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Market interpretation of reported currency effects on revenue in quarterly financial statements

reporting opaqueness, investor attention and market efficiency implications

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BUSN79 Degree Project in Accounting and Finance

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Abstract

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Key words: currency effects on revenue, investor attention, market efficiency, portfolio strategies, alpha

Purpose: investigate the relationship between reported currency growth on revenue and subsequent stock prices following quarterly reports. Design a portfolio strategy to exploiting potential corrections of initial overreactions by market participants.

Methodology: deductive approach using panel regression models on both the entire sample and constructed portfolios based on screening criteria. The main model used for sample and portfolio regressions have been the Fama-French three factor model to evaluate performance of the portfolios.

Theoretical perspectives: main theoretical frameworks include investor attention and distraction theories, efficient market hypothesis, and the intrinsic value of a firm framework.

Empirical foundation: the final sample consists of 169 firms from five large cap Northern European indices, namely: Sweden, Denmark, Norway, Finland, and Germany. High sample attrition related to lack of currency effects reporting and inconsistent reporting.

Conclusions: no exploitable relationship has been found and only a few portfolios generate statistically significant positive overperformance. The reason is concluded to be related to lacking investor attention and hence limited interpretation due to the high opaqueness of the reporting of currency effects.

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List of Abbreviations and Declarations, alphabetically stated

Alpha, α: The return that is generated over the relevant market premium during a period t, correcting for all other factors impacting stock returns.

Fama-French three factor model: A model developed by Eugene Fama and Kenneth French in 1993 including three main factors for stock returns. The factors consist of a market premium ("*market risk premium*", "*Mkt-Rf*"), size factor ("*small-minus-big*", "*SMB*"), and a valuation factor ("*high-minus-low*", "*HML*").

Going Long, be long: A strategy implying the investor purchasing with the aim to profit from increases in a firm's stock price.

Going Short, be short: A strategy betting on falling stock prices. Here, the strategy uses inversed certificates of companies most exposed to positive currency growth and, consequently, an initial overreaction due to overestimations of growth.

HML, HML-factor: This is the value premium, extracted from the Fama-French three-factor model. It is one factor derived to predict stock returns by expecting an outperformance of stocks with a high book-to-market ratio, compared to those with low book-to-market ratios.

Indexing, to index, indexed: A method, which divides each day's stock price by the stock price on the first trading day of the observation period. That means that each stock or index starts at 1. For the graphical illustration, the indexed stock prices all start at 100. This ensures comparability and visibility.

Intrinsic value: the value of a firm generated through a discounted cash flow valuation or intrinsic value formula.

Mkt-Rf: This factor referred to in the thesis is known as the market premium, which is the excess return of the market over a risk-free-rate.

Organic revenue growth: growth generated by the underlying business, excluding effects from mergers and acquisitions, and reported currency effects.

Sample: The sample denotes the companies chosen for the assessment of the chosen topic. The final complete sample including firms with reported currency effects in all relevant quarters includes 169 companies from the large cap indices of following countries: Sweden, Denmark, Norway, Finland, and Germany.

SMB: This factor described the premium for a lower size of a firm, being reflected in a higher risk and, thus, volatility, but also higher growth opportunities.

Stoxx Europe 600: Index comprising the 600 largest European companies.

Russell 2000: Index comprising 2000 different companies from the United States with a medium market cap.

1. Introduction

1.1 Background

In today's globalised world, more and more companies seek to expand their business operations to as many countries as possible in the desperate hunt for growth (HSBC, 2019). In the preceding decade, growth was seen as some sort of holy grail on global financial stock markets (Lynch, 2021), and companies strived to generate it at any cost. However, the expansion of the business model is accompanied by a variety of challenges. One of these challenges is the entering of new markets, which trade in foreign currencies (Jankensgård et al., 2020). Regardless of the treatment of those foreign currencies and the amount of hedging that companies engage in, they become vulnerable to suffer or benefit from currency exposure. This exposure can lead to severe distortions of financial metrics, most importantly on revenue. Most often, this exposure is expressed in a positive or negative impact on a company's business growth, and when companies subsequently report the generated revenues, they are almost always impacted by currencies (Jankensgård et al., 2020).

Due to investors' obsession with growth in recent years, and revenue growth also being a key component of a company's fundamental equity valuation in almost every financial model (Koller, Goedhart & Wessels, 2020), the growth originated solely by foreign currency appreciations or depreciations could lead to severe misestimations of a company's value, if they are not interpreted correctly. The basic intuition behind this paper can, thus, be described as an investigation if investors will realise the impact of currency effects on growth and, if at all, when this happens.

1.2 Problem Discussion

In an optimal market, also described as efficient market, investors will immediately find, interpret, and incorporate currency effects on financial statements into stock prices (Kendall, 1953; Fama, 1970). In contrast to this theoretical assumption, however, there are many prevalent theories in literature arguing that investors seem to focus solely on superficial line items in companies' quarterly financial statements and benchmark these against market expectations and analysts' consensus (Desai & Jain, 1997; Dichev & Piotroski, 2001; Bernard & Thomas, 1989).

Hence, initial trading behaviour is expected to be mainly driven by these line-items, although they face certain shortcomings. These shortcomings importantly include the possibility that currency effects' impact on reported organic growth can be inflated or deflated, leading to misspecifications in the discounted cash flow framework and a stock price not aligned with intrinsic value (Koller, Goedhart & Wessels, 2020).

Adding to the issue of limited investor attention, firms often include such effects in either their notes or opaque, standardised formulations, and there is no immediate, clear distinction between actual performance, paper volatility from unrealized currency effects and actual economic volatility from currency effects (Jankensgård et al., 2020). Market efficiency is assumed to be overall strong, but it is unclear if all information, such as currency effects in opaquely stated notes, are interpreted equally rationally in the first trading around a new quarterly statement. Investor attention and distraction theories such as that of DellaVigna and Pollet (2009) and Hirshleifer and Teoh (2003; 2005), predict that markets are not entirely rational when interpreting information from financial reports and that the market can ignore economically relevant information in financial statements.

In extension, this could possibly lead to a firm's stock overreacting, either positively or negatively, following the lack of interpreting currency effects correctly and missing to extract organic growth from the reports. This leads to the research question brought up by this paper, which can be found in the following section.

1.3 Research Question

Does the market correct the initial overreaction in stock price, caused by inflated or deflated revenue growth from currency effects, in the following period?

1.4 Purpose

This paper is written on the purpose of investigating any market inefficiencies arising from the market's reactions to reported currency effects compared to organic revenue growth. Furthermore, it is aimed at giving an indication if market participants adjust their expectations of intrinsic value in the following period by correcting for reported currency effects. It seeks

to develop an understanding of how the market interprets these currency effects, and if the currency effects are incorporated into the stock prices.

Additionally, several theoretical frameworks such as market efficiency, investor distraction and attention, and intrinsic valuation, are used to interpret the market's pricing of these currency effects. As an extension, this paper investigates if these currency effects can be exploited to generate profit from potential patterns of overreactions. The paper therefore opens an unexplored area of research and provides guidance on initial possibilities for empirical examination.

1.5 Results

Overall, the empirical results provide inconclusive results regarding the relationship between currency growth and subsequent stock returns. The summary statistics and correlation tables potentially hint of an expected negative relation, but the complete sample regressions and constructed portfolios do not generate statistically significant results and the formulated hypotheses, which imply the correction of initial overreactions due to misinterpretations of growth and currency effects, are thus rejected. Moreover, it is difficult to assess whether market efficiency is either very strong or rather weak in interpretation of these currency growth effects. Based on investor attention arguments (Hirshleifer & Teoh, 2003; 2005; DellaVigna & Pollet, 2009; Hirshleifer, Lim & Teoh, 2009), we conclude that market efficiency is rather weak in the interpretation ability for reported currency growth, especially given the extensive reporting opaqueness and lack of readability.

1.6 Scope and limitations

This paper specifically investigates currency effects on revenue and the markets interpretation of these effects. Since it is the first piece of literature in this area, it develops three different strategies to scrutinize if it is possible to profit on currency impacts on revenue. It evaluates the average impact of currency effects on stock returns across the whole, collected sample, and then develops a portfolio strategy based on both reported currency growth and currency effects as share of total growth.

Doing this, the investigated and impacted metric is revenue, and in our paper we ignore currency effects on other financial metrics. The chosen period, limited by a lack of existing historical data on currency effects, starts in 2018 and reaches to 2020. This is a period of relative turbulence in the financial markets, characterized by the post-Brexit negotiations, US – China trade tensions and the start of the Covid19-pandemic.

Moreover, other related topics like various firm hedging strategies, such as operational, governance and financial, are not evaluated in relation to the markets' reaction to reported currency effects on revenue. Another limitation is that the study specifically targets large cap listed firms in selected markets, which is mainly a consequence of the reluctancy of most firms to report currency effects and the limited exposure of smaller companies to foreign currencies. It follows that the final sample is restricted to 169 companies, which could impact the generalizability of the study.

1.7 Target Group

This paper targets corporate finance academics and practitioners alike with an interest in financial reporting, market reactions to new information, and subsequent stock returns. Moreover, it can be helpful for any stock market participant to understand the potential market inefficiencies and the trading behaviour in relation to currency effects on financial statements.

2. Theoretical Background

2.1 Efficient Market Hypothesis

The efficient market hypothesis, its implications and criticism can be seen as the foundation of this paper and its investigation. In 1953, as one of the first theorists researching potential market inefficiencies, Kendall observed that stock prices seem to wander along a random walk, and that returns are therefore neither predictable nor easily characterized. Later, Fama (1970) popularized the efficient market hypothesis by collecting existing research and structuring it. Efficient markets can be characterized as capital markets, that incorporate and reflect new positive or negative information immediately, and market participants are expected to have access to all available data and be able to rationally interpret it. Therefore, in efficient markets, it is impossible for investors to achieve a short-, medium- or long-term outperformance (Fama, 1970).

As a further implication of this hypothesis, even if transaction costs, taxes and trading frictions exist, the market can still be considered efficient as long as market participants can access all information cost-free and interpret it the same way (Fama, 1970). This means that capital markets should be a fair game and that stock prices should follow a random walk around intrinsic value. In extension, this assumes that all investors have access to the same trading methods and ability to interpret financial markets' news such as quarterly financial statements announcements. However, Fama (1970) introduces two further states of the market, which can be described as weak efficiency and medium efficiency. According to Fama (1970), the three different markets can be classified into three different sublevels:

- Weak efficiency: asset prices reflect information about price and volume, but it is possible to use fundamental and technical analysis to generate abnormal returns.
- Medium efficiency: the market incorporates not only price and volume, but also historical financial data, macroeconomic factors, and other events such as stock splits. It is difficult, but not impossible to predict returns and generate abnormal returns.
- Strong efficiency: all available relevant stock price information about the past, present and future is incorporated by market participants and it is not possible to generate abnormal returns.

If markets are in the latter state and, thus, truly strongly efficient, investors will not have incentives to trade and invest, therefore giving rise to market inefficiencies (Grossman &

Stiglitz, 1980). Grossman and Stiglitz (1980) hence conclude, that market efficiency can be very strong, but not perfect. Lim and Brooks (2011), on the other hand, argue that market efficiency is generally considered strong, but can vary depending on the market environment, as rationality can suffer in extreme market environments, such as the IT-bubble in the late nineties and the 2008 financial crisis. Other authors such as Campbell, Lo and MacKinlay (1997) introduce the theory that market efficiency should not be viewed as binary, but rather as a spectrum.

This extensive criticism of the efficient market hypothesis in literature gave rise to the adaptive market hypothesis, in which market efficiency and market inefficiency can coexist in various time periods and market environments. The total efficiency of the market is therefore dependent on natural selection of the individual investors' ability to rationally interpret and trade on market information in various market environments (Lo, 2004). One of the most meaningful contributions to this theory is the paper of Ball (1996), who argues that the market generally prices and trades on both positive and negative earnings surprises in relation to quarterly announcements. This implies that few market inefficiencies exist and that the market is close to strong efficiency, with little ability to generate abnormal returns. In the context of currency effects, this would mean that the market is able to immediately incorporates the organic growth of a business model, and no overreaction in any way occurs following the reported revenue and its growth being impacted by currency effects. Consequently, there would be no possibility of observing and trading the stock correcting for an overreaction.

2.1.1 Empirical violations and limitations with the efficient market hypothesis

However, a vast range of corporate finance literature found contradicting evidence, assessing market efficiency in both short- and long-term studies, using a variety of variables. These variables include the size factor researched by, among others, Dhatt, Kim, and Mukherji (1999), Banz (1981) and Reinganum (1981), who find that smaller firms on average generate abnormal returns as compared to larger firms. The book-to-market ratio, which is said to communicate information about a firm's future growth prospects and examined by authors such as Fama and French (1992), Chan, Hamao and Lakonishoks (1991), Pontiff and Schall (1998), Lewellen (2004) and Narayan and Bannigidadmath (2015), also provide empirical violations of perfect market efficiency. The P/E ratio, which is often inversed as "E/P" in academic research, has demonstrated predictive power, where firms with high E/P (low P/E) tend to

generate higher abnormal returns than firms with low E/P (high P/E) ratios in subsequent periods (Ball, 1978; Basu, 1982; Reinganum, 1981).

Many other papers on empirical violations of market efficiency exist and empirical critique towards the efficient market hypothesis has given rise to several multifactor models, such as the Fama and French three-factor model (1993), which uses market premium, size premium and value premium.

2.2 Behavioural theories on investor attention and irrational reactions to corporate events

Evaluating further on the efficient market hypothesis, behavioural theories can be seen as some of these violations of perfect efficiency, where market participants are expected to trade both rationally and irrationally, leading to misinterpretations and incomplete information. These theories are originally based on foundational papers within the psychology field, which have focused on humans' attention and examined, to what extent it can differ and be limited when being presented with contradicting information, too much information, or irrelevant information (Stroop, 1935; Cherry, 1953; Moray, 1959). This is highlighted in the original Stroop test, where participants were asked to name an object's colour, but where a conflicting colour was written on the object in question (Stroop, 1935). The same type of limited attention behaviour was found when participants in other studies were asked to repeat a word, when similar words were played in the participants' ears using earphones (Cherry, 1953; Moray, 1959).

From a financial markets' perspective, in theoretical models presented by DellaVigna and Pollet (2009) and Hirshleifer and Teoh (2003; 2005), a subset of risk-averse investors tends to unconsciously disregard important information about future profitability included in companies' financial reports. Hirshleifer and Teoh (2003) conclude that differences in the presentation of accounting information exist between firms, mainly regarding the inclusion of specific line items or creating notes. Since time and attention is costly in the authors' theoretical model, investors may unconsciously disregard economically important aspects of financial reports. This, again, could lead to differences in perception and interpretation of the information presented (Hirshleifer & Teoh, 2003; 2005). Closely relating to these predictions,

Grossman & Stiglitz (1976) argue that differences in trading liquidity and general market noise will give rise to market imperfections leading to potential mispricing of new information.

This, on average, results in underreactions to positive news and overreactions to unfavourable news, causing subsequent returns to be higher for positive news and lower for negative news, a version of a post-earnings announcement drift (DellaVigna & Pollet, 2009; Hirshleifer & Teoh, 2003; 2005).

From a behaviour finance psychological point of view, in the words of Hirshleifer, Lim and Teoh (2009):

> Because minds are finite, attention must be allocated selectively. When individuals try to process multiple information sources or perform multiple tasks simultaneously, performance suffers. Indeed, conscious thought requires a focus on particular ideas or information to the exclusion of others. These elemental facts suggest that an investor's effort to process a news announcement by a firm and understand its implications for profitability can be hampered by extraneous news events that draw attention toward other firms. Therefore, greater distraction implies more severe underreaction to the firm's earnings news—a weaker immediate reaction to the earnings surprise and stronger post-earnings announcement drift (Hirshleifer, Lim & Teoh, 2009).

The authors refer to this phenomenon as the investor distraction hypothesis (Hirshleifer, Lim & Teoh, 2009). Limited attention and insufficient interpretation ability in relation to financial report announcements do not contradict rational capital markets, but rather adds nuances, as in the long run, wealth would on average be redistributed from less rational to more rational market participants (Hirshleifer, Lim & Teoh, 2009). Imperfections may persist over time in a model with limited attention affecting all market participants and not only irrational ones, as more investor attention towards a certain stock will lead to less attention to another stock (Hirshleifer, Lim & Teoh, 2009).

2.3 Currency Effects on Financial Statements

One of those previously discussed overreactions caused by limited investor attention could occur due to the misinterpretation of growth, with investors consciously or unconsciously ignoring currency effects inflating or weighting on the reported revenue growth. Adding to this assumption, currency effects on financial statements have notoriously been difficult to interpret, especially since many firms report these effects opaquely and approach their currency exposures in a variety of ways. According to Jankensgård et al. (2016), currency effects on

revenue and earnings can be large, and often relate to revaluation of market-to-market based balance sheet items, intercompany transactions and loans, and off-balance sheet items. Some large currency effects are the result of unrealized gains and losses which carry no economic meaning and are not related to actual operational performance but can rather be described as 'noise', generated by accounting rules (Jankensgård et al., 2016). Therefore, these line items can be regarded as paper volatility, disconnected from actual firm performance.

However, currency effects, especially in large multinational corporations, can have very real and major economic effects on firm performance. Currencies can gain or lose between 20-30% of value in a limited time frame, generating a drastic economic impact on firms' financial statements (Jankensgård et al., 2020, ch 1). Economically, this means that currency effects can either add to operating performance or diminish it. A firm's structure and the markets the firm operates in will give rise to a web of currency matrices, as described by Jankensgård et al. (2020, ch. 3).

Forecasting foreign exchange rates can also be exceptionally difficult. While some theories and practitioners view rates as an aggregate of macroeconomic variables, according to Jankensgård et al. (2020, ch 1), there is a lack of supporting empirical evidence thereof. Additionally, currencies are often assumed to mean-revert to historical averages and remain stable over time. While this may hold in certain time periods, high volatility is not uncommon in others (Jankensgård et al., 2020, ch 1). This explains the constant exposure of companies to currency effects on financial statements. Certain treasury managers take speculative beats on exchange and interest rates based on arguments of predictability and boards often seem to mandate this.

Additionally, firms often report either too little or too much information regarding their foreign exchange exposures and risk management program. That is, information is either too generic and lacking, or too cluttered and extensive (Jankensgård et al., 2020, ch 10):

> It is quite possible to suffer from problems of too much and too little FXRM disclosure at the same time. There may be excessive reporting of financial instruments and related hedge accounting, while the firm simultaneously fails to produce a decent communication of commercial exposures and a narrative to connect the commercial exposures and its FXRM activities. (Jankensgård et al., 2020, ch 10)

In conclusion, finding and interpreting currency effects in financial statements is opaque, and thus, investors are likely to consciously or unconsciously ignore them due to their limited attention, giving rise to the theory that there will be an initial overreaction, which will subsequently be corrected and, hence, be traded upon.

2.4 Intrinsic Value of a Firm

It follows that, if these overreactions related to distorted growth by currency effects occur, and are subsequently corrected, the impact on a company's equity value, and thus, its stock price, will be profound, since the estimation of growth is central to the valuation of a company and a key component of a discounted cash flow analysis, according to Koller, Goedhart and Wessels (2020). As the name already implies, discounted cash flows from the future determine the company valuation in this model. These cash flows can be broken down as follows:

$$Cash\ Flow = Return\ on\ Invested\ Capital * growth$$

Additionally, a company can also be valued more simply with the value-driver formula, which can be written as follows:

$$Company\ value = \frac{NOPAT_{t+1} * (\frac{1-g}{RONIC})}{(WACC - g)}$$

As can be seen from both equations, growth, expressed with g, is, along with profitability, expressed in Return on Invested Capital and RONIC (Return on new Invested Capital), one of the two key components in valuing a company. Based on this methodology, market participants will collectively generate a stock price which represents the present value of expected future cash flows. Furthermore, despite various market environments with temporary inefficiency (Lo, 2004; Lim & Brooks, 2011), the market should, in the long-term, price stocks at approximately intrinsic value to prevent arbitrage opportunities (Coakley & Fuertes, 2006). Moreover, Coakley and Fuertes (2006) argue that valuation multiples and metrics can temporarily diverge from intrinsic values during times of market euphoria, such as the IT-bubble, but the market tends to revert to more accurate reflections of intrinsic values in the following periods. Importantly, in the long run, the market tends to reflect intrinsic values, despite time periods of inefficiency or pockets of inefficiency (Coakley & Fuertes, 2006). Thus, if there are negative or positive overreactions from market participants by only incorporating growth distorted by currency effects into stock prices, there must be an opportunity to exceptionally profit on the subsequent return to intrinsic valuation, which reflects the organic growth of a company.

2.5 Previous empirical research

To our best knowledge, there is no previous research testing market participants' interpretation of reported currency effects using a similar methodology to this paper. However, there are still papers that act as an inspiration to the methodology, theoretical foundation, and interpretation of empirical results.

As future cash flows and discount rates are not observable by market participants, there is a growing field of research on the importance of cash flows parameters in determining the intrinsic value of a firm. Ang and Bekaert (2007) argue that stock return predictability is mainly a short horizon phenomenon as opposed to long horizon arguments by Campbell (1991). The authors conclude that dividend yield and E/P have strong predictive power of future cash flows, but not necessarily future abnormal returns (Ang & Bekaert, 2007). In addition, Binsbergen and Koijen (2010) construct a present value model using historical dividend yield and dividend growth to predict future dividend growth and future stock returns. The present value model generates more accurate predictors for stock returns compared to dividend yield, but the authors model emphasizes the important of cash flow variables to predict future stock prices (Binsbergen & Koijen, 2010). These empirical intrinsic value estimations serve as a backdrop to understanding market participants' pricing of information. All the above measurements use revenue and organic revenue growth to compute the final measurement, hence, it is important use an accurate measurement of long-term revenue growth.

Authors investigating investor attention find support for violations of the efficient market hypothesis. DellaVigna and Pollet (2009) investigate if investor attention is lacking by constructing portfolios based on earnings announcements on Fridays. The authors generate substantial alpha with average trading volume being 8% lower around Friday financial reports, which imply that limited investor attention causes underreactions to new market information (DellaVigna & Pollet, 2009). Additionally, Hirshleifer, Lim and Teoh (2009) find empirical support that the post-earnings announcement drift is stronger for a given stock when there are other announcements from different firms competing for the same limited investor attention. By constructing various portfolios, the authors generate statistically significant alpha, highlighting the economic importance of limited investor attention and competing distracting information (Hirshleifer, Lim & Teoh, 2009). Moreover, empirical studies on institutional investor biases support the hypothesis that institutional traders prefer to ride losses, betting on

a turnaround, but realize profits quickly, which leads to imperfections in reactions to firm news (Coval & Shumway, 2005; Frazzini, 2006).

2.6 Criticism of the Theoretical Framework

Previously highlighted empirical papers use different methodologies, approaches, time periods and data sets. Some articles are more short-term oriented and employ a portfolio-based trading approach, while other articles test return predictability by using multiple regression models with lagged variables on different time horizons. Articles on investor attention theory base research on vastly different variables compared to articles on return predictability and intrinsic value inputs.

Most articles base their research on firms listed on various US indices, which could be both problematic and potentially insightful, as caution has been practiced when comparing the findings of this paper with US-based research.

Moreover, results in this paper also depend on the selected time period of 2018 to 2020, and results are therefore not necessarily applicable to other time periods. Much of previous research covers periods between 1980 and 2010. Hence, previous papers have acted as a theoretical, empirical, and methodological backdrop to the approach of this paper and there is no intention to firmly relate the findings of this paper to support or contradict previous findings. The focus will rather be on understanding and potentially explaining the findings of this paper through previous research, not testing the empirical evidence of previous research.

2.7 Hypothesis development and formulation

DellaVigna and Pollet (2009), and Hirshleifer, Lim and Teoh (2009) support the view that markets are imperfectly efficient due to limited investor attention. Limited investor attention would imply market participants to potentially be unable to immediately capture the real growth excluding currency effects on revenue, causing an overreaction in either direction on the announcement day. However, this overreaction is expected to subsequently fade throughout the following months post the announcement date. Given the above reasoning, the following broad and foundational hypothesis is formulated:

- H_1: The assumed initial overreaction on reported growth will subsequently be corrected when more market participants realise currency effects on growth.

As organic revenue growth is a key intrinsic value input in a discounted cash flow valuation (Koller, Goedhart & Wessels, 2020), and could be inflated or deflated due to reported currency effects, this leads to far-reaching implications for a company's valuation, which needs to be corrected upwards or downwards as soon as new information on growth is presented. Firms with high currency-related growth, having reported inflated organic revenue growth from currency effects, are assumed to undeservingly gain from currency growth. Hence, market participants are expected to initially overreact to the high nominally reported growth, but in the following period adjust expectations of intrinsic value to reflect the expected growth of the underlying business. Therefore, the following hypothesis is also a key element of our analysis:

- H_2: It is possible to outperform the market by compiling portfolios betting on the corrections of initial overreactions in stock prices following a misinterpretation of growth projections.

Before testing these hypotheses empirically, however, the following chapter serves a comprehensive explanation of the methodology.

3. Methodology and data

3.1 Choice of methodology

3.1.1 Deductive approach

The research question is evaluated through a quantitative methodology based on the deductive approach described by Bryman, Bell, and Harley (2019). Previous research has guided the foundation of research question, methodology and hypothesises. The formulated hypotheses have been assessed using empirical tests in the econometric and statistical program Stata. The intention of the empirical tests is to add new nuances to currency effects on revenue and therefore provide insight to the research frontier, which could enable other researchers to evaluate related perspectives.

3.1.2 Measuring currency effect on revenue

Since companies are not required to report currency effects and their impact on revenues in financial statements, only a fraction of them publish them on a voluntary basis. This implies that their incorporation into the quarterly statements lacks any standards and framework, and companies can report currency effects very individually. Consequently, there is no standardised database with available information on currency effects, and they had to be extracted manually from each company's quarterly report.

Doing this, we found a variety of different ways to report currency effects: These included firms stating currency effects in percentage terms, showing the impact on revenue growth. Similarly, plenty of firms state growth adjusted for currency effects. However, some of them only report organic growth, which is adjusted for both acquisitions and currency effects, and, consequently, they had to be excluded from the sample. Few firms merely reported currency effects broken down in their different operational activities, which had to be manually summed to get total currency exposure of revenues.

Further individual reporting methods included a statement about the impact of currency effects in nominal numbers, or the additional reporting of growth in constant or local currencies. Adding to the complexity and opaqueness of the data gathering, the reporting currencies, as well as the reference size, be it reporting in thousands, hundreds of thousands, millions, or billions, varied considerably from firm to firm. Two ways of transparent currency reporting are illustrated in appendix 1 and 2, using the examples of SAP and Husqvarna.

It follows that these different reporting methods had to be standardised, which was done by transforming them all into percentage terms of revenue growth. This was done by either measuring the difference in revenue growth in constant and actual currency, or by dividing the revenue exposure by the previous year's corresponding quarterly revenue to get the currency growth in percentage terms.

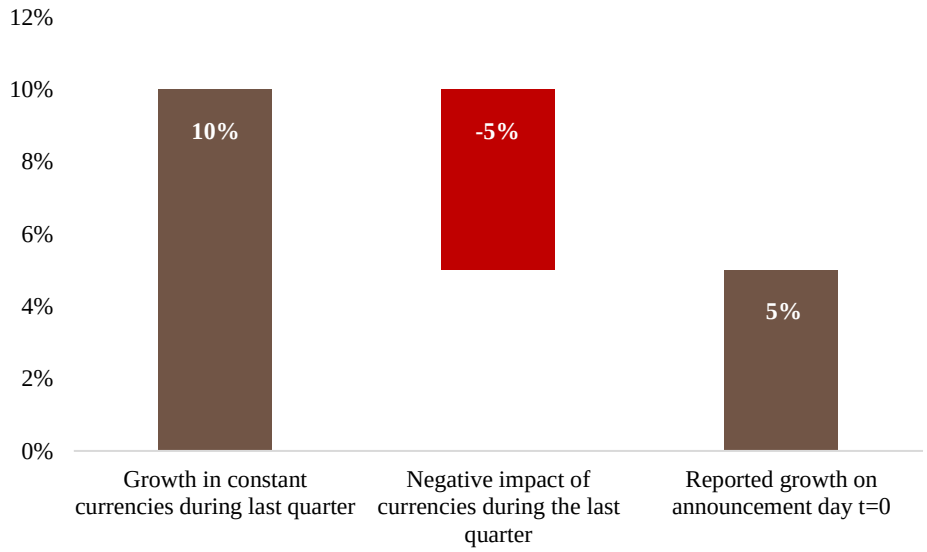
3.1.3 Screening methods

The reasoning behind this data compiling and measuring an assumed, temporary overreaction in stock prices on the announcement day, when investors focus solely on the perceived achieved growth of the company. In the subsequent period following the announcement day, however, investors are expected to increasingly become aware that this growth is not only the business growth, but also related to positive or negative currency impacts. This implies that the growth projections must subsequently be adjusted upwards for those firms with negative impact, but adjusted downwards for those firms with a positive impact. Since a company's intrinsic value relies heavily on future growth projections according to Koller, Goedhart and Wessels, 2020 (2020), the stock price is expected to follow the realisation of the investors that the business growth is higher or lower in reality than initially assumed from the company's reporting.

This reasoning is explained graphically using a simplified hypothetical example with a firm suffering from a negative currency impact:

Graph 1: Growth reporting in a company's quarterly report with negative currency effects

The following graph shows a hypothetical example of the negative influence that currency effects can have on the quarterly growth reporting. The firm actually reported 5% growth, although the growth of the business model was 10% in reality. However, negative currency headwinds caused the growth to decline to 5%.

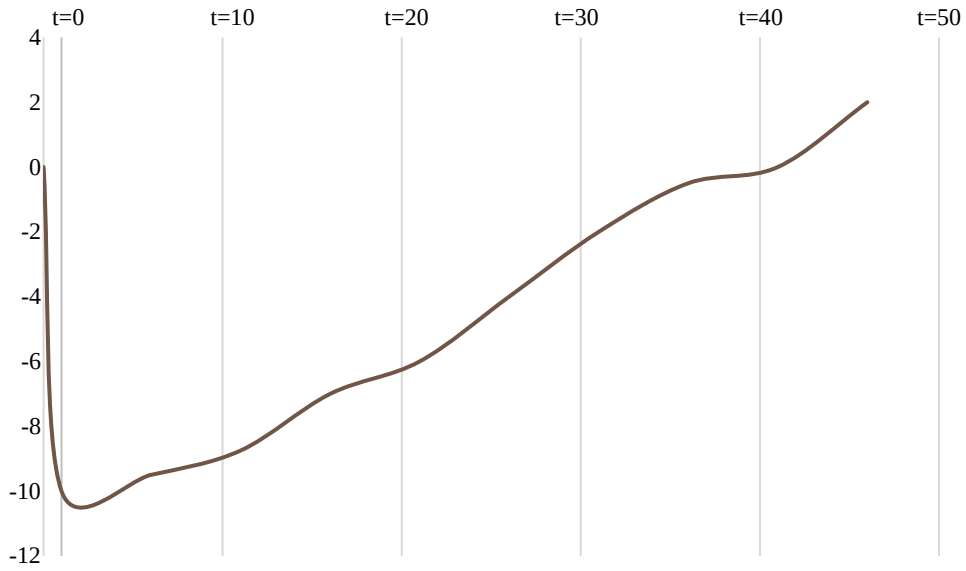


The firm in the example thus reports 5% total growth, but will state the negative currency impact of 5% accordingly within the quarterly report. However, depending on the firm's reporting, this number is not immediately visible and stock market investors are expected to initially incorporate the lower, negatively impacted growth.

It is expected, however, that investors subsequently realise their misinterpretation, and the overreaction will be corrected after correctly factoring in the growth projections of the business model. In our hypothetical case, this would result in the following stock price movement:

Graph 2: Stock price movement on and after the announcement day t=0 of a company reporting negative currency effects

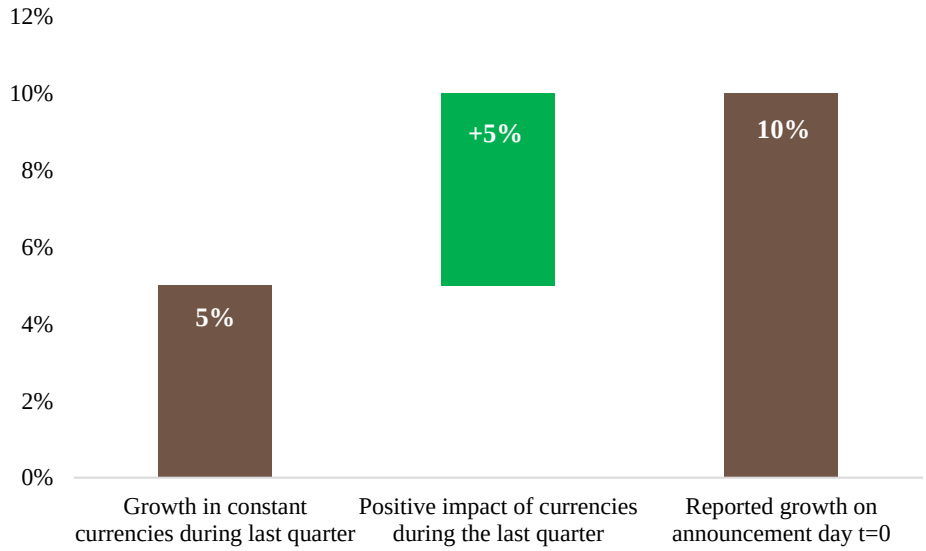
The following graph shows the investor reaction around the reporting displayed in graph 1. The stock price will initially react strongly negatively, which is shown by a 10% decrease in stock price. Over the following period, however, this trading behaviour is expected to boost the stock price once more and more investors realise the better than initially assumed growth of the business model. The x-axis illustrates the time dimension, showing the negative reaction in t=0, and the positive, subsequent, stock price development up to t=45, with t being the days after the announcement. The y-axis shows the stock price development, expressed in percentage and starting at 0. Due to other external influences, the stock price is not expected to exactly return to the initial level, but to show an approximation to it.



The opposed reaction is expected for companies reporting a favourable impact of currencies on their quarterly operations. The following graphs shall illustrate this, again using a hypothetical example of a company.

Graph 3: Growth reporting in a company's quarterly report with positive currency effects

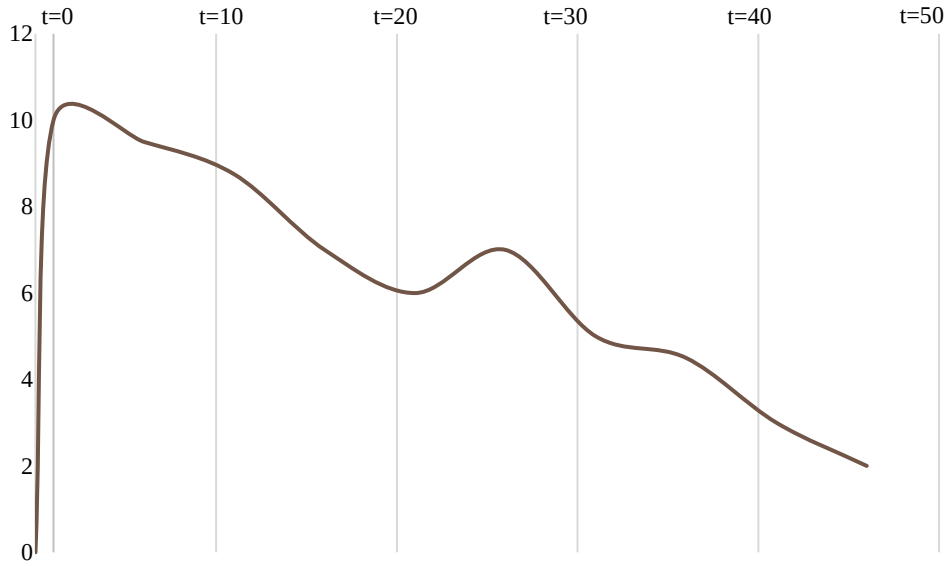
The following graph shows a hypothetical example of the positive influence that currency effects can have on the quarterly growth reporting. The firm actually reported 10% growth, although the growth of the business model was only 5% in reality. However, positive currency tailwinds caused the growth to accelerate to 10%.



Graph 4: Stock price movement on and after the announcement day t=0 of a company reporting positive currency effects

The following graph shows the investor reaction around the reporting displayed in graph 1. The stock price will initially react strongly positively, which is shown by a 10% increase in stock price. Over the following period,

however, this trading behaviour is expected to weigh on the stock price once more and more investors realise the worse than initially assumed growth of the business model. The x-axis illustrates the time dimension, showing the negative reaction in t=0, and the positive, subsequent, stock price development up to t=45, with t being the days after the announcement. The y-axis shows the stock price development, expressed in percentage and starting at 0. Due to other external influences, the stock price is not expected to exactly return to the initial level, but to show an approximation to it.



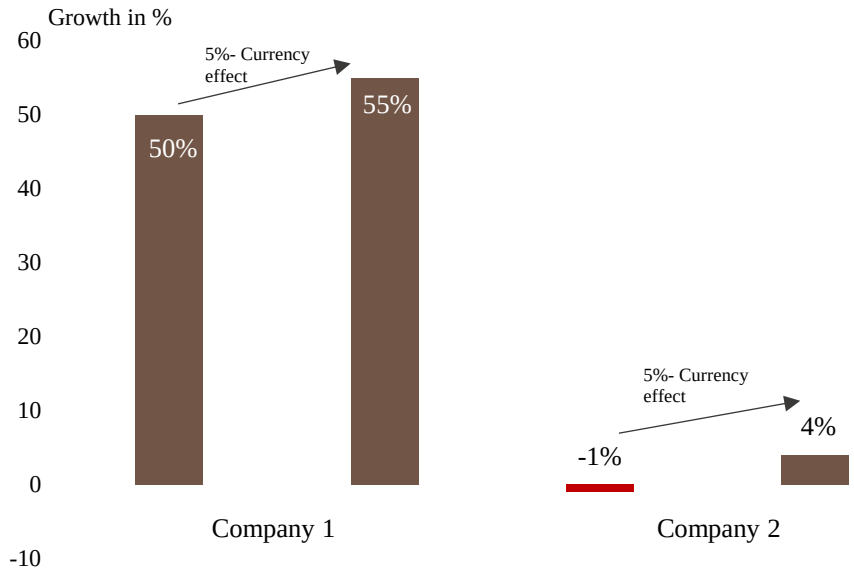
Obviously, due to the influence of other factors such as varying expectations around the quarterly reporting and other factors related to the reporting and new information in the following days, the stock price is not expected to reach the initial value, but to show an observable and tradeable mean reversion, as outlined in the graphs.

Following these assumptions about the stock price behaviour, one must also keep in mind that the currency reporting may be small or big in size, but when set into relation to the total growth, may not have that large of an impact. Fast-growing firms, which show growth numbers in double or even triple digits, naturally face larger currency effects, since these effects, as well as growth itself, are measured upon the previous year's quarterly revenue from the same period. On the other hand, this currency impact is less severe than for lower growing firms, when compared to the quarterly revenue in the quarter it actually occurred. The following graph is aimed to illustrate this further:

Graph 5: Currency effects on a company with fast-growing revenue and a company with revenue decline

The following graph shows the hypothetical example of two company's reporting their quarterly results in a given quarter. Both companies were influenced positively by currency movements, increasing their growth from 50% to 55% and -1% to 4% respectively. Company 1 therefore represents a fast-growing company, whereas company 2 is a company with revenue decline. Thus, when comparing the currency effect of 5% to the reported growth of

the companies, there are differences in terms of the impact. Whereas only 10% of the reported growth was caused by currency effects for Company 1, 500% of the reported growth was caused by currency effects for Company 2.



As can be seen in the graph, Company 1 was able to increase its revenues by 55%, of which 5% were related to favourable currency developments. Company 2, on the other hand, suffered a 1%-decline in revenues in constant currencies, but also had a positive impact of 5% originated from currency movements, leaving them with growth of 4%. Consequently, currency effects made up 10% of the total growth of Company 1, whereas it made up 500% of growth for Company 2. We therefore believe, that by observing any mean reversions of initial overreactions, it is important to not only look at the reported currency impact in percentage, but also to set it into relation to the total reported growth.

It follows that thesis investigates the mean-reversion of stock prices by using the following two metrics, expressed in Table 1:

Table 1: Reported currency growth and currency growth as share of total growth

Type	Computation	Explanation
Reported Currency growth	$Reported\ currency\ growth\ in\ \%$	Currency growth as reported is transformed to percentage terms, measured on the previous year's corresponding quarter and its revenue
Currency growth as share of total reported growth	$\frac{Reported\ currency\ growth\ in\ \%}{Total\ reported\ growth\ in\ \%}$	Emphasizes the relation between currency growth and total growth. This means that

		firms with high overall growth, for which high overall growth and, thus, also currency growth is actually more prevalent due to the lower basis revenue from the previous year, will be further down in the screening.

3.1.4 Time period

Since companies only recently started to report quarterly financials in a more extensive manner, it was only possible to use a very recent time frame, as otherwise the sample would have suffered. The study uses quarterly data from eleven quarters ranging from the first quarter 2018 to the third quarter 2020. The fourth quarter 2020 is excluded due to lack of sufficient number of days post the firm specific announcements. The time period thus includes one of the decade's most volatile market environments, namely the Covid19-pandemic. Other market events have also impacted the chosen period, such as the post-Brexit negotiations and US – China trade tensions.

However, the paper investigates market efficiency and benchmarks the portfolio performances against a market portfolio, meaning that the potential outperformance is in relation the wider market performance and environment. Using another period of relative calm, constant increase or decrease, would not affect the benchmarking against the market portfolio and the Covid19-pandemic is therefore deemed to have a negligible impact on the results and implications of this study. The relatively short and selected period is mainly a result of the companies' enhanced focus on reporting metrics in recent years, which is why currency effects' reporting is a rather recent phenomenon. Indeed, it was hardly possible to find any data on currency effects prior to 2018, when only a fraction of the sample companies reported them, which is why we did not consider enhancing the period as value-adding.

3.1.5 Measuring the degree of mean-reversion

This screening methodology thoroughly explained above was applied for the whole sample of 169 companies, meaning that two lists were created, with one of them containing all reported

currency impacts for each firm in the 11 observed quarters, and one of them applying the formula stated in Table 1 and setting them into relation to total reported growth.

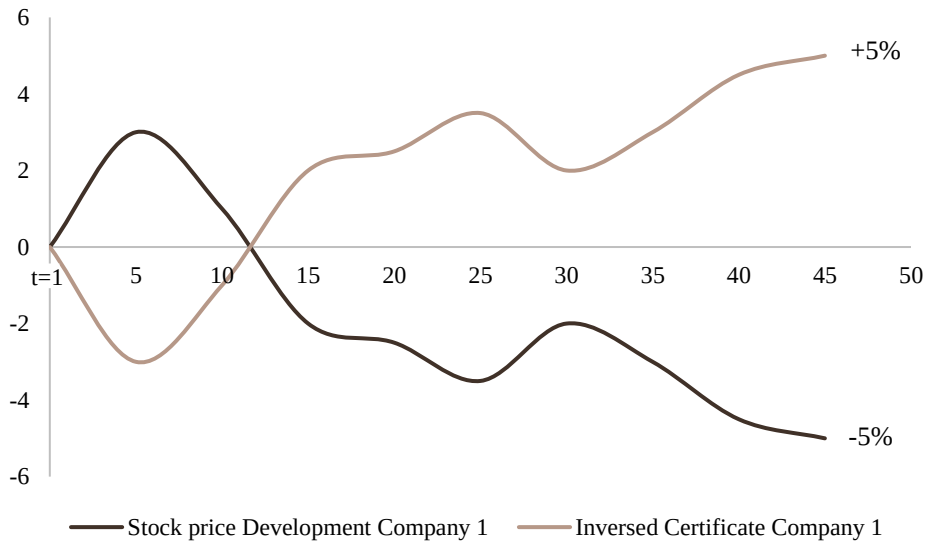
In evaluating the degree of correcting the overreaction of the announcement day t=0, the stock development of each security was measured individually until it reported the next quarterly results. This initial overreaction is however only assumed, since it is not possible to extract the actual reaction to currency effects from the total reaction to the announced results.

Then, for both lists, the predictive content of the reporting of currency effects for the stock price development in the period following this announcement was measured. In a second step, portfolios were constructed for each quarter as soon as the first company reported. These portfolios included trading on both the positive correction of the assumed negative initial overreaction, which are explained in the Graphs 1 and 2, and the negative correction following the assumed positive initial overreaction explained in the Graphs 3 and 4.

Thus, whereas the negative initial overreaction and subsequent reversion could be traded upon by simply theoretically buying shares, another method needed to be developed in order to be able to profit on those securities, which had benefitted from the initial positive overreaction in the stock price. Thus, assuming no trading commissions nor any other transaction costs, a theoretical certificate with a factor of -1 was bought for each of those securities with a positive impact, showing the inversed stock price development during the investment period. This can be inferred from the following graph:

Graph 6: Development of a company's stock price and its inversed certificate

The following graph shows the development of an inversed certificate, set up on Company 1, which benefitted from currency effects in the quarter before. Thus, Company 1 reported positive currency effects, and, after the positive overreaction of the initial announcement, the stock price mean-reverts in the following period. The x-axis shows the days following the announcement, whereas the y-axis shows the stock price development for Company 1 and the respective certificate with the factor of -1. The graph shows that the theoretical certificate shows the exact opposite development of the stock price, and, thus, profits from the share price decline in the following period.



While constructing the portfolios based on the methodology above, we focused on the 10 securities that were the most suffering from currency effects in the previous period, and the 10 securities that were the most benefitting in the previous period. This is owed to the fact, that we expect the severest correction of the initial overreaction to happen in firms with the largest impact, and the trading behaviour around currency effects to be most visible and significant. Both strategies are summarized in the following table.

Table 2: Normal "Long" and inversed "short" screening

Type of screening	Explanation
Normal "Long" screening	Firms with high negative currency growth are hypothesized to wrongfully suffer from overreaction to the deflated growth on initial announcement. Hence, these firms are purchased in the portfolios, betting on increasing stock prices to more accurate measures of intrinsic value.
Inversed "Short" screening	Firms with high positive currency growth are hypothesized to wrongfully gain from overreaction to the inflated growth on initial announcement. Hence, inversed certificates based on the methodology of Graph 5 are purchased, betting on decreasing stock prices to more accurate measures of intrinsic value. For simplicity reasons, this strategy betting on falling stock prices will in the following be called short strategy, although it is actually the purchase of inversed certificates.

We created those portfolios for each quarter both separately and aggregated in a combined portfolio to capture both movements. Additionally, the portfolios have both been tested on an equal-weighted basis and market capitalisation weighted basis. Theoretically, smaller firms are more volatile and also carry a higher risk premium (Banz, 1981), which means, ceteris paribus, that equal-weighted portfolios will be more volatile, but are also expected to generate bigger returns due to the heavier weighting of smaller stocks.

However, market-weighted portfolios also create certain dynamics. First, there is an overweight towards larger firms with generally more stable business, higher entry barriers, but lower growth numbers. As growth is a key component of value creation (Koller, Goedhart & Wessels, 2020), the nominal growth numbers and currency effects on these figures are likely lower for market-weighted portfolios as compared to equal-weighted portfolios, implying that currency inflated growth will actually have a bigger relative impact. Therefore, it is relevant to evaluate if these portfolios outperform those compiled on an equal basis. Hence, both equal-weighed and market-weighted portfolios are of relevance.

3.1.6 Benchmarking and market portfolio considerations

In order to find out, whether the overreaction is really corrected in the following period, the portfolios must be benchmarked regarding their stock price development. Thus, relevant and accurate benchmark indices had to be chosen, which the stock price development could be compared to. These indices include the following: The Stoxx Europe 600, the Russell 2000, and the theoretical performance of the whole, equal-weighted sample, which the portfolios in the corresponding quarters were selected from.

First, the Stoxx Europe 600 index was chosen, since it is the market index covering the European companies closest to the sample, consisting of Nordic as well as German companies. In comparison to the Euro Stoxx 50, which consists of Europe's biggest 50 companies, we believe the Stoxx 600 reflects the whole European stock market more accurately. Although the Euro Stoxx 50, consisting only of European large caps, seems a perfect benchmark for portfolios chosen from domestic large caps, the companies of the index differentiate significantly in size from those of the sample. Especially the companies originating in Denmark, Sweden, Finland, and Norway may not be considered large in a European context, but rather medium sized. Thus, the Stoxx Europe 600 appears to be the most suitable proxy.

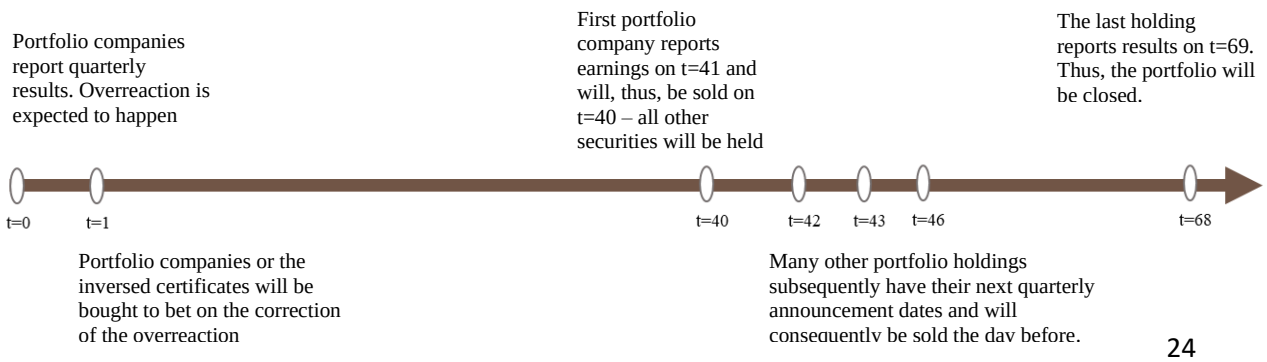
In addition to the Stoxx Europe 600, the Russell 2000 was selected for benchmarking, since the portfolio regressions conducted to find a potential outperformance also used the Fama French market risk premium. This was derived by observing the American stock market, and again, the Russell 2000 seems to best reflect it due to its sheer size and industry variation, compared to the Dow Jones, S&P 500, and the NASDAQ 100.

Finally, a potential under- or outperformance becomes the most obvious when comparing against the own chosen sample. This eliminates potential subconscious biases in the data gathering and selection process as well as country or region specific under- or outperformances. Therefore, a theoretical index was created, consisting of 169 companies. These companies all contributed to the index development on an equal basis, and, for the graphical benchmarking, their stock prices were indexed to 1 at the starting date to account for potential distortions arising from different share prices. After careful consideration, the sample was not used to additionally create an index based on the firms' market capitalization, since this would leave it exposed to being dominated too heavily by the German market. In contrast to the market capitalization weighted portfolios, the stock development would not be owed to the idiosyncratic performance, but rather one based solely on the German market.

In general, companies report their quarterly earnings on different dates. Hence, this paper uses the following method for benchmarking: First, the observation period starts on April 24 in 2018, which is the day after the first portfolio company reported its Q1 earnings in 2018. Due to the different periods from one earnings press release to the next one, the portfolios remained the same until the last company reported their earnings, while selling each security the day before their next quarterly announcement, as stated above.

Graph 7: Portfolio holding

The following graph shows the incorporation and holding of companies over the period following the quarterly announcement to profit from the correction of the overreaction. On t=1, all portfolio companies or their inversed certificates will be bought into the theoretical portfolio, and each portfolio security will be held until the day before it announces the next quarterly results, and new information on currency effects is presented.



This may be slightly punishing for the respective portfolios, since the stocks of companies, that have been theoretically sold before, are not able to perform in favour of the portfolio anymore. But then again, there is an overlap almost each quarter, since the next quarter's portfolio starts before the previous one expires. The last day of activity for the portfolios following the announcements from the third quarter in 2020 is March 02, 2021, and the benchmarking period ends there.

Each portfolio's security is indexed on their first trading day in the portfolio, which means each stock starts at 1 to measure its exact development. In order to account for the correct index developments, overlapping portfolios are multiplied with each other, and the total performance of all expired quarterly portfolios is multiplied with the quarterly portfolio that is active. The total performance of the whole strategy is thus computed by multiplying all portfolios on their last trading day.

3.1.7 Sample

To evaluate the currency effects on revenue, markets with high reporting quality have been selected. Furthermore, there was a need to capture markets where a vast majority of firms do business in different countries with different currencies, giving rise to currency effects on the firms' quarterly statements. This resulted in a focus on Northern Europe, as a large share of Nordic firms are export oriented and dependent on the value of the local currency. Five markets where selected, namely Sweden, Norway, Denmark, Finland, and Germany. The sample consists of 169 companies in total. A complete list of all companies can be found in appendix 3.

The UK was initially also considered, but, as no single company reported currency effects out of the first 10 firms of the FTSE100 index, eventually we decided to exclude it. Germany, in turn, was mainly chosen due to their huge export exposure to China and the United States. As larger firms generally report more detailed data and have a higher degree of globalized operations, the large cap indices for each country where selected. The large cap indices have been adjusted in two main regards. First, cross-listings have been adjusted so that a firm is only included in one index, which affects firms such as Nordea and TietoEVRY. Second, the indices have been adjusted so that a firm is only included once, even if it has different share classes such as class A-, B-, C- and preference shares.

To be included into the final sample the firms need to have reported currency effects on revenue during the entire sample period. Certain firms only report currency effects in annual reports, and these have therefore been excluded. The sample is also limited to firms which were listed in the indices at the time the paper originated. Hence, the sample could suffer from survivorship bias, as several firms have been delisted for several reasons, mainly related to M&A. We, however, do not expect an impact of that, since the portfolios only filtered for the companies with the most extreme currency effects on revenue, thus the relation between currency effects and stock returns should also be unimpacted.

3.1.8 Sample attrition analysis

Due to the general opaqueness of currency effects reporting and inconsistencies among the sample firms, a large share of the firms in the five large cap indices has been excluded. Reasons include a total lack of currency data, inconsistent reporting, and incomplete reporting. The complete list of firms, pre-investigation of currency effects, consisted of 298 firms across the selected five large cap indices.

The currency data has been gathered by going through each of the 298 firms' quarterly statements for the eleven quarters between first quarter 2018 and third quarter 2020. Other data related to stock returns for each stock, such as market capitalization in each quarter, has been retrieved from Thomson Reuters Eikon. The Fama-French (1993) factors have been collected from Kenneth French's database (2021).

The sample with both currency data and other data consists of 169 firms, with an attrition rate of 43%. The attrition rate was the highest for Germany and Finland, and lowest for Sweden. Gathered data has been processed, streamlined, and structured in Excel to enable the econometrical and statistical evaluation through the program Stata.

3.1.9 Portfolio construction

Based on the above defined screening methodology, various portfolios have been constructed. Both the reported currency growth measure and the currency impact as share of total growth measure, together with screening of positive and negative overreactions, form the basis for the portfolios. The next step consists of creating of both equal-weighted and market capitalization-

weighted portfolios. Each regression table's headline states whether the reported currency growth or the currency growth as share of total growth has been applied, as well as which of the three different benchmark indices has been applied. Additionally, each portfolio has been assigned a name based on two factors:

1. Equal- ("E") or market-capitalization ("MC")- weighted
2. Long ("L"), short ("S"), or long-short ("LS")

Hence, an example of a portfolio name could therefore be *ELS*, meaning that the portfolio is equal-weighed with a long-short strategy.

A portfolio does not consist of one calendar quarter, but rather 10 stocks with separate announcement dates and stock return developments matched accordingly. The portfolios are constructed on a theoretical basis consisting of only 10 firms within each quarter, since we expect the companies most exposed to currency gains or losses to react the severest. Every portfolio is then benchmarked against the respective indices described in the previous section. Thirs, since the foundation of the portfolio construction is rather theoretical, so is the rebalancing. The theoretical rebalancing occurs quarterly, when new information about currency effects and revenue growth is released to the market. Lastly, each portfolio strategy is evaluated across all observed quarters, which causes temporary shortages in holdings to less than ten securities, but also overlapping of some portfolios as a consequence of the first firms' reporting for t_1 overlapping with the periods following t_0 for some firms, as explained above. The quarterly portfolios for both explained strategies can be found in the appendices 4 and 5.

3.2 Regression analysis framework

Once the portfolios are composed, they must be regressed and analysed to find out, whether there indeed is a correction of the assumed temporary overreaction following the revelation of inflated or punished growth by currency effects. The first step does not include the portfolios yet, but instead conducts a statistical regression of both compiled lists, using *Stock return* as the dependent variable and *Currency growth* in each list as the main independent variable. The dependent variable *Stock return*, in this connection, measures the stock price development of each security throughout the period following the quarterly announcement, until the day before the release of the next quarterly results, where new information on currency effects and growth is presented. The reasoning behind this is to find out whether there is a connection between

currency growth and stock returns at all, and if this connection is negative, as expected, implying that the more favourable the currency effects are, the higher the overreaction on the announcement day, and the more severe its correction will be. This implies the following:

- Hypothesis 1 will be supported, if there is a statistically significant coefficient for the main independent variable *Currency growth*, and this coefficient is economically negative.
- Hypothesis 1 will be rejected, if there is no statistically significant coefficient for the main independent variable *Currency growth* or/and this coefficient is economically positive.

The other independent variables are chosen to be the three factors set up by Fama-French (1993), since it is an extended version of the original capital asset pricing model (CAPM) developed by Sharpe (1964) and Lintner (1965) on the foundation of modern portfolio theory by Markowitz (1952). This implies that these factors are the main explanatory ones for stock returns, which is why they are also incorporated into the regressions. Thus, the regression equation looks as follows:

$$StockReturn_{i,t} = \beta_0 + \beta_1 * CurrencyEffects_{i,t-1} + \beta_2 * (r_{market\ t} - r_{rf\ t}) + \beta_3 * SMB_t + \beta_4 * HML_t.$$

The three parameters from β_2 to β_4 describe the market premium, the size factor and the value factor. The market premium can be described as the excess return over the risk-free rate during that period, whereas the size factor gives a premium to small companies due to their higher volatility and growth prospects, expressed in subtracting returns from big companies from those from small companies. The value factor assumes a premium for companies with high book-to-market ratios, subtracting returns from companies with low boot-to-market ratios from them.

In the second step, the constructed portfolio returns are regressed against the market return. Portfolio strategies are also often evaluated through the Fama-French (1993) framework, such as by Hirshleifer, Lim and Teoh (2009). Thus, we use this methodology as well to find, if there is any outperformance of the constructed portfolios. The outperformance, in this connection, is described by the factor *alpha* (α) in accordance with Jensen (1968), which is the constant of the regression output, while all the independent variables are the ones originating from the Fama-French (1993) model. Alpha thus measures the surplus stock return generated over the market, when corrected for the market premium, the size factor and the value factor. A portfolio generating positive alpha should be interpreted as outperforming the benchmark market

premium and a portfolio generating negative alpha should be interpreted as underperforming the benchmark market premium (Jensen, 1968; Fama & French, 1993). The foundational equation is presented below:

$$StockReturn_{i,t} = \alpha + \beta_1 * r_{rf\,t} + \beta_2 * (r_{market\,t} - r_{rf\,t}) + \beta_3 * SMB_t + \beta_4 * HML_t.$$

To test whether portfolios generate alpha, the intercept, the risk-free rate has been subtracted to formulate the final complete model:

$$StockReturn_{i,t} - r_{rf\,t} = \alpha + \beta_2 * (r_{market\,t} - r_{rf\,t}) + \beta_3 * SMB_t + \beta_4 * HML_t.$$

The hypothesis 2 is rejected or supported depending on the value that the α returns. Thus, the hypothesis will be treated as follows:

- Hypothesis 2 will be supported as long as the portfolios with companies that suffered from negative currency effects and a negative overreaction and the inversed certificates from those companies that benefitted from positive currency effects and an immediate overreaction will generate positive and significant α caused by the correction of this initial overreaction.
- Hypothesis 2 will be rejected, if the portfolios generate negative and/or insignificant α, implying that it is not possible to return alpha with the applied strategies.

Both the complete sample regressions and the portfolio regressions are evaluated at the significance levels 1%, 5% and 10%.

The regressions for the portfolios are carried out using panel data. As panel data contains more degrees of freedom and accurately reflects the dynamic effects of independent variable, it has been selected to find the impact of currency effects on revenue and subsequent mean reversion of stock prices. Panel data also facilitates the estimation of individual effects over a specific period and sample (Hsiao, 2014). Therefore, if available, panel data is preferred to other analytical approaches. This also implies that the portfolio holdings had to be randomized and given an ID from 1 to 20 every quarter.

3.2.1 Calculation of the three Fama-French factors

The risk-free rate has been retrieved from the Kenneth French (2021) database, in addition to the factors market risk premium, *SMB* and *HML*. The Kenneth French (2021) database uses the

yield on US 1-month treasury bills. However, as this study evaluates European firms as opposed to US firms, with market capitalizations converted into the euro, several different benchmark approaches have been applied. First, each constructed portfolio has been regressed using only Kenneth French's (2021) database, meaning that US returns and US risk-free rate has been applied. Second, each portfolio has been regressed using the Stoxx Europe 600 index and EURIBOR 1-month yield as the market premium factor. The other two factors by Fama-French stayed the same. Lastly, each portfolio has been regressed using the returns of the entire sample, constructing a representative index for the firms, with the EURIBOR 1-month interest rate as the risk-free interest rate. Again, the sample subtracted with the EURIBOR was used as the market premium, and the *SMB* and the *HML* factors remained the same as with the other two benchmarks.

According to Damodaran (2012), each security's return should be matched against the interest rate of the underlying currency, which is why we included the Stoxx Europe 600 and the sample market premium. However, the Kenneth French's (2021) database is widely applied within empirical corporate finance research, hence this paper uses three different benchmarks for the risk-free interest rate and market portfolio.

3.2.2 Further implications

In order to run the statistical regressions, some final considerations had to be made to make the results robust and meaningful.

3.2.2.1 Hausman Test

The Hausman test allows for the selection between fixed effects and random effects models. The null hypothesis is that random effects models are to be preferred for the sample in question. Furthermore, *sigmamore* is used as an estimation of the contrast variance for exogeneity and overidentification tests in instrumental-variables regressions.

The Hausman test for the reported currency growth sample returned 1.38, while the currency growth as share of total growth sample's test resulted in 1.25. Both numbers return probabilities of 0.24 and 0.26, which means that the null of random effects cannot be rejected. Therefore, the regressions were executed using random effects, and in the portfolio regressions, random effects will be used, too.

3.2.2.2 Jarque-Bera Test

The main option to test for nonnormalities in the sample is the Jarque Bera Test. In contrast to the Hausman test, however, it is not suitable for panel data in its original version, since error-component models, that may lack the Gauss distribution could arise in several components, and it might be unclear which of them causes them (Galvao, et al., 2013). Galvao, et al. (2013) thus introduce a bootstrapping procedure to detect lack of symmetry, kurtosis, and normality. They argue that '[…] Since the tests are asymptotically normal, the bootstrap can be used to compute the corresponding variance–covariance matrices […]' in panel models with a short time horizon. This paper thus relies on the command -*xtsktest*-, introduced by Alejo, et al. (2015) based on the results shown by Galvao, et al. (2013), to test for skewness, normality, and kurtosis of the sample. Similar to Alejo, et al. (2015), the test is conducted using 500 bootstrap replications and a seed number of 123.

The results of the Jarque Bera Test are shown in Appendix 6 and 7. The strong rejection of normality for both samples at the 0.01 level means that the results are not normally distributed. The positive values for both the samples' skewness in e and u indicate that there is a clustering of higher stock returns for smaller currency effects. The values are significant at the 10% interval for the systematic clustering and at the 5% interval for random clustering. The excess kurtosis in *e* and *u* for both firms reveals that there are systematic and unsystematic excess stock returns in some firms with lower currency effects. While the systematic excess returns are significant at 1%, the latter are at the 5% interval.

3.2.2.3 Friedman Test for cross-sectional interdependence

Cross sectional dependence has been receiving an increased attention in recent literature due to growing concerns, that error terms could be caused by external shocks and events, which is why the likelihood of correlation among the observations is high. The preferred test to investigate such correlations is the Breusch-Pagan test, which is, however, not valid for panel data where $T < N$, and, thus, not applicable for this sample. Based on this shortcoming, De Hoyos and Sarafidis (2006) introduce a way to execute the Friedman test using the command -*xtcsd, friedman*-, where the null hypothesis described cross-sectional independence.

The Friedman Test generate values of 0.9787 for the reported currency growth sample and 0.9718 for the currency growth as share of total growth sample, which means that the null hypothesis of cross-sectional independence cannot be rejected. Although it would be

reasonable to assume that external currency depreciation can cause cross-sectional dependencies, there is no need to adjust the robust standard errors following this test.

3.2.2.4 Further statistical implications

For a panel data model using random effects, statistical methods to test for heteroskedasticity and time series correlation are scarce and Stata commands do not yet exist. Therefore, the White test is computed manually for both samples. This is done by first predicting the residuals -*uhat*-, before calculating the linear prediction of the fitted model using the command -*xb*-. The squared residuals are then regressed on the linear model using clustered standard errors. By testing if the coefficients of all variables of the linear model are equal to zero, the model yields the F-statistic.

While serial correlations rather occur in panels reaching over long time series, there is no problem associated with it in smaller panels (Akel & Torun, 2017, p.332). Nevertheless, clustered standard errors are used as a precaution for potential, minor correlations, which could be linked to time dimensions. The manually computed White test generates a value of 0.000 for both samples, strongly rejecting the null hypothesis of homoscedasticity. The sample is thus strongly heteroskedastic. The F-statistics yield values of 15.91 for the reported currency growth sample and 16.54 for the currency growth as share of total growth sample.

3.2.3 Robustness checks

In order to ensure robustness and meaningfulness of our results, we conducted several robustness checks. First, we controlled in the sample regressions for potential variations in quarter-effects and industry-effects. We therefore included these variables into the statistical regressions and looked for potential changes in the magnitude and statistical significance of all the coefficients.

Furthermore, this paper investigates, if portfolios compiled on an equal-weighted basis and on a market-cap weighted basis are able to outperform their respective benchmarks. While it is an interesting value-added to check if market-weighted portfolios outperform those on an equal-weighted basis, and if currency effects are more visible when compiling those, especially when benchmarking them against indices compiled on the same criteria, these portfolios can also serve as robustness checks. Following the reasoning of Desai, et al. (2002), which is inspired

by the framework by Fama (1998), the results could originate from misspecifications of the asset-pricing model, by valuing smaller stocks, which, according to theory, will deliver higher abnormal returns over time, with the same portfolio weighting as their larger counterparts. Introducing value-weighted portfolios, where smaller stocks will be given a lower weighting based on their equity value, this error will be corrected for and it will be ensured, that an outperformance of the portfolios will not only originate from higher returns of smaller firms.

In contrast to some previous research on portfolio returns, however, we decided against using other percentiles of the sample to benchmark our portfolios with, but instead used the whole sample itself and two further indices as benchmarks. This is mainly related to the sample being smaller than in most research studies, and further breakdowns could potentially produce some extreme values, making them useless as robustness tests. Second, it is this study's aim to capture the extreme currency effects and profit on them to find a relationship between currency effects and stock returns, since they are expected to show the biggest movements in either direction. It is subject to further research using larger samples to use additional percentiles as robustness checks. However, the robustness checks executed for this study will be sufficient to produce meaningful results.

3.3 Methodology discussion and limitations

3.3.1 Excluded variables and choice of factor model

Other variables beyond the Fama-French (1993) framework as well as defined currency effects measurements could potentially impact both portfolio construction and independent variables in the performed regressions. Since the currency effects are rather opaque, other variables could potentially have been constructed as proxies to measure currency effects on financial statements. However, when evaluating and constructing screening criteria, no such proxy of that kind was sufficient for the sample firms.

Based on the Kenneth French (2021) database, a vast variety of portfolios can be constructed on industry, size, and the book-to-market ratio, however, the aim of this paper was to research the market's interpretation of currency effects on revenue. This is why we chose to apply a currency-based portfolio approach. As a paper by McLean and Pontiff (2016) highlights, 97 previously researched variables have supported explanatory power of stock returns, but there

is no research consensus on which of these would be the most suitable for portfolio construction.

Moreover, several other widely used factor models exist, such as the original CAPM constructed by Sharpe (1964) and Lintner (1965), the Carhart (1997) four factor model and the Fama-French five factor model (2015). Based on the critique by Fama and French (1993) towards the original CAPM and the authors extension of it, as well as the lack of prevalence in recent previous research, the three factors model is used as the foundation of this study similar to that of Hirshleifer, Lim and Teoh (2009).

3.3.2 Reliability and replicability

Reliability guides the quality of the work process and interpretation of results. According to Bryman et al. (2019), for a study to be deemed reliable, the results generated must be repeatable throughout various time periods. Moreover, researched variables should be stable over time and markets, and do not change in their interpretation (Bryman et al., 2019). Stability has been assessed by regularly preforming controls on the sample data throughout the data gathering and regression testing period. Controls have been performed randomly on several variables and currency data has been re-evaluated through going back to quarterly reports. Performed controls have demonstrated errors within the data set, which have been adjusted accordingly. However, based on the manual data gathering of currency effects, minor mistakes can be present.

Additionally, Thomson Reuters Eikon is to be considered a reliable database. However, minor errors could occur for selected variables, which the authors cannot be held accountable for. These potentially existing minor data errors are not deemed to affect the regression results in any direction. The Fama-French (1993) three factors are computed on US data, but the market premium is adjusted in several portfolios and *SMB* and *HML* are deemed reliable for European data too. Hence, the overall replicability of the study is deemed as high, albeit depending on the extensity of firms' quarterly reporting. By following the detailed methodology and applying it to the chosen markets, the same results should be achieved.

Chosen methodology has followed previous research to the extent possible. Since there is, to our knowledge, no research on this exact topic, several choices, however, have been made regarding data and regressions. These choices impact the reliability of this paper, but the

choices have been taken in regard to prestigious frameworks such as the Fama-French (1993) three factor model and guiding theories such as the investor attention theory, developed by DellaVigna and Pollet (2009), Hirshleifer and Teoh (2003), and Hirshleifer, Lim and Teoh (2009).

3.3.3 Validity and generalizability

Bryman et al. (2019) state several components of validity, concerning how the material is interpreted, generalized, and put into perspective to the research frontier, consensus, and the wider reality. In the context of this paper, the most relevant aspects of the validity arguments presented Bryman et al. (2019) is generalizability. Due to the general opaqueness surrounding the reporting of currency effects, it is difficult to generalize the findings of this paper to other advanced financial markets such as the US. As mentioned, the UK was excluded due to a lack of currency effects data. This means that the findings of this paper are most likely not generalizable to UK-listed firms.

Moreover, as this study evaluates large cap firms, it is unclear if the findings can be applied to firms listed on mid-, small-, and micro-cap indices. As smaller firms are more likely to have a higher degree of localized revenue and operations, portfolio construction could potentially not be applied to these firms. Finally, we have found no similar papers on currency effects on revenue from quarterly reports, contextualizing and comparing the findings to previous literature is limited, which also limits generalizability.

4. Empirical results

4.1 Summary statistics

The first table, which is a summary statistic of all observations especially related to currency effects, serves as a comprehensive overview of the whole sample. It is aimed to give an insight in the actual exposure to currency fluctuations that companies face.

Table 3: Sample summary

This table reports the currency effects both for reported currency growth and currency growth as share of total growth across the whole sample of firms compiled for this study. The number of observations adds up to 1,859, which includes all 169 individual firms over a period of 11 quarters. The quarterly analysis starts after the firms reported their Q1/2018 results and ends the day before the firms reported their Q4/2020 results. The table analyses the measures mean, minimum, 25 percentile, median, 75 percentile, maximum and the standard deviation for both screening methods. The former describes the reported currency growth, whereas the latter set them into relation of reported growth to find out, how much of the reported growth is solely relatable to exchange rate fluctuations.

Variable	mean	min	p25	median	p75	max	sd	obs number
Reported currency growth	0.017	-0.156	-0.015	0.000	0.020	0.278	0.036	1,859
Currency growth as share of total growth	-0.431	-473.580	-0.167	0.000	0.214	254.870	13.446	1,859
Stock return	0.032	-99.870	-0.055	0.033	0.116	0.934	0.162	1,859

The mean reported currency growth over the whole period was positive across the sample, amounting to 1.7%. Based on the positive average and on the assumption, that the overall currency effects approximate zero in larger samples, this implies an underperformance of the compiled sample compared to the other two benchmark indices, if our assumptions hold, since there is expected to be an initial positive overreaction on the announcement day on average across the whole sample, which is expected to be subsequently corrected.

In the currency-growth-as-a-share-of-total-growth-sample, however, currency had a negative effect in relation to growth of -0.43. Thus, the assumed underperformance based on the reported currency growth could be flawed if investors' attention is strong enough and they are able to reflect the growth from currency effects in relation to total growth. Then, the logical assumption would be an actual outperformance of the sample.

Interestingly, the median of all companies' currency effects for both reported currency growth and currency growth as share of total growth is exactly zero, which is attributable to the many companies merely operating in their domestic country. Thus, deriving conclusions from the

median, the sample should exactly perform like an average index, if the performance was solely related to currency effects.

Additionally, stock returns were positive on average on a quarterly basis, amounting to 3.2%. However, during one quarter, one firm lost almost all its value, with the share price plummeting by 99.9%. The biggest quarterly share price gain was at 93.4% for the whole period. In contrast to the currency effects, the median stock return was positive at 3.3%, and thus, very close to the mean, indicating an almost normal distribution of stock return. The following table, in contrast, gives an indication of the economic numbers of the sample.

Table 4: Sample summary using economic numbers

This table reports the currency effects in both reported currency growth terms and as share of total growth terms across the whole sample of firms compiled for this study. The number of observations adds up to 1,859, which includes all 169 individual firms over a period of 11 quarters. In contrast to Table 3, this table uses economic numbers to evaluate the average exposure to currency effects per quarter. It does not reflect any positive or negative impact, but only the magnitude of the economic severity.

Variable	mean	p25	median	p75	obs number
Reported currency growth	0.024	0.005	0.018	0.036	1,859
Currency growth as share of total growth	1.340	0.042	0.197	0.526	1,859

The table gives ample insights into the exposure of firms to currency effects. The average exposure was at 2.4%, with the median being lower at 1.8%. For the currency effects as a share of growth, the difference between the median and the mean was even higher at 1.14. This implies that the sample consist of some extreme values, which is exactly the pattern this paper targets to see use the largest corrections of an initial overreaction in the stock price.

When looking at the country-wide distribution across the sample, the effects are visible in Table 5 below:

Table 5: Currency effects and stock returns across countries

The following table reports the currency fluctuations on reported currency growth and currency growth as share of total growth, as well as the stock returns across the whole sample, however divided into subsets of the companies' countries of origin. The stock returns and currency effects are measured on a quarterly basis. The observation period is the same as in the whole sample. The number of observations sums to 1,859, consisting of 242 observations for Denmark, 154 observations for Finland, 506 observations for Germany, 176 observations for Norway and 781 observations for Sweden. The sample includes 22 Danish companies, 14 Finnish companies,

46 German companies, 16 Norwegian companies and 71Swedish companies, all reporting over a period of eleven quarters.

Country	Variable	mean	min	median	max	sd	obs number
Denmark	Reported currency growth	-0.008	-0.154	-0.001	0.092	0.031	242
	Currency growth as share of total growth	-0.190	-13.795	0.000	32.207	2.742	242
	Stock return	0.036	-0.465	0.044	0.776	0.159	242
Finland	Reported currency growth	-0.012	-0.156	-0.012	0.039	0.030	154
	Currency growth as share of total growth	-0.735	-21.993	-0.001	3.543	2.600	154
	Stock return	0.021	-0.557	0.026	0.641	0.172	154
Germany	Reported currency growth	-0.007	-0.137	0.000	0.278	0.032	506
	Currency growth as share of total growth	-1.833	-473.580	0.000	11.074	22.443	506
	Stock return	0.021	-0.999	0.020	0.806	0.178	506
Norway	Reported currency growth	0.006	-0.077	0.000	0.120	0.031	176
	Currency growth as share of total growth	1.452	-15.974	0.000	254.870	19.291	176
	Stock return	0.046	-0.324	0.047	0.456	0.133	176
Sweden	Reported currency growth	0.012	-0.123	0.010	0.276	0.039	781
	Currency growth as share of total growth	0.037	-66.938	0.093	63.528	3.886	781
	Stock return	0.037	-0.544	0.033	0.934	0.157	781

Interestingly, the country with the highest average currency growth as share of total growth is Norway, whereas Sweden shows the highest average reported currency effects. Based on the assumption, that these countries' companies will experience the highest positive overreaction on the announcement day, both countries should thus deliver the lowest average stock returns in the subsequent, correcting period. Surprisingly, however, both countries' companies also deliver the highest average stock returns, with Norway having a higher stock return of 4.6% per quarter on average. The companies suffering the most from currency effects impacting their growth, on the other hand, are those located in Germany and Finland, which both also delivered the lowest stock returns during the period.

This is a first strong indicator that eventually hypothesis H_1 will not be supported. However, the pattern changes when assessing the median instead of the mean, meaning that no indication can be drawn on the assumption that there is a correction of an initial overreaction.

Finally, the sample is analysed on its seasonal patterns, which can be observed in the following table:

Table 6: Quarterly currency effects and stock price development

In the following table, the currency effects and the stock returns can be found distributed on a quarterly basis. The stock market return was measured from t_0=1 to t_1=-1 for each individual company, so the periods, which the stock price development is measure over, may slightly deviate from company to company. The sample starts with the reporting of Q1/2018 and ends with Q3/2020. The sample was investigated regarding the mean, minimum, 25 percentile, median, 75 percentile, maximum and standard deviation.

Period following	Variable	mean	min	median	max	sd	obs number
Q1/2018	Reported currency growth	-0.020	-0.156	-0.042	0.229	0.046	169
	Currency growth as share of total growth	-4.677	-473.580	-0.163	6.771	37.804	169
	Stock return	0.037	-0.367	0.036	0.479	0.114	169
Q2/2018	Reported currency growth	-0.005	-0.085	0.000	0.276	0.040	169
	Currency growth as share of total growth	-0.290	-23.672	0.000	32.207	3.621	169
	Stock return	-0.055	-0.557	-0.066	0.254	0.119	169
Q3/2018	Reported currency growth	0.005	-0.075	-0.000	0.258	0.040	169
	Currency growth as share of total growth	-0.214	-4.463	0.000	1.114	0.816	169
	Stock return	0.017	-0.327	0.024	0.322	0.106	169
Q4/2018	Reported currency growth	0.005	-0.154	0.000	0.229	0.036	169
	Currency growth as share of total growth	-0.810	-92.777	0.000	1.844	7.333	169
	Stock return	0.058	-0.272	0.053	0.365	0.100	169
Q1/2019	Reported currency growth	0.019	-0.057	0.017	0.082	0.027	169
	Currency growth as share of total growth	0.206	-3.709	0.131	4.583	0.724	169
	Stock return	-0.006	-0.386	0.003	0.341	0.110	169
Q2/2019	Reported currency growth	0.011	-0.089	0.010	0.063	0.022	169
	Currency growth as share of total growth	0.332	-5.560	0.128	8.510	1.225	169
	Stock return	0.046	-0.244	0.043	0.495	0.105	169
Q3/2019	Reported currency growth	0.017	-0.061	0.014	0.278	0.029	169
	Currency growth as share of total growth	0.331	-9.202	0.145	7.880	1.267	169
	Stock return	0.053	-0.443	0.057	0.934	0.169	169
Q4/2019	Reported currency growth	0.014	-0.045	0.012	0.085	0.021	169
	Currency growth as share of total growth	0.694	-7.651	0.103	63.528	5.203	169
	Stock return	-0.127	-0.593	-0.140	0.613	0.208	169
Q1/2020	Reported currency growth	0.008	-0.093	0.008	0.120	0.027	169
	Currency growth as share of total growth	0.026	-21.993	0.057	7.059	2.251	169
	Stock return	0.154	-0.566	0.124	0.776	0.179	169
Q2/2020	Reported currency growth	-0.009	-0.115	-0.004	0.134	0.032	169
	Currency growth as share of total growth	1.240	-15.974	-0.288	254.870	19.688	169
	Stock return	0.051	-0.999	0.035	0.788	0.166	169
Q3/2020	Reported currency growth	-0.026	-0.123	-0.024	0.149	0.036	169
	Currency growth as share of total growth	-1.583	-66.937	-0.216	3.827	7.340	169
	Stock return	0.127	-0.195	0.107	0.684	0.168	169

Interestingly, the quarters after the highest negative currency fluctuations on average returned positive stock price returns, which can be observed in Q1/2018 and Q3/2020, whereas Q1/2019 and Q4/2019, which delivered the highest positive currency effects on average, returned negative stock returns. Both observations underline the initial assumption of the corrected

overreaction following inflated or punished growth by currency effects. When looking at the median, the same pattern can be found for all quarters but Q1/2019. More thorough sample descriptions regarding distributions across market capitalizations and industries can be found in the appendices from 8 to 13.

In addition, the following two tables show correlation matrices across the sample about reported currency effects and those as a share of growth:

Table 7: Correlation matrix across sample with reported currency growth

The following table shows all correlations of the independent and dependent variables with each other. The correlation matrix was created using the sample of 169 companies. Each dependent or independent variable's correlation without any impact from another variable. The currency effect is measured in reported growth terms.

	Stock return	Currency growth	Mkt-Rf	SMB	HML
Stock return	1				
Currency Effect	-0.042	1			
Mkt-Rf	0.355	-0.120	1		
SMB	0.330	-0.243	0.724	1	
HML	0.250	-0.103	0.350	0.264	1

Table 8: Correlation matrix across sample with currency growth as share of total growth

The table below shows all correlations of dependent and independent variables across the sample. The observations begin after each company individually reports their Q1/2018 results. The sample size is the same as in table 7.

	Stock return	Currency growth	Mkt-Rf	SMB	HML
Stock return	1				
Currency Effect	-0.016	1			
Mkt-Rf	0.355	-0.016	1		
SMB	0.330	-0.645	0.724	1	
HML	0.250	-0.023	0.350	0.264	1

In both matrices, it is observable that stock returns and currency effects correlate negatively with each other. Thus, both matrices indicate that the higher the positive currency effect in the reporting was, the lower the subsequent stock return will be, and reversed, excluding all other factors. This, again, leads to the assumption that the overreactions will indeed be corrected, and supports the reasoning behind the hypotheses. However, the statistical regressions in the following chapter will give a more sophisticated insight in the results and their implications.

4.2 Complete sample regressions

4.2.1 Reported currency growth sample regression

The models described in chapter 3 can be found in the following table:

Table 9: Reported currency growth regression models

The table below shows the overall regression results to give a first indication of the relation between the reported currency growth and its subsequent stock price performance. The dependent variable is *Stock return*, which is measured from the day after the quarterly announcement until the day before the next quarterly announcement. The main independent variable is *Currency growth*, which is reported in the financial statement on the quarterly announcement day. Thus, the table is aimed to investigate, if there is a negative connection between the currency effects and subsequent stock returns, because the higher the currency effects were in either direction, the higher the expected overreaction on the announcement day, and the higher the correction of this overreaction in following months. The sample consists of 1,859 observations with 169 unique company IDs. The regressions for the whole samples are executed as follows: The first model describes a base model with stock returns as the dependent variable and reported currency growth, market premium, size factor and the valuation factor as the main independent variables, since it wants to observe the relation between currency effects and stock returns, and thus, corrects for the three other factors by Fama-French (1993), which are assumed to drive stock returns. It is regressed using normal standard errors, and without adjusting for industry effects or quarterly effects. The second regression included industry effects, whereas the third solely includes quarterly effects. Regression four accounts for both effects, and regression five uses robust standard errors in contrast to the normal standard errors used in the previous models. Regression six uses robust standard errors clustered by Firm ID.

Model	I Basic	II Basic	III Basic	IV Basic	V Robust SE	VI Clustered SE
	Stock return	Stock return	Stock return	Stock return	Stock return	Stock return
Currency growth	0.157	0.153	0.080	0.066	0.066	0.066
	(0.100)	(0.104)	(0.102)	(0.107)	(0.098)	(0.098)
Mkt-Rf	0.766***	0.766***	1.678***	1.681***	1.681***	1.681***
	(0.128)	(0.128)	(0.179)	(0.178)	(0.220)	(0.220)
SMB	0.012***	0.012***	0.010**	0.010**	0.010**	0.010**
	(0.002)	(0.002)	(0.004)	(0.004)	(0.005)	(0.005)
HML	0.009***	0.009***	-0.002	-0.002	-0.002	-0.002
	(0.001)	(0.001)	(0.004)	(0.004)	(0.004)	(0.004)
Constant	0.034***	-0.047	0.000	-0.083**	-0.083*	-0.083*
	(0.005)	(0.032)	(0.016)	(0.035)	(0.042)	(0.042)
Industry effects	No	Yes	No	Yes	Yes	Yes
Quarterly effects	No	No	Yes	Yes	Yes	Yes
Observations	1,859	1,859	1,859	1,859	1,859	1,859
Number of FirmID	169	169	169	169	169	169
R-Squared	0.156	0.169	0.208	0.221	0.221	0.221

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

It can be inferred from the table, that reported currency growth shows a positive initial connection to stock returns. However, even in the base model the coefficient, while being positive at 0.16, is not statistically significant at any level. Thus, currency effects initially have a positive statistical impact on stock returns across the sample, albeit an insignificant one. Each percent increase in currency growth can thus be associated in a stock price gain of 0.16%. On the other hand, all Fama-French factors are statistically significant at the 1% significance level. The market factor amounts to 0.77, whereas the size factor and the valuation factor are positive at 0.01 and 0.01, respectively. Neither sign nor statistical significance for those three factors change, when incorporating industry effects into the model. The currency effects, however, slightly decline to 0.15, while remaining insignificant. The constant loses all significance and gets negative.

In comparison to model 2, one could observe a much higher impact of quarterly effects. While the currency effect remains insignificant at any significance level, their economic magnitude gets much lower to only 0.08. The valuation factor even loses its complete significance and turns negative, while the size factor gets slightly less positive, but remains statistically significant at the 5% level. The market premium maintains statistical significance at any level and becomes much more economically significant to 1.68.

While the market factor gets slightly more positive in model IV, and the currency growth loses even more economic significance, being only associated with 0.06% of each percent of stock return, and remaining insignificant at any significance level. The size factor remains significant at the 5% level. Using robust and clustered robust standard errors, neither significance nor amount of the independent variables change, but standard errors for currency effects decline from 0.11 to 0.10, while they increase for all other variables. The R-squared amounts to 0.22 for the models IV, V and VI.

4.2.2 Currency growth as share of total growth sample regression

The currency growth as share of total growth sample regression models can be found in the table below:

Table 10: Currency growth as share of total growth regression models

The table below shows the overall regression results to give a first indication of the relation between the currency growth, which is measured as a share of total growth, and its subsequent stock price performance. The dependent variable is Stock return, which is measured from the day after the quarterly announcement until the day before the next quarterly announcement. The main independent variable is Currency growth, which is the reported quarterly currency growth divided by the total quarterly growth, which are both released on the announcement day. Thus, the table is aimed to investigate, if there is a negative connection between the currency effects as a share of total growth and subsequent stock returns, because the higher the currency effects as a share of total growth were in either direction, the higher the overreaction on the announcement day is expected, and the higher the correction of this overreaction in the weeks and months following the announcement day should be. The sample consists of 1,859 observations with 169 unique company IDs. The regressions for the whole samples are executed as follows: The first model describes a base model with stock returns as the dependent variable and reported currency growth, market premium, size factor and the valuation factor as the main independent variables, since it wants to observe the relation between currency growth as a share of total growth and stock returns, and thus, corrects for the three other factors by Fama-French (1993), which are assumed to drive stock returns. It is regressed using normal standard errors, and without adjusting for industry effects or quarterly effects. The second regression included industry effects, whereas the third solely includes quarterly effects. Regression four accounts for both effects, and regression five uses robust standard errors in contrast to the normal standard errors used in the previous models. Regression six uses robust standard errors clustered by Firm ID.

Model	I	II	III	IV	V	VI
	Basic	Basic	Basic	Basic	Robust SE	Clustered SE
	Stock return	Stock return	Stock return	Stock return	Stock return	Stock return
Currency growth	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Mkt-Rf	0.785***	0.786***	1.693***	1.693***	1.693***	1.693***
	(0.128)	(0.127)	(0.178)	(0.177)	(0.218)	(0.218)
SMB	0.011***	0.011***	0.010**	0.010**	0.010**	0.010**
	(0.002)	(0.002)	(0.004)	(0.004)	(0.005)	(0.005)
HML	0.009***	0.009***	-0.003	-0.003	-0.003	-0.003
	(0.001)	(0.001)	(0.004)	(0.004)	(0.004)	(0.004)
Constant	0.034***	-0.049	-0.002	-0.086**	-0.086**	-0.086**
	(0.005)	(0.032)	(0.016)	(0.035)	(0.042)	(0.042)
Industry effects	No	Yes	No	Yes	Yes	Yes
Quarterly effects	No	No	Yes	Yes	Yes	Yes
Observations	1,859	1,859	1,859	1,859	1,859	1,859
Number of FirmID	169	169	169	169	169	169
R-Squared	0.155	0.168	0.207	0.221	0.221	0.221

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

In contrast to the reported currency growth regressions, these show a negative initial currency growth effect, while being not statistically significant at any significance level, which is similar to the patterns on the reported currency growth regressions. Although it can be inferred from the table, that negative currency effects as share of total growth have a positive impact and vice versa, this effect appears to be minimal, expressed by the economic significance, which is invisibly negative and thus, very close to zero.

Again, the industry effects are barely visible, merely adjusting the *Mkt-Rf* upwards by a thousandth, while keeping statistically significance for all Fama-French factors. Again, there is no statistical significance for currency effects, but the constant becomes negative and entirely insignificant. The quarterly effects, however, repeatedly have a much bigger impact. While *Mkt-Rf* rises to 1.69 and *SMB* gets slightly lower to a rounded 0.01, the valuation factor loses its significance at any level and even changes its impact from a positive one to negative. In addition, the size factor also loses significance, remaining statistically significant at the 5% level.

Incorporating both quarterly and industry effects into the regressions, no independent variable changes, but the constant gets much more negative, changing from -0.00 to -0.10, while gaining statistical significance at the 5% level. In model five and six, none of the coefficients changes either, while the standard errors *Mkt-Rf, SMB* and *HML* increase. The standard errors for the currency effects are at a bare minimum, meaning that no change in standard errors could be found, although there may have been a minor one.

Overall, no statistical significance for any of these models could be found for currency effects. In addition, their impact seems to minimal, slightly below 0.00. Regarding the statistical significance, the same pattern can be observed for reported currency growth effects. Thus, the whole sample regressions give a first indication that currency effects have a limited impact on the stock return overall, regardless of if they are negative or positive.

4.3 Portfolio results

4.3.1 Overview of names of portfolio strategies

Table 11: names of evaluated portfolio strategies

Abbreviation	Full name of portfolio	Strategy
ELS	Equal-weighted long-short portfolio	Seeks to generate alpha through both overreactions to currency growth inflating and deflating revenue growth. Each stock is equal-weighted in the portfolio.
EL	Equal-weighted long only portfolio	Seeks to generate alpha through overreactions to currency growth deflating revenue growth, betting on increasing stock prices correcting the initial negative overreaction. Each stock is equal-weighted in the portfolio.
ES	Equal-weighted short only portfolio	Seeks to generate alpha through overreactions to currency growth inflating revenue growth, betting on decreasing stock prices to correcting the initial positive overreaction. Each stock is equal-weighted in the portfolio.
MCLS	Market-cap-weighted long-short portfolio	Seeks to generate alpha through both overreactions to currency growth inflating and deflating revenue growth. Each stock is weighted based on its market capitalization in the portfolio.
MCL	Market-cap-weighted long only portfolio	Seeks to generate alpha through overreactions to currency growth deflating revenue growth, betting on increasing stock prices correcting the initial negative overreaction. Each stock is weighted based on its market capitalization in the portfolio.
MCS	Market-cap-weighted short only portfolio	Seeks to generate alpha through overreactions to currency growth inflating revenue growth, betting on decreasing stock prices to correcting the initial positive overreaction. Each stock is weighted based on its market capitalization in the portfolio.

4.3.2 Portfolio regressions

The number of portfolios totals 36, which consist of twelve portfolios for each benchmark market premium. Out of those twelve portfolios, the first six are the portfolios based on reported currency growth, with the six portfolios compiled on currency growth as share of total growth following. Consequently, the order is the same as with the total sample regressions. Within each section of six portfolios, the first three of them measure the performance weighting each portfolio security equally regardless of their market cap. The three subsequent portfolios do the same while weighting the securities based on their market capitalization at the start of the period. The first of each trio, thus, measures the combination of a long and short portfolio,

while the second portfolio only integrates stocks punished by currency growth to go long. The third portfolio will solely consist of the inversed certificates of the stocks with an initial positive overreaction due to favourable currency growth, described as short. These stocks are expected to fall in the subsequent period. The same order repeats for the portfolios with the Stoxx Europe and the sample return used for the market premium.

When regressing the first six portfolios with the Fama French market premium, the results look as follows:

Table 12: Regression models for portfolios I to VI benchmarked against the FF-market premium

The following table describes the portfolios that are compiled on the measurement of reported currency growth. Portfolio I includes 20 companies, 10 of which reported the highest negative currency growth, and 10 of which reported the highest positive currency growth. The former are expected to suffer an initial negative overreaction on the announcement day, while the latter are expected to benefit from an initial positive overreaction on the announcement day. For the former, this negative overreaction is expected to be corrected upwards, while for the latter, it is expected to be corrected downwards. Therefore, for Portfolio I, the securities facing negative reported currency growth are purchased, and for those facing positive reported currency growth, an inversed certificate with the factor of -1 is purchased. Portfolio II and III split this strategy in the following substrategies: Portfolio II attempts to generate α by only purchasing the securities negatively affected by currency growth, while Portfolio III only holds the inversed certificates of the companies, which got boosted by positive currency growth. The Portfolios I, II and III are compiled valuing each security or each inversed certificate equally. Portfolios IV, V and VI value the weighting of these securities or the inversed certificates in the portfolios based on the market capitalization of the respective companies. However, for the combined Portfolio IV, both strategies will be weighted equally with 50%, and the market-cap weighting only happens within the substrategies. The benchmark used to regress the portfolios to find α, which is the abnormal return over the benchmark expressed in the constant of the regression output, is the Fama-French market premium over the risk-free interest rate, which were both extracted from the Kenneth French (2021) database. Together with the SMB and the HML factors, these three factors are expected to drive stock returns, and each positive constant α signals a return beyond the one explainable by the three factors.

Portfolios based on reported currency growth (Fama French benchmark as market premium)						
Model	I	II	III	IV	V	VI
Strategy	ELS	EL	ES	MCLS	MCL	MCS
α	-0.006	0.025	-0.038**	-0.004	0.028	-0.018*
	(0.015)	(0.018)	(0.019)	(0.014)	(0.022)	(0.011)
Mkt-Rf	0.319	1.069*	-0.431	1.146*	2.262***	-0.980***
	(0.421)	(0.608)	(0.511)	(0.626)	(0.430)	(0.268)
SMB	0.005	0.019**	-0.009	-0.002	0.005	0.004
	(0.007)	(0.008)	(0.010)	(0.006)	(0.005)	(0.003)
HML	0.004	0.015**	-0.008	-0.001	0.011	-0.009
	(0.005)	(0.007)	(0.006)	(0.007)	(0.007)	(0.007)

Observations	220	110	110	220	110	110
Number of FirmID	20	10	10	20	10	10

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Overall, the reported currency growth portfolios return slightly negative returns for the combined portfolios, while being statistically insignificant. While portfolio III returns the most negative α of all portfolios and is statistically significant, the long portfolios II and V are able to return positive excess returns of 0.03 and 0.03. For portfolio II, all Fama French factors show positive coefficients and statistical significance, while for portfolios III and VI, the negative alpha does. In other words, the underperformance of the short portfolios is significant even when correcting for the Fama-French factors. For all three market-cap weighted portfolios, the *Mkt-Rf* is statistically significant, and shows values of 1.15, 2.26 and -0.98 in that respective order.

Portfolios VII to XII follow the same order, but are compiled and regressed based on the measure of currency growth as a share of total growth:

Table 13: Regression models for portfolios VII to XII benchmarked against the FF-market premium

The following table describes the portfolios that are compiled on the measurement of currency growth as share of total reported growth. Portfolio VII includes 20 companies, 10 of which reported the highest negative currency growth in relation to total growth, and 10 of which reported the highest positive currency growth in relation to total growth. The former are expected to suffer an initial negative overreaction on the announcement day, while the latter are expected to benefit from an initial positive overreaction on the announcement day. For the former, this negative overreaction is expected to be corrected upwards, while for the latter, it is expected to be corrected downwards. Therefore, for Portfolio VII, the securities facing negative currency growth in relation to total growth are purchased, and for those facing positive currency growth in relation to total growth, an inversed certificate with the factor of -1 is purchased. Portfolio VIII and IX split this strategy in the following substrategies: Portfolio VIII attempts to generate α by only purchasing the securities negatively affected by currency growth, while Portfolio IX only holds the inversed certificates of the companies, which got boosted by positive currency growth. The Portfolios VII, VIII and IX are compiled valuing each security or each inversed certificate equally. Portfolios X, XI and XII value the weighting of these securities or the inversed certificates in the portfolios based on the market capitalization of the respective companies. However, for the combined Portfolio X, both strategies will be weighted equally with 50%, and the market-cap weighting only happens within the substrategies. The benchmark used to regress the portfolios to find α, which is the abnormal return over the benchmark expressed in the constant of the regression output, is the Fama-French market premium over the risk-free interest rate, which were both extracted from the Kenneth French (2021) database. Together with the SMB and the HML factors, these three

factors are expected to drive stock returns, and each positive constant α signals a return beyond the one explainable by the three factors.

Portfolios based on currency growth as share of total reported growth (Fama French benchmark as market premium)						
Model	VII	VIII	IX	X	XI	XII
Strategy	ELS	EL	ES	MCLS	MCL	MCS
α	-0.023**	-0.010	-0.036**	-0.014	-0.012	-0.020
	(0.011)	(0.016)	(0.016)	(0.013)	(0.017)	(0.013)
Mkt-Rf	0.660*	1.860***	-0.540	0.654	2.295***	-0.721**
	(0.372)	(0.335)	(0.390)	(0.656)	(0.799)	(0.339)
SMB	-0.003	-0.004	-0.003	-0.003	-0.007	-0.002
	(0.005)	(0.005)	(0.008)	(0.007)	(0.012)	(0.008)
HML	-0.004	0.009**	-0.018***	-0.001	0.006	-0.009**
	(0.004)	(0.004)	(0.004)	(0.006)	(0.007)	(0.005)
Observations	220	110	110	220	110	110
Number of FirmID	20	10	10	20	10	10

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

In all the portfolios, a negative constant could be found, while showing statistical significance at the 5% level in portfolio VII and IX. In portfolio VII, only *Mkt-Rf* shows statistical significance besides alpha, which describes the α generated by the portfolio, and is positive at 0.66. The other independent variables *SMB* and *HML* are both negative and do not show any significance. Portfolio VIII, however, incorporates only long stocks, which makes the valuation factor positive and statistically significant at the 5% level. Besides, the market premium is at 1.86 and significant at the 1% level. The returned α for portfolio IX is the lowest of all portfolios, showing -0.04, while the *HML* is negative, since the short stocks develop quite oppositely compared to the market. At the same time, it is still clearly visible that all three market-cap weighted portfolios X to XII also returned negative α, with all of them being not significant at any given significance level. For portfolio XI, the *Mkt-Rf* shows strong statistical significance while seeming the crucial factor for stock returns of the whole portfolio.

Portfolio XII, on the other hand, shows that the underperformance is mainly caused by the reversed valuation factor for shorted stocks, and a negative market premium.

The following portfolios are aligned the same way as the first twelve but using the Stoxx Europe 600 index as a relevant benchmark for the market premium to find outperformance. The portfolios based on reported currency growth are shown in the following table.

Table 14: Regression models for portfolios I to VI benchmarked against the Stoxx Europe 600 as market premium

The following table describes the portfolios that are compiled on the measurement of reported currency growth. Portfolio I includes 20 companies, 10 of which reported the highest negative currency growth, and 10 of which reported the highest positive currency growth. The former are expected to suffer an initial negative overreaction on the announcement day, while the latter are expected to benefit from an initial positive overreaction on the announcement day. For the former, this negative overreaction is expected to be corrected upwards, while for the latter, it is expected to be corrected downwards. Therefore, for Portfolio I, the securities facing negative reported currency growth are purchased, and for those facing positive reported currency growth, an inversed certificate with the factor of -1 is purchased. Portfolio II and III split this strategy in the following substrategies: Portfolio II attempts to generate α by only purchasing the securities negatively affected by currency growth, while Portfolio III only holds the inversed certificates of the companies, which got boosted by positive currency growth. The Portfolios I, II and III are compiled valuing each security or each inversed certificate equally. Portfolios IV, V and VI value the weighting of these securities or the inversed certificates in the portfolios based on the market capitalization of the respective companies. However, for the combined Portfolio IV, both strategies will be weighted equally with 50%, and the market-cap weighting only happens within the substrategies. The benchmark used to regress the portfolios to find α, which is the abnormal return over the benchmark expressed in the constant of the regression output, is the Stoxx Europe market premium over the EURIBOR risk-free interest rate, which were used to have an accurate benchmark measurement of the European market, where all companies originated. Together with the SMB and the HML factors, the market premium is expected to drive stock returns, and each positive constant α signals a return beyond the one explainable by these combined three factors.

Portfolios based on reported currency growth (Stoxx Europe 600 benchmark as market premium)						
Model	I	II	III	IV	V	VI
Strategy	ELS	EL	ES	MCLS	MCL	MCS
α	-0.002	0.030	-0.035*	0.010	0.044**	-0.015
	(0.015)	(0.020)	(0.018)	(0.013)	(0.020)	(0.011)
Mkt-Rf	0.213	0.569***	-0.143	0.439**	0.826***	-0.429***
	(0.165)	(0.214)	(0.203)	(0.219)	(0.159)	(0.128)
SMB	0.002	0.014*	-0.010	-	0.006	0.005*
	(0.007)	(0.008)	(0.011)		(0.006)	(0.003)
HML	0.002	0.012	-0.007	-	0.008	-0.007
	(0.005)	(0.007)	(0.006)		(0.007)	(0.006)
Observations	220	110	110	220	110	110
Number of FirmID	20	10	10	20	10	10

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

With portfolio IV being positive, this portfolio is the first with a combined strategy of speculating on corrections of overreactions on positive and negative currency growth stocks to

return a positive α, whereas the same, equal weighted portfolio I returns negative returns. Both are statistically insignificant. Portfolio V, on the other hand, is the first portfolio returning statistical significance at the 5% level, and portfolio II returns a positive, but insignificant, α of 0.03. Both portfolios with inversed certificates, III and VI, again return negative results, with portfolio III being statistically significant at -0.04. For both portfolios with companies suffering from negative currency growth, as well as portfolio IV, the *Mkt-Rf* factor drives the portfolio performance, being statistically significant and positive. Portfolio VI shows a negative market premium and a positive size factor, both being significant, while α is the only significant factor for portfolio III.

The following portfolios also benchmark against the Stoxx Europe 600, but are compiled again by setting currency growth in relation to total growth:

Table 15: Regression models for portfolios VII to XII benchmarked against the Stoxx Europe 600 as market premium

The following table describes the portfolios that are compiled on the measurement of currency growth as share of total reported growth. Portfolio VII includes 20 companies, 10 of which reported the highest negative currency growth in relation to total growth, and 10 of which reported the highest positive currency growth in relation to total growth. The former are expected to suffer an initial negative overreaction on the announcement day, while the latter are expected to benefit from an initial positive overreaction on the announcement day. For the former, this negative overreaction is expected to be corrected upwards, while for the latter, it is expected to be corrected downwards. Therefore, for Portfolio VII, the securities facing negative currency growth in relation to total growth are purchased, and for those facing positive currency growth in relation to total growth, an inversed certificate with the factor of -1 is purchased. Portfolio VIII and IX split this strategy in the following substrategies: Portfolio VIII attempts to generate α by only purchasing the securities negatively affected by currency growth, while Portfolio IX only holds the inversed certificates of the companies, which got boosted by positive currency growth. The Portfolios VII, VIII and IX are compiled valuing each security or each inversed certificate equally. Portfolios X, XI and XII value the weighting of these securities or the inversed certificates in the portfolios based on the market capitalization of the respective companies. However, for the combined Portfolio X, both strategies will be weighted equally with 50%, and the market-cap weighting only happens within the substrategies. The benchmark used to regress the portfolios to find α, which is the abnormal return over the benchmark expressed in the constant of the regression output, is the Stoxx Europe market premium over the EURIBOR risk-free interest rate, which were used to have an accurate benchmark measurement of the European market, where all companies originated. Together with the SMB and the HML factors, the market premium is expected to drive stock returns, and each positive constant α signals a return beyond the one explainable by these combined three factors.

Portfolios based on currency growth as share of total growth (Stoxx Europe 600 benchmark as market premium)						
Model	VII	VIII	IX	X	XI	XII
Strategy	ELS	EL	ES	MCLS	MCL	MCS
α	-0.016	0.000	-0.032**	-0.006	0.001	-0.018
	(0.011)	(0.015)	(0.015)	(0.012)	(0.015)	(0.014)
Mkt-Rf	0.298*	0.800***	-0.204	0.285	0.947***	-0.249*
	(0.156)	(0.132)	(0.171)	(0.267)	(0.351)	(0.150)
SMB	-0.005	-0.006	-0.003	-0.004	-0.008	-0.003
	(0.005)	(0.005)	(0.010)	(0.008)	(0.013)	(0.008)
HML	-0.006	0.005	-0.017***	-0.003	0.002	-0.009*
	(0.004)	(0.005)	(0.005)	(0.006)	(0.007)	(0.005)
Observations	220	110	110	220	110	110
Number of FirmID	20	10	10	20	10	10

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Again, when regressed with the market premium from the Stoxx Europe 600, the combined portfolios VII and X deliver negative α of -0.02 and -0.01. For portfolio VII, the market premium is positive and significant at the 10% level, but considerably smaller than for portfolio VII using the market premium of Fama French sample, which can be found in table 13. The coefficient, being at 0.30, compares to 0.66 of the Fama-French model. For the long portfolios, *Mkt-Rf* is the only significant variable, but again much lower than in for the Fama French benchmark. In contrast to the former benchmark, both long portfolios do not return negative α even for the measure of currency growth as share of total growth, but still show no statistical significance. The short portfolios again return negative excess returns, which are statistically significant for the equal-weighted portfolio III at -0.03. Again, the *HML* factors are significant and negative for those portfolios, as they develop inversely to the market.

Like the previous portfolios, the same procedure applies to the two following portfolios, benchmarked this time, however, against the own selected sample of 169 firms.

Table 16: Regression models for portfolios I to VI benchmarked against the sample

The following table describes the portfolios that are compiled on the measurement of reported currency growth. Portfolio I includes 20 companies, 10 of which reported the highest negative currency growth, and 10 of which reported the highest positive currency growth. The former are expected to suffer an initial negative overreaction on the announcement day, while the latter are expected to benefit from an initial positive overreaction on the announcement day. For the former, this negative overreaction is expected to be corrected upwards, while for the latter, it is expected to be corrected downwards. Therefore, for Portfolio I, the securities facing negative reported

currency growth are purchased, and for those facing positive reported currency growth, an inversed certificate with the factor of -1 is purchased. Portfolios II and III split this strategy in the following substrategies: Portfolio II attempts to generate α by only purchasing the securities negatively affected by currency growth, while Portfolio III only holds the inversed certificates of the companies, which got boosted by positive currency growth. The Portfolios I, II and III are compiled valuing each security or each inversed certificate equally. Portfolios IV, V and VI value the weighting of these securities or the inversed certificates in the portfolios based on the market capitalization of the respective companies. However, for the combined Portfolio IV, both strategies will be weighted equally with 50%, and the market-cap weighting only happens within the substrategies. The benchmark used to regress the portfolios to find α, which is the abnormal return over the benchmark expressed in the constant of the regression output, is the sample market premium over the EURIBOR risk-free interest rate. The reasoning behind this is the sample being the most accurate measurement of an outperformance, since it only reflects the aggregated domestic markets where the portfolios were compiled from. The EURIBOR is the risk-free rate valid for all those countries. Together with the SMB and the HML factors, the market premium is expected to drive stock returns, and each positive constant α signals a return beyond the one explainable by these combined three factors.

Portfolios based on reported currency growth (Sample Benchmark)						
Model	I	II	III	IV	V	VI
Strategy	ELS	EL	ES	MCLS	MCL	MCS
α	-0.032	-0.055**	-0.015	-0.016	-0.009	-0.000
	(0.020)	(0.027)	(0.031)	(0.013)	(0.015)	(0.014)
Mkt-Rf	0.757*	1.991***	-0.470	0.800**	1.529***	-0.546**
	(0.392)	(0.383)	(0.377)	(0.349)	(0.140)	(0.218)
SMB	-0.006	-0.009	-0.005	-0.005	0.001	0.003
	(0.007)	(0.009)	(0.011)	(0.006)	(0.004)	(0.005)
HML	-0.005	-0.007	-0.003	-0.006	-0.001	-0.005
	(0.006)	(0.010)	(0.007)	(0.007)	(0.006)	(0.006)
Observations	220	110	110	220	110	110
Number of FirmID	20	10	10	20	10	10

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 17: Regression models for portfolios VII to XII benchmarked against the sample

The following table describes the portfolios that are compiled on the measurement of currency growth as share of total reported growth. Portfolio VII includes 20 companies, 10 of which reported the highest negative currency growth in relation to total growth, and 10 of which reported the highest positive currency growth in relation to total growth. The former are expected to suffer an initial negative overreaction on the announcement day, while the latter are expected to benefit from an initial positive overreaction on the announcement day. For the former, this negative overreaction is expected to be corrected upwards, while for the latter, it is expected to be corrected downwards. Therefore, for Portfolio VII, the securities facing negative currency growth in relation to total growth are purchased, and for those facing positive currency growth in relation to total growth, an inversed certificate

with the factor of -1 is purchased. Portfolio VIII and IX split this strategy in the following substrategies: Portfolio VIII attempts to generate α by only purchasing the securities negatively affected by currency growth, while Portfolio IX only holds the inversed certificates of the companies, which got boosted by positive currency growth. The Portfolios VII, VIII and IX are compiled valuing each security or each inversed certificate equally. Portfolios X, XI and XII value the weighting of these securities or the inversed certificates in the portfolios based on the market capitalization of the respective companies. However, for the combined Portfolio X, both strategies will be weighted equally with 50%, and the market-cap weighting only happens within the substrategies. The benchmark used to regress the portfolios to find α, which is the abnormal return over the benchmark expressed in the constant of the regression output, is the sample market premium over the EURIBOR risk-free interest rate. The reasoning behind this is the sample being the most accurate measurement of an outperformance, since it only reflects the aggregated domestic markets where the portfolios were compiled from. The EURIBOR is the risk-free rate valid for all those countries. Together with the SMB and the HML factors, the market premium is expected to drive stock returns, and each positive constant α signals a return beyond the one explainable by these combined three factors.

Portfolios based on currency growth as share of total growth (Sample benchmark as market premium)						
Model	VII	VIII	IX	X	XI	XII
Strategy	ELS	EL	ES	MCLS	MCL	MCS
α	-0.026*	-0.049**	-0.012	-0.020	-0.042***	-0.012
	(0.015)	(0.020)	(0.026)	(0.016)	(0.015)	(0.015)
Mkt-Rf	0.405	1.454***	-0.517	0.483	1.414***	-0.274
	(0.325)	(0.272)	(0.376)	(0.372)	(0.275)	(0.223)
SMB	-0.004	-0.011*	0.001	-0.005	-0.008	-0.005
	(0.006)	(0.006)	(0.011)	(0.006)	(0.009)	(0.007)
HML	-0.007*	-0.003	-0.013*	-0.005	-0.004	-0.008
	(0.004)	(0.006)	(0.007)	(0.007)	(0.006)	(0.005)
Observations	220	110	110	220	110	110
Number of FirmID	20	10	10	20	10	10

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

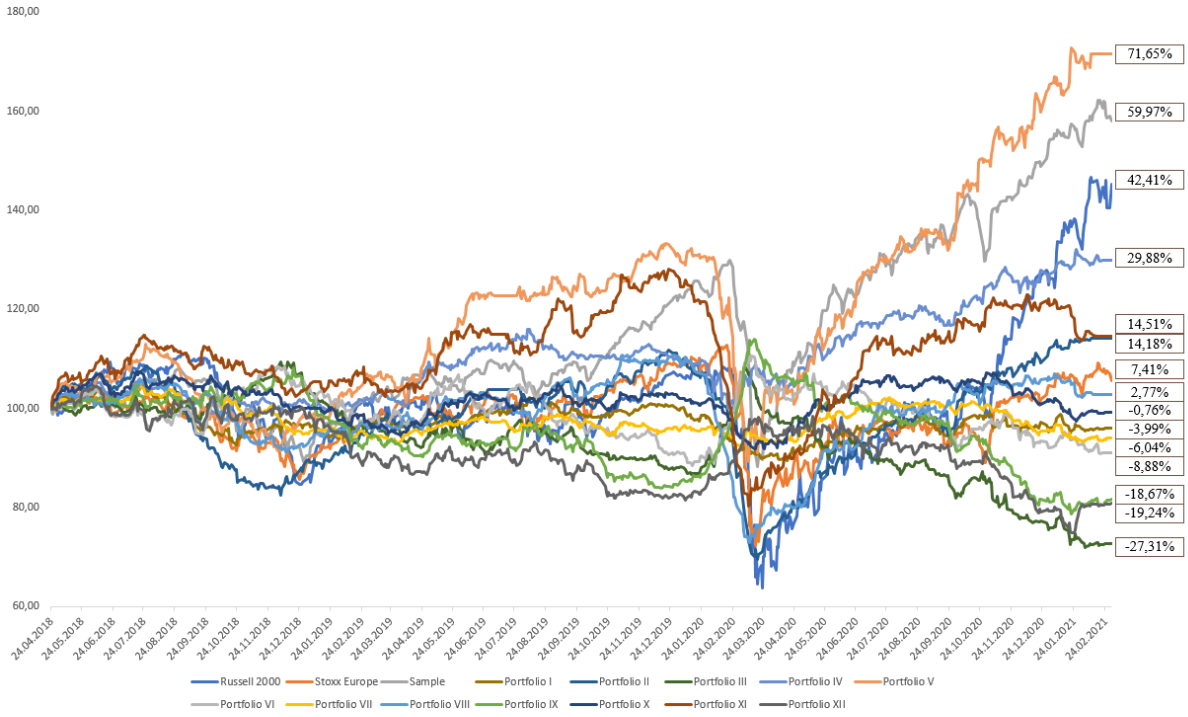
When regressing the portfolios using the market premium extracted from the sample, neither reported currency growth or currency growth as share of total growth portfolios returned positive α. The long portfolio VIII delivered a statistically negative α of -0.05, and portfolio II even had a negative α of -0.06, both being significant at the 5% level. While portfolio V was able to generate positive, albeit insignificant α when being compared with the Fama-French factors and the Stoxx Europe 600, it also generates negative returns. However, it must be considered that both portfolios II and V have a very high *Mkt-Rf* at 1.99 and 1.53, respectively, which are statistically significant at the 1% significance level, meaning an outperformance is possible, but only due to a higher risk premium.

Interestingly, whereas in the benchmarking regressions for the Fama-French factors and the Stoxx Europe 600, the short portfolios performed the worst in terms of their alpha, this seems to turn around for the sample benchmark. Rather, the better performance of the long portfolios compared to the short portfolios, which we have seen in the preceding regressions, is attributed to the *Mkt-Rf* factors, which are, again, economically negative for all short-portfolios, whereas being strongly positive for the long-portfolios.

Overall, the regressions imply that, combined with the Fama-French factors, no portfolio is able to outperform its own sample, and portfolio V as the best performing portfolio is the only one showing a positive statistical significance, when outperforming the Stoxx Europe 600. The following graph aims to visualize these results. In contrast, however, it does not measure the results over a quarterly period, but over the whole investment horizon, starting on April 24 in 2018 and ending on March 2 in 2021.

Graph 8: Portfolio development from April 24, 2018, to March 02, 2021, compared to benchmarks

The graph below illustrates the stock price development of all portfolios starting the day after the first portfolio company reported its Q1/2018 results and ending the day before the last portfolio company reports its Q4/2020 results. The portfolios are aligned in the same order and with the same names as described in the previous regressions. All portfolios are indexed on their first trading day to 100 to ensure entire comparability.



As visible, portfolio V, which is the market-cap weighted long-only portfolio based on reported currency growth, is the one with the best return over the whole period. However, it was the

only portfolio out of the twelve portfolios created that could really outperform the whole sample, and the regressions suggest, that this was not related to currency effects, but rather to the market premium factor. Portfolio IV, which consisted of portfolio V and VI combined, was the second-best performing portfolio, and already underperformed the sample as well as the Russell 2000 by a remarkable margin. While the sample returned 59.97% over the period, the Russell 2000 had a positive performance of 42.41%. Portfolio IV, however, which is the best-performing portfolio incorporating both positive and negative currency effects, yielded a return of only 29.88%.

Aside from the portfolios IV and V, only the portfolios II, VIII and XI were able to even finish the whole period with a positive result, while all other portfolios declined in value. This implies that, aside from portfolio IX, only long-only portfolios delivered positive returns, while all portfolios with inversed certificates returned very negative results. The worst-performing portfolio was portfolio III, plummeting by 27.31% over the whole observation horizon. The other short-portfolios XII, IX, and VI returned -19.24%, -18,67% and -8.88% in that respective order.

It follows that the combined portfolios VII, X and I end the period slightly below their initial values at -6.04%, -0.76% and -3.99%, respectively, being drawn down by the bad performance of the short portfolios. This can also be seen, when analysing the quarterly performance benchmarked against the indices in the following table:

Table 18: Quarterly performance benchmarking

The following table illustrates the quarterly development of all portfolios and the three benchmarks used in the graphical benchmarking. The portfolio number is the same used in the regressions and the description of the strategy is added for convenience. Beginning and ending of the measurement is identical to the graphical outline.

Portfolio Nr.	Beginning of Benchmarking	End of Benchmarking	Quarterly Performance (Period following)											Total Performance
			Q1/2018	Q2/2018	Q3/2018	Q4/2018	Q1/2019	Q2/2019	Q3/2019	Q4/2019	Q1/2020	Q2/2020	Q3/2020	
Russell 2000	23.04.2018	02.03.2021	8,06%	-5,76%	-12,25%	9,27%	-1,20%	-1,29%	9,50%	-20,78%	25,98%	11,27%	19,05%	42,41%
Stoxx Europe 600	23.04.2018	02.03.2021	1,12%	-9,05%	-5,66%	11,41%	1,80%	1,92%	9,37%	-18,30%	8,77%	-6,62%	13,83%	7,41%
Sample	23.04.2018	02.03.2021	6,30%	-3,74%	-7,34%	12,15%	3,41%	1,77%	16,63%	-11,30%	22,19%	1,92%	16,05%	59,97%
I	23.04.2018	24.02.2021	4,97%	-10,05%	1,17%	0,84%	3,32%	-1,19%	-0,57%	-8,45%	8,15%	0,95%	-1,76%	-3,99%
II	23.04.2018	19.02.2021	7,58%	-21,05%	5,56%	9,02%	6,14%	-0,44%	0,45%	-25,26%	24,60%	6,31%	11,17%	14,18%
III	23.04.2018	24.02.2021	2,36%	0,73%	-3,41%	-7,33%	0,50%	-1,95%	-1,58%	8,36%	-8,31%	-4,20%	-14,68%	-27,31%
IV	23.04.2018	24.02.2021	5,31%	-5,26%	1,26%	0,69%	10,28%	-1,45%	-0,18%	-6,05%	13,91%	3,35%	6,42%	29,88%
V	23.04.2018	19.02.2021	9,77%	-11,72%	3,11%	4,90%	17,02%	2,23%	3,43%	-22,04%	29,12%	11,41%	18,02%	71,66%
VI	23.04.2018	24.02.2021	0,85%	1,16%	-0,64%	-3,51%	3,54%	-5,14%	-3,79%	9,94%	-1,31%	-4,17%	-5,18%	-8,88%
VII	23.04.2018	02.03.2021	3,94%	-3,35%	-4,58%	-2,55%	4,06%	-1,44%	1,18%	-3,91%	8,14%	-0,04%	-6,68%	-6,04%
VIII	23.04.2018	01.03.2021	4,15%	-5,54%	-3,04%	1,78%	5,22%	2,74%	-0,04%	-23,58%	22,67%	4,54%	-0,04%	2,77%
IX	23.04.2018	02.03.2021	3,73%	-0,35%	-6,13%	-6,88%	3,95%	-5,62%	2,40%	15,76%	-6,39%	-4,62%	-13,32%	-18,67%
X	23.04.2018	02.03.2021	6,97%	-4,02%	-2,48%	-5,04%	7,33%	-1,32%	0,95%	-6,99%	11,74%	-0,01%	-6,06%	-0,76%
XI	23.04.2018	01.03.2021	12,46%	-3,99%	-2,35%	-1,56%	10,87%	3,65%	-0,94%	-23,87%	27,01%	2,28%	-2,01%	14,51%
XII	23.04.2018	02.03.2021	1,47%	-3,60%	-2,61%	-8,53%	3,28%	-6,30%	2,85%	9,89%	-3,53%	-2,30%	-10,11%	-19,24%

Whereas the Russell 2000 index and the Stoxx Europe 600 had to suffer from severe drawdowns following the quarterly announcement dates for Q4/2019 due to the outbreak of the Covid19-pandemic in the beginning of 2020, the portfolios I, IV, VII and X managed to remain fairly stable, caused by the influence of the shorted stocks in the sample. The declines amounted to -6.05%, -8.45%, -6.99% and -3.91%. However, especially the equal weighted portfolios lagged behind the benchmarks during the following periods of recovery in the stock market, and also in the period following Q4/2018, when the overall stock market performed very well.

The long-only portfolios, on the other hand, underperformed the indices during the period following Q4/2019 announcements. The negative performance resulted in -23.58% for portfolio VIII, -23.87% for portfolio XI, -25.26% for portfolio II, and -22.04% for portfolio V. During the same time, the Russell 2000 lost 20.78% in value, while the Stoxx Europe 600 declined by 18.30%. Across the whole benchmarking, the sample was able to reach the best performance by far, when comparing long-only portfolios and indices, solely losing 11.30% in value.

Overall, the portfolios with a combination of a long and short strategy showed a much lower volatility than the indices and the portfolios focusing on only one strategy, which was beneficial in times of crisis, but an impediment to the stock price development during times, when the index development was very favourable. This is clearly outlined when comparing the risk measures. The portfolios VII, X, I and IV show the lowest standard deviations, while having a

less severe maximum drawdown than all other portfolios and a lower daily value at risk. However, the Sharpe ratio, measuring the quality of a return by dividing the excess return by the volatility of a portfolio, clearly support the statistical regression output, revealing that the sample yielded the highest return quality. A thorough overview over the risk measures can be found in appendix 14. However, these will not be discussed in more detail since they only serve a brief illustration of the performance of the portfolios.

5. Analysis

5.1 Results interpretation and alpha generation

First, the summary statistics deliver mixed results, when looking at the relation between currency growth and subsequent stock returns. While the quarterly statistics clearly indicate, that after periods of overall negative currency effects, stock were able to increase in value, and vice versa, the country distribution rather indicates that there is no specific or even a positive relation between the two variables. But then again, the correlation matrices support hypothesis H_1.

When looking at the overall regression results of the samples, however, hypothesis H_1 must eventually be rejected, since there is no indication that positive reported currency growth can lead to an underperformance and vice versa. This is valid for the reported growth itself and also when set into relation to total growth, since the coefficient is only marginally negative and statistically insignificant. This implies that there either has never been an overreaction solely attributable to currency effects on the announcement day, or this overreaction tends to persist across the observed horizon.

Analysing the portfolio returns, the Fama-French (1993) three factor model was designed to capture the general market premium, size premium and valuation premium, which combined are constructed to determine stock returns. Hence, generating alpha through a specific factor is to be considered difficult as the Fama-French (1993) model is already robust. Adding to this issue, the sample was compiled during a period of mainly favourable market conditions, causing gains in all major indices during the period (seen in graph 8), including unprecedently low interest rates especially for the Eurozone (appendix 15), monetary expansion and global GDP growth. Even though market shocks like the Covid19-pandemic occurred during that period, the overall market performance was strong. This potentially explains why especially the short portfolios delivered such a poor performance during the horizon of three years, with no positive significant alpha generation and a few quarters with significant negative alpha.

The market environment also impacted the combined long-short portfolios with the short part of the portfolios negatively impacting the overall portfolio performance. Performance was thus kept low during periods of market expansion, but the long-short combination also restricted losses during the impact from Covid19. This resulted in negative alpha generation for all combined long-short portfolios except portfolio IV. However, even portfolio IV did not generate statistically significant positive alpha compared with the benchmark Stoxx Europe

600, which is the worst performing benchmark out of the three applied ones. For the Fama-French and sample benchmarks, portfolio IV generated minor negative alpha like the rest of long-short portfolios. The low volatility, which is detailed in the volatility factors shown in appendix 14, but also expressed by the economically low, but statistically significant *Mkt-Rf* factor for the combined portfolios, therefore acts as a limitation on the returns of the portfolios. The market premium in all long-short combinations is lower than one, meaning that, compared to any market premium, it is lower, probably due to a lower volatility.

Interestingly, even the portfolios merely created with long-purchased stocks did not create significant alpha in most cases. Only portfolio V was able to outperform the Stoxx Europe 600 index at a 5% significance level. Furthermore, the portfolios II and V managed to generate positive yet insignificant alpha in the Fama French market model, and portfolio II generated insignificant alpha compared to the Stoxx Europe. The portfolios VIII and XI did not generate negative alpha, when compared to the Stoxx Europe, but when being compared to the other two indices. Benchmarked against the sample, which they were extracted from, all portfolios generated negative alpha, being even significant for portfolio II. This supports the argument that it is not possible to outperform with a strategy based on currency effects, since not only companies benefitting from currency movements did not reveal alpha when being shorted, but also companies being punished by unfavourable exchange rate developments did not return any alpha over their own sample benchmark even in times of very favourable stock market conditions. This indicates that the hypothesis H_2 can strongly be rejected. Such arguments are supported by the investor distraction hypothesis with limited investor attention (Hirshleifer & Teoh, 2003; 2005; DellaVigna & Pollet, 2009; Hirshleifer, Lim & Teoh, 2009).

Summed up, neither the whole sample regressions nor the portfolio regressions generated statistically significant results. Therefore, H_1 and H_2 are rejected, implying that stock prices do not correct for initial overreaction after companies having announced revenue growth impacted by positive or negative currency effects or they immediately incorporate the correct growth from operations. This adds unique findings to existing theories in the literature mainly regarding investor attention (Hirshleifer & Teoh, 2003; 2005; DellaVigna & Pollet, 2009; Hirshleifer, Lim & Teoh, 2009) and efficient markets, which will be analysed in following subsection.

5.2 Implications

Based on theoretical arguments (Ball, 1996; Campbell, Lo & MacKinlay, 1997; Lo, 2004; Lim & Brooks, 2011), the stock market could be expected to be close to perfect efficiency, which implies that the market is efficiently incorporating the new organic growth adjusted for currency effects immediately, which is not captured by the portfolio construction methodology. Furthermore, it is also possible that currency effects were not incorporated in the first reaction, but subsequently on the announcement day t=0, which would also imply a very strong stock market efficiency. The intra-day patterns on t=0 could be subject to further research investigating currency effects.

Alternatively, the currency effects on new organic growth could not be incorporated at all or only weakly, which would lead to inaccurate assumptions in a discounted cash flow valuation. Organic revenue growth assumptions including inflated or deflated non-adjusted inputs may therefore persist in line with limited investor attention arguments by Hirshleifer and Teoh (2003; 2005). An argument speaking in that favour is the portfolios on reported currency growth performing better than the other portfolios compiled on currency growth as a share of total growth. It is clearly visible that only portfolio IX performs better than its respective portfolio compiled on reported currency growth, portfolio II. The regressions confirm this graphical illustration, showing that the portfolios IV, V and VI consistently outperform the portfolios X, XI and XII. This is also valid for portfolio I and II compared to VII and VIII, with the exception of the sample benchmark, where they had a slightly lower performance.

This indicates that the market participants indeed subsequently incorporate currency effects into better reflections of intrinsic value, albeit on a superficial basis. Seemingly, investors merely interpret the reported currency growth effect, and do not relate it to the company's overall revenue growth. This is also in line with theoretical predictions of limited investor attention (Hirshleifer & Teoh, 2003; 2005; DellaVigna & Pollet, 2009; Hirshleifer, Lim & Teoh, 2009), which restricts investors to the basic revelations, and further measures will not be set into any relation to other metrics such as growth. However, the outperformance of the portfolios compiled on reported currency growth compared to the currency growth as share of total growth portfolios could also be random, as even a majority of those do not outperform any benchmark, and the whole sample regressions convey a positive effect for the reported currency growth sample's currency effects on stock returns.

Moreover, there is no clear research consensus on intrinsic value inputs in actual financial markets (Campbell, 1991; Ang & Bekaert, 2007; Binsbergen & Koijen, 2010; McLean & Pontiff, 2016), and there is a high degree of general opaqueness around the reporting of currency effects.

There currently is no clear guideline on how to implement currency effects into quarterly and annual reports by legal authorities and, consequently, each firm, if at all, reports them in a different manner. The ways the firms which were scrutinized for this paper reported currency effects reached from reported currency growth to currency growth as share of total growth impacts, to just a brief comment on if they had a positive or negative impact on revenues to not mentioning them at all. Even those companies, which were extensive in reporting the effects, focused on their implementation into qualitative sections and argumentation, and only few firms really incorporated them into their financial statements, or even created the income statement using constant currencies. Hence, incorporating and adjusting growth expectations in the discounted cash flow valuation framework detailed by Koller, Goedhart and Wessels (2020), as well as other reporting metrics such as net income and expected dividends, may be difficult due to the opaqueness of locating the relevant information about currency effects.

Both arguments lead to the assumption that the stock market efficiency around currency effects is rather weak. Based on the argumentation above, as demonstrated by Hirshleifer and Teoh (2003; 2005), investors may disregard economically relevant aspects of financial reports, while solely focusing on visible key metrics emphasized by the firms themselves in their announcements. This could also be a result from different reporting formats (Hirshleifer & Teoh, 2003), which appear especially relevant due to the opaqueness and lack of visibility of the currency effects reporting.

Additionally, general market noise and differences in reactions to corporate news may impact the investors perception and ability to adjust currency effects (Grossman & Stiglitz, 1976; DellaVigna & Pollet, 2009; Hirshleifer & Teoh, 2003; 2005). In contrast to DellaVigna and Pollet (2009), and Hirshleifer, Lim and Teoh (2009), the portfolios in this paper do not generate statistically significant alpha and investor attention therefore appeared to remain limited, ignoring reported currency effects throughout the period following a quarterly announcement.

Beyond the results on stock market efficiency and investor attention, the results show clearly, that portfolios compiled on market capitalization perform better than equal weighted portfolios. This is interesting, since it in in sharp contrast to both the size premium in the Fama-French

(1993) three factor model and related research such as that of Banz (1981), Reinganum (1981), and Dhatt, Kim, and Mukherji (1999). These theories and models overall predict that smaller market size is a factor of increased returns compared to larger firms. This indicates that large companies had a better stock price performance over the observed horizon, which also potentially explains the outperformance of the Russell 2000 and the Stoxx Europe 600 over most portfolios since they are not compiled on an equal-weighted basis either.

6. Summary and conclusion

The stated purpose of this study was to investigate how the market interpret currency effects on revenue, and if a portfolio strategy can be set up to profit from correction of assumed initial overreactions. Therefore, two hypotheses were constructed on the theoretical basis of the efficient market hypothesis and limited investor attention serving as a violation of it. Growth was expected to be irrationally incorporated into projections by market participants and, thus, misinterpreted, which would serve as support to the theories of limited investor attention and another violation of the efficient market hypothesis. Thus, the hypotheses can be summarized as follows:

- H_1: The assumed initial overreaction on reported growth will subsequently be corrected when more market participants realise currency effects on growth.
- H_2: It is possible to outperform the market by compiling portfolios betting on the corrections of initial overreactions in stock prices following a misinterpretation of growth projections.

Whereas the overall sample was analysed using summary statistics and a statistical regression with *Stock return* as the dependent and *Currency growth* as the main independent variable to investigate H_1, portfolios compiled from companies exposed to extreme currency effects on their revenue growth were used to investigate hypothesis H_2. The portfolios were then regressed using the Fama-French (1993) three-factor model to find any outperformance, called alpha, going beyond the one explainable by these three factors. Alpha, thus, described the constant of the regressions, being the residual stock return over the market premium, the value premium and the size premium.

Across the sample, no systematic correction to an assumed prior overreaction was found, and, thus, hypothesis H_1 was rejected in our analysis. Since the portfolios mostly underperformed their benchmarks and no statistically significant outperformance could be found, this hypothesis H_2 also had to be rejected. This leaves us with the following conclusions:

To begin with, it is highly unclear if the market participants ever misinterpret currency related growth in the very beginning, as our empirical findings suggest otherwise. This would lead us to assume a very strong market efficiency. If it is incorporated, however, it is expected to not be corrected in the following period, and market participants simply continue to misinterpret the quarterly growth until new information is presented in the form of the next quarterly release.

Supporting that view, the reporting of currency effects on revenue is extremely opaque, the original selected indices had an attrition rate of 40%, with the firms reporting currency effects in a multitude of ways. As Jankensgård et al. (2020) note, reported currency effects can both be presented too simply and too complex. We find this to be the case, since the firms reporting currency growth use a variety of methods and wording for their presentation, ranging from a transparent and structured to a merely qualitative, opaque, or even reluctant manner.

This is especially interesting given limited investor attention theories, as several papers suggest that market participants may disregard economically relevant information completely (Hirshleifer and Teoh, 2003; 2005). Finally, the findings could imply a subsequent, but weak incorporation of currency related growth, mainly based on the observation that reported currency growth portfolios generate better returns than portfolios constructed on currency growth as share of total growth. This leads us to the conclusion that market efficiency is very weak and not very strong.

Our paper was the first to examine possible overreactions around the reporting of quarterly financial statements, originating from the wrong interpretation of growth related to positive or negative currency. Owed to the complexity and the only recent enhancement efforts in reporting, the sample size of our study is limited in nature. The time period is also short, capturing 11 quarters between 2018 and 2020. This opens up many possibilities for further research to enrich the literature around growth reporting and the incorporation of currency effects by the market. Since in this study, initial overreactions are only assumed, intra-day analyses could focus on measuring these potential overreactions on the announcement day and try to categorize them.

As previously stated, we expect a variety of factors driving stock returns on the announcement day, with the overreaction on growth partly being impacted by currency effects being only one of those. However, there may be possibilities to observe specific intra-day patterns and assign those to metrics to find the occurrence and degree of the overreaction to assess stock market efficiency regarding the treatment of currency-related growth.

Furthermore, it is up to further research to increase the sample size as well as the observation period. As more and more firms have been starting to report currency effects on revenue in their quarterly financial statements and proactively communicate them, the sample attrition is expected to become smaller, which enables future research to use longer time frames as well as larger samples for their investigations. Finally, enhancing the analysis to other financial

metrics such as operating profit or net income and their currency impacts will lead to findings adding evidence to the literature.

Finally, this paper is restricted to one methodology using portfolios, which seek to generate and outperformance over a subsequent quarter. There are plenty of opportunities to add types of investigations to this topic, such as sensitivity analyses or seasonal patterns over time. We can still see a research gap regarding those methods, and it would be value adding to conduct studies accordingly. For now, this paper has given first insights into trading behaviour and potential corrections of overreactions investigating companies extremely impacted by currency growth, and thus entered another area of research. The findings are very clear towards assuming no overreaction, or at least no correction of that, and serve as a good starting point for future research.

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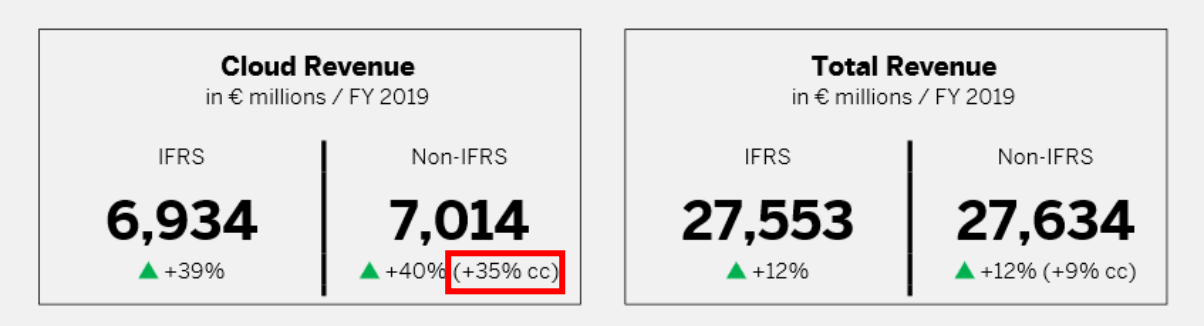
Appendix

Appendix 1: Currency reporting for SAP, extracted from the SAP quarterly report Q4/2019



Appendix 2: Currency reporting for Husqvarna, extracted from the Husqvarna quarterly report Q1/2019

Group SEKm	Q1 2019	Q1 2018	Change, %	LTM*	Jan-Dec 2018
Net sales	13,651	12,303	11	42,433	41,085
Currency adjusted change, %*	*4*	*-1*	-	-	*2*
Operating income	1,644	1,373	20	2,341	2,070
*Excl. items affecting comparability**	*1,686*	*1,373*	*23*	*3,554*	*3,241*
Operating margin, %	*12.0*	*11.2*	-	*5.5*	*5.0*
*Excl. items affecting comparability**	*12.3*	*11.2*	-	*8.4*	*7.9*
Income for the period	1,140	940	21	1,413	1,213
Earnings per share after dilution, SEK	1.99	1.64	21	2.47	2.12
Net sales, Divisions					

Appendix 3: Complete sample

Country	Firm Name	Country	Firm Name	Country	Firm Name	Country	Firm Name
Sweden	AAK	Sweden	Ericsson	Denmark	GN Store Nord	Norway	Kongsberg Gruppen
Sweden	ABB	Sweden	Essity	Denmark	ISS	Norway	Leroy Seafood Group
Sweden	Addtech	Sweden	Evolution Gaming group	Denmark	Jyske Bank	Norway	Mowi
Sweden	Ahlstrom-Munksjo	Sweden	Fast. Balder	Denmark	Lundbeck	Norway	Nordic Semiconductor
Sweden	Alfa Laval	Sweden	Getinge	Denmark	Netcompany Group	Norway	Lav Thon Eiendomsselskap
Sweden	Arjo	Sweden	Handelsbanken	Denmark	Novo Nordisk	Norway	Orkla
Sweden	Assa Abloy	Sweden	Hennes & Mauritz	Denmark	Novozymes	Norway	Scatec
Sweden	AstraZeneca	Sweden	Hexagon	Denmark	Pandora	Norway	Schibsted
Sweden	Atlas Copco	Sweden	Hexpol	Denmark	Rockwool Int.	Norway	Telenor
Sweden	Autoliv	Sweden	Holmen	Denmark	Scandinavian Tobacco Group	Norway	Tomra Systems
Sweden	Betsson	Sweden	Husqvarna	Denmark	SimCorp	Norway	Veidekke
Sweden	BillerudKorsnas	Sweden	ICA Gruppen	Denmark	Tryg	Norway	Yara International
Sweden	Bravida	Sweden	Indutrade	Denmark	Vestas Wind Systems	Finland	Citycon
Sweden	Bure Equity	Sweden	Intrum	Denmark	ossur	Finland	Elisa
Sweden	Castellum	Sweden	JM	Norway	Atea	Finland	Huhtamaki
Sweden	Catena	Sweden	Kindred	Norway	Austevoll Seafood	Finland	Kemira
Sweden	Dometic	Sweden	Klovern	Finland	Kone	Germany	HeidelbergCement
Sweden	Electrolux	Sweden	Kungsleden	Finland	Konecranes	Germany	Henkel
Sweden	Elekta	Sweden	Latour	Finland	Metso Outotec	Germany	Linde
Sweden	Epiroc	Sweden	Lifco	Finland	Metsa Board	Germany	Merck
Sweden	Loomis	Sweden	SKF	Finland	Neles	Germany	RWE
Sweden	Lundbergforetagen	Sweden	SSAB	Finland	Nokia	Germany	SAP
Sweden	Lundin Energy	Sweden	Stora Enso	Finland	Nokian Renkaat	Germany	Siemens
Sweden	Medicover	Sweden	Sweco	Finland	Valmet	Germany	Volkswagen
Sweden	Mycronic	Sweden	Swedbank	Finland	Wartsila	Germany	Airbus
Sweden	Nibe	Sweden	Swedish Match	Finland	YIT	Germany	Alstria office REIT
Sweden	Nobia	Sweden	Swedish Orphan Biovitrum	Germany	Adidas	Germany	Aroundtown
Sweden	Nordea	Sweden	Tele2	Germany	Bayer	Germany	Aurubis
Sweden	Pandox	Sweden	Telia Company	Germany	Continental	Germany	Bechtle
Sweden	Peab	Sweden	Thule Group	Germany	Covestro	Germany	Brenntag
Sweden	Ratos	Sweden	TietoEVRY	Germany	Daimler	Germany	Cancom
Sweden	SAAB	Sweden	Trelleborg	Germany	Delivery Hero	Germany	Carl Zeiss Meditec
Sweden	Samhallsbyggnadsbolaget i Norden	Sweden	Veoneer	Germany	Deutsche Telekom	Germany	Durr
Sweden	Sandvik	Sweden	Vitrolife	Germany	Deutsche Wohnen	Germany	Encavis
Sweden	SCA	Sweden	Volvo	Germany	Fresenius Medical Care	Germany	Evonik
Sweden	SEB	Sweden	aF Poyry	Germany	Fresenius	Germany	Evotec
Sweden	Sectra	Denmark	A.P. Moller - Mærsk	Germany	Fuchs petrolub	Germany	Qiagen
Sweden	Securitas	Denmark	ALK-Abelló	Germany	Hannover Ruck	Germany	Rational
Sweden	Sinch	Denmark	Ambu	Germany	Hella	Germany	Rheinmetall
Sweden	Skanska	Denmark	Chr. Hansen Holding	Germany	Lanxess	Germany	Siemens Healthineers
Denmark	Coloplast	Norway	Bakkafrost	Germany	LEG Immobilien	Germany	Software
Denmark	Demant	Norway	Equinor	Germany	Nemetschek	Germany	Symrise
Denmark	DSV Panalpina	Norway	Frontline	Germany	ProSiebenSat1 Media	Germany	Thyssenkrupp
Denmark	FLSmidth & Co	Norway	Gjensidige Forsikring	Germany	Puma	Germany	Wacker Chemie

Appendix 4: Portfolios on reported currency growth

Period following	Strategy	Firm Name	Period following	Strategy	Firm Name	Period follov	Strategy	Firm Name
Q118	Long	Neles	Q119	Long	TietoEVRY	Q120	Long	Volkswagen
Q118	Long	Novozymes	Q119	Long	Veoneer	Q120	Long	Citycon
Q118	Long	Fresenius Medical Care	Q119	Long	ossur	Q120	Long	RWE
Q118	Long	Scandinavian Tobacco Group	Q119	Long	Linde	Q120	Long	Medicover
Q118	Long	Novo Nordisk	Q119	Long	Qiagen	Q120	Long	Schibsted
Q118	Long	Nokia	Q119	Long	Kindred	Q120	Long	Bakkafrost
Q118	Long	Delivery Hero	Q119	Long	Chr. Hansen Holding	Q120	Long	A.P. Moller - Mærsk
Q118	Long	Henkel	Q119	Long	AstraZeneca	Q120	Long	Hella
Q118	Long	SAP	Q119	Long	Carl Zeiss Meditec	Q120	Long	Linde
Q118	Long	Metso Outotec	Q119	Long	Lundbeck	Q120	Long	Vestas Wind Systems
Q118	Short	Loomis	Q119	Short	Volvo	Q120	Short	Tele2
Q118	Short	Qiagen	Q119	Short	Swedish Match	Q120	Short	Telenor
Q118	Short	Pandox	Q119	Short	Pandox	Q120	Short	Orkla
Q118	Short	Tele2	Q119	Short	Hexpol	Q120	Short	Atea
Q118	Short	RWE	Q119	Short	Swedish Orphan Biovitrum	Q120	Short	Dometic
Q118	Short	AstraZeneca	Q119	Short	Getinge	Q120	Short	Austevoll Seafood
Q118	Short	Lifco	Q119	Short	Elekta	Q120	Short	Kongsberg Gruppen
Q118	Short	Pandora	Q119	Short	SSAB	Q120	Short	Pandox
Q118	Short	Orkla	Q119	Short	Dometic	Q120	Short	Telia Company
Q118	Short	ossur	Q119	Short	Mycronic	Q120	Short	Tomra Systems
Q218	Long	Fresenius Medical Care	Q219	Long	ABB	Q220	Long	TietoEVRY
Q218	Long	Ambu	Q219	Long	Mowi	Q220	Long	Austevoll Seafood
Q218	Long	Neles	Q219	Long	Veoneer	Q220	Long	Epiroc
Q218	Long	Delivery Hero	Q219	Long	ossur	Q220	Long	FLSmidth & Co
Q218	Long	RWE	Q219	Long	Linde	Q220	Long	Lifco
Q218	Long	Henkel	Q219	Long	Aroundtown	Q220	Long	Bure Equity
Q218	Long	Metso Outotec	Q219	Long	Qiagen	Q220	Long	Kongsberg Gruppen
Q218	Long	Novo Nordisk	Q219	Long	Arjo	Q220	Long	Aroundtown
Q218	Long	Huhtamaki	Q219	Long	AstraZeneca	Q220	Long	Schibsted
Q218	Long	Symrise	Q219	Long	RWE	Q220	Long	Autoliv
Q218	Short	Pandox	Q219	Short	Hennes & Mauritz	Q220	Short	SCA
Q218	Short	SCA	Q219	Short	Swedish Orphan Biovitrum	Q220	Short	Pandox
Q218	Short	ABB	Q219	Short	Telia Company	Q220	Short	Tomra Systems
Q218	Short	Vitrolife	Q219	Short	Hexpol	Q220	Short	Telenor
Q218	Short	Loomis	Q219	Short	aF Poyry	Q220	Short	Atea
Q218	Short	Bure Equity	Q219	Short	Swedish Match	Q220	Short	Carl Zeiss Meditec
Q218	Short	ALK-Abelló	Q219	Short	Getinge	Q220	Short	Metsa Board
Q218	Short	Scandinavian Tobacco Group	Q219	Short	Dometic	Q220	Short	Telia Company
Q218	Short	Intrum	Q219	Short	Bure Equity	Q220	Short	Orkla
Q218	Short	AstraZeneca	Q219	Short	Skanska	Q220	Short	Kindred
Q318	Long	Ambu	Q319	Long	Yara International	Q320	Long	Securitas
Q318	Long	Hella	Q319	Long	Aroundtown	Q320	Long	Electrolux
Q318	Long	Scatec	Q319	Long	AstraZeneca	Q320	Long	Essity
Q318	Long	Chr. Hansen Holding	Q319	Long	Linde	Q320	Long	Epiroc
Q318	Long	Metso Outotec	Q319	Long	ossur	Q320	Long	Sandvik
Q318	Long	Neles	Q319	Long	Pandox	Q320	Long	Bayer
Q318	Long	Rheinmetall	Q319	Long	ABB	Q320	Long	Elekta
Q318	Long	Telia Company	Q319	Long	Veoneer	Q320	Long	Betsson
Q318	Long	Tele2	Q319	Long	A.P. Moller - Mærsk	Q320	Long	FLSmidth & Co
Q318	Long	Adidas	Q319	Long	TietoEVRY	Q320	Long	AAK
Q318	Short	Pandox	Q319	Short	RWE	Q320	Short	Pandox
Q318	Short	Elekta	Q319	Short	Electrolux	Q320	Short	Bakkafrost
Q318	Short	Scandinavian Tobacco Group	Q319	Short	Epiroc	Q320	Short	Atea
Q318	Short	Hexpol	Q319	Short	HeidelbergCement	Q320	Short	Veidekke
Q318	Short	Thule Group	Q319	Short	Loomis	Q320	Short	Orkla
Q318	Short	Swedish Orphan Biovitrum	Q319	Short	Telenor	Q320	Short	Telia Company
Q318	Short	Ericsson	Q319	Short	Atlas Copco	Q320	Short	Tomra Systems
Q318	Short	SKF	Q319	Short	Telia Company	Q320	Short	Hennes & Mauritz
Q318	Short	Trelleborg	Q319	Short	Volvo	Q320	Short	Veoneer
Q318	Short	Vitrolife	Q319	Short	Skanska	Q320	Short	Telenor
Q418	Long	Chr. Hansen Holding	Q419	Long	Nordea			
Q418	Long	Metso Outotec	Q419	Long	ALK-Abelló			
Q418	Long	Scandinavian Tobacco Group	Q419	Long	TietoEVRY			
Q418	Long	Aroundtown	Q419	Long	Lifco			
Q418	Long	Puma	Q419	Long	Pandox			
Q418	Long	Telia Company	Q419	Long	Tele2			
Q418	Long	Hella	Q419	Long	ossur			
Q418	Long	Novo Nordisk	Q419	Long	Linde			
Q418	Long	Henkel	Q419	Long	Citycon			
Q418	Long	Neles	Q419	Long	Catena			
Q418	Short	Pandox	Q419	Short	Essity			
Q418	Short	Dometic	Q419	Short	Nemetschek			
Q418	Short	Bure Equity	Q419	Short	Volvo			
Q418	Short	Hexpol	Q419	Short	RWE			
Q418	Short	SSAB	Q419	Short	Vitrolife			
Q418	Short	Thule Group	Q419	Short	Getinge			
Q418	Short	Rheinmetall	Q419	Short	Telia Company			
Q418	Short	Swedish Orphan Biovitrum	Q419	Short	Skanska			
Q418	Short	Sinch	Q419	Short	Tomra Systems			
Q418	Short	Elekta	Q419	Short	SKF			

Appendix 5: Portfolios compiled on currency growth as a share of total growth

Period following	Strategy	Firm Name	Period following	Strategy	Firm Name	Period following	Strategy	Firm Name
Q118	Long	SAP	Q119	Long	Nordea	Q120	Long	Kone
Q118	Long	Brenntag	Q119	Long	Qiagen	Q120	Long	A.P. Moller - Mærsk
Q118	Long	Wacker Chemie	Q119	Long	Citycon	Q120	Long	Metso Outotec
Q118	Long	Merck	Q119	Long	ossur	Q120	Long	Henkel
Q118	Long	ISS	Q119	Long	Nokian Renkaat	Q120	Long	RWE
Q118	Long	Kemira	Q119	Long	TietoEVRY	Q120	Long	Linde
Q118	Long	AAK	Q119	Long	Chr. Hansen Holding	Q120	Long	Citycon
Q118	Long	DSV Panalpina	Q119	Long	Kongsberg Gruppen	Q120	Long	FLSmidth & Co
Q118	Long	Ahlstrom-Munksjo	Q119	Long	Kindred	Q120	Long	Schibsted
Q118	Long	Symrise	Q119	Long	AstraZeneca	Q120	Long	ossur
Q118	Short	Pandora	Q119	Short	Daimler	Q120	Short	Trelleborg
Q118	Short	Lundbergforetagen	Q119	Short	Merck	Q120	Short	ProSiebenSat1 Media
Q118	Short	Holmen	Q119	Short	Novozymes	Q120	Short	Tele2
Q118	Short	Tele2	Q119	Short	Novo Nordisk	Q120	Short	Carl Zeiss Meditec
Q118	Short	AstraZeneca	Q119	Short	Nokia	Q120	Short	Hexpol
Q118	Short	ossur	Q119	Short	SKF	Q120	Short	Pandox
Q118	Short	Arjo	Q119	Short	Wacker Chemie	Q120	Short	Atea
Q118	Short	Loomis	Q119	Short	Dometic	Q120	Short	Brenntag
Q118	Short	RWE	Q119	Short	Skanska	Q120	Short	Austevoll Seafood
Q118	Short	Pandox	Q119	Short	Vestas Wind Systems	Q120	Short	Ericsson
Q218	Long	Siemens Healthineers	Q219	Long	Nordea	Q220	Long	Kongsberg Gruppen
Q218	Long	Kone	Q219	Long	Qiagen	Q220	Long	ALK-Abelló
Q218	Long	ISS	Q219	Long	RWE	Q220	Long	Wartsila
Q218	Long	Merck	Q219	Long	Jyske Bank	Q220	Long	RWE
Q218	Long	Henkel	Q219	Long	Austevoll Seafood	Q220	Long	Tryg
Q218	Long	Software	Q219	Long	Pandox	Q220	Long	Metso Outotec
Q218	Long	Novozymes	Q219	Long	ABB	Q220	Long	Ratos
Q218	Long	Neles	Q219	Long	ossur	Q220	Long	Schibsted
Q218	Long	Huhtamaki	Q219	Long	TietoEVRY	Q220	Long	Tele2
Q218	Long	Fresenius	Q219	Long	Veoneer	Q220	Long	Elekta
Q218	Short	Pandora	Q219	Short	AAK	Q220	Short	Tomra Systems
Q218	Short	Mowi	Q219	Short	SKF	Q220	Short	Telia Company
Q218	Short	Vitrolife	Q219	Short	Dometic	Q220	Short	Metsa Board
Q218	Short	AstraZeneca	Q219	Short	Electrolux	Q220	Short	Veidekke
Q218	Short	Veoneer	Q219	Short	Sandvik	Q220	Short	Kindred
Q218	Short	Bure Equity	Q219	Short	Epiroc	Q220	Short	Telenor
Q218	Short	ALK-Abelló	Q219	Short	Telia Company	Q220	Short	Orkla
Q218	Short	Holmen	Q219	Short	Scandinavian Tobacco Group	Q220	Short	Atea
Q218	Short	Loomis	Q219	Short	Brenntag	Q220	Short	Latour
Q218	Short	Scandinavian Tobacco Group	Q219	Short	Telenor	Q220	Short	Ericsson
Q318	Long	Chr. Hansen Holding	Q319	Long	A.P. Moller - Mærsk	Q320	Long	Arjo
Q318	Long	ISS	Q319	Long	Yara International	Q320	Long	Fresenius Medical Care
Q318	Long	Novo Nordisk	Q319	Long	Qiagen	Q320	Long	Indutrade
Q318	Long	Henkel	Q319	Long	Citycon	Q320	Long	Ahlstrom-Munksjo
Q318	Long	ProSiebenSat1 Media	Q319	Long	Nordea	Q320	Long	Fresenius
Q318	Long	Nokia	Q319	Long	TietoEVRY	Q320	Long	Ericsson
Q318	Long	Siemens Healthineers	Q319	Long	Rockwool Int.	Q320	Long	Henkel
Q318	Long	Hella	Q319	Long	Pandox	Q320	Long	AAK
Q318	Long	Rheinmetall	Q319	Long	Kindred	Q320	Long	Epiroc
Q318	Long	Siemens	Q319	Long	Aroundtown	Q320	Long	Electrolux
Q318	Short	Hexpol	Q319	Short	Lanxess	Q320	Short	A.P. Moller - Mærsk
Q318	Short	Sectra	Q319	Short	Henkel	Q320	Short	Kongsberg Gruppen
Q318	Short	Scandinavian Tobacco Group	Q319	Short	SKF	Q320	Short	ProSiebenSat1 Media
Q318	Short	Trelleborg	Q319	Short	SSAB	Q320	Short	Telia Company
Q318	Short	Ericsson	Q319	Short	Dometic	Q320	Short	Encavis
Q318	Short	Electrolux	Q319	Short	Telia Company	Q320	Short	Tomra Systems
Q318	Short	Elekta	Q319	Short	Epiroc	Q320	Short	Telenor
Q318	Short	Pandox	Q319	Short	Brenntag	Q320	Short	Atea
Q318	Short	Essity	Q319	Short	Nokian Renkaat	Q320	Short	Veidekke
Q318	Short	Thule Group	Q319	Short	Hexagon	Q320	Short	ossur
Q418	Long	Henkel	Q419	Long	TietoEVRY			
Q418	Long	AstraZeneca	Q419	Long	Citycon			
Q418	Long	Hella	Q419	Long	Tele2			
Q418	Long	Orkla	Q419	Long	Lifco			
Q418	Long	Konecranes	Q419	Long	Novozymes			
Q418	Long	Fuchs petrolub	Q419	Long	Kemira			
Q418	Long	Scandinavian Tobacco Group	Q419	Long	Nordea			
Q418	Long	Fresenius	Q419	Long	Catena			
Q418	Long	Citycon	Q419	Long	Rheinmetall			
Q418	Long	Lundbergforetagen	Q419	Long	HeidelbergCement			
Q418	Short	SKF	Q419	Short	SKF			
Q418	Short	Qiagen	Q419	Short	Volvo			
Q418	Short	Wacker Chemie	Q419	Short	Brenntag			
Q418	Short	Pandora	Q419	Short	Atea			
Q418	Short	Pandox	Q419	Short	BillerudKorsnas			
Q418	Short	ALK-Abelló	Q419	Short	Rockwool Int.			
Q418	Short	Getinge	Q419	Short	Nokian Renkaat			
Q418	Short	BillerudKorsnas	Q419	Short	Siemens			
Q418	Short	Ericsson	Q419	Short	Telia Company			
Q418	Short	Electrolux	Q419	Short	Nokia			

Appendix 6: Jarque-Bera Test reported currency growth sample

The Jarque-Bera test is conducted to find any indicators implying a non-normal distribution of the observations. It was conducted using 500 bootstrapping steps, and reveals the observed coefficients, the standard errors occurred during the bootstrapping, the z and the probability of z and the 95% confidence interval. The observed variables are the skewness and the kurtosis, both on unsystematic factors u and systematic factors e.

	Observed Coefficients	Bootstrap Standard errors	z	P>z	Normal-based [95% Confidence Intervall]	
Skewness_e	0.360	0.193	1.87	0.062	-0.018	0.738
Kurtosis_e	3.732	0.757	4.93	0.000	2.248	5.215
Skewness_u	1.240	0.603	2.06	0.040	0.060	2.421
Kurtosis_u	5.894	2.523	2.34	0.019	0.949	10.840
Joint test for Normality on e:			chi2(2)= 27.79		Prob > chi2 =	0.000
Joint test for Normality on u:			chi2(2)= 9.70		Prob > chi2 =	0.008

Appendix 7: Jarque Bera Test currency growth as share of total growth sample

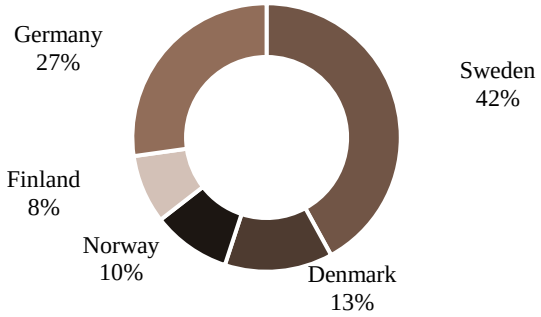
The following table shows the results of the Jarque-Bera test following the identical methodology as appendix 3, but using the observed currency growth as share of total growth and the impact in the regression. Again, the investigated variables include the skewness and the kurtosis, both on unsystematic factors u and systematic factors e. The joint test of normality eventually gives an indication of how the observations are distributed. The null is a normal distribution, and a result below 0.05 indicates that the null will be rejected.

	Observed Coefficients	Bootstrap Standard errors	z	P>z	Normal-based [95% Confidence Intervall]	
Skewness_e	0.354	0.194	1.82	0.069	-0.027	0.735
Kurtosis_e	3.760	0.760	4.95	0.000	2.270	5.248
Skewness_u	1.253	0.622	2.02	0.044	0.034	2.472
Kurtosis_u	6.113	2.650	2.31	0.021	0.919	11.306
Joint test for Normality on e:			chi2(2)= 27.80		Prob > chi2 =	0.000
Joint test for Normality on u:			chi2(2)= 9.38		Prob > chi2 =	0.009

Appendix 8: Sample country distribution

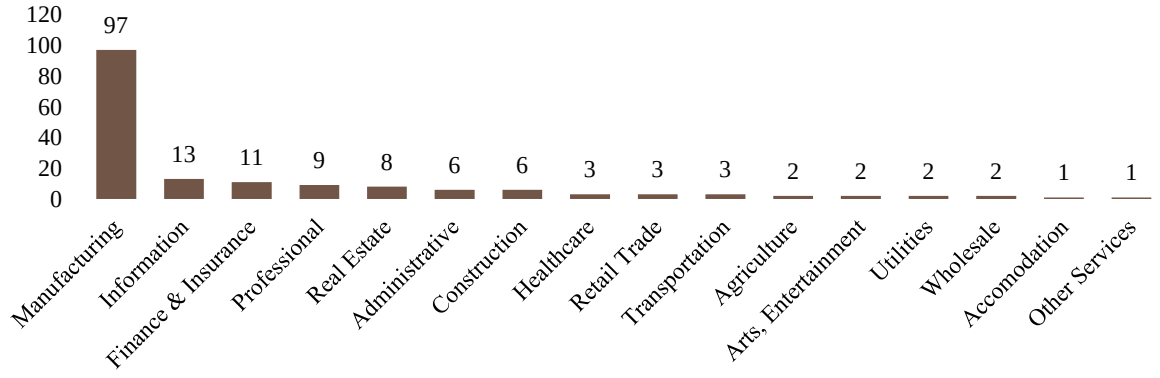
The diagram shows the distribution of companies across the whole sample. The sample consists of Swedish, German, Danish, Norwegian and Finnish companies. Swedish firms are the most prevalent ones, summing up to 71 firms, with German firms following with 46 firms. Both countries account for 42% and 27% of the sample's companies, respectively. Denmark, Finland, and Norway, represent 31% of the sample size, which can mainly be related to the indices being smaller than the Swedish and Germany ones. Whereas 22 companies are listed in Denmark, Norway and Finland contribute 16 and 14 firms to the sample, respectively. Companies with two different index listings, have been adjusted to be included in the index based on the highest liquidity of the share.

For an example, the company TietoEVRY was included in the Swedish sample since the stock has the highest liquidity there, although it is listed in Norway and Finland too.



Appendix 9: Sample distribution across NAICS sectors

The table shows the whole sample's distribution across industry categories. The NAICS industry classification is originally a US-based system (US Census Bureau, 2021), the classifications provided the most comprehensive view of industries in the sample compared to other options in Thomson Reuters Eikon. The most extensively used industry classification using SiC codes was unfortunately not available for European securities in the database. The absolute majority of firms is assignable to the manufacturing sector. The European indices are composed according to the local industries, which results in the huge dominance by the manufacturing sector. Aside from manufacturing, other major industries include information, the finance and insurance, and the professional sector. Contrastingly, utilities, wholesale, and accommodation are minor sectors in the sample. Since the most commonly used SIC industry codes were not accessible via Thomson Reuters, the study relies on the NAICS sector assignment. Overall, the NAICS categorization divides the companies into 20 industries, with four categories being assigned zero companies to.



Appendix 10: Currency effects across NAICS sectors

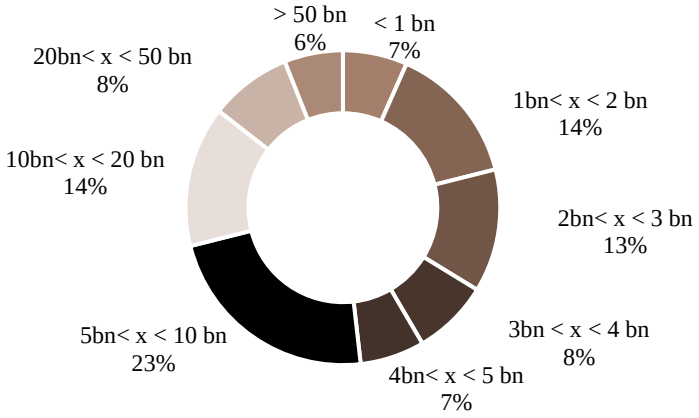
The following table shows the average currency effect related growth for both reported currency growth and currency growth as share of total growth across the 16 different NAICS sector descriptions, which the companies of this sample were assigned to. It is noticeable, however, that the manufacturing sector is located directly in the

middle of all sectors, when it comes to comparing reported currency growth, which means that the most meaningful industry seems to be distributed quite normally around zero, showing an average currency effect of 0.1%. Similarly, the information sector and the finance and insurance sector have quite low values. Whereas currency effects finance & insurance amount to -0.3%, average currency movement in the information sector are even closer to zero and only very marginally negative. The table is aligned according to the average reported currency growth, starting with the lowest and ending with the highest average reported currency growth.

NAICS Sector Name	Average Reported Currency Growth	Average Currency Growth as Share of Total Growth
Healthcare and Social Assistance	-0.012	-2.104
Wholesale Trade	-0.008	-5.000
Other Services	-0.006	-0.275
Transportation & Warehousing	-0.005	-0.784
Arts, Entertainment & Recreation	-0.004	0.038
Finance & Insurance	-0.003	-0.206
Real Estate, Rental & Leasing	-0.001	-0.133
Information	-0.000	-3.265
Manufacturing	0.001	-0.278
Agriculture, Forestry, Fishing & Hunting	0.003	0.019
Professional, Scientific, & Technical Services	0.005	-0.089
Construction	0.007	0.251
Utilities	0.011	-0.192
Retail Trade	0.014	0.445
Administrative, Waste Mgt. & Remediation	0.015	0.272
Accomodation & Food Services	0.126	0.718

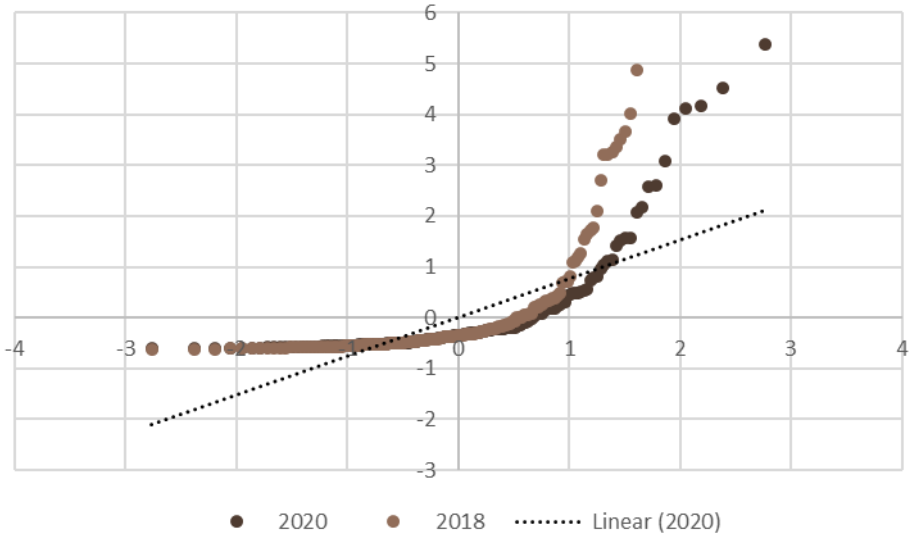
Appendix 11: Sample distribution across market caps

The following graph shows the distribution of the whole sample across market capitalization. Although all companies are denoted as ‘large caps’ in their respective domestic country, there are large variation in stock market valuations depending on the country. The diagram shows each market capitalization at the 24.04.2018, when the observation period started.



Appendix 12: QQ-Plot for market cap distribution

The qq-plot shows the distribution of the sample across market caps. It is a graphical illustration to show how far the sample deviates from an exact normal distribution. The dots coloured in light brown show the distribution using the market cap from the April 24 in 2018, when the reporting started, and the dots coloured in darker brown show the market capitalizations on March 02, 2020. The fitted line shows an ideal normal distribution based on the 2020 sample and their market capitalizations.



Appendix 13: Currency effects distribution across market capitalization

The table shows the distribution of total observations across market capitalization. It is important to note, that companies are not classified into one category on a permanent basis, but vary, as a company's stock price grows or falls over the period and must thus be classified into another valuation range in the following period. The market capitalization is measured at the beginning of each reporting period, and is valid for the period following this quarterly report. 139 observations were found for companies below €1bn market capitalization, 295 for those valued between €1bn and €2bn, 243 for those between €2bn and €3bn, 148 for companies between €3bn and €4bn, 119 observations for firms' equity values in the range of €4bn and €5bn, 399 for firms exceeding €5bn in value, but falling short of €10bn, and 242 observations for companies with more than €10bn market value, but less than €20bn. The biggest categories, describing companies with more than €20bn and less than €50bn, and those valued higher than €50bn, contained 166 and 108 observations, respectively.

Period following	Variable	mean	min	p25	median	p75	max	sd	obs number
x<1bn	Reported currency growth	0.008	-0.087	-0.002	0.002	0.024	0.149	0.033	139
	Currency growth as share of total growth	0.122	-6.300	-0.017	0.009	0.186	6.291	1.111	139
	Stock return	0.101	-0.544	-0.042	0.079	0.218	0.934	0.210	139
1bn<x<2bn	Reported currency growth	0.003	-0.154	-0.009	0.000	0.018	0.276	0.043	295
	Currency growth as share of total growth	-0.300	-66.937	-0.115	0.000	0.152	6.543	4.244	295
	Stock return	0.051	-0.557	-0.033	0.051	0.123	0.684	0.171	295

2bn<x<3bn	Reported currency growth	0.005	-0.115	-0.013	0.000	0.025	0.117	0.034	243
	Currency growth as share of total growth	-0.111	-15.974	-0.101	0.000	0.271	3.830	1.502	243
	Stock return	0.035	-0.566	-0.063	0.037	0.130	0.788	0.182	243
3bn<x<4bn	Reported currency growth	-0.001	-0.156	-0.013	0.004	0.022	0.092	0.035	148
	Currency growth as share of total growth	-0.390	-34.433	-0.178	0.034	0.223	8.509	3.186	148
	Stock return	0.034	-0.502	-0.064	0.043	0.124	0.641	0.172	148
4bn<x<5bn	Reported currency growth	0.009	-0.075	-0.004	0.005	0.025	0.110	0.031	119
	Currency growth as share of total growth	2.292	-4.215	-0.035	0.084	0.350	254.870	23.383	119
	Stock return	0.014	-0.519	-0.077	0.023	0.113	0.613	0.158	119
5bn<x<10bn	Reported currency growth	0.001	-0.095	-0.018	0.000	0.020	0.136	0.032	399
	Currency growth as share of total growth	-0.245	-121.984	-0.205	0.000	0.178	63.528	7.753	399
	Stock return	0.012	-0.999	-0.068	0.020	0.095	0.806	0.152	399
10bn<x<20bn	Reported currency growth	-0.002	-0.123	-0.019	0.000	0.015	0.278	0.039	242
	Currency growth as share of total growth	-0.595	-53.088	-0.281	0.000	0.192	3.576	4.284	242
	Stock return	0.033	-0.359	-0.035	0.033	0.109	0.468	0.124	242
20bn<x<50bn	Reported currency growth	-0.000	-0.137	-0.020	0.000	0.025	0.091	0.037	166
	Currency growth as share of total growth	-1.099	-92.777	-0.532	0.000	0.318	12.213	7.830	166
	Stock return	0.013	-0.456	-0.067	0.022	0.085	0.500	0.131	166
>50bn	Reported currency growth	-0.005	-0.100	-0.030	0.000	0.016	0.080	0.032	108
	Currency growth as share of total growth	-4.577	-473.580	-0.335	0.000	0.236	6.449	45.604	108
	Stock return	0.007	-0.593	-0.056	0.028	0.067	0.557	0.143	108

Appendix 14: Risk measures

The table includes the standard risk measures for securities traded on public stock markets. The maximum drawdown is the highest loss occurred over the period of three years, starting on April 1, 2018, from the stock price building out a top. The daily value at risk gives an indication of more than what percentage the portfolio or index has not lost in a single day in at least 95% of observations. The standard deviation reveals the deviations from the mean and highlights how high the volatility in an index or portfolio is in general. The sharp ratio, on the other hand, measures the quality of return, dividing the excess return by the volatility. A sharp ratio above one indicates a better reward than risk profile. The observations include the three benchmarks and the twelve created portfolios in the order described in the paper.

Portfolio Nr.	Volatility Parameters			
	Daily VaR (5%)	Maximum Drawdown	Standard Deviation	Sharpe Ratio
Stoxx Europe	-2,02%	-35,90%	1,24%	5,68
Russell 2000	-2,92%	-42,65%	1,81%	0,74
Sample	-1,27%	-30,99%	0,81%	12,09
I	-0,79%	-14,49%	0,48%	-1,16
II	-1,24%	-37,85%	0,77%	4,16
III	-1,17%	-34,18%	0,68%	-6,95
IV	-1,00%	-14,86%	0,63%	7,66
V	-1,76%	-33,05%	1,12%	10,20

VI	-1,16%	-18,37%	0,70%	-2,04
VII	-0,69%	-11,73%	0,42%	-2,26
VIII	-1,09%	-34,29%	0,66%	1,46
IX	-1,12%	-30,87%	0,66%	-4,54
X	-0,85%	-14,55%	0,51%	0,05
XI	-1,34%	-37,33%	0,82%	3,65
XII	-1,29%	-28,39%	0,77%	-4,20

Appendix 15: EURIBOR 1-month and US 1-month

The graph shows the development of the 1-month EURIBOR and the 1-month US T-bill risk-free interest rates. The period applied is 2018-01-01 to 2021-03-31.