Master Thesis

Value and Momentum Investing in the European Markets

Understanding if value and momentum strategies can be used in combination to increase excess return of an investment portfolio

- Evidence from the STOXX Europe 600 Index

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Abstract

Through a cross sectional analysis of the 600 largest Pan-European equities over the period from January 1999 through December 2014 the study finds that value investors have been rewarded, while momentum investors have experienced insignificant returns, which favour the efficient market postulates. Further, it appears that a combined value and momentum portfolio remains superior and exhibits lower risk exposure. Consequently, an equal-weighted 50/50 portfolio of value and momentum stocks outperforms on a risk-adjusted basis. The main explanation rests on the fact that value and momentum returns correlate negatively with each other, whereby the overall portfolio volatility is reduced.

The findings are based on a holding period of six months, a monthly rebalancing frequency and an approach that focuses on all equities in the STOXX Europe 600 index in the beginning of each year throughout the sample period. The equal-weighted value portfolio is constructed using the Fama and French methodology of buying the cheapest and selling the most expensive stocks measured by book-to-market ratio and using 30 pct. as breakpoint. The equal-weighted momentum portfolio is based on a ranking of the past 2-12 months, skipping the most recent month’s return, as it is standard in the momentum literature to evade the common 1-month reversal effect.

Moreover, the study stress test the findings through changing the weighting scheme and imposing sector neutrality. When applying market value weights rather than an equal-weighted portfolio, the value-premium also becomes insignificant. Finally, the study evaluates the impact of applying an industry-neutral approach similar to Moskowitz and Grinblatt (1999), because the value portfolio exhibits a distinct industry bias towards financials but underweight consumer services and the health care industry. Imposing sector neutrality confirms that an equal-weighted portfolio that combines value and momentum outperforms all other strategies on a risk-adjusted basis. Also, it gives no clear indication that the performance of a pure momentum or a pure value strategy is weakened when taking account for industry effects.
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1. Introduction and background

Among finance academics and professionals, two of the most studied capital market phenomena focus on the relation between an asset's return to its ratio of "long-run" (e.g. book) value relative to its current market value, called the "value" effect, and the relation between an asset's return and its recent performance, termed the "momentum" effect after the study by Jegadeesh and Titman (1993). These two strategies are a key example of the fruitful exchange of ideas between academic research and investment practice. The findings from academic studies have formed the basis for investment styles that are widely used in equity markets. In addition, excess returns from hedge funds have initiated further research and fueled the market efficiency debate.

Value investing stems back to 1928, where Ben Graham and David Dodd taught at Columbia Business School about the principles of buying undervalued securities and selling over-valued securities. The valuation was often based on some type of fundamental analysis such as market-to-book value or price-to-earnings multiples. Most renowned became one of their students, Warren Buffet, who has become a legend for his investment approach based on the core principles of value investing.

At the other end of the investment spectrum, momentum investing rests on the roots of the relation between an asset's return and its recent performance history. Momentum strategies seek to exploit the on-going continuation and reversal trends of an asset's price, and it has become an increasingly popular field of research within the last few decades. Pedersen (2015) argues that the intuition is based on the idea that the performance will continue more often that it will be reversed, which basically implies buying securities that have recently performed well and selling securities that have recently performed below average.

But if past performance is an indication of which assets that will produce abnormal returns in the future it violates the core assumptions of the efficient market hypothesis (EMH) as suggested by Eugene Fama’s (1965, 1970), which is among the most basic finance theories taught at business schools around the world. Advocates of classical finance theories argue that these anomalies are merely deviations from the efficient market equilibrium. Nonetheless, price momentum has been proven to exist among different markets and asset classes, see for example the study by Asness, Moskowitz and Pedersen (2013). Hence, the existence of price momentum premia implies some sort of irrational investment behaviour. Students of capital markets theory primarily attribute the explanation to behavioural biases such as the case
around earnings announcements, where the fact that information travels slowly or investors are irrational and underreact to new information, both of which give rise to a negative or positive drift in stock prices.

Until more recent studies, most research on market anomalies examined value or momentum strategies separately. Later years, more literature has focused on the effects of examining them jointly as for instance Leivo and Pätäri (2009) and Clifford, Moskowitz and Pedersen (2013). Also, these studies have mainly focused on longer historic periods, ranging from 25-40 years. The purpose of this research paper is to extend the UK study by Larsen (2014) and clarify the benefits and possible gains of applying value and momentum strategies in a more recent setting on the European equity markets.

1.1. Research questions and objectives

The following research question summarizes the overall purpose of the study:

*How can investors apply value and momentum strategies to increase excess return of their investments, and how have such strategy performed in the European markets since 1999?*

The overarching research question takes form as a case study of the STOXX Europe 600 Index. Consequently, the research design emanates from both the descriptive and exploratory method. Further, it is convenient to divide the overarching research question into three to five sub questions to clarify and structure the overall problem:

1. What is meant by momentum and value investments, and why do some theorists and professionals argue that one can do even better by combining these two strategies?
2. How are momentum and value strategies designed?
3. What are the theoretical explanations for the existence of momentum and value premiums?
4. How have the strategies performed during the last fifteen years through both prosperous and less fortunate periods with financial turbulence?

From the research community’s point of view, research objectives are generally more practicable than general questions because research objectives give a better sense of direction and purpose (Saunders et al. 2009, p. 34). Therefore, each of the four sub-questions is briefly elaborated in the following sections.
1.1.1. Value and momentum investing

In order to understand the underlying drivers of the strategies, it is necessary to explain the characteristics of the strategies and their joint relation. The first sub question is based on the descriptive method and searches to define the area of interest and the background of momentum and value strategies. Further, exploring the logic behind the strategies makes it easier to approach the subsequent research questions, as the theoretical framework supports how momentum and value strategies are implemented in the financial markets, which is explored in the second sub question.

1.1.2. How to construct the investment strategy

To evaluate value and momentum performance there is no theoretical and complete standard measure. Selecting indicators is a balance between coming up with the best predictors of returns and maintaining a simple and fairly uniform approach. Therefore the second research objective is to understand how value and momentum strategies are formed in practice on the basis of composite value and momentum measures.

This is important because different academics and practitioners have their angle to approach the investment strategies. For example, Fama and French (1992) suggested using the common book-to-market ratio \((B/M)\) as value measure, which is applied in mostly all later value investing studies. Alternatively, value strategies can rest on other value indicator such as price-to-earnings \((P/E)\) ratios [see Rousseau and Van Rensburg (2004), Bird and Whitaker (2003)] as well as price-to-sales (Bird and Casavecchia, 2007) or price-to-cash flow ratios. Furthermore, Leiro and Pätäri (2009) rested their study on EBITDA/EV multiple with evidence from the Finnish equity market. For example, they argued that EBITDA/EV more efficiently takes the leverage differential between companies into account than price-to-earnings does.

When implementing the momentum strategy, studies have shown the importance of two factors: The length of the past performance period, and the subsequent holding period. Scholars have tested and debated both of these intensively. However, it seems that the majority of academics argues that using the past 2-12 months is the most prudent and sound measure for the momentum effect. Most scholars have agreed to avoid the 1-month reversal in stock returns, the so-called mean reversion effect, because of short-term liquidity or microstructure issues (Asness, Moskowitz and Pedersen, 2013; Novy-Marx, 2012A). Nonetheless, to understand these findings, it is necessary to explore it further.
1.1.3. Explanation of value and momentum effect

If it was that easy to beat the market from past returns, everyone would exploit the information until it is arbitrated away. Yet, the momentum effect violates that fundamental principle, and runs counter the predictions of the efficient market hypothesis. While practitioners have benefitted from this strategy for decades, the idea has gained broad acceptance in the academic community only within the past 20 years after Jegadeesh and Titman (1993) published their study academic paper ‘Returns to Buying Winners and Selling Losers: Implications for the Stock Market Efficiency’ with evidence from the U.S. equity market from 1965 to 1989. In addition, the momentum effect was identified in every stock market the efficient market advocates Eugene Fama and Kenneth French analysed from 1989 to 2011, except Japan (see Fama and French, 2011).

In general, it is surprising that a simple value strategy such as buying companies that are viewed as cheap measured by one or several value indicators has generated significant returns historically. But to implement the strategies in practice, it is often advantageous to understand the risk-based and behavioural explanations for the phenomenon. Therefore, the third research objective of the study is to explore how risk-based and behavioural models can explain value and momentum effects. These findings will thus be drawn from the findings of behavioural finance scholars and risk-oriented practitioners.

1.1.4. Historical performance and evidence from the European markets

While value strategies allow investors to profit from pessimistic market actors, momentum strategies allow investors to profit from its optimism. Or said differently, momentum tends to do well in periods where value does not, and vice versa. And because they are two sides of the same coin, both with excess return, Asness, Moskowitz and Pedersen (2013), or henceforth AMP (2013), suggested combining value and momentum in a portfolio to gain from their powerful diversification benefits.

However, although momentum looks good on paper, these strategies require high turnover, often in excess of 100 % in order to work (Bryan, 2013). Consequently, it increases transaction cost, which may dilute profits. Also, momentum does not work well when markets are rough and volatility rises. Thus, the strategy underperforms when it is most painful, that is, when one is losing money on other investments, and the risk of margin calls increases. Therefore, it is vital to explore how such value and momentum strategies, or a combination of both, perform in volatile markets such as under the global financial crisis in 2008 and the Dot-com bubble in 2000-2001.
Earlier studies mainly focused on the U.S. equity market (Jegadeesh and Titman, 1993; Lakonishok, Schleifer and Vishny, 1994 etc.), however, more recent research have focused on global stock markets as well as other asset classes, e.g. commodities and currencies (e.g. Asness, Moskowitz and Pedersen, 2013) or corporate bonds (e.g. Gebhardt, Hvidkjær, Swaminathan, 2005). The evidence shows that the momentum effect is robust not only across different time periods and stock markets, but also among different asset classes. But except for the U.S. studies, only few researchers have centred upon a single equity market like Leiro and Pätäri (2009), who tested how value performance could be enhanced with momentum strategies with evidence from the Finnish stock market, as well Larsen (2014) that focused on the FTSE 100 equity market.

Therefore, this study aims to validate the UK conclusions from Larsen (2014) with evidence from the broader European markets in contrast to several asset classes and global markets. In this case, it is straightforward to apply the STOXX Europe 50 or 600 Index to see if investors can benefit from value and momentum investments on individual European stocks. In other words, the fourth research objective is to identify how value and momentum strategies have worked on the European equity market from the late 90s to 2014. The benefits of focusing on a major index are twofold. First, the larger stocks are often more liquid, which reduces transaction costs when frequent rebalancing occurs. Second, it is probable easier to get access to the necessary information.

1.2. Overall research design

The description of the first three sub questions; the characteristics of momentum and value investments and an academic understanding of why these strategies tend to work in practice, will be based on an examination of the existing body of knowledge via secondary literature such as academic and professional journals. This is because academic journals are written by professionals and experts and target a narrow audience that is passionate about the area. Professional journals are published for their members by several dedicated organizations such as 'Journal of Asset Management' and 'Institutional Investor Journals'.

Answering the last sub-question requires both numeric and non-numeric data that can be analysed with quantitative methods. The research design as well as the methodology of the numerical analysis is elaborated in section 0 and 0.
1.2.1. Limitations of the study

As mentioned, the study strives solely to explore if a few single and uniform approaches of constructing value and momentum portfolios have proven to be profitable investment strategies in the European equity markets since the introduction of the Euro in 1999. Therefore, it is not the overall goal to find the most optimal value or momentum measures, since several other studies have already taken this approach. Further, the findings will mainly be based on equal-weighted portfolios rather than market capitalization weights.
2. Critical review of the academic literature

The first part of the literature review centres about value investing and highlighting the fundamental concepts, pros and cons as well as an overview of the extensive empirical studies. The second part explores momentum strategies, including the behavioural and rational explanations of the existence of the *momentum-effect*. Lastly, the third part elaborates how recent studies have focused on combining value and momentum strategies, before section three and four go into detail with the methodology and the European evidence of the study.

2.1. Value investing

A value investor will typically focus on equities and other securities that are undervalued in some way or out of balance compared to the fundamental value of the company. The value premium insinuates that ‘value stocks’ with low valuation measures (e.g. low market-to-book, price-to-dividend or price-to-earnings ratios etc.) tend to earn higher long-run returns than ‘growth stocks’, also known as ‘glamour stocks’, which tend to have higher valuation measures (Ilmanen, 2011).

The value investing approach has roots back to the Great Depression during the 30s, where a large range of investors experienced significant losses. The essence of value investing is to find securities that yield reasonable returns in combination with a margin of safety, if things go bad. Thus, a value investor live by the ideal that having right more often than not, on average, is not sufficient, as it is the extent to which you can limit the downside risk that matters (Kara, 2014). Or using the imagery as Kurt Kara, chief of Maj Invest Value Stocks, the captain of Titanic might have been right 99.9 pct. of the time, but sooner or later, all people do make mistakes, and hence, it is the amount of losses that counts.

Benjamin Graham from Colombia Business School was one of the investors during the Great Depression who puzzled over this concern together with his fellow colleague David Dodd. Today Graham is renowned as the father of value investing based on his book “Security Analysis” from 1934 and the bestseller “The intelligent Investor”, which was published in 1949. In both books Graham explains that one should only buy a share of a company when it is considered cheap, and when the company exhibits a strong and robust balance sheet that can survive headwind and a tough financial environment.
More or less, Graham’s novel ideas have endured all type of financial markets. This is evident when contemplating few of Graham’s students at Columbia Business School, e.g. Warren Buffet, who became one of the most successful investors in the world, as well as William Ruane and Irving Kahn etc. All three have implemented a variant of Graham’s value doctrine, despite the fact that the financial markets have developed and become more efficient since the 1930s, which tend to erode easy profits.

While modern portfolio theory considers volatility as a measure of risk, value investors consider volatility as an opportunity to buy a solid company cheaply, e.g. if the stock has fallen as a result of negative rumours or temporary troubles. However, despite the fact that the majority of the market comprises experienced and intelligent investors, a low price does not necessarily mean that the business plan is flawed. Instead, most value investors trade on their discretionary judgement and seize these moments as a bargain opportunity (Pedersen, 2015). And given that value investors often have a long-term investment horizon, value investors consider the probability of permanent capital loss as the true risk measure. Consequently, you often see that value portfolios perform relatively better than the overall market in times of distress, even though value investors likely have faced periods with price fluctuations and higher volatility.

In general, a value investor can be compared to carry investors, as value investors often look at dividend yield similar to equity carry traders. The carry of a stock is its dividend yield, and therefore, a carry investor looks for equities with high dividend payout ratios, while underweighting those with lower dividend yields. It corresponds to a currency carry trader borrowing funds in low-interest rate countries, while investing the proceeds in high-interest rate countries, thus, betting against the well-known interest rate parity (IRP).

2.1.1. Be aware of the value trap

But value investing is harder than it may sound, because it means going against conventional wisdom (AMP, 2013). Normally, stocks tend to be cheap or expensive for a reason, and buying those nobody favours or shorting those that most people admire is never easy. This is expressed more elegantly in Graham’s fourth principle:

“Have the courage of your knowledge and experience. If you have formed a conclusion about the facts and if you know your judgement is sound, act on it – even though others may hesitate or differ” (Graham, 1973, p.286-7)
Finding cheap companies and locate promising investment opportunities require hard work and thoughtful consideration. When you buy a stock with a low price, for example, a high market-to-book value (equivalent to low book-to-market) or price-to-earnings, you must always ask yourself (Pedersen, 2015): ‘does the stock look cheap because it is cheap or because it deserves to be cheap?’ Hence, the value investor is somewhat a ‘bargain hunter’ that seeks to uncover the jewels in disguise that other investors somehow fail to recognize, and at the same time, avoid the flawed stocks whose underlying fundamentals truly fall apart. This is also known as the value trap, where the nightmare of a value investor is to buy a company whose price continues to fall and catch the so-called ‘falling knives’ (Truitt, 2013).

Take for example a pharmaceutical stock. It might appear cheap because the market participants have realized that it is subject to a costly lawsuit. Alternatively, it may turn out that one of its auspicious medical products fails the final phase in the clinical research trials, or the launch get postponed. As a consequence, the value investor can face large opportunity costs associated with holding a stock with great potential, but whose value takes an inordinate length of time to be recognized by the market.

Pedersen (2015) illustrates the value trap dilemma with the following line of thought. Consider that you buy a cheap stock because it has an unusually low price-to-book (P/B) value compared to historical values of similar firms, and because you believe the P/B will normalize over time. Does this mean that you will make money when buying the stock? Not necessarily! It depends whether it is the price or the book value that will adjust. Hence, the investor makes money, if the mean-reversion is driven by a higher stock price. But the investor loses money, if the mean-reversion is driven by a decreasing book value and bad performance, which make it live up to the market’s low expectations.

**Avoiding the value trap**

According to Warren Buffet, there is one simple and effective way to avoid the value trap. He claims that it is not essential to discover cheap and undervalued companies, but rather finding the right company with sound underlying fundamentals such as his life-long investment in Coca-Cola. It exhibits a true value investment with a long-term horizon. Actually, he has never sold Coca-Cola share, and he never intends to do so (Moye, 2013). It started when he as a seven-years-old entrepreneur in 1937 began to buy and sell six packs of Coca-Cola from his grandfather’s store for a quarter and sell the bottles at the corner of the street to thirsty neighbours for a nickel apiece. As his sentiment for Coca-Cola grew with the years, he became the single largest shareholder of Coca-Cola with a 9 pct. stake of
interest through his investment imperium, Berkshire Hathaway. His mentality is illustrated in the following quote:

‘I could give you other personal examples of a ‘bargain-purchase’ folly but I’m sure you get the picture: It’s far better to buy a wonderful company at a fair price than a fair company at a wonderful price.


Although, studies show that several value measures have been profitable on average, e.g. P/B, P/E and P/CF, some value trades still lead to losses as a result of the value trap. Pedersen (2015) states with reference to Warren Buffet’s quote that this investment failure can be mitigated, at least partially, by considering a stock's quality characteristics. But how do you actually decide whether a company is “good” and has a high quality?

According to Asness, Frazzini and Pedersen (2013), a stock’s quality can be characterized in four broad groups based on Gordon’s Growth Model – profitability (ROA), pay-out ratio, growth and required return. Therefore, a comprehensive value investor can screen the best investment opportunities by combining a hard value measure, say earnings yield (the reverse of P/E), with a quality measure like the profitability of the company measured by ROA or others.

2.1.2. Evidence from earlier research

Since Basu (1977) studied the price earnings ratio (P/E) anomaly, which reflects the observation that stocks with particularly low P/E ratios (the lowest decile) outperform high P/E stocks on a risk-adjusted basis, there has been considerable evidence confirming the existence of a value effect. Ilmanen (2011) expresses that the topic really caught academic attention in the early 1990s with two influential publications – Fama and French (1992) and Lakonishok, Schleifer, and Vishny (1994). These academic papers and a large body of other empirical studies specify that value stocks, on average, earn a higher return than growth stocks (e.g. Fama and French, 1998, 2011; Chan and Lakonishok, 2004; Asness, Moskowitz and Pedersen, 2013; Asness, Frazzini and Pedersen, 2013, etc.).

In general, the benefits of value investing is more prominent for small-cap stocks, but it is also present in large-cap stock markets. For instance, Fama and French (2011) examine value and momentum portfolios in developed markets and they experience a significant value premium in all four major regions: Asia Pacific, Europe, Japan and North America. More interesting, they find that except for
Japan, value premiums are larger for small stocks, which could mirror the fact that the small cap stock market is less liquid and not as efficiently priced as the market for larder stocks, which opens for arbitrage possibilities and easier return.

According to Ilmanen (2011), the Fama-French HML factor (High Minus Low) is one of the most applied benchmark for value stocks in academia. It is also known as the VMG (Value Minus Growth) factor, and it reflects a long-short portfolio. Nonetheless, the latter notation may be more intuitive, because it explicitly designates the company type, i.e. we go long value firms, while we short growth firms. Recall, that Fama and French use the book-to-market ratio, whereas academics and professionals both apply book-to-market as well as its reverse, market-to-book. Applying the VMG notation, one never mix up that value firms have high book-to-market ratios, whereas growth firms have high market-to-book ratios.

The Fama-French methodology is straightforward. They group all stocks into six categories with two groups indicating their size - either above or below the median market capitalization, and three groups based on their book-to-market ratios. Hence, the HML factor buys the cheapest 30 % of the stocks in both the large and small-cap category (“value stocks”) and sells the richest 30 % of the stocks (“growth/glamour stocks”). Thus, the VMG portfolio looks like:

\[
VMG = \frac{1}{2} \cdot (Small\ Value + Big\ Value) - \frac{1}{2} \cdot (Small\ Growth + Big\ Growth)
\]

Figure 2.1 illustrates the performance of a value portfolio and a momentum portfolio as well as a market portfolio based on the global Fama and French (2011) study from 1991 to 2010, whose factor returns are available and updated at Kenneth French’s homepage. Interestingly, value stocks underperformed growth stocks during the late 90s until the Dot-com Bubble burst in March 2000, where the over-optimism and investor sentiment about the prospects of technology and telecommunication stocks did not follow the fundamental patterns and was hard to reconcile with economic logic (Chan and Lakonishok, 2004). However, value stocks regained ground over the coming years.

In addition, the global market and momentum strategies took a big hit after Lehman defaulted in September 2008, although they have emerged noticeably since then. In contrast, the global value portfolio have lain flat for a decade and only gained 10 % since August 2004.
Figure 2.1. The cumulative outperformance of global value (value vs. growth) and momentum (winner vs. losers) strategies since 1991. Source: Ken.French Data Library (2014).

2.1.3. **Explanation of the value effect**

Although there is great agreement about the existence of a general value premium, there is less agreement as to why the anomaly exists (Chan and Lakonishok, 2004). Overall, there are two schools of thought: the traditional (or rational) finance versus behavioural finance that put up different explanations. Advocates of traditional finance like Fama and French (1992) first argued that markets are efficient, risk and return go hand-in-hand, and that value premia simply reflect a compensation risk, as value stocks are riskier than growth stocks. However, the evidence is blurred, and in the aftermath, academics have shifted their attention towards book-to-market ratios and company size as the leading explanatory variables for the excess return anomalies.

Taking the opposite view, behavioural finance advocates argue that mispricing may occur because market actors are not always rational but exhibit behavioural biases, such as human cognitive biases (e.g. Barberis et al., 1998, and Daniel et al., 1998), and agency costs of professional investment management, which are all root of the rewards to value investing (Ilmanen, 2011).

Yet, some argue that another cause for the value premium rests on methodological issues of data-selection bias (see Kothari, Shanken, and Sloan, 1995). However, a careful study by Chan, Jegadeesh, and Lakonishok (1995) suggest that no such bias can explain the performance differential of value and growth strategies.
Do value stocks have higher fundamental risk than growth stocks?

One explanation takes basis in alleged misspecification of the Sharpe (1964) and Lintner (1965) Capital Asset Pricing Model (CAPM), where earnings yield among other value measures are presumed to be proxies for some omitted risk factor (Basu, 1977, in Thaler, 1985). Fama and French (1996) claimed that stocks with low market-to-book ratios (value stocks) are more prone to financial distress, and consequently, are riskier than glamour stocks. They applied a version of the multi-factor asset-pricing model to attribute the higher returns of value stocks to a greater exposure towards a financial distress factor.

However, Chan and Lakonishok criticise their arguments and respond that ‘data snooping is considered to be a sin, and coming up with ad hoc risk measures to explain returns should be regarded as no less of a sin’ (2004: 75). In their study of US equity returns from 1968-90, they find that the value portfolio outperformed the growth portfolio, on average, by 10.7 percent points, and that these dissimilarities in returns were not accompanied by notable differences in risk measured by beta and volatility, as can be seen in Appendix 1. Furthermore, they highlight that these two key measures of risk, beta and volatility, may be rough proxies that do not capture all risk components. As a result, they related the returns in down-market months to back up their standing. These findings showed that even though market returns were negative, value stocks still outperformed glamour stocks. Yet, they do not reject the fact that there exist other proxies for risk.

More recent studies have also tried to relate the value premium with distress risk and credit risk using debt ratings or various bankruptcy indicators as variables. See for example, Avranov (2010) who argues that value investors can fairly easy try to weed out distressed firms from the universe of cheap stocks and pick the remaining low multiple stocks, which makes it difficult to reconcile with the rational risk story. This is also seen in Fama and French (1992, 1993) that simply remove companies with negative book value of equity from their sample. Hence, it appears that researchers find it challenging to pinpoint a meaningful risk concept that covaries with the value premium.

Ultimately, finance theory states that if losses co-vary with bad times, then any risk factor justifies a high-risk premium. At first glance, such risk factor could be compensation for liquidity risk. But in a study globally across asset classes Asness, Moskowitz, and Pedersen (2013) find that liquidity risk is negatively related to value strategies, but positively correlated with momentum strategies. Or said
differently, value stocks appear to limit the downside risk, since value investors do not lose as severely in down markets as momentum investors, when liquidity dries up and liquidity spread rises (Brunnermeier and Pedersen, 2009). This is also evident in Figure 2.1 above. Consequently, value stocks should not bear a liquidity premium in contrast to momentum stocks, and therefore, the positive value premium becomes an even deeper puzzle.

As Chan and Lakonishok (2004) conclude, if the superior performance of value stocks cannot be attributed to their risk exposure, then a more plausible explanation rests on the characteristics of human behaviour and agency cost related to portfolio managers.

**Behavioural considerations and agency costs**

Studies in psychology have implied that humans are prone to apply simple heuristics for decision making, which gives rise to the possibility of judgemental and human biases in investment behaviour. Particularly, investors may extrapolate past performance too far into the future creating a natural overreaction [see e.g. De Bondt and Thaler (1985) and Shefrin and Statman (1985)]. When the bad performance for the growth stocks then catches up with the too enthusiastic investor sentiment, the glamour stocks tend to underperform. By the same token, investors that are too gloomy about value stocks, they wind up being pleasantly surprised, or rather unpleasantly, if they acted on their disbelief (Chan and Lakonishok, 2004).

A continuation of the convergence of valuation ratios argument, Ilmanen states that value and growth stocks arranged by their P/B ratios, ‘tend to be at the opposite ends of the profitability spectrum’ (2011; 255). Whereas glamour and growth stocks tend to be profitable and investors believes them to continue this path, value stocks are less profitable end expected to remain so. Yet, low profitability is not sustainable, and extremely high profitability is not persistent, because competition inclines to erode growth firm’s profit advantage. Therefore, the price-to-book ratio of growth stocks incline to fall in the year(s) after portfolio formation, and those of value stocks tend to rise.

As the reader later will recognize in section 2.2.3.2, the behavioural literature is enormous. Still, academics and professionals tend to agree that the key behavioural drivers of the value premium are a result of too overoptimistic prospects of growth firms and too conservative prospects of value firms.
2.2. Momentum investing

Whereas value investors are going for bargain opportunities and buy stocks that look comparatively cheap, momentum investors seek to identify stocks with good (or bad) recent performance and hope for a continuation of the stock price movement (Pedersen, 2015). Therefore, momentum investing is more equivalent to growth investors attempting to buy interests in firms that are believed to experience prosperous growth in the future. And since these firms often have experienced promising news and substantial growth in the past, their stock prices have likely been climbing in value with growing P/E and P/B ratios. While the value investor might be selling such stocks that have been on the rise, the growth and momentum investor might be buying such stocks.

Investment strategies that seek to exploit the positive autocorrelation in stock returns, i.e. that prices continue in the same direction, are referred to as ‘relative strength’ strategies based on the original description by Jegadeesh and Titman (1993). Although in subsequent literature, it is more commonly referred to as momentum strategies. In line with the value strategies, the two determining factors of the momentum strategies are divided into the formation period and the holding period. The formation period is the past time period of which the stock returns are ranked, and the holding period is the time period in which the investor holds the momentum stocks. Naturally, the formation and holding period are variables that can be changed in length, but since momentum has shown to be more prevalent in the intermediate term (3-12 months) the duration of both formation and holding periods are generally within this range.

The intuition of the strategy is straightforward: Stocks that have performed well in the formation period are expected to continue to perform well in the holding period. In contrast, those stocks that have performed poorly in the past are expected to continue to do poorly in the future, and therefore, a momentum investor will underweight these stocks. Or more directly, a hedge fund may even take a short position to benefit from the expected price decrease, rather than underweighting the poor stocks.

Although momentum investor mentality contradicts the efficient market hypothesis (Fama, 1965), the evidence is too overwhelming to ignore, since practitioners have utilized this relationship for decades, while the academic community has shown obvious momentum returns within the past 20 years (Bryan, 2013). As the reader shortly will see, the existence of price momentum, its duration,
and its magnitude have been recognized in a series of empirical studies conducted on local and worldwide stock markets.

### 2.2.1. Momentum studies (Intermediate horizon)

When examining the historical performance of momentum strategies around the world, the evidence is sound. It underlies the old term within investment management: “Don’t fight the tape”, which means, do not bet or trade against the trend in the financial markets (Investorwords, 2014). Here, the “tape” relates to the ticker tape, which was applied at the stock exchanges from the 1870s to the late 1970s to transmit the price of stocks.

As mentioned, the fundamental concepts of momentum investing stems back to Jegadeesh and Titman (1993), who analysed the U.S. equity market from 1965 – 1989. They applied three ”$J \times K$-strategies”: a long, a short and a zero cost strategy, where they bought the best performing decile of stocks (top 10 %) and short-sold the worst performing decile of stocks. They formed a total of 48 portfolios based on the performance over the previous $J$ months and hold it for $K$ months, where $J, K \in \{3, 6, 9, 12\}$. Interestingly, they found that all statistics were positive, which indicates a positive correlation between the past and future returns, so-called ’positive autocorrelation’, for all holding periods of 3 to 12 months. They end up concluding that the $6 \times 6$ strategy is representative for the remaining strategies, equivalent to an average return of just below 1 % per month.

Six years later Jegadeesh and Titman (1999) assess their previous findings using data consisting of stock prices of the subsequent 8 years of their original sample. Yet, they continually find significant momentum returns akin to their earlier studies, which can counter-argue the main allegations of data mining or data-snooping, since their findings are robust out-of-sample, i.e., they test how the estimated sample statistics perform on a new data set, from which the model was not created in the first place.

That U.S. stocks have exhibited positive momentum returns like Jegadeesh and Titman concluded in 1993 and 1999 corresponds to the conclusions of several subsequent momentum studies throughout the world [see e.g. Rouwenhorst (1998) for a study of momentum in the European stock market; Liu, Strong and Xu (1999) for a study of momentum in the UK stock market; Griffin, Ji and Martin (2003) and Chui, Titman and Wei (2010) for global studies and Asness, Moskowitz and Pedersen (2013) for both local and global equity markets and different asset classes]. To highlight two findings, the worldwide study by Griffin et al (2003) concluded that the average monthly momentum profit for Europe
was 0.77 % (about 9.24 % per year) from 1975 -2000, which is somewhat lower than the 1.16 % per month Rouwenhorst (1998) found from 1980 through 1995 using six month formation period and six month holding period.

2.2.1.1. Other studies of momentum

Several subsequent studies have analysed how one can improve the abovementioned momentum profits without concentrating on the issues associated with standard risk-based models of expected return. For example, Chan, Jegadeesh, and Lakonishok (1996) explained that momentum returns co-exists with earnings momentum. Asness (1997) found that companies with high market-to-book ratio, i.e. growth or glamour stocks, produce improved momentum profits. Moreover, Daniel and Titman (1999) argued that such profitability stems from the large weight of intangible assets and the fact that investors are prone to overreact to news related to intangible assets, that is, growth prospects, brand and know-how (in Sagi and Seasholes, 2007).

Turnover and firm size

Moskowitz and Grinblatt (1999) demonstrated that industry momentum is significant, which Hou (2001) later argued to be as a result of slow information diffusion within industries. Hong, Lim, and Stein (2000) found that small firms with low analyst coverage exhibit higher momentum, which corresponds to the hypothesis that firm-specific information disseminate only gradually across the investing public. Lee and Swaminathan (2000) documented that momentum is more prevalent in stocks with higher turnover.

Also, Glaser and Weber (2003) test the positive autocorrelation of stocks in relation to stock turnover (volume) based on the German stock market from 1988 – 2001. Their research documents that stocks with larger turnover exhibit higher price momentum effects than stocks with a low turnover. Size, market-to-book and industry factors also contribute to price momentum but to a lesser extent than turnover.

The evidence from Grinblatt and Moskowitz (2004) also support these conclusions. They discovered that momentum is more predominant for small companies with a limited number of institutional owners, growth firms and firms with high volume. However, small capitalization stocks are often more illiquid and, unfortunately, more costly to trade. Consequently, a high trading frequency may dilute profits due to the increased transaction costs. This implies that momentum investors should
focus on the most traded small capitalization stocks, i.e. the small companies that experience the highest trading volume.

In contrast, Novy-Marx (2012) argues that momentum is more evident to large stocks, because the Fortune 500 companies exhibit a strong momentum. This is somewhat the opposite conclusion than Rouwenhorst (1998) and Fama and French (2011). The latter studies argued that the Winner Minus Loser spreads decrease from smaller to larger stocks, hence, momentum returns are larger for small companies.

Moreover, Sagi and Seasholes (2007) recognised three observable firm-specific attributes that drive momentum profits: revenue, costs and growth options. They concluded that momentum strategies that use firms with (1) high revenue growth volatility, (2) low costs (i.e. high profit margin), and (3) high market-to-book ratio as a proxy for the presence of high growth options outperformed traditional momentum strategies by approximately 5 pct. per year.

**Construction characteristics of momentum strategies**

Different approaches have been used to test for momentum effect. However, it seems that it has become convention among many researchers and traders to use stock returns over a trailing 12-months period. Further, the majority favour the method used as by Asness, Moskowitz and Pedersen (2013), where they use the historical 12 month stock return, while skipping the most recent month’s return to avoid the last month reversal effect. But similar to Grinblatt and Han (2005), the model can easily be extended and modified to apply several factors. For example, they extended the model to include the prior cumulative returns over a short (1-4 weeks), an intermediate (5-52 weeks) and a long-term (53-156 weeks) horizon of all ordinary common shares traded at NYSE and AMEX exchanges from 1962 to 1996. In addition, they also tested for possible volume effects calculated as the median turnover over the past 12 months and a factor reflecting a capital gains related proxy.

**2.2.2. Mean-reversal studies (Short and long-term horizon)**

A natural consequence of the existence of the momentum effect is that stock prices, eventually, correct themselves. Or as expressed in a statistical phrases, stock returns tend to exhibit negative autocorrelation for certain holding periods, so that ‘what goes up must come down’, and vice versa (Lo and MacKinlay, 1990: 185). As originally suggested by De Bondt and Thaler (1985, 1987), stock prices overreact to information, which implies that contrarian strategies also produce abnormal returns. Hence, buying past losers and selling past winners seems to be profitable for some holding
periods, as current winners are likely to become the future losers, and the current losers are likely to become the future winners.

Earlier studies have disclosed evidence of both short and long-term reversals. First, De Bondt and Thaler (1985) found that over holding periods of 3 to 5 year equities that have underperformed the previous 3 to 5 years would tend to outperform equities that have performed well over the same time horizon. Second, later studies by Jegadeesh (1990) and Lehmann (1990) propose that short-term contrarian strategies that select stocks based on the previous week or month also generate significant returns. Some scholars argue that these returns are a product of short-term price pressure or lack of liquidity, rather than overreaction (Jegadeesh and Titman, 1991).

After the classical papers by De Bondt and Thaler (1985), Jegadeesh (1990), and Jegadeesh and Titman (1993) among others, several explanation have been proposed to clarify these reversal and momentum phenomena. They range from data matters like data snooping biases and short-term microstructure issues, to rational risk-based explanations as well as irrational investment behaviour. These primary reasons will be explored in more detail in the following sections.

### 2.2.3. Explanations to the momentum effect

A brief search for the term “momentum” at the most well-known academic research databases obviously illustrates the extent of the current body of knowledge about the subject. For example, 607 results appear if you search for ‘momentum’ in the paper title at SSRN and 525 from EBSCO. Although many academics validate the existence of excess momentum returns, some academics still debate the underlying reasons for its existence (Frazzini, 2006)

Griffin, Ji and Martin (2003) state that the momentum phenomenon is unlikely to be explained neither by risk-based theories nor other rational explanations. Instead, behavioural explanations seem to have gained common acceptance in the research community. For instance, while Daniel, Hirshleifer, and Subrahmanyam (1998) explain how the momentum patterns can be a result of investors’ overconfidence and self-attribution bias, Barberis, Shleifer, and Vishny (1998), Hong and Stein (1999), and later Liu, Strong and Xu (2003) argue that the continuation of stock prices is a product of investors’ initial underreaction to information, especially regarding earnings announcements.
Since most evidence points toward the behavioural explanations, the following section will begin with an examination of the most apparent rational and risk-based explanations.

### 2.2.3.1. Rational and risk-based theories

Both empirical and theoretical literature have studied possible rational arguments for the continuation of stock returns like data mining and risk exposure. Nevertheless, the first-mentioned argument seems to be an unlikely explanation in the aftermath of the U.S. stock market study by Jegadeesh and Titman (1993, 1999) that proved “out-of-sample” evidence of momentum premia both geographically and temporally.

Consequently, one could wonder which other factors that drive momentum profits. Jegadeesh and Titman (1993) emphasize that momentum is not driven by market risk, since they find that the loser stocks have greater systematic risk (beta) relative to the past winners. Fama and French (1996) convey that their common three-factor model, which includes size (SML), value (HML) and market risk ($R_{m-t}$), cannot explain momentum either. Instead, more focus has been devoted to macroeconomic variables as well as cross-sectional variation and industry bias.

#### Macroeconomic drivers

The study by Chordia and Shivakumar (2002) investigates the ‘one-step-ahead forecasts’ obtained by projecting momentum profits onto lagged macroeconomic variables that are related to the business circle. They apply four ordinary macroeconomic variables: default spread, dividend yield, term structure spread and the yield on three-month T-bills. Their U.S. evidence indicates that momentum returns are entirely explainable using these four forecast variables.

In contrast, Griffin, Ji and Martin (2003) subsequently find no statistical evidence to support the claim that macroeconomic risk and price momentum are related. They apply an unconditional model and a conditional forecasting model to determine whether a macroeconomic risk variable can explain momentum. But their study finds that momentum is present in all macroeconomic situations no matter the GDP growth and the combined stock market movement, hence, they infer that macroeconomic factors cannot explain relative strength strategies.

#### Industry drivers

Moskowitz and Grinblatt (1999) analysed the positive time-series pattern anomaly from an industry perspective. Based on U.S. stock quotes from 1963-95 they document strong industry effects as a
primary factor of individual stock momentum. They argued that momentum strategies are far riskier than what was earlier argued, because past winners or past losers seem to be bundled in the same industries. Conclusively, they argue that industry momentum is a result of what behavioural finance scholars call ‘the herding effect’, as investors tend to flock to the same industries, quite similar to the nature of lemmings.

Likewise, Lewellen (2002) supports the conclusions of Moskowitz and Grinblatt (1999). He accentuates that cross-sectional variation, i.e., excess covariance between stocks in the same industry, is the principal explanation to price momentum. His findings demonstrate that stocks co-vary across industries, size and value factors.

2.2.3.2. Behavioural explanations

As a product of the difficulties linking momentum profits and risk-based stories, many scholars and professionals favour behavioural finance theory as the main explanation for the momentum effect. The behavioural supporters express that investors are prone to be too deeply rooted in their views and are slow to update their beliefs in response to new information. Numerous studies during the 90s have proven that stocks that outperform earnings expectations tend to have positive excess returns for several weeks succeeding the announcement. Equally, stocks that do not meet expectations tend to continue to underperform. This phenomenon is known as short-term momentum effect, which, as earlier mentioned, is a main factor for the existence of the long-term mean reversion (De Bondt and Thaler, 1995).

Two of the most quoted papers in the behavioural literature is the study by Barberis, Schleifer and Vishny (1998) and Daniel, Hirshleifer and Subramanyam (1998). They come up with two different explanations of how investor judgement biases can cause underreaction to some events, while underreaction to others. BSV (1998) ground their model on two cognitive psychology biases: representativeness bias and conservatism. The first-mentioned bias was originally suggested by Kahneman and Tversky (1982) and reflects that people give too much weight to recent patterns and too little to the properties of the population that generate the data. The latter bias, is attributed to Edwards (1968) and reflects that people tend to be too slow updating their models in response to new evidence and new information.

Despite the fact that the DHV (1998) model comes to the same conclusion, their behavioural foundation is different than the BSV model. Following the DHV view, markets comprise informed and unin-
formed investors, although, only the informed investors determine stock prices. However, the informed investors are typically subject to two human biases: (1) biased self-attribution, which makes them to down-weight public signals, especially when the signals contradict their own views and perceptions, and (2) overconfidence, which makes them exaggerate a stock’s growth prospects and, in consequence, its value. This overreaction to private information and underreaction to public information leads to short-term continuations and long-term reversals, when the public information eventually overwhelms the behavioural biases.

**Mental accounting and the disposition effect**

In addition to the above-mentioned behavioural finance studies where certain investor behaviour results in overreaction and underreaction of stock prices, other event studies propose that investors engage in irrational mental accounting (Thaler, 1984; Ginblatt and Han, 2005) and tend to change behaviour under uncertainty, as theoretically explained by Kahneman and Tversky (1979). Based on results obtained in a controlled experimental setting, Kahneman and Tversky argued that humans exhibit a certain behaviour pattern when considering risk and return. They found that people are averse to realize losses, and that decision-makers apply an s-shaped valuation function, which is concave in the domain of gains (i.e. risk averse in terms of gains) and convex in the loss domain (i.e. risk seeking in terms of losses). Grinblatt and Han (2005) further argue that a combination of prospect theory and mental accounting is perhaps the leading explanation for the disposition effect.

**Regret and inertia**

Besides prospect theory and mental accounting, Shefrin and Statman (1985) also highlight regret aversion and self-control as likely explanations to the irrational investment behaviour. They argue that investors ‘ride losers to postpone regret and sell winners too quickly, because they want to hasten the feeling of pride at having chosen the correct bet in the past’ (1985:782). But in contrast to what conventional finance theory would suggest, traders often cut profits and let their losses “ride”, which underlies the trader quote: ‘Small profits and large losses’ (Pedersen, 2015). This is in accord with the findings of Glick (1957) (in Shefrin and Statman, 1985), where he studied FX and Futures traders, and found that they were aware that riding losers was not rational, but their problem was to exhibit sufficient self-control, to cut losses, or close down accounts at a loss.

Furthermore, Kahneman, Tversky and Thaler all argue an asymmetry between regret and the quest for pride. Regret is stronger, which points to inaction and procrastination in preference to action.
Hence, an investor who is prone to this bias might not even realize gains, because the initial feeling of pride will be tempered by the regret at having sold too quickly.

In conclusion, though much evidence favour the disposition effect, that is, the tendency to hang on to losers too long and selling winners to early, Frazzini (2006) stresses that the interpretation of the behavioural evidence is still highly contentious, because no rational or irrational explanation has won general acceptance. Also, Fama (1998) underlines that the efficient market hypothesis (EMH) cannot be abandoned, because many of the event-studies are random, where apparent overreaction to information is about as frequent as underreaction. Further, Fama states that most long-term return anomalies are fragile to methodology and do not stand up to out-of-sample replication.

2.3. Combination of value and momentum investing

The previous sections clarify that both value and momentum have been profitable investment strategies historically, although their investment approach appears to be at odds with one another. While the value investor seek to buy stocks that have plunged in value and look cheap, the momentum investor may seek to sell the same stocks, as "he" categorizes stocks based on their actual growth. Therefore, the two strategies may act in opposite directions, which opens for possible diversification benefits, as originally suggested in Asness (1997). A later study by Asness, Moskowitz and Pedersen, (2013) demonstrates that one garner significant benefits of diversification by combining the best of elements of these two concepts.
Figure 2.2 exhibits a sub period from 1999 to end of 2012 based on the study of AMP (2013). It shows that the combined momentum and value strategy outperforms the individual strategies on a risk-adjusted basis. The Combi strategy delivers a sharp ratio of 0.84, which is more than double compared to 0.38 and 0.37 for the momentum and the value portfolio, respectively. This is in line with the findings of the whole sample period from 1974 to 2011 in AMP (2013), where the sharp ratio equals 0.87 for the Combi, 0.55 for the momentum and 0.42 for the value strategy.

Further, the negative correlation of -0.66 reflects the fact that the two strategies are contrasting of nature, where the value strategy works when momentum does not, and vice versa. Also, the strategies tend to appeal to different investors, as value investors often have a long-term focus, while momentum investors primarily focus on short-term news and changes in share price.

Pedersen (2009) proposes a simple idea that momentum represents the most popular trades, as trend-investors crowd to the stocks that have appreciated the most recently. If a liquidity shock takes place, cash needs and risk management may cause investors to liquidating sell-offs, which will put more selling pressure on the most crowded and popular trades like high growth or momentum securities, as everyone runs for the exit at the same time. On the other hand, the less crowded and contrarian trades like value stocks will be less affected in periods of financial distress.

A combined momentum and value strategy is naturally not risk-free, but a few studies have proven its worth for the long-term investor. For instance, O’Shaughnessy (2012) demonstrates that a combi
strategy outperforms in 70-80 pct. of the years from 1928 – 2009. Moskowitz (2012) makes the point that portfolio volatility is reduced by 50 pct. when combining value and momentum. Finally, AMP (2013) emphasize these benefits in the paper ‘Value and Momentum Everywhere’.

2.3.1. The drivers of the combination strategy

When both momentum and value strategies have produced excess returns historically, it is no surprise that a combination of the two also have worked well. But it does not explain why a combination portfolio generates even better results. Borg (2013) has suggested to divide stocks into four categories based on two dimensions: value characteristics and momentum characteristics. Every stock is categorized by one of the dimensions, but the category change over time as a result of numerous factors ranging from microeconomic and stock specific factors to macroeconomic and market specific factors. These dynamics drive all share price developments, but the movement and the speed with which it happens vary over time.

![Figure 2.1: The four value and momentum categories. The arrows indicate how a stock typically moves from one category to another. Source: Borg (2013), Jyske Invest.](image)

**Value plays** are value-stocks with no momentum. The valuation is attractive, but the development of the company is below average. Regularly the company has ended in the category as a result of operational challenges, or simply because investors have devoted more attention to other companies. The low fundamental valuation reflects that the company has potential, but it also indicates that it may take some time before it materializes, which seldom translates into sound investor returns.
**Winners** are value-stocks that exhibit momentum. This category is the most attractive as the valuation of the company is attractive and the company has caught the wind. Typically, it is companies that have advanced from *value plays*, where challenges have been overcome and recent company announcements have surprised markets positively. As a result, the company experiences a sound and upwards trend, which bring high returns for investors.

**Momentum plays** are growth and momentum-stocks with no value component. Stocks in this category have experienced a period of fortune and share appreciation, but the relatively high valuation may cause investors to buy a “greater fool” stock, similar in concept to the Keynesian beauty contest. Stocks in this category are popular and have delivered sound investor returns in the past, but a high valuation also increases the risk that the stock may be penalized, if the company cannot live up to the high expectations.

**Losers** are those stocks that exhibit neither value nor momentum characteristics. This groups is in contrast to the winners. The outlook of the company is sombre, and despite it probably has experienced falling share prices, a relatively high valuation still entails increased risk of further downturns. Typically, *momentum plays* shift to this category, if the company has shown signs of disappoint.

A general risk related to value investing is to buy the ‘dogs’ with obviously poor growth prospects ([Ilmanen, 2011](#)), that is, one fall flat into the value-trap. Although more importantly, one may find the right company, but simply buy the cheap stocks too early (*Losers*), before the potential value creation takes place and the stock price begins to climb (the change from *Value plays* to *Winners*). As a result, one can include a momentum criterion to help with the timing ([Borg, 2013](#)). Similarly, the risk related to momentum investing is to jump on the bandwagon when it is *too late* and *too expensive* (*Momentum plays*). Therefore, one can apply a value criterion to reduce the risk of buying the stock too expensive.

In conclusion, the Holy Grail is, on the one side, to find value-stocks whose hidden value starts to materialize and will continue to do so, i.e. become a *winner* stock, and on the other side, to avoid being the “greater fool” and buy the speculative momentum stocks whose technicals are unsupported by their fundamental value, and end up holding the stock when the direction of the wind changes.
3. Research design and methodology

As the current body of knowledge is elaborated in the previous chapters, this section seeks to explain the methodology of the study before the findings of the research is discovered.

It appears from the overarching research question that the purpose of the study is to explore and understand the reasoning behind the existence of a momentum and a value premium. Further, the study seeks to test it empirically with evidence from the European stock markets using the STOXX Europe 600 Index from January 1999, where the Euro was introduced as accounting currency to the financial markets. In other words, the study applies a deductive approach to extend the existing body of knowledge on the area with emphasis on the most recent performance of such strategies, as Larsen (2014). Consequently, the research takes form as an exploratory study with elements from descriptive studies as noted in the first three sub-questions.

Although the majority of the study focuses on quantitative data from Thomson Reuters Datastream such as stock prices and total return index etc., the study also integrates qualitative data. Therefore, a so-called mixed method research is applied (Tashakkori and Teddlie, 2003, in Saunders et al, 2009: 153). Despite the fact that qualitative data primarily is used to elaborate the descriptive research objectives about momentum and value strategies, it can also be used as a powerful tool to design and implement the right data processing and regression analysis. Further, secondary literature like expert opinions in academic and professional journals is useful not only when planning the data analysis but also to function as a benchmark and reference point in the understanding of the empirical findings of the study.

### 3.1. Designing the strategies

Although backtesting of a strategy may appear as a time-series study, since data is gathered at discrete and equally time intervals, e.g. daily or monthly closing prices of a stock, the analysis takes form as a cross-sectional study. This is because the formation of each portfolio is based on the stock prices at a single point in time. Hence, the study applies a so-called security selection strategy, where a group of stocks is elected based on their relative performance. Or said differently, this strategy simply compares one security’s signal, say book-to-market value or the past 12 months stock performance, to the average signals of the other securities at that point in time. Consequently, you do not need to know which security is best over time; you simply need to find the securities that have better properties than others (Pedersen, 2015).
To avoid any problems associated with thin trading and the resulting illiquidity, the study focuses on large capitalization shares as AMP (2013). As this study is focusing on the STOXX 600 constituents alone, it is therefore equivalent to limiting the remaining universe of European stocks to a very liquid set of securities that can be traded for reasonable low costs at reasonable trading volume sizes.

Further, this approach also eliminates part of the size effect, which has broadly been concluded as one of the explanatory factors of the momentum phenomenon. With that said, the results are conservative since value and momentum premia are larger among smaller and less liquid securities [see e.g. Rouwenhorst (1998) and Fama and French (2011)]

In the design of the value and momentum strategies one needs to address the following four issues:

1) Trading signal
2) Holding period and formation
3) Rebalancing frequency
4) Selection process

The trading signal is the value or momentum measure that is used in the security selection process when the portfolio is constructed. The signal depends on whether one is looking at the value strategy or the momentum strategy as described below.

Trading signal

Asness, Moskowitz and Pedersen (2013) highlight that they apply a single measure for value and a single measure for momentum for all eight markets they study. In their approach, they have chosen the most studied or simplest measure in each case, since their study does not seek to come up with the best predictors of returns in each asset class. Instead, they attempt to maintain uniformity across asset classes and to minimize the pernicious effects of data mining and data snooping.

This approach is also in line with the study by Leivo and Pätäri (2009), which finds that spending resources on spotting the “right” proxy only has a marginal effect. Therefore, this study solely applies the ratio of book value of equity to market value of equity, B/M, like AMP and Larsen (2014). Some academics also refer to this measure as book-to-price, or the reverse, price-to-book. But the common term book-to-market ratio stems from the HML-model by Fama and French (1992, 1993).

In terms of the momentum measure, the far majority of momentum studies apply the past 12-month cumulative raw return of the stock, see for example Jagadeesh and Titman (1993), Fama and French
(1996), Grinblatt and Moskowitz (2004), while skipping the last month. Skipping the last month has become standard in the momentum literature to avoid the 1-month short term stock reversal effect, which may be caused by liquidity or microstructure issues (AMP, 2013). By only looking at the formation period of 2-12 month past return, the study takes the same approach as AMP (2013) in which they intentionally keep most regressions as simple as possible both for clarity and understanding as well as a precaution against the pernicious effects of data mining.

**Holding period and formation**

To ensure unanimity and comparability both the value and momentum portfolio returns are based on a six-month holding period. It corresponds to the most representative horizon in the study of Jegadeesh and Titman (1993), which examined the effects of selecting different holding and formation periods.

With respect to the application of the common book-to-market ratio as a proxy for value, the timing has given rise to academic debate. In most studies, the book value is lagged a number of months to ensure that book value would actually be available at the time of portfolio construction or when rebalancing takes place like Fama and French (1992). It reflects the fact that it often takes two-three months before the corporate information is publicly available and additional time before it is fully incorporated in the market prices. Failing to consider this would otherwise lead to the so-called *look-ahead bias*, which is, using information that is not available at the time to construct the sample.

Asness, Moskowitz and Pedersen (2013) state that using lagged or contemporary (i.e. historical) prices in contrast to market values matched contemporaneous in time is not important. In fact, they noted that their conclusions were not materially affected. This study applies the former approach, where book values are lagged 6 months to ensure data availability to investors at the time of portfolio formulation, while using the most recent price to compute the book-to-market ratios. Thus, when the book-to-market value as of December 31th 2010 is published H1 2011, it is seen in relation to the current market price end of June 2011. This is in contrast to the HML methodology of Fama and French (1992) but in line with the new standards suggested by Asness and Frazzini (2012).

**Rebalancing**

Value and momentum investors must also consider how frequently the portfolio is rebalanced. This decision is a balance between information decay in value signals against the extra trading costs imposed by often rebalancing. To exemplify, Fama and French (1998) and Leiro and Pätäri (2009) etc.
apply a 1-year rebalancing frequency, while AMP (2013) rebalance by the end of each month to maintain value weights. This study also rebalances each month. Hence, by the end of each month all stocks are sorted into three groups, i.e. tertiles, based on their respective value and momentum measure.

Selection process

In general, the selection process works on a spectrum between two poles: *Fully systematic or fully discretionary*. The former reflects that the stock selection is based on "hard data", exclusively, such as valuation ratios. On the other end of the spectrum, a discretionary investor only applies value measures as inputs for judgemental decisions (Ilmanen, 2011). This study takes the view of a quantitative investor, or “a quant” for short, and selects stocks systemically based on specified trading rules, which are easy to implement in a systematic order. This is in contrast to virtually all equity long-short equity hedge funds and dedicated short bias hedge funds (and most hedge funds in general) that are engaged in *discretionary trading* and, obviously, these type of investors incline to use a more discretionary selection process (Derman, 2007).

3.1.1. Credibility

When performing a backtest and doing quantitative research, one needs to ensure that the findings are credible and believable. Therefore, the quality of the data measurement must be reliable. Reliability refers to ‘the degree to which the findings could be repeated if the enquiry was replicated in the same or a similar context’ (Lincoln and Guba, 1985). As a consequence, certain precautions must be taken to ensure the trustworthiness of the research. Hence, any backtest study must address the following 3 points before implementing the strategies: biases, the applied time horizon and issues concerning shorting of stocks.

Biases

When back-testing in general, the results often look a lot better than the performance of the actual trades, if they are implemented in the real world. This is due to a several reasons. First, the world is dynamic and ever changing and, thus, strategies that worked in the past do not necessarily perform
as well in the future (Pedersen, 2015). This could be because competitive pressure adjusts prices and as more and more people pursue these strategies profitability is reduced.

Second, one must be extremely focused to avoid a number of avoidable biases when performing backtests. For example, considering the stocks with the *current* highest market capitalization of the constituents in the STOXX Europe 600 index will naturally be a biased sample, since the current stocks in the index are the ones that have performed best historically.

This bias is often divided into *survivorship bias* and *backfill bias*. Survivorship bias explains the fact that bad performing companies (or hedge funds) can go bust or merge with superior ones, whereby the underperforming returns are excluded from the sample. This leads to an overvaluation of the empirical results, as defaulted or poor performing companies no longer are included. On the other hand, backfill bias, which is also known as *instant history bias*, reflects the fact that unsuccessful hedge funds may choose not to report their fund performance to a database from the fund’s inception, but instead choose to ‘backfill’ the database later, when it has established a more successful trade record. Hence, in this perspective, backfill bias indicates that successful companies may be included during the sample period, because smaller firms have advanced or prosperous companies are taken public.

Or said differently, you have survivorship taking out bad records and then you have backfill bias adding superior records, both of which cause the universe of active management to appear to be better than the reality. The importance of avoiding these biases are enforced in his renowned investor book ‘A Random Walk Down Wall Street’, in which Malkiel (2007) found that a group of 331 hedge funds in 1996 had decreased by 75 pctl. in 2004, and estimated that the survivorship bias made up surprisingly 4.4 pctl. and backfill bias accounted for a total of 7.3 pctl. of the stated returns.

To avoid such biases one can apply the method as Larsen (2014) and only look at the companies that were in the index at the beginning of the backtest period. However, the drawback of this methodology is that the sample size may be too small to have statistical power and sufficient credibility. Alternatively, it might be worthwhile to update the constituents continuously, exactly as if one had to perform the trades in real time (Pedersen, 2015). Therefore, this research study updates the STOXX 600 constituents annually in January.

**Time horizon**
Another central empirical matter concerns the time horizon of the data. Naturally, it is favourable to analyse a period as long as possible, since the number of periods is a contributing factor to the significance of the results. In this study, the sample period is truncated January 1999, reflecting the day where the euro was introduced to the financial markets, although it was not until January 2002 that the euro notes and coins were in physical circulation. Naturally, the EURIBOR rates begin January 1999, which seems to be the natural choice, when selecting the risk free rate.

Using monthly data over a 16-year period, from January 1999 to December 2014, gives a total of 193 months, while analysing approximately 600 shares annually yields a grand total of 115,800 data points. It clearly satisfies Green's rule of thumb (1991) suggesting a regression sample size of N > 50 plus the number of dependent variables for testing statistical relationships. See section 4.1.2 to explore how the sample size evolves over the period.

**Shorting**

Although shorting is a central part of following a cost-neutral trading strategy, it may introduce certain drawbacks in the financial markets. Surely, the external validity of the study, i.e. the extent to which the findings can be generalized to other studies or be implemented in practice, is questioned when the strategies are contingent on shorting and if shorting is too costly or not implementable in practice. This is because it may be troublesome to locate and borrow the stocks concerned, or shorting may in some instances be banned in certain financial environments e.g. comparable to EU’s regulation on naked or uncovered short selling in November 2012 (ESMA, 2015).

Nonetheless, Frazzini, Israel and Moskowitz (2012) provide evidence that trading costs of shorted stock positions are not significantly different from the costs of long positions, and that large institutional investors do not have real-world shorting costs that restrict running considerable funds in these strategies. Further, the fact that this study simply focuses on the major European multinationals makes it more unlikely that shorting restrictions will be a constraining factor.

Furthermore, other studies have shown that both value and momentum strategies still produce abnormal returns even without shorting, albeit long-short strategies tend to perform even better. See for example the study of Jegadeesh and Titman (1993), who finds that the long only portfolio actually outperforms the cost-neutral Winners Minus Losers (WML) portfolio.
3.2. Calculation methodology

In the portfolio formation process all stocks are first sorted based on their value or momentum measures. The study applies the common Fama-French methodology, where all stocks are sorted into three groups. Like AMP (2013), the study goes long the best 1/3 stocks and short sells the worst 1/3 of the stocks measured by their respective measures.

In every month, all stocks are weighted equally among the long/short positions, which constitute 2/3 of the total number of stocks, N, such that the weight on security i at time t is:

\[ w_{i,t} = \frac{1}{\frac{2}{3}N_t} \]

Note that the weights are either positive or negative and sum to zero across all stocks, representing a dollar (or euro) neutral long-short portfolio. Hence, one can assume that €1,000 is invested in the long positions, and the short position sums to - €1,000, equivalent to a total investment of zero, when ignoring the cost of margin requirements.

The stocks are ordered using Excel’s “rank-function”, and the position can afterwards be determined using the “if-function”. For example, if a stock \( S_{i,t} \) has a rank among the top tertile, we go long the stock (1), if the rank is among the lowest tertile, we short the stock (-1), while we hold a neutral position in the mediocre stocks (0). Consequently, a stock is excluded for three reasons. Firstly, a security can be ranked within the middle tertile. Secondly, the stock may not be part of the STOXX 600 Index in January the given year. Thirdly, data may simply not be available for the given stock or for the given period. The latter may either be as a result of lacking information in Datastream, or because the stock is excluded manually, as elaborated in section 3.3.

Calculation of statistics

Recall that each strategy is rebalanced monthly and that the holding period is six months. It implies that we have 6 portfolios at any point in time, each of which is formed with one-month lag as Jegadeesh and Titman (1993) to avoid statistics that are based on overlapping returns. Hence, the monthly return of the strategy in June is the aggregate return of the six portfolios that is formed in the beginning of each of the prior six months, as shown in Figure 3.1.
The monthly profits of the above portfolios are calculated using the simple arithmetic average. Thus, the return in month $t$ is the average return of all the six portfolios:

$$r_t = \frac{1}{N} \sum_{i=1}^{N} r_{i,t}$$

Thereafter a cost-neutral long-short portfolio is constructed based on the entire cross section of stocks in the sample at time $t$. Hence, the monthly profit of the neutral value strategy is determined as the returns of the Value portfolio minus the return of the Growth portfolio ($\bar{R}_{VMG}$), and similar for the neutral momentum portfolio ($\bar{R}_{WML}$). In other words, the monthly WML return at time $t$ is calculated as the difference between the mean monthly return of the past winner portfolio ($\bar{R}_{Winners}$) and the mean monthly return of the past loser portfolio ($\bar{R}_{Losers}$):

$$R_{Momentum (WML),t} = \bar{R}_{Winners,t} - \bar{R}_{Losers,t}$$

Under the null-hypothesis, that is, testing for the weak form of market efficiency (Fama, 1963), the EMH would predict that the average returns of the momentum portfolio equal zero. If these returns are significantly different from zero we can reject the weak form of EMH, assuming that transaction costs do not influence $\bar{R}_{WML}$. In contrast, a significant and positive value for $\bar{R}_{WML}$ would support the foregoing momentum studies carried out globally (e.g. Fama and French, 1998).

The test-statistic of the VMG and WML portfolio can then be computed using:

$$t - statistic = \frac{\mu_{Winners} - \mu_{Losers}}{\sqrt{\frac{\sigma^2_{winner}}{N_{winner}} + \frac{\sigma^2_{loser}}{N_{loser}}}}$$
where $\mu$ (mu) is the mean monthly return, and the denominator represents the square root of the summed standard errors, i.e. $\sigma^2$ (sigma squared) is the variance, and $N$ is the number of observations in the portfolio.

Finally, the last step is to compute the return of the combination strategy based on the excess return of the neutral value portfolio (VMG) and the neutral momentum portfolio (WML). As in AMP (2013), the study uses equal weights similar to a 50-50 investment strategy:

$$\bar{R}_{combi} = 0.5 \cdot \bar{R}_{value} + 0.5 \cdot \bar{R}_{Momentum}$$

**Risk measures**

To measure the risk-adjusted performance of all strategies Sharp ratio, Treynor ratio and Jensen alpha will be applied. Although volatility is not constant over time, as volatility spikes during times of panic and financial turbulence, the study calculates an average volatility over the whole sample period to compute sharp ratio, and an average of the past 1-year returns, when scaling portfolio returns to a fixed volatility.

Similarly, the market exposure of each portfolio, i.e. the beta value, may change over time, and thus, it is calculated as the average beta over a trailing period of 24 consecutive months. In comparison, the beta coefficient is according to Worldscope and Datastream based on monthly data between 23 and 35 consecutive months and 30 months, respectively, while Bloomberg uses weekly data over the past 24 months.

**Formation and holding period returns**

When forming the momentum portfolio, one must also consider which prices that are applied in the calculation of the historical returns. This concerns both whether to apply returns in local or foreign currency as well as whether to apply historical price returns or total index returns.

In regards to the choice of currency, the study displays all prices in Euro, thus, it includes the impact of exchange rate changes over the period for those stocks that are listed outside the Euro countries, e.g. the Scandinavian countries or the UK. It means that if British Petroleum experiences a stock return of 5 pct., while the pound (GBPEUR) depreciates 3 pct. vis-à-vis the Euro, then the total return
in Euro is 2 pct. Fortunately, Datastream’s Times Series Request can calculate prices in any given currency automatically by multiplying local prices with the daily exchange rate.

Also, a cost-neutral strategy is not long and short the same stocks, and thus, one cannot ignore dividend payments when considering the returns. Therefore, the analysis must apply the total return index (RI) to calculate monthly stock returns, because the total equity return is the sum of dividend yield and capital appreciation:

$$R_t = \frac{D_{t+1}}{P_t} + \frac{P_{t+1} - P_t}{P_t}$$

Thomson Reuters Datastream defines RI as ‘the theoretical growth in value of a shareholding over a specified period, assuming that dividends are re-invested to purchase additional units of an equity at the closing price applicable on the ex-dividend date’, while it furthermore includes the impact of stocks splits.

Though it seems there is joint agreement to use the total index returns to calculate the performance of both value and momentum strategies over the holding period, it appears there is less agreement among momentum practitioners whether to use historical stock price returns or total returns to rank the stocks based on their past performance. For example, Glaser and Weber (2005) analyse price momentum on the German stock market and use monthly closing prices to calculate returns similar to what Jegadeesh and Titman did back in 1993. Further, Grundy and Martin (1998) find that a US momentum strategy that ranks stocks based on the ‘stock-specific return component’, i.e. the historical stock price return, outperforms one that ranks based on total return. The disagreement is further illustrated in practise as the global MSCI Momentum Index applies historical prices, while Quant-Shares’, one of the global leading providers of market neutral ETFs, defines a stock's momentum based on its total return.

Nonetheless, it may seem more natural to apply total index returns to form the portfolio when one also applies the total index returns in the calculation of holding period return. However, like Asness, Moskowitz and Pedersen (2014) and Larsen (2014), this study follows the Jegadeesh and Titman-approach and applies the raw return in the formation period, i.e. historical stock price returns. However, the results barely change, and in contrast to the findings of Grundy and Martin (1998), total index returns do yield marginally better results, as the attentive reader can note in Appendix 13.
3.3. Data collection methodology

To carry out a credible analysis it is central to apply a sound and, if possible, a well-tested methodology to ensure that the findings are reliable. Therefore, the first issue one must address concerns the reliability of the data. In order to avoid the so-called *garbage-in garbage-out* problem, we cannot use the raw data from Thomson Reuters Datastream without taking some precautions. These regard first and foremost, that the index constituents constantly change as some companies are listed while others are delisted. Secondly, one cannot overlook the fact that certain companies may be dual-listed or have several asset classes.

Therefore, the following sections explain the static and dynamic screening process with inspiration from Ince and Porter (2006) and Schmidt et al (2011). The first mentioned section is an evaluation of the quality and the representativeness of the data, while the succeeding section elaborate how the study address changes in the data during the analysis period, such as new listings or delistings of companies.

### 3.3.1. Static screening - Static data

The first adjustments are made directly based on the ‘raw’ data from Datastream. It consists of making sure that no duplicates are included in the analysis and that the sample only contains primary notes and no other asset classes. Therefore, this section will address the following four issues:

- Preference shares vs. common shares
- Several common shares
- Dual-listed shares across borders
- Wrong asset class (none equity securities)

As one would guess, the STOXX-600 Index consists of 600 stocks. However, the constituents change over time and the index does not necessarily make up exactly 600 stocks as some companies are dual-listed and have several equity classes such as preferred shares and ordinary shares. In total, the sample period from January 1999 to December 2014 spans over 1351 different shares. However, the total number decrease to 1,313 companies when taking account for the fact that some of those shares represent companies that have several equity classes or are listed in more than one country.
Preference shares vs. common shares

Some German and Italian companies have both its preference shares and common shares listed and included in the STOXX Europe 600 Index certain years. Therefore, those companies count twice unless one adjusts for this. For example, the German auto company Volkswagen AG (Aktiengesellschaft) has two shares listed; its common or ordinary shares, Volkswagen STK, and its preference shares, Volkswagen Vorzüge.

As the name indicates, the preference shareholders have a greater claim on the company’s assets and earnings, somewhat, similar to the characteristics of a bond. As described at Investopedia, this is evident in three aspects. First, preference shareholders receive dividends before common stockholders during times of success, but more importantly, they have higher seniority during times of insolvency, that is, common stockholders do not receive anything unless the preferred shareholders are paid out. Second, and similar to the properties of fixed-income securities, the dividend payments are paid at regular intervals and dividends to preferred shareholders are typically guarantied, meaning that if any dividends have been missed, these must be caught up before any future dividends are paid out on either stock. Third, unlike common shareholders, preference shareholders usually have no voting rights. Further, preferred stock dividends are typically, but not necessarily, higher than those to the common stockholders, which is, for instance, the case for Volkswagen AG over the period 2008 – 2013.

Consequently, this study ignores the preferred shares if those are part of the STOXX Europe 600 Index in the same periods as its common shares to ensure that the returns of Volkswagen is not counted double. This cannot be done using ISIN codes alone, since ordinary shares and preferred shares have different ISINs. Thus, company duplicates must be found using Datastream’s trade description code TRAD, which indicate whether the shares are common (ordinary) or preferred shares. Other companies that have both their equity classes presented during certain years include the German health care group Fresenius SE, the Italian insurance company Unipol Gruppo and Fiat Chrysler Automobiles.

Several common shares

The analysis indicates that 24 companies have several common shares listed during the sample period, such as the Danish brewer, Carlsberg A and Carlsberg B. In this case, the only difference is the number of votes linked to each stock, as Carlsberg A stockholders have 20 votes, while the B-stock
gives 2 votes. Other companies in the same category comprise Wallenberg’s Swedish investment company, Investor AB; the Swedish industrial group, Atlas Copco AB; Volvo AB; the Finish paper and pulp manufacturer, Stora Enso Oyj; the Swiss Swatch Group; and the French telecom company, Orange SA, among others.

If both shares are included in the STOXX 600 the same year, hence, the least liquid share is excluded using the Datastream category MAJOR. If a company has more than one equity, then MAJOR returns Y (yes) or N (no) to indicate which of the securities is the most significant in terms of market value and liquidity of the primary quotation of that security. Note however, that one cannot exclude the least liquid common share of, say Carlsberg, all years, because the two share classes are not necessarily part of the STOXX 600 Index the same years. While Carlsberg B was included in 1999 and in the period 2002 until 2014, Carlsberg A was only part of the Index in 1999 and 2000. Hence, both common shares were represented in 1999, and therefore the least liquid share, Carlsberg A, is only excluded in 1999.

**Listed in several countries**

Finally, some multinationals may have either several common shares or common and preferred shares listed across borders. This concerns three big multinationals: Unilever, Reed Elsevier and Royal Dutch Shell.

The Anglo-Dutch Unilever, is for example a dual-listed multinational consumer goods company that has its shares listed on more than one stock exchange. It has its Unilever N.V. listed in Rotterdam, The Netherlands, and has its Unilever Plc. listed at London stock exchange. Including both shares will mistakenly implicate that the company has twice the weight, though an investor in reality may be able to buy both shares at either London Stock Exchange or Rotterdam Stock Exchange. In addition, Unilever has also shares listed at NYSE through its American Depository Receits (ADRs), however, these are naturally not part of the STOXX Europe 600 Index.

To distinguish between the Anglo and Dutch shares Datastream’s trade description code TRAD is useful, since only the British listing is titled ‘ordinary shares’. In contrast, the Dutch listing is represented by a ‘depository receit’ indication in Datastream or ‘Dutch certificate’ in Bloomberg. Consequently, the study only applies the UK stock listing of Unilever.
It becomes more troublesome to distinguish between the other two British and Dutch listings concerning Reed Elsevier and Royal Dutch Shell. This is because both the British and Dutch listings are noted 'common shares', coincident with Datastream label both listings as 'Y' in the MAJOR field, as described above. Similar to the case for Carlsberg's A and B shares, the Royal Dutch Shell listing in UK is only part of the STOXX Europe 600 Index in 1999 through 2001, while the Dutch listing is included most years from 1999 through 2014. Therefore, only the Dutch listing is included in the sample. In contrast, both listings of Reed Elsevier are included all years from 1999-2014, hence, only the most liquid share is applied in the given year.

**Wrong asset classes**

Lastly, a few companies are not categorized as stock investment products. Since the study is only focusing on equity-investments, only those stocks labelled “EQ” in Datastream's STOCK TYPE variable is applied. Therefore, companies that are categorized as Investment Trusts (INV), American Depository Receipts (ADR), Closed End Funds (CF) or Exchange Traded Funds (ET) are not included. However, the far majority of securities in the STOXX Europe 600 index are equities and only seven of the constituents over time are nonequity instruments, such as the major UK 3I Group, which is labelled Investment Trust. When excluding those nonequity investments, the sample size constitutes 1,313 different shares.

As for the screening whether certain multinational conglomerates are counted double, the stock type screening must be done manually to make sure which securities are excluded in the study.

### 3.3.2. Dynamic screening – Time series

Even though the data conform to the requirements, some ongoing adjustments still has to be made on a continuous basis, because some stocks may lack data in certain time periods. It could be a result of takeovers and delistings, new listings or simply because data is not available for the given equity.

**Mergers, takeovers and delistings**

Thomson Reuters Datastream does not write explicitly if a company has delisted except that prices and total return index remain constant since the last trading day. If one does not adjust for this after the delisting date, the respective stock return will show a monthly return of zero, which may collide with those stocks that have not changed in value. Therefore, all future return calculations must be
deleted manually to avoid that delisted companies affect the results. In total, there are 248 stocks that delist over the period.

Take for example in October 2007, where the major Dutch bank ABN AMRO was acquired in three parts by a consortium of Banco Santander, Fortis and Royal Bank of Scotland Group. The takeover was completed in May 2008, and therefore Thomsen Reuters Datastream shows the end of May stock price and total return index value onwards. Therefore, all these future returns are deleted manually, so they do not distort the results.

**IPOs and new listings**

As mentioned, new stocks are included in the pan-European index on a continuously basis. It means that Thomson Reuters Datastream shows data from the initial public offering date an onwards, while no data is available on earlier dates. For example, Glencore Plc, the Anglo-Swiss multinational company within commodity trading and mining, was listed on London Stock Exchange May 18th, 2011, thus the first monthly price and market value data begin June 2011, and Glencore enters the STOXX 600 index from the quarterly rebalancing end of June. When the study applies an annual update of the constituent list, it implies that Glencore is included in the sample by January 2012, while all returns before then is excluded in the analysis. This approach is applied with all 419 stock listings during the period.

**Lacking data**

The study naturally requires data concerning historic stock prices (P), price-to-market value, or Price-to-Book Value (PTBV) as used in Datastream, Market Value (MV) and Total-Return Index (RI) for all stocks. However, it turns out that those data is not available for 17 of the companies. If data is not available for a stock, hence, the stock is naturally neglected in the study.
4. Data and Findings of the research

This section explores the quantitative findings of the research based on the assumptions stated in the methodology described above. The study builds on huge amounts of financial data which is used to form discussions and derived conclusions. But before we look at the empirical results of the study, the first few sections will briefly describe the characteristics of the STOXX Europe 600 Index as well as the evolution of the sample size.

4.1. Elaboration of the sample

The STOXX Europe 600 Index is a subset of the STOXX Global 1,800 Index, which contains three regions: 600 European, 600 American and 600 Asian/Pacific. The STOXX Europe 600 Index consists of the largest companies across 18 countries of the European region: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

The selection list is derived from the STOXX Europe Total Market Index (TMI), which includes 95 % of the free-float market capitalization of the investable stock universe in each country. From this selection list, the largest 550 companies are selected, from which only the most liquid stocks are selected. The remaining 50 stocks are then chosen as the largest remaining current components ranked between 551 and 750 (STOXX Index Methodology Guide, 2014). For example, it means that only 19 Danish stocks were included in 2014, where FLSmidth & Co A/S was the smallest with a total market capitalization of €1,874 million by the end of the year, 2014.

The Stoxx Indexes are reviewed on a quarterly basis to ensure an up-to-date index basket. The rebalancing is conducted after the close every third Friday in March, June, September and December and is effective the next trading day. Further, all constituent weights are determined according to the free-float market capitalization, i.e. number of shares outstanding multiplied by the current share.

The STOXX Europe 600 Index was launched on December 31, 1986, and has a base value of 100 as of December 31, 1991. Since then, the index constituents has changed beyond recognition as the constituents change over time, which underline the purpose of the index of acting as a barometer of market activity of the European economy.
Table 4.1 shows several characteristics of the two central European STOXX Indexes: STOXX-600 and STOXX-50, end of December 2014. The snapshot illustrates that there is a wide difference among the 600 listed companies. The STOXX-50 is naturally a selection of the 50 largest STOXX-600 companies. These 50 companies constitute a total of 40 per cent of the total market capitalization, while the market value of the top ten companies make up 16 per cent of the net market capitalization of all 600 stocks.

<table>
<thead>
<tr>
<th>Attributes</th>
<th>STOXX Europe-600</th>
<th>STOXX Europe-50</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of constituents</td>
<td>600</td>
<td>50</td>
</tr>
<tr>
<td>Net MCap (EURm)</td>
<td>8,758,809</td>
<td>3,502,339</td>
</tr>
<tr>
<td>Dividend Yield %</td>
<td>3.01%</td>
<td>3.71%</td>
</tr>
<tr>
<td>Constituent Sizes (Net MCap EURm)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>14,574</td>
<td>70,047</td>
</tr>
<tr>
<td>Largest</td>
<td>207,853</td>
<td>207,853</td>
</tr>
<tr>
<td>Smallest</td>
<td>1,017</td>
<td>6,420</td>
</tr>
<tr>
<td>Median</td>
<td>6,420</td>
<td>57,694</td>
</tr>
<tr>
<td>Weight of Largest Constituent (%)</td>
<td>2.37%</td>
<td>5.93%</td>
</tr>
<tr>
<td>Top 10 Holdings (% Index MCap)</td>
<td>15.56%</td>
<td>38.91%</td>
</tr>
</tbody>
</table>

Table 4.1: Characteristics of the current STOXX Europe Index by December 31, 2014. Source: Datastream.

Also it can be noted that larger companies tend to pay out a higher proportion of earnings to shareholders, since the dividend yield increases with size. Therefore, one should be aware that it is essential to apply the total return index rather than historical stock prices to calculate annual returns, because a main part of the shareholder return comes in the form of dividend yield for larger stocks, exactly as Larsen (2014) highlights from the UK equity markets.

Further, and most notably, it turns out that the three most valuable European companies are Swiss. Novartis (health care) has a value of €207.9 billion; almost triple the value of Novo Nordisk A/S (health care), while Nestle SA (consumer goods) and Roche Holding AG (health care) comes in at a second and third with a total market value of €195.7 and €157.8 billion, respectively. To put these market capitalizations in perspective, the OMX C20 Index had a total market value of €257.8 billion end of December, 2014, corresponding to a modest 2.9 pct. of the total Pan-European STOXX-600 equities.
4.1.1. Data and sample

All stock price data is found using Datastream, where it is possible to indicate whether values are shown in local or foreign currency. Index constituents are found and tested using both Bloomberg and Datastream. In Datastream, the code: ‘LDJSTOXX0114’ indicates the STOXX Europe 600 constituents by January 2014. While Bloomberg has historical constituent information back to January 2002, Datastream’s data goes back a little further, until August 1999. Consequently, stock prices and total index returns in 1999 are based on the companies that were part of the STOXX-600 Index in August, and not in January, as all other years.

Consequently, one can argue that the 1999 data might be subject to a slight backtesting bias, more specific, survivorship bias, as earlier mentioned. This is not the case for any of the other years, as the study does not focus on the current STOXX 600 stocks but the companies that were part of the index every January each year.

Since changes in the index occur on a quarterly basis due to new listings, mergers and acquisitions, delistings or even bankruptcy, only 42.3 pct. of the current listed companies were part of the STOXX-600 index in August 1999, as seen in Table 4.2 below. Similarly, almost the same fraction of the 50 largest stocks was listed 15 years earlier.

<table>
<thead>
<tr>
<th>Index constituents</th>
<th>Companies</th>
<th>Recurrent</th>
</tr>
</thead>
<tbody>
<tr>
<td>STOXX-600</td>
<td>613</td>
<td>601</td>
</tr>
<tr>
<td>STOXX-50</td>
<td>50</td>
<td>50</td>
</tr>
</tbody>
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<table>
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<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>STOXX-600</td>
<td></td>
<td></td>
<td>254</td>
<td>42.3%</td>
</tr>
<tr>
<td>STOXX-50</td>
<td></td>
<td></td>
<td>22</td>
<td>44.0%</td>
</tr>
</tbody>
</table>

Table 4.2: Number of listed companies in August 1999 and December 2014 in the STOXX-600 and STOXX-50 Index as well as the number of companies that were part of the index at both points in time. Source: Datastream.

4.1.2. The evolution of the sample size

To avoid backfill and survivorship bias the study concentrates on the stocks listed in the beginning of every year and only excludes those with lacking data, e.g. because the company has been taken private. Consequently, the number of stocks in the formation portfolio only varies slightly over the time horizon. In Figure 4.1 below, it is seen that the number of available stocks in the formation port-
folio from January 1999 is fairly stable ranging from 541-594 stocks in the momentum strategy. January to December 1998 and July to December 2014 are not relevant, as these data are based on the 12M formation period and a 6M holding period.

Figure 4.1: Number of listed and excluded companies in the momentum portfolio as well as the size of the long and short portfolio based on the STOXX Europe-600 Index from January 1999 to December 2014.

Figure 4.1 also illustrates the number of stocks in a long or short momentum portfolio over the time horizon. Hence, a cost-neutral long-short strategy in 1999 comprise 370 stocks, which is equivalent to 185 long and 185 short positions. This number ranges from 180 to 198 throughout the analysis period.

In comparison, the number of companies in the VMG (value stock) portfolio varies from 174 to 201 long and short positions, while the total sample of stocks ranges from 523 to 589, when looking at the value measures. Note that this spread is slightly larger than the momentum strategy, because more stocks are excluded in the value portfolio as a result of fewer market-to-book ratios available than pure price data.

In addition, the long and short portfolio may not necessarily balance when looking at each month individually, because several companies may have the same book-to-market ratio in certain months, as Datastream only applies two decimals. However, over the whole sample period, the cost-neutral value portfolio seems to have an equal number of long and short positions.
4.2. Empirical results

The analysis consists of three parts. First, the empirical results of implementing a pure value strategy and a pure momentum strategy, which is followed by a presentation of an equal-weighted combination strategy. Thus, it becomes evident which of the three strategies that has thriven the most based on the STOXX Europe 600 Index during the period from 1999 to 2014.

Second, the risk of the three strategies is compared with one another and the overall market as well as set in relation with the current body of knowledge on the area. On the one hand, the study covers risk measures as standard deviation and beta, and on the other, it explores the consequences of implementing each strategy including an understanding of the drawdown and high water marks, which are well-known measures when following such hedge fund strategies. Finally, the research explores the performance of a sector neutral portfolio to evaluate the extent to which the performance is attributable to simple industry exposure.

4.2.1. Value and momentum premium

The excess returns of the three portfolios: value, momentum and a 50/50 combination of the two are illustrated in Figure 4.2. It is seen that a pure value strategy has outperformed with an annual excess return of 12.23 pct., while a growth strategy has yielded a more decent return of 5.76 pct. It corresponds to a value premium of 6.5 pct., when combining these value stocks and growth stocks.

As a momentum investor would hope for, the past years winners have performed only slightly better than the past years losers when holding them for a period of six months. Consequently, the cost-neutral momentum strategy (Winner Minus Losers) has been a relatively poor investment strategy as €1 invested in January 1999 would have been worth simple €1.36 end of December 2014, corresponding to an annual gain of 1.96 pct., almost equivalent to the average return of a risk free investment since 1999. This meagre momentum performance is in sharp contrast to earlier evidence, but in line with Larsen (2014), who found that momentum gave insignificant returns from 1997 to 2014 in the UK equity market.

In contrast, the global study among different asset classes in AMP (2013) generated an annualized average excess return of 8.1 pct. in the European stock markets from 1974 to 2011, equivalent to a sharp ratio of 0.55. In comparison, Figure 2.2 also illustrates that the momentum portfolio exhibit insignificant returns (t = 1.34) and SR = 0.38, if their data period is shorted to 1999-2013, using the online data Library of Pedersen.
Figure 4.2: Annualized excess returns for value and momentum strategies from January 1996 to October 2014, where all returns are based on a 6-month holding period. The WML and VMG portfolios are based on a company ranking of the past 2-12 months performance and the most recent book-to-market value, respectively.

Finally, the Combi portfolio yields an average annual return of 4.22 pct., which is slightly lower than the 5.9 pct. AMP (2013) found in the European markets from 1974 through 2011, but slightly higher than the 2.39 pct. Larsen (2014) found in the UK markets over the period 1996 to 2014. However, as Ilmanen (2011) note several times in his book, historical average premia may be misleading, when expected returns vary over time. Therefore, one cannot recklessly compare returns when the time and length of the sample period varies.

Furthermore, the Fama and French studies (2011), found that both a worldwide momentum portfolio, as earlier illustrated in Figure 2.1, and a European momentum portfolio clearly outperform both value stocks and the general market over the period 1990 to 2011. Instead, these European findings over the last fifteen years correspond to the Fama and French (2011) results from the Japanese equity market, where value investments have been superior to both momentum and market investments.

Figure 4.3 illustrates the historic performance of the strategies. In the upper part (1) it is seen that the STOXX Europe 600 equity market has outperformed all three cost-neutral portfolios on a gross return basis in the aftermath of the Financial Crisis. Especially pure momentum (WML) and the combined momentum and value portfolio (Combi) have yielded mediocre returns since 2008. However,
if one takes account for their different volatility as seen in the lower part (2), then the neutral value and the Combi portfolio have clearly been superior investment strategies throughout the investment horizon.

Figure 4.3: Cumulative portfolio performance from January 1999 to December 2014. Upper graph (1) shows nominal returns, while lower graph (2) shows nominal returns scaled to 10 pct. portfolio volatility. All returns are based on a 6-month holding period. The momentum (WML) and value (VMG) portfolios are based on a company ranking of the past 2-12 months performance and the most recent book-to-market value, respectively. The volatility is computed as the average of the past 12M VOL over the sample period, although, volatility varies a lot throughout the sample period, as illustrated in Appendix 3.

As a result, the study can conclude that the momentum portfolio, especially, has not performed as well in the last two centuries as they have historically. See for example the European evidence from Griffin et al. (2003) that found monthly average momentum profits of 0.77 pct. (or 9.24 pct. p.a.) from 1990 until December 2000 using only six month of historic data, excluding the last month and a hold-
ing period of 6 month, while Rouwenhorst (1998) found a slightly higher ‘country neutral’ momentum profit of 0.93 pct. per month (or 11.16 pct. annually) from 1978 through 1995. At first glance, and in the light of this study, one might think that those returns are based on the winner or loser portfolio only, but their medium-term findings indicate that winners earn positive medium term profits, while losers remain losers with negative returns.

**Insignificant momentum returns**

If we look at the t-statistics of the excess returns, as shown in Table 4.3 in the next section, the value and the combi portfolios are the only cost-neutral portfolios with statistically significant excess returns. On the contrary, the returns of the neutral momentum portfolio are statistically insignificant. Recall that the *t-statistic* of the regression coefficient is considered statistically significant when it is below two, as 1.96 implies that the *p*-value is equal to 5 % in a two-tailed test. The *test-statistic* of the average return of the momentum portfolio indicates that the weak form of EMH (Fama, 1963) cannot be rejected.

Based on the momentum statistics it seems that the past years losers almost perform as well as the past years winners. Hence, we cannot reject the possibility of a medium-term reversal effect over the sample period. The 7.10 pct. excess return of the loser portfolio is not statistically significant at a 10 pct. significance or alpha level. Consequently, a cost-neutral momentum investment has proven not to be a fortunate investment strategy over the last fifteen years. The fact that the t-statistic on the WML portfolio is insignificant can imply that capital markets have become more efficient than historically, likely because of the increased sums that are invested in quantitative hedge funds and the development of high-frequency firms, as described in Lewis (2014).

For example, Gil and Bennett (2012) from the Derivatives group Banco Santander estimated that high-frequency trading accounted for up to three-quarters of US equity trading volume back in 2012. ESMA (2014) finds that HFT now accounts for 43 pct. of value traded and up to 76 pct. of number of orders in the European Markets when using a 'lifetime of orders' identification approach. Although there have appeared to be positive autocorrelation of stock returns due to momentum buying historically, it is not unlikely that the returns of such a simple trading strategy have faded during the last decade.

As a result, it appears that stock prices follow a random walk, where short-term continuation has been just as frequent as short-term reversals. This view is also confirmed if the formation period includes the past one month performance, thus ignoring the short-term reversal effects. Using the past 1-12 months returns it gives an insignificant annual return of -2.18 pct.
4.2.2. Risk-adjusted performance

The best portfolio is not necessarily the one with the highest return. Instead, it is the one with the most superior risk-adjusted return. Therefore, one cannot simply compare the excess return on long or short positions with cost-neutral strategies as the risk may vary considerably. Thus, it is evident to check whether the value premium can be explained by a correspondingly higher risk as traditional financial theory predicts.

In practice, several metrics are applied to measure a manager’s risk-adjusted performance, as there is no individual metric that grasps all aspects. Three of the most frequent applied metrics are the Treynor ratio (1965), Sharp ratio (1966) and Jensen’s alpha (1968) that combine risk and return into a single value. Often Sharp ratio is the most well-known risk-adjusted performance measure, so let us start by looking at standard deviation as risk measure.

4.2.2.1. Sharp ratio

When evaluating the portfolio performance, Sharp ratio sets the excess return in relation to the total portfolio risk. Thereby, Sharp ratio takes into account the effects of diversification and hence, it is more appropriate for well-diversified portfolios (Body et al, 2011, p. 822). In Table 4.3 it appears that the high excess return of value stocks also comes with slightly higher risk in terms of volatility (standard deviation) relative the market, and that the long value and cost-neutral value (VMG) portfolio are almost equal on a risk-adjusted basis.

<table>
<thead>
<tr>
<th>Measures</th>
<th>Value</th>
<th>Momentum</th>
<th>Combi</th>
<th>STOXX 600</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>VMG</td>
<td>Value</td>
<td>Growth</td>
<td>WML</td>
</tr>
<tr>
<td>Excess return (p.a.)</td>
<td>6.48%</td>
<td>12.23%</td>
<td>5.76%</td>
<td>1.96%</td>
</tr>
<tr>
<td>(t-value)</td>
<td>(2.14)</td>
<td>(2.33)</td>
<td>(1.33)</td>
<td>(.47)</td>
</tr>
<tr>
<td>Cor (Value;Growth)</td>
<td>0.87</td>
<td>Cor (Winner;Loser)</td>
<td>0.81</td>
<td>Cor (Val;Mom)</td>
</tr>
<tr>
<td>Risk</td>
<td>12.12%</td>
<td>20.97%</td>
<td>17.30%</td>
<td>16.56%</td>
</tr>
<tr>
<td>Beta</td>
<td>0.22</td>
<td>1.09</td>
<td>0.88</td>
<td>-0.29</td>
</tr>
<tr>
<td>Risk-adjusted performance</td>
<td>Sharp ratio</td>
<td>0.53</td>
<td>0.58</td>
<td>0.33</td>
</tr>
<tr>
<td>Treynor ratio</td>
<td>0.30</td>
<td>0.11</td>
<td>0.07</td>
<td>-0.07</td>
</tr>
<tr>
<td>Jensen’s Alpha</td>
<td>4.4%</td>
<td>1.8%</td>
<td>-2.6%</td>
<td>4.7%</td>
</tr>
</tbody>
</table>

Table 4.3: Annualized performance and risk measures of value and momentum portfolios from January 1999 to December 2014, where all returns are based on a six month holding period. The WML portfolio is based on a company ranking of the past 2-12 months raw price return performance, and the VMG portfolio is ranked based on the most recent book-to-market value.
Turning to the momentum portfolios, the past year’s loser portfolio has clearly the highest volatility. As a result, the Winner portfolio outperforms the Loser portfolio noticeably when adjusting for their volatility differences.

Finally, the 50/50 Combi portfolio performs much better on a risk-adjusted basis. This is likely because the correlation between value and momentum is -0.48 on average, which means that the benefit of diversification more than make up for the poor performance of the WML portfolio. The correlation is computed as the average of a moving 2-year period and is illustrated in Appendix 4, which also displays the positive correlation between value and growth stocks and past winner and past loser stocks. In comparison, AMP (2013) found a correlation between value and momentum of -0.43 and -0.52 in UK and the European markets from 1974 to 2011, respectively, while Larsen (2014) found an average correlation of -0.63 in the UK equity market from 1997 to 2014.

AMP (2013) explain the negative correlation with funding liquidity risk, where momentum tend to underperform during a crisis, when liquidity dries up and liquidity spread rises, while the less popular trades like value stocks will be less affected. Therefore, value stocks incline to limit the downside risk in times of financial turmoil. This view is for instance underlined during the Internet Bubble in 2001 and 2002. When the STOXX 600 equities fell 15.6 and 24.8 pct., respectively, the HML (VMG) portfolio gained 25.6 and 22.6 pct., while the WML gained 10.6 and 25.5 pct., respectively. Even though all portfolios lost on an individual basis, the balanced portfolios did surprisingly good, mainly because growth stocks suffered and lost around one third, while the loser portfolio lost both years in the area -23.1 to 40.5 pct., both of which were significantly larger than what the value and winner stocks lost, as can be seen in Appendix 5. Similar results appear in 2009 where the Pan-European markets dropped 58.3 pct. before it rebounded in 2009 and 2010.

In accordance with Chan and Lakonishok (2004) the marginal differences in volatility and beta are unlikely to explain the fact that value stocks have outperformed growth stocks on average. Furthermore, both the pure value portfolio and the pure winner portfolio seem to have among the highest sharp ratios, both of which are fairly equal to the general STOXX 600 market. But since these strategies involve a directional bet in the market and are not cost-neutral to implement, one is more interested in the performance of the VMG, WML and Combi strategies. Obviously the momentum strategy
(WML) with an annualized sharp ratio of 0.12 is unattractive. In contrast, the sharp ratio of the VMG strategy gives a risk-adjusted return of 0.53, while the Combi portfolio gives 0.58. This is somewhat lower than the findings in AMP (2013), where the sharp ratio of the 50/50 portfolio for example constituted 0.77 in UK and 0.87 in Europe as a whole, even though the average volatility over the period 1974 to 2011 was almost similar (6.8 pct. and 8.1 pct.).

**Evaluating the sharp ratio**

But is an annualized sharp ratio of 0.53 or 0.58 good over a period of 15 years? When looking at a pure market portfolio that has given 0.52, in excess return per unit of risk, one would be encouraged to say no regarding the VMG performance. However, hedge funds do not use a relative benchmark such as the market return, because they are often market-neutral. Instead, hedge funds have a tendency to apply an absolute benchmark of zero, or naturally, the risk free rate, which corresponds to a sharp ratio of zero.

To come up with a reasonable comparison, one can look at the performance of Warren Buffet who has become one of the wealthiest investors in the world based on his investment philosophy over the past fifty years. Frazzini, Kabiller, and Pedersen (2013) reveal that Berkshire Hathaway has delivered a Sharp Ratio of 0.76 from 1976 to 2011, which corresponds to twice the return per unit of risk as the general market over the 35-year period. The reason to this exceptional performance roots back to his investment approach of buying “safe” (stocks with low beta and low volatility), “cheap” (value stocks with high book-to-market ratios), and “high-quality” (stocks that are profitable, growing, have stable cash flows and high pay-out ratios). These conclusions correspond to Buffet’s own statements in Frazzini et al (2013):

> “Whether we’re talking about socks or stocks, I like buying quality merchandise when it is marked down”. (Warren Buffett, Berkshire Hathaway Inc., Annual Report, 2008).

As a more recent comparison over a shorter lifespan, Holte Capital delivered an average sharp ratio of 1.5 over the period 2000 to its close in February 2008. According to Kroijer (2010), this was seen as a decent or mediocre return in the hedge fund industry. In comparison, the Combi portfolio, the VMG portfolio and the overall European market have delivered a sharp ratio of 0.84, 1.05 and 0.52 over the same period, respectively. Hence, the cost-neutral value portfolio has proven rather successful over the first eight years, but it faced a hard time the last six years, as earlier illustrated in Figure 4.3.
4.2.2.2. *Treynor measure and beta*

Sharp ratio and Treynor ratio are closely linked as they both measure the “reward”, that is, the excess return, per unit of risk. But where Sharp ratio applies the underlying volatility as measure of risk, Treynor ratio uses the systematic risk, i.e., the market beta. Hence, if you only apply the sharp ratio, then you give the hedge fund credit for all excess returns, including simple market exposure. Therefore, it is central to include beta as another risk measure than volatility, as it is a standard measure of the relationship between the volatility of the stock and the volatility of the market. Naturally, a hedge fund manager is not compensated for taking purely market exposure.

Recall that the overall market has a beta of 1 and, hence, the past loser portfolio with a beta higher than 1 is more risky than taking a market position. Interestingly, value stocks exhibit only marginally higher systematic risk than growth stocks, which further deepens the value versus growth premium puzzle. Finally, as one would expect, the Combi and the two neutral portfolios (VMG and WML) have a beta near zero, as they go long one part of the market and short another. But since the loser stocks tend to be more risky than the winners, the WML portfolio has negative market exposure. In other words, the WML portfolio benefits when markets go down.

However, keep in mind that a negative Treynor measure is not necessarily a bad sign. Note that the return of the Combi portfolio exceeds the risk-free rate, but its beta is negative, which implies that the fund outperformed the risk-free rate by betting against the market. In conclusion when looking at the Treynor ratio, the cost-neutral value strategy (VMG) and the combined value and momentum strategy have the highest risk-adjusted performance as a result of their low market exposure.

4.2.2.3. *Jensen’ measure and alpha*

Lastly, Jensen’s measure is also known as alpha (α), because it calculates the excess return a portfolio generates over and above its expected return based on CAPM. Like the Treynor measure, Jensen’s alpha calculates risk premiums in terms of beta, or undiversifiable risk, and therefore assumes that the portfolio is already properly diversified.

Naturally, the market has an alpha of zero, as all excess return comes from market exposure. In accordance with the conclusions from the Treynor measure, the cost-neutral value and Combi strategies are superior on a risk-adjusted basis. Actually, the poor WML momentum portfolio comes in on top, just above the Combi and VMG alpha. In other words, because the cost-neutral momentum portfolio has a negative beta of -0.29, CAPM expects an excess return of minus 2.7, pct. (-0.29×9.53%). As a result, even a small profit makes the momentum portfolio look good in this perspective.
In conclusion, the combi portfolio seems to deliver a gross return similar to the market. However, on a risk-adjusted basis the Combi portfolio appear to outperform all other strategies. Therefore, one might be interested in testing whether the strategy truly has such a low risk on a long-term basis, or if this period was just fortunate not to blow up, such as if a hedge fund is selling out-of-the-money options or credit default swaps collecting a small premia until a big market move blows it up. Further, if the returns are non-normal distributed and a hedge fund has a significant crash risk, e.g. as a consequence of too high leverage, then volatility and beta may not be the best risk measures. Therefore, it becomes evident to look at a hedge fund's drawdown (DD), which takes the hedge fund strategy and leverage into consideration (Pedersen, 2015). But before we analyse the frequency and magnitude of the losses, we will take a snapshot of the drivers of the portfolio returns.

### 4.2.3. Portfolio exposures

When computing and evaluating the portfolio returns it is useful to check whether the portfolios have the desired exposures. Therefore, Table 4.4 runs a combination of regressions on the portfolio returns of the equal-weighted long/short value (HML) and momentum (WML) strategy with market, size, value, and momentum factors as explanatory or independent variables. The first line in panel A and panel B indicates that both the value portfolio and the momentum portfolio have a high positive exposure to the market of 86 and 91 per cent, respectively, using traditional CAPM. However, note that the coefficient of determination, R squared, is approximately 25 per cent, which indicates that the CAPM model alone does a poor work explaining the variation in excess returns.

When the model is extended to Fama and French’ (1993) famous three-factor model with a market (CAPM), size (Small Minus Big) and value (High Minus Low) factor or Carhart’s (1997) extension including the 1-year momentum factor, also known in the industry as the MOM (or Up Minus Down, UMD) factor, the market exposure diminishes totally, as well as the R² improves significantly. Intuitively, this makes good sense, since a strategy where one buys the value portfolio and sells the growth portfolio, or similarly, buys the past winners and sells the past losers, should have a beta near zero, if the two individual portfolios have an equal sized beta.
Table 4.4: Regression statistics of the value portfolio (Panel A) and the momentum portfolio (Panel B) with corresponding R² and t-values (in parenthesis). The sample period is from January 1999 to December 2014.

Further, as one would expect, the value portfolio has an exposure to the value factor (HML) close to 1, while the market and momentum factor cannot explain any of the value returns when using FF3 and FF4. Same reasoning goes for the momentum portfolio, where the CAPM and FF3 models leave approximately two thirds of the total variance unexplained.

Naturally, Table 4.4 could show different combinations, since the parameter coefficients change depending on the independent variables applied. Nonetheless, the table gives a clear indication of the portfolio exposures.

Interestingly, one can note the negative exposure to the size factor for both the value and the momentum portfolio. It means that if the SMB factor increases by 1 unit, the dependent variable decreases by 0.14 for the value portfolio and .15 for the momentum portfolio. In other words, both strategies have a tendency to hold big companies while selling smaller ones. This might actually be a little surprising for the value portfolio, given the definition that value stocks have a small market value relative to book value.
To test the latter point, one can make the same regressions on the value and the growth portfolio, individually. Remarkably, a FF3 and FF4 regression comes up with the reverse conclusion, as all SMB parameter coefficients are positive and ranging from 0.51 to 0.65 for both value stocks and growth stocks. It point towards, that both the value premium and the growth premium tend to be long smaller stocks and short larger stocks.

As we will soon recognize in section 4.3.1, this evidence is in line with the low market value of the value portfolio, but contradicts the high market value of growth stocks. Logically, one would assume that the value portfolio, on average, consists of smaller companies, while the growth portfolio consists of larger companies.

4.2.4. Crash risk and drawdown

When adjusting the nominal returns for risk it seems that the cost-neutral strategies perform far better than originally suggested when looking at the gross returns solely. Consequently, the degree to which a hedge fund can apply leverage to these strategies in order to bring satisfactory returns depends on the magnitude of the negative returns. Frequent and large negative returns can lead to redemptions from investors and margin calls that ultimately may cause the demise of the hedge fund.

To measure the extent and frequency to which a strategy may experience large negative returns the two statistics skewness and kurtosis is often applied. This is especially evident if the strategies have negative skewness, which indicates that extreme negative returns are more likely than extreme positive returns, in combination with high kurtosis. Kurtosis measures the ‘peakedness’ of the distribution and the thickness of the tails, i.e. the magnitude of the extreme returns.

Looking at Table 4.5, the momentum portfolio is skewed to the left, while being leptokurtic, since its kurtosis exceeds 3, which is the kurtosis of a normal distribution. This means that the WML portfolio experiences larger and more frequent extreme negative returns, which may cause the hedge fund to collapse like a house of cards, if the position weights too heavily. In comparison, the 50/50 Combi portfolio has an excess kurtosis of 2.07, indicating that it may experience more extreme returns. Yet, the manager may not worry too much, as these extremes are evenly distributed, where negative returns are approximately as frequent as positive returns.
However, the two statistics do not express how much the strategies lose in down periods and when these inopportune events occur. Therefore, it is valuable for a hedge fund to include the two concepts high water mark and drawdown. The high water mark (HWM) indicates the highest cumulative return up to a given date ($P_t$), and is often used because hedge funds only charge performance fees when their returns are above their HWM. Hence, if the hedge fund manager makes losses, he must first regain what is lost before the hedge fund makes money. The drawdown is determined as the cumulative loss since started. Therefore, drawdown at time $t$ ($DD_t$) is calculated as the percentage distance from the peak, i.e. from the high water mark:

$$DD_t = \frac{HWM_t - P_t}{HWM_t}$$

In Figure 4.4 and Figure 4.5 the cumulative return and drawdown are illustrated for both the value (VMG) and the Combi portfolio. It appears that the drawdown on the value strategy primarily lies within a reasonable area, within a maximum of 26.7 pct. in February, 2002, until it peaks at 32.1 pct. in July 2012. Note the drawdown spike in February, 2009, before it quickly rebounded, followed by a five year-long drawdown period in the repercussions of the financial crisis.

One should further note that the balanced value portfolio has experienced only a modest improvement of 25.7 pct. since Lehman’s default in September, 2008, corresponding to an annual growth of 3.7 pct. In comparison, a passive market investor gained 15.9 pct. annually over the same horizon, if he, however, would manage to survive a 55.0 pct. drawdown in February, 2009, more than double compared to the drawdown a value investor would face over the same period. Though the value investor might survive the drawdowns on the VMG portfolio, as seen above, it becomes more problematic if a hedge fund applies leverage to the combined strategy.

<table>
<thead>
<tr>
<th>Statistics</th>
<th>Value</th>
<th>Momentum</th>
<th>Combi</th>
<th>STOXX 600</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>VMG</td>
<td>Value</td>
<td>Growth</td>
<td>WML</td>
</tr>
<tr>
<td>Skewness</td>
<td>0.70</td>
<td>0.04</td>
<td>-0.66</td>
<td>-1.20</td>
</tr>
<tr>
<td>Kurtosis</td>
<td>3.69</td>
<td>2.70</td>
<td>1.03</td>
<td>4.62</td>
</tr>
</tbody>
</table>

Table 4.5: Skewness and kurtosis statistics of the return distribution for each strategy from January 1999 to December 2014.
In Figure 4.5 it is illustrated that the Combi portfolio experiences problems from beginning of 2009 until the second half of 2013. The drawdown ranges from a short term high of 26 pct. in November 2001 to an all-time maximum of 27 pct. in June 2010. More importantly, investors that have applied the Combi strategy have actually managed to recover after the financial crisis, although with a slight drawdown of 10 pct. by the end of 2014.
As the momentum strategy (WML) delivered poor returns over the sample period, following such an investment strategy alone would unsurprisingly lead to larger drawdowns. In Appendix 6 one can note that the pure momentum strategy experienced a maximum drawdown of 47 pct. in September 2009. This is in line with the larger negative skewness and its leptokurtic distribution as earlier mentioned. Consequently, an investor had certainly experienced unfortunate returns if one had applied leverage to the pure momentum strategy.

Naturally, experiencing a long drawdown period is costly and risky, as it not only may lead to losses, but also to redemptions from investors and concerns from counterparties (Pedersen, 2015). For the three strategies, the Combi portfolio would have experienced a drawdown period of 63 months from July 2008 until September 2013, while the cost-neutral value and the cost-neutral momentum strategy would face a period of 63 and 71 months, respectively, starting from October 2010 and February 2009 until end of 2014.

A main concern is for example whether a prime broker will increase margin requirements or ultimately pull the financing of the hedge fund’s positions. It must be estimated to be very likely during such a tough period unless the hedge fund has applied a modest leverage, has differentiated across a number of non-related strategies or has sufficient capital to put up further collateral to keep the position afloat.

4.3. Analysis of the strategy components

This section seeks first to explore the impact of changing the weighting from equal weights to value based weights. Second, it tries to ascertain if the strategies have any industry or country overhang that might explain the results.

4.3.1. Market values and portfolio weight

In general, the literature on momentum and value investing can be divided into two groups: The group that uses equally-weighted portfolios and the group that uses market-cap-weighted, i.e. value-weighted, portfolios. For example, Scowcroft and Sefton (2005) exhibit that Jegadeesh and Titman (1993, 2001), Grundy and Martin (2001) and Rouwenhorst use equally-weighted portfolios, whereas Richards (1997), Chan et al (2000), Moskowitz and Grinblatt (1999) as well as others use market value-weights.
From the definition of value stocks with high book-to-market values it is obvious that value stocks tend to be smaller, or currently undervalued, companies that have not yet realized their full potential. On the other hand, growth stocks will often be overvalued after a period of growth and share appreciation. All things equal, this should indicate that the value portfolio, on average, consists of less valuable companies, while the growth portfolio, on average, comprise more valuable companies. Looking at Table 4.6 below, this reasoning turns out to hold, since the average market capitalization of the companies in the value portfolio is lower than the average market capitalization of the companies in the growth portfolio.

<table>
<thead>
<tr>
<th>Average market value (Billion EUR)</th>
<th>Value</th>
<th>%</th>
<th>Momentum</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Long</td>
<td>1,858</td>
<td>28%</td>
<td>2,002</td>
<td>30%</td>
</tr>
<tr>
<td>Medium</td>
<td>2,473</td>
<td>37%</td>
<td>2,511</td>
<td>38%</td>
</tr>
<tr>
<td>Short</td>
<td>2,335</td>
<td>35%</td>
<td>2,154</td>
<td>32%</td>
</tr>
<tr>
<td>Total</td>
<td>6,667</td>
<td>100%</td>
<td>6,667</td>
<td>100%</td>
</tr>
</tbody>
</table>

Table 4.6: Average market capitalization of the companies in the portfolios during the period 1999 to 2014 measured as the companies' equity capital (in billion €), that is, share price multiplied by the number of ordinary shares in issue.

Further, the market value development of the portfolio companies is shown in Appendix 7, where one can observe an upwards trend for value stocks over the period in Panel A. For example, during 1999 value stocks constituted modest 15 pct., while growth stocks made up 49 pct. In 2014 the market values converged to 35 and 33 pct., respectively.

The fact that the market capitalization of the value stocks increase during the period underlines the statement that value stocks are profitable as a long-term strategy. In contrast, the momentum strategy tends to mean-revert, as seen in Panel B, which exhibits a pattern that looks like a random walk with large ups and downs. As a result, the momentum portfolio has less exposure towards the size factor, since the market value of the companies in the long and short momentum portfolio seem to balance on average, which also appears in Table 4.6 above.

With reference to the growing market value of the value companies, one might wonder if the risk and return would change significantly if the analysis had applied value-weights instead of equal portfolio weights. Therefore, Appendix 8 and Appendix 9 focus on the impact of changing the weighting scheme.
In general, when constructing an equal-weighted portfolio, the size of the individual stocks does not impact the results. Naturally, it means that the impact of larger companies is scaled down and the impact of smaller companies is scaled up. For example, in 2014 the shareholders of Europe’s largest company, Novartis, earned a total return of 36.6 pct., while the smallest among the 600 biggest European companies, Hunting plc, a British supplier to the oil and gas industry, experienced a total return of –25.3 pct., as seen in Appendix 8. Using equal weights, the average of these two are 5.7 pct., while it surges to 36.3 pct. using market value weights, since Novartis is 204 times larger than Hunting plc by the end of 2014.

Appendix 9 clarifies what happens with the value and growth portfolio when applying value-weights. It appears that the monthly returns are halved, although this is not explained by a similar reduction in risk. Remarkably, none of the four statistics are longer statistically significant. Therefore, the risk-adjusted performance of all four portfolios: VMG, Value, Growth and Market are far less attractive. For example, the sharp ratio of the neutral value portfolio (VMG) is reduced from 0.53 to 0.29, while the sharp ratio of the market portfolio changes from 0.57 to 0.24.

As Larsen (2014) also finds, these findings likely indicate two things. First, the major value companies perform below average. Second the returns of the smaller companies are above average, and those superior returns are enforced further, when applying equal weights. In conclusion, the equal-weighted portfolio has yielded far better results than the value-weighted portfolio, and (maybe) part of the answer can be attributed to specific industry outperformance, as will be discussed in the following sections.

4.3.2. Performance attribution and industry overhang

With inspiration from Rousseau and Rensburg (2004), it is useful to analyse whether the returns can be attributed to one or few so-called ‘star performers’. However, with a total of 1320 stocks, it may be difficult to highlight the effects of any specific stock. Instead one can look at tendencies of industry overhang and evaluate the performance of the individual industries as Asness, Porter and Stevens (2000).

Moskowitz and Grinblatt (1999) found that industry effects are a key-driving factor of individual stock momentum. With inspiration from their analysis of U.S. stock prices from 1963-95, this section explores whether it is needed to take into account any persistent industry concentration among the major European companies over the sample period.
Figure 4.6 displays a snapshot of the sector distribution based on market values ultimo 2014, where the financial sector weights the heaviest with 22.7 pct., closely followed by industrials with 20.1 pct. and consumer goods with 13.8 pct. At the other end of the spectrum, it seems that only a fraction of the major European companies operate within technology and telecommunications. Interestingly, those relative percentages have only changed marginally since 1999. Compared to 1999, industrials have increased five percentage points, mainly at the expense of the financials, which accounted for a total 25.7 pct. prior to the dot-com bubble and the financial crisis.

Having this industry distribution in mind, it is interesting to test if those dominating industries, on average, have been bought or shorted more than others. Looking at portfolio level in Figure 4.7 it turns out that the momentum strategy tends to balance fairly equally, only with a minor overweight in consumer goods (long past winners) and underweight in consumer services (short past losers). Hence, no industries seem to have outperformed or underperformed particularly during the period, except that the past losers portfolio has a slight overweight of consumer service and financial stocks.
In contrast, the value strategy seems to have a clear tendency towards finance stocks and to a lesser extent the utility industry, while the short portfolio (growth stocks) mainly includes consumer goods, consumer services and health care, which roughly constitute a third of the market combined. For example, the value portfolio has 7,933 net long positions out of 26,536 positions in financial stocks (13,311 long, 5,378 short and 7,847 neutral) based on a total of 108,374 positions across all industries, i.e. the financial companies constitute 24.5 pct. of all positions, roughly equal to the industry distribution in Figure 4.6.

These industry positions match the findings in the UK study by Larsen (2014), which may be explained by the large proportion of UK companies in the STOXX Europe 600 Index. For example, in 2014 UK companies made up 30.33 pct. of the market value of all STOXX Europe 600 companies - more than double compared to Germany measured by market value and almost three times the number of companies from France that have made it to the STOXX Europe 600 Index, as seen in Appendix 10.

Ilmanen (2011) states that several practitioner studies highlight the empirical benefits of sector-neutral methods. Consequently, adjusting for industry performance within financials, consumer goods and the health care sector seems to be vital, both because they almost make up half the index market value, and because the value strategy takes a directional bet on those industries.

Further, analysing the specific performance of each industry, as shown in Appendix 11 and
Appendix 12, it appears that the financial sector as well as consumer services and utilities have underperformed with an average annual return of 7-10 pct., well below the overall average industry return of 12.13 pct. from 1999 to 2014. Therefore, it is logical to presume that these industry biases affect the performance of the strategies. It is not clear whether such sector bias may or may not boost average returns, because the value portfolio is long financials and utilities, while short consumer services. But clearly, such industry overhang impairs value portfolio diversification and thus raises its overall volatility.

4.4. Sector neutrality

Although other academic studies (e.g. FF, 1998, and LSV, 1994) and many popular investment products (e.g. MSCI-Barra, S&P value/growth indices as well as the RAFI fundamental index) do nothing to obtain sector neutrality, this next section pursues a sector-neutral portfolio strategy. First, the methodology is briefly explained followed by a presentation of the findings. Finally, the section ends up summarizing the drawdown characteristics of the sector-neutral portfolios and sets it in relation to the none-sector neutral portfolio.

4.4.1. Methodology and design

Sector neutrality can generally be implemented in several ways. There is no correct design; both simple-but-smart and more complex approaches have their supporters (Ilmanen, 2011). While the study of Scowcroft and Sefton (2005) likely belongs in the first category, Moskowitz and Grinblatt (1999) certainly belong in the latter. For example, whereas Moskowitz and Grinblatt (1999) calculate three industry-neutral value-weighted portfolios and three stock momentum portfolios, all six in different ways, Scowcroft and Sefton (2005) apply one simple methodology. For every period they rank the 10 MSCI sectors and sell a value-weighted portfolio of all stocks in the two worst sectors and buy a similar portfolio of all stocks operating within the two best performing sectors.

However, both studies focus on price momentum exclusively. In contrast, this study includes a value strategy as well as the combined value and momentum strategy. Therefore, this study tries to employ one simple and uniform approach to pursue sector-neutrality. But as mentioned above, there is several ways to eliminate sector bias. At first glance, it could be straightforward to create a sample consisting of an equal number of companies in each industry any given year. However, the downside with such approach is that the impact of smaller industries like telecommunications or technology
will be scaled up, while major industries like financials or industrials will be scaled down, which distort the normal industry distribution.

Similarly, a method that groups all companies into ten industries, sort them by market value each year and limit the sample to the top tertile (30 pct.) of companies measured by market value in each industry, will naturally maintain the regular compartmentation in the markets. Nonetheless, it turns out that such ‘semi’ sector neutral approach does not take fully account for the sector bias, because the same industry bias towards financials and consumer services appears.

Instead, this study focuses on the so-called excess industry method, one of the six methods applied by Moskowitz and Grinblatt (1999). First, all stocks are sorted into ten industries to calculate the monthly industry average of the value and momentum measures. Second, the excess industry measure is calculated for each stock in the value and momentum portfolio based their book-to-market and past 2-12M raw return, respectively. Third, all stocks are ranked across all industries based on their value and momentum measure in excess of their industry average, thus, all industry performance is neutralized, although no industries are excluded in the portfolio at any point in time. To put this method into perspective, Scowcroft and Sefton (2005) only take a position in four industries (two longs and two shorts) at the same time, similar to few of the other approaches by Moskowitz and Grinblatt (1999). Finally, all portfolios are held for a holding period of 6 months, which gives a total of six portfolios, each of which is formed in different months, similar to the description in section 3.2.

4.4.2. Sector-neutral performance

The performance of the excess industry portfolios is demonstrated in Table 4.7. It is seen that both the long-short value and the long-short momentum portfolio produce smaller annual profits, approximately two-thirds relative to the previous findings, when we did not account for industry effects.

Although momentum profits decrease vaguely from 1.96 pct. to 1.14 pct. when taking account for industry effects, it is difficult to distinguish whether a fraction of the momentum profits should be attributed to industry performance. The intuition is twofold. First, the risk is fairly constant – both in terms of volatility and in terms of beta. Second, the momentum returns remain statistically insignificant in both studies. Nonetheless, it underlines the previous findings in section 4.2.1 that market prices are efficient and that the returns of past losers tend to be quite similar to those of the past winners. This is in accordance with the findings of Moskowitz and Grinblatt (1999), who finds that momentum premium is literally none existing when adjusting for industry effects.
With respect to the value portfolio, it is interesting that the volatility of the cost-neutral (VMG) strategy decreases by more than the premium, hence, the risk adjusted return measured by sharp ratio increases vaguely from 0.53 to 0.59. This is in line with one of the findings in Scowcroft and Sefton (2005) that value investors will reduce risk by imposing industry-neutrality. However, the change in volatility is not directly visible when looking at the pure value or pure growth portfolio, since the market exposure and volatility remain at the same level for the two directional portfolios. This does not conform to the second conclusion in Scowcroft and Sefton (2005), where they argued that growth investors would benefit from fewer sector constraints.

Further, the profits of the Combi portfolio increase to 7.51 pct., equal to a remarkable climb of 3.3 percent points or 78 pct. But the improvement comes at the expense of a similar increase in volatility, which leaves the investor slightly worse of at a risk-adjusted performance perspective with a sharp ratio of 0.57, rather than 0.58. The increase in total risk occurs in spite of the unchanged diversification benefit, where the correlation coefficient between value and momentum equals -0.49. Furthermore, as one would expect, the market exposure is also close to zero when pursuing industry-neutrality. As a result of the enforced Combi performance and low beta when pursuing industry-neutrality, an investor that combines a value and momentum portfolio will almost double the alpha from 4.5 pct. to 8.3 pct.
### 4.4.2.1. Crash risk and drawdown

To decide whether a hedge fund truly would have benefited from using an industry-neutral Combi portfolio it is central to highlight the crash risk and drawdown, as earlier described in section 4.2.4. In Table 4.8 below it is illustrated that the risk of the cost-neutral value portfolio remains fairly unchanged as the maximum drawdown decreases from 33.3 pct. to 31.5 pct., while the longest drawdown period changes by one month. Now it begins one month earlier, in September 2009, and remains below the high water mark throughout the sample period until December 2014. As one would expect, the marginally lower value premium (it falls from 6.48 pct. to 5.97 pct.) also comes with marginally lower risk in terms of less extreme negative returns, so that fewer investors may withdraw their funds.

![Drawdown summary of the three cost-neutral portfolios. The left side shows the original portfolios and the right columns show the industry-neutral portfolios.](image)

Logically, larger volatility has a direct impact on the magnitude of the negative returns. This intuition is also evident when looking at the industry-neutral combi portfolio, which almost experienced a twofold increase in overall risk from 7.24 pct. 13.07 pct., as seen in Table 4.7. Correspondingly, the maximum drawdown doubled from 13 pct. to 25.8 pct., whereas the longest recovery period remained unchanged at 63 months. Note further that although the portfolios begin their longest drawdown at different time periods during the financial crisis, the length of their recovery periods are surprisingly similar.

In conclusion, the Combi portfolio has proven to be the best investment strategy based on the Treynor and Jensen's alpha measure, while being the portfolio that experiences the lowest maximum drawdown of all portfolios, notwithstanding that one takes account for industry effects or not. Finally, despite the fact that the industry-neutral VMG portfolio has slightly lower volatility relative the industry-neutral Combi portfolio, the latter exhibit lower crash, as the magnitude of the negative portfolio returns are lower. Therefore, all parameters favor the combined value and momentum portfolio as the superior investment strategy.
4.4.2.2. Evaluation of industry bias

Last and not least, it is worth evaluating whether the excess industry approach has limited the industry overhang towards buying financials and selling consumer service and health care companies, as earlier shown in Figure 4.7.

According to Figure 4.8, it is clearly illustrated that the industry bias has changed significantly for the value portfolio. Now, the value portfolio is fairly neutral towards consumer services and healthcare, while the view of financials has changed 180 degrees.

![Industry overhang (Sector neutral portfolios)](image)

Figure 4.8: Industry overhang of the sector-neutral portfolios. The figure illustrates the overweight and underweight of industries in the value and momentum portfolio that are formed to eliminate industry bias. The number reflects the net position based on a total of 103,021 positions divided equally among long, short and neutral positions across all stocks.

In Figure 4.7 the financial industry amounted to 7,933 net long positions, whereas the industry-neutral value portfolio, as shown in Figure 4.8 below, has 1,865 net short positions out of a total 25,016 positions in financial stocks (8,383 long, 10,248 short and 6,385 neutral). Hence, the impact of the major financial industry is reduced in relative terms.

To sum up, it seems that all industries are more evenly represented in the excess industry approach, although the industry bias for the value portfolio remains substantially higher relative the bias of the momentum portfolio. Yet, the industry-neutral value portfolio has a positive exposure towards consumer goods and industrials and a vague negative correlation with the basic materials and oil & gas industry.
4.5. Perspective and implementation

The final section of the analysis sets the study into perspective and tries to identify possible flaws in the implementation process. The primary driver in this evaluation is the impact of transaction costs, followed by the issue of timing and lags in the construction of the portfolio. Finally, the conclusion will sum up the research plus suggest alternative approaches to mitigate any drawbacks.

Transaction costs

Although most academic studies tend to ignore the effects of trading costs, as stated in Frazzini, Israel and Moskowitz (2012), transaction costs remain the first major issue related to the implementation of the strategy. The study has focused on the most liquid assets in the Pan-European markets, partly to avoid issues of thin trading and consequently higher transaction costs. Nonetheless, ignoring bid-ask spreads, commissions as well as price impact and capacity constraints is far from the real world, since a regular rebalancing strategy, all things equal, reduce net excess return. This is especially evident for the momentum strategies, which are prone to frequent portfolio rebalancing as stock prices move. Thus, a portfolio manager with high turnover may face significant trading costs. As a result, the stated results in this study overestimate the profitability of implementing such strategies in real-life.

Frazzini, Israel and Moskowitz (2012) show that real world trading costs of momentum and value strategies tend to be low for large institutions. If the study, on the other hand, integrated Small Cap companies in the analysis, then bid-ask spreads would have been much higher, while an institutional buyer may have much higher impact on the price formation, when trading smaller equities. Consequently, a Small-Cap portfolio manager loses ability to change portfolio weights without experiencing increased transaction costs.

AMP (2013) also argue that it is difficult to include all issues related to transaction costs, and if you are focusing on the most liquid stocks, then spending these extra resources is plausible not worth the trouble. Further, Garleanu and Pedersen (2012) claims that simple precautions, such as choosing an optimal rebalancing period, can quite easy reduce transaction costs. Such implementations would naturally affect the results of this study, since the portfolios are rebalanced every month without looking at increased transaction costs. Though monthly rebalancing requires a frequent change in the portfolios, positions in the momentum portfolio and, certainly, in the value portfolio often remain
over several holding periods. It indicates that only limited trading occurs over some periods. In line with this approach, one can implement a rebalancing strategy only to change portfolio weights if some price or book-to-market measures have changed significantly from last month.

**Time lag**

A second issue that researchers often ignore in such back-testing studies is the academic assumption that you are able to observe the closing price, form the portfolio and then implement the trade at the very same closing price. Naturally, it is unrealistic in real life, since the window is closed when the broker has rung the bell for the last time. In addition, it takes time to analyse and process the rebalancing of the portfolios and actually implement the trading strategy. Therefore, some studies such as Jegadeesh and Titman (1993), and Asness et al (2013) to name a few, base their study on two separate portfolios. One is implemented immediately ignoring the closing price assumption, while the other portfolio is formed with a one week lag to mitigate bid-ask spreads, price pressure, and lagged reaction effects as documented in Jegadeesh (1990).

Normally, one would suspect that the lagged portfolio would yield lower returns, as a result of information decay. However, interestingly several of the 1-week lagged portfolios yield a marginally higher average return. Given that these findings are representative, omitting the 1-week lag in this study simply makes the results look conservative.
5. Conclusion and recommendations of the research

The study has applied a cross sectional analysis to evaluate the performance of value and momentum strategies viewed separately as well as combined. The empirical evidence is based on the European equity markets since the Euro was introduced as accounting currency in January 1999. The study focuses on large capitalization stocks for two reasons. First, the study seeks to avoid any problems associated with thin trading and the resulting illiquidity, which affects the pricing, and thereby the costs of implementing the strategies in practice. Second, the study seeks to eliminate part of the size effects, which has been broadly documented to improve value and momentum returns. As a result, the study applies the STOXX Europe 600 Index, which represent the 600 largest European companies.

The formation of all portfolios are based on a monthly returns, a monthly rebalancing frequency, and a six month holding period. To avoid the pernicious effects of backfill bias and survivorship bias, the study simply analyse those stocks that are part of the STOXX Europe 600 index in January each year. Hence, changes in the index constituents occur once a year to include the effects of IPOs, mergers or de-listings of major companies as well as changes in the STOXX 600 index because smaller companies have advanced or larger companies have fallen back.

The value portfolio is constructed based on the common Fama and French (1992) methodology using the book-to-market ratio as proxy for value, while the momentum portfolio is based on the past 2-12 month raw returns. Hence, the study applies the same approach as Asness, Moskowitz and Pedersen (2013) in which they intentionally keep most regressions as simple as possible both for clarity and understanding as well as a precaution against the claims of data mining.

The value strategy

The study documents that a value investor focuses on securities that are considered cheap compared to its fundament value based on one or several value measures like its book-to-market ratio. But buying the cheap stocks increases the risk of falling into the value-trap and buy the so-called ‘falling knives’ whose value will never be recognized by the market. Therefore, a value investor needs to do a proper homework, when evaluating whether it’s a bargain opportunity or not.

Nonetheless, the European evidence during the past 15 years shows that a cost-neutral value strategy have been a successful investment approach. Since 1999, a value portfolio that goes long value stocks and shorts growth stocks have given an annual excess return of 6.48 pct. with a modest volatility of
12.12 pct. and practically no market exposure. It corresponds to a sharp ratio of 0.53, which is far better than the momentum portfolio, but less than the combined value and momentum strategy. Putting this into perspective with the current body of knowledge, Frazzini, Kabiller, and Pedersen (2013) showed that Warren Buffet has delivered a sharp ratio of 0.76 over a 40-year period. But as earlier mentioned, capital markets change and risk and return varies over time. And since the sample period includes the dot-com bubble in 2001 and the financial crisis in 2008, which escalated to a general sovereign debt crisis in Europe, it does not necessarily reflect that the value strategy has delivered poor returns.

The industry analysis of the value portfolio shows that value investors have an obvious industry overhang towards companies in the financial sector, but underweight companies in the health care and consumer service industry. Nonetheless, the study finds that these conclusions stand up for industry bias and industry overhang, as the results are not materially affected, if one pursues industry neutrality.

The momentum strategy
In contrast to the value doctrine, a momentum investor believes that stock prices will continue their past performance. Therefore, it should be possible to realize excess returns when buying stocks that have recently performed well and selling those stocks that recently have done poorly. But in contrary to the positive momentum premia that several earlier studies have found historically (e.g. Jagadeesh and Titman, 1993), this study finds insignificant momentum returns of mere 1.96 pct. annually from 1999 through 2014. These results are regardless of taking account for industry effects or not, or if one applies either total return, including dividends, or raw return, excluding dividends. Same conclusions is found if one ignores the past 1-month return and the related short-term liquidity and microstructure issues as mentioned in Asness, Moskowitz and Pedersen (2013). Hence, the momentum portfolio delivers an insignificant loss of -2.18 pct. a year, which also enforces the 1-month short term reversal effects.

The reason that the momentum has performed poorly is related to the fact that the past winners and the past losers have fared equally well. Consequently, a strategy that buys winners and short sells losers does not add much value. The evidence underlines the Fama (1965) theory about efficient markets, where momentum and reversals are two sides of the same coin. But looking at the major stocks in the financial markets, it is not surprising that markets have become more efficient with the increasing number market participants and hedge funds that have specialized in locating arbitrage opportunities as well as the fact that high frequency firms have begun to flourish during the 2000s.
The combined value and momentum strategy

Despite the fact that momentum strategies have underperformed since 1999, the study discovers that a combined value and momentum portfolio still outperforms all other strategies on a risk-adjusted basis. The study finds that a cost-neutral strategy, which ignores industry bias, gives an annual excess return of 4.22 pct., equivalent to a sharp ratio 0.58. In comparison, the industry-neutral Combi portfolio yields an excess return of 7.51 pct. per annum, which is equal to a sharp ratio of 0.57. But while the sharp ratio looks fairly equal to the cost-neutral value strategy, the Combi portfolio clearly outperforms measured by Treynor ratio and Jensen’s alpha, because of its low market exposure.

The reason for the higher risk-adjusted performance of the combined value and momentum portfolio is related to the negative correlation between the two strategies. Because the correlation on average constitute approximately -0.5, it reflects that value and momentum stocks are affected differently during times distress, which produces possible diversification benefits and lower portfolio volatility. Therefore, a value investor who fears the risk of buying a cheap company whose price continue to fall, or whose price take an inordinate time to realize, can benefit from considering the price momentum, and only buy the cheap stocks, when they are on the rise. Similarly, a momentum investor can reduce the risk of buying a “greater fool” stock, that is, a stock that has become too expensive and is unsupported by the fundamental value, if one includes a value component to evaluate the fundamental value of the stock.

Hence, the combined value and momentum study can conclude that the combination of higher return and lower risk is likely driven by focusing on a subset of stocks that exhibit good value and good momentum characteristics. Rather than focusing on value and momentum strategies individually, a prominent investor should seek to buy undervalued stocks that have exhibited a short-term positive trend, while selling overvalued stocks that have undergone a negative short-term momentum.

5.1. Recommendation and suggested further research

Even though the presented results of a combined value and momentum strategy seems to have worked reasonable well during the Internet-bubble and the financial crisis, then such studies often unties further questions.

First of all, the study can relatively easy be extended to other countries. It could for example be relevant to implement the same approach in the emerging markets or the BRIC countries that do not have an equity market that is as well functioning and developed as in the US and in the bigger European coun-
tries, from which the majority of the existing body of knowledge is based upon. Hence, it would be interesting to see if the momentum returns remain statistically insignificant or if those findings are exclusive for the major European equities over last fifteen, as explored in this study.

Further, the study could be constructed in several different ways, rather than applying uniform measures as simple as possible. Naturally, it is straightforward to change the setup of the portfolio formation, as for instance, changing value and momentum measures or applying a different holding period than six month. Nonetheless, during the analysis of such study one can easily fall short of the data mining bias and look for possible ways to boost profits. For example, it induces one to search for alternative investment approaches similar to the methodology of Jegadeesh and Titman (1993) and test the implications of different formation and holding periods between 3 and 12 months.

Alternatively, Rousseau and Rensburg (2004) suggested using longer time horizons or lag the formation variable. Their study found significant excess returns of low P/E from Johannesburg Stock Exchange over longer time horizons beyond 12 months. Therefore, they recommend that instead of buying the currently cheapest shares measured by low P/E, it may be better to create a portfolio based on what were the cheapest shares 12 months ago, because the currently low P/E shares are likely to exhibit poor price momentum.

With this perspective in mind, and with respect to the increasing market capitalization of the companies in the value portfolio, it could indicate that a long-term value portfolio might be worthwhile. For example, it could be interesting to test if the value premium increases with longer holding period, or if it is beneficial to lag the book-to-value measure 12 months to enforce the value creation of the value stocks, thus, moving from 'dogs' to the 'cash cows' category. In other words, buying value stocks that were the cheapest 12 months ago may benefit because the true potential of the stock has begun to realize. Unless one becomes victim for the value trap, such approach may ultimately improve returns.

This suggestion may, however, only relate to the value portfolio, because earlier evidence has shown negative autocorrelation for periods beyond 12 months (e.g. Moskowitz et al, 2012; Lo and MacKinlay, 1988, 1990). Or said differently, long-term reversal effects have historically caused momentum strategies with holding periods for more than one year to be sub-prime investment strategies. Logically, it may therefore not be worthwhile to combine value and momentum strategies, as suggested by Asness (1997) and Asness et al (2013), if the holding period extends 12 months.
6. Reference list


Larsen, J.K. (2014) 'Understanding if value and momentum strategies can be used in combination to increase excess return of an investment portfolio: Evidence from the UK equity market (FTSE 100 Index)'. Working paper: European School of Economics, London, UK.


## 7. Appendices


### Table 4. Returns, Risk, and Past Performance for Value and Glamour Portfolios, May 1968–April 1990

<table>
<thead>
<tr>
<th>Measure</th>
<th>Growth (%)</th>
<th>Value (%)</th>
<th>Difference (value – growth, in pps)</th>
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<td><strong>A. Postformation returns and risk measures</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Average annual return over 5 postformation years (%)</td>
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<td>22.1</td>
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<tr>
<td>Size-adjusted average annual return (%)</td>
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<tr>
<td>Standard deviation of size-adjusted return (%)</td>
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<td><strong>B. Postformation returns in good and bad states</strong></td>
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<td>1. By market</td>
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<td>Return during worst 25 stock market months (%)</td>
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<td>Return during best 25 stock market months (%)</td>
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<td>2. By economy</td>
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<td>Return during worst 10 quarters of GNP growth (%)</td>
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</tbody>
</table>

*Notes: The sample was all NYSE and Amex stocks with data on returns and accounting information. Monthly returns were measured on equally weighted portfolios. Portfolios were formed in April each year from the largest 50 percent of eligible stocks. Stocks were sorted into three groups by CF/P and sorted independently by average growth rate of sales over five preformation years. The glamour portfolio contained the intersection of the lowest ranked category by CF/P and the highest ranked by past sales growth. The value portfolio was the intersection of the highest ranked category by CF/P and the lowest ranked by past sales growth. Betas in Panel A are reported with respect to the value-weighted CRSP index. Mean growth rates in Panel C are geometric. Source: Results are from Lakonishok, Shleifer, and Vishny (1994).*
## Returns of Relative Strength Portfolios

The relative strength portfolios are formed based on $J$-month lagged returns and held for $K$ months. The values of $J$ and $K$ for the different strategies are indicated in the first column and row, respectively. The stocks are ranked in ascending order on the basis of $J$-month lagged returns and an equally weighted portfolio of stocks in the lowest past return decile is the sell portfolio and an equally weighted portfolio of the stocks in the highest return decile is the buy portfolio. The average monthly returns of these portfolios are presented in this table. The relative strength portfolios in Panel A are formed immediately after the lagged returns are measured for the purpose of portfolio formation. The relative strength portfolios in Panel B are formed 1 week after the lagged returns used for forming these portfolios are measured. The $t$-statistics are reported in parentheses. The sample period is January 1965 to December 1989.

<table>
<thead>
<tr>
<th>$J$</th>
<th>$K = 3$</th>
<th>$6$</th>
<th>$9$</th>
<th>$12$</th>
<th>$K = 3$</th>
<th>$6$</th>
<th>$9$</th>
<th>$12$</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Sell</td>
<td>0.0108</td>
<td>0.0091</td>
<td>0.0092</td>
<td>0.0087</td>
<td>0.0083</td>
<td>0.0079</td>
<td>0.0084</td>
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<tr>
<td></td>
<td></td>
<td>(2.16)</td>
<td>(1.87)</td>
<td>(1.92)</td>
<td>(1.87)</td>
<td>(1.67)</td>
<td>(1.64)</td>
<td>(1.77)</td>
</tr>
<tr>
<td>3</td>
<td>Buy</td>
<td>0.0140</td>
<td>0.0149</td>
<td>0.0152</td>
<td>0.0156</td>
<td>0.0156</td>
<td>0.0158</td>
<td>0.0158</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(3.57)</td>
<td>(3.78)</td>
<td>(3.83)</td>
<td>(3.89)</td>
<td>(3.95)</td>
<td>(3.98)</td>
<td>(3.96)</td>
</tr>
<tr>
<td>3</td>
<td>Buy-sell</td>
<td>0.0032</td>
<td>0.0058</td>
<td>0.0061</td>
<td>0.0069</td>
<td>0.0073</td>
<td>0.0078</td>
<td>0.0074</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(1.10)</td>
<td>(2.29)</td>
<td>(2.69)</td>
<td>(3.53)</td>
<td>(2.61)</td>
<td>(3.16)</td>
<td>(3.36)</td>
</tr>
<tr>
<td>6</td>
<td>Sell</td>
<td>0.0087</td>
<td>0.0079</td>
<td>0.0072</td>
<td>0.0080</td>
<td>0.0066</td>
<td>0.0068</td>
<td>0.0067</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(1.67)</td>
<td>(1.56)</td>
<td>(1.48)</td>
<td>(1.66)</td>
<td>(1.28)</td>
<td>(1.35)</td>
<td>(1.38)</td>
</tr>
<tr>
<td>6</td>
<td>Buy</td>
<td>0.0171</td>
<td>0.0174</td>
<td>0.0174</td>
<td>0.0166</td>
<td>0.0179</td>
<td>0.0178</td>
<td>0.0175</td>
</tr>
<tr>
<td>6</td>
<td>Buy-sell</td>
<td>0.0084</td>
<td>0.0095</td>
<td>0.0102</td>
<td>0.0086</td>
<td>0.0114</td>
<td>0.0110</td>
<td>0.0108</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(2.44)</td>
<td>(3.07)</td>
<td>(3.76)</td>
<td>(3.36)</td>
<td>(3.37)</td>
<td>(3.61)</td>
<td>(4.01)</td>
</tr>
<tr>
<td>9</td>
<td>Sell</td>
<td>0.0077</td>
<td>0.0065</td>
<td>0.0071</td>
<td>0.0082</td>
<td>0.0058</td>
<td>0.0058</td>
<td>0.0066</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(1.47)</td>
<td>(1.29)</td>
<td>(1.43)</td>
<td>(1.66)</td>
<td>(1.13)</td>
<td>(1.15)</td>
<td>(1.34)</td>
</tr>
<tr>
<td>9</td>
<td>Buy</td>
<td>0.0186</td>
<td>0.0186</td>
<td>0.0176</td>
<td>0.0164</td>
<td>0.0193</td>
<td>0.0188</td>
<td>0.0176</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(4.56)</td>
<td>(4.53)</td>
<td>(4.30)</td>
<td>(4.03)</td>
<td>(4.72)</td>
<td>(4.56)</td>
<td>(4.30)</td>
</tr>
<tr>
<td>9</td>
<td>Buy-sell</td>
<td>0.0109</td>
<td>0.0121</td>
<td>0.0105</td>
<td>0.0082</td>
<td>0.0135</td>
<td>0.0130</td>
<td>0.0109</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(3.03)</td>
<td>(3.78)</td>
<td>(3.47)</td>
<td>(2.89)</td>
<td>(3.85)</td>
<td>(4.09)</td>
<td>(3.67)</td>
</tr>
<tr>
<td>12</td>
<td>Sell</td>
<td>0.0060</td>
<td>0.0065</td>
<td>0.0075</td>
<td>0.0087</td>
<td>0.0048</td>
<td>0.0058</td>
<td>0.0070</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(1.17)</td>
<td>(1.29)</td>
<td>(1.48)</td>
<td>(1.74)</td>
<td>(0.93)</td>
<td>(1.15)</td>
<td>(1.40)</td>
</tr>
<tr>
<td>12</td>
<td>Buy</td>
<td>0.0192</td>
<td>0.0179</td>
<td>0.0168</td>
<td>0.0155</td>
<td>0.0196</td>
<td>0.0179</td>
<td>0.0167</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(4.63)</td>
<td>(4.36)</td>
<td>(4.10)</td>
<td>(3.81)</td>
<td>(4.73)</td>
<td>(4.36)</td>
<td>(4.09)</td>
</tr>
<tr>
<td>12</td>
<td>Buy-sell</td>
<td>0.0131</td>
<td>0.0114</td>
<td>0.0093</td>
<td>0.0068</td>
<td>0.0149</td>
<td>0.0121</td>
<td>0.0096</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(3.74)</td>
<td>(3.40)</td>
<td>(2.95)</td>
<td>(2.25)</td>
<td>(4.28)</td>
<td>(3.65)</td>
<td>(3.09)</td>
</tr>
</tbody>
</table>
Appendix 3: Development of the volatility measured by the monthly return over the past 12 months.

Appendix 4: Development of the past 2-year moving correlation between value and momentum portfolios from 2001 to December 2014.
Appendix 5: Annual portfolio performance based on the constituents of STOXX Europe 600 Index from 1999 to 2014.

<table>
<thead>
<tr>
<th>Portfolio performance</th>
<th>STOXX 600 Value</th>
<th>Momentum</th>
<th>Combi</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Market</td>
<td>VMG</td>
<td>WML</td>
</tr>
<tr>
<td>1999</td>
<td>33.5%</td>
<td>-4.1%</td>
<td>36.0%</td>
</tr>
<tr>
<td>2000</td>
<td>4.2%</td>
<td>24.4%</td>
<td>10.4%</td>
</tr>
<tr>
<td>2001</td>
<td>-15.6%</td>
<td>25.6%</td>
<td>-4.5%</td>
</tr>
<tr>
<td>2002</td>
<td>-24.8%</td>
<td>22.6%</td>
<td>-15.4%</td>
</tr>
<tr>
<td>2003</td>
<td>27.0%</td>
<td>20.0%</td>
<td>37.3%</td>
</tr>
<tr>
<td>2004</td>
<td>18.6%</td>
<td>7.2%</td>
<td>21.9%</td>
</tr>
<tr>
<td>2005</td>
<td>26.6%</td>
<td>6.6%</td>
<td>29.3%</td>
</tr>
<tr>
<td>2006</td>
<td>26.1%</td>
<td>6.8%</td>
<td>28.6%</td>
</tr>
<tr>
<td>2007</td>
<td>-1.9%</td>
<td>-11.4%</td>
<td>-10.2%</td>
</tr>
<tr>
<td>2008</td>
<td>-58.3%</td>
<td>-9.1%</td>
<td>-61.0%</td>
</tr>
<tr>
<td>2009</td>
<td>47.9%</td>
<td>30.7%</td>
<td>63.0%</td>
</tr>
<tr>
<td>2010</td>
<td>38.2%</td>
<td>-10.2%</td>
<td>15.1%</td>
</tr>
<tr>
<td>2011</td>
<td>-12.6%</td>
<td>-13.8%</td>
<td>-19.5%</td>
</tr>
<tr>
<td>2012</td>
<td>23.9%</td>
<td>3.4%</td>
<td>25.8%</td>
</tr>
<tr>
<td>2013</td>
<td>25.4%</td>
<td>7.7%</td>
<td>29.2%</td>
</tr>
<tr>
<td>2014</td>
<td>9.7%</td>
<td>-2.8%</td>
<td>9.9%</td>
</tr>
</tbody>
</table>

Appendix 6: Cumulative excess returns for the cost-neutral momentum strategy (WML) with a holding period of 6-months, including the drawdown throughout the period 1999 to December 2014. The momentum strategy is based on a ranking of the past 2-12 months performance.
Appendix 7: Average market capitalization (in billion €) of the companies that make up the value and the momentum portfolio during the sample period from 1999 to 2014. Panel A: The value portfolio goes long the stocks with the highest tertile of book-to-market value (value stocks) and shorts the lowest tertile (growth stocks). Panel B: The momentum portfolio goes long the winners and shorts the losers over the past 2-12 months stock performance.

Source: Datastream
Appendix 8: Market value and return of the six biggest and six smallest companies that were part of the STOXX Europe 600 Index in January, 2014. Total return is based on Datastream’s total index returns.

<table>
<thead>
<tr>
<th>Country</th>
<th>Market value (Million EUR)</th>
<th>Total return</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Largest companies</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NOVARTIS CH</td>
<td>207,853</td>
<td>36.6%</td>
</tr>
<tr>
<td>NESTLE SA CH</td>
<td>195,654</td>
<td>17.5%</td>
</tr>
<tr>
<td>ROCHE HOLDING AG CH</td>
<td>157,706</td>
<td>13.7%</td>
</tr>
<tr>
<td>ANHEUSER-BUSCH BE</td>
<td>150,950</td>
<td>24.2%</td>
</tr>
<tr>
<td>HSBC HOLDINGS PLC GB</td>
<td>150,700</td>
<td>3.3%</td>
</tr>
<tr>
<td>ROYAL DUTCH SHELL NL</td>
<td>108,076</td>
<td>12.3%</td>
</tr>
<tr>
<td><strong>Smallest companies</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ELECTROCOMPONENT GB</td>
<td>1,218</td>
<td>-13.2%</td>
</tr>
<tr>
<td>SERCO GROUP PLC GB</td>
<td>1,137</td>
<td>-64.6%</td>
</tr>
<tr>
<td>PREMIER OIL PLC GB</td>
<td>1,101</td>
<td>-41.9%</td>
</tr>
<tr>
<td>AVEVA GROUP PLC GB</td>
<td>1,083</td>
<td>-34.2%</td>
</tr>
<tr>
<td>OPHIR EN GB</td>
<td>1,055</td>
<td>-53.7%</td>
</tr>
<tr>
<td>HUNTING PLC GB</td>
<td>1,017</td>
<td>-25.3%</td>
</tr>
</tbody>
</table>

Appendix 9: Annualized performance and risk measures from January 1996 to October 2014 for portfolios that are either equal-weighted or market value-weighted based on the market capitalization in the beginning of the month for each security. All returns are based on a six month holding period.

<table>
<thead>
<tr>
<th>Measures</th>
<th>Equal-weighted</th>
<th>Value-weighted</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Performance</strong></td>
<td>VMG</td>
<td>Value</td>
</tr>
<tr>
<td>Excess return (p.a.)</td>
<td>6.48%</td>
<td>12.23%</td>
</tr>
<tr>
<td>(t-value)</td>
<td>(2.14)</td>
<td>(2.33)</td>
</tr>
<tr>
<td>Cor (Value;Growth)</td>
<td>0.87</td>
<td>Cor (Value;Growth)</td>
</tr>
<tr>
<td><strong>Risk</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Volatility</td>
<td>12.12%</td>
<td>20.97%</td>
</tr>
<tr>
<td>Beta</td>
<td>0.22</td>
<td>1.12</td>
</tr>
<tr>
<td><strong>Risk-adjusted performance</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sharp ratio</td>
<td>0.53</td>
<td>0.58</td>
</tr>
<tr>
<td>Treynor ratio</td>
<td>0.30</td>
<td>0.11</td>
</tr>
<tr>
<td>Jensen’s Alpha</td>
<td>4.4%</td>
<td>1.2%</td>
</tr>
</tbody>
</table>
Appendix 10: List of countries with the largest combined market value of the companies included in the STOXX Europe 600 Index by January 2014. Market value is measured by end of the year 2014.

<table>
<thead>
<tr>
<th>Country</th>
<th>Market value (million €)</th>
<th>%</th>
<th>Companies (number)</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>United Kingdom</td>
<td>2,663,382</td>
<td>30.3%</td>
<td>170</td>
<td>28.4%</td>
</tr>
<tr>
<td>Germany</td>
<td>1,190,999</td>
<td>13.6%</td>
<td>60</td>
<td>10.0%</td>
</tr>
<tr>
<td>France</td>
<td>787,498</td>
<td>9.0%</td>
<td>65</td>
<td>10.9%</td>
</tr>
<tr>
<td>Switzerland</td>
<td>665,779</td>
<td>7.6%</td>
<td>49</td>
<td>8.2%</td>
</tr>
<tr>
<td>Spain</td>
<td>499,835</td>
<td>5.7%</td>
<td>29</td>
<td>4.8%</td>
</tr>
<tr>
<td>Sweden</td>
<td>424,112</td>
<td>4.8%</td>
<td>38</td>
<td>6.4%</td>
</tr>
<tr>
<td>Finland</td>
<td>400,669</td>
<td>4.6%</td>
<td>17</td>
<td>2.8%</td>
</tr>
<tr>
<td>Nederland</td>
<td>363,141</td>
<td>4.1%</td>
<td>31</td>
<td>5.2%</td>
</tr>
<tr>
<td>Italy</td>
<td>359,681</td>
<td>4.1%</td>
<td>25</td>
<td>4.2%</td>
</tr>
<tr>
<td>Denmark</td>
<td>307,775</td>
<td>3.5%</td>
<td>20</td>
<td>3.3%</td>
</tr>
<tr>
<td>Others</td>
<td>1,119,442</td>
<td>12.7%</td>
<td>94</td>
<td>15.7%</td>
</tr>
<tr>
<td><strong>Grand Total</strong></td>
<td><strong>8,782,313</strong></td>
<td><strong>100%</strong></td>
<td><strong>598</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

Appendix 11: Pivot table of the industries summarizing total market value EoY 2014, average annual return and number of net long positions (longs minus shorts) for the momentum and value portfolio. Market values are measured in € million.

<table>
<thead>
<tr>
<th>Industry</th>
<th>Market values (EoY 2014)</th>
<th>Avg. Return (p.a.)</th>
<th>Avg. Period (Months)</th>
<th>Positions (Momentum)</th>
<th>Positions (Value)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic Materials</td>
<td>817,111</td>
<td>11.99%</td>
<td>158</td>
<td>319</td>
<td>49</td>
</tr>
<tr>
<td>Consumer Gds.</td>
<td>1,206,546</td>
<td>14.97%</td>
<td>154</td>
<td>581</td>
<td>-32</td>
</tr>
<tr>
<td>Consumer Serv.</td>
<td>773,641</td>
<td>10.39%</td>
<td>157</td>
<td>-531</td>
<td>-1948</td>
</tr>
<tr>
<td>Financials</td>
<td>1,979,552</td>
<td>9.51%</td>
<td>152</td>
<td>-1093</td>
<td>7933</td>
</tr>
<tr>
<td>Health Care</td>
<td>552,126</td>
<td>13.19%</td>
<td>158</td>
<td>268</td>
<td>-2527</td>
</tr>
<tr>
<td>Industrials</td>
<td>1,754,188</td>
<td>15.24%</td>
<td>160</td>
<td>296</td>
<td>-765</td>
</tr>
<tr>
<td>Oil &amp; Gas</td>
<td>605,360</td>
<td>13.99%</td>
<td>158</td>
<td>163</td>
<td>-773</td>
</tr>
<tr>
<td>Technology</td>
<td>286,461</td>
<td>11.14%</td>
<td>166</td>
<td>372</td>
<td>-1273</td>
</tr>
<tr>
<td>Telecom.</td>
<td>331,841</td>
<td>13.03%</td>
<td>143</td>
<td>-94</td>
<td>-865</td>
</tr>
<tr>
<td>Utilities</td>
<td>432,215</td>
<td>7.17%</td>
<td>162</td>
<td>-288</td>
<td>411</td>
</tr>
<tr>
<td><strong>Grand Total</strong></td>
<td><strong>8,739,041</strong></td>
<td><strong>12.13%</strong></td>
<td><strong>156</strong></td>
<td><strong>0</strong></td>
<td><strong>58</strong></td>
</tr>
</tbody>
</table>

Source; DataStream, symbols: ICB Level 2 Industry index.
Appendix 12: Relative performance of the STOXX Europe 600 sectors from January 1999 to December 2014. The equity indices are chosen in Euro. For example, when the area of the technology variable increases during the dot-com bubble in 2000-2001 it reflects that the technology index increases by more than its peers.

![Graph showing relative performance of STOXX Europe 600 sectors from 1999 to 2014](image)

Source: DS Level 2 Industry Index names and Datastream symbols: S1SE01E, S1SEBME, S1SEIDE, S1SECGE, S1SECSE, S1SEH1E, S2SET2E, S2SEU2E, S1SEFNE and S2SEG2E.

Appendix 13: Comparison of return and risk measures of the momentum portfolios depending whether the formation period returns are based on raw price returns or total index returns. Hence, only the latter case includes the effects of dividend payments.

<table>
<thead>
<tr>
<th>Measures</th>
<th>Raw price returns</th>
<th>Total index returns</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>WML Winner</td>
<td>Loser</td>
</tr>
<tr>
<td>Excess return (p.a.)</td>
<td>1.96%</td>
<td>9.06%</td>
</tr>
<tr>
<td>(t-value)</td>
<td>(.47)</td>
<td>(2.13)</td>
</tr>
<tr>
<td>Cor (Winner;Loser)</td>
<td>0.81</td>
<td>0.81</td>
</tr>
<tr>
<td>Risk</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Volatility (p.a.)</td>
<td>16.56%</td>
<td>16.98%</td>
</tr>
<tr>
<td>Beta</td>
<td>-0.29</td>
<td>0.88</td>
</tr>
</tbody>
</table>