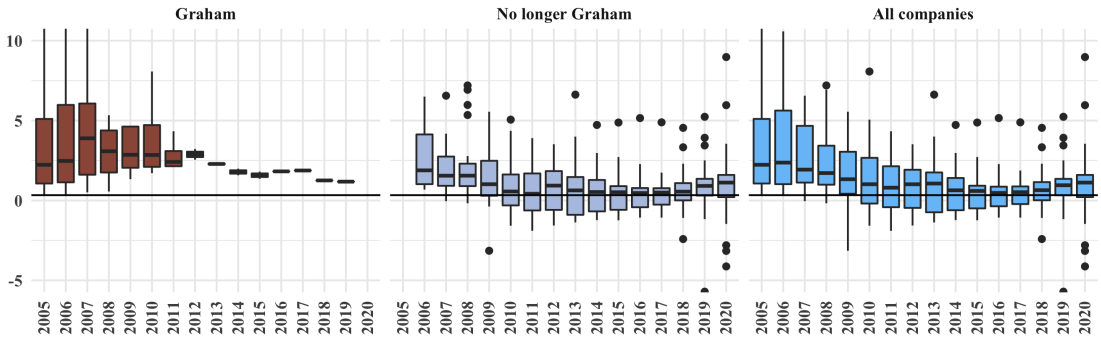

Figure 5.4: The earnings growth criterion.

However, the EPS growth metric can be misleading. Specifically, the primary purpose of the metric is to analyze whether a company is capable of increasing its profits over time or not, but increased EPS growth could also be achieved because the comparison metric—which is EPS achieved ten years ago—had an underperforming year.

Table 5.5: EPS vs. EPS growth.

	Increasing growth	Decreasing growth
Increasing EPS	39%	30%
Decreasing EPS	8%	23%

Table 5.5 studies this point in more detail by identifying the potential underlying cause behind the increased or decreased EPS growth. The table shows the year-over-year differences,

illustrating that 62 % of the observations, which is the diagonal sum, resulted in increased (decreased) EPS growth because the EPS increased (decreased). Thus, for these observations, the EPS growth metric signals what it attempts to signal.

However, 30 % of the observations increased their EPS from one year to another but still experienced a decreasing growth because the trailing three-year EPS average ten years ago was higher than the three-year EPS average 11 years ago.

Similarly, 8 % of the observations could boast about increasing their EPS growth despite having a decreased year-over-year EPS to report. This figure is particularly raising concerns. For these observations, increased growth occurred because the trailing three-year EPS average ten years ago was lower than the three-year EPS average eleven years ago.

Although I apply the EPS growth to identify the 2006 cohort, I consider it a potentially misleading indicator of earnings growth when analyzing the year-by-year performance. This is particularly the case when a considerable amount of portfolio investments consist of cyclical and sensitive companies as the EPS growth numbers are especially prone to fluctuate for these companies and may show an increased (decreased) EPS growth although the EPS decreased (increased).

5.2.4 Dividend Record

With the modification presented in the methodology chapter, a company must pay dividends uninterruptedly for the last ten years to fulfill the dividend criterion. Table 5.6 gives an overview of the Graham companies that continued to meet the criterion and those who violated it after 2006 up until 2020.

By 2010, only 5 companies violated the criterion, with the worst performer paying dividends for 8 consecutive years, resulting in a weighted mean of 9.77. In 2015, 23 companies were left that fulfilled the dividend criterion, and 7 companies violated it. For 2019 and 2020, however, the average improved again. Surprisingly, most companies in the 2006 cohort continued to pay uninterrupted dividends, even during the Great Recession when few companies respected all of the SEEDS criteria.

Table 5.6: Dividend record.

	10	9	8	7	6	5	4	3	2	1	0	n	Mean	Min
2005	36											36	10.00	10
2006	36	0										36	10.00	10
2007	35	0	0									35	10.00	10
2008	32	0	0	0								32	10.00	10
2009	29	3	0	0	0							32	9.91	9
2010	26	3	2	0	0	0						31	9.77	8
2011	26	1	2	2	0	0	0					31	9.65	7
2012	26	1	0	3	0	1	0	0				31	9.52	5
2013	25	1	1	1	3	0	0	0	0			31	9.42	6
2014	23	2	0	2	2	1	0	0	0	0		30	9.30	5
2015	23	2	0	1	3	0	1	0	0	0	0	30	9.23	4
2016	23	1	1	1	3	0	0	1	0	0	0	30	9.17	3
2017	23	1	0	2	3	0	0	0	1	0	0	30	9.10	2
2018	23	1	0	1	4	0	0	0	1	0	0	30	9.07	2
2019	22	2	1	1	2	1	0	0	0	0	0	29	9.31	5
2020	23	2	0	3	0	0	1	0	0	0	0	29	9.41	4

5.2.5 Sufficiently Strong Financial Condition

Graham specifies two metrics to evaluate whether a company has a sufficiently strong financial condition. First, a current ratio of at least two is required. Second, long-term debt must be less than net current assets (Graham & Zweig, 2006).

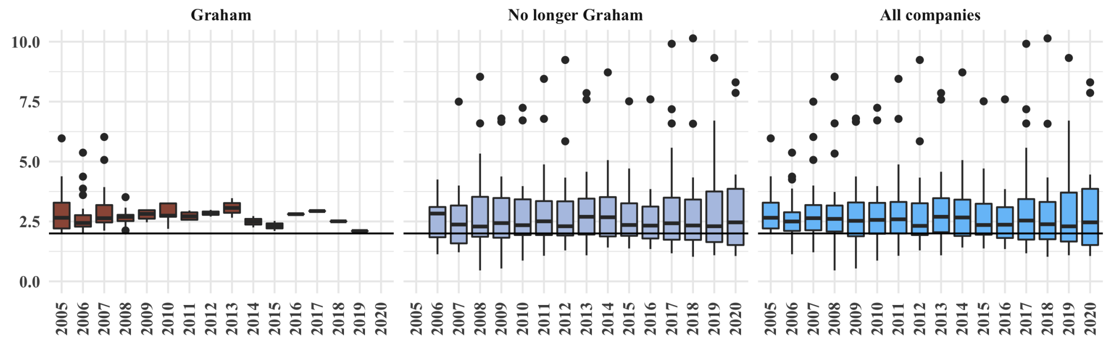

Figure 5.5: Current ratio.

Figure 5.5 presents the current ratio of the companies still respecting all criteria, companies that violated any criteria, and all companies, respectively. The horizontal line represents a current ratio of two, which is the minimum requirement. It is interesting to observe that most companies had a current ratio above two throughout the investment period. Additionally, the variation of current ratios is higher for companies that previously violated any of the SEEDS criteria, and the median current ratio generally remains higher for the companies that still respect all SEEDS criteria. Also, there are many outliers for the current ratio—which are cropped out of the plot for greater clarity of the remaining points—and several of these outliers range up to a current ratio of 11. Additionally, Wilson Bowden Ltd. had a current ratio of 30.4 and 35.4 in 2018 and

2019, respectively, which later fell to 11.1 in 2020. A potential reason for 10+ current ratios could be because a company took up a substantial long-term loan and did not invest the cash by the end of the accounting period.

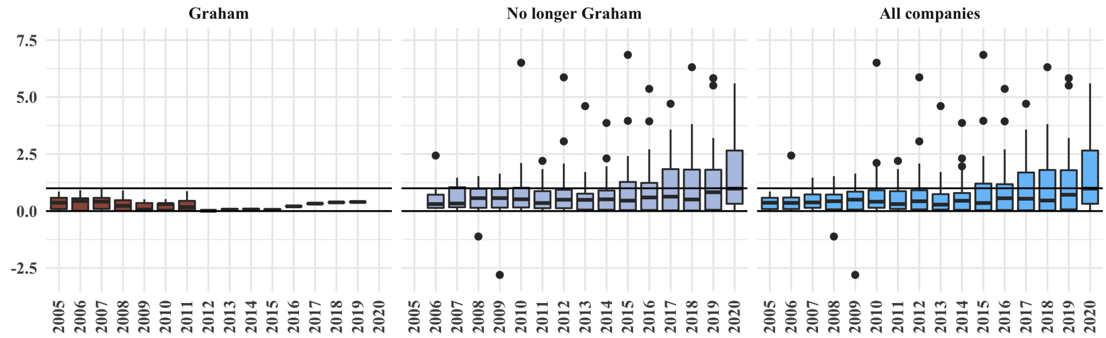

Figure 5.6: Long-term debt ratio.

The high values in the later years in figure 5.6 contribute to strengthen this hypothesis. The figure studies long-term debt relative to the net current assets. For a more straightforward interpretation, I converted the long-term debt less the net current assets criterion into a ratio. Specifically, the criterion is respected if the ratio lies between 0 and 1. If the ratio is negative, the net current assets are negative. If above 1, the company has more long-term debt than net current assets. Moreover, when comparing the companies that still respected the SEEDS criteria versus those that no longer did, an interesting observation emerges—the former generally decreased their long-term debt relatively to their net current assets, whereas the latter generally increased it.

While there are multiple reasons why a company may choose to raise more long-term debt, the developed world's low interest rates have generally faced since the Great Recession is likely a contributing factor. If so, then it is essential to consider the economic environment that Graham experienced when he wrote The Intelligent Investor, in which interest rates were substantially higher than during the investment period. Assuming the ability to repay the loan with interest is of key concern when studying the financial condition criterion, it could be relevant to modify the criterion to depend on the size of the loan and the current and future expected interest rates. Otherwise, many companies may be disqualified as a company respecting the SEEDS criteria, although they still have a strong financial condition with the current interest rates.

5.2.6 The Price Criterion

While Graham and Zweig (2006) recommend a price-to-book value of smaller than 22.5, this criterion was excluded from the SEEDS criteria because the "performance" of the price depends to a large extent on factors outside of the company's control. As demonstrated by the left plot in figure 5.7, barely any (6) companies would remain in the 2006 cohort if the price criterion was enforced. While I study the portfolio of companies respecting the price criterion of 22.5 in more detail in the results chapter, this observation is an indicative reason to ignore the price criterion from the cohort filtering because few companies would remain. When only a few companies remain, it is hard to construct a well-diversified portfolio and extract any results that may validate in later cohorts.

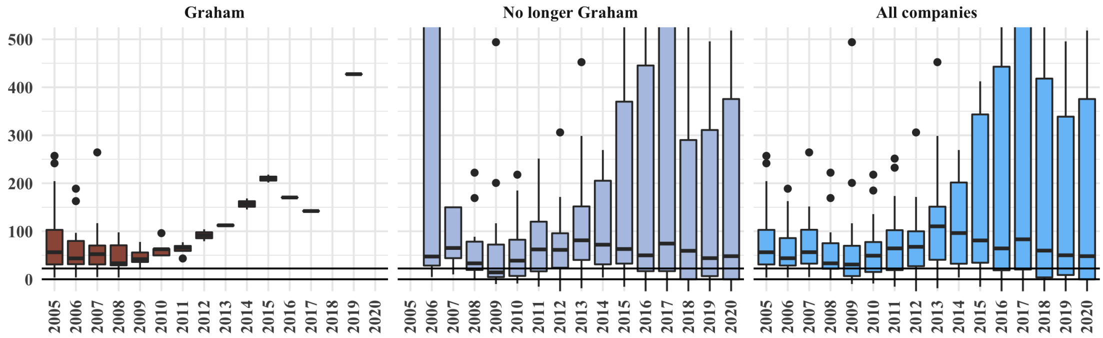

Figure 5.7: Graham's price criterion. The most extreme observations are cropped out to more easily illustrate the majority of the observations.

Moreover, it is interesting to note that the price criterion score generally falls for the companies that still respect the SEEDS criteria, whereas the companies that violate the SEEDS criteria face substantially more variation. Additionally, most of the pricing scores are multiples higher for most companies in the cohort than Graham's upper limit of 22.5. Considering that lower interest rates—which have present during the investment period compared to historical rates—generally lead to more investments in the stock market, which contributes to driving the prices higher up (Tessaromatis, 2003), this figure may indicate that the 22.5 criterion is outdated and should either be replaced by a higher limit or removed altogether.

Finally, three factors affect the pricing score—price, EPS, and tangible book value. The fact that the pricing score generally increases over time may indicate that the 2006 cohort delivers high nominal returns to the investor. By the same line of reasoning, the high pricing scores for companies that previously violated the SEEDS criteria may signify that it is wise to continue holding the investments despite violating the SEEDS criteria. The company returns are explored superficially in the next section and thoroughly in the next chapter.

5.3 Return Performance

Before exploring how the 2006 cohort performs in an investment strategy and relatively to a benchmark, it is valuable first to understand the companies' and benchmarks' nominal returns.

Table 5.7: Summary statistics of the 2006 cohort's annual returns. All numbers in percent.

Min	1Q	Median	3Q	Max	Mean
-92.8	-7.9	8.6	32.4	279.6	12.2

Table 5.8: Summary statistics of the 2006 cohort's HPR. All numbers in percent.

Min	1Q	Median	3Q	Max	Mean
-97.0	21.5	191.5	534.1	1522.5	313.3

As Table 5.7 shows, the annual returns of the 2006 cohort vary substantially and are skewed in the positive direction. The mean and median annual return is 12.2 % and 8.6 %, respectively, which are promising numbers. However, they must be considered relatively to the risk they pose, which is studied in the next chapter.

When studying the holding period returns in table 5.8, the returns still look promising. The average company delivered 313.3 % of the return on investment, while the median return is substantially lower at 191.5 %. The large difference is primarily caused by the fact that a few companies vastly outperform the rest in terms of nominal returns not adjusted for risk. For instance, the best-performing company overall, Novo Nordisk, delivered over 15 times total return on the investment, and the best single-year performance was a return of 291.3 % in 2009 when the British housebuilding company Taylor Wimpey PLC regained some of its large losses that it experienecd during the Great Recession. However, it is promosing that the third quartile delivered as much as 534.1 % HPR over a 15-year period, meaning that a decent amount of companies delivered high holding period returns.

On the other side of the spectrum, five companies delivered negative holding period returns. For example, the worst single-year performer, Sears, delivered a –92.8 % return in a single year, whereas the worst total performer Esprit Holdings Ltd., eventually ended up with a holding period return of –97.0 %. The remaining three companies delivering a negative HPR were Centex LLC, Kate Spade & Co LLC, and Kellwood Co LLC, with an HPR of –83.0 %, –46.3 %, and –7.1 %, respectively.

Table 5.9: Benchmark returns and average risk-free rate for the corresponding country. All numbers in percent.

		Annual returns								
Ticker	Country	Min	1Q	Median	3Q	Max	Mean	HPR	CAGR	r_f
CAC	France	–42.68	–2.64	6.69	16.95	26.37	3.49	17.73	1.09	2.02
FBMKLCI	Malaysia	–39.33	–5.22	5.11	17.14	45.17	6.10	80.84	4.03	3.80
HSI	Hong Kong	–48.27	–5.27	4.09	31.38	52.02	8.17	83.05	4.11	2.17
OMX	Sweden	–38.75	–4.61	7.37	20.37	43.69	6.48	95.28	4.56	1.43
OMXCCAPGI	Denmark	–49.32	4.41	20.51	29.79	38.55	13.09	379.42	11.01	0.91
OSEBX	Norway	–54.06	5.20	13.71	18.91	64.78	11.16	192.92	7.43	2.29
SPTSX	Canada	–35.03	–7.30	7.29	14.50	30.69	4.40	54.66	2.95	2.35
SPX	USA	–38.49	0.88	12.09	17.97	29.60	8.58	200.90	7.62	2.64
TPX	Japan	–41.77	–9.63	3.76	13.89	51.46	2.60	9.39	0.60	0.67
UKX	UK	–31.33	–4.38	6.74	11.76	22.07	3.07	14.98	0.93	2.33
MXWO	Global	–42.08	–1.33	8.32	19.57	26.98	6.39	113.87	5.20	2.64

Relatively to the results presented in Table 5.7 and 5.8, the benchmark results presented in Table 5.9 is a considerable contrast. With the Danish and Norwegian benchmarks being two exceptions, the mean annual returns trail substantially below the 2006 cohort's mean annual return. Additionally, all benchmarks deliver a substantially lower HPR than the 3^{rd} quartile of the 2006 cohort, and only the Danish benchmark deliver an HPR higher than the cohort's mean HPR. The differences between the cohort and the benchmark performances increases further when one notes that the Danish, Norwegian, and US benchmarks deliver substantially higher HPR than the other benchmarks.

Moreover, these results also apply when studying the global benchmark, MSCI World (MXWO), which delivers a mean annual return rate of 6.39% and an HPR of 113.87% (CAGR of 5.20%). However, it is important to notice that the global benchmark is underperforming substantially against—amongst others—the US benchmark. Since the 2006 cohort has a majority of US companies, the results from Table 5.9 imply that the local reference index may likely deliver higher returns than the global reference index. If so, this observation will, in turn, have the consequence that the excess return of the portfolios I am studying in this thesis will be relatively lower when compared against a local benchmark and relatively higher when comparing against a global benchmark. This observation demonstrates the importance of choosing a proper benchmark to compare against and preferably having more than one benchmark to study.

Chapter 6

Results

This thesis aims to study how the 2006 cohort of companies meeting the SEEDS criteria perform relatively to the market during the investment period 2006–2020. While evaluating just one cohort is a weakness to validate the results because there are no new data (cohorts) to test the findings on, the results found in this chapter will primarily be used to form a main hypothesis that will be tested on new cohorts as future research after this thesis.

Therefore, this chapter focuses on analyzing various pricing, holding, and rebalancing strategies. Additionally, each strategy will be tested against both a local and a global benchmark, and the final suggested strategy will also be tested against multiple base currencies instead of using only the local currencies. Hence, all evaluated strategies before the currency section will be listed in local currency (LCY). For brevity, the LCY code will not be appended to the strategy code. For instance, the strategy P1–H1–R1–LCY will be listed as P1–H1–R1.

Moreover, while discovering a specific strategy that hopefully delivers promising results is important to form a specific hypothesis to test on new cohorts, it is not the main aspiration of this chapter. Instead, I hope that the results are generally consistent across many strategy alternatives because such a finding may indicate that I am able to avoid overfitting. Hence, the discussion throughout the chapter will center on these two key considerations.

6.1 Pricing Strategies

While having overlapping investment philosophies, Benjamin Graham and Charlie Munger differ substantially in which of the investment candidates to actually invest in. Specifically, Benjamin Graham was occupied with buying stocks well below their intrinsic value, leading him to recommend the defensive investor to buy stocks meeting the SEEDS criteria and having a price criterion score $\frac{P}{E} \cdot \frac{P}{tBV} \leq 22.5$. Warren Buffett followed Graham's principle, too, and often sold his investments only a couple of years after the acquisition because the investment had reached its intrinsic value (Greenwald et al., 2020a). It was only after he met Charlie Munger, however, that Buffett became less occupied with price and more occupied with holding high-quality stocks, and preferably to hold them indefinitely (Munger, 1994).

Munger appreciates buying at a discount, but he is more occupied with buying quality company shares that have the potential to deliver high returns and that he can hold for many years. His reasoning was a contributing factor as to why Graham's pricing criterion was excluded as a required criterion in this thesis, forming the SEEDS criteria. Hence, it is natural that the results chapter starts by exploring how well Graham and Munger's suggestions regarding price hold up when applied to the 2006 cohort. These will be studied next.

6.1.1 Pricing Strategy 1: Graham's Selection

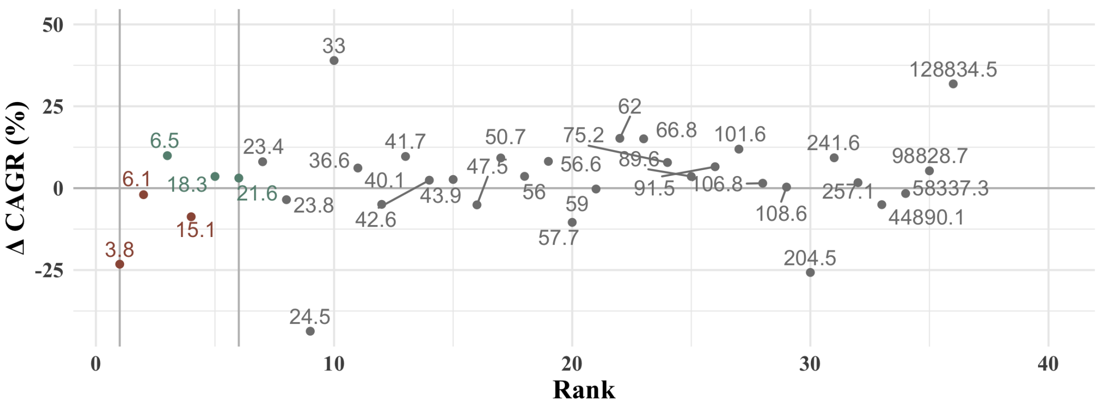

Figure 6.1: Pricing strategy 1's pricing score rank against $\Delta CAGR$.

The first strategy involves testing whether the companies meeting Graham's price criterion exceed the market's returns, assuming the hold–index (H1) and no rebalancing (R1) strategies. Since the P1 strategy involves a limited pricing score range, only six companies enter the investment portfolio—illustrated between the vertical thresholds in figure 6.1—and only four of these companies are still tradeable at the end of 2020. Specifically, Orkla, Leggett and Platt Inc., MDC Holdings Inc., and PPB Group Bhd. are tradeable throughout the investment period, while Kellwood Co. LLC and Sears Canada Inc. stop trading during the investment period.

Moreover, four of the six companies are cyclical, whereas the remaining two are defensive investments. Country-specific, three companies are listed in the US, which creates a 50 % portfolio exposure to the USA.

Table 6.1 provides a further overview of this strategy's performance.

Table 6.1: Overview of strategy P1–H1–R1.

No. companies	Portfolio
Start	6
Cyclical	4
Defensive	2
Sensitive	0
End	4
Exposure and returns (%)	
Asset weight, max	62.45
Asset weight, min	0.40
Best annual return	49.2
Worst annual return	–24.8
Price criterion score	
Min	3.80
Median	10.79
Max	21.61

Table 6.2: Absolute and relative performance of strategy P1–H1–R1.

Risk-unadjusted returns (%)	Local	Global
HPR, portfolio	220.0	206.1
HPR, benchmark	155.2	113.9
Holding period excess return	64.8	92.2
CAGR, portfolio	8.06	7.74
CAGR, benchmark	6.44	5.20
Risk-adjusted returns		
Risk-free rate (%)	2.72	2.64
Asset beta	0.79	0.65
Jensen's Alpha (%)	2.38	3.43
Information ratio	0.17	0.22
Other metrics (%)		
ΔCAGR	1.62	2.54
COR	97.1	96.5
AOR	53.3	53.3

When comparing against the local and global benchmarks, strategy P1–H1–R1 delivers a positive alpha of 2.38 % and 3.43 %, respectively, each with a beta well below 1. Since the CAPM model assumes a well-diversified portfolio and the portfolio in strategy P1 only consists of 4–6 companies at any given time, these numbers provide little insight. Additionally, the highest and lowest asset exposure during the investment period was 62.45 % and 0.40 %, demonstrating that the portfolio is not well-diversified over time.

It may, therefore, be more relevant to study the information ratio. An information ratio of 0.17 and 0.22 for the local and global benchmark indicates that while the portfolio delivers risk-adjusted excess returns, the strategy does not perform consistently well. Both the local and the global metric partially confirm this, and the AOR further shows that the strategy provides a higher annual return than the benchmark in only 8 of the 15 years (53.3 %). However, the strategy's holding period return (HPR) is higher than the benchmark's HPR by as much as 97.1 % and 96.5 % of the days in the investment period when comparing against the local and global benchmark. The final holding period excess return (HPER) is 64.8 % and 92.2 %—a $\Delta CAGR$ of 1.62 % and 2.54 %—against the benchmarks, respectively. These results indicate that although the strategy does not outperform the market more than about half of the years in the investment period, it usually outperforms the benchmarks cumulatively. This is confirmed by figure 6.2, which shows that the strategy outperformed the benchmarks substantially during the Great Recession, resulting ultimately in a high COR. However, it is interesting to observe that while HPER increased substantially during and shortly after the Great Recession, it fell drastically during COVID-19's stock market crash in the spring of 2020.

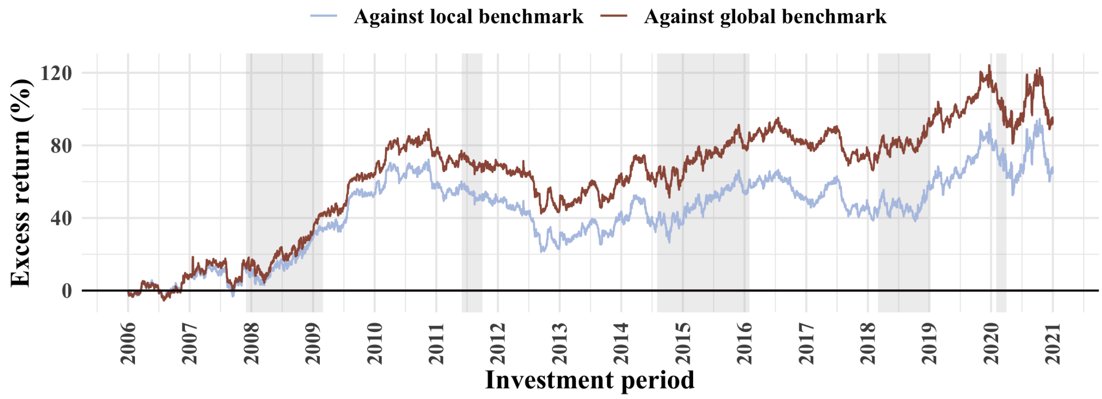

Figure 6.2: Strategy P1–H1–R1's cumulative excess returns. Time periods highlighted in gray are the global benchmark's bear periods.

6.1.2 Pricing Strategy 2: All Companies

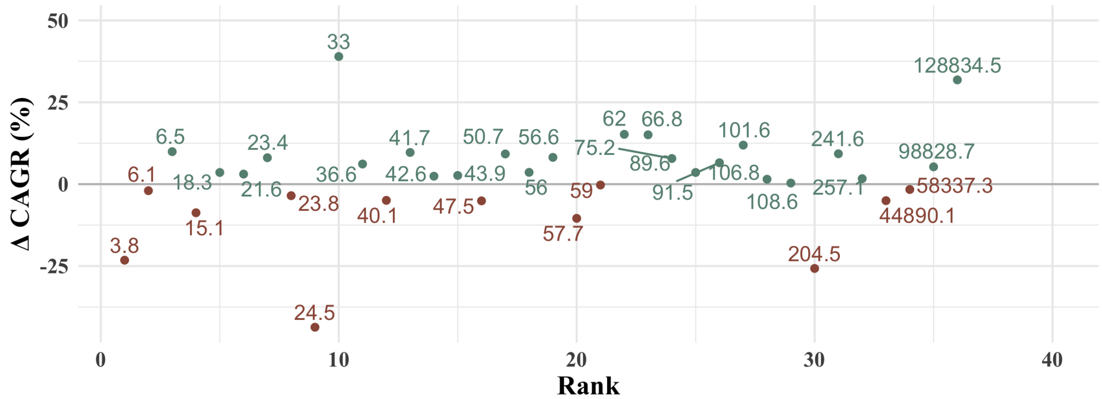

Figure 6.3: Pricing strategy 2's pricing score rank against Δ*CAGR*.

The second strategy involves investing in all 36 companies that meet the SEEDS criteria on December 31st 2005, assuming the hold–index (H1) and no rebalancing (R1) strategies. Of these, 21 companies are cyclical, six are defensive, nine are sensitive, and 29 are still tradeable at the end of 2020.

Table 6.1 provides a further overview of this strategy's performance.

Table 6.3: Overview of strategy P2–H1–R1.

No. companies	Portfolio
Start	36
Cyclical	21
Defensive	6
Sensitive	9
End	29
Exposure and returns (%)	
Asset weight, max	17.51
Asset weight, min	0.01
Best annual return	37.4
Worst annual return	–35.8
Price criterion score	
Min	3.80
Median	56.30
Max	128,834.52

Table 6.4: Absolute and relative performance of strategy P2–H1–R1.

Risk-unadjusted returns (%)	Local	Global
HPR, portfolio	327.2	326.7
HPR, benchmark	146.3	113.9
Holding period excess return	180.9	212.8
CAGR, portfolio	10.17	10.16
CAGR, benchmark	6.19	5.20
Risk-adjusted returns		
Risk-free rate (%)	2.33	2.64
Asset beta	0.98	0.87
Jensen's Alpha (%)	4.04	5.29
Information ratio	0.79	0.81
Other metrics (%)		
ΔCAGR	3.98	4.96
COR	89.2	83.6
AOR	80.0	73.3

Strategy P2–H1–R1 shows promising risk-adjusted results, with an alpha of 4.04 % and 5.29 % against the local and global benchmark. This achievement is partially caused by high returns delivered by the investment pool, and partially because strategy P2–H1–R1 has a lower volatility than the benchmarks, with a beta of 0.98 and 0.87 against the local and global benchmark. In addition, also an information ratio of 0.79 and 0.81 against the two benchmarks show promising results.

Moreover, the strategy's portfolio delivered an annualized return, CAGR, of over 10 % annually, which outperformed the benchmarks with a $\Delta CAGR$ by 3.98 % and 4.96 %. Thus, compared to strategy P1–H1–R1, the AOR has improved and outperforms the benchmarks in 12 and 11 years. However, the COR fell in P2–H1–R1 because it underperformed the benchmarks for a longer time during the Great Recession than strategy P1–H1–R1 (see figure 6.4).

While strategy P2–H1–R1 demonstrates promising results, the importance of these results extends beyond the strategy. Specifically, when backtesting, it is imperative to avoid overfitting strategies. Strategy P2–H1–R1 may arguably be the most general strategy evaluated in this thesis, telling investors to buy all companies in the cohort once and then hold the portfolio. Additionally, reinvestments are not affecting excess returns much because the amounts are reinvested into the index and not the portfolio. Therefore, this strategy may avoid overfitting the most, making the results of this strategy particularly promising for further research into other cohorts.

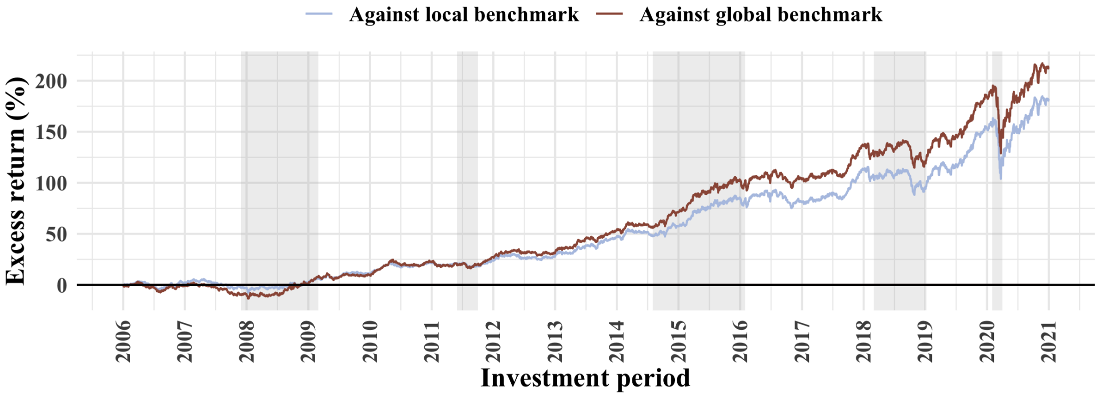

Figure 6.4: Strategy P2–H1–R1's cumulative excess returns.

6.1.3 Pricing Strategy 3: All Excluding Tails

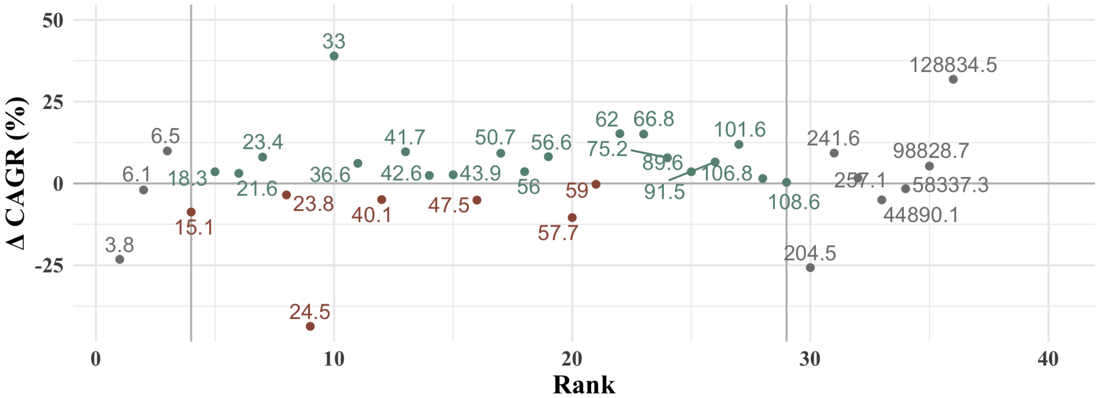

Figure 6.5: Pricing strategy 3's pricing score rank against $\Delta CAGR$.

Whereas strategy P2–H1–R1 shows promising results, the range of the pricing criterion scores is concerning. Specifically, table 6.3 showed that the score ranged from less than four to almost 130,000. This extensive range may be caused by some underlying structural problems with the outlier companies not captured by the SEEDS criteria. Hence, a relevant strategy to test next is to invest in all companies with a reasonable pricing criterion score.

By specifying that the price criterion score $\frac{P}{EPS} \cdot \frac{P}{tBV}$ must be larger than or equal to 10 and less than or equal to 200, 26 companies are selected at the start of the investment period, of which 21 are still tradeable at the end of 2020. These 26 companies have a price criterion score ranging from 15.10 to 108.65, which places them all well inside the thresholds.

Among these 26 companies, 14 are cyclical, three defensive, and nine sensitive. Hence, seven, three, and zero of the cyclical, defensive, and sensitive companies were removed, respectively, limiting the allowable pricing score range.

Table 6.5: Overview of strategy P3–H1–R1.

No. companies	Portfolio
Start	26
Cyclical	14
Defensive	3
Sensitive	9
End	21
Exposure and returns (%)	
Asset weight, max	22.19
Asset weight, min	0.33
Best annual return	38.5
Worst annual return	–35.6
Price criterion score	
Min	15.10
Median	49.12
Max	108.65

Table 6.6: Absolute and relative performance of strategy P3–H1–R1.

Risk-unadjusted returns (%)	Local	Global
HPR, portfolio	380.8	375.9
HPR, benchmark	168.6	113.9
Holding period excess return	212.2	262.0
CAGR, portfolio	11.04	10.96
CAGR, benchmark	6.81	5.20
Risk-adjusted returns		
Risk-free rate (%)	2.25	2.64
Asset beta	0.99	0.90
Jensen's Alpha (%)	4.27	6.02
Information ratio	0.76	0.84
Other metrics (%)		
ΔCAGR	4.23	5.76
COR	90.4	82.7
AOR	73.3	80.0

While the performance results are better than in some metrics and are worse than strategy P2–H1–R1 in others, the results are still promising. With volatility still lower than the benchmarks, the strategy delivers an alpha of 4.27 % and 6.02 % against the local and global benchmarks, respectively. This is an improvement against P2–H1–R1, and the same applies to $\Delta CAGR$, which increased to 4.23 % and 5.76 %. The information ratio remains high at 0.76 and 0.84. Also, both the COR and AOR metrics are consistent with the P2–H1–R1 strategy findings.

What is particularly interesting is studying the HPER visually in figure 6.6. While achieving nominal returns of approximately 250 % over 15 years for a portfolio that is slightly less volatile than a broad stock market benchmark is impressive in itself, it is necessary to keep in mind that figure 6.6 does not show nominal returns. Instead, it illustrates *excess* nominal returns against a benchmark that has also delivered good results in the investment period. For instance, the HPER against the global benchmark was 262.0 %, whereas the HPR of the global benchmark was 113.9 %. This means that the excess holding period return of strategy P3–H1–R1 is more than two times higher than all of the return the global benchmark delivered in the same investment period, and the HPER consistently increased during the investment period. These are promising results that will make the following sections especially interesting to explore further.

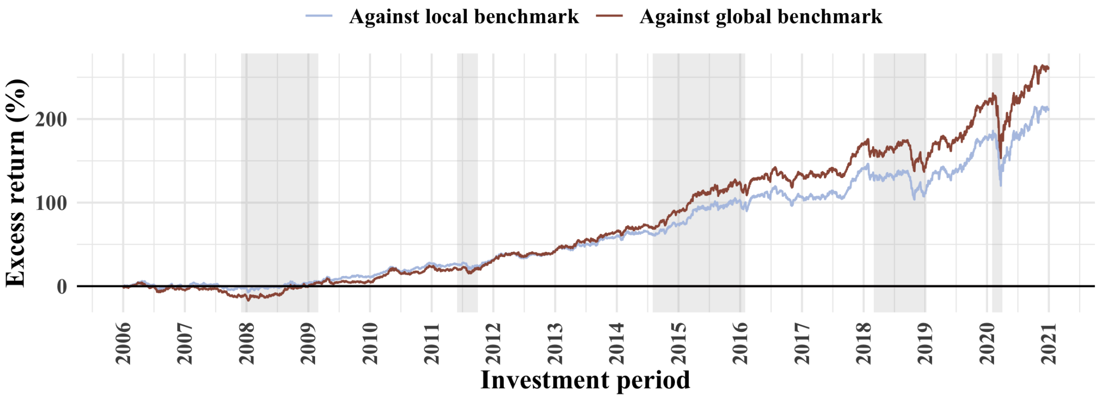

Figure 6.6: Strategy P3–H1–R1's cumulative excess returns.

6.1.4 Pricing Strategy 4: Maximize Returns

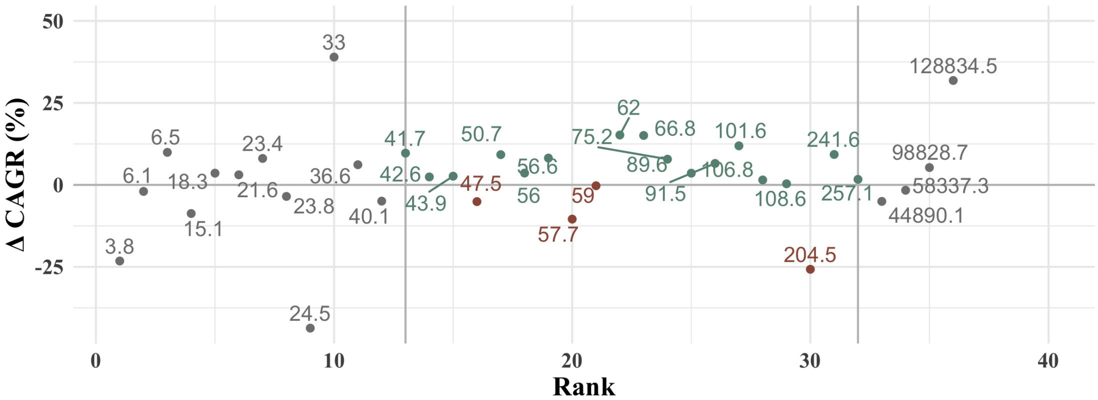

Figure 6.7: Pricing strategy 4's pricing score rank against $\Delta CAGR$.

While strategies P2–H1–R1 and P3–H1–R1 delivered good results with a wide price criterion interval, a natural question is which price criterion interval delivers the highest returns. I try answering this question by exploring the pricing strategy P4. However, this strategy should not be selected as the pricing strategy to move forward with as it uses the performance data both as inputs and as outputs. Nevertheless, the results from this strategy may form new hypotheses that could be tested in later cohorts. Additionally, pricing strategy P4 may provide insights into how close pricing strategy P3's price criterion interval is to the return-maximizing interval

Table 6.7: Overview of strategy P4–H1–R1.

No. companies	Portfolio
Start	20
Cyclical	8
Defensive	4
Sensitive	8
End	18
Exposure and returns (%)	
Asset weight, max	24.87
Asset weight, min	0.02
Best annual return	38.8
Worst annual return	–33.6
Price criterion score	
Min	41.71
Median	64.40
Max	257.11

Table 6.8: Absolute and relative performance of strategy P4–H1–R1.

Risk-unadjusted returns (%)	Local	Global
HPR, portfolio	450.0	445.7
HPR, benchmark	179.5	113.9
Holding period excess return	270.5	331.8
CAGR, portfolio	12.04	11.98
CAGR, benchmark	7.09	5.20
Risk-adjusted returns		
Risk-free rate (%)	2.27	2.64
Asset beta	0.96	0.87
Jensen's Alpha (%)	5.12	7.11
Information ratio	0.85	0.96
Other metrics (%)		
ΔCAGR	4.95	6.78
COR	98.5	86.3
AOR	86.7	86.7

For pricing strategy P4, a minimum of 20 companies was required. The same number of companies was selected by strategy P4–H1–R1 and resulted in the price criterion interval of 41.71 to 257.11. Of these 20 companies, 18 still traded at the end of 2020. Interestingly, pricing strategy P2 and P3 had substantially higher exposure to cyclical companies, whereas pricing strategy P4 has equally many cyclical as sensitive companies in its portfolio. However, because the strategy involves no rebalancing, the portfolio exposure to single stocks deviates substantially from the target weights of 5 % each during the investment period. For instance, the highest asset weight of any single investment at any point in time during the investment period is 24.87 %.

Although the risk exposure to specific investments is considerable, the beta remains below both benchmarks. The alpha is 5.12 % and 7.11 % against the local and global benchmarks, which is 85 and 109 basis points higher than the alphas achieved in strategy P3–H1–R1. In addition, the portfolio's CAGR is 12.04 % and 11.98 % when reinvesting into the local versus the global benchmark, which is a 100 and 102 basis point improvement against strategy P3–H1–R1.

Hence, when comparing against strategy P3–H1–R1, there are still considerable risk-adjusted and risk-unadjusted nominal returns that could have been achieved by improving the pricing score interval even further. However, it is crucial to be aware that although the results could have been improved for this particular cohort, this is a helpful example of how overfitting may occur when backtesting investment strategies.

Therefore, a future analysis could first involve forming a hypothesis that a cohort delivers outperforming results for companies with a pricing score in the range of, for example, 40 to 250, and then test this hypothesis on new data on a different cohort than the one of 2006. Considering the sample period considerations that were made and described in the data considerations chapter, the new cohort should preferably be one after 2006 but also a cohort that is not too present. Additionally, if a cohort is chosen shortly after 2006, most of the 2006 cohort would also qualify for the new analyzed cohort. It could therefore be a potential idea to exclude these companies from the hypothesis testing since I would otherwise have formed the hypothesis based on data I have already seen—a process typically called “data snooping”.

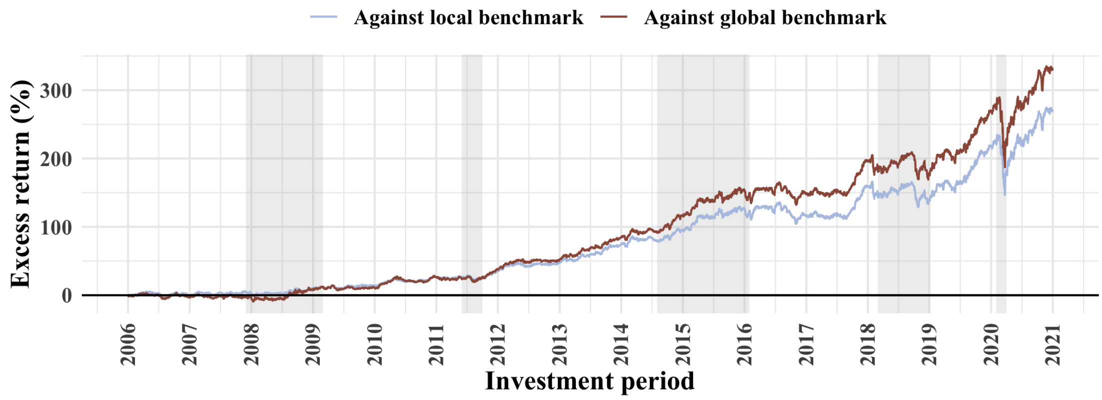

Figure 6.8: Strategy P4–H1–R1’s cumulative excess returns. With a local COR of 98.5 %, strategy P4–H1–R1 underperforms the local benchmark for less than 3 months during the entire 15-year investment period.

6.1.5 The Chosen Pricing Strategy

Graham’s investment philosophy on price, represented by pricing strategy P1, outperformed both the local and global market when applied to strategy P1–H1–R1. However, the portfolio of only six companies, four of which were still tradeable at the end of the investment period, performed worse than the strategies that resemble Munger’s investment philosophy on price. While strategy P4–H1–R1 outperformed the market the most, pricing strategy P4 should not be selected as it snooped in the data set when selecting the price interval range. Additionally, although a more active investor could choose pricing strategy P2, a defensive investor may be wiser in selecting strategy P3 because it may weed out companies with more substantial structural problems not identified by the SEEDS criteria. Since this thesis focuses on Benjamin Graham’s stock selection criteria for the defensive investor, I propose to choose pricing strategy P3 and analyze further with various holding and rebalancing strategies.

6.2 Holding Strategies

Munger and Graham have seemingly different perspectives on stocks’ holding period. On one side, Munger’s philosophy involves holding the few selected quality stocks forever. When applied to this thesis, this investment philosophy involves that if a company violates a SEEDS criteria, it should still be kept in the portfolio. On the other hand, while Graham and Zweig (2006) propose no clear directions on whether an intelligent investor should sell a stock that violated any of the SEEDS criteria, as the father of value investing, Graham was prone to buy a stock under its intrinsic value and sell it above its intrinsic value. His attitude was described more precisely in Phalon (2002, p. 21), "Ben himself rarely tried to push profits, cautiously selling ... when he saw a 50 % profit." Considering both that Graham frequently sold even a high-quality company as long as it traded on a favorable price and that Graham and Zweig (2006) stress the importance of undertaking due diligence of the quality of the company, especially if you are an "enterprising investor", is it reasonable to assume that Graham would consider selling an investment once it violates a SEEDS criterion. Therefore, I explore both holding strategies in this section.

Additionally, to ensure that potential good (bad) portfolio performances are not caused merely by reinvestment into the remaining well (poorly) performing investments, I consider both reinvestments into the portfolio and the appropriate index. Hence, I evaluate four holding strategies as a next step while applying the chosen pricing strategy P3 from the previous section and still assuming no rebalancing (R1).

6.2.1 Holding Strategy 1: Hold–Index

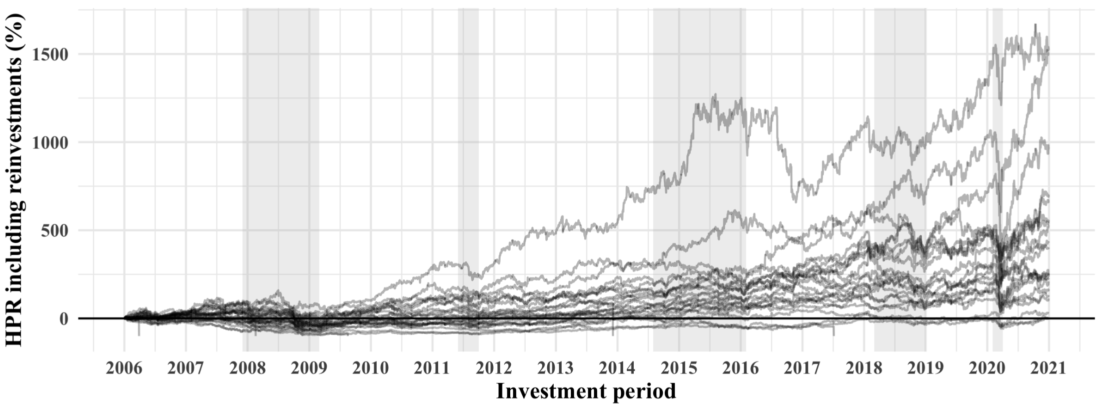

Figure 6.9: Strategy P3–H1–R1's individual asset HPR including reinvestments.

Strategy P3–H1–R1 was analyzed in section 6.1.3 on page 57 and will not be covered in detail again. However, it is worth noting that since the strategy involves no rebalancing, the weights of the various investments change considerably over time, as shown in figure 6.9.

6.2.2 Holding Strategy 2: Hold–Portfolio

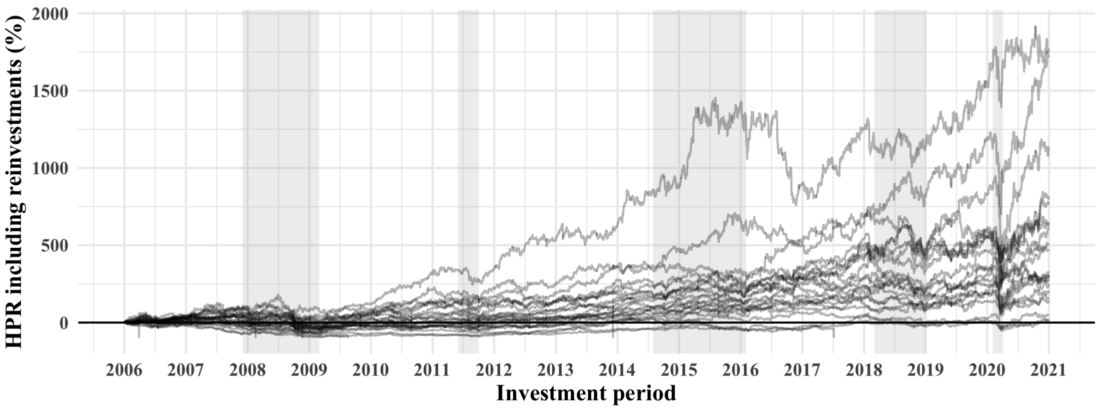

Figure 6.10: Strategy P3–H2–R1's individual asset HPR including reinvestments.

While strategy P3–H1–R1 reinvests into the index when a company stops trading, holding strategy H2 reinvests these amounts into the remaining portfolio assets. Since the amounts are invested in such a way that the weights of the investments do not change, the only considerable difference between figure 6.9 and figure 6.10 is that higher amounts are invested into each remaining investment.

Table 6.9: Overview of strategy P3–H2–R1.

	Portfolio
No. companies	
Start	26
Cyclical	14
Defensive	3
Sensitive	9
End	21
Exposure and returns (%)	
Asset weight, max	22.19
Asset weight, min	0.33
Best annual return	39.5
Worst annual return	–35.5
Price criterion score	
Min	15.10
Median	49.12
Max	108.65

Table 6.10: Absolute and relative performance of strategy P3–H2–R1.

	Local	Global
Risk-unadjusted returns (%)		
HPR, portfolio	406.7	406.7
HPR, benchmark	168.6	113.9
Holding period excess return	238.1	292.8
CAGR, portfolio	11.43	11.43
CAGR, benchmark	6.81	5.20
Risk-adjusted returns		
Risk-free rate (%)	2.25	2.64
Asset beta	0.99	0.89
Jensen's Alpha (%)	4.65	6.51
Information ratio	0.77	0.85
Other metrics (%)		
ΔCAGR	4.62	6.23
COR	89.9	82.6
AOR	73.3	80.0

However, considerable differences arise performance-wise. Precisely, since the investment pool is chosen with pricing strategy *P*3, which delivers higher returns than the benchmarks, strategy P3–H2–R1 delivers a 25.9 % and 30.8 % points higher portfolio HPR than strategy P3–H1–R1 (studying with reinvestments into the local versus the global benchmark, respectively). However, the beta is nearly identical, so alpha has also increased—by 38 and 49 basis points against the local and global benchmark.

Some metrics are mainly unaffected by the chosen reinvestment method. For instance, the information ratio is largely unaffected, and the same applies to the COR and AOR. However, there are no noteworthy differences between the two strategies except that strategy P3–H2–R1 delivers higher returns, and it can be concluded that when certain investments stop trading, P3–H2–R1 strategy is a better alternative than reinvesting the amounts into the index. It is also more reasonable for a portfolio manager to reinvest any amounts into the remaining portfolio than reinvest them into the index from a practical perspective. Hence, holding strategy H2 should be favored over H1 regardless of the pricing and holding strategy.

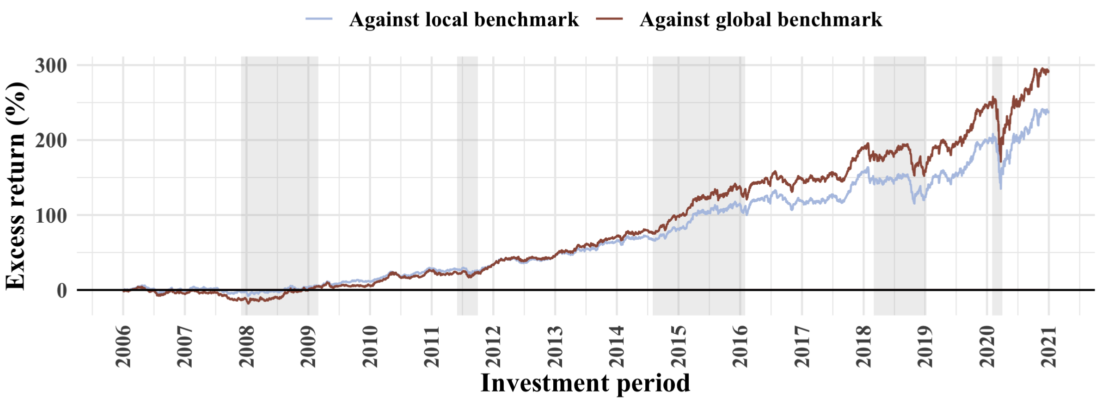

Figure 6.11: Strategy P3–H2–R1's cumulative excess returns.

6.2.3 Holding Strategy 3: Sell–Index

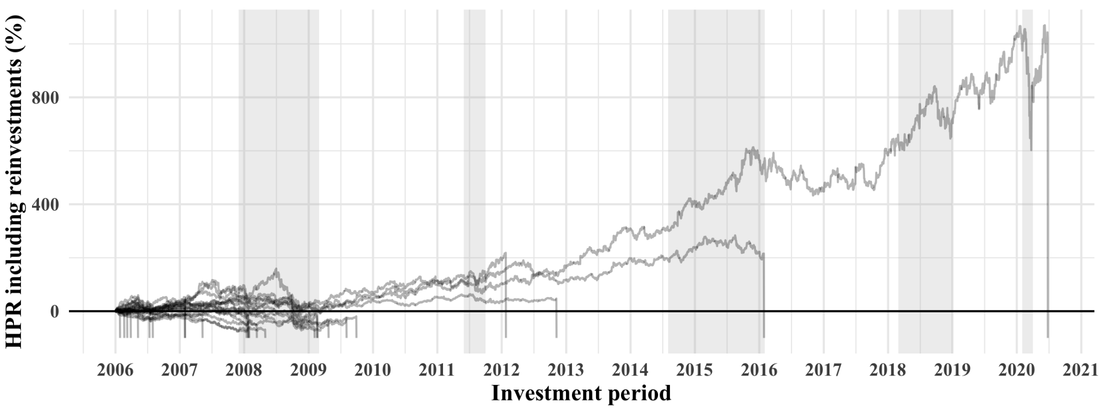

Figure 6.12: Strategy P3–H3–R1's individual asset HPR including reinvestments.

The third holding strategy involves selling a portfolio investment the first day it violates any SEEDS criteria, refusing any re-entry for the rest of the investment period, and then reinvesting the proceeds into the index. For example, figure 6.12 shows how the HPR develops for all 26 companies until no more investments were left in the portfolio in 2020. The steep HPR decline at the end of each investment period indicates that the investment is being sold in total and ends with a final holding period return of –100 % because of the sale.

Table 6.11: Overview of strategy P3–H3–R1.

No. companies	Portfolio
Start	26
Cyclical	14
Defensive	3
Sensitive	9
End	0
Exposure and returns (%)	
Asset weight, max	100
Asset weight, min	1.36
Best annual return	32.5
Worst annual return	–38.9
Price criterion score	
Min	15.10
Median	49.12
Max	108.65

Table 6.12: Absolute and relative performance of strategy P3–H3–R1.

Risk-unadjusted returns (%)	Local	Global
HPR, portfolio	218.8	166.4
HPR, benchmark	168.6	113.9
Holding period excess return	50.2	52.5
CAGR, portfolio	8.04	6.75
CAGR, benchmark	6.81	5.20
Risk-adjusted returns		
Risk-free rate (%)	2.25	2.64
Asset beta	0.98	0.95
Jensen's Alpha (%)	1.34	1.68
Information ratio	0.40	0.43
Other metrics (%)		
ΔCAGR	1.23	1.55
COR	83.1	73.9
AOR	73.3	73.3

Although the strategy delivers outperforming results, they are not as promising as the results from the previously studied strategies (except for strategy P1–H1–R1). As table 6.12 shows, the portfolio is still less volatile than the market, but alpha is substantially lower than past strategies with only 134 and 168 basis points outperformance against the local and global benchmark. However, since the CAPM model assumes a well-diversified portfolio, and there are only two companies left in the portfolio during the second half of the investment period, both the beta and the alpha may be misleading. Instead, studying the information ratio shows a decently good score but not nearly as good as previous strategies.

While a strategy that sells all investments during the investment period may not be that interesting to study for a single cohort, holding strategy H3, which invests frequently, may make more sense for a portfolio manager to consider. Specifically, a portfolio manager may invest both in 2006, and in cohorts of the following years. Eliminating investments that violate any SEEDS criteria will reduce investments from each cohort, but new investments are likely added to the portfolio pool every year. Thus, the holding strategies that involve selling when a criterion is violated may provide insights into how well the remaining companies performed. Also, it may indicate how well a portfolio that invests into new cohorts every year could potentially have performed. However, as specified in the previous section, it may be more relevant for a portfolio manager to reinvest the funds into the remaining portfolio, not an index—studied in the following section.

6.2.4 Holding Strategy 4: Sell–Portfolio

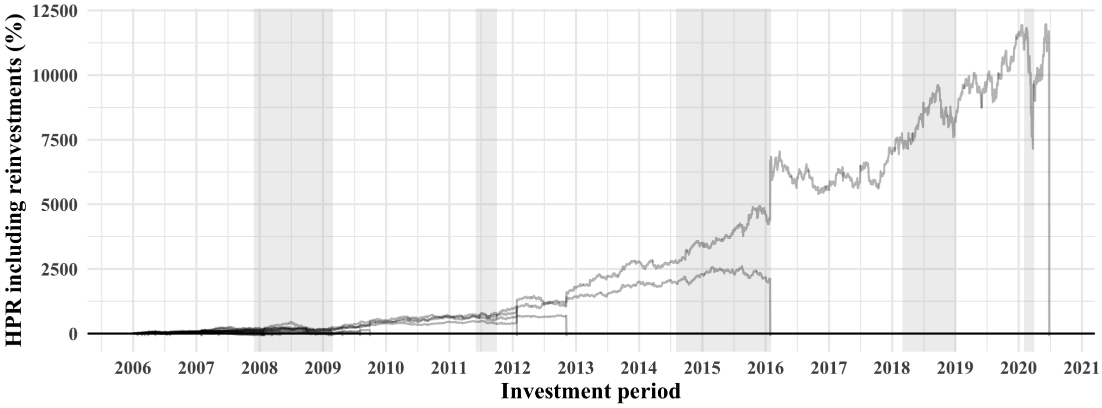

Figure 6.13: Strategy P3–H4–R1's individual asset HPR including reinvestments.

In comparison to holding strategy P3–H3–R1, amounts are reinvested into the portfolio. Thus, although the two strategies have the same weight exposure in each asset, the difference between the two is that the invested amounts in each company are substantially higher in holding strategy H4. This can be seen from the *y*-axis in figure 6.13 and compared against figure 6.12.

Table 6.13: Overview of strategy P3–H4–R1.

No. companies	Portfolio
Start	26
Cyclical	14
Defensive	3
Sensitive	9
End	0
Exposure and returns (%)	
Asset weight, max	100
Asset weight, min	1.36
Best annual return	46.9
Worst annual return	–37.1
Price criterion score	
Min	15.10
Median	49.12
Max	108.65

Table 6.14: Absolute and relative performance of strategy P3–H4–R1.

Risk-unadjusted returns (%)	Local	Global
HPR, portfolio	442.2	453.7
HPR, benchmark	168.6	113.9
Holding period excess return	273.6	339.8
CAGR, portfolio	11.93	12.09
CAGR, benchmark	6.81	5.20
Risk-adjusted returns		
Risk-free rate (%)	2.25	2.64
Asset beta	0.93	0.85
Jensen's Alpha (%)	5.43	7.26
Information ratio	0.40	0.51
Other metrics (%)		
ΔCAGR	5.12	6.89
COR	77.2	71.9
AOR	66.7	66.7

Moreover, table 6.13 indicates substantially higher portfolio HPR than strategy P3–H3–R1 achieved (table 6.13). Hence, it outperformed the previous strategy by 223,4 and 287,3 against the local and benchmark, respectively. Moreover, with a higher portfolio HPR, identical benchmark returns, and lower betas, the alpha also improves substantially—from 134 and 168 basis points in strategy P3–H3–R1 to 543 and 726 basis points in strategy P3–H4–R1. Hence, strategy P3–H4–R1 performs substantially better than P3–H3–R1. However, since the CAPM model assumes a well-diversified portfolio, which is not the case for strategy P3–H4–R1 after the Great Recession, these metrics cannot be given too much weight. Nevertheless, the portfolio delivers substantially better returns than strategy P3–H3–R1.

Additionally, this strategy is prone to overfitting because the returns depend on how well the last few companies perform. Since NIKE Inc.—one of the best performers in the cohort—was the only remaining investment in the portfolio for the last four years of the investment horizon, it is natural that the portfolio also performs well for this cohort. Whereas past performance is no guarantee of future returns, this is likely even more true for strategy P3–H4–R1 if applied to other cohorts than if following any of the other holding strategies.

6.2.5 The Chosen Pricing–Holding Strategy

Given pricing strategy P3 and rebalancing strategy R1, Graham's perspective of selling an investment when it violates any SEEDS criteria outperforms the market when reinvesting the proceeds into an index and portfolio. For the sell–index holding strategy (H4), the outperformance was the greatest of all holding strategies across multiple key metrics. However, its performance is sensitive to the few remaining portfolio investments, primarily since no more cohorts are considered in this analysis. Additionally, the alpha should not be given too much weight for strategy H4 because few companies remain in the portfolio after the financial crisis.

Munger's holding philosophy (H1 and H2) is favored when emphasizing the information ratio as it delivers a substantially higher number. Additionally, since the other performance metrics are favorable for strategy P3–H1–R1 and P3–H2–R1 and it is reasonable for a portfolio manager to reinvest any proceeds back into the portfolio, the recommendation of this section is to proceed with the hold–portfolio holding strategy (H2).

As a result, the following section will assume pricing strategy P3 and holding strategy H2 when evaluating various rebalancing strategies.

6.3 Rebalancing Strategies

The previous sections explored seven strategies that all assumed no rebalancing. However, as seen from the tables presented with each strategy, the maximum asset exposure can grow large.

For instance, for strategy P3–H2–R1, the most considerable asset weight at any given time was 22.19 % in a portfolio holding between 21 and 26 investments. This high asset exposure calls for analysis on rebalancing efforts. On this topic, Zweig (Graham and Zweig, 2006, pp. 104–105) writes in a commentary chapter, "The key is to rebalance on a predictable, patient schedule—not so often that you will drive yourself crazy, and not so seldom that your targets will get out of whack".

Achieving an easy-to-manage rebalancing strategy is the focus of this section. To make rebalancing simple, all assets invested are rebalanced back to the same asset weight.

6.3.1 Rebalancing Strategy 1: No Rebalancing

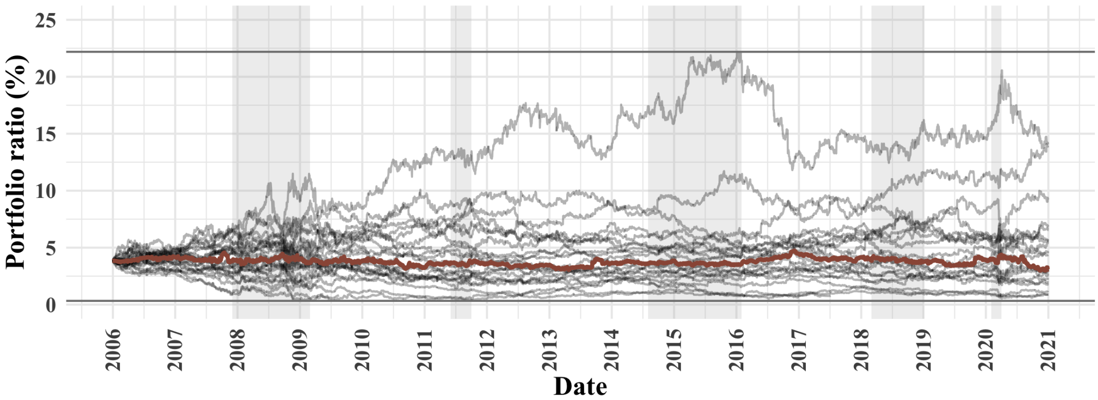

Figure 6.14: Strategy P3–H2–R1's individual asset exposure in portfolio.

Strategy P3–H12-R1 was analyzed in section 6.2.2 on page 63 and are not covered in detail again. However, to illustrate the effect that the following rebalancing strategies will have on the variation in portfolio weights, figure 6.14 is provided as a comparison. As can be seen from the figure, particularly the years at the end of the Great Recession caused a few companies to appreciate so much in value that they made up a substantial portion of the entire portfolio. For instance, at the end of 2020, Novo Nordisk and NIKE Inc. combined 27.9 % of the portfolio.

This increased risk exposure to certain investments can also be observed by the red line, representing the median investment's weight on any given date. The line is slightly decreasing over time, although the reduced number of tradeable companies from 26 to 21 companies should have increased the median weight, all else held equal. The fact that the median investment decreased, from 3.85 % at the start of the investment period to 3.08 % at the end of the investment period, indicates how the risk exposure has changed over time.

6.3.2 Rebalancing Strategy 2: Annual Rebalancing

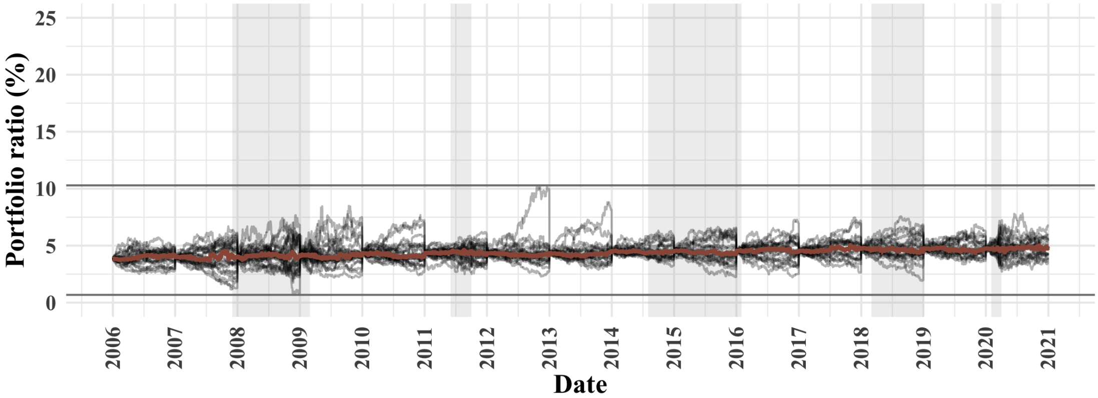

Figure 6.15: Strategy P3–H2–R2's individual asset exposure in portfolio.

So far in this thesis, all strategies have involved a no rebalancing strategy. A considerable downside with all the previous strategies has been that the exposure to specific investments such as Novo Nordisk and NIKE Inc. grew large while other investments such as Sears and Kate Spade & Co decreased to almost zero. Since the literature frequently mentions annual rebalancing as an often-used method, this rebalancing strategy is tested out next on the 26 investments selected from the P3 pricing strategy.

Table 6.15: Overview of strategy P3–H2–R2.

No. companies	Portfolio
Start	26
Cyclical	14
Defensive	3
Sensitive	9
End	21
Exposure and returns (%)	
Asset weight, max	10.29
Asset weight, min	0.68
Best annual return	43.8
Worst annual return	–34.8
Price criterion score	
Min	15.10
Median	49.12
Max	108.65

Table 6.16: Absolute and relative performance of strategy P3–H2–R2.

Risk-unadjusted returns (%)	Local	Global
HPR, portfolio	468.9	468.9
HPR, benchmark	158.3	113.9
Holding period excess return	310.6	355.0
CAGR, portfolio	12.29	12.29
CAGR, benchmark	6.53	5.20
Risk-adjusted returns		
Risk-free rate (%)	2.25	2.64
Asset beta	1.12	1.00
Jensen's Alpha (%)	5.26	7.10
Information ratio	0.74	0.81
Other metrics (%)		
ΔCAGR	5.76	7.09
COR	89.2	82.6
AOR	73.3	73.3

Compared to strategy P3–H2–R1, the upside exposure to single assets decreases substantially. Specifically, P3–H2–R1 had a maximal asset exposure of 22.19 %—illustrated by the upper horizontal line in figure 6.14—with Novo Nordisk on January 6^{th} 2016. In comparison, the maximal exposure in strategy P3–H2–R2 was only 10.29 %, which PulteGroup Inc. achieved on October 21st 2012.

Despite annual rebalancing reducing the exposure of great performers such as Novo Nordisk and NIKE Inc., portfolio P3–H2–R2 delivers the best returns of all portfolios analyzed so far, delivering a rebalancing bonus of 86 basis points. In addition, the beta surprisingly increases substantially, in which the beta is above one as the first strategy analyzed so far.

Nevertheless, since the nominal return increased substantially against strategy P3–H2–R1, from a CAGR of 11.43 % per year to 12.29 per year in the annual rebalancing strategy, alpha also increased. Specifically, when comparing against a local benchmark, alpha was 61 basis points higher with annual rebalancing than no rebalancing when comparing against a local benchmark, and 59 basis points higher when comparing against a global benchmark. It is also interesting to note that annual rebalancing had only a marginal effect on COR, meaning that rebalancing did not have much effect to help the portfolio eliminate its underperformance against the benchmark during the Great Recession. This point can be seen by comparing figure 6.16 with figure 6.11.

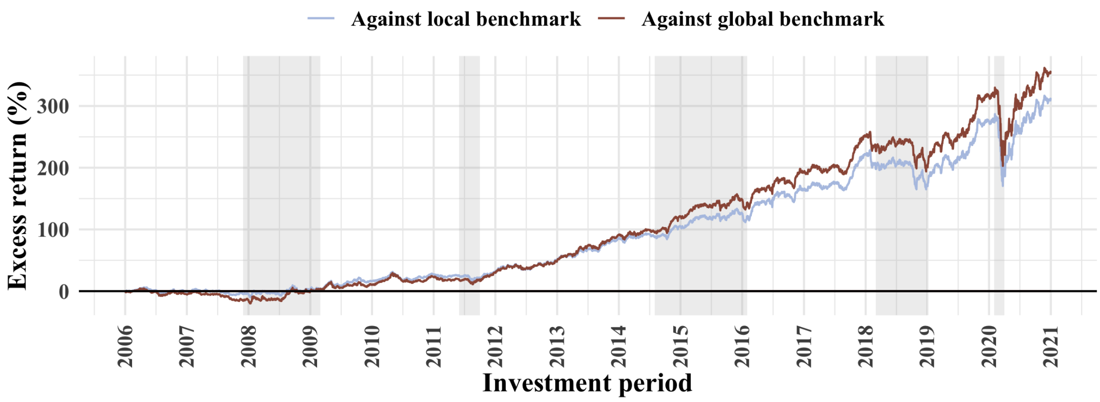

Figure 6.16: Strategy P3–H2–R2's cumulative excess returns.

6.3.3 Rebalancing Strategy 3: Monthly Rebalancing

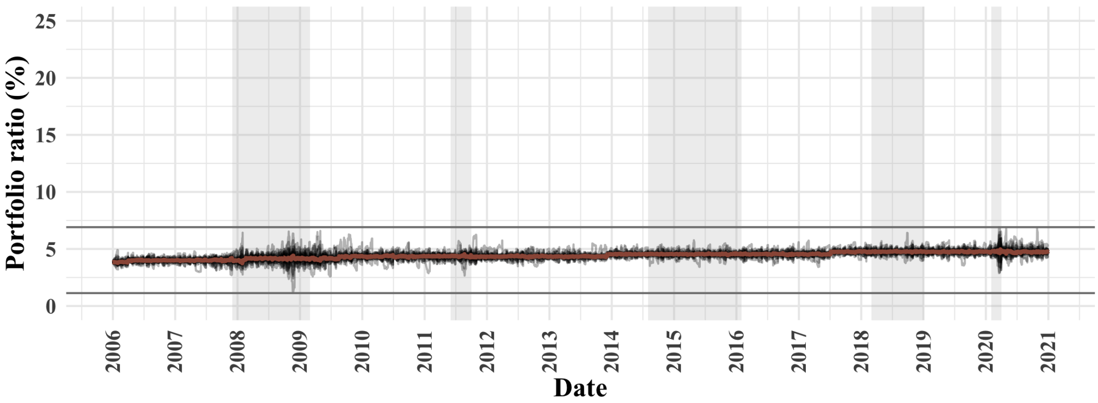

Figure 6.17: Strategy P3–H2–R3's individual asset exposure in portfolio.

Another commonly mentioned rebalancing method in the literature is the monthly method. This method may be favored compared to an annual rebalancing strategy by investors who are mainly concerned with not deviating too much from the target weights. For example, the highest asset exposure in strategy P3–H2–R2 was approximately 2.7 times higher than the target weight. By rebalancing more often, then, the individual asset exposure can decrease further.

Table 6.17: Overview of strategy P3–H2–R3.

No. companies	Portfolio
Start	26
Cyclical	14
Defensive	3
Sensitive	9
End	21
Exposure and returns (%)	
Asset weight, max	6.91
Asset weight, min	1.13
Best annual return	46.9
Worst annual return	–34.9
Price criterion score	
Min	15.10
Median	49.12
Max	108.65

Table 6.18: Absolute and relative performance of strategy P3–H2–R3.

Risk-unadjusted returns (%)	Local	Global
HPR, portfolio	495.5	495.5
HPR, benchmark	159.0	113.9
Holding period excess return	336.5	381.6
CAGR, portfolio	12.63	12.63
CAGR, benchmark	6.55	5.20
Risk-adjusted returns		
Risk-free rate (%)	2.25	2.64
Asset beta	1.14	1.02
Jensen's Alpha (%)	5.47	7.39
Information ratio	0.77	0.84
Other metrics (%)		
ΔCAGR	6.08	7.43
COR	88.2	81.3
AOR	80.0	80.0

With a maximum asset exposure of 6.91 %, the largest asset exposure has reduced to approximately 1.8 times the target weight. Moreover, the HPR improved more than strategy P3–H2–P2 did, delivering close to 500 % return over 15 years with a marginally higher beta. Hence, the alpha increased further to 5.47 % and 7.39 % against the local and global benchmark, respectively, a 21 and 29 basis point improvement against the annual rebalancing. Of all rebalancing strategies, monthly rebalancing delivers the highest rebalancing bonus with 119 basis points.

Although both the nominal return and the alpha improved, in addition to a better information ratio and AOR, I do not recommend the monthly rebalancing strategy over the annual rebalancing strategy. The reason is that compared to the annual rebalancing strategy, monthly rebalancing delivered 26.6 percentage points higher portfolio HPR under the assumption of no transaction costs. However, assuming 26 transactions every period (ignoring the fact that five companies stop trading during the investment period) leads to 390 transactions when rebalancing annually, whereas that number increases to 4680 transactions if rebalancing monthly. Hence, the transaction costs will likely eat up the additional HPR earned when rebalancing monthly compared to annually. Additionally, such a systematic rebalancing strategy as monthly rebalancing violates Graham's advice of being a defensive investor that spends only a few hours a year administering her portfolio (Graham & Zweig, 2006). Hence, I will advise against choosing a monthly rebalancing strategy despite the seemingly better returns that are listed in table 6.17.

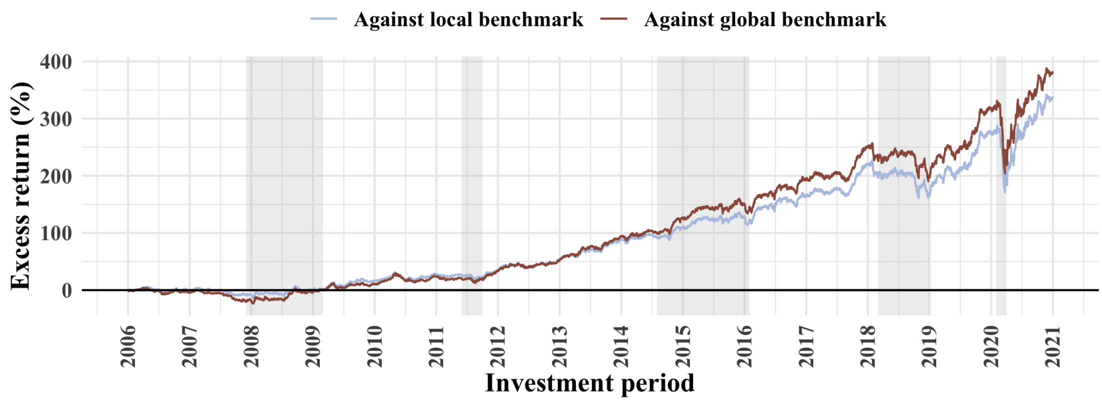

Figure 6.18: Strategy P3–H2–R3's cumulative excess returns. Final HPR is particularly high for the monthly rebalancing strategy when assuming no transaction costs.

6.3.4 Rebalancing Strategy 4: Threshold Rebalancing

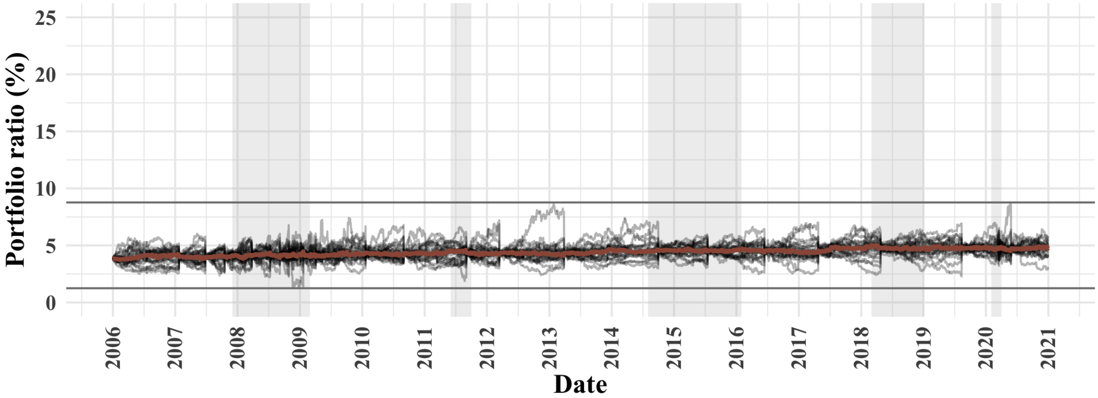

Figure 6.19: Strategy P3–H2–R4's individual asset exposure in portfolio.

A third commonly used rebalancing method is rebalancing when the portfolio deviates from the target weights by a certain amount. For rebalancing strategy R4, I specify that this threshold is set to when the sum of the absolute deviations surpasses 15 percentage points.

Table 6.19: Overview of strategy P3–H2–R4.

No. companies	Portfolio
Start	26
Cyclical	14
Defensive	3
Sensitive	9
End	21
Exposure and returns (%)	
Asset weight, max	8.77
Asset weight, min	1.25
Best annual return	42.9
Worst annual return	–33.8
Price criterion score	
Min	15.10
Median	49.12
Max	108.65

Table 6.20: Absolute and relative performance of strategy P3–H2–R4.

Risk-unadjusted returns (%)	Local	Global
HPR, portfolio	470.1	470.1
HPR, benchmark	159.5	113.9
Holding period excess return	310.6	356.2
CAGR, portfolio	12.30	12.3
CAGR, benchmark	6.56	5.20
Risk-adjusted returns		
Risk-free rate (%)	2.25	2.64
Asset beta	1.13	1.01
Jensen's Alpha (%)	5.16	7.09
Information ratio	0.72	0.79
Other metrics (%)		
ΔCAGR	5.74	7.10
COR	88.8	82.3
AOR	80.0	80.0

For strategy P3–H2–R4, a rebalancing occurs three times in 2007, four times in 2008, twice in 2009 and 2010, once each year from 2011 to 2019, and finally twice in 2020. Unsurprisingly, the thresholds are frequently passed during times of distress, such as the Great Recession and the COVID-19 stock market crash in 2020. However, compared to annual rebalancing–which has 15 rebalancings compared to the threshold rebalancing strategy's 22—most performance measures are practically equal, with the rebalancing bonus deviating by only 1 basis point, except for a decreased asset exposure range in the threshold rebalancing. This is natural since the thresholds were calculated on a sum of absolute deviations basis with a low threshold of only 15 %. However, despite the similarities in results between annual and threshold rebalancing, it is essential to highlight that this result may be primarily a coincidence for this particular cohort and may deviate more for later cohorts. Moreover, considering that most threshold rebalancing occurred during the Great Recession, more considerable performance differences between annual and threshold rebalancing are likely.

6.3.5 Rebalancing Strategy 5: Annual Rebalancing Excluding Low Performers

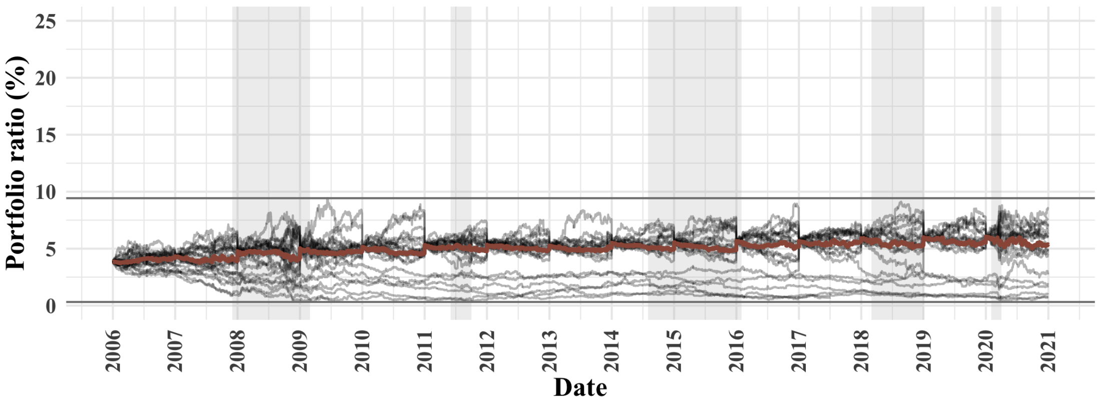

Figure 6.20: Strategy P3–H2–R5's individual asset exposure in portfolio.

A downside of rebalancing all portfolio investments when the investing style is defensive, including no further analysis of each company besides the initial SEEDS and price criterion screening, is that the portfolio may include some companies that consistently underperform. This insight calls for a rebalancing strategy that applies annual rebalancing but does not rebalance the lowest 25 % of the underperformers as measured by HPR. The effect of this strategy can be seen in figure 6.20, in which the underperformers are only rebalanced again if they deliver high returns for a more extended period of time so they are not part of the bottom 25 % of performers.

Table 6.21: Overview of strategy P3–H2–R5.

No. companies	Portfolio
Start	26
Cyclical	14
Defensive	3
Sensitive	9
End	21
Exposure and returns (%)	
Asset weight, max	9.43
Asset weight, min	0.42
Best annual return	44.5
Worst annual return	–34.6
Price criterion score	
Min	15.10
Median	49.12
Max	108.65

Table 6.22: Absolute and relative performance of strategy P3–H2–R5.

Risk-unadjusted returns (%)	Local	Global
HPR, portfolio	471.4	471.4
HPR, benchmark	158.3	113.9
Holding period excess return	313.1	357.5
CAGR, portfolio	12.32	12.32
CAGR, benchmark	6.53	5.20
Risk-adjusted returns		
Risk-free rate (%)	2.25	2.64
Asset beta	1.04	0.93
Jensen's Alpha (%)	5.60	7.30
Information ratio	0.90	0.93
Other metrics (%)		
ΔCAGR	5.78	7.12
COR	90.1	83.3
AOR	80.0	73.3

When comparing against the results presented in table 6.15 on page 69, strategy P3–H2–R5 outperforms strategy P3–H2–R2. Specifically, although HPR is practically the same in the two strategies, the beta is reduced with the modified rebalancing strategy, which further improves the alpha to 5.60 % and 7.30 % against the local and global benchmark, respectively. The rebalancing bonus is the second highest with 89 basis points, although it is substantially lower than the rebalancing bonus from the monthly rebalancing strategy at 119 basis points. Additionally, the information ratio increases substantially, from 0.74 and 0.81 to 0.90 and 0.93 when compared against the local and global benchmark, respectively. Moreover, while the AOR increases with one more year of outperformance against a local benchmark, COR and AOR are almost identical for the two strategies. According to the results presented in table 6.22 then, a defensive investor who will not undergo a thorough analysis of the investment portfolio may therefore prefer a rebalancing strategy R5 in which money will not repeatedly be poured into the consistent underperformers.

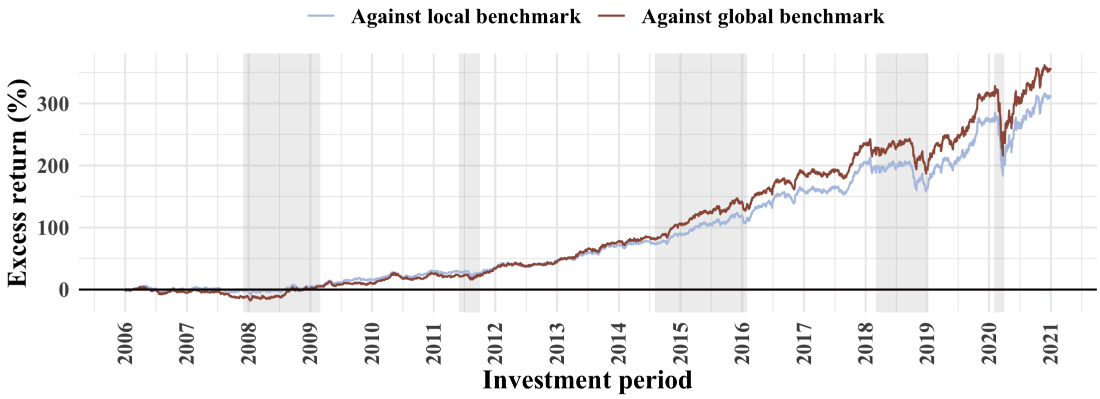

Figure 6.21: Strategy P3–H2–R5's cumulative excess returns. The strategy outperforms the market—and by a substantial amount—in five of six bull periods, and underperforming slightly in one. For the five bear periods, the strategy underperforms in two—of which heavily during the COVID-19 stock market crash in 2020—outperforms in two, and performs equally well in one.

6.4 P3–H2–R5—The Chosen Strategy

This thesis aims to answer whether the 2006 cohort of companies that respect the SEEDS criteria outperform the market in the investment period from 2006 to 2020. But, more importantly, the thesis also aims to formulate a hypothesis of an investment strategy that can be tested against more future cohorts and preferably perform well. Hence, identifying a general but well-performing strategy has been a more critical focus of this thesis than identifying the single best-performing strategy.

Such a general, well-performing strategy was achieved with strategy P3–H2–R5, both when compared against a locally constructed benchmark and compared against a global benchmark–the MSCI World–that is well-recognized as the reference index for many internationally focused mutual funds.

The portfolio is dominated by US stock listings—with 18 companies listed in the USA, three in Japan, and one in each of Canada, Denmark, France, Norway, and Sweden. Even though the majority of the companies in the strategy belongs to the consumer cyclical and industrial sector (as can be seen in table 6.23), it can still be said that all the portfolio alternatives studied in this thesis have an international, non-sector-specific focus. Using a global benchmark as the comparison is, therefore, a good decision. Hence, when studying strategy P3–H2–R5–LCY-G, it can be concluded that higher returns are achieved with less volatility than the benchmark.

Table 6.23: Investment pool with corresponding sector and country exposure for strategy P3–H2–R5. The † symbol indicates that the stock stopped trading during the investment period.

Sector	Companies	Names
Basic materials	4	ArcelorMittal Dofasco Inc. (Canada)†; Reliance Steel & Aluminium (USA); UFP Industries Inc. (USA); Vulcan Materials Co. (USA)
Communication services	0	
Consumer cyclical	9	H & M Hennes & Mauritz AB. (Sweden); Harley-Davidson Inc. (USA); Kate Spade & Co LLC (USA)†; Kellwood Co LLC (USA)†; Leggett & Platt Inc (USA); NIKE Inc. (USA); PulteGroup Inc. (USA); SEB SA (France); Thor Industries Inc (USA)
Consumer defensive	1	Orkla ASA (Norway)
Energy	0	
Financial services	0	
Healthcare	2	Becton Dickinson and Co. (USA); Novo Nordisk A/S (Denmark)
Industrials	6	Cintas Corp (USA); Illinois Tool Works Inc. (USA); Molex LLC (USA)†; Parker.Hannifin Corp. (USA); Secon Co Ltd (Japan); WW Grainger Inc. (USA);
Real estate	1	Centex LLC (USA)†
Technology	3	Intel Corp (USA); Nomura Research Institute Ltd (Japan); Rohm Co Ltd (Japan)
Utilities	0	

6.5 The Chosen Strategy's ESG Risk Exposure

Table 6.24: ESG risk summary of strategy P3–H2–R5–LCY-G (Sustainalytics, 2021a).

Min	1Q	Median	3Q	Max	Mean	Global average	NA
14.8	17.5	21.2	28.9	48.7	24.6	22.3	5

Table 6.25: ESG risk classification of strategy P3–H2–R5–LCY-G (Sustainalytics, 2021a).

Neglibible risk	Low risk	Medium risk	High risk	Severe risk	NA
0	9	8	2	2	5

Although the portfolio has a large representation of sectors that are often considered ESG-unfriendly—according to Sustainalytics (2021a)—the portfolio investments does not deviate much from the global average and are primarily classified as low or medium risk as per 2021. As can be seen from table 6.24 and 6.25, last updated April 15th 2021, the global Sustainalytics universe of 13,829 companies has an average ESG risk 22.3, while the portfolio (ignoring missing values for five of the companies) has an average ESG risk score of 24.6.

Two companies in particular—Reliance Steel & Aluminium Co. and Leggett & Platt Inc.—increases the mean substantially with ESG risk scores of 43.9 and 48.7, respectively. However, while these are the only two companies in the portfolio being labeled as having a severely high ESG risk, the risk is representing their industry more than the company. Specifically, Reliance Steel & Aluminium Co. and Leggett & Platt Inc. are ranked 49th and 68th in their industries containing 144 and 109 companies, respectively[1].

Table 6.26: Absolute ESG rankings of companies in strategy P3–H2–R5–LCY-G.

Min	1Q	Median	3Q	Max	Mean	Global universe	NA
956	1816	3422	7343	13,138	4946	13,829	5

Considering the portfolio as a whole, the portfolio performs well on Sustainalytics' rankings. Specifically, out of 13,829 companies in the database, the portfolio at large has a mean ranking ranking of 4946 and a median rank of 3422. If the mean represents the portfolio at large, the portfolio would therefore rank among the top 36 % performers in the universe. The best-performer ESG-wise has a rank of 956 (Nomura Research Institute Ltd.), whereas the worst performer (Leggett & Platt Inc.) has a rank of 13,138. These numbers place Nomura among the highest 7% ranked companies and Leggett & Platt among the lowest 5% ranked companies in Sustainalytics' global universe.

Table 6.27: ESG industry rankings of companies in strategy P3–H2–R5–LCY-G.

	Min	1Q	Median	3Q	Max	Mean	NA
Industry rank	4	24	46	113	295	73,3	5
Relative industry rank (%)	2.40	5.71	24.16	44.44	62.39	28.42	5

When studying each company's ESG risk exposure against the peers of their respective industries in table 6.27, the results improve further. Specifically, the mean rank within the industry is among the 28.42 % best ranked companies, and the median rank is lower with 24.16 %. The

[1]On May 24th 2021, Sustainalytics updated their review of Reliance Steel & Aluminium, in which it now ranks 12th in the industry with a low-risk score of 18.7 (Sustainalytics, 2021b). Hence, of the two initial severe ESG risk companies in the portfolio, only Leggett & Platt Inc. remains.

worst industry-specific performer is Leggett & Platt with is 68^{th} position of 109 peers, whereas the best performer (W.W. Grainger Inc.) ranks the best both on an absolute and a relative level within the industry with an industry rank of 4 among all 167 traders and distributors.

Although certain companies in the portfolio contribute negatively to the ESG risk exposure, it is fair to say that the chosen portfolio provide a generally low-to-medium ESG risk, and that some of these companies are among the ESG lodestars within their industries. Therefore, it can be concluded that the outperforming results provided by strategy P3–H2–R5 does not come at the expense of ESG considerations.

6.6 The Efficient Frontier

Throughout the thesis, all portfolio strategies involve having the same investment weight into each company. However, risk-averse investors prefer to achieve a given level of return at the lowest risk possible, and investing an equal amount into each company may not achieve this aim. Therefore, it is relevant to study the efficient frontier and the corresponding weights into the portfolio companies to explore how far away from the efficient frontier that the chosen strategy P3–H2–R5–LCY-G actually is.

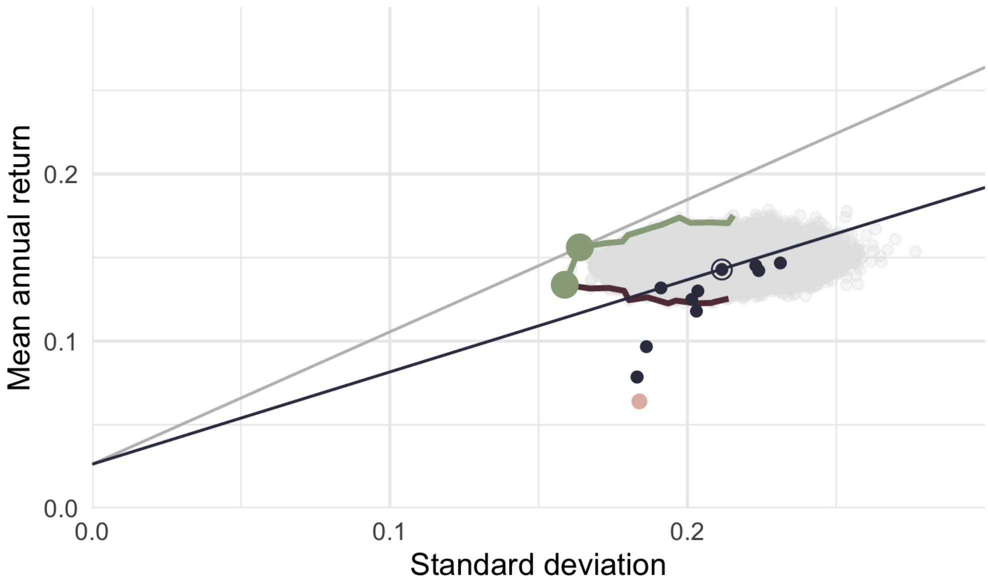

Figure 6.22: The efficiency frontier, global benchmark, and explored strategies.

Figure 6.22 illustrates the efficient frontier of strategy P3–H1–R1–LCY-G. 100,000 randomized portfolio weights were drawn, and every company in the portfolio is required to have at least some amounts invested since they were all part of the portfolio. While it would be favourable to illustrate the efficient frontier for the chosen strategy, P3–H2–R5–LCY-G, it would take considerable rewriting of the necessary R code to produce an accurate frontier for a strategy that both reinvests funds to the remaining portfolio and also involves rebalancing. Hence, as a simplification, the efficient frontier for the related strategy P3–H1–R1, with the same portfolio investment but a hold–index and no rebalancing strategy is analyzed and visualized.

The strategy performances are also highlighted in the plot. The pink dot represents the global benchmark with the same target weights that were applied throughout this chapter for pricing strategy P3, with an annual return of 6.4 % and a standard deviation of 18.4%. The 11 black dots represent the portfolio strategies that were analyzed in this chapter. As the figure shows, every strategy outperforms the global benchmark in terms of average annual return, and almost all of the 11 strategies deliver higher average returns at the expense of higher risk. However, one of these strategies—P3–H3–R1–LCY–G—also dominates the global benchmark by providing a lower standard deviation and higher annual return, while all the other strategies give a higher standard deviation and a higher annual return. Hence, a risk-averse investor would not have chosen to invest in the global benchmark considering the fact that the global benchmark is dominated by one of the strategies. However, which of the other strategies to choose depends, among others, on the investor's level of risk aversion.

Moreover, the selected portfolio strategy P3–H2–R5–LCY–G is encircled with a border line in figure 6.22. Among all strategies, both this strategy and strategy P4–H1–R1–LCY–G provide the highest Sharpe ratio of 0.55, and they are tangent with the black line.

However, each of the evaluated strategies are far from being efficient, which is illustrated by their distance to the efficient frontier. The reason for this is primarily because of equal weighting of the portfolio investments, while the weights along the efficient frontier differ substantially. For instance, the optimal risk portfolio has a portfolio weight standard deviation of 3.66 percentage points. Since the average is 4.76 percentage points, the weights vary substantially. By allowing the weights in the portfolio to differ, the portfolio would have moved closer to the efficient frontier and consequently calls for future research to be conducted if future cohorts deliver promising results similar to what have been found in this thesis.

Additionally, despite the fact that the efficient frontier was produced with strategy P3–H1–R1 and only 100,000 samples were drawn, two important insights can be drawn from the efficient frontier. First, the minimum-variance portfolio achieves an average annual return of 13.4 % with a standard deviation of 15.9. With a risk-free rate of 2.64 %, the Sharpe ratio in the minimum-variance portfolio is 0.68. Second, the boundary point to the CAL gives the highest Sharpe ratio of all the portfolio combinations. This portfolio gives a return of 15.6 % per year and a standard deviation of 16.4 %, which results in a Sharpe ratio of 0.79. These number stand in stark contrast with the recommended strategy P3–H2–R5, which delivers a Sharpe ratio of

0.55 from an average of 14.3 % return at a standard deviation of 21.2 %.

Table 6.28: Strategies' risk–return performances and corresponding Sharpe ratios. All except the four strategies highlighted with • deliver higher returns for higher levels of risk. Standard deviation and average numbers in percent, and portfolios delivering the highest Sharpe ratios are highlighted with an asterisk.

Strategy	Std deviation	Average	Sharpe ratio
P3–H3–R1–LCY–G	18.3	7.9	0.29
P3–H3–R1–LCY–G	18.3	7.9	0.29
P1–H1–R1–LCY–G	18.6	9.7	0.38
P4–H1–R1–LCY–G	19.1	13.2	*0.55
P3–H1–R1–LCY–G •	20.1	12.5	0.49
P2–H1–R1–LCY–G •	20.3	11.8	0.45
P3–H2–R1–LCY–G •	20.3	13.0	0.51
P3–H2–R5–LCY–G	21.2	14.3	*0.55
P3–H2–R2–LCY–G	22.3	14.5	0.53
P3–H2–R4–LCY–G •	22.4	14.2	0.52
P3–H2–R3–LCY–G	23.1	14.7	0.52

6.7 The Chosen Strategy's Currency Exposure

Throughout the thesis thus far, all investments have been valued and measured against their local currency. However, for any investor, measuring each investment in a local currency is inaccurate as long as the portfolio contains investments in multiple countries, which is the motivation for the international CAPM model. Hence, this section will study the main differences in portfolio performance that occurs when assuming the investor is running the investment portfolio from a certain country.

Table 6.29 studies performance differences between the local currency (LCY), Norwegian Crowns (NOK), and the currencies of four major finance centres of the world—New York (USD), Frankfurt (EUR), Zürich (Switzerland), and London (GBP). In other words, it is assumed that a portfolio is operated from any of these five locations, measuring the portfolio value through any of their corresponding currencies.

Table 6.29: Currency performance evaluation of strategy P3–H2–R5.

		Annual returns						
Ticker	Min	1Q	Median	3Q	Max	Mean	HPR	CAGR
USD	–34.44	3.93	16.64	23.35	44.51	14.32	474.89	12.37
NOK	–35.79	3.59	16.23	22.88	44.06	13.43	395.12	11.25
EUR	–35.16	3.88	16.38	23.15	44.54	13.90	444.00	11.95
CHF	–34.02	4.19	16.44	23.32	44.82	14.30	477.12	12.40
GBP	–35.57	3.76	16.35	23.17	44.41	13.82	433.64	11.81
LCY	–34.59	3.93	16.64	23.30	44.46	14.29	471.42	12.32

Table 6.29 shows primarily two interesting findings.

First, the summary statistics of annual returns show no large differences across the various currencies, with the exception that USD and CHF delivered equally high mean annual returns as LCY whereas the other three currencies delivered a markedly lower (but still high) mean return. This is a promising result because it indicates that the selected portfolio is still able to outperform the market despite the large currency fluctuations that occurred with certain currency pairs, such as USD–EUR, over the last 15 years.

Second, although there are mostly smaller differences within the summary statistics of annual returns, it is important to remember that these returns compound over a 15-year period. Hence, seemingly small differences in the annual returns may cause larger changes in the holding period return. Table 6.29 shows that this is indeed the case, with the HPR ranging from 395.12 % when nominated in NOK to 477.12 % when nominated in CHF. When annualizing these returns, a portfolio nominated in NOK delivered 11.25 %, whereas a portfolio nominated in CHF delivered 12.40 % annually. Compared to the local currency, only portfolios nominated in USD and CHF achieved approximately the same total return, whereas portfolios nominatedd in NOK, EUR, and GBP delivered reduced results.

Consequently, while the choice of location and corresponding currency does have some effect in nominal returns, the differences are not large enough to pose a large risk for strategy P3–H2–R5. Nevertheless, if a location should be chosen, then operating the 2006 cohort of the selected strategy from Switzerland would have provided the highest nominal returns in the investment period January 1^{st} 2006 to December 31^{st} 2020. Hence, strategy P3–H2–R5–CHF–G has presented itself as the preferred one for the 2006 cohort.

6.8 Analyzing All 960 Strategy Alternatives

A final relevant question is how sensitive the performance measures are to different pricing, holding, rebalancing, benchmark, and currency alternatives when tested against many alternatives. The main findings of the key metrics are summarized as follows.

First, the information ratio performs consistently well across currencies, benchmarks, and rebalancing strategies. However, holding strategy H1 and H2 delivers consistently high information ratios with a median value of 0.71 and 0.72 across all strategy alternatives, respectively. With these holding strategies, no portfolios delivered a negative information ratio. Moreover, all pricing strategies except for P1 deliver consistently high results, whereas P1 ranges from an information ratio of –0.58 to 0.26. Hence, from the perspective of achieving a high information ratio, it is advisable to choose any pricing strategy besides P1 and the holding strategy H1 or

H2.

Second, the alpha is particularly sensitive to the choice of rebalancing strategy and in the negative direction. This is largely caused by pricing strategy P1, which consists of a high ratio of consistently underperforming investments. Interestingly, only rebalancing strategy R5 avoids this problem, demonstrating its usefulness. With rebalancing strategy R5, the worst achieved alpha out of all strategy alternatives still achieves a positive alpha (0.01 %), whereas the highest achieved alpha was 7.57 %. Additionally, both holding strategy H1 or H2 also produce positive alpha values across all alternatives. Hence, from achieving a high alpha, it is advisable to choose rebalancing strategy R5 and holding strategy H1 or H2.

Third, the beta is not particularly variable to a group of strategies, but is particularly variable to pricing strategy P1 and holding strategy H3. Interestingly, many strategies can achieve a beta of approximately 0, which are all caused by choosing pricing strategy P1. Moreover, the highest beta values typically occur for pricing strategy P4, holding strategy H1 and H2, and rebalancing strategy R5 with mean beta values of 0.93, 0.89, 0.88, and 0.90, respectively. These values are generally lower than the beta of the chosen strategy P3–H2–R5.

In short, testing all 960 alternatives indicates that to achieve the highest information ratio and alpha, strategy H1 or H2 should be chosen. Additionally, there are indications that any pricing strategy except P1, in addition to rebalancing strategy R5 delivers good results. However, these choices comes at the cost of higher volatility, although the volatility is less than the return compensation. Overall, the chosen strategy P3–H2–R5 is a well-performing strategy among all alternatives.

Chapter 7

Conclusion

This thesis aimed to answer the research question, "Are companies that meet Graham's SEEDS criteria delivering a risk-adjusted excess return, and does a Graham–Munger investment style produce any improved performance?"

Two key considerations have been kept in mind to answer the research question. First, to explore if companies respecting the SEEDS criteria perform consistently well across a range of investment strategies to avoid cherry-picking strategies. The research question was attempted to answer by studying a range of strategies across multiple pricing, holding, and rebalancing strategies in detail, with an extra focus on the choice of currencies and comparisons against two benchmarks. All portfolios showed promising results—confirming the first part of the research question—although multiple strategies had structural weaknesses, as discussed in the results chapter.

The second key consideration was to identify one strategy that performs well and is general enough to be tested on future cohorts with hopefully similar results. Therefore, the chosen strategy was P3–H2–R5, or P3–H2–R5–CHF-G if currency and choice of the benchmark are also included. This strategy involves investing equal amounts in all companies that meet the SEEDS criteria, which fits with Munger's investment style, except for those with unnaturally high or low price criterion scores. Moreover, the strategy involves holding the portfolio throughout the entire investment period and adhering to Munger's investment style. If a company stops trading for a particular reason, the sales proceeds were reinvested into the portfolio and not the index. Additionally, the portfolio is rebalanced annually, but the lower 25 % performers are not rebalanced to protect the defensive investor from continuously pouring large amounts into companies that constantly underperform.

For the 2006 cohort, strategy P3–H2–R5 outperformed the market substantially along with all reported metrics, delivering higher returns with 26 investments at lower risk than the market when compared against a global benchmark. Against the global benchmark using a local currency, the strategy delivered an annual alpha of 7.30 %, which was produced primarily because of a high portfolio CAGR of 12.32 %, a decent but not impressive benchmark CAGR of 5.20 %, and a low beta of 0.93. The total holding period return over 15 years was 471.4 %, whereas the benchmark's holding period return was 113.9 %. Moreover, the portfolio outperformed consistently well throughout the investment period, delivering an information ratio of 0.93, outperforming the market in 11 of the 15 years (AOR of 73.3 %), and delivering a positive cumulative excess return for 83.3 % of the days in the investment horizon. This steady performance was positively affected by the rebalancing strategy—achieving a rebalancing bonus of 89 basis points—albeit at the expense of a slightly worse AOR. Although no thorough analysis of bull and bear markets was undertaken, the strategy generally outperformed the benchmark in bull periods and performed equally well during the bear periods.

Moreover, the strategy achieved this result without being heavily exposed to any single asset. Specifically, due to annual rebalancing of the top 75 % performers, the largest asset exposure at any point in time was 9.43 %, which is approximately 2.5 times higher than the asset target weight. Operating a portfolio from the preferred country, Switzerland did not pose large performance effects due to currency fluctuations, either, with the portfolio CAGR increased from 12.32 % to 12.40 % when the chosen currency was implemented.

Finally, although there are multiple high and severe ESG-risk companies in the portfolio, the portfolio poses no immediate concern from an ESG perspective as most companies belonged in the low- or medium-risk category. Since this strategy also performed better than most portfolios and the benchmark—with additional risk-adjusted returns being possible to achieve if discarding the equal-weighting principle—the second part of the research question has been confirmed.

However, while the strategy performed well for the 2006 cohort, it is still important not to get overly excited about the results. Most importantly, similar results with the same investment strategy may not be achieved when applied to later cohorts. Although a general investment strategy was chosen in the hopes of avoiding an overfitting strategy, the strategy still has a large exposure to the USA, with almost 70 % of the initial investments being stock-listed in the USA. Additionally, the strategy was heavily exposed to consumer cyclicals and industrials, in particular, two sectors that represented 58 % of the initial investments. Hence, the performance of an equal-weight portfolio against a global benchmark could be heavily affected by the general performance both in the US stock market and within these two sectors.

The efficient market hypothesis—particularly the semi-strong form—also indicates that outperforming the market in future cohorts should not be possible. On the other hand, Warren Buffett is a strong advocate that there are frequent inefficiencies in the market that can be exploited because the prices are ultimately set by the person who is the most emotional, the greediest, or the most depressed—and that it is challenging, then, to argue that the market is rationally priced (Buffett, 1984). Buffett goes further, saying, "Ships will sail around the world, but the Flat Earth Society will flourish. There will continue to be wide discrepancies between price and value in the marketplace, and those who read their Graham & Dodd will continue to prosper" (Buffett, 1984, p. 15).

Ultimately, the empirical findings from this thesis cannot conclude in either direction. Instead, more research needs to be conducted on future cohorts before anything conclusive can be said about this investment strategy. For the time being, then, the results from investing strategy P3–H2–R5 should be treated as a mere hypothesis for further testing.

Fittingly enough, Munger's investment philosophy—to invest by "sitting on your ass"—forms the acronym SOYA. Hence, I want to propose that the selected investing strategy P3–H2–R5 gets the more personal name "the SOYA SEEDS investment strategy". This name then refers to the strategy of Sitting On Your Ass investing in all companies meeting requirements of Size, Earnings stability, Earnings growth, Dividend records, and Strong financial conditions—except for those with an unnaturally high or low price criterion score. Additionally, reinvestments are done into the remaining portfolio, and all but the lowest 25 % performers are rebalanced annually. Then the SOYA SEEDS strategy is the hypothesis that will be tested on multiple future cohorts to ultimately identify whether the efficient market hypothesis or its critics may prevail in this branch of the value investing research tree.

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