EXPLAINING THE CROSS-SECTION IN EXCESS RETURNS

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ABSTRACT

The purpose of this thesis is to explore how well selected economic variables explain the excess return on the Danish stock market. The purpose is formulated in the following problem formulation: *"What has been the determining factor of high-performing stocks on the Danish stock market between 2008-2018?"*

According to the CAPM, the beta value alone should be sufficient to explain stock returns. However, the conceptual framework and literature review show that the beta value is not entirely adequate for accounting for the cross-section in stock returns. Based on a review of related work, multiple economic variables that have previously been linked to stock returns are selected. In order to answer the problem statement above, quarterly stock data for the KAX Index between 2008 and 2018 is extracted from Bloomberg. The 20 percent stocks with the highest cumulative CAPM-adjusted return are assigned to a winner portfolio. It is the average excess return of this portfolio that function as the dependent variable. A multiple regression is set up for the sample period as well as two subperiods.

The study finds a significant relationship between the average excess return and five of the nine variables considered – they are, FCF-yield, firm size, financial leverage, interest rate and ROIC. Especially the interest rate and FCF-yield are strongly related to the excess return. This thesis detects a zero correlation between firm size and the excess return; it can, however, not be rejected that a non-linear relationship exists. Furthermore, the paper only finds very limited support that value investing can explain the excess return.

The evidence from this thesis indicates that the market at the beginning of the sample period is low-priced and normalizes towards 2018 just as the observed correlations seem to be dependent on the portfolio composition, i.e. there is a bias towards stocks that have been less affected by the financial crisis rather than cheaper stocks which would do well when economic fundamentals are improving

The thesis concludes that the Danish stock performance between 2008 and 2018 in particular seems to be determined by the economic conditions, including the interest rate level. Based on this study, there seems to be no advantage in investing in stocks with certain characteristics, such as low P/E ratios or high leverage.

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1. INTRODUCTION

It has been just a little more than 10 years since the start of the global financial crisis. Since then, Danish stocks have risen sharply. Especially the OMX Copenhagen 20, which has risen by as much as 380 percent since March 6, 2009[1] (Sjølin, 2019). Compared to the rest of Europe, the US and the major Asian market, it is actually the biggest increase of all. For comparison, the S&P 500 has risen by 325 percent over the same period while it is just 143 percent for the STOXX Europe 600.

At the same time, more Danes have begun investing in shares (Frandsen, 2016) just as it has been an objective of the government to get far more Danes introduced to and involved in the stock market (Ritzau, 2017).

The aforementioned period should thus be subject to some interesting insights in relation to the Danish stock market that may contribute with insights which can help investors select stocks. Moreover, the time horizon also means that such an analysis could be interesting for long-term investors as well.

So, which stocks, in particular, have been the winners on the Danish stock market since the financial crisis? Can the performance of relatively best performing stocks be ascribed to specific key figures or the interest rate? Which has been the decisive factor for stock performance on the Danish stock market in this period: the company or the economic cycle?

The introduction above leads to the following problem statement and research questions.

1.1 Problem statement and research questions

The aim of this study is to examine the correlation between firm-specific financial figures and interest rate level with the Danish stock market between 2008-2018. Thus, the focus of this paper is on financial theory and partly on macroeconomics. Based on this, the following problem statement and research questions are advanced:

[1] As on April 20, 2019

1.1.1 Problem statement:

What has been the determining factor of high-performing stocks on the Danish stock market between 2008-2018?

1.1.2 Research questions:

In order to answer the problem statement, the following research questions are outlined to examine the stock performance on the Danish stock market from different perspectives and in more manageable questions:

- What is the relationship between the stock market and different financial figures?
- To what extent can firm specific (financial) figures explain the performance of the firm from 2008-2018?
- To what extent can the value strategy explain the cross-variations in average excess returns?
- To what extent can the economic cycle in Denmark explain the performance on the Danish stock market, i.e. to what extent is the Danish stock market correlated with the interest rate?
- Which other factors can affect stock performance and, hence, create uncertainty regarding the above correlations?

The questions put forward are based on methodological triangulation which can be defined as *"... the use of multiple methods mainly qualitative and quantitative methods in studying the same phenomenon for the purpose of increasing study credibility."* (Hussein, 2009, p. 3). Triangulation is thought to be beneficial in providing an enhanced understanding of factors and assumptions influencing the stock performance of companies on the Nasdaq OMX Copenhagen and, hence, increase the validity of findings.

1.2 Hypotheses

The research questions above can be formulated as hypotheses, except for the first and last research question which cannot be tested. The first research question gives rise to the selection of economic variables[2] for use in the analysis based on a literature review whereas the last research question is concerned with a discussion of the observed results, i.e. the hypotheses.

[2] Economic variables is used as a collective term for financial (key) figures and the interest rate

The following specific and testable predictions will be evaluated and confronted with observations in order to either confirm or disprove them.

Hypothesis 1: The performance of the top Danish stocks can be attributed to selected economic variables

Hypothesis 2: The cross-section in the excess return can be explained by variables attributed to value investing

Hypothesis 3: The interest rate is correlated with excess returns on the Danish stock market

1.3 Research approach

The paper is starting from the neo-positivist paradigm. A paradigm is defined by Guba (1990, p. 18) as *"... a basic set of beliefs that guides action, whether of the everyday garden variety or action taken in connection with a disciplined inquiry."*. Within the neo-positivist paradigm, the ontology assumes that there is a true value of all companies on the KAX Index[3] as well as universal relations and mechanisms that can explain this. These aspects can, however, only be understood incompletely. For instance, it is not possible to incorporate all relevant information and figures in the regression just as it is impossible to make accurate forecasts about the future.

For this reason, the epistemology is modified objective since our objectivity is affected by experiences and values. This is particularly true in relation to the selection of figures to correlate the stock performance against. To compensate for it, objectivity is a guiding and governing ideal within the neo-positivist paradigm. More specifically, objectivity is approximated through the use of approved theories and models just as the reliability and validity of the data used for this paper is discussed below. As for the methodology and structure of the paper, the object is to identify value drivers with significance for the stock performance of Danish stocks.

[3] The KAX Index is an index that holds all shares listed on the Copenhagen Stock Exchange

1.4 Methodology

In this section, the methodological approach of the project is presented together with a review of the data. Moreover, the structure of the project is outlined in section 1.6.

The deductive approach is used to explore known causal relationships between average excess returns and different variables on the Danish stock market (Andersen, 2003, p. 265). This approach involves formulation of hypotheses that are tested with the application of relevant quantitative methods – for this study, correlation and regression analysis – which either lead to confirmation or rejection of the hypotheses.

Since the focus of this paper is to test investment-related hypotheses derived from theories within financial theory as well as previous findings, quantitative data forms the foundation of the present work. The quantitative method is useful for *"... analyzing various known and measurable variables that relate to (the) research questions."* (Nega, 2017, p. 4).

More specifically, a correlational design is applied as it enables statistical analysis on *"... secondary data from a single group sample to ascertain the extent and nature of the relationship between the predictor and criterion variables."* (Nega, 2017, p. 5). Thus, the correlational design is used to examine the strength, direction and significance of the relations between average excess returns on the Danish stock exchange and economic variables.

1.4.1 Data type and quality

Based on the problem statement and research questions as well as the available resources, in terms of financial data and academic articles, secondary data is utilized. Secondary data is defined as being gathered by someone else as opposed to primary data where the researcher(s) obtain data directly from subjects specifically for their study's purpose (Institute for Work & Health, 2015, p. 2).

More precisely, administrative data is used which designates data that is *"... collected routinely as part of the day-to-day operations of an organization, institution or agency."* (Institute for Work & Health, 2015, p. 2). In this case, it is stock prices and key figures gathered by Bloomberg.

The benefits of secondary data include that it is *"... readily available and inexpensive to obtain."* (Institute for Work & Health, 2015, p. 2). Moreover, administrative data often consists of large samples since the data collection is comprehensive and routine. At the same time, data is collected over a long period (ibid). This is also the case for Bloomberg, where 10 years of structured and homogenous data has been extracted. With that, it is possible to investigate and detect change over time (ibid).

The quality of the secondary data is assessed in terms of reliability and validity (Andersen, 2003, p. 84).

Reliability refers to whether data is authentic and if another researcher would reach the same conclusions. Thus, it is about ensuring that the data and the measurements are free of inaccuracies.

The data has, primarily, been extracted from a Bloomberg terminal at Copenhagen Business School. A Bloomberg terminal is a software system from Bloomberg which contains the *"... largest repository of data useful to brokers, traders, analysts, and researchers that is all available in one place."* (CBInsights, 2018, p. 1). Through this terminal, it is possible to, among other things, access real-time and historic price data, financials data and news feeds.

The data from Bloomberg is assumed to be of high quality as it is used by more than 300,000 professional market participants – typically institutional investors – around the world (CBInsights, 2018, p. 1).

It has not been possible to extract all required data via Bloomberg. Thus, beta values and excess returns have been calculated in Excel based on data from the Bloomberg terminal. All data and all calculations are attached to the thesis which increases the reliability of the paper as it allows other researchers to review the data and calculations.

Besides Excel, JMP has been used to work with the dataset. JMP is a business unit of Statistical Analysis Software (SAS). SAS is the leading and largest provider of business analytics software and services in the business intelligence market (JMP, 2018). It also applies to the statistical tests that they are attached.

Furthermore, chapter five seeks to provide an overview of and contribute with a better understanding of the choices made in connection with the data processing. Moreover, the thorough review of the study's data method enables other to easily replicate the study, which increases the transparency and reliability of the paper.

Validity, on the other hand, refers to the soundness of the conclusions reached and if the study measures what it intended.

Using similar methodology in this paper as Fama and French (1992; 1995) and De Bondt and Thaler (1985) ensures a general correspondence between the theoretical framework and the empirical model (Andersen, 2003, p. 84).

Regarding the quality of the sources used in the paper, then the main sources include Nobel Prize-winning economists such as Fama and Thaler. In addition, the articles are published in major journals such as the Journal of Finance and Journal of Financial Economics just as they have thousands of citations. For instance, De Bondt and Thaler (1985) as well as Fama and French (1992), which provide inspiration for the data processing, have more than 8,000 and 18,000 citations respectively.

The literature survey helps to ensure that the empirical variable selection is relevant to the problem formulation (Andersen, 2003, p. 84). Similarly, and based on the neo-positivist paradigm, subjectivity is attempted limited by comparing the results of the study with scientific articles.

1.5 Delimitation

The scope of the paper has necessitated a number of delimitations. This study is limited to stock performance between January 2008 and December 2018 as well as stocks on the Copenhagen Stock Exchange (KAX Index). Due to the chosen period, stocks that have been delisted or gone bankrupt between 2008 and 2018 are not included just as it is required that the stocks have been on the Danish stock exchange since, at least, January 2008. Thus, the screening of stocks is affected by the following selection criteria:

- The chosen stocks are active throughout the period (i.e. 01.01.2008 – 31.12.2018)
- The stocks are all listed on the KAX Index
- Key figures are available for the companies

Moreover, the macro environment factors are alike for the companies to some extent, in terms of regulation and economic cycle. Of course, not all companies are equally affected by the condition of the Danish economy as some firms have their primary markets outside of Denmark. As a result, it is not possible to limit the influence of factors coming from outside Denmark completely for which reason some noise can be expected in the dataset.

Numerous economic variables and financial figures could potentially influence the stock performance. Since this paper aims at a thorough and in-depth statistical analysis, the number of included variables has been limited. The selected number of economic variables which are examined have, thus, previously shown a significant influence on stock performance or have a strong theoretical reason for such. The companies are compared across industries based on their individual financial figures.

In consequence of the above, many variables are not investigated for which reason omitted-variable bias can occur. This means that if *"... relevant variables are omitted, our ability to estimate casual inferences correctly is limited"* (Clarke, 2009, p. 49)[4]. This paper does, nonetheless, employ several different perspectives in attempt to explain the performance of high performers. As evident from the literature review, most academic articles examine only a single or a few factors. Hence, the risk of omitted-variable bias is assumed to be low. Biases and potential noise are elaborated on in section 4.4.

1.6 Advanced organizer

The paper is outlined as follows: Chapter two contains conceptual frameworks that elaborate on the problem statement and research questions. Chapter three reviews work and academic articles relevant to the measure of this paper to get a deeper understanding of the scientific field. The first research question is answered in this chapter.

In chapter four, the winner portfolio, which is to be examined, is constructed. This is done by determining the sample period, describing how the stock performance is evaluated and how stocks have

[4] An important assumption of the standard least squares method is that explanatory variables are uncorrelated with the error term. Since omitted variables become part of the error term, there is a risk (provided that correlation between the error term and the independent variables exists) that this assumption is violated.

been assigned to the winner portfolio. Moreover, the chapter also includes a theoretical review of the selected economic variables.

The data analysis process, including specific tests for applicability and validity as well as the multiple regression, is described and discussed in chapter five. The results are then presented in chapter seven together with a revision of the results. The main points from the literature review are brought in to interpret the results. Thus, in chapter seven, the three hypotheses are either confirmed or rejected while the last research question is answered in section 7.6. A conclusion as well as a discussion in relation to the problem statement are found in chapter eight and nine, respectively.

2. CONCEPTUAL FRAMEWORK

2.1 Capital asset pricing model (CAPM)

The capital asset pricing model (CAPM) describes the relationship between systematic risk and the expected return for assets (Bodie, Kane and Marcus, 2013, p. 291). Its logic is used to give a general understanding of investment theory. Developed by Sharpe (1964), Lintner (1965) and Mossin (1996), CAPM remains the most important asset pricing model, particularly stocks (ibid). The insight that only systematic risk is priced is a key insight in finance (ibid). CAPM is given by:

$$E(r_i) = r_f + \left[E(r_M) - r_f\right] \cdot \beta_i$$

This expression can also be illustrated via the Security Market Line (SML):

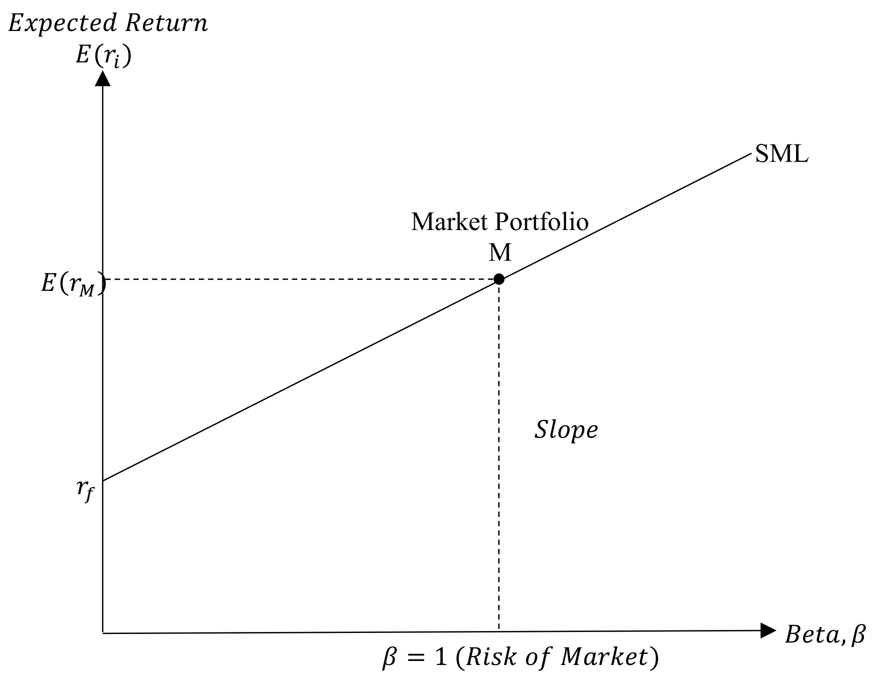

Figure 1: The Security Market Line (SML)

As mentioned, it is the contribution of the systematic risk to the risk of the market portfolio that is compensated for through a risk premium, $E(r_M) - r_f$. Hence, it is only the systematic risk that is priced since idiosyncratic risk can be substantially mitigated or even eliminated from a portfolio through diversification. The systematic risk is quantified by the beta value.

This is illustrated below:

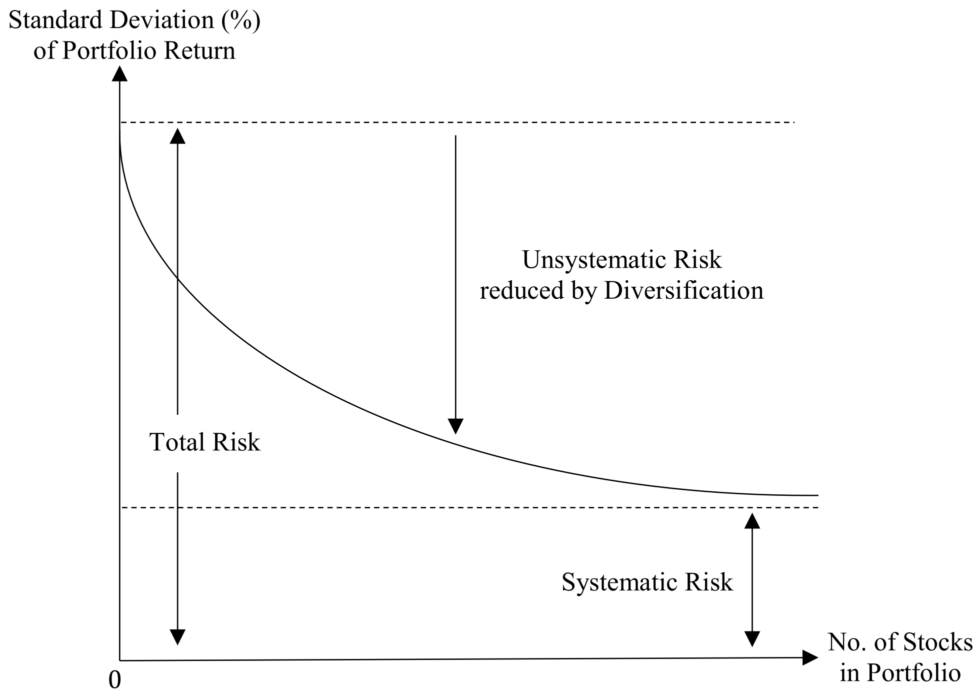

Figure 2: Diversification and the elimination of unsystematic risk

The CAPM has been criticized heavily for lacking empirical validity, making the model less realistic (Fama and French, 2004). This is largely due to the assumptions of the model. The CAPM model relies on several unrealistic assumptions, including no frictions (no transaction costs and taxes), that investors are price takers[5], that the investors have identical preferences, the same information and hold the same portfolio (market). In addition, identifying and measuring the market return is difficult – if not impossible.

According to Fama and French (2004), the relation between beta and the average return is flatter than anticipated in the CAPM model. Thus, the expected return of a stock with a high beta is too high and vice versa for stocks with low betas. As an alternative to the CAPM model, Fama and French advanced their three-factor model which is an extension of the CAPM with firm size (SMB) and book-to-market ratio (HML) included. It is suggested by the authors that firm size and book-to-market ratio can be estimates of unknown sources of systematic risk, currently not captured by the CAPM-model.

[5] As opposed to Arbitrage Pricing Theory (APT)

Similarly, Drew and Veeraraghavan (2003) find that *"... the CAPM beta alone is not sufficient to describe the cross-section of expected returns."* (p. 354), although beta is assumed to be sufficient to explain the returns of securities. Other factors, besides the overall market factor, influence the performance of stocks it seems. In the following section, some of these are discussed.

In the context of CAPM, it is tested whether any of the selected economic variables are independent sources of movement in stock returns. It could be, for instance, that leveraged firms have high returns but also high betas. In this case, financial leveraged may be an important determinant of firm value but it is not independently identifiable through stock returns.

2.2 Investment strategies

"It's far better to buy a wonderful company at a fair price than a fair company at a wonderful price." (Buffett, 1990, p. 1). This quote by Warren Buffett embodies the idea of value investing. Value investors focus on the company itself, i.e. its fundamental value, rather than its stock price. There is compelling evidence that value stocks, that is stocks with high book-to-market ratios, earn higher average returns than growth stocks, i.e. stocks with low book-to-market ratios (Chen, Petkova and Zhang, 2008, p. 269).

If markets were efficient, all stocks would be traded at a fair value reflecting all available information (Fama, 1970, p. 414). Hence, the price of a stock will, at all times, be the best estimate of the company's fundamental value and buying undervalued stocks and selling overvalued stock would be impossible. Systematic differences in average returns would be due to differences in risk (Fama and French, 1995, p. 131). Value investors, such as Warren Buffett, as well as behavioral economists, such as Shiller, De Bondt and Thaler, do not believe markets are efficient but that significant and continuous price deviations appear (De Bondt and Thaler, 1985; Shiller, 2003). These deviations allow value investors to trade stocks where the prices do not reflect the fundamental value of the stocks.

A point underlined by Fama and French (1992) in relation to the above, i.e. observed anomalies, deals with the tradeoff between risk and return. A common misconception regarding undervalued stocks is too underestimate the risk of the same stocks. Compared to below graph, those stocks may be falsely believed to be in the top left corner while, in fact, the stock is in the top right corner.

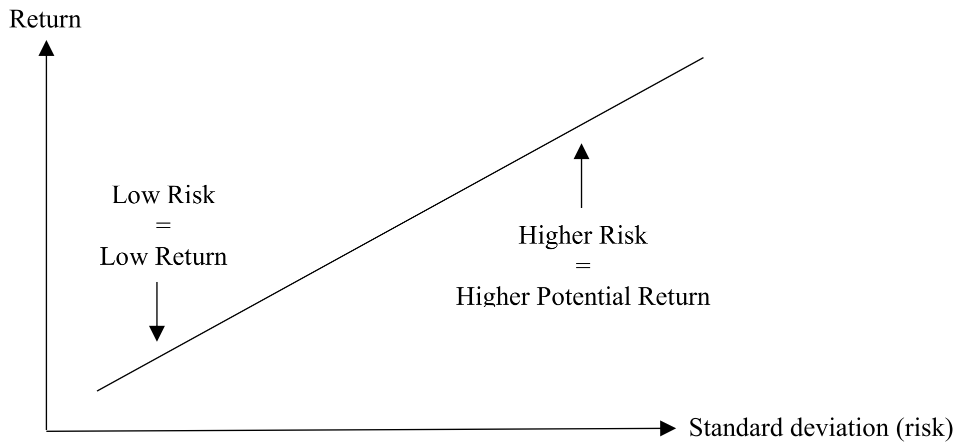

Figure 3: Trade-off between risk and return

This paper will not discuss whether the Danish stock market is efficient or not. Even if the Danish stock market is assumed to be inefficient, how are “wonderful” companies identified? Warren Buffett looks for companies with a high ROE and whose earnings are financed through their equity (debt to equity) (RHBInvest, 2014, p. 1). Whether or not financial figures can be used to predict stock performance will be tested.

The second major investment strategy seeks to exploit the momentum effect by buying the stocks with the highest return in the past period and selling (or shorting) those with the lowest returns. The momentum strategy is not part of the research design and will not be mentioned further.

3. RELATED WORK

Together with section 4.3, the first section of this paper seeks to answer the first research question regarding the relationship between the stock market and selected economic variables. Furthermore, studies with similar methodology are explored in section 3.2.

3.1 Academic articles on similar research questions

The research on whether different variables effect the stock market is extensive, with the vast majority concerning the American stock market. An obvious advantage of the American stock market compared to the Danish stock market is that the amount of data is much greater. Despite most of the research being related to the American stock market, the conclusions are global and form the basis of modern financial- and investment theory (Chan, Hamao and Lakonishok, 1991, p. 1740).

Much of the existing literature and research on asset pricing focuses on the variation in expected returns and test whether these variations are captured by rational risk-based factor models, such as CAPM. Thus, these researchers seek to match known anomalies in existing asset pricing models and find priced factors. Some of these are discussed below.

In their article 'Common risk factors in the returns on stocks and bonds', Fama and French (1993) identify five common risk factors in the returns on stocks and bonds, of which three are stock market factors. These are: an overall market factor, firm size and book-to-market equity.

Fama and French argue that the correlation between firm size (and book-to-market ratios) and stock returns arises as firm size is a proxy for non-diversifiable risk, i.e. distress (1993, 1996). Thus, higher returns are compensation for higher systematic risk. It is suggested by Fama and French (1993) that distressed firms are more sensitive to business cycles, including changing credit conditions/constraints, compared with firms less financially vulnerable. Lakonishok, Shleifer and Vishny (1994), on the other hand, contend that association between firms with high book-to-market ratios and their high returns are generated by investors *"... who incorrectly extrapolate the past earnings growth rates of firms. They suggest that investors are overly optimistic about firms which have done well in the past and are overly pessimistic about those which have done poorly."* (Thaler, 2005, p. 318). This resembles the definition of momentum strategy. According to Lakonishok et al. (1994), investors increase prices for firms with low book-to-market ratios and, hereby, reduce the expected returns of these stocks. While Lakonishok et al. do not dispute the possibility that the higher returns can be compensation for higher systematic risk, their evidence suggests that the covariance with macro factors is too low to fully explain the return premia associated with firm size and book-to-market ratios.

According to Fama and French (1995), firm size is also related to profitability. *"Controlling for BE/ME[6], small stocks tend to have lower earnings on book equity than do big stocks."* (p. 132). Stattman (1980) as well as Rosenberg, Reid and Lanstein (1985) also find a positive correlation between average returns and the BE/ME ratio. This relation is, according to the Fama and French (1995, p. 132), largely due to the low profits of small stocks. Stocks with a high price relative to book value (or low BE/ME, i.e. growth stocks) earn high average returns on capital whereas firms with a low price relative to book value, typically, are relatively distressed (ibid). The market judges the prospects of these latter firms to be poor compared with the firms with low BE/ME (Fama and French, 1992, p. 444). In addition, Fama and French (1995) finds that firms with ow BE/ME) *"... remain more profitable than high-BE/ME firms for at least five years after portfolios are formed on BE/ME."* (p. 132).

Similar to Fama and French (1993), Chan, Hamao and Lakonishok (1991) related the difference in performance for Japanese stock to the underlying behavior of four variables: earnings yield, firm size, book to market ratio and cash flow yield. The authors conclude that the book-to-market ratio and cash flow yield had *"... the most significant positive impact on expected returns."* (p. 1761).

Datar, Naik and Radcliffe (1998) looks specifically at liquidity and stocks returns. In their paper, the number of shares traded as a fraction of the number of shares outstanding, i.e. the turnover rate, is used as a proxy for liquidity and the paper suggests that liquidity is a significant explanatory variable regarding cross-sectional variation in stock returns. Even after controlling for *"... well-known determinants of stock returns like the firm-size, book-to-market ratio and the firm beta… (the) effect persists…"* (p. 1). Amihud and Mendelson (1986) use the bid-ask spread as a proxy for liquidity instead of the turnover rate – nonetheless, they too find a significant relation between liquidity and the stock market. Datar et al. (1998) finds that less liquid stocks have higher returns which is confirmed by Hu (1997) and Brennan et al. (1998).

[6] Ratio of book equity (BE) to market equity (ME)

In relation to value investing, Koller, Goedhart and Wessels (2010, p. 337) argue, in their book "Valuation – Measuring and Managing the Value of Companies", that the fundamental value of the market is driven by ROIC and economic growth. Despite recognizing that the market can differ from its fundamental value on the short term, the authors point to research showing that the market as well as individual companies on the long term reflect their fundamental value (ibid). Thus, companies with higher ROIC and higher growth (given by e.g. EPS[7]-growth) have higher returns in the long term, i.e. at least 10 years – as long as ROIC > WACC (p. 338). In the short term, the stocks' returns seem to be depending on expectations according to Koller et al. (ibid) indicated by P/E. Thus, for a time horizon up to 10 years, P/E (expectations) is expected to have larger impact on the stock development than ROIC and EPS-growth.

In continuation of the above, ROIC, EPS-growth and P/E are presumed to be related to the value strategy. In that regards, Chen, Petkova and Zhang (2008, p. 279), like Jagannathan and Wang (1996), Lettau and Ludvigson (2001) and Zhang (2005), find that the expected value premium is countercyclical, i.e. *"… that value is riskier than growth in bad times when the price of risk is high."*.

With respect to the P/E ratio, it was observed for American stocks between 1968 and 1988 that the stocks with the lowest P/E ratios had an average annual excess return of 16% while it was just 7% for the stock with the highest P/E-values (Damodaran, 2002, ch. 6, p. 38). Shiller and Campbell (1988) finds a similar tendency. The two authors used a moving average after one year, 10 years and 30 years of data – the longer the period, the clearer the relation between P/E and the stock return.

Basu (1983) finds that earnings-price ratios (E/P) help explain the cross-section of average returns in tests that include size and market beta (Fama and French, 1992, p. 428). *"Ball (1978) argues that E/P is a catch-all proxy for unnamed factors in expected returns[8] … "* (ibid), which Fama and French (ibid) argue may also apply to size (ME), leverage, and book-to-market equity. Since all these are *"… scaled versions of price, it is reasonable to expect that some of them are redundant of describing average returns."* (p. 450). Fama and French (1995, p. 4) find that E/P and leverage have explanatory power when tested alone but also that size and book-to-market equity *"… seem to absorb the apparent roles of leverage and E/P in average returns."* (ibid).

[7] Earnings per share
[8] Assuming that earnings are positive

During recessions when monetary policy is tight, credit constraints bind more (Gertler and Hubbard, 1988; Gertler and Gilchrist, 1994; Kashyap, Lamont and Stein 1994). Perez-Quiros and Timmermann (2000) find that *"... small firms display the highest degree of asymmetry in their risk across recession and expansion states, which translates into a higher sensitivity of their expected stock returns with respect to variables that measure credit market conditions."* (p. 1). This means that small firms are strongly affected by tighter credit market conditions under a recession compared with large firms, due to little collateral. It is likely that the interest rate may measure the stance of monetary policy and credit conditions. Moreover, research by Gertler and Gilchrist (1994) shows that sales and inventories of small firms are more cyclical and more responsive to downturns in the economy.

Bhandari (1988), Chan and Chen (1991), Fama and French (1992) as well as Shumway (1996) do, however, all find that *"... firms with high measures of leverage, financial distress, or probability of tend to earn higher returns than other firms."* (X) – this is in line with figure 3. For the firms, with these high measures, that fail to achieve those high returns, bankruptcy awaits.

Based on the literature review, there seems to be considerable evidence that stock returns can be explained by firm size, book-to-market ratios as well as cash flow yield and liquidity. Moreover, ROIC, EPS-growth and interest rate have shown reliable power to explain the cross-section of average stock returns. The effect of P/E ratios and leverage on average stock returns seem more ambiguous. In particular, studies by Fama and French (1992; 1995) indicate that they are redundant in explaining excess returns. A test on the Danish stock exchange may clarify this and reconcile conflicting observations.

The above type of studies has been criticized, among other by Robert Shiller (2005). According to Shiller (ibid), stock markets are characterized by irrationality. Thus, expected developments based on rational behavior cannot be expected. Fama (1970) argues, likewise, that stock prices cannot be predicted via his hypothesis on efficient markets. This paper touches upon this criticism later on leading to higher reliability and more credible conclusions.

3.2 Academic articles on similar methodology

The method of data processing is chosen with inspiration from De Bondt and Thaler's 1985 article "Does the Stock Market Overreact?". In the article, the two economists test if the overreaction hypothesis is predictable by constructing a "winner" and a "loser" portfolio (De Bondt and Thaler, 1985, p. 795). The winners are the stocks that have increased the most in the three years before the portfolio formation while the losers are the stocks that have fallen the most during the same period.

Since this paper explores factors affecting the best performing Danish stocks, a winner portfolio is constructed similarly to De Bondt and Thaler.

The two authors use a time period of three years whereas a considerably longer period is used in this paper (De Bondt and Thaler, 1985, p. 797). First of all, the focus of this paper is vastly different from De Bondt and Thaler's article. Secondly, it is desired to examine the residual return over a longer period of time, with which the business cycle changes.

The excess return is the difference between the actual return and the expected return over a specified period. De Bondt and Thaler apply a market adjusted return, i.e. an active return $= r_i - r_M$ (De Bondt and Thaler, 1985, p. 797). In this paper the CAPM is used to calculate expected returns and, hence, determine excess returns. By doing so, the excess return will be the fraction of a stock's return that is not explained by the market nor its risk, i.e. beta. This is further elaborated on in section 4.2.

With regards to the number of companies that are to be included in the winner portfolio, De Bondt and Thaler (1985, p. 797) assign *"… the top 35 stocks (or the top 50 stocks, or the top decile)… to the winner portfolio…"*. These top stocks are selected from common stocks on the New York Stock Exchange (NYSE)[9]. Although, the total number of companies is not known, it is presumed to be a very low percentage that De Bondt and Thaler assigns to the winner portfolio.

In contrast, Fama and French (1995, p. 8) use breakpoints for the bottom 30%, middle 40% and top 30% for the ranked values of BE/ME for stocks on the NYSE when forming their portfolios on size and book-to-market equity. For this study, the top 20% will be assigned to the winner portfolio which is between what De Bondt and Thaler (1985) and Fama and French (1995) do. This way, there will be a sufficient number of companies so that the results are not conditional on single companies while maintaining a focus on the relatively best performing stocks.

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[9] De Bondt and Thaler (1985, p. 797) use monthly return data for NYSE compiled by the Center for Research in Security Prices (CRSP) of the University of Chicago between 1926 and 1982

4. PORTFOLIO FORMATION

This paper aims at testing whether there is a common source of covariation in the returns of the winner portfolio. Hence, the hypothesis is that there are one or more common components in stock prices in terms of key figures or interest rate.

If no relations are found, that would suggest that the variables set up are not important determinants in the variation of stock returns and that they do not expose companies to common fluctuations. Hence, it would seem that the stock prices exhibit random walks. If a relation with any of the variables is found, however, that would be valuable for evaluating and selecting stocks on the Danish stock market.
Although, a factor is found to covary strongly with stock returns it does not necessarily result from there being particular risks associated with the factor. In fact, it may be that the firms have the same properties, e.g. might be in the same industry. It is interesting to examine if the covariance is equally strong across business cycles.

The matter in question is addressed from two perspectives: finance and macroeconomics. In the area of macroeconomics, it is examined whether the portfolio moves systematically over the business cycle and, hence, whether average excess returns are driven by macroeconomic fluctuations and/or interest rate level.

One portfolio of companies is formed and tested for common covariation in the stock returns. The portfolio is comprised of the 20% companies with the highest relative return between 2008 and 2018. To measure the impact of financial figures, firm-level information is utilized.

4.1 Selection of sample period

The background for choosing this particular time period (2008-2018) is that it includes two business cycles starting with the financial crisis (see figure 4). With which, it is possible to examine if the included variables can explain the dispersion across business cycles or if different variables explain the cross-section in stock return depending on the economic condition in Denmark (and in the world).

A recession can be defined as two consecutive quarters with a decline in GDP (Amadeo, 2018, p. 1). Thus, it is evident from below that Denmark experienced a recession in 2008 and 2009. Despite a boom in 2010, the period between 2010-2012 involves another recession, cf. aforementioned definition (ibid). From 2012 and onwards, the Danish economy has grown without, however, being rapid. To test if the included variables are stable across business cycles, it is decided to perform a linear regression between 2008-2012 and 2013-2018 in addition to the full period. It is, however, also clear from below that the fluctuations in the Danish are not that extreme, although the contraction in 2008 and 2009 is severe. As a result, the business cycle may not be apparent from the analysis.

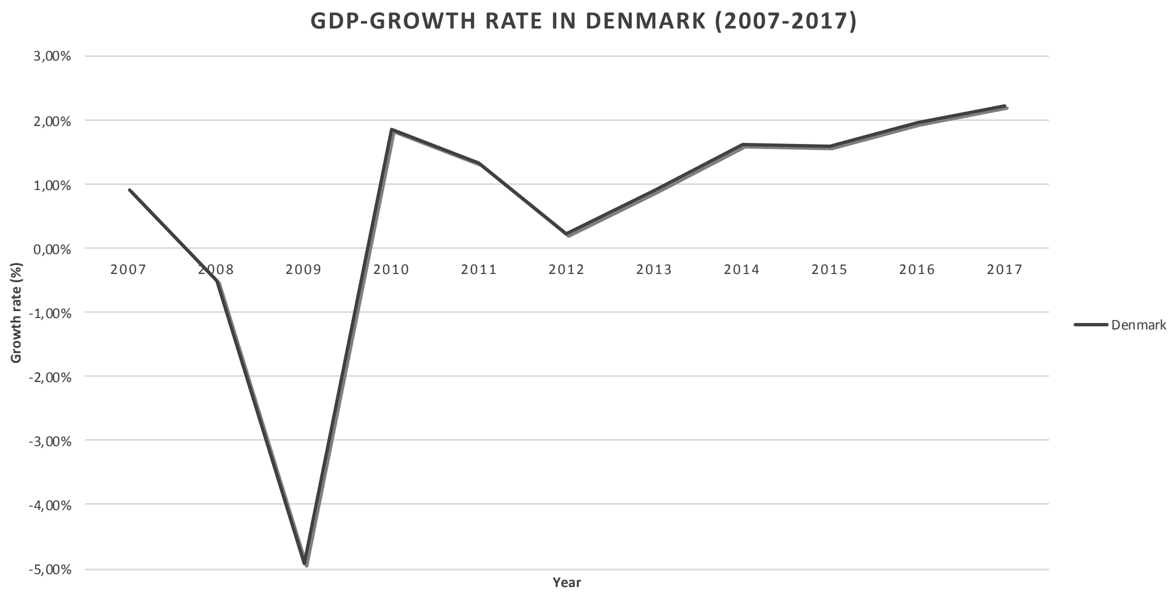


Figure 4: GDP-growth rate in Denmark (2007-2017) / source: The World Bank (2018)

According to Benjamin Graham, *"... the interval required for a substantial underevaluation to correct itself averages approximately 1½ to 2½ years."* (De Bondt and Thaler, 1985, p. 799). Presumably, the same interval exists for overevaluations. The test period of 10 years should, therefore, also be true of the stock developments. In continuation of this, some variables are assumed to display a correlation short-term (below five years) and others in the long-term (after minimum five years). If so, it will evident from the two shorter regressions (i.e. 2008-2012 and 2013-2018).

4.2 Selection of companies

The KAX Index (NASDAQ OMX Copenhagen) forms the basis for the portfolio. This index is chosen to limit the investigation to the Danish market just as the index is found to be liquid and with easy access to information. The two latter aspects are emphasized by Fama in his discussion of efficient markets (Fama, 1970, p. 388). Compared with the OMX Copenhagen 20, the test sample is significantly larger just as the OMX Copenhagen index is comprised of both small- and large cap.

4.2.1 Characterization of the Copenhagen Stock Exchange

Below pie chart divides the KAX Index into sector weighed by their relative market capitalization. The number in brackets refers to the number of companies in the specific sector.

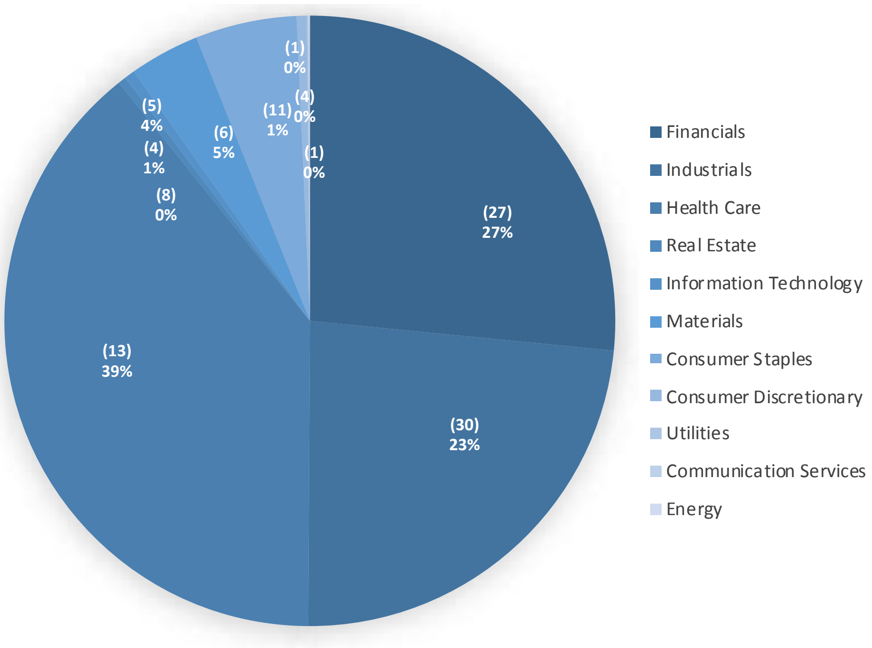


Figure 5: The KAX Index by sector

Novo Nordisk, Nordea and AP Moller Maersk account for 53% of the total market value for the 110 companies, while eight companies constitute 75%. Thus, a few stocks comprise the vast majority of the market value while most stocks on the KAX Index are small. The average market cap over the 10 years period and across all 110 firms is 17,272,568,106 DKK. 91 firms have an average market cap below this while 19 companies have a market cap higher. This distortion in size can also lead to a distortion in liquidity (see below).

Below, the development in the number of listed companies in Denmark is illustrated.

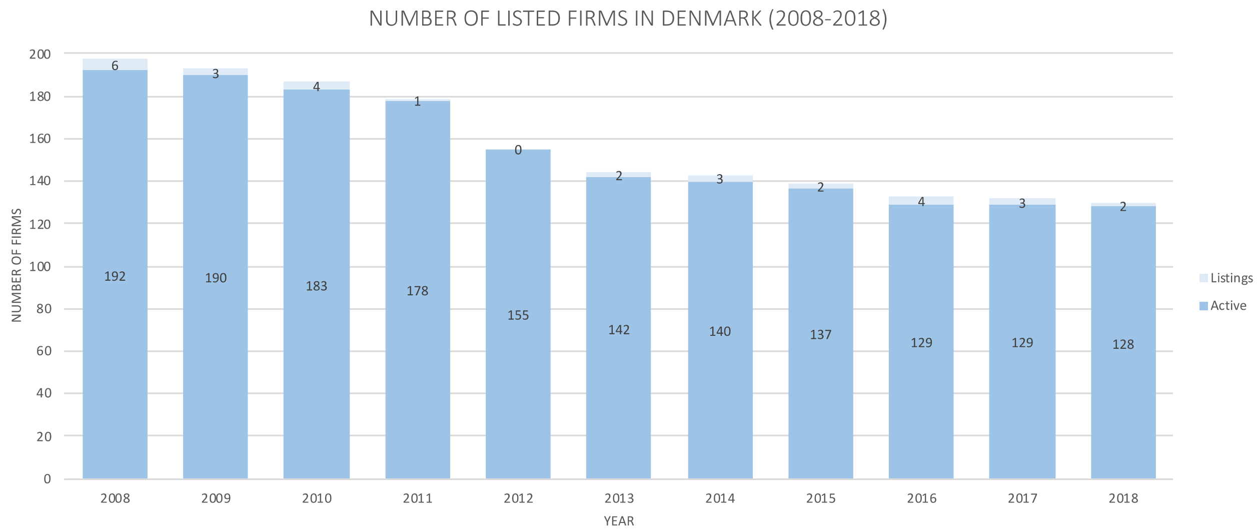


Figure 6: Number of listed firms in Denmark (2008-2018)

232 companies have been listed on the OMX Copenhagen between 2008 and 2018. Of those 232, only 110 companies, or 47%, have been active throughout the entire period. This testifies to a market characterized by many delistings. According to managing partner in Polaris Jan Johan Kühl, the reason for this is that *"... many listed companies simply are too small, and that private equity funds can offer both money and, as a rule, at the same time give the founders the opportunity to retain an ownership interest."* (Ritzau Finans, 2016, p. 1).

According to the chairman of the Danish shareholder association, Niels Mengel, Denmark does not *"... have a real market outside the largest companies in the C20-index. In Sweden, you have a living market both among the large and small companies where there are both investors and analysis houses that also spend time on the smaller companies. We lack this at home."* (Johnsen, 2015, p. 1).

This is supported by external lecturer at CBS Robert Spliid who points out that the stock culture in Denmark is not nearly as developed as in Sweden. *"As soon as we get down among the slightly smaller companies with a market value of around DKK 1 billion the market is very illiquid. At the same time, many of the pension funds keep away from such small investments. For the capital funds, there is therefore no point in sending smaller companies on the stock exchange here in Denmark"* (Johnsen, 2015, p. 1).

From below graph, it is evident that the past years have led to substantial capital inflows into alternative investments, including private equity funds[10]. The reason for this is a combination of economic growth and historical low interest rates (DVCA, 2017, p. 4).

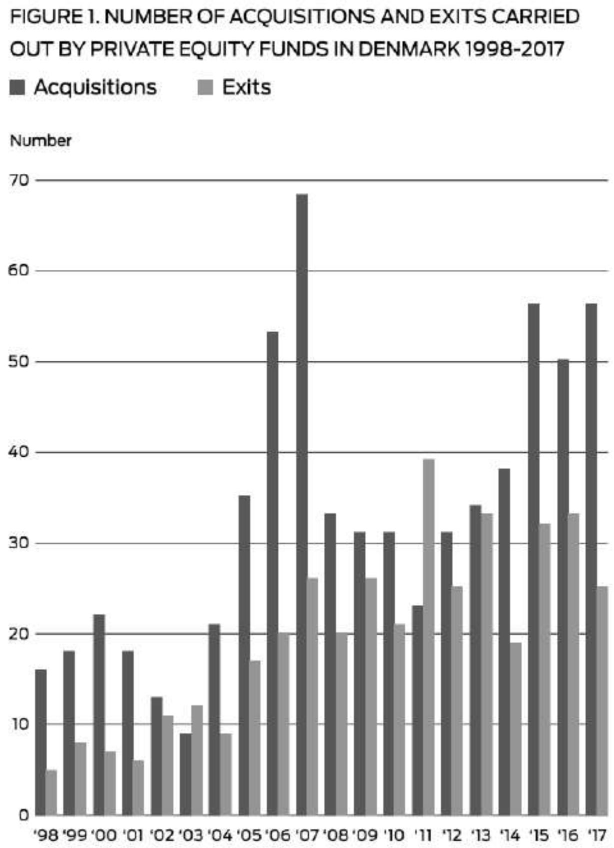


Figure 7: Number of acquisitions and exits carried out by private equity funds in Denmark (1998-2017)

Acquisitions thus have been a major reason for the many delistings between 2008 and 2018. For instance, in 2018, the payment service provider Nets was denoted after being bought by the equity fond Evergood while the three Danish pension funds, ATP, PFA and PKA as well as the Australian investment bank Macquarie bought the telecommunications group TDC (Euroinvestor, 2018, p. 1).

Other reasons for delistings include liquidations and mergers. For instance, Cimber Sterling went bankrupt in 2012 while OW Bunker collapsed in 2014[11].

[10] Even though, the Swedish economy is larger than the Danish and more private equity funds operate in Sweden than in Denmark, substantially more equity was contributed in Denmark in 2017 (DVCA, 2017, p. 7). This means that the Danish market was significantly larger, in terms of volume, than the Swedish in 2017 (ibid)
[11] OW Bunker (world's largest marine fuel (bunker) supplier at the time) went from IPO to bankruptcy in less than a year

As mentioned initially, 110 companies have been active from the beginning of 2008 and to the end of the sample period in 2018. It is the 20% best performing stocks among the 110 companies that are analyzed in this paper – equal to 22 companies.

4.2.2 Evaluation of stock performance and calculation of residual returns

There are multiple ways of evaluating the performance of an investment. One way is the price return which is the capital gain of an investment (Ganti, 2019, p. 1). It is simply determining whether the stock rose or fell and by how much: $\frac{Ending\ Price - Beginning\ Price}{Beginning\ Price}$. Nevertheless, there are other components than capital gains that make up the total return of a stock. A more accurate and comparable evaluation of the returns of different companies is the total shareholder return. With that, not only the capital appreciation is included but also the income received on the stock (ibid):

$$Total\ Shareholder\ Return\ (TSR) = \frac{\left(Ending\ Price - Beginning\ Price + Dividends^{12}\right)}{Beginning\ Price}$$

Although the total return per stock would be preferable, the data has not been available from Bloomberg so far back in time. Instead, stock prices form the basis of the calculation of the residual return. Just as with evaluating stock performance, there are multiple ways of calculating residual returns. As previously mentioned, De Bondt and Thaler (1985, p. 797) use a simple market-adjusted return, i.e.

$$Excess\ return = R_{i,j} - R_{M,t}.$$

Fama and French (1993), on the other hand, would likely recommend using their three-factor model to measure the excess return as the model adjusts for both the market and risk as well as two firm-specific factors, i.e. firm size and book-to-market ratio. In this paper, the CAPM is used as it is *"... center-piece of modern financial economics."* (Bodie, Kane and Marcus, 2013, p. 291). CAPM also accounts for risk, allowing for comparison of stocks with different risk levels. This is not possible to the same extent using only a marked-adjusted return. Compared to the three-factor model, the CAPM model works, as mentioned, as the standard of reference in the financial world just as it is widely used in the academic environment (ibid). Thus, the excess returns are calculated as:

[12] Dividends also include *"... cash payments returned to stockholders, stock buyback programs, one-time dividend payments, and regular dividend payouts."* (Ganti, 2019, p. 1)

$$Excess\ return, \alpha = R_{j,t} - \left(r_f + \left(r_M - r_f\right)\beta_{j,t}\right)$$

With the 10-year excess return being computed as follows:

$$10Y\ excess\ return = \left((1+\alpha_1)\cdot(1+\alpha_2)\cdot\ldots\cdot(1+\alpha_N)\right)^{\frac{1}{N}} - 1$$

Beta values are not available in Bloomberg for the first few years (not before 2011). Therefore, the beta values are calculated by a regression analysis on historical stock prices for each stock compared to a general index – in this case, the OMX Copenhagen. When estimating the betas, a time horizon of five years is used based on quarterly observations. This has been chosen to ensure a sufficient number of observations and to ensure that short-term fluctuations are offset.

The beta value is given by:

$$\beta_i = \frac{Cov(r_i, r_M)}{\sigma_M^2} = Corr \cdot \frac{\sigma_i}{\sigma_M}$$

The beta component is typically derived from historical returns, as is in this paper (Plenborg and Petersen, 2012, p. 253). The challenges of deriving the volatility of an asset include that the risk of an asset is not necessarily stable over time (Plenborg and Petersen, 2012, p. 253). Historical risk is not necessarily equal to future risk. In addition, the liquidity of the given asset may distort the beta estimate and thus not be true to the underlying risk of the asset. Of course, it must be acknowledged that the beta value is of great importance for determining the expected return and, hence, the residual return. It is, thus, likely that another time horizon has led to another portfolio composition of companies. However, it is expected that the beta value for many companies will not vary significantly at a different time horizon and therefore only a few companies in the winner portfolio might change.

The risk premium is defined as the excess return expected on an investment compared to the risk-free rate (Hillier, Clacher, Ross, Westerfield and Jordan, 2014, p. 305). Hence, the risk premium represents an investor's compensation for undertaking a bigger risk as a result of investing in stocks rather than a risk-free investment in government bonds. It is not possible to observe the risk premium on stocks directly in the market. Instead, it is necessary to estimate it which can be done either historically or using a forward-looking approach. Given the purpose of the paper, historical risk premia on the Danish market have been obtained (Fenebris, 2019).

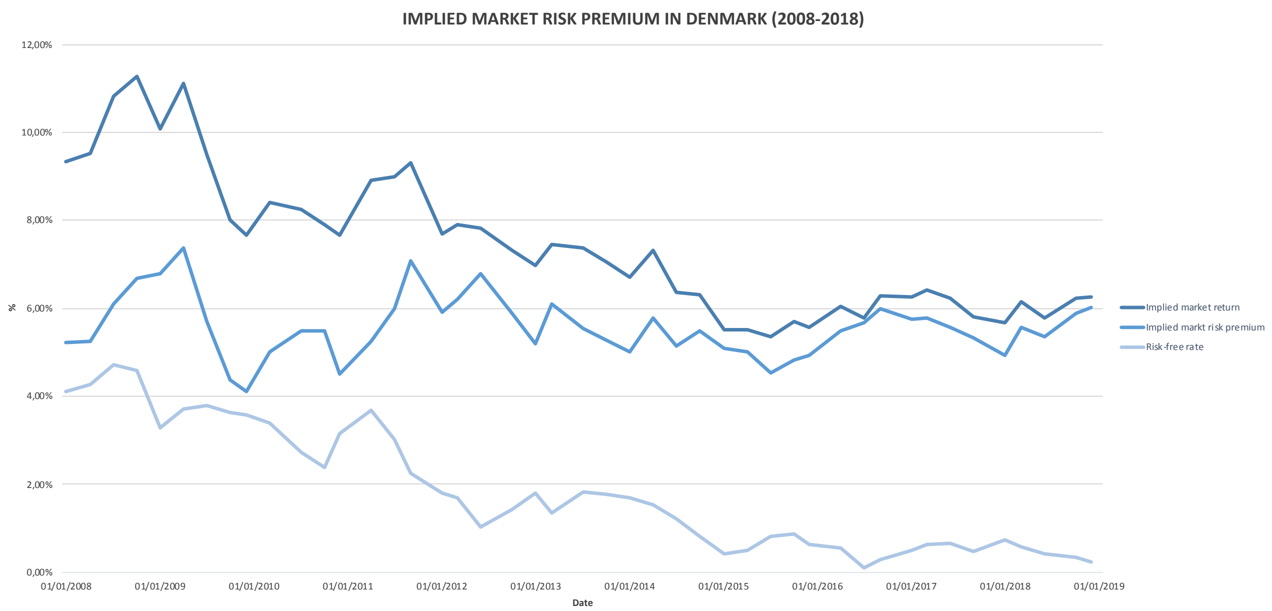


Figure 8: Implied market risk premium in Denmark (2008-2018)

From the graph above, it appears that the risk-free rate has fallen from a level of 4% to a level below 1% in the course of 15 years. For the past couple of years, the risk-free rate has been historically low (PWC, 2017, p. 14) whereby the implied market return is almost equal to the implied market risk premium.

4.2.3 Winner portfolio

The calculations of the excess return for all 110 companies are available in the attached spreadsheet while the 22 companies with the highest excess return in the period 2008-2018 are shown in appendix A. The five stocks with the highest CAPM-adjusted return are: FE Bording A/S, Lan & Spar Bank, Jeudan A/S, German High Street Properties and H Lundbeck A/S.

The 22 companies seem to be characterized by a low beta value. 21 of the companies have an average beta value below the average beta value for all 110 companies. This may reflect the impact of the financial crisis. Thus, the relatively best performing companies may be those that have been least affected by the downturn in the market economy (and the world economy) – indicated by the beta value. If so, there are a few variables included in the regression analysis that hopefully can help determine this.

Moreover, it should be noted that no company has a positive excess return in the period 2008-2018[13]. This can express several things. First and foremost, the sample period starts with a financial crisis, which is expected to be reflected in the returns for most companies, if not all. In addition, the lack of adjustment for dividends and stock splits as well as the estimated beta values can be contributing factor to the low excess returns. Finally, it may (also) be a consequence of an overestimated market premium. The latter is not serious as it affects all stocks in the same way – therefore, it is rather a shift in the excess returns than a change in the excess return for some companies. Since this thesis wants to form a portfolio of the top 20% relatively best performing stocks, the latter will have no significance for the analysis just as it is the development of the excess return that is correlated with different economic variables – the absolute values are thus irrelevant for the analysis and for the testing of the hypotheses.

4.3 Description of variables and their expected correlation with the target variable

Based on the literature review, cross-sectional variations in stock performance seem to be correlated with firm size, book-to-market ratios, cash flow yield, liquidity, ROIC, EPS-growth and interest rate level. Thus, these variables are examined in this paper. Likewise, P/E ratios and leverage are included as explanatory variables.

All key figures are drawn from Bloomberg on a quarterly basis via below transactions:

- Market Cap
- Market Capitalization to Book Value[14]
- EPS – 1 Yr Gr:Q
- FCF Yld
- Finl Lev LF
- P/E
- ROIC:Q
- Volume (I)
- Shares Out LF

[13] Several companies show a positive excess return in the subperiod 2013-2018
[14] Book-to-market ratio as well as turnover rate are calculated based on the formulas in section 4.3.1 and 4.3.9, respectively

All variables are in nominal terms, due to availability in Bloomberg. Although, real terms would be preferable, the most important thing is to be consistent. Even though, inflation can vary widely, it has the same effect on all variables. As already mentioned, the focus of the study is on the correlation between the variables and the average excess return rather than on the return itself. Therefore, it is not considered a significant problem for the reliability of the data. Nominal terms can, however, potentially lead to other issues in the form of cointegration and multicollinearity. Both are therefore also addressed in the regression analysis – this is discussed in more detail in chapter five. The data series do not give rise to correction for outliers[15]. As previously mentioned, all data is gathered in an Excel spreadsheet.

The following theoretical examination of selected financial figures contributes with an overview of the expected correlation between the financial figures and the stock development as well as the theoretical background for the correlation. Financial figures are a cost- and time efficient way of ranking different companies as opposed to performing in-depth analyses for each company.

4.3.1 Book-to-market ratio

In their paper "Size and Book-to-Market Factors in Earnings and Returns", Fama and French (1995, p. 134) set up a model to show the relation between book-to-market equity and expected stock return which is reproduced in appendix B. The model predicts that "*... firms with higher required equity returns, r, will have higher book-to-market ratios The prediction is consistent with the positive relation between average stock return and BE/ME observed by Fama and French (1992, 1993) and others.*" (ibid).

Thus, a positive correlation is expected between book-to-market ratio and excess return.

4.3.2 EPS-growth

Earnings per share is a financial ratio that measures the amount of net income earned per outstanding share. This metric, given below, is often used in assessing the profitability of a firm (Chen, 2019, p. 1)[16].

[15] The time series for P/E is corrected for one outlier as NTR Holding A/S on April 1, 2008, according to data from Bloomberg, had a P/E of 21,635

[16] A share repurchase would, of course, also increase EPS as the net income is divided by fewer shares

$$Earnings\ per\ share\ (EPS) = \frac{(Net\ income - Preferred\ dividends)}{Average\ shares\ outstanding}$$

EPS-growth may be more interesting than EPS alone as the former voice whether a company can sustain a high EPS and not just increase EPS by short-term decisions, such as reducing R&D expenses (Koller et al., 2010, p. 13). Hence, it is more difficult for a firm to uphold a growing EPS than to maintain a level of EPS. Furthermore, growth is a key driver for stock prices (if ROIC > WACC) as also mentioned in section 3.1.

A strong positive correlation is expected.

4.3.3 Firm size

In this paper, market capitalization (market cap) is used to determine a firm's size as opposed to sales or total asset figures. Market cap specifies the market value of a publicly traded company and is equal to:

$$Market\ cap = Share\ price \cdot Number\ of\ shares\ outstanding$$

Company size is a *"…basic determinant of various characteristics in which investors are interested, including risk."* (Chen, 2018, p. 1). Large companies have *"… usually been around for a long time, and they are major players in well-established industries."* (ibid). Thus, large firms provide stability. As mentioned in section 3.1, smaller firm with fewer resources are more sensitive to business cycles. While the growth in terms of stock price for large firms is often limited (creating only little capital appreciation), they typically pay steady dividends. Smaller firms, on the other hand, carry greater inherent risk but also have a greater growth potential (ibid).

Especially considering the sample period, which includes an economic slowdown, a positive correlation is expected between firm size and the excess return.

4.3.4 Free cash flow yield (FCF-yield)

Is given by:

$$FCF\ yield = \frac{Free\ cash\ flow\ per\ share}{Market\ price\ per\ share}$$

The free cash flow yield represents the financial capability of a firm. *"Generally, the lower the ratio, the less attractive a company is as an investment, because it means investors are putting money into the company but not getting a very good return in exchange. A high free cash flow yield result means a company is generating enough cash to easily satisfy its debt and other obligations, including dividend payouts."* (Kenton (A), 2019, p. 1).

Free cash flow is the amount left of surplus cash after deducting capital expenditures and operating expenses. Unlike earnings, free cash flow *"... excludes the non-cash expenses of the income statement and includes spending on equipment and assets as well as changes in working capital."* (Kenton (B), 2019, p. 1). For that reason, free cash flow is regarded *"... as a more accurate representation of the returns shareholders receive from owning a business.*" (Kenton (A), 2019, p. 1) by some investors.

High free cash flows entail economic freedom for a company. To this, it is of high value for investors as the free cash flow can be used for share buyback, dividend payout, debt repayment or investments (Reese, 2013, p. 1). That is not to say, however, that a high FCF yield is good necessarily as it can be for lack of profitable investments (ibid). A low FCF yield can, likewise, be due to profitable investments that may have a positive influence in the long run. Smaller and newly established companies (i.e. growth companies) are expected to have low free cash flows as most is spent on creating future growth.

All other things equal, free cash flow is a good indicator of a firm's situation. This is supported by the fact that the discounted cash flow (DCF) model pivots on free cash flow as they are not affected by the chosen recognition criteria and accounting principles (Koller et al., 2010, p. 190).

Given the above, FCF yield is assumed to be positively correlated with the stock price.

4.3.5 Interest rate

Besides the firm-specific variables above, average excess return within the constructed portfolio is correlated with the Danish 10-year government bond yield (DK10Y). The government bond yield is often used as a proxy for the risk-free rate (Investopedia, 2018, p. 1).

An increase in the government bond yield will, all other things equal, increase a firm's borrowing costs and hamper its investment opportunities – reducing the firm's estimated amount of future cash flows. This will, all other things equal, lower the firm's share price, i.e. inverse relationship between interest rate and the stock market (Hall, 2018). To this, investors are likely to put their money elsewhere as stock ownership becomes less desirable (ibid.). This relationship has been proved by Bekaert and Ang (2006) as well as Fame and Schwert (1977). Shiller and Beltratti (1992) found long-term interest rates (e.g. DK10Y) – in their paper, the effective yield of a treasury bond is used as a proxy – to be negatively correlated with the stock market. The authors do, however, argue that this relationship is not necessarily correct and that it might even be positively correlated. The latter was actually discovered by Engsted and Tanggaard (2001) on the Danish stock market.

Chen, Roll and Ross (1986, p. 385) also find the risk-free rate to be negatively correlated with the stock market. If stock prices are written as expected discounted dividends:

$$p = \frac{E(c)}{k},$$

with c being the dividend stream and k the discount rate, it is implied that actual returns in any given period are given by:

$$\frac{dp}{p} + \frac{c}{p} = \frac{d[E(c)]}{E(c)} - \frac{dk}{k} + \frac{c}{p}$$

According to the authors (1986, p. 385), this means that the systematic forces that either affect discount factors, k, or expected cash flows, E(c), influence returns. Since *"The discount rate is an average of rates over time, and it changes with both the level of rates and the term-structure spreads across different maturities."* (ibid), unanticipated changes in the risk-free rate will have an effect on pricing which affects the time value of future cash flows which in turn will affect returns (ibid).

Based on the above, a negative correlation between the interest rate and the excess return is expected.

4.3.6 Financial leverage

High financial leverage is, generally, linked with higher long-term liquidity risk. Capital structure varies considerably across industries and, in some industries, even within.

Companies can use financial leverage to increase their return on equity (ROE) but will, at the same time, be exposed to higher volatility (Hayes (A), 2019, p. 1).

$$Financial\ leverage = \frac{Total\ debt}{Shareholder's\ equity}$$

In his 1974 paper "On the Pricing of Corporate Debt", Merton advanced a model of the link between a firm's bankruptcy risk and its capital structure. Since equity in a firm is a residual claim, equity can be viewed as a call option with firm value, V, as the underlying asset and a strike price equal to the face value of the debt, F (Damodaran, 2019, p. 1). This is illustrated below. Thus, the payoff the equity holders is given by $\max(0; V_T - F)$.

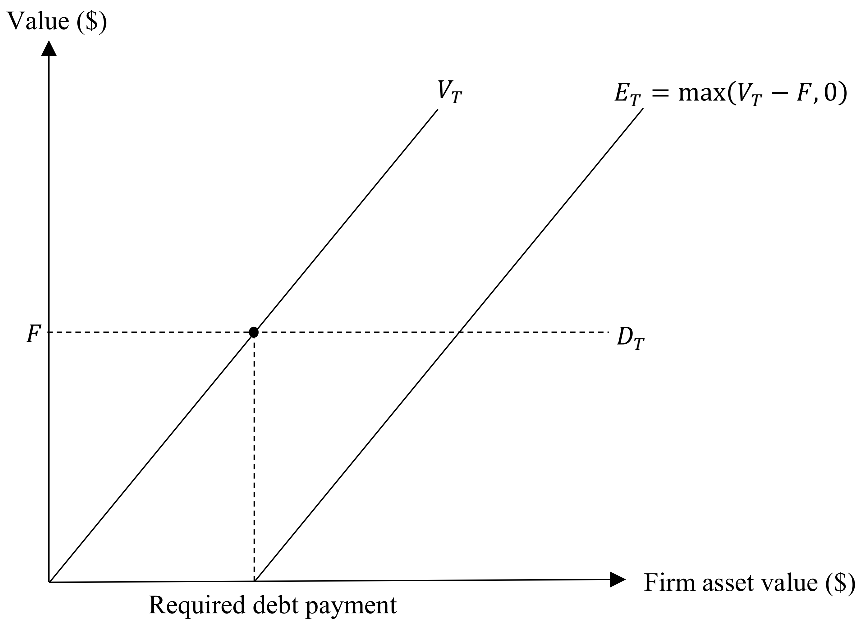


Figure 9: Equity as a call option

In continuation of the above, a firm's capital structure determines its financial risk. A large proportion of debt entails, all other things equal, higher financial risk for the shareholders. This is because the shareholders are the last to be paid in the event of a bankruptcy. In terms of return, the link between the return on equity and the firm's leverage is illustrated below:

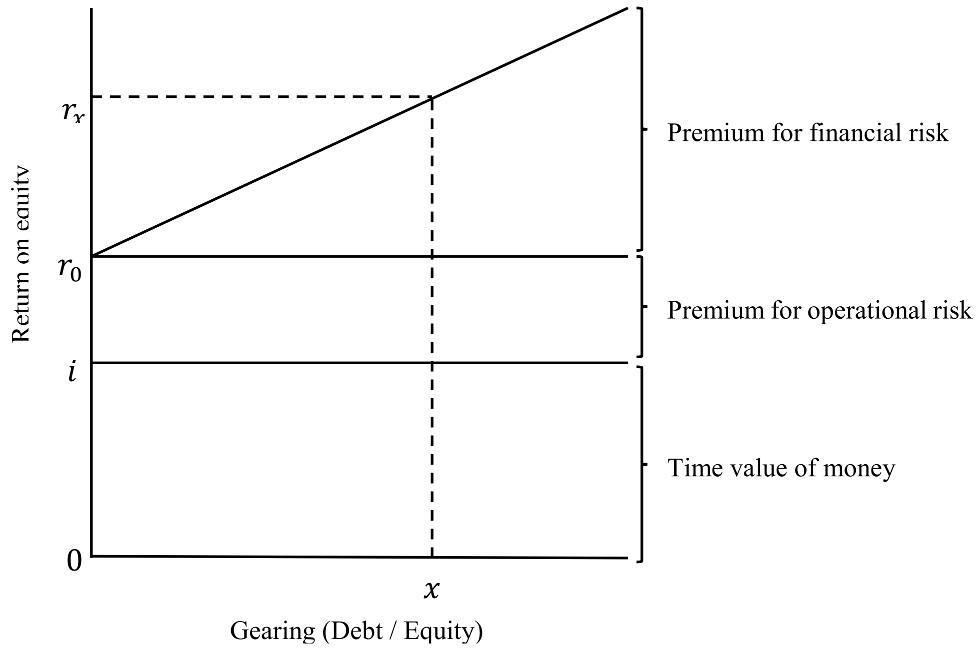


Figure 10: Link between return on equity and leverage

Based on the literature review, a positive correlation is expected between financial leverage and the excess return.

4.3.7 Price-to-earnings (P/E) ratio

An often-used metric for, especially, value investors, P/E measures how much investors are willing to pay for a company's stock compared with how much the company is earning (Hayes (B), 2019, p. 1). P/E is given by:

$$\frac{P}{E} = \frac{Market\ price\ per\ share}{Earnings\ per\ share}$$

P/E can be used as an indicator of whether a company is under- or overvalued (Hayes (B), 2019, p. 1). Value investors seek to buy a stock when it is undervalued, i.e. with a low P/E, and sell it when it is overvalued, i.e. high P/E. Hence, a negative correlation with stock returns is expected.

Since P/E is driven by factors such as risk, ability to generate free cash flow and expected growth in earnings, a company expected to grow the coming years will be traded at a higher P/E than similar companies with stagnated growth (Damodaran, 2002, ch. 18, p. 4). Thus, a high P/E can signal a growth stock and, in turn, attract growth investors. The company's future earnings are, of course, based on expectations and, as a result, subject to risk just as over-optimism, i.e. optimism bias, can force the share price to a level that is not sustainable.

Likewise, investors are willing to pay more for a firm with a good ability to generate cash flows which increase P/E. Consequently, P/E may not be clearly negatively correlated with stocks' future development.

Moreover, net earnings are used in the calculation of P/E rather than EBITDA (Koller et al., 2010, p. 317). With that, one-time charges can reduce net earnings and increase P/E unduly. An alternative to P/E could be EV/EBITDA which also takes the gearing of a firm into account.

Multiples, such as P/E, are often used in valuation as the multiples of different companies can be compared quickly and without many assumptions (Damodaran, 2002, ch. 17, p. 1). In some cases, multiples may give a better impression of a company's current situation on the market as they are relative and do not measure intrinsic value (ibid).

4.3.8 ROIC

ROIC measures how much a company earns on its net operating assets, i.e. how efficiently it utilizes its invested capital (Higgins, 2012, p. 41). ROIC is given by:

$$ROIC = \frac{Net\ Operating\ Profit\ After\ Tax\ (NOPAT)}{Book\ Value\ of\ Invested\ Capital}$$

While ROE is affected by a company's capital structure, ROIC is independent of how a company is financed (Koller et al., 2010, p. 317). As already mentioned, ROIC is a key figure that interests many of a firm's stakeholders. A high ROIC is associated with competitive advantages which, in turn, are required to obtain a high return on the invested capital. *"In strategic management literature, superior economic performance is seen as the result of a sustained competitive advantage. A firm that has gained a sustained competitive advantage is then able to create more economic value than rival firms…"* (Bausch, Hunoldt and Matysiak, 2009, p. 16).

In terms of the ROIC concept, a competitive advantage leads to a return on capital invested (ROIC) above the industry average WACC which is value creating. The residual rent of the invested capital, i.e. $ROIC - WACC$, can also be defined as the economic profit (Bausch, Hunoldt and Matysiak, 2009, p. 18).

Value creation is often linked with excellent performance on the stock market (Haspelagh, Noda and Boulos, 2001, p. 1). In contrast, poor performing companies are typically linked with a low ROIC that is also below WACC and, thus, value destroying.

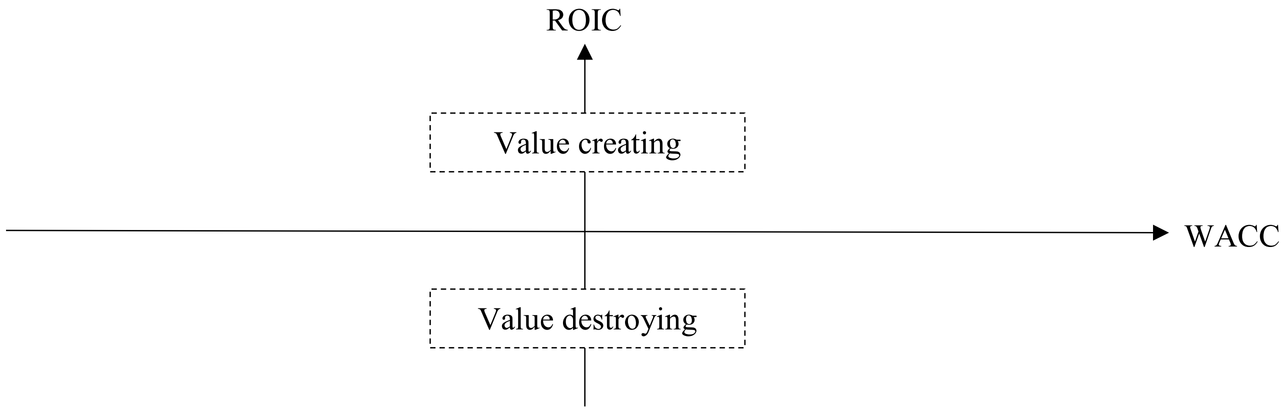


Figure 11: ROIC v. WACC

Given the above, ROIC is expected to covary positively with the stock price.

4.3.9 Turnover rate (proxy for liquidity)

Liquidity designates the ease and speed with which an asset can be sold at fair market value. Illiquidity is costly since a seller must accept a discount from fair market value to obtain a quick sale. In this paper, liquidity is estimated similarly to Datar et al. (1998) by using the turnover rate.

$$Turnover\ rate = \frac{Number\ of\ shares\ traded}{Number\ of\ shares\ outstanding}$$

Based on the literature review, a negative correlation is expected between turnover rate and the excess return.

4.3.10 Summary of expected correlations

Below table shows the empirically determined variables and their expected correlation with the average excess return:

Table 1: Summary of expected correlations between stock returns and economic variables

SUMMARY of Expected Correlations between Stock Returns and Economic Variables	
Variable	Expected Correlation
Book-to-market ratio	Positive correlation
EPS-growth	Positive correlation
Firm size	Positive correlation
FCF-yield	Positive correlation
Interest rate	Negative correlation
Leverage	Positive correlation
P/E ratio	Negative correlation
ROIC	Positive correlation
Turnover rate	Negative correlation

Should the results of the paper be consistent with above expectations, it could prove possible to identify buying- and selling opportunities by finding companies with such characteristics.

4.4 Bias

It has to be noted that all key figures are based on historical information and, in consequence, are backward-looking. A significant problem with key figures on a company level is that they are not adjusted for industry composition. By failing to adjust for industry composition of each key figure, it likely overstates some industries with relatively high measures and understates others. Ideally, one would adjust or benchmark the key figures to the respective industry. This has not been done.

The firms are, as previously mentioned, compared on firm level. It is, however, clear that different industries have different levels of, for instance, ROIC and P/E. Consequently, a high P/E compared to all other companies in the portfolio may, in fact, be low compared to the industry. In that way, bias in the interpretation of the results of the regression can occur.

By requiring a firm to have been listed on the KAX Index since 2008, it is clear that only well-established firms are examined. Thus, the conclusions may not apply to newly established firms. Furthermore, it can be assumed that the aforementioned requirement in particular excludes smaller firms.

An often-mentioned bias in this type of study is survivorship bias. This could, for instance, stem from only concentrating on those firms that are active throughout the entire period as in this study and assume that to be a representative comprehensive sample. If the purpose of this paper was to compare the best performing stocks with the average market, there would be a risk of overestimating the historical performance as a result of delisted companies. Since this study aims at correlating the relatively best performing Danish stocks over 10 years with different key figures, the threat of survivorship bias seems strongly limited.

In addition to above biases, potential noise in the regression could originate from the selected variables.

Omitted variable bias has already been touched upon in section 1.5. As explained, omitted variable bias occurs when the excess return (target variable) is affected by other important key figures or economic variables that, erroneously, are not included in the regression. Provided that is the case, there is a risk of estimating an incorrect β_i for the included variables. This is caused by an over- or underestimation of β_i, depending on the correlation between the variables not included and those that are included. Specifically, omitted variable bias occurs when two conditions are met: 1) when a non-included variable is correlated with one or more included variables and 2) when a non-included variable influences the target variable.

To reduce the risk of omitted variable bias, the inclusion of all significant variables in the multiple regression is tested which meets the second condition as the omission of these is a potential source of omitted variable bias. To this, the correlation between the significant variables is tested to meet the first condition.

Besides the risk of leaving out important variables, there is also the risk of adding unnecessarily many explanatory variables to the model. This is known as overfitting and is avoided by only including significant variables in the multiple regression – the purpose of the literature review was to identify variables where other researchers and economists have provided evidence for a connection with the stock market. In this way, it is likely that these variables will also be significant in explaining performance on the Danish stock market.

5. DATA ANALYSIS PROCESS

This chapter intends to describe how it is ensured that the time series are suitable and applicable for regression analysis, how the regression analysis is performed and how the robustness of the results of the regression analysis is measured.

The process of performing a regression analysis allows for confidently determining which factors that matter most, which factors can be ignored, and how these factors influence each other (Agresti, 2017). Linear regression seeks to explain the connection between two variables: X and Y (Newbold, Carlson and Thorne, 2013, p. 421). In this paper, X is an economic variable while Y is the average excess return of the winner portfolio. The slope and intercept are estimated using the ordinary least squares (OLS) method. OLS estimates the unknown parameters in a linear regression model and the idea is to minimize the differences between the actual observations in some arbitrary dataset and the predicted observations by the data's linear approximation (Newbold et al., 2013, p. 419). This can also be expressed as: $\varepsilon_i = Y_i - \widehat{Y_i}$ with ε_i being the error term.

The formula for linear regression is given by:

$$Y_i = \beta_0 + \beta_i X_i + \varepsilon_i$$

β_0 is the intercept with y-axis while β_i is the slope, i.e. it states the change in Y given a change in X. To test if the individual key figures are important for explaining the cross-section in excess return a null hypothesis test is carried out. By it, it is tested whether the key figures' coefficients are equal to zero (H_0) or different from zero (H_1). To do so, the p-value for each key figure is determined using a confidence interval of 95% which is the same as a significance level of 5%. If the p-value < 0.05, H_0 is rejected, i.e. the coefficient is different from zero and may affect the excess return (Newbold et al., 2013, p. 354).

Besides a p-value, the regression output shows in which direction X affects Y, i.e. β_i, as well as r^2. The latter indicates how much of the variability in the excess return that can be explained by the key figure.

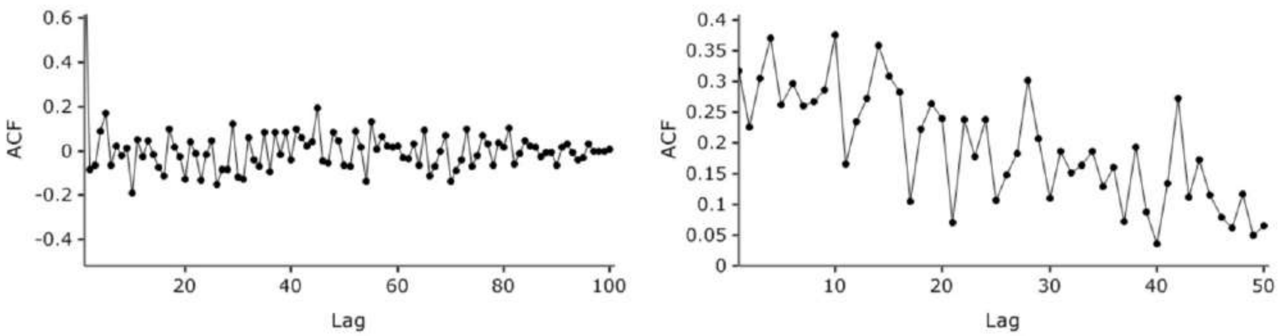
So, the purpose of investigating the dataset with linear regression is to test how well the selected economic variables can explain the excess return and, hence, explain the performance of the relatively best stocks on the Copenhagen stock exchange. Thus, the assumption is also that there is a linear correlation between the given variables and the excess return (Agresti, 2017).

Often, the target variable is affected by multiple variables. Consequently, multiple regression is employed[17]. Section 5.2 describes this more closely.

5.1 Stationarity and cointegration

In time series analysis, it is important to assess whether one's variables are stationary or non-stationary as it influences the processing of one's data and the outcome of one's test results. The statistical properties, such as mean, variance and autocorrelation, of a stationary time series (A) are all constant over time (Brooks, 2008, p. 318) in contrast to a non-stationary time series (B). This is illustrated below:

(A) (B)



Economic data will often exhibit non-stationarity for which reason it is important to address the problem in order not to draw incorrect conclusion on the basis of mistreatment of the data material used (Hyndman and Athanasopoulos, 2018, ch. 8.1). Non-stationary time series can affect both one's F-test and t-test[18] so that they are not correctly distributed as otherwise assumed.

Furthermore, non-stationary data can lead to misinterpreted relationships between variables and misleading r^2 values. This is also referred to as a spurious regression (Brooks, 2008, p. 319) where a

[17] It is also possible to see if the variables are more significant combined than individually from a multiple regression
[18] An F-test is a statistical test (test statistic follows an F-distribution under the null hypothesis) that is, typically, used to compare statistical models

The student's t-test is a statistical test (test statistic follows a t-distribution…) which can be used to determine if the mean of two datasets are significantly different from each other relationship between two variables is observed but where there is, in fact, no causal relationship. Instead, both time series are affected by a third underlying variable or chance. For instance, David Leinweber notices in his book "Nerds on Wall Street" that butter production in Bangladesh is closely related to the returns of the S&P 500 (Wigglesworth, 2018, p. 1).

There are a number of different tests of the long-term causal relationship between time series. In practice, cointegration between the variables is tested – that is, whether the non-stationary variables show a long-term relationship where the residuals between the variables are approximately constant (Koop, 2009, p. 166).

5.1.1 Test of stationarity

Usually, non-stationary time series can be made stationary by taking the difference between t and $t - 1$. The required number of differences, k, to achieve stationarity depends on the number of unit roots contained in the time series, $I(k)$[19]. A time series that is $I(0)$ contains no unit roots and so differencing is not necessary since the data is already stationary (Stock and Watson, 2012, p. 685).

The Augmented Dickey Fuller (ADF) method (1979) is utilized in this paper to test for stationarity. This test is performed similarly to hypothesis testing with the null hypothesis being non-stationarity. The alternative hypothesis is, then, that the time series is stationary (no unit root). First, the original data tested. If the null hypothesis is rejected in favor of the alternative hypothesis, there is no need to take the first difference (assuming the original data causes no other distortions). If it is not possible to reject the null hypothesis, the test is performed again on the first difference. Provided that the null hypothesis is, then, rejected, the original data is $I(1)$, i.e. has a single unit root.

There are several ways of undertaking an ADF test depending on the time series development. Most prevalent is the distinction of whether the time series exhibit trend (Stock and Watson, 2012, p. 590). Since the variables are not expected to be stationary, the ADF test without trend is used as the first difference usually eliminates trend.

[19] The data has an order of integration (I) corresponding to the number of unit roots

When utilizing an ADF test, it is necessary to consider the number of lagged values, ρ (lag length), of one's variables the test should include. Different lag lengths yield different results. Too few lag lengths may mean that important information is omitted in the test while too many lags can increase one's error estimates (Stock and Watson, 2012, p. 587). A simple and widespread method of determining lags is proposed by Schwert (1989) which is also used here. ρ_{max} is determined from below formula with n being the number of observations – in this paper, $n = 45$[20].

$$\rho_{max} = \left[12\left(\frac{n}{100}\right)^{0.25}\right] = \left[12\left(\frac{45}{100}\right)^{0.25}\right] = 9.8284 \approx 10$$

Besides the ADF test, the most prevalent test for stationarity is the Phillips-Perron tests. The latter is more comprehensive than the ADF test but otherwise very much alike. The two types of test usually have the same outcome and have also been criticized for the same (Brooks, 2008, p. 330). In the case where the null hypothesis is only just rejected (close to the significance level) and stationarity can be assumed, both methods have also been criticized for not being reliable – the contention is amplified by fewer observations (Brooks, 2008, p. 331).

Since the ADF- and the Phillips-Perron tests have many similarities and also are criticized for the same, only the ADF test is used.

The weaknesses of the ADF test can, of course, affect the dissertation's results. To counter this, the autocorrelation of the time series is analyzed just as various validity tests are conducted.

5.1.2 Test of cointegration

In continuation of the above, it is examined whether the time series contain long-term causal relationships which have already been briefly described. Testing for cointegration is vital in examining whether stock prices are predictable (Rangvid, 2002) and, thus, in answering the problem statement. The relevance of the cointegration test is further enhanced by the fact that nominal terms are used – by which, all variables are influenced by inflation.

[20] For the sample period, i.e. 2008-2018

Of the most well-known tests for cointegration, the Engle-Granger Test (1987) and the Johansen Test (1990) can be mentioned. The theoretical details of the latter require experience with multivariate time series, in particular vector autoregressive models (VAR)[21], which is beyond the scope of this paper. Instead, the Engle-Granger Test is employed which also often used in textbooks.

As previously mentioned, cointegration can be formulate as the *"... phenomenon that nonstationary processes can have linear combinations that are stationary."* (Johansen, 2004, p. 1) or, alternatively, that two $I(1)$ timeseries form a $I(0)$ time series in their residuals (Koop, 2009, p. 166).

In the Engle-Granger Test, a regression analysis is performed on the original data material. It is known in advance, from the ADF-test, whether the different time series are $I(1)$ and, thus, if it is necessary to test for cointegration. After obtaining the results from the regression, an ADF-test is performed on the residuals with the same lag length as in the original ADF-test (Koop, 2009, p. 177). The null hypothesis is that cointegration does not occur while the alternative hypothesis is that it does. The critical values from the Engle-Granger test, by which it is determined whether or not to reject the null hypothesis, are not the same as in the original ADF-test. Instead, the critical values from the Engle-Granger test are compared to the t-values of the ADF-test. Hereby, a valid result of one's test is obtained (Koop, 2009, p. 170).

In the event of both non-stationarity and cointegration, it is necessary to adjust for this long-term relationship via an error correction model (ECM) by saving the residuals after the regression and adding these to the regression model. This should, however, only be done if cointegration appears between variables – adjusting one's regression model if no cointegration is found would be wrong (Stock and Watson, 2012, p. 691).

There are several criticisms of the Engle-Granger test. Since the ADF-test is also part of the Engle-Granger test, the criticism of the former recurs – especially, the discussion on optimal lag length. Besides this, the Engle-Granger test is criticized for its results to depend on which variable that is chosen as the dependent variable. That is, the result can be influenced by whether variable X is re-gressed on variable Y, or if Y is regressed on X (Rangvid, 2002).

[21] Multidimensional extension of the autoregressive models (AR)

Whether the cointegration test can create a potential validity problem is considered minimal as the coherence has to be fairly consistent. As the literature review also showed, share prices seem to be influenced by many different external factors. Hence, it is not expected that the development in one variable alone affects the share price to a degree that gives rise to cointegration.

5.2 Regression model

The hypotheses and problem statement of this paper about the relationships between economic variables and stock performance are either accepted or rejected on the basis of a regression analysis. The regression model is adjusted depending on whether stationarity and/or cointegration exists as discussed above.

Three regression analyses will be performed on the dependent variable with the time period, i.e. number of events, as the only difference.

In general, long time series reinforce a regression as it thereby becomes less affected by extraordinary events. At the same time, it can also create a bias towards rejecting the hypothesis of no relationship (Rangvid, 2006). Major changes in the time series can be diluted in one's regression and therefore be omitted from the results. To avoid this, the sample period is divided into two sub-periods to analyse whether the data contains trends or patterns that do not appear in the full period.

The influence of nine variables is examined via multiple regression. The optimal regression equation is constructed using backwards elimination which also allows for determination of the importance of each independent variable (Statistics Solutions, 2019, p. 1). To begin with, all the independent variables are entered into the regression equation. Then, the variable that is least significant, i.e. has the largest p-value, is removed and the model is refitted. This process is continued until all remaining independent variables have individual p-value below 0.05[22] (ibid). By doing so, only the independent variables that contribute to the regression equation remain. Likewise, the retained explanatory variables will account for almost as much of the variance as the total set of explanatory variables – indicated by R^2.

[22] 5% significance level is utilized

By beginning with all independent variables in the model, any joint predictive capability will be noticed, i.e. it is possible that, for instance, two variables have considerable predictive power combined even though they do not individually (Dallal, 2012, p. 1).

5.3 Validity tests

There are a number of assumptions that must be met when performing the regression, F-test and Student's t-test:

- Linearity and additivity
- Statistical independence of the errors
- Normality of the error distribution
- Homoscedasticity of the errors
- No multicollinearity

Independence refers to the residuals not showing any trend or other patterns. In case the residuals are not independent of each other, it can affect the reliability of the results from the regression. The independence is tested by looking at the autocorrelation for the residuals and by a Durbin-Watson test. In addition, the autocorrelation plots will also support the tests for stationarity.

Autocorrelation denotes the situation in which values can be predicted based on preceding values in the series, i.e. a relationship between the current value of a variable and its past values exist. Since this paper operates with subperiods, autocorrelation could be a problem[23]. A certain amount of autocorrelated observations is to be expected for most time series. Thus, the Durbin-Watson test is also performed. As seen from below, the test gives a value between 0 and 4 where 2 indicates that the residuals are random, i.e. no autocorrelation (Makridakis, Wheelwright and Hyndman, 1998, p. 268).

[23] If the variables show signs of season it can be remedied by adding a dummy variable to one's regression. These seasonal patterns must, however, be rather consistent before a dummy variable is added (Makridakis, Wheelwright and Hyndman, 1998, p. 269)

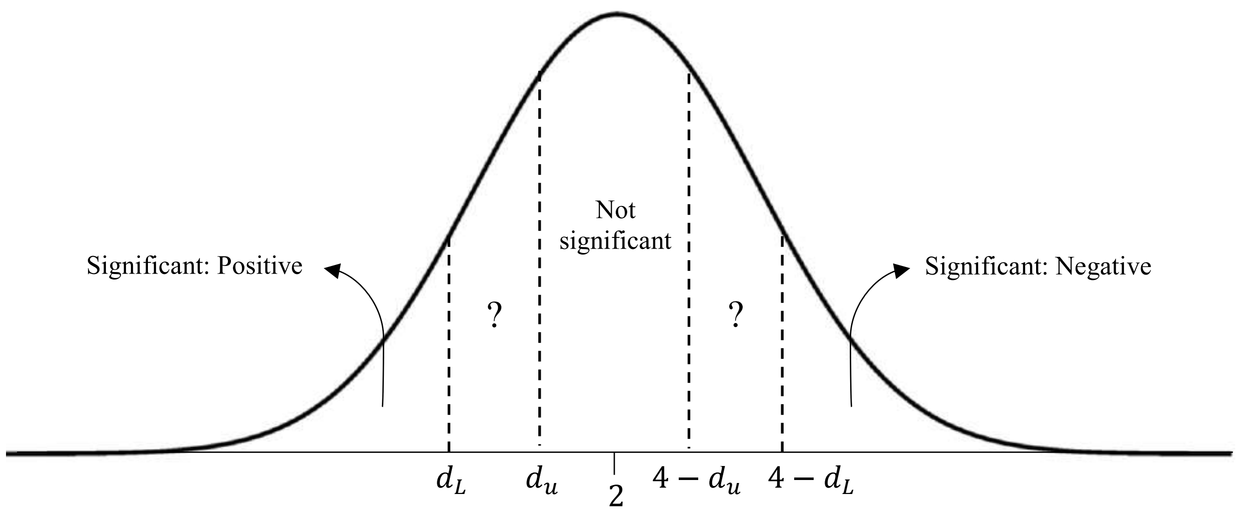


Figure 12: Durbin-Watson statistic

The Durbin-Watson is limited in that it can only be performed on lag 1. Consequently, it does not test for autocorrelation on higher lags. It is, however, not as restrictive as it may sound as lag 1 is the most common. In addition, it has been found that if autocorrelation exists on lag 1, it will often also be present at higher lags (Makridakis, Wheelwright and Hyndman, 1998, p. 265).

Equally, the residuals are assumed to follow a normal distribution which is tested by setting up a histogram. This assumption is not vital, and it is only in case of great deviations that one's test and data material should be reconsidered (Makridakis, Wheelwright and Hyndman, 1998, p. 261).

Regarding the assumption of homoscedasticity, it is tested if the standard errors of a variable, ε_i, are constant over a specified amount of time. If the variance of ε_i vary with the variables being modeled, it exhibits heteroscedasticity. Conditional heteroscedasticity often arises *"... in the prices of stocks and bonds."* (Hayes (C), 2019, p. 1) which means that *"... future periods of high and low volatility cannot be identified."* (ibid), i.e. non-constant volatility. Two tests for heteroscedasticity are performed to assist each other: the Breusch-Pagan test (1979) and the White test (1980). Graphical representation, such as a scatter plot, can be misleading since the individual variables can yield different results – e.g. ROIC may reject heteroscedasticity while P/E confirms it (Brooks, 2008, p. 133).

As for the mean value, it will always be 0 if the regression model contains a constant. However, it may well occur the time series are best explained without a constant with which the problem will have to be further elucidated (Brooks, 2008, p. 131). The assumption can only be tested after the regression is performed as the residuals from the regression must be used. If satisfactory results are not obtained for the above tests on the residuals, considerations should be given to changing the data to get a more accurate regression model, e.g. by further transforming the time series or alternatively by changing the model (Makridakis, Wheelwright and Hyndman, 1998, p. 326).

Multicollinearity refers to a (typically approximate) linear relationship arising among two or more independent variables. A linear regression is not significantly damaged by the emergence of non-perfect multicollinearity, although the coefficient estimates may be slightly inaccurate. Multicollinearity is difficult to test for in practice. Thus, in some analyses, multicollinearity is simply recognized as a potential problem but otherwise ignored (Brooks, 2008, p. 171). A certain correlation is also inevitable since some economic variables, in their nature, are correlated due to either inflation or coincidence in their components. In this paper, correlation matrixes are employed which enables identification of highly correlated variables.

There are additional assumptions regarding regression analysis and its validity, including no correlation between the independent variables and residuals, which will not be tested for. Instead, it will simply be recognized that they exist and accepted as potential sources of error. The tests employed in this paper have been selected on the basis of the academic literature and similar studies. Therefore, the main assumptions are presumed to be elucidated. If all the tests in the literature were to be prepared, it would be enormously time consuming as well as give the thesis a different character than intended.

Finally, most of the tests as well as relevant issues in relation the data material will be assessed graphically or from economic intuition as recommended in most of the applied literature.

5.4 Revision of results

The applicability tests on the data material and the validity tests ensure a credible result which could potentially reject the advanced hypotheses and the problem statement. The obtained results will challenge the observed relationships from the literature review and test if the relationships occur on the

Danish stock market as the evidence suggests. One question that arises in case of deviations from previous studies or theory is why these deviations occur. A thorough answer to this question lies outside the focus of this paper but the subsequent revision and discussion of the results will try to discuss issues that can affect the results and, with that, provide a more nuanced conclusion.

5.5 Summary

The figure below summarizes the processes of this paper.

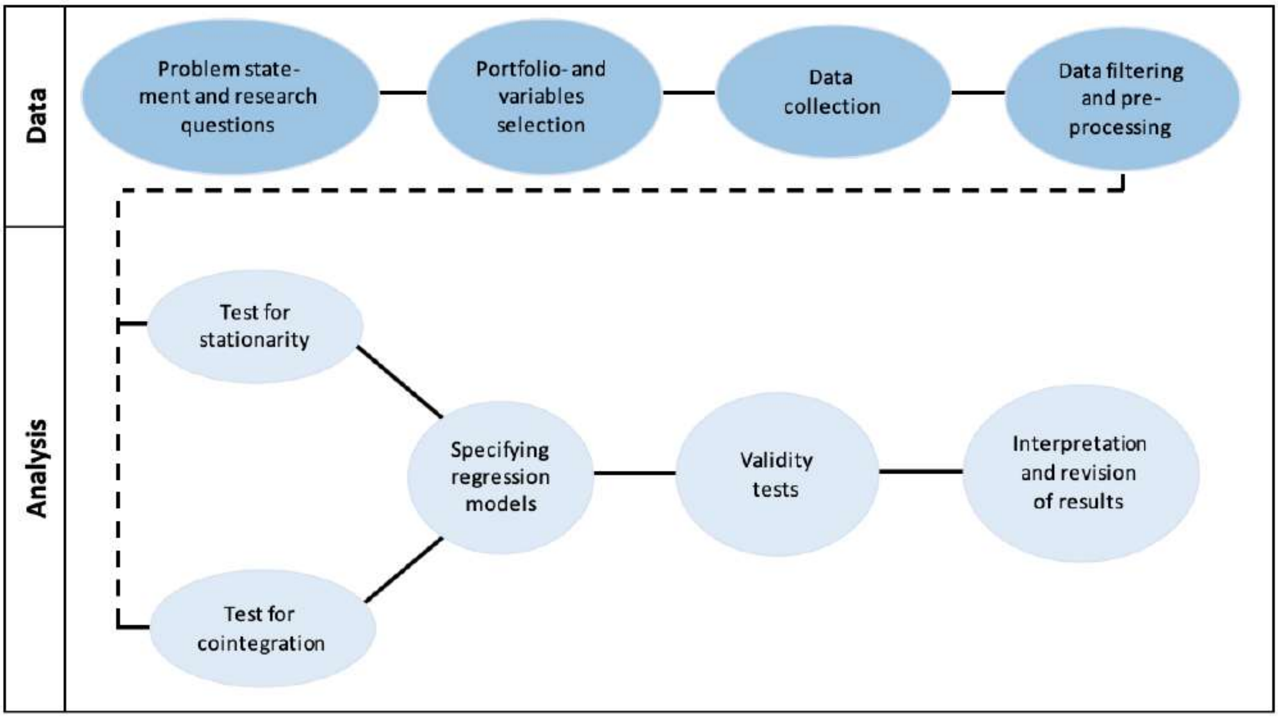


Figure 13: Data analysis process diagram

To mitigate potential noise in the regression, emphasis is placed on the following parameters in the selection of variables for the multiple regression model:

- Theoretical basis for variables included in the model, cf. section 3.1 and 4.3
- Test of whether the variables are significantly different from zero, via a null hypothesis test
- Investigate possible sources of noise in the regression
- Clarity about the results so it is clear what effect it has to include or exclude a variable in/from the model

6. DATA- AND TEST RESULTS

This chapter presents and goes through the results of the econometric tests. It is, thus, the first step to answering the problem statement of the thesis on whether there is a connection between the selected economic variables and stock performance in Denmark. The chapter is structured according to figure 13 so that tests for stationarity and cointegration are reviewed first. Then, the regression models and the results of the regression analyses are shown. Finally, the validity tests are reviewed which will illustrate the robustness of the models.

Three regressions have been performed: one for the entire period 2008-2018 and one for each sub-period 2008-2012 and 2013-2018. The regressions for the subperiods are performed to show if the relationships change over time and to test whether the total amount of observations dilutes potentially important information.

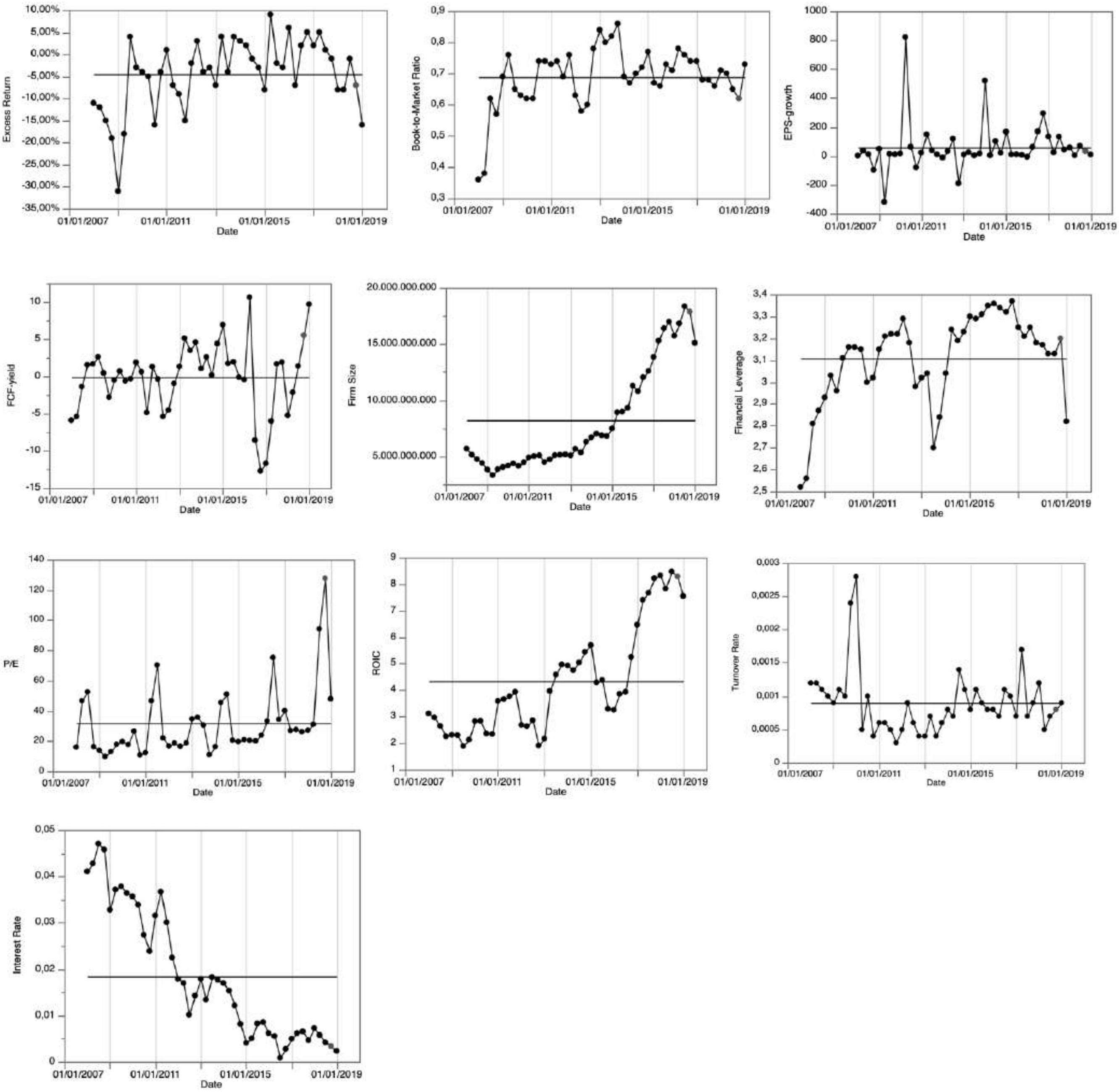
6.1 Test for stationarity

To ensure that the results of the regression analysis are meaningful, the time series are required to be stationary. This is first examined through a graphic representation and by looking at the time series' autocorrelation. The graphical representation contributes, in particular, to the final test for stationarity – the Augmented Dickey Fuller test. From figure 14, it is evident that the majority of the time series have had up- or downward (only applies to the interest rate) trends regardless of the period being analyzed.

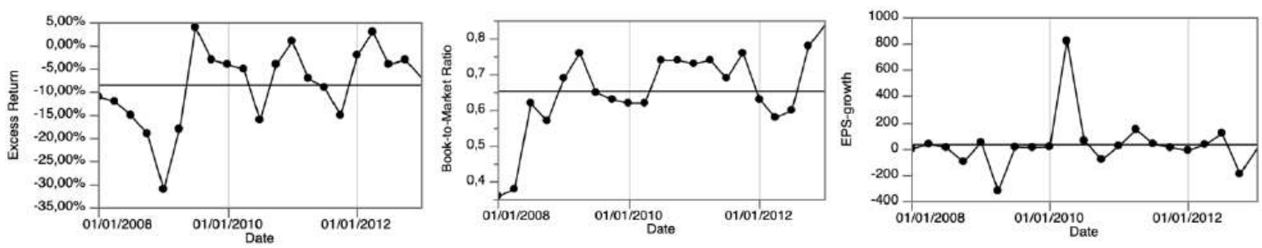
Several of the variables, including book-to-market and ROIC, seem to have been at a low level during the first few years; a significant part of this is probably due to the financial crisis. Conversely, the interest rate was at a high level but has since fallen to a historically low level. During a recession, consumers tend to save money rather than spending it. Thus, there is less demand for credit for which reason interest rates drop.

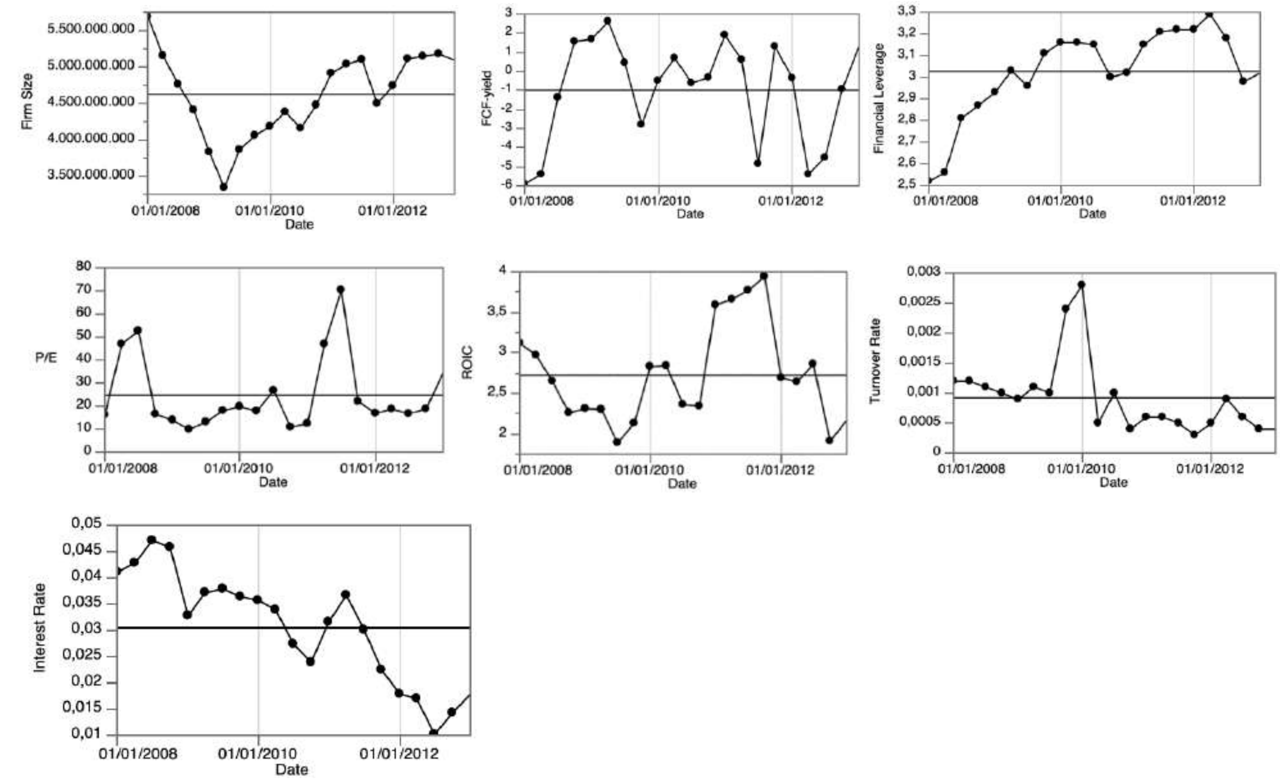
EPS-growth, turnover rate and maybe also FCF-yield indicate being stationary. They do not show signs of trend. There is, however, some variation in the variance of all three.

(A) Entire period, 2008-2018

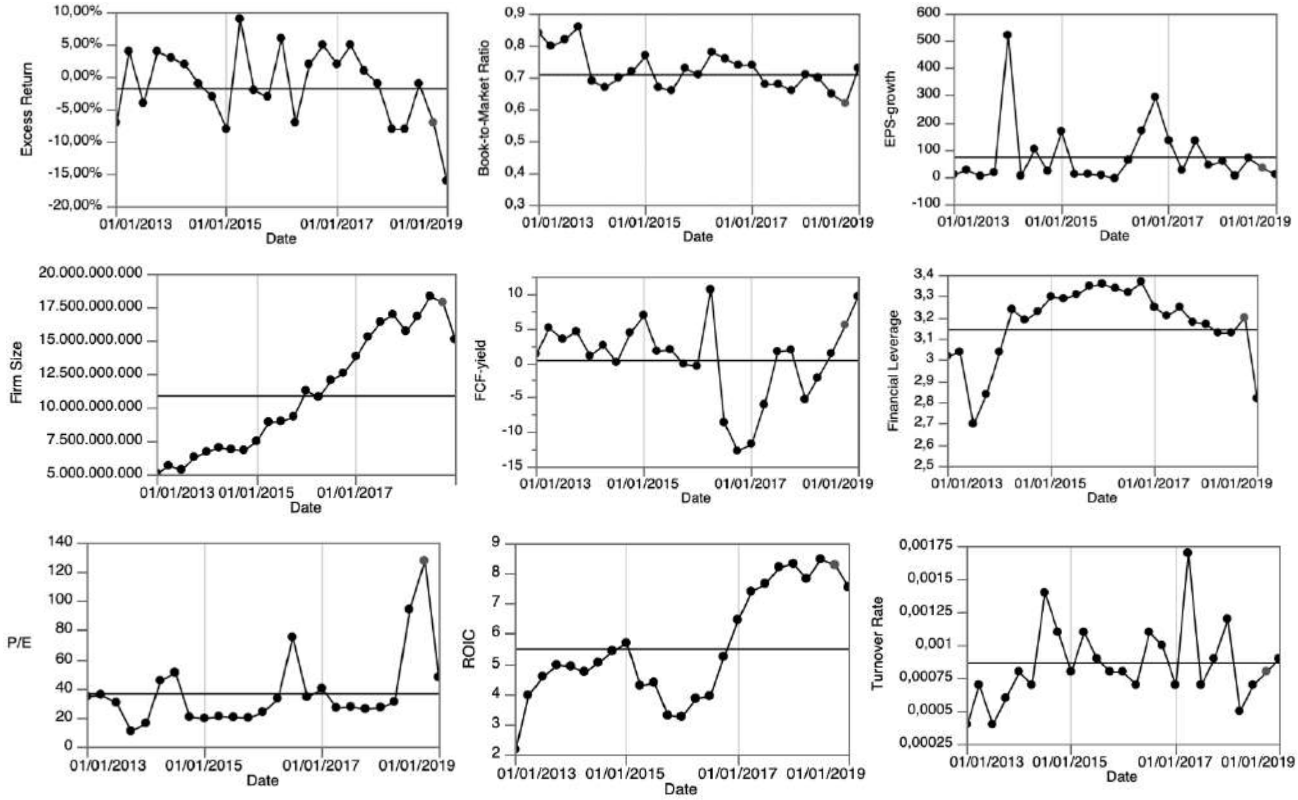


(B) Subperiod, 2008-2012





(C) Subperiod, 2013-2018



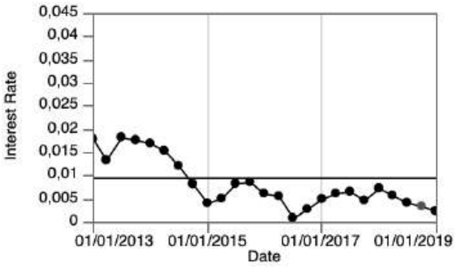


Figure 14: The development of the variables during the respective periods

ACF plots, which show the autocorrelation for the different time series at different lags, are visible from appendix C. *"For a stationary time series, the ACF will drop to zero relatively quickly, while the ACF of non-stationary data decreases slowly. Also, for non-stationary data, the value of* r_1 *is often large and positive."* (Hyndman and Athanasopoulos, 2018, ch. 8.1). Moreover, if the

$$test\ statistic\ (tau\ value) < \ Critical\ value = Reject\ H_0$$

The critical values are calculated as follows:

$$Critical\ value = t + \frac{u}{N} + \frac{v}{N^2} + \frac{w}{N^3}$$

where t, u, v and w are defined in appendix D (Zaiontz, 2019, p. 1). Likewise, if

$$P - value < 0.05 = Reject\ H_0$$

The ACF plots show that the values for autocorrelation, for most time series, fall within the critical values. For several time series, they are significant at most of their lags, while for others, they are not by any lag or only very few lags. In this way, some time series give the impression of being stationary while others do not. Whether the time series are stationary is finally confirmed in the ADF test where the results are shown below. The determination of lag length is based on Schwert's formula. The entire period is analyzed by lag 10, while the two subperiods 2008-2012 and 2013-2018 are decided on lag 8 and 9, respectively.

Table 2: Results from the Augmented Dickey-Fuller test

Variable	Critical value	Test statistic	p-value	Comment	Test statistic	p-value	Comment	$I(k)$
	No differencing				First-order differencing			
	2008-2018, 10 lags							
Excess return	-2.9283	-3.7093	0.0108	Reject H_0	-8.3220	0.0826	Fail to reject H_0	$I(0)$
Book-to-market	-2.9283	-4.3852	0.0146	Reject H_0	-6.8670	0.4931	Fail to reject H_0	$I(0)$
EPS-growth	-1.9483	-6.4774	0.9785	Fail to reject H_0	-10.778	0.2095	Fail to reject H_0	$I(2)$
Firm size	-3.5130	-2.3106	<.0001	Reject H_0	-4.3181	0.7711	Fail to reject H_0	$I(0)$
FCF-yield	-2.9283	-3.5991	0.0021	Reject H_0	-7.1536	0.1627	Fail to reject H_0	$I(0)$
Fin. leverage	-2.9283	-3.0673	<.0001	Reject H_0	-5.4362	0.7056	Fail to reject H_0	$I(0)$
P/E	-3.5130	-4.2806	0.1117	Fail to reject H_0	-6.1040	0.0863	Fail to reject H_0	$I(1)$*
ROIC	-3.5130	-2.2962	<.0001	Reject H_0	-5.0902	0.0905	Fail to reject H_0	$I(0)$
Turnover rate	-1.9483	-1.8843	0.4932	Fail to reject H_0	-9.3025	0.2525	Fail to reject H_0	$I(2)$
Interest rate	-3.5130	-2.5881	<.0001	Reject H_0	-6.2538	0.0447	Reject H_0	$I(0)$
	2008-2012, 8 lags							
Excess return	-3.0131	-2.5802	0.4269	Fail to reject H_0	-4.3439	0.1449	Fail to reject H_0	$I(2)$
Book-to-market	-3.6450	-2.6931	0.4486	Fail to reject H_0	-4.4762	0.8663	Fail to reject H_0	$I(k)$
EPS-growth	-1.9581	-4.2490	0.9754	Fail to reject H_0	-6.9760	0.3854	Fail to reject H_0	$I(2)$*
Firm size	-3.6450	-3.1791	0.0031	Reject H_0	-3.2197	0.7123	Fail to reject H_0	$I(0)$
FCF-yield	-3.6450	-3.1950	0.4378	Fail to reject H_0	-4.3041	0.1466	Fail to reject H_0	$I(2)$
Fin. leverage	-3.6450	-1.6951	0.0112	Reject H_0	-4.5455	0.9227	Fail to reject H_0	$I(0)$; $I(2)$*
P/E	-3.0131	-3.0504	0.5091	Fail to reject H_0	-4.4221	0.5236	Fail to reject H_0	$I(k)$
ROIC	-3.6450	-1.9569	0.0012	Reject H_0	-4.2414	0.7175	Fail to reject H_0	$I(0)$; $I(2)$*
Turnover rate	-3.6450	-3.0395	0.6227	Fail to reject H_0	-5.1731	0.8673	Fail to reject H_0	$I(k)$
Interest rate	-3.6450	-2.9873	<.0001	Reject H_0	-3.7031	0.2596	Fail to reject H_0	$I(0)$
	2013-2018, 9 lags							
Excess return	-3.6035	-4.4242	0.6749	Fail to reject H_0	-8.3103	0.0267	Reject H_0	$I(1)$; $I(2)$
Book-to-market	-3.6035	-3.2990	0.2510	Fail to reject H_0	-5.1583	0.2518	Fail to reject H_0	$I(2)$
EPS-growth	-2.9865	-4.9408	0.9208	Fail to reject H_0	-8.0868	0.2596	Fail to reject H_0	$I(2)$
Firm size	-3.6035	-1.6247	<.0001	Reject H_0	-3.1727	0.8224	Fail to reject H_0	$I(0)$
FCF-yield	-1.9551	-2.5048	0.0084	Reject H_0	-5.3628	0.1269	Fail to reject H_0	$I(0)$; $I(2)$
Fin. leverage	-2.9865	-1.4650	0.0006	Reject H_0	-4.0497	0.9816	Fail to reject H_0	$I(0)$
P/E	-2.9865	-2.8049	0.1531	Fail to reject H_0	-4.2315	0.3242	Fail to reject H_0	$I(3)$*
ROIC	-3.6035	-1.6050	<.0001	Reject H_0	-3.7061	0.0356	Reject H_0	$I(0-2)$
Turnover rate	-3.6035	-4.9492	0.2142	Fail to reject H_0	-8.6372	0.0002	Reject H_0	$I(1)$; $I(2)$
Interest rate	-3.6035	-2.0393	<.0001	Reject H_0	-4.6600	0.4428	Fail to reject H_0	$I(0)$

*At a 90% confidence interval

The null hypothesis can, to a large extent, be rejected by $I(0)$ for the entire period. Moreover, the null hypothesis can be rejected for half of the variables for the period 2013-2018. Since it would be necessary to transform this half of the variables s, it is chosen to continue with $I(0)$ for 2013-2018[24]. If the time series for 2008-2012 is transformed into second difference, it is seen that the null hypothesis is rejected at the majority of the variables for the subperiod, although it is only marginally better than with no difference – also because the null hypothesis is rejected at a 10% significance level for multiple variables. It should also be pointed out that in the period of 2008-2012, more than three differences are required for the three explanatory variables book-to-market ratio, P/E and turnover rate to achieve the rejection of the null hypothesis.

The tests for stationarity have determined part of the regression models that are finally shown in section 6.3. The regression is run without any transformation for the entire sample period and the 2013-2018 subperiod while the regression is run on the variables' second-order difference for 2008-2012. This is also chosen and driven from a desire for consistency in the order of integration in the respective regression models. Consistency is important as it has an influence on what is analyzed – the choice is further elaborated in section 6.4. The following section tests for cointegration. If the tests show cointegration, the regression models are adjusted to take this into account.

6.2 Test for cointegration

As previously mentioned, cointegration refers to whether non-stationary time series show a stationary relationship. The tests are, therefore, performed on the original time series and not the transformed, cf. section 6.1. Moreover, since no unit roots were found for the entire period and for subperiod 2013-2018, the cointegration test is carried out solely on subperiod 2008-2012 where the variables are integrated of order two, $I(2)$. To ensure that no individual relationships are overlooked, a total of five tests for cointegration are performed. Four tests are the individual variables against the average excess return while the last test is all explanatory variables combined against the average excess return.

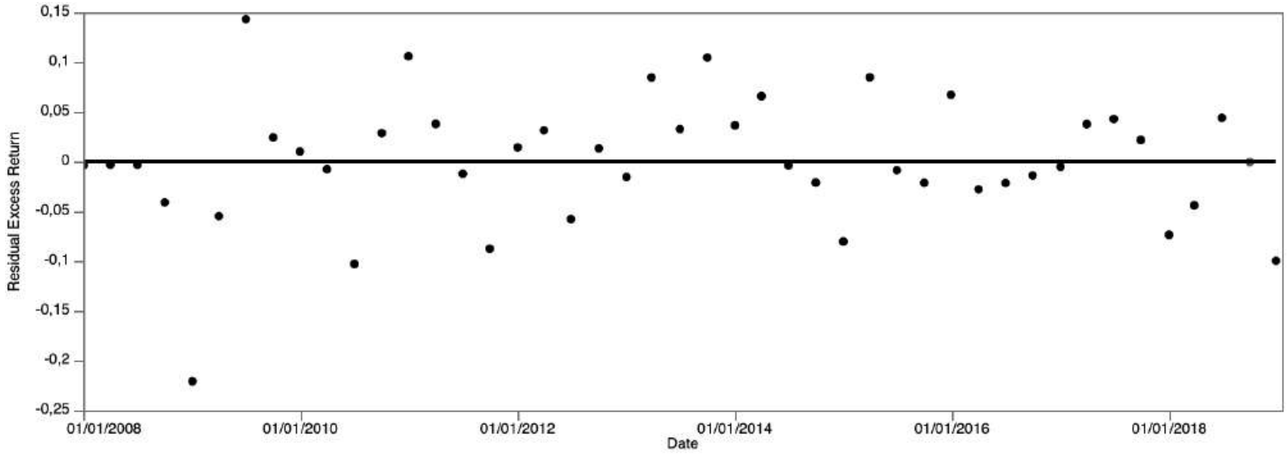
The test for cointegration is done by regressing each of the explanatory variables against the average excess return and then testing for stationarity in the residuals via the ADF test. The critical values in

[24] A transformation will also influence the interpretation at the end. Thus, it is preferred to use the original data set as far as possible

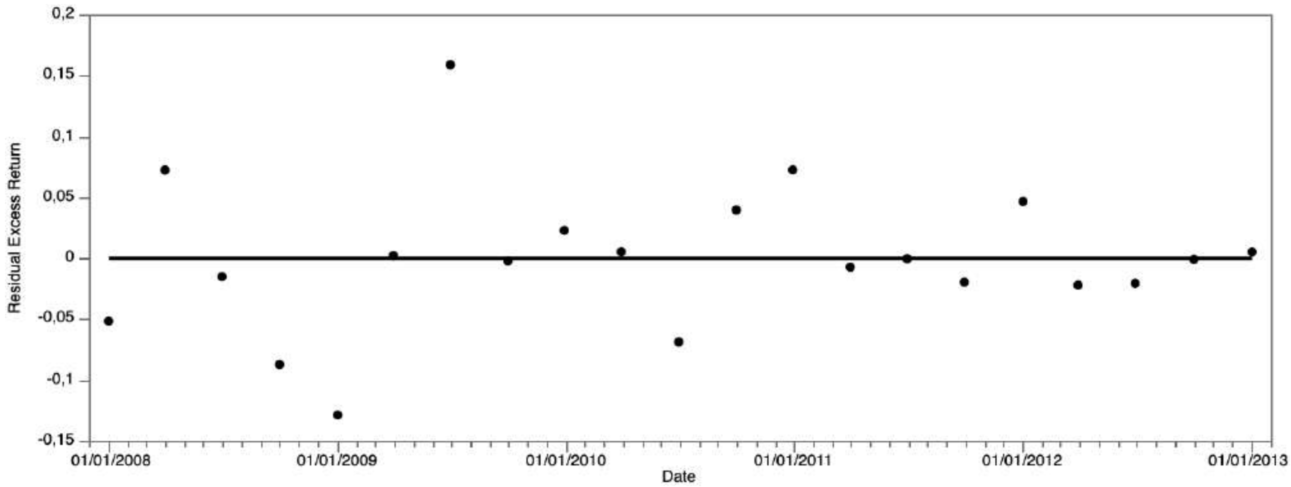
the Engle Granger test are different from those in the ADF test and thus the p-values cannot be used. Instead, critical values from MacKinnon (2010, p. 13) are used which are shown in appendix E.

Test for cointegration is first shown graphically. It has been chosen to show the residuals for the model with all variables as this is also expected to show if there are individual connections.

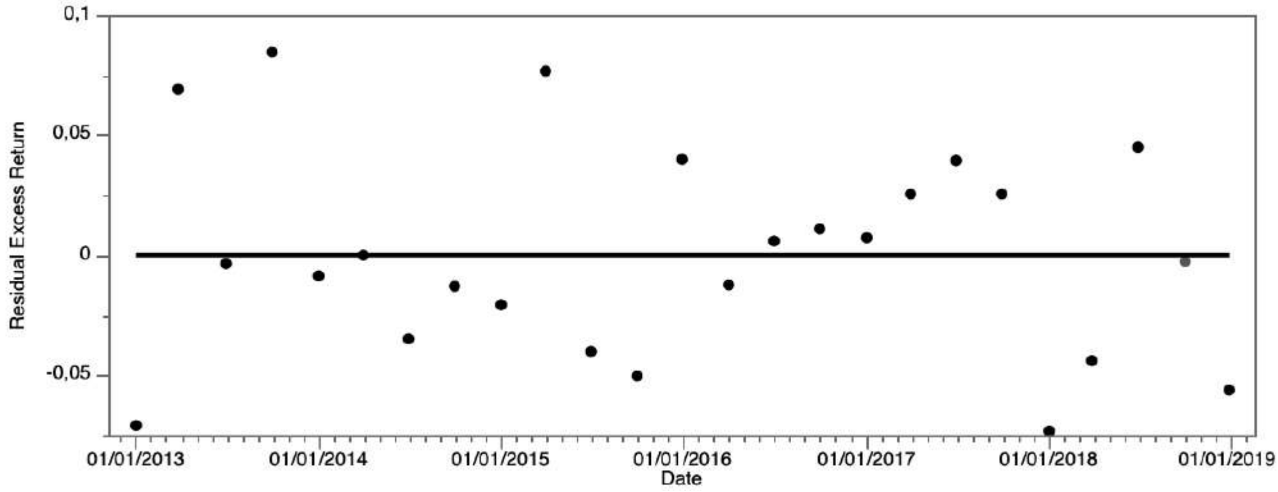
(A) Entire period, 2008-2018



(B) Subperiod, 2008-2012



(C) Subperiod, 2013-2018



(A) has slightly fluctuating variance at the beginning of the period but the variance seems to be reduced over the period. The same is true for (B). Regarding (C), the Y-axis should be noted; although, the variance seems to be fluctuating over the period (and thus does not appear to be stationary in its residuals), most residuals are actually around the mean.

Table 3: Results from the Engle Granger test

Variable	Critical value	Test statistic	Comment	Cointegration
For non-stationary time series				
2008-2012, 8 lags				
Book-to-market	-3.67	-3.0319	Fail to reject H_0	No
EPS-growth	-3.67	-3.0953	Fail to reject H_0	No
Firm size	-3.67	-2.6632	Fail to reject H_0	No
FCF-yield	-3.67	-3.1726	Fail to reject H_0	No
Fin. leverage	-3.67	-3.0538	Fail to reject H_0	No
P/E	-3.67	-3.0593	Fail to reject H_0	No
ROIC	-3.67	-3.0319	Fail to reject H_0	No
Turnover rate	-3.67	-3.0474	Fail to reject H_0	No
Interest rate	-3.67	-3.2237	Fail to reject H_0	No
All variables	-4.71	-3.8985	Fail to reject H_0	No

If the values from the ADF-test are lower than the critical values, the null hypothesis is rejected, and it is concluded that there is cointegration. Based on the results above, there is no cointegration in the subperiod 2008-2012.

6.3 Specifying the regression models

As mentioned in section 5.2, the regression models form the empirical basis for whether or not the hypotheses and problem statement can be rejected. It is, thus, the regression models that show whether some of the theoretical relationships between the explanatory variables and the stock market found in section 3.1 also apply to the Danish stock market during the period examined. As shown in the ADF test, the variables in the period 2008-2018 and for 2013-2018 are $I(0)$, whereas the variables in the subperiod 2008-2012 are $I(2)$ (shown as $\delta 2$). The integration of order is consistent in the respective models as it is important for the interpretation of the results.

The regression models are given by:

$$2008-2018\text{: } Excess\ return = \beta_0 + \beta_1 \cdot Book-to-market + \beta_2 \cdot EPS-growth + \beta_3 \cdot Firm\ Size + \beta_4 \cdot FCF-yield + \beta_5 \cdot Financial\ Leverage + \beta_6 \cdot P/E + \beta_7 \cdot ROIC + \beta_8 \cdot Turnover\ Rate + \beta_9 \cdot Interest\ Rate + \varepsilon_t$$

$$2008-2012\text{: } \delta 2Excess\ return = \beta_0 + \beta_1 \cdot \delta 2Book-to-market + \beta_2 \cdot \delta 2EPS-growth + \beta_3 \cdot \delta 2Firm\ Size + \beta_4 \cdot \delta 2FCF-yield + \beta_5 \cdot \delta 2Financial\ Leverage + \beta_6 \cdot \delta 2P/E + \beta_7 \cdot \delta 2ROIC + \beta_8 \cdot \delta 2Turnover\ Rate + \beta_9 \cdot \delta 2Interest\ Rate + \varepsilon_t$$

$$2013-2018\text{: } Excess\ return = \beta_0 + \beta_1 \cdot Book-to-market + \beta_2 \cdot EPS-growth + \beta_3 \cdot Firm\ Size + \beta_4 \cdot FCF-yield + \beta_5 \cdot Financial\ Leverage + \beta_6 \cdot P/E + \beta_7 \cdot ROIC + \beta_8 \cdot Turnover\ Rate + \beta_9 \cdot Interest\ Rate + \varepsilon_t$$

Before the results of the regression are shown in table 5, it is briefly described what the three models are trying to explain.

All models are linear with a constant term, β_0, and an error term, ε_t. The β-terms are the coefficients for the respective variables and indicate how the variable moves relative to the excess return. As a result, these coefficients are important in relation to the set hypotheses and their interpretation. A negative coefficient conveys an inverse correlation between the variable and the excess return, while a positive coefficient exhibits that the variable has a positive correlation with the excess return.

As the variables for 2008-2012 are in their second difference, the model seeks to show how "the change in the change" in the explanatory variables affects the change in the change in the excess return. In other words, the model tries to explain how the development in the changes in the explanatory variables affects the development of the change in the excess return.

As described in section 5.2, backward elimination is applied to construct optimal regression equations containing only those explanatory variables *"... that are necessary and account for nearly as much of the variance as is accounted for by the total set."* (Statistics Solutions, 2019, p. 1). Along with this, backward selection helps to assess the effect of eliminating a variable and hence determine the level of important of each explanatory variable.

The equations above include all independent variables. In appendix F, the variables are removed one at a time if they do not contribute to the regression model. The equations below show the variables retained based on their statistical contribution together with the results from the multiple regression:

$$2008-2018\colon Excess\ return = \beta_0 + \beta_1 \cdot FCF-yield + \beta_2 \cdot Interest\ rate + \varepsilon_t$$

$$\begin{aligned}2008-2012\colon &\delta 2Excess\ return\\ &= \beta_0 + \beta_1 \cdot \delta 2EPS-growth + \beta_2 \cdot \delta 2Firm\ size + \beta_3 \cdot \delta 2Turnover\ rate + \varepsilon_t\end{aligned}$$

$$2013-2018\colon Excess\ return = \beta_0 + \beta_1 \cdot FCF-yield + \beta_2 \cdot ROIC + \varepsilon_t$$

Table 4: Multiple OLS regression results for the excess return

Regression coefficients, 2008-2018						
Variable	Coefficient	Std error	t-value	p-value	Lower 95%	Upper 95%
β_0	0.0070	0.0172	0.40	0.6879	-0.0277	0.0417
FCF-yield	-0.0039	0.0022	-1.79	0.0812*	-0.0084	0.0005
Interest rate	-2.8451	0.7473	-3.81	0.0005	-4.3533	-1.3370
R^2	0.2861					
ANOVA Table						
Source	DF[25]	Sum of squares (SS)	Mean square	F value	p-value	
Explained	2	0.0804	0.0402	8.4154	0.0008	
Unexplained	42	0.2006	0.0048			

*At a 10% significance level

Regression coefficients, 2008-2012						
Variable	Coefficient	Std error	t-value	p-value	Lower 95%	Upper 95%
β_0	-0.0059	0.0212	-0.28	0.7829	-0.0511	0.0392
δ2EPS-growth	-0.0002	0.0001	-2.45	0.0270	-0.0003	-0.0000
δ2Firm size	0.0000	0.0000	4.23	0.0007	0.0000	0.0000
δ2Turnover rate	-82.5019	31.4270	-2.63	0.0191	-1.4949	-1.5517
R^2	0.6030					
ANOVA Table						
Source	DF	SS	Mean square	F value	p-value	
Explained	3	0.1935	0.0645	7.5955	0.0026	
Unexplained	15	0.1274	0.0085			

[25] Degrees of freedom

Regression coefficients, 2013-2018						
Variable	Coefficient	Std error	t-value	p-value	Lower 95%	Upper 95%
β_0	0.0467	0.0330	1.42	0.1702	-0.0216	0.1151
FCF-yield	-0.0046	0.0018	-2.58	0.0170	-0.0083	-0.0009
ROIC	-0.0101	0.0056	-1.82	0.0831*	-0.0217	0.0014
R^2	0.2973					
ANOVA Table						
Source	DF	SS	Mean square	F value	p-value	
Explained	2	0.0242	0.0121	4.6544	0.0206	
Unexplained	22	0.0572	0.0026			

*At a 10% significance level

From table 5, it is clear the results change after which period is analyzed. Looking at the ANOVA table, all three regressions show a high f-value and very low p-values, indicating that the remaining independent variables explain a significant part of the variability in the excess return. Furthermore, the results must be viewed together with the coefficient of determination, R^2, which is an expression of the goodness of fit of the models, i.e. how well the models' predictions approximate the real data points for the excess return. The higher R^2, the better the model's estimates for the excess return fit on the original excess return data. As it can be seen, the R^2 is low for 2008-2018 and 2013-2018 but, on the other hand, relatively high for 2008-2012. In the case of the regression model for both 2008-2018 and 2013-2018, it seems to be a fair assumption that the models' variables explain only the development of the excess return to a limited extent. However, 60% of the variance in the target variable can be explained by EPS-growth, firm size and turnover rate for the subperiod 2008-2012[26].

Regarding the regression coefficients, appendix F shows that there is a considerable difference in the effect of the explanatory variables depending on the period being analyzed. It is different variables that are significant in the three models. It should be noted that the tests show the significance of the respective coefficients in the presence of the other (retained) variables. It would, therefore, be wrong

[26] The remaining 40% can be attributed to unknown variables or inherent variability

to treat the individual variables as if they could explain the regression alone, unless the variables are uncorrelated (Makridakis, Wheelwright and Hyndman, 1998, p. 255).

For the period 2008-2018, the results show:

- A significant negative correlation between the excess return and FCF-yield
- A significant negative correlation between the excess return and the interest rate

The subperiod (2008-2012) shows:

- A significant negative correlation between the excess return and EPS-growth
- A significant zero correlation between the excess return and firm size
- A significant negative correlation between the excess return and turnover rate

The subperiod (2013-2018) shows:

- A significant negative correlation between the excess return and FCF-yield
- A significant negative correlation between the excess return and ROIC

The zero correlation between the excess return and firm size indicates no linear relationship between the two variables; there may, however, still be a relationship (for instance, a curvilinear relationship (Nickolas, 2018, p. 1)).

There is no variable whose relevance is consistent through all three regressions. Only FCF-yield is significant in multiple regression models, showing a negative correlation in both periods. Moreover, it is interesting that neither book-to-market ratio, financial leverage nor P/E are significant in any of the periods.

6.4 The robustness of the results

This section reviews the validity of the regressions and the results. In addition to the problem of multicollinearity and the validity tests referred to in section 5.3, the decisions in some of the tests will also be discussed. It can also be noted, cf. appendix G, that the requirement of normal distribution in the residuals for all models is satisfied.

6.4.1 Test for multicollinearity

The variables used in the regression models have been selected according to their relevance to the problem statement but also to avoid the problem of multicollinearity. There are many different explanatory variables with potential relevance to the excess return. The selection of the variables for this thesis is based on the literature review and if evidence for a correlation between a given variable and the stock market has been found.

Table 5: Correlation matrixes for the explanatory variables

(A) Sample period, 2008-2018

	Book-to-Market Ratio	EPS-growth	Firm Size	FCF-yield	Financial Leverage	P/E	ROIC	Turnover Rate	Interest Rate
Book-to-Market Ratio	1,0000	-0,0674	0,0647	0,3170	0,3498	-0,0574	0,1108	-0,3477	-0,4217
EPS-growth	-0,0674	1,0000	0,0755	-0,1354	0,2020	0,0500	0,1330	-0,0900	-0,0906
Firm Size	0,0647	0,0755	1,0000	-0,0543	0,3359	0,4913	0,8952	-0,0316	-0,7312
FCF-yield	0,3170	-0,1354	-0,0543	1,0000	-0,0794	-0,0126	0,0781	-0,2024	-0,0687
Financial Leverage	0,3498	0,2020	0,3359	-0,0794	1,0000	0,1015	0,2269	-0,0031	-0,6005
P/E	-0,0574	0,0500	0,4913	-0,0126	0,1015	1,0000	0,4500	-0,0629	-0,2611
ROIC	0,1108	0,1330	0,8952	0,0781	0,2269	0,4500	1,0000	-0,0507	-0,6676
Turnover Rate	-0,3477	-0,0900	-0,0316	-0,2024	-0,0031	-0,0629	-0,0507	1,0000	0,2234
Interest Rate	-0,4217	-0,0906	-0,7312	-0,0687	-0,6005	-0,2611	-0,6676	0,2234	1,0000

(B) Subperiod, 2008-2012

	Book-to-Market Ratio	EPS-growth	Firm Size	FCF-yield	Financial Leverage	P/E	ROIC	Turnover Rate	Interest Rate
Book-to-Market Ratio	1,0000	-0,1594	-0,3410	0,6743	0,5925	-0,0426	-0,1034	-0,3595	-0,4341
EPS-growth	-0,1594	1,0000	0,0965	-0,0410	0,2038	0,0935	0,2515	-0,1245	0,0364
Firm Size	-0,3410	0,0965	1,0000	-0,6143	-0,2274	0,3981	0,4181	-0,3350	-0,2681
FCF-yield	0,6743	-0,0410	-0,6143	1,0000	0,2129	-0,3484	-0,1763	-0,1754	0,0842
Financial Leverage	0,5925	0,2038	-0,2274	0,2129	1,0000	-0,0594	0,1547	-0,1264	-0,5832
P/E	-0,0426	0,0935	0,3981	-0,3484	-0,0594	1,0000	0,4339	-0,1028	0,2150
ROIC	-0,1034	0,2515	0,4181	-0,1763	0,1547	0,4339	1,0000	-0,2153	0,0434
Turnover Rate	-0,3595	-0,1245	-0,3350	-0,1754	-0,1264	-0,1028	-0,2153	1,0000	0,4623
Interest Rate	-0,4341	0,0364	-0,2681	0,0842	-0,5832	0,2150	0,0434	0,4623	1,0000

(C) Subperiod, 2008-2012 (second-order)

	Book-to-market (second-order)	EPS-growth (second-order)	Firm size (second-order)	FCF-yield (second-order)	Financial leverage (second-order)	P/E (second-order)	ROIC (second-order)	Turnover rate (second-order)	Interest rate (second-order)
Book-to-market (second-order)	1,0000	-0,3263	-0,5839	0,3996	0,3333	-0,0191	0,0553	0,1645	0,0207
EPS-growth (second-order)	-0,3263	1,0000	0,4230	0,0360	-0,0846	-0,0332	0,2129	-0,7642	-0,0623
Firm size (second-order)	-0,5839	0,4230	1,0000	-0,4615	-0,2215	0,2687	-0,2036	-0,2286	0,2414
FCF-yield (second-order)	0,3996	0,0360	-0,4615	1,0000	-0,1398	-0,6937	0,2356	-0,2120	0,2124
Financial leverage (second-order)	0,3333	-0,0846	-0,2215	-0,1398	1,0000	0,3030	0,3253	0,3834	0,2586
P/E (second-order)	-0,0191	-0,0332	0,2687	-0,6937	0,3030	1,0000	-0,1518	0,2146	0,0346
ROIC (second-order)	0,0553	0,2129	-0,2036	0,2356	0,3253	-0,1518	1,0000	0,0948	0,0054
Turnover rate (second-order)	0,1645	-0,7642	-0,2286	-0,2120	0,3834	0,2146	0,0948	1,0000	0,0437
Interest rate (second-order)	0,0207	-0,0623	0,2414	0,2124	0,2586	0,0346	0,0054	0,0437	1,0000

(D) Subperiod, 2013-2018

	Book-to-Market Ratio	EPS-growth	Firm Size	FCF-yield	Financial Leverage	P/E	ROIC	Turnover Rate	Interest Rate
Book-to-Market Ratio	1,0000	-0,0600	-0,5877	0,1027	-0,4458	-0,3595	-0,5459	-0,4049	0,4642
EPS-growth	-0,0600	1,0000	-0,0573	-0,3124	0,1185	-0,0594	0,0035	0,0865	0,0111
Firm Size	-0,5877	-0,0573	1,0000	-0,2609	0,2151	0,4584	0,8145	0,1862	-0,7290
FCF-yield	0,1027	-0,3124	-0,2609	1,0000	-0,3509	-0,0005	-0,0747	-0,3248	0,2370
Financial Leverage	-0,4458	0,1185	0,2151	-0,3509	1,0000	0,0283	-0,1064	0,3738	-0,5630
P/E	-0,3595	-0,0594	0,4584	-0,0005	0,0283	1,0000	0,3504	-0,0044	-0,3464
ROIC	-0,5459	0,0035	0,8145	-0,0747	-0,1064	0,3504	1,0000	0,2094	-0,4526
Turnover Rate	-0,4049	0,0865	0,1862	-0,3248	0,3738	-0,0044	0,2094	1,0000	-0,3741
Interest Rate	0,4642	0,0111	-0,7290	0,2370	-0,5630	-0,3464	-0,4526	-0,3741	1,0000

From the above, it appears that some of the variables have a high correlation which can cause multicollinearity. In the period 2008-2018, it is especially firm size and ROIC as well as firm size and interest rate that show a high correlation. Since neither firm size nor ROIC are included in the regression model for 2008-2018, this does not affect the credibility of the results. For subperiod 2013-2018, firm size is highly correlated with book-to-market ratio, ROIC and interest rate. There is almost no correlation between the two variables included in the regression model for 2013-2018 – hence, the credibility of the results for 2013-2018 are not affected either.

For the period 2008-2012, especially book-to-market ratio and FCF-yield are highly correlated. It is, however, not relevant since the model for this period is set up according to the second-order difference of the variables, corresponding to the third matrix. Of the explanatory variables used for the regression for 2008-2012, EPS-growth and turnover rate show a correlation that can cause multicollinearity.

"Multicollinearity affects the coefficients and p-values, but it does not influence the predictions, precision of the predictions, and the goodness-of-fit statistics." (Frost, 2019, p. 1). Unfortunately, the aim of this thesis is not to make predictions but to analyze relationships between selected variables and the excess return for the best performing Danish stocks. Multicollinearity is quite serious in this context as it makes it difficult to interpret the coefficients and reduces the regression model's ability to identify independent variables that are statistically significant.

Potential solutions for multicollinearity include removing some of the highly correlated independent variables (Frost, 2019, p. 1). Thus, the backward elimination for 2008-2012 is repeated without EPS-growth and turnover rate as explanatory variables[27]. The results for the adjusted multiple regression are presented in the following (see also appendix H):

$$2008-2012: \delta 2 Excess\ return = \beta_0 + \beta_1 \cdot \delta 2 Firm\ size + \beta_2 \cdot \delta 2 Fin.leverage + \beta_3 \cdot \delta 2 Interest\ rate + \varepsilon_t$$

[27] It was also attempted to only include one of the two variables in the regression model. In the case where only one is included, none of the two variables is significant

Table 6: Adjusted multiple OLS regression results for the excess return

Regression coefficients, 2008-2012 (adjusted model)						
Variable	Coefficient	Std error	t-value	p-value	Lower 95%	Upper 95%
β_0	-0.0057	0.0197	-0.29	0.7778	-0.0477	0.0364
$\delta 2$Firm size	0.0000	0.0000	2.65	0.0183	0.0000	0.0000
$\delta 2$Financial leverage	-0.4315	0.1592	-2.71	0.0161	-0.7708	-0.0921
$\delta 2$Interest rate	7.9601	2.9988	2.65	0.0180	1.5683	14.3520
R^2	0.6557					
ANOVA Table						
Source	DF	SS	Mean square	F value	p-value	
Explained	3	0.2104	0.0701	9.5226	0.0009	
Unexplained	15	0.1105	0.0074			

Now, the subperiod (2008-2012) shows:

- A significant zero correlation between the excess return and firm size
- A significant negative correlation between the excess return and financial leverage
- A significant positive correlation between the excess return and interest rate

At the same time, the new result also means that the interest rate is significant in both 2008-2018 and 2008-2012. It is noteworthy that interest rate changes correlation with excess return, i.e. negative correlation between 2008-2018 and positive correlation in 2008-2012.

In terms of multicollinearity, below matrix clearly shows a weak correlation between the three independent variables. To this, the residuals meet the condition of normality, cf. appendix H.

Table 7: Correlation matrix for the explanatory variables in adjusted regression

	Firm size (second-order)	Financial leverage (second-order)	Interest rate (second-order)
Firm size (second-order)	1,0000	-0,2215	0,2414
Financial leverage (second-order)	-0,2215	1,0000	0,2586
Interest rate (second-order)	0,2414	0,2586	1,0000

Thus, all regression models now meet the assumption of no multicollinearity.

6.4.2 Test for statistical independence

In section 5.3, it is mentioned that the residuals need to be independent of each other and, hence, can show no sign of autocorrelation.

Table 8: Results from the Durbin Watson tests

Period	Durbin Watson	d_L*	d_u	p-value
2008-2018	1.3791	1.430	1.615	0.0084
2008-2012	1.8524	0.967	1.685	0.4712
2013-2018	2.0039	1.206	1.550	0.3715

*See Durbin-Watson significance table in appendix K

The Durbin Watson tests (see also appendix I) show signs of autocorrelation between the residuals. As evident from the table, the values of the models fall outside of the lower, d_L, and upper limit, d_u, of acceptable values. This is a problem for the modelss robustness. However, Durbin Watson tests only on lag 1 for which reason ACF plots of the autocorrelation between the residuals are also used in the assessment of independence (appendix J). Here it appears that autocorrelation is not a major problem for any of the regressions. Makridakis, Wheelwright and Hyndman (1998, p. 326) argue that it is generally acceptable that a few values fall outside of the critical limits because it may be due to coincidences. The risk of autocorrelation in the residuals affecting the results is considered limited.

6.4.3 Test for homoscedasticity

The test for homoscedasticity examines whether the residuals have constant variance and mean throughout the period being analyzed. For this, both the Breusch-Pagan test and White test are used.

The Breusch-Pagan is performed by running a regression where the residual raised to the second power act as the dependent variable. The explanatory variables are the same as used in the original regression analysis. To assess whether the residuals show signs of homoscedasticity, the p-value of the f-test is inspected. The null hypothesis is homoscedasticity while the alternative hypothesis is heteroscedasticity. If the p-value > 0.05, it cannot be denied that there is homoscedasticity in the model. The White test has the same null hypothesis and is also performed as a multiple regression with the residuals squared as the dependent variable. Unlike the Breusch-Pagan test, the explanatory variables are the predicted values of the excess return from the original regression models raised to the power of one and two, respectively.

Table 9: Results from the Breusch-Pagan tests[28]

Breusch-Pagan test						
2008-2018						
Variable	Coefficient	Std error	t-value	p-value	Lower 95%	Upper 95%
β_0	0.0024	0.0019	1.23	0.2250	-0.0015	0.0062
FCF-yield	0.0004	0.0003	1.52	0.1363	-0.0001	0.0009
Interest rate	0.1154	0.0835	1.38	0.1742	-0.0531	0.2839
R^2	0.0859					
ANOVA Table						
Source	DF	SS	Mean square	F value	p-value	Comment
Explained	2	0.0002	0.0001	1.9736	0.1516	Fail to reject H_0
Unexplained	42	0.0025	0.0001			

2008-2012						
Variable	Coefficient	Std error	t-value	p-value	Lower 95%	Upper 95%
β_0	0.0058	0.0014	4.03	0.0011	0.0027	0.0089
δ2Firm size	0.0000	0.0000	0.30	0.7654	-0.0000	0.0000
δ2Financial leverage	0.0072	0.0012	0.62	0.5425	-0.0175	0.0320
δ2Interest rate	-0.0076	0.2185	-0.03	0.9726	-0.4733	0.4581
R^2	0.0291					
ANOVA Table						
Source	DF	SS	Mean square	F value	p-value	Comment
Explained	3	0.0000	0.0000	0.1499	0.9281	Fail to reject H_0
Unexplained	15	0.0006	0.0000			

[28] See also appendix L

2013-2018						
Variable	Coefficient	Std error	t-value	p-value	Lower 95%	Upper 95%
β_0	0.0028	0.0017	1.69	0.1056	-0.0001	0.0063
FCF-yield	0.0001	0.0001	0.93	0.3601	-0.0001	0.0003
ROIC	-0.0001	0.0003	-0.37	0.7126	-0.0007	0.0005
R^2	0.0464					
ANOVA Table						
Source	DF	SS	Mean square	F value	p-value	Comment
Explained	2	0.0000	0.0000	0.5354	0.5929	Fail to reject H_0
Unexplained	22	0.0002	0.0000			

Table 10: Results from the White tests

White test						
2008-2018						
Variable	Coefficient	Std error	t-value	p-value	Lower 95%	Upper 95%
β_0	0.0022	0.0017	1.31	0.1964	-0.0012	0.0056
Predicted values	-0.0490	0.0533	-0.92	0.3636	-0.1566	0.0586
Predicted $values^2$	0.0051	0.5313	0.01	0.9924	-1.0672	1.0774
R^2	0.0717					
ANOVA Table						
Source	DF	SS	Mean square	F value	p-value	Comment
Explained	2	0.0002	0.0001	1.6207	0.2099	Fail to reject H_0
Unexplained	42	0.0025	0.0001			

2008-2012						
Variable	Coefficient	Std error	t-value	p-value	Lower 95%	Upper 95%
β_0	0.0044	0.0021	2.08	0.0535	-0.0001	0.0090
Predicted values	-0.0039	0.0134	-0.29	0.7722	-0.0323	0.0244
Predicted values^2	0.1253	0.1452	0.86	0.4008	-0.1825	0.4331
R^2	0.0454					
ANOVA Table						
Source	DF	SS	Mean square	F value	p-value	Comment
Explained	2	0.0000	0.0000	0.3803	0.6897	Fail to reject H_0
Unexplained	16	0.0006	0.0000			

2013-2018						
Variable	Coefficient	Std error	t-value	p-value	Lower 95%	Upper 95%
β_0	0.0010	0.0002	5.05	<.0001	0.0006	0.0013
Predicted values	-0.0046	0.0050	-0.92	0.3656	-0.0151	0.0058
Predicted values^2	112.2680	7.4438	15.08	<.0001	96.8306	127.7054
R^2	0.9130					
ANOVA Table						
Source	DF	SS	Mean square	F value	p-value	Comment
Explained	2	0.0001	0.0001	115.4160	<.0001	Reject H_0
Unexplained	22	0.0000	0.0000			

Both tests for 2008-2018 and 2008-2012 show that homoscedasticity cannot be rejected. Therefore, this element is not considered to affect the validity of the regressions negatively. Regarding the period 2013-2018, the Breusch-Pagan shows that homoscedasticity cannot be rejected while the White test reject the null hypothesis. Heteroscedasticity must therefore be considered a potential problem in the model for 2013-2018. It may be a consequence of the lack of transformation of several variables that did not show stationarity, cf. section 6.1, but where consistency in the integration of order was preferred.

6.4.4 Further observations

Concerning the ADF tests, it is clear the conclusions about stationarity depend to a large extent on the determination of lag length. The lag length is, in this paper, based on Schwert's formula. In this context, it should also be mentioned that for some variables, especially in the period 2008-2012, a 10% significance level was used where the other variables were assessed at a 5% significance level. This is due to the desire to be consistent in the transformation of the variables.

6.5 Sub-conclusion

The interest rate and FCF-yield are the only variables that show a significant correlation with the excess return in multiple regressions. The correlation between the average excess return and the interest rate changes, however, between the periods; of course, it has to pointed out that the regression model for 2008-2012 investigates how the change in the change in interest rate affects the change in the change in the excess return. Different correlations have also been found by other researchers – for instance, Hall (2018), Bekaert and Ang (2006), Fame and Schwert (1977), Shiller and Beltratti (1992) as well as Chen et al. (1986) all found an inverse relationship between the interest rate and the stock market while Engsted and Tanggaard (2001) found a positive relationship.

The correlation for the FCF-yield is negative in both 2008-2018 and 2013-2018, which is inconsistent with the conclusion reached by Chan, Hamao and Lakonishok (1991). In addition, ROIC shows a significant correlation in the period 2013-2018, but not for the entire sample period or the other subperiod. Firm size and financial leverage show significant relationships in the period 2008-2012 but not in any of the other periods.

All three regression models show robust results for the ADF-, Engle-Granger and validity tests. The model for 2008-2012 did, initially, not meet the requirement of no multicollinearity but the model was improved considerably by correcting for EPS-growth and turnover rate as the two variables showed a severe correlation. That the model changes for the subperiods supports Rangvid's (2006) argument that long time series create a bias towards accepting the hypothesis of coherence. That means in relation to, for instance, valuations and asset pricing models that the same impact from the respective variables cannot be expected in the short and long run just as the correlation is not necessarily consistent.

The test results answer research questions two (or first hypothesis), three (or second hypothesis) and four (or third hypothesis). In relation to the first hypothesis, it seems that the performance of the 20% best Danish stocks over a 10-year period is related to FCF-yield while it can be attributed to firm size and financial leverage for the period 2008-2012 and ascribed to FCF-yield and ROIC for the period 2013-2018.

Regarding the second hypothesis and the second hypothesis on whether the investment strategy, value investing, could explain the excess return, the null hypothesis must almost be rejected – or at least it is not confirmed. Only one of the key figures normally related to the value strategy shows a significant correlation with the excess return and that is just for one of the three periods.

The third hypothesis of this paper deals with the importance of the interest rate for the excess return on the Danish stock market. The interest rate shows a clear but also changing correlation with the excess return. Hence, it is confirmed that the interest rate is correlated with the excess return of the best performing stocks on the KAX Index.

7. ANALYSIS OF RESULTS

In the following, the results from chapter six are compared with the observed relationships shown in chapter three. This chapter is structured so that the individual significant explanatory variables are treated in separate sections. By the end of this chapter, the hypotheses of whether the expected correlations between the economic variables and the stock market also applies to the Danish market are either rejected or confirmed.

Before commenting on the individual relationship between the significant explanatory variables and the excess return, it is necessary to be informed of the development in the excess return.

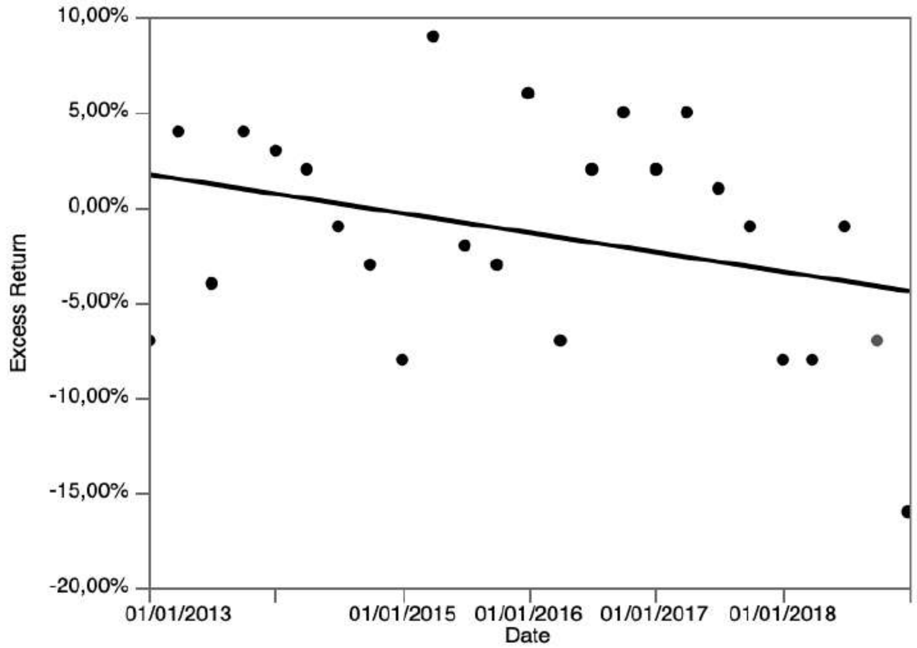


Figure 14: Plot of excess return (2008-2018)

The above graph indicates that the winner portfolio seems to consist of stocks that have been less affected by the financial crisis rather than stocks that have grown tremendously after the crisis. It supports the presumption in section 4.2.3 where it was mentioned that the shares in the portfolio were characterized by low beta values, i.e. below the index average.

7.1 FCF-yield

Chan, Hamao and Lakonishok (1991, p. 1742) find that cash flow yield has a positive impact on expected stock returns. In contrast, evidence in this paper for the period 2008-2018 and the subperiod 2013-2018 suggests that the correlation is negative while the period 2008-2012 shows no significant correlation.

As figure 4 also shows, the Danish economy has improved over the period, which is also reflected in improved earnings (ROIC graph).

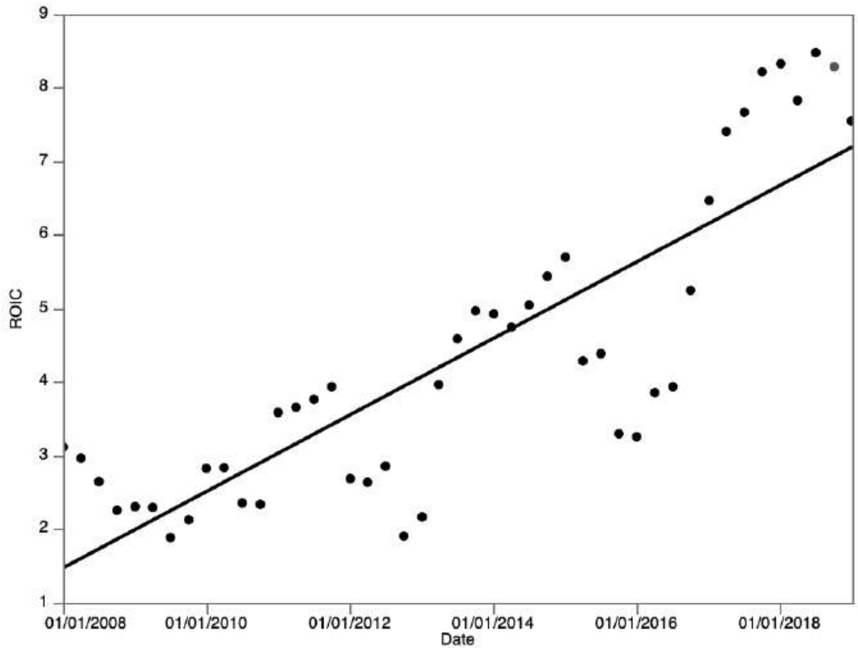


Figure 15: Plot of ROIC (2008-2018)

As defined in section 4.3.4, the FCF-yield is calculated as the free cash flow divided by the share price. Given figure 14, the average free cash flow must have increased relatively more than the average share price in the portfolio – higher capital expenditures towards increasing revenue and productivity seems likely based on the development in ROIC; some profitable investments may also have been postponed due to the financial crisis. Again, this demonstrates that the portfolio formation has been biased towards, presumably, stable stocks rather than cheaper stocks which would do well when economic fundamentals are improving.

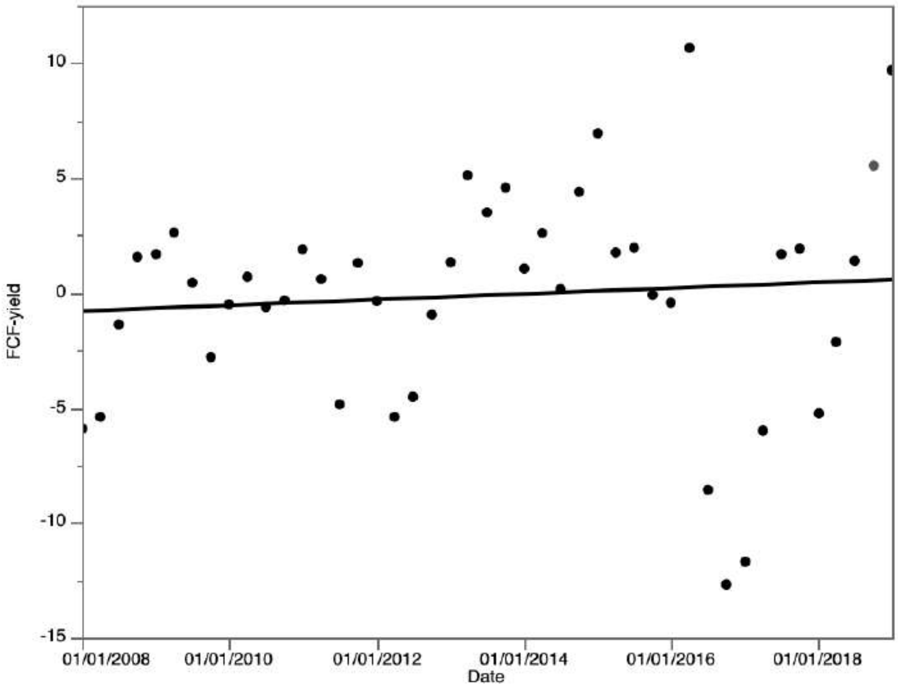


Figure 16: Plot of FCF-yield (2008-2018)

The correlation for FCF-yield is in line with the observed correlation on interest rates.

7.2 Interest rate

When the interest rate falls, investors are willing to pay more for a share[29]. This is also seen by the figure of the P/E ratio which is increasing over the period and which indicates how much an investor is willing to pay per krone of earnings. A falling interest rate also means that stocks become relatively more attractive in relation to bonds (Jessen, 2015, p. 1); more investors will therefore seek towards the stock market (higher demand), thereby increasing share prices. Rising share prices will, all other things equal, reduce the FCF-yield.

[29] Their required rate of return falls. If the interest rate is 4%, i.e. an investor can obtain a 4% return with no risk, an investment in a stock which contains risk will have to yield a higher rate of return to induce the investor to hold it. If the interest rate is 1%, instead, the required rate of return for holding the same stock is relatively lower as the investor only can obtain a risk-free return of 1% now

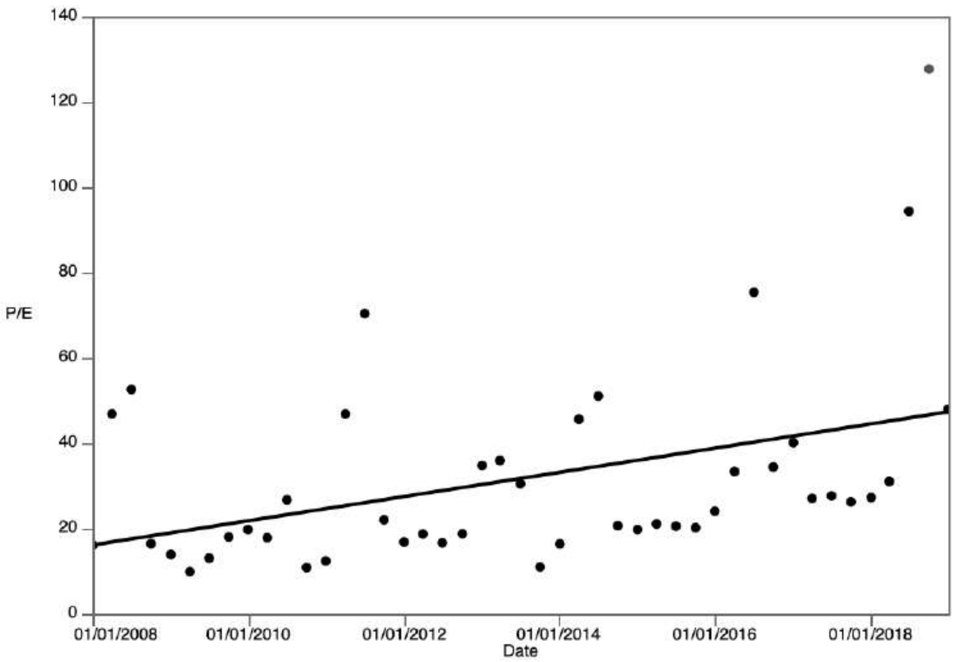


Figure 17: Plot of P/E ratio (2008-2018)

The figures and the development in the interest rate appear to be an expression of a low-priced stock market at the beginning of the period, which normalizes over the period as investor confidence returns[30] (Rangvid et al., 2013, p. 117). The intention of a fall in interest rates is, precisely, also to stimulate firms and consumers to increase investments and spending (Østergaard, 2002, p. 1). As discussed, the stocks in the winner portfolio have reacted less strongly to the financial crisis than other stocks on the KAX Index. The normalization of the stock market has thus been less significant, presumably, to the winner portfolio.

The finding supports that the stock market is strongly correlated with the interest rate.

The negative correlation between the interest rate and the excess return in the period 2008-2018 is in line with the expected correlation. As mentioned in section 4.3.5, an inverse relationship between interest rate and the stock market was also found by Hall (2018), Bekaert and Ang (2006), Fame and Schwert (1977), Shiller and Beltratti (1992) as well as Chen et al. (1986). The third hypothesis of a significant and inverse relationship can hereby be confirmed.

[30] The financial crisis of 2007-2008 was followed by recession in Denmark (as well as several other western economies) with, among other things, worsened investor confidence (Rangvid et al., 2013, p. 117)

For the period 2008-2012, a positive correlation is seen between the interest rate and the excess return – it should, of course, be noted that the regression model for 2008-2012 is in $\delta 2$. The interpretation is therefore that an increase in the change in the interest rate leads to an increase in the change in the excess return. This result is therefore not contradictory with that for the period 2008-2018. Rather, it seems to emphasize the strong relationship between the interest rate and the excess return.

7.3 Firm size

As discussed in section 3.1, several researchers find a significant correlation between firm size and expected returns – in particular Fama and French (1993, 1996) are advocates for this just as they use the variable in their three-factor model. Fama and French (1993) suggest that firm size is a proxy for distress and that distressed firms are more sensitive to business cycles. This thesis likewise finds that firm size is a significant variable but without finding a linear relationship. A non-linear relationship cannot, however, be rejected and given the other variables that exhibit relevance for the excess return, Fama and French's (1993) aforementioned suggestion seems like a probable explanation.

7.4 Financial leverage

Given the fall in interest rate, companies have benefitted from having debt unless the debt is interest-protected. All other things equal, this leads to higher share prices. Unlike Bhandari (1988), Chan and Chen (1991), Fama and French (1992) and Shumway (1996) who all find a positive correlation between leverage and expected returns, this study finds no significant correlation in the period 2008-2018.

A significant negative correlation is observed for 2008-2012. This means that an increase in the change in the financial leverage leads to a fall in the change in the excess return.

7.5 ROIC

Koller et al. (2010) note a long-term (at least 10 years) positive correlation between ROIC and stock returns. This paper only finds a significant correlation between ROIC and the excess return in the subperiod 2013-2018. Thus, no long-term correlation is detected.

It is clear from figure 14 that ROIC is increasing from 2013 to 2018. Hence, the negative correlation between ROIC and the excess return also contradicts the suspected correlation.

7.5 Summary

The purpose of this chapter was to confirm or reject the hypotheses that the expected correlations between the stock market and the independent variables also apply to the Danish stock market. Table 11 gives an overview of the expected correlation on which the hypothesis is based and the empirically found results from the regression models.

Table 11: Expected and statistical correlation for the variables

Expected and statistical correlation for the variables			
Variable	Expected correlation	Statistical correlation	Significant
Book-to-market ratio	Positive correlation	N/A	NO
EPS-growth	Positive correlation	N/A	NO
Firm size	Positive correlation	Zero correlation*	YES, for 2008-2012
FCF-yield	Positive correlation	Negative correlation	YES, for 2008-2018 and 2013-2018
Financial leverage	Positive correlation	Negative correlation*	YES, for 2008-2012
P/E	Negative correlation	N/A	NO
ROIC	Positive correlation	Negative correlation	Yes, for 2013-2018
Turnover rate	Negative correlation	N/A	NO
Interest rate (2008-2018)	Negative correlation	Negative correlation	YES, for 2008-2018
Interest rate (2008-2012)	Negative correlation	Positive correlation*	YES, for 2008-2012

*In $\delta 2$

The only variables that are significant in more than one period is the interest rate and the FCF-yield. As section 7.2 shows, the observed correlations for the interest rate match the expected correlation and supports the importance of the interest rate for the stock market. The FCF-yield, on the other hand, contrasts previous studies.

With regards to firm size, no linear relationship has been found unlike Fama and French (1995) and others who have found a positive correlation. It is possible that a correlation between the excess return and firm size exists but is just not linear.

ROIC and financial leverage contradict the expected correlation.

For the last variables, the expected correlation cannot be confirmed or rejected since none of their coefficients is significant. Based on the results, there is only very little evidence that an investment strategy, such as value investing, is correlated with excess returns. It cannot, however, be rejected as only the coefficients for ROIC is significant, i.e. EPS-growth and P/E are insignificant.

7.6 Revision of results

The purpose of this section is to discuss other factors that may affect the excess return and thus answer the fifth research question. As it appeared from the regression models there is a significant part of the excess return which is not explained by the included variables. Particularly, behavioral finance and irrationality in the stock market is highlighted.

Moreover, other possible distortions that may affect the regression results are discussed.

Behavioral finance and irrationality

Behavioral finance refers to the use of psychological aspects in the explanation of, for example, the stock price. Within behavioral finance, the assumption of rational investors is disregarded, and irrationality is, instead, used as a potential explanation for price developments. For example, Shiller (2005, p. 32) argues that fundamental economic indicators, such as the interest rate, affect the stock price but also that irrationality affects the stock prices to such an extent that the fundamental indicators may not necessarily explain the price development. That is, the stock prices deviate from the rational expectations due to irrational behavior. In this way, the influence of other factors blurs the influence of the individual variable.

In May 2015, a fictitious offer was made for Avon Products listed on the New York Stock Exchange which caused the stock to rise sharply. When it was discovered that the offer was fictitious, the price fell again but to a higher level than before the rumor was spread despite the fact that there was no substance in the rumor (The Economist, 2015, p. 1). This is an example of what Kahneman and Tversky (1974) designates anchoring[31] – the offer sets an arbitrary focal point for the following pricing of the stock.
Such a fluctuation as the above shows that the assumption of rationality does not always apply. To this, such a fluctuation in the stock price cannot be explained by economic variables.

[31] Anchoring designates a cognitive bias in which an individual relies too heavily on an initial piece of information offered, i.e. the "anchor" when making decisions

Various players can also affect the stock market and create irrational fluctuations in stock prices. For example, a bank can have a positive expectation for a given stock and give it a 'buy' recommendation. This can lead to self-reinforcing effects and drive the stock price artificially up and above the rational expectations of the company's operations (Shiller, 2005, p. 68).

Behavioral finance may be a reason why economic variables do not necessarily have the relationship with the stock market that the theory states. Specifically in relation to this thesis, behavioral finance and irrationality may be contributing factors to the relative low R^2 for the regression model for 2008-2018 and that several of the variables show no significance.

Other distortions

In section 4.2.2 it was mentioned that the actual return is not adjusted for either dividends or stock splits. This can of course blur the results. Both factors can affect stock prices and cause them to deviate from the correlations that have been tested for. For example, dividend payments can vary widely depending on where a company is in its business cycle (Bodie, Kane and Marcus, 2011, p. 750).

It was briefly mentioned in section 4.2.1 that there is a massive size distortion on the KAX Index which may also cause a distortion in relation to liquidity. Both Datar, Naik and Radcliffe (1998) and Amihud and Mendelson (1986) find that increased illiquidity affects the stock price negatively – investors demand a liquidity premium for buying an illiquid stock. In addition, illiquidity can cause the stock price to deviate from its correlation with fundamental economic factors such as the interest rate.

8. CONCLUSION

The purpose of this thesis was to analyze the impact of selected economic variables on the Danish stock market. The purpose was formulated in the following problem formulation:

What has been the determining factor of high-performing stocks on the Danish stock market between 2008-2018?

According to the CAPM, the beta value alone should be sufficient to explain stock returns. However, the literature review shows that the beta value is not entirely adequate for accounting for the cross-section in stock returns. There seems to be consensus that firm size, book-to-market ratios as well as cash flow yield and liquidity are pervasive risk factors besides the beta value. Moreover, ROIC, EPS-growth and interest rate have also shown reliable power in describing the cross-section of average stock returns. Other factors, such as P/E ratios and leverage, are indicated to be redundant in capturing the cross-section of stock returns and be merely statistical artifacts.

Quarterly stock data for the Copenhagen Stock Exchange (KAX Index) compiled by Bloomberg between 2008 and 2018 constitute the sample for this study. The CAPM has been used to calculate excess returns. Besides adjusting for the market, the CAPM also accounts for risk which allows for comparison of stocks with different risk levels. The 22 stocks (equal to top 20%) with the highest excess return between 2008 and 2018 are assigned to the winner portfolio. It is the average excess return of this portfolio that function as the target variable.

The tests in this study assess the extent to which excess return behavior among the best performing Danish stocks is associated with eight financial figures and the interest rate (DK10Y). Specifically, three regressions analyses are performed on the dependent variable with the time period as the only difference.

The influence of the economic variables is examined via multiple regression where the optimal regression equations are constructed using backwards elimination. The latter ensures that only the independent variables that contribute to the regression equation are retained just as any joint predictive capability is noticed. Before specifying the regression models, great efforts have been made to ensure that the time series are suitable and applicable for regression just as the robustness of the results from the three regression models has been tested thoroughly, e.g. by testing for multicollinearity and statistical independence of the errors.

The findings reveal a significant relationship between the excess return and five of the nine variables considered. The interest rate and the FCF-yield are the only variables that are consistent in both the sample period and one of the subperiods. The performance of the firm size, financial leverage and ROIC turn out to be highly dependent on the specific model and time period.

The interest rate has dropped to a historically low level over the sample period. As a result, investors' required rate of return has fallen and they are willing to pay more for a share – this is, for instance, indicated by the increase in the P/E ratio over period which suggests how much investors are willing to pay for 1 kr. of earnings. While earnings have improved over the sample period, indicated by ROIC, free cash flows have increased relatively more causing a negative correlation between the average excess return the FCF-yield. The latter contradicts the positive relationship found by Chan et al. (1991).

The observed correlations for the interest rate support the conclusions from previous studies by Hall (2018), Bekaert and Ang (2006) and others just as it confirms that the interest rate is strongly correlated with the Danish stock market.

The evidence from this thesis suggests, in part, a low-priced stock market at the beginning of the sample period which normalizes towards 2018 as investor confidence also increases. It does, however, also appear that the observed correlations are largely determined by the portfolio composition. Hence, the stocks in the winner portfolio are characterized by having beta values below the index average. It seems to indicate a bias towards stocks that have been less affected by the financial crisis rather than cheaper stocks which would do well when economic fundamentals are improving. It is proposed that a portfolio formation conditioned on, for instance, the past five years excess returns would yield different correlations. This does, nonetheless, require further research.

In continuation of the above, it is found that firm size, financial leverage and interest rate capture much of the cross-section of the average excess return for 2008-2012. Since the regression is performed on second-order differenced variables, the obtained correlations indicate how a change in the development of the explanatory variables affects the change in the development of the average excess return. With regards to firm size, a zero correlation is observed. Thus, this study only finds limited support that firm size reflects stocks returns as it cannot be rejected that another non-linear relationship exists.

While previous studies document a strong relationship between value investing and stock returns, only very limited evidence is found for that hypothesis in this study. Only one of the key figures attributed to the value strategy, i.e. ROIC, shows a significant correlation with the excess return and only in one of the subperiods. Hence, it cannot be confirmed that the value strategy can explain the excess return.

Overall, it is concluded that the Danish stock performance between 2008 and 2018 in particular seems to be determined by the economic conditions, including the interest rate level. Based on this study, there seems to be no advantage in investing in stocks with certain characteristics, such as low P/E ratios or high leverage. However, such correlations cannot be rejected either.

Other factors that may affect the excess return have also been considered, especially behavioral finance and irrationality. According to behavioral economists such as Shiller (2005), irrational behavior may cause stock prices to deviate from rational expectations and blur individual variable's influence on expected stock returns. Given that a considerable part of the excess return is not explained by the included explanatory variables, research into the impact of behavioral finance and irrationality on the excess return could be incredibly interesting.

9. DISCUSSION

During the study, new interesting problems have occurred. Due to the scope of the thesis, it has not been possible to examine these, but they are presented briefly here to inspiration for further studies.

A natural subsequent study would be to further test the robustness of the results of this thesis and possibly develop an asset pricing model to test whether the results can be used for predictability.

Testing the robustness could specifically be done by minimizing elements with an adverse effect on the validity of this study. For example, the same analysis could be done on a capped index to minimize liquidity risk. Since the KAX Index has been used to select the sample of the study, it has been limited to the Danish market. Based on the correlations found, it would be relevant to expand the sample to more markets. For instance, the study could be extended to the Nordic countries to test if the relationships are generally applicable.

In relation to testing whether the results could be used for predictability on the stock market, the interest rate would be the most relevant variable to test. Thus, an adjusted CAPM that takes interest rate into account could be interesting to analyze. Such a model would also challenge the hypothesis of efficient markets and shed light on this discussion.

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11. APPENDIX

Appendix A: Best performing Danish stocks between 2008-2018 (top 20%)

20% stocks with highest excess return					
k	Company Name	Sector	Above or Below Avg. Market Cap	Beta	Excess Return, 2008-2018
1	FE Bording A/S	Industrials	Below	-0.18	-1.79%
2	Lan & Spar Bank	Financials	Below	0.22	-3.25%
3	Jeudan A/S	Real Estate	Below	0.49	-3.93%
4	German High Street Properties	Real Estate	Below	0.34	-4.27%
5	H Lundbeck A/S	Health Care	Above	0.50	-4.52%
6	Brodrene Hartmann A/S	Materials	Below	0.55	-5.31%
7	DSV A/S	Industrials	Above	0.84	-5.32%
8	NTR Holding A/S	Industrials	Below	0.26	-5.72%
9	Kreditbanken	Financials	Below	0.48	-5.93%
10	G4S PLC	Industrials	Above	0.48	-5.97%
11	Andersen & Martini A/S	Consumer Discretionary	Below	0.41	-5.99%
12	cBrain A/S	Information Technology	Below	0.65	-6.05%
13	Kobenhavns Lufthavne	Industrials	Above	0.87	-6.07%
14	Ambu A/S	Health Care	Below	0.65	-6.26%
15	United International Enterprises	Consumer Staples	Below	0.97	-6.69%
16	Lollands Bank A/S	Financials	Below	0.50	-6.78%
17	Harboes Bryggeri A/S	Consumer Staples	Below	0.53	-6.82%
18	Rias A/S	Industrials	Below	0.61	-7.04%
19	Genmab A/S	Health Care	Above	0.74	-7.11%
20	Arkil Holding A/S	Industrials	Below	0.71	-7.12%
21	Silkeborg IF Invest A/S	Communication Services	Below	0.55	-7.21%
22	BRD Klee A/S	Industrials	Below	0.82	-7.38%
…					
110		Average (KAX Index):	17,272,568,106 DKK	0.95	-74.06%

Appendix B: Relation between book-to-market equity and expected stock return

(Fama and French, 1995, p. 134)

A simple model is useful for thinking about the relation between book-to-market-equity and expected stock return, and between BE/ME and earnings on book equity. Consider an all-equity firm that finances its investments entirely with retained earnings. Dividends paid by the firm in any year t ($D(t)$) are equal to equity income plus depreciation ($DP(t)$) minus investment outlays ($I(t)$),

$$D(t) = EI(t) + DP(t) - I(t).$$

Suppose that at time t expected depreciation and investment for any year $t + i$ are proportional to expected future equity income, that is,

$$\begin{aligned} E_t D(t+i) &= E_t[EI(t+i) + DP(t+i) - I(t+i)] \\ &= E_t EI(t+i)(1 + k_1 - k_2), \end{aligned}$$

where k_1 and k_2 are the proportionality factors. If the discount rate, r, for expected dividends is constant, the value of market equity at t is,

$$ME(t) = (1 + k_1 - k_2) \sum_{i=1}^{\infty} \frac{E_t EI(t+i)}{(1+r)^i}, \tag{1}$$

and the ratio of market-to-book-equity is,

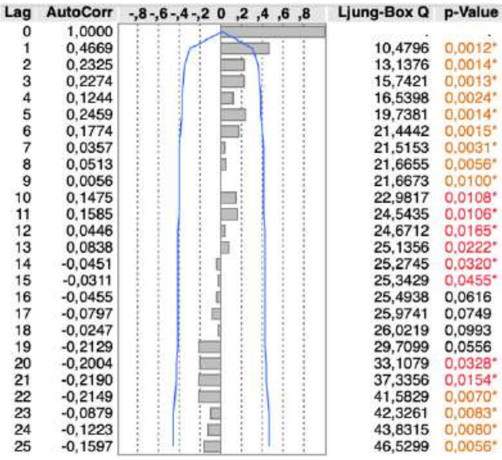
$$\frac{ME(t)}{BE(t)} = (1 + k_1 - k_2) \sum_{i=1}^{\infty} \frac{E_t EI(t+i)/BE(t)}{(1+r)^i}. \tag{2}$$

This simple model predicts that firms with higher required equity returns, r, will have higher book-to-market ratios. The prediction is consistent with the positive relation between average stock return and BE/ME observed by Fama and French (1992, 1993) and others. More important for current purposes, equations (1) and (2) say that brief periods when equity income is expected to be high or low relative to book equity do not have much effect on market equity and the book-to-market ratio. Thus, the prediction is that high BE/ME should be associated with a persistently low ratio of earnings to book equity, while low BE/ME should be associated with persistently strong EI/BE. Figure 1 supports this prediction.

Appendix C: ACF-plots[32]

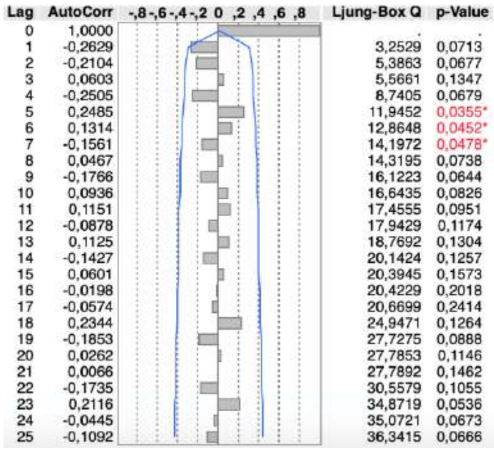
Autocorrelation plots for variables, 2008-2018

Excess return



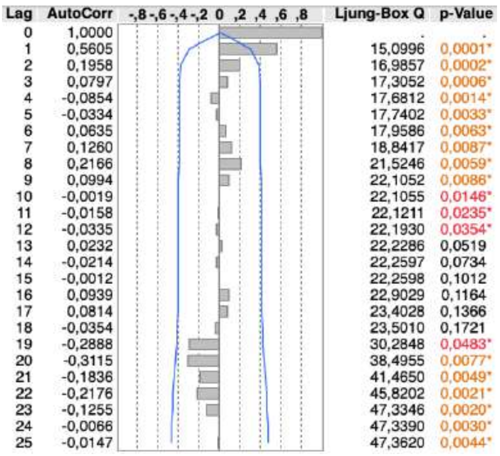
Lag	AutoCorr	Ljung-Box Q	p-Value
0	1,0000	.	.
1	0,4669	10,4796	0,0012*
2	0,2325	13,1376	0,0014*
3	0,2274	15,7421	0,0013*
4	0,1244	16,5398	0,0024*
5	0,2459	19,7381	0,0014*
6	0,1774	21,4442	0,0015*
7	0,0357	21,5153	0,0031*
8	0,0513	21,6655	0,0056*
9	0,0056	21,6673	0,0100*
10	0,1475	22,9817	0,0108*
11	0,1585	24,5435	0,0106*
12	0,0446	24,6712	0,0165*
13	0,0838	25,1356	0,0222*
14	-0,0451	25,2745	0,0320*
15	-0,0311	25,3429	0,0455*
16	-0,0455	25,4938	0,0616
17	-0,0797	25,9741	0,0749
18	-0,0247	26,0219	0,0993
19	-0,2129	29,7099	0,0556
20	-0,2004	33,1079	0,0328*
21	-0,2190	37,3356	0,0154*
22	-0,2149	41,5829	0,0070*
23	-0,0879	42,3261	0,0083*
24	-0,1223	43,8315	0,0080*
25	-0,1597	46,5299	0,0056*

Excess return (first difference)



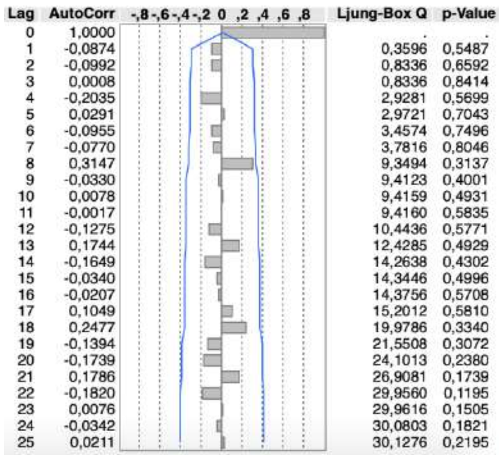
Lag	AutoCorr	Ljung-Box Q	p-Value
0	1,0000	.	.
1	-0,2629	3,2529	0,0713
2	-0,2104	5,3863	0,0677
3	0,0603	5,5661	0,1347
4	-0,2505	8,7405	0,0679
5	0,2485	11,9452	0,0355*
6	0,1314	12,8648	0,0452*
7	-0,1561	14,1972	0,0478*
8	0,0467	14,3195	0,0738
9	-0,1766	16,1223	0,0644
10	0,0936	16,6435	0,0826
11	0,1151	17,4555	0,0951
12	-0,0878	17,9429	0,1174
13	0,1125	18,7692	0,1304
14	-0,1427	20,1424	0,1257
15	0,0601	20,3945	0,1573
16	-0,0198	20,4229	0,2018
17	-0,0574	20,6699	0,2414
18	0,2344	24,9471	0,1264
19	-0,1853	27,7275	0,0888
20	0,0262	27,7853	0,1146
21	0,0066	27,7892	0,1462
22	-0,1735	30,5579	0,1055
23	0,2116	34,8719	0,0536
24	-0,0445	35,0721	0,0673
25	-0,1092	36,3415	0,0666

Book-to-market



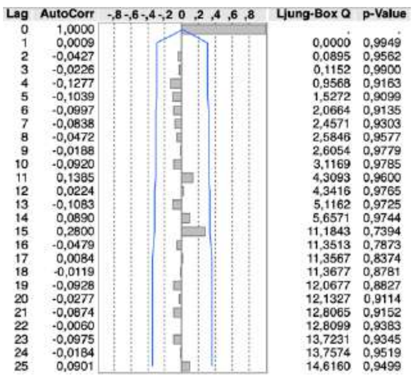
Lag	AutoCorr	Ljung-Box Q	p-Value
0	1,0000	.	.
1	0,5605	15,0996	0,0001*
2	0,1958	16,9857	0,0002*
3	0,0797	17,3052	0,0006*
4	-0,0854	17,6812	0,0014*
5	-0,0334	17,7402	0,0033*
6	0,0635	17,9586	0,0063*
7	0,1260	18,8417	0,0087*
8	0,2166	21,5246	0,0059*
9	0,0994	22,1052	0,0086*
10	-0,0019	22,1055	0,0146*
11	-0,0158	22,1211	0,0235*
12	-0,0335	22,1930	0,0354*
13	0,0232	22,2286	0,0519
14	-0,0214	22,2597	0,0734
15	-0,0012	22,2598	0,1012
16	0,0939	22,9029	0,1164
17	0,0814	23,4028	0,1366
18	-0,0354	23,5010	0,1721
19	-0,2888	30,2848	0,0483*
20	-0,3115	38,4955	0,0077*
21	-0,1836	41,4650	0,0049*
22	-0,2176	45,8202	0,0021*
23	-0,1255	47,3346	0,0020*
24	-0,0066	47,3390	0,0030*
25	-0,0147	47,3620	0,0044*

Book-to-market (first difference)



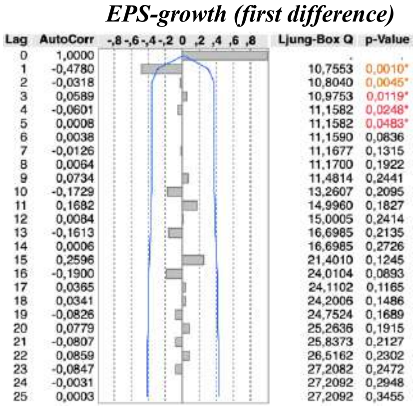
Lag	AutoCorr	Ljung-Box Q	p-Value
0	1,0000	.	.
1	-0,0874	0,3596	0,5487
2	-0,0992	0,8336	0,6592
3	0,0008	0,8336	0,8414
4	-0,2035	2,9281	0,5699
5	0,0291	2,9721	0,7043
6	-0,0955	3,4574	0,7496
7	-0,0770	3,7816	0,8046
8	0,3147	9,3494	0,3137
9	-0,0330	9,4123	0,4001
10	0,0078	9,4159	0,4931
11	-0,0017	9,4160	0,5835
12	-0,1275	10,4436	0,5771
13	0,1744	12,4285	0,4929
14	-0,1649	14,2638	0,4302
15	-0,0340	14,3446	0,4996
16	-0,0207	14,3756	0,5708
17	0,1049	15,2012	0,5810
18	0,2477	19,9786	0,3340
19	-0,1394	21,5508	0,3072
20	-0,1739	24,1013	0,2380
21	0,1786	26,9081	0,1739
22	-0,1820	29,9560	0,1195
23	0,0076	29,9616	0,1505
24	-0,0342	30,0803	0,1821
25	0,0211	30,1276	0,2195

EPS-growth



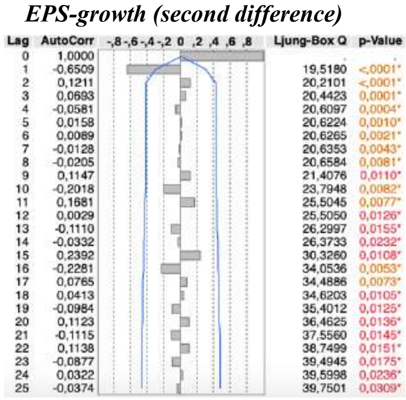
Lag	AutoCorr	Ljung-Box Q	p-Value
0	1,0000	.	.
1	0,0009	0,0000	0,9949
2	-0,0427	0,0895	0,9562
3	-0,0226	0,1152	0,9900
4	-0,1277	0,9568	0,9163
5	-0,1039	1,5272	0,9099
6	-0,0997	2,0664	0,9135
7	-0,0838	2,4571	0,9303
8	-0,0472	2,5846	0,9577
9	-0,0188	2,6054	0,9779
10	-0,0920	3,1169	0,9785
11	0,1385	4,3093	0,9600
12	0,0224	4,3416	0,9765
13	-0,1083	5,1162	0,9725
14	0,0890	5,6571	0,9744
15	0,2800	11,1843	0,7394
16	-0,0479	11,3513	0,7873
17	0,0084	11,3567	0,8374
18	-0,0119	11,3677	0,8781
19	-0,0928	12,0677	0,8827
20	-0,0277	12,1327	0,9114
21	-0,0874	12,8065	0,9152
22	-0,0060	12,8099	0,9383
23	-0,0975	13,7231	0,9345
24	-0,0184	13,7574	0,9519
25	0,0901	14,6160	0,9499

EPS-growth (first difference)



Lag	AutoCorr	Ljung-Box Q	p-Value
0	1,0000	.	.
1	-0,4780	10,7553	0,0010*
2	-0,0318	10,8040	0,0045*
3	0,0589	10,9753	0,0119*
4	-0,0601	11,1582	0,0248*
5	0,0008	11,1582	0,0483*
6	0,0038	11,1590	0,0836
7	-0,0126	11,1677	0,1315
8	0,0064	11,1700	0,1922
9	0,0734	11,4814	0,2441
10	-0,1729	13,2607	0,2095
11	0,1682	14,9960	0,1827
12	0,0084	15,0005	0,2414
13	-0,1613	16,6985	0,2135
14	0,0006	16,6985	0,2726
15	0,2596	21,4010	0,1245
16	-0,1900	24,0104	0,0893
17	0,0365	24,1102	0,1165
18	0,0341	24,2006	0,1486
19	-0,0826	24,7524	0,1689
20	0,0779	25,2636	0,1915
21	-0,0807	25,8373	0,2127
22	0,0859	26,5162	0,2302
23	-0,0847	27,2082	0,2472
24	-0,0031	27,2092	0,2948
25	0,0003	27,2092	0,3455

EPS-growth (second difference)



Lag	AutoCorr	Ljung-Box Q	p-Value
0	1,0000	.	.
1	-0,6509	19,5180	<,0001*
2	0,1211	20,2101	<,0001*
3	0,0693	20,4423	0,0001*
4	-0,0581	20,6097	0,0004*
5	0,0158	20,6224	0,0010*
6	0,0089	20,6265	0,0021*
7	-0,0128	20,6353	0,0043*
8	-0,0205	20,6584	0,0081*
9	0,1147	21,4076	0,0110*
10	-0,2018	23,7948	0,0082*
11	0,1681	25,5045	0,0077*
12	0,0029	25,5050	0,0126*
13	-0,1110	26,2997	0,0155*
14	-0,0332	26,3733	0,0232*
15	0,2392	30,3260	0,0108*
16	-0,2281	34,0536	0,0053*
17	0,0765	34,4886	0,0073*
18	0,0413	34,6203	0,0105*
19	-0,0984	35,4012	0,0125*
20	0,1123	36,4625	0,0136*
21	-0,1115	37,5560	0,0145*
22	0,1138	38,7499	0,0151*
23	-0,0877	39,4945	0,0175*
24	0,0322	39,5998	0,0236*
25	-0,0374	39,7501	0,0309*

[32]The blue lines represent two standard errors

Firm size

Lag	AutoCorr	-,8 -,6 -,4 -,2 0 ,2 ,4 ,6 ,8	Ljung-Box Q	p-Value
0	1,0000		.	.
1	0,9557		43,9074	<,0001*
2	0,8834		82,2896	<,0001*
3	0,8061		115,015	<,0001*
4	0,7339		142,801	<,0001*
5	0,6575		165,661	<,0001*
6	0,5635		182,880	<,0001*
7	0,4726		195,312	<,0001*
8	0,3873		203,888	<,0001*
9	0,3138		209,672	<,0001*
10	0,2468		213,353	<,0001*
11	0,1818		215,409	<,0001*
12	0,1235		216,386	<,0001*
13	0,0660		216,675	<,0001*
14	0,0181		216,697	<,0001*
15	-0,0290		216,756	<,0001*
16	-0,0747		217,163	<,0001*
17	-0,1084		218,049	<,0001*
18	-0,1370		219,520	<,0001*
19	-0,1699		221,867	<,0001*
20	-0,2023		225,328	<,0001*
21	-0,2322		230,081	<,0001*
22	-0,2565		236,130	<,0001*
23	-0,2749		243,394	<,0001*
24	-0,2921		251,988	<,0001*
25	-0,3039		261,755	<,0001*

Firm size (first difference)

Lag	AutoCorr	-,8 -,6 -,4 -,2 0 ,2 ,4 ,6 ,8	Ljung-Box Q	p-Value
0	1,0000		.	.
1	0,1265		0,7530	0,3855
2	-0,0898		1,1415	0,5651
3	0,0700		1,3831	0,7095
4	0,2542		4,6529	0,3248
5	0,1378		5,6386	0,3430
6	-0,0267		5,6765	0,4604
7	0,0013		5,6766	0,5780
8	-0,1144		6,4125	0,6011
9	0,0229		6,4430	0,6949
10	-0,0326		6,5064	0,7711
11	0,0436		6,6229	0,8287
12	-0,1737		8,5305	0,7424
13	0,1092		9,3088	0,7492
14	0,0079		9,3130	0,8105
15	-0,1428		10,7367	0,7710
16	-0,0786		11,1828	0,7981
17	-0,0108		11,1915	0,8464
18	0,0842		11,7440	0,8602
19	-0,0890		12,3859	0,8685
20	-0,0549		12,6397	0,8923
21	-0,0860		13,2903	0,8981
22	-0,0274		13,3594	0,9227
23	-0,0623		13,7338	0,9342
24	-0,0341		13,8515	0,9499
25	0,0540		14,1623	0,9588

FCF-yield

Lag	AutoCorr	-,8 -,6 -,4 -,2 0 ,2 ,4 ,6 ,8	Ljung-Box Q	p-Value
0	1,0000		.	.
1	0,4453		9,5326	0,0020*
2	0,0437		9,6265	0,0081*
3	-0,0921		10,0540	0,0181*
4	-0,0722		10,3231	0,0353*
5	0,1326		11,2534	0,0466*
6	0,0321		11,3092	0,0793
7	-0,2834		15,7801	0,0272*
8	-0,3381		22,3134	0,0044*
9	-0,2889		27,2167	0,0013*
10	-0,0749		27,5557	0,0021*
11	0,0023		27,5560	0,0038*
12	-0,1266		28,5831	0,0045*
13	-0,1794		30,7103	0,0037*
14	-0,1557		32,3653	0,0036*
15	-0,0842		32,8654	0,0049*
16	0,0894		33,4481	0,0064*
17	0,2158		36,9665	0,0034*
18	0,2002		40,1068	0,0020*
19	0,0461		40,2797	0,0030*
20	0,0416		40,4265	0,0044*
21	0,0544		40,6870	0,0061*
22	0,0673		41,1036	0,0080*
23	0,0736		41,6250	0,0100*
24	0,0025		41,6256	0,0142*
25	-0,0714		42,1653	0,0173*

FCF-yield (first difference)

Lag	AutoCorr	-,8 -,6 -,4 -,2 0 ,2 ,4 ,6 ,8	Ljung-Box Q	p-Value
0	1,0000		.	.
1	-0,1163		0,6361	0,4251
2	-0,2084		2,7298	0,2554
3	-0,1058		3,2823	0,3501
4	-0,1558		4,5107	0,3413
5	0,2465		7,6648	0,1757
6	0,2089		9,9890	0,1251
7	-0,2095		12,3890	0,0885
8	-0,0323		12,4477	0,1323
9	-0,1483		13,7201	0,1326
10	0,0927		14,2317	0,1627
11	0,0137		14,2432	0,2198
12	0,0464		14,3792	0,2772
13	-0,0911		14,9211	0,3123
14	-0,1068		15,6902	0,3327
15	-0,0680		16,0132	0,3812
16	-0,0186		16,0381	0,4503
17	0,1356		17,4166	0,4265
18	0,1862		20,1155	0,3264
19	-0,1607		22,2056	0,2741
20	0,0091		22,2126	0,3291
21	-0,0157		22,2344	0,3861
22	0,0052		22,2369	0,4458
23	0,0665		22,6625	0,4806
24	0,0169		22,6913	0,5381
25	-0,0127		22,7086	0,5946

Financial leverage

Lag	AutoCorr	-,8 -,6 -,4 -,2 0 ,2 ,4 ,6 ,8	Ljung-Box Q	p-Value
0	1,0000		.	.
1	0,7127		24,4147	<,0001*
2	0,4906		36,2533	<,0001*
3	0,3758		43,3647	<,0001*
4	0,2382		46,2916	<,0001*
5	0,1078		46,9061	<,0001*
6	0,0193		46,9264	<,0001*
7	-0,0235		46,9570	<,0001*
8	-0,0482		47,0896	<,0001*
9	-0,0885		47,5492	<,0001*
10	-0,0367		47,6308	<,0001*
11	-0,0232		47,6645	<,0001*
12	-0,1086		48,4207	<,0001*
13	-0,1745		50,4341	<,0001*
14	-0,1641		52,2717	<,0001*
15	-0,1204		53,2932	<,0001*
16	-0,0726		53,6781	<,0001*
17	0,0060		53,6809	<,0001*
18	0,1230		54,8654	<,0001*
19	0,1580		56,8961	<,0001*
20	0,1751		59,4905	<,0001*
21	0,2290		64,1122	<,0001*
22	0,2697		70,7992	<,0001*
23	0,0686		71,2513	<,0001*
24	-0,0642		71,6663	<,0001*
25	-0,1140		73,0412	<,0001*

Financial leverage (first difference)

Lag	AutoCorr	-,8 -,6 -,4 -,2 0 ,2 ,4 ,6 ,8	Ljung-Box Q	p-Value
0	1,0000		.	.
1	0,0156		0,0114	0,9148
2	-0,1146		0,6444	0,7246
3	0,1215		1,3725	0,7120
4	0,0517		1,5077	0,8253
5	-0,0258		1,5422	0,9082
6	-0,1726		3,1294	0,7924
7	0,0693		3,3918	0,8466
8	0,1109		4,0836	0,8495
9	-0,2188		6,8519	0,6525
10	0,0774		7,2082	0,7056
11	0,1536		8,6557	0,6536
12	-0,0338		8,7279	0,7260
13	-0,1092		9,5068	0,7337
14	-0,0620		9,7662	0,7791
15	-0,0135		9,7788	0,8334
16	-0,0888		10,3485	0,8478
17	-0,0797		10,8240	0,8656
18	0,1169		11,8881	0,8530
19	-0,1190		13,0338	0,8368
20	-0,1655		15,3433	0,7564
21	-0,0345		15,4480	0,7998
22	0,3226		25,0218	0,2960
23	0,0865		25,7423	0,3132
24	-0,0650		26,1700	0,3446
25	0,1591		28,8649	0,2696

P/E

Lag	AutoCorr	Ljung-Box Q	p-Value
0	1,0000	.	.
1	0,4708	10,6550	0,0011*
2	-0,0151	10,6662	0,0048*
3	-0,0831	11,0137	0,0117*
4	-0,0384	11,0898	0,0256*
5	-0,0330	11,1475	0,0485*
6	0,0261	11,1844	0,0828
7	0,0713	11,4672	0,1195
8	0,1996	13,7456	0,0886
9	0,1664	15,3714	0,0812
10	-0,0614	15,5990	0,1117
11	-0,0122	15,6082	0,1563
12	0,1109	16,3971	0,1737
13	-0,0056	16,3992	0,2282
14	-0,1115	17,2469	0,2433
15	-0,1049	18,0221	0,2615
16	-0,0213	18,0553	0,3207
17	0,0687	18,4119	0,3633
18	0,0196	18,4421	0,4269
19	-0,0734	18,8798	0,4646
20	0,0096	18,8876	0,5291
21	0,0271	18,9523	0,5882
22	0,0037	18,9536	0,6482
23	-0,0060	18,9570	0,7037
24	-0,0324	19,0630	0,7486
25	-0,1112	20,3717	0,7271

P/E (first difference)

Lag	AutoCorr	Ljung-Box Q	p-Value
0	1,0000	.	.
1	-0,0774	0,2818	0,5955
2	-0,3789	7,1996	0,0273*
3	-0,0905	7,6036	0,0550
4	0,0384	7,6781	0,1041
5	-0,0544	7,8318	0,1658
6	0,0140	7,8423	0,2499
7	-0,0772	8,1682	0,3180
8	0,1478	9,3958	0,3100
9	0,1896	11,4738	0,2446
10	-0,2904	16,4949	0,0863
11	-0,0546	16,6774	0,1178
12	0,2379	20,2577	0,0624
13	0,0147	20,2717	0,0886
14	-0,0926	20,8503	0,1055
15	-0,1057	21,6304	0,1179
16	-0,0092	21,6365	0,1553
17	0,1345	22,9927	0,1495
18	0,0195	23,0223	0,1897
19	-0,1661	25,2557	0,1523
20	0,0929	25,9833	0,1664
21	0,0441	26,1542	0,2006
22	-0,0301	26,2376	0,2416
23	-0,0011	26,2377	0,2898
24	0,0537	26,5293	0,3269
25	-0,0282	26,6141	0,3754

P/E (second difference)

Lag	AutoCorr	Ljung-Box Q	p-Value
0	1,0000	.	.
1	-0,2017	1,8746	0,1709
2	-0,2336	4,4507	0,1080
3	-0,0418	4,5353	0,2092
4	0,1161	5,2040	0,2670
5	-0,0977	5,6898	0,3376
6	0,0880	6,0946	0,4127
7	-0,1957	8,1523	0,3194
8	0,1345	9,1531	0,3295
9	0,1887	11,1806	0,2635
10	-0,2225	14,0838	0,1692
11	-0,1016	14,7085	0,1962
12	0,2448	18,4484	0,1027
13	-0,0664	18,7332	0,1316
14	-0,0030	18,7337	0,1754
15	-0,0867	19,2535	0,2025
16	-0,0368	19,3503	0,2509
17	0,0865	19,9068	0,2790
18	0,0968	20,6324	0,2984
19	-0,2101	24,1927	0,1889
20	0,1318	25,6541	0,1775
21	-0,0301	25,7339	0,2168
22	-0,0239	25,7866	0,2610
23	-0,0224	25,8352	0,3087
24	0,0805	26,4944	0,3286
25	-0,0545	26,8132	0,3653

ROIC

Lag	AutoCorr	Ljung-Box Q	p-Value
0	1,0000	.	.
1	0,9157	40,3017	<,0001*
2	0,7948	71,3707	<,0001*
3	0,6661	93,7140	<,0001*
4	0,5303	108,218	<,0001*
5	0,4012	116,730	<,0001*
6	0,2907	121,313	<,0001*
7	0,1983	123,501	<,0001*
8	0,1292	124,455	<,0001*
9	0,1134	125,210	<,0001*
10	0,1125	125,975	<,0001*
11	0,1303	127,031	<,0001*
12	0,1667	128,813	<,0001*
13	0,2058	131,612	<,0001*
14	0,2180	134,855	<,0001*
15	0,1879	137,343	<,0001*
16	0,1282	138,541	<,0001*
17	0,0285	138,603	<,0001*
18	-0,0498	138,797	<,0001*
19	-0,1174	139,918	<,0001*
20	-0,1730	142,451	<,0001*
21	-0,2146	146,508	<,0001*
22	-0,2437	151,967	<,0001*
23	-0,2600	158,465	<,0001*
24	-0,2550	165,012	<,0001*
25	-0,2247	170,351	<,0001*

ROIC (first difference)

Lag	AutoCorr	Ljung-Box Q	p-Value
0	1,0000	.	.
1	0,1920	1,7353	0,1877
2	-0,0106	1,7407	0,4188
3	0,1267	2,5327	0,4694
4	-0,1867	4,2961	0,3674
5	-0,1998	6,3682	0,2720
6	-0,1442	7,4764	0,2790
7	-0,2027	9,7238	0,2048
8	-0,3394	16,2016	0,0396*
9	0,0477	16,3332	0,0602
10	-0,0010	16,3333	0,0905
11	-0,1858	18,4512	0,0717
12	0,1569	20,0073	0,0669
13	0,2577	24,3420	0,0281*
14	0,2244	27,7406	0,0154*
15	0,3103	34,4616	0,0029*
16	0,0398	34,5762	0,0045*
17	-0,1925	37,3552	0,0030*
18	-0,0463	37,5219	0,0045*
19	-0,1538	39,4379	0,0039*
20	-0,1802	42,1772	0,0026*
21	-0,0276	42,2444	0,0039*
22	-0,0307	42,3312	0,0057*
23	-0,0845	43,0188	0,0069*
24	0,0644	43,4387	0,0089*
25	0,1318	45,2896	0,0077*

Turnover rate

Lag	AutoCorr	Ljung-Box Q	p-Value
0	1,0000	.	.
1	0,3622	6,3053	0,0120*
2	0,1633	7,6175	0,0222*
3	0,1563	8,8473	0,0314*
4	-0,0576	9,0184	0,0606
5	0,0493	9,1470	0,1033
6	0,0119	9,1547	0,1651
7	-0,0345	9,2208	0,2372
8	-0,0360	9,2949	0,3180
9	-0,0313	9,3526	0,4054
10	-0,0323	9,4155	0,4932
11	-0,1060	10,1145	0,5201
12	-0,2421	13,8704	0,3091
13	-0,1431	15,2238	0,2936
14	-0,1925	17,7508	0,2184
15	-0,2781	23,2048	0,0799
16	-0,1015	23,9555	0,0905
17	-0,1276	25,1850	0,0906
18	-0,0096	25,1921	0,1197
19	0,0812	25,7287	0,1379
20	-0,0105	25,7379	0,1746
21	0,0008	25,7380	0,2166
22	-0,0001	25,7380	0,2631
23	-0,0282	25,8142	0,3097
24	-0,0331	25,9244	0,3570
25	-0,0562	26,2580	0,3939

Turnover rate (first difference)

Lag	AutoCorr	Ljung-Box Q	p-Value
0	1,0000	.	.
1	-0,3469	5,6641	0,0173*
2	-0,1493	6,7376	0,0344*
3	0,1655	8,0894	0,0442*
4	-0,2509	11,2744	0,0236*
5	0,1091	11,8916	0,0363*
6	0,0094	11,8963	0,0643
7	-0,0697	12,1624	0,0953
8	-0,0155	12,1759	0,1435
9	0,0600	12,3842	0,1925
10	0,0454	12,5071	0,2525
11	0,0639	12,7574	0,3095
12	-0,1904	15,0504	0,2387
13	0,1172	15,9474	0,2520
14	0,0312	16,0133	0,3126
15	-0,2020	18,8624	0,2200
16	0,1555	20,6104	0,1940
17	-0,1235	21,7534	0,1944
18	0,0291	21,8192	0,2401
19	0,1491	23,6195	0,2112
20	-0,0811	24,1748	0,2348
21	0,0023	24,1752	0,2846
22	0,0286	24,2505	0,3342
23	-0,0231	24,3021	0,3872
24	0,0093	24,3108	0,4439
25	-0,0656	24,7693	0,4754

Turnover rate (second difference)

Lag	AutoCorr	Ljung-Box Q	p-Value
0	1,0000	.	.
1	-0,5736	15,1562	<,0001*
2	-0,0438	15,2468	0,0005*
3	0,2744	18,8888	0,0003*
4	-0,2915	23,1052	0,0001*
5	0,1710	24,5948	0,0002*
6	-0,0040	24,5956	0,0004*
7	-0,0557	24,7623	0,0008*
8	-0,0034	24,7629	0,0017*
9	0,0323	24,8223	0,0032*
10	-0,0137	24,8333	0,0057*
11	0,1027	25,4712	0,0078*
12	-0,2089	28,1962	0,0052*
13	0,1465	29,5804	0,0054*
14	0,0550	29,7825	0,0082*
15	-0,2211	33,1603	0,0045*
16	0,2383	37,2295	0,0019*
17	-0,1601	39,1373	0,0017*
18	0,0088	39,1433	0,0027*
19	0,1326	40,5607	0,0028*
20	-0,1175	41,7220	0,0030*
21	0,0213	41,7618	0,0045*
22	0,0305	41,8476	0,0065*
23	-0,0332	41,9539	0,0092*
24	0,0408	42,1237	0,0125*
25	-0,0355	42,2588	0,0169*

Interest rate

Lag	AutoCorr	Ljung-Box Q	p-Value
0	1,0000	.	.
1	0,9136	40,1185	<,0001*
2	0,8184	73,0623	<,0001*
3	0,7348	100,251	<,0001*
4	0,6605	122,754	<,0001*
5	0,6278	143,593	<,0001*
6	0,5812	161,912	<,0001*
7	0,5279	177,426	<,0001*
8	0,4531	189,161	<,0001*
9	0,3869	197,958	<,0001*
10	0,3394	204,918	<,0001*
11	0,2864	210,023	<,0001*
12	0,2284	213,366	<,0001*
13	0,1507	214,866	<,0001*
14	0,0670	215,172	<,0001*
15	-0,0061	215,175	<,0001*
16	-0,0520	215,372	<,0001*
17	-0,0831	215,893	<,0001*
18	-0,1244	217,105	<,0001*
19	-0,1499	218,932	<,0001*
20	-0,1768	221,577	<,0001*
21	-0,2082	225,396	<,0001*
22	-0,2235	229,988	<,0001*
23	-0,2449	235,754	<,0001*
24	-0,2829	243,812	<,0001*
25	-0,3226	254,815	<,0001*

Interest rate (first difference)

Lag	AutoCorr	Ljung-Box Q	p-Value
0	1,0000	.	.
1	0,0253	0,0302	0,8621
2	-0,3282	5,2212	0,0735
3	-0,0918	5,6368	0,1307
4	-0,0943	6,0869	0,1927
5	-0,0806	6,4238	0,2671
6	0,0587	6,6075	0,3587
7	0,2661	10,4814	0,1629
8	-0,1634	11,9834	0,1519
9	-0,2772	16,4281	0,0585
10	0,1941	18,6702	0,0447*
11	0,2560	22,6884	0,0196*
12	-0,0407	22,7931	0,0295*
13	-0,0887	23,3069	0,0381*
14	0,0336	23,3831	0,0543
15	-0,2033	26,2671	0,0353*
16	-0,0950	26,9200	0,0424*
17	0,2259	30,7442	0,0215*
18	0,1029	31,5681	0,0247*
19	-0,0628	31,8874	0,0322*
20	-0,0504	32,1012	0,0422*
21	-0,0550	32,3675	0,0537
22	-0,0964	33,2230	0,0588
23	0,0814	33,8622	0,0672
24	0,1255	35,4559	0,0619
25	-0,0443	35,6653	0,0768

Autocorrelation plots for variables, 2008-2012

Excess return

Lag	AutoCorr	Ljung-Box Q	p-Value
0	1,0000	.	.
1	0,4609	5,1297	0,0235*
2	-0,0244	5,1448	0,0764
3	-0,0861	5,3437	0,1483
4	-0,1262	5,7963	0,2149
5	0,1286	6,2953	0,2785
6	0,1139	6,7130	0,3482
7	-0,1183	7,1957	0,4088
8	-0,1532	8,0677	0,4269
9	-0,1074	8,5321	0,4815
10	0,1205	9,1697	0,5161
11	0,1638	10,4653	0,4891
12	-0,0840	10,8444	0,5423
13	-0,1765	12,7251	0,4693
14	-0,1911	15,2438	0,3617
15	-0,1854	18,0101	0,2621
16	-0,1236	19,4847	0,2443
17	-0,0673	20,0324	0,2726
18	-0,0282	20,1603	0,3239
19	-0,0134	20,2035	0,3824
20	-0,0026	20,2067	0,4451

Excess return (first difference)

Lag	AutoCorr	Ljung-Box Q	p-Value
0	1,0000	.	.
1	-0,0569	0,0749	0,7844
2	-0,4009	4,0039	0,1351
3	-0,0364	4,0381	0,2574
4	-0,2946	6,4253	0,1696
5	0,2850	8,8074	0,1170
6	0,2360	10,5572	0,1031
7	-0,1974	11,8762	0,1047
8	-0,0853	12,1432	0,1449
9	-0,1673	13,2633	0,1510
10	0,1647	14,4575	0,1531
11	0,2814	18,3289	0,0743
12	-0,1372	19,3637	0,0801
13	-0,0880	19,8500	0,0990
14	-0,0309	19,9199	0,1327
15	-0,0419	20,0744	0,1691
16	0,0427	20,2747	0,2081
17	0,0155	20,3101	0,2587
18	0,0082	20,3248	0,3148
19	0,0033	20,3295	0,3750
20	0,0000	.	.

Excess return (second difference)

Lag	AutoCorr	Ljung-Box Q	p-Value
0	1,0000	.	.
1	-0,3333	2,4624	0,1166
2	-0,3483	5,3097	0,0703
3	0,3100	7,7060	0,0525
4	-0,3790	11,5273	0,0212*
5	0,2763	13,7027	0,0176*
6	0,1775	14,6702	0,0230*
7	-0,2656	17,0163	0,0173*
8	0,1096	17,4522	0,0257*
9	-0,1906	18,9019	0,0260*
10	0,0798	19,1844	0,0380*
11	0,2649	22,6829	0,0196*
12	-0,2273	25,6270	0,0121*
13	-0,0097	25,6333	0,0190*
14	0,0701	26,0259	0,0257*
15	-0,0503	26,2783	0,0352*
16	0,0165	26,3144	0,0498*
17	-0,0034	26,3168	0,0689
18	0,0028	26,3198	0,0927
19	0,0000	.	.
20	0,0000	.	.

Book-to-market

Lag	AutoCorr	Ljung-Box Q	p-Value
0	1,0000	.	.
1	0,4893	5,7821	0,0162*
2	0,0503	5,8465	0,0538
3	-0,0315	5,8731	0,1180
4	-0,1373	6,4089	0,1706
5	-0,0129	6,4140	0,2680
6	0,0766	6,6028	0,3591
7	0,1125	7,0394	0,4248
8	0,1474	7,8465	0,4486
9	0,0540	7,9640	0,5378
10	-0,1076	8,4727	0,5828
11	-0,2098	10,5990	0,4774
12	-0,2592	14,2051	0,2878
13	-0,1758	16,0716	0,2453
14	-0,0771	16,4815	0,2849
15	0,0234	16,5255	0,3480
16	0,0883	17,2794	0,3677
17	0,0580	17,6863	0,4089
18	-0,0878	18,9280	0,3963
19	-0,3089	41,9669	0,0018*
20	-0,1919	59,7503	<,0001*

Book-to-market (first difference)

Lag	AutoCorr	Ljung-Box Q	p-Value
0	1,0000	.	.
1	-0,0856	0,1695	0,6805
2	0,0096	0,1718	0,9177
3	-0,0382	0,2096	0,9760
4	-0,2556	2,0067	0,7345
5	0,0216	2,0203	0,8463
6	-0,0530	2,1088	0,9094
7	-0,1359	2,7343	0,9084
8	0,1780	3,8966	0,8663
9	0,0601	4,0411	0,9087
10	0,0790	4,3158	0,9320
11	0,0242	4,3445	0,9587
12	-0,2840	8,7820	0,7214
13	-0,0513	8,9477	0,7769
14	-0,1639	10,9171	0,6925
15	0,0098	10,9256	0,7578
16	-0,0546	11,2530	0,7936
17	0,1957	16,8680	0,4633
18	0,0451	17,3149	0,5016
19	-0,0009	17,3153	0,5685
20	0,0000	.	.

Book-to-market (second difference)

Lag	AutoCorr	Ljung-Box Q	p-Value
0	1,0000	.	.
1	-0,5557	6,8457	0,0089*
2	0,0791	6,9926	0,0303*
3	0,0887	7,1890	0,0661
4	-0,2197	8,4734	0,0757
5	0,1384	9,0195	0,1083
6	0,0176	9,0290	0,1720
7	-0,1899	10,2287	0,1760
8	0,2019	11,7077	0,1647
9	-0,0623	11,8628	0,2212
10	0,0192	11,8792	0,2932
11	0,1295	12,7155	0,3123
12	-0,2489	16,2475	0,1802
13	0,1597	17,9425	0,1597
14	-0,1206	19,1033	0,1610
15	0,0875	19,8665	0,1771
16	-0,1511	22,9012	0,1164
17	0,2042	31,2217	0,0188*
18	-0,0775	33,6208	0,0140*
19	0,0000	.	.
20	0,0000	.	.

EPS-growth

Lag	AutoCorr	Ljung-Box Q	p-Value
0	1,0000	.	.
1	-0,0044	0,0005	0,9826
2	-0,0892	0,2026	0,9037
3	0,0039	0,2030	0,9771
4	-0,2024	1,3668	0,8500
5	0,0405	1,4162	0,9225
6	-0,1299	1,9595	0,9234
7	-0,0777	2,1678	0,9500
8	0,0059	2,1691	0,9754
9	0,0519	2,2774	0,9863
10	-0,2171	4,3477	0,9303
11	-0,0017	4,3478	0,9586
12	0,0080	4,3513	0,9762
13	-0,0263	4,3930	0,9862
14	0,0955	5,0220	0,9855
15	-0,0063	5,0252	0,9919
16	0,0333	5,1321	0,9951
17	0,0100	5,1441	0,9973
18	-0,0032	5,1458	0,9986
19	0,0084	5,1628	0,9993
20	0,0009	5,1632	0,9996

EPS-growth (first difference)

Lag	AutoCorr	Ljung-Box Q	p-Value
0	1,0000	.	.
1	-0,4604	4,9090	0,0267*
2	-0,0846	5,0842	0,0787
3	0,1458	5,6347	0,1308
4	-0,2217	6,9859	0,1366
5	0,1992	8,1499	0,1482
6	-0,1042	8,4913	0,2043
7	-0,0142	8,4981	0,2907
8	0,0171	8,5088	0,3854
9	0,1709	9,6765	0,3773
10	-0,2537	12,5082	0,2525
11	0,1106	13,1061	0,2864
12	0,0123	13,1143	0,3608
13	-0,0754	13,4718	0,4121
14	0,1094	14,3489	0,4241
15	-0,0757	14,8532	0,4620
16	0,0362	14,9973	0,5248
17	-0,0062	15,0030	0,5953
18	-0,0092	15,0216	0,6605
19	0,0040	15,0286	0,7208
20	0,0000	.	.

EPS-growth (second difference)

Lag	AutoCorr	Ljung-Box Q	p-Value
0	1,0000	.	.
1	-0,6127	8,3223	0,0039*
2	0,0345	8,3503	0,0154*
3	0,2065	9,4135	0,0243*
4	-0,2666	11,3045	0,0233*
5	0,2460	13,0298	0,0231*
6	-0,1301	13,5496	0,0351*
7	0,0104	13,5532	0,0597
8	-0,0458	13,6293	0,0920
9	0,2191	15,5449	0,0770
10	-0,2510	18,3377	0,0495*
11	0,0939	18,7778	0,0652
12	0,0283	18,8233	0,0929
13	-0,0925	19,3922	0,1114
14	0,1129	20,4087	0,1178
15	-0,0742	20,9572	0,1382
16	0,0318	21,0916	0,1750
17	-0,0036	21,0943	0,2221
18	-0,0069	21,1133	0,2737
19	0,0000	.	.
20	0,0000	.	.

Firm size

Lag	AutoCorr	Ljung-Box Q	p-Value
0	1,0000	.	.
1	0,7172	12,4213	0,0004*
2	0,4043	16,5773	0,0003*
3	0,1507	17,1870	0,0006*
4	-0,0544	17,2713	0,0017*
5	-0,1055	17,6070	0,0035*
6	-0,1073	17,9774	0,0063*
7	-0,2284	19,7767	0,0061*
8	-0,3049	23,2315	0,0031*
9	-0,3236	27,4463	0,0012*
10	-0,2668	30,5725	0,0007*
11	-0,1685	31,9445	0,0008*
12	-0,1520	33,1845	0,0009*
13	-0,1634	34,7966	0,0009*
14	-0,1689	36,7643	0,0008*
15	-0,1734	39,1841	0,0006*
16	-0,0056	39,1871	0,0010*
17	0,1147	40,7764	0,0010*
18	0,1362	43,7619	0,0006*
19	0,1252	47,5482	0,0003*
20	0,0743	50,2145	0,0002*

Firm size (first difference)

Lag	AutoCorr	Ljung-Box Q	p-Value
0	1,0000	.	.
1	0,3027	2,1213	0,1453
2	0,0195	2,1306	0,3446
3	0,0354	2,1631	0,5393
4	-0,0917	2,3944	0,6636
5	0,1392	2,9626	0,7058
6	-0,0019	2,9627	0,8135
7	-0,1883	4,1629	0,7608
8	-0,1849	5,4160	0,7123
9	-0,2139	7,2458	0,6115
10	0,0397	7,3150	0,6954
11	0,0393	7,3904	0,7666
12	-0,0909	7,8452	0,7971
13	-0,0638	8,1011	0,8370
14	-0,0139	8,1152	0,8832
15	-0,1299	9,6007	0,8441
16	-0,0887	10,4659	0,8412
17	-0,0153	10,5004	0,8813
18	-0,0048	10,5055	0,9142
19	0,0122	10,5713	0,9374
20	0,0000	.	.

FCF-yield

Lag	AutoCorr	Ljung-Box Q	p-Value
0	1,0000	.	.
1	0,3235	2,5275	0,1119
2	-0,2255	3,8204	0,1480
3	-0,0931	4,0528	0,2558
4	-0,0892	4,2788	0,3696
5	-0,2572	6,2762	0,2803
6	-0,0686	6,4276	0,3770
7	0,2059	7,8907	0,3423
8	-0,0418	7,9555	0,4378
9	-0,1143	8,4816	0,4864
10	0,0284	8,5170	0,5785
11	-0,0947	8,9499	0,6265
12	-0,2165	11,4647	0,4896
13	-0,1267	12,4338	0,4924
14	-0,0579	12,6649	0,5531
15	-0,0870	13,2740	0,5811
16	0,1617	15,7985	0,4671
17	0,2909	26,0187	0,0741
18	0,1097	27,9568	0,0627
19	-0,0707	29,1627	0,0635
20	-0,0771	32,0354	0,0429*

FCF-yield (first difference)

Lag	AutoCorr	Ljung-Box Q	p-Value
0	1,0000	.	.
1	-0,0762	0,1343	0,7140
2	-0,4280	4,6113	0,0997
3	0,2236	5,9058	0,1163
4	0,0865	6,1114	0,1910
5	-0,3106	8,9409	0,1114
6	-0,0473	9,0113	0,1729
7	0,2770	11,6077	0,1142
8	-0,1163	12,1034	0,1466
9	-0,1289	12,7683	0,1734
10	0,1920	14,3903	0,1559
11	-0,0215	14,4129	0,2110
12	-0,1092	15,0692	0,2377
13	0,0098	15,0752	0,3027
14	-0,1402	16,5162	0,2829
15	-0,1094	17,5695	0,2860
16	0,0528	17,8761	0,3312
17	0,0997	19,3347	0,3097
18	0,0445	19,7703	0,3459
19	0,0017	19,7716	0,4084
20	0,0000	.	.

FCF-yield (second difference)

Lag	AutoCorr	Ljung-Box Q	p-Value
0	1,0000	.	.
1	-0,3485	2,6921	0,1008
2	-0,4558	7,5678	0,0227*
3	0,4045	11,6475	0,0087*
4	0,1042	11,9364	0,0178*
5	-0,3529	15,4861	0,0085*
6	0,0344	15,5224	0,0166*
7	0,3131	18,7829	0,0089*
8	-0,1975	20,1979	0,0096*
9	-0,1459	21,0476	0,0124*
10	0,2591	24,0228	0,0075*
11	-0,0732	24,2903	0,0116*
12	-0,1028	24,8927	0,0153*
13	0,1568	26,5274	0,0144*
14	-0,0935	27,2253	0,0180*
15	-0,0762	27,8048	0,0228*
16	0,0582	28,2551	0,0295*
17	0,0295	28,4287	0,0402*
18	-0,0133	28,4991	0,0549
19	0,0000	.	.
20	0,0000	.	.

Financial leverage

Lag	AutoCorr	Ljung-Box Q	p-Value
0	1,0000	.	.
1	0,7194	12,4985	0,0004*
2	0,4144	16,8644	0,0002*
3	0,2678	18,7881	0,0003*
4	0,1295	19,2647	0,0007*
5	0,0556	19,3580	0,0016*
6	0,0038	19,3584	0,0036*
7	-0,0757	19,5561	0,0066*
8	-0,0790	19,7880	0,0112*
9	-0,0912	20,1225	0,0172*
10	-0,0747	20,3673	0,0260*
11	-0,0822	20,6939	0,0367*
12	-0,1877	22,5853	0,0315*
13	-0,2901	27,6664	0,0101*
14	-0,3358	35,4486	0,0013*
15	-0,3168	43,5257	0,0001*
16	-0,2946	51,9083	<,0001*
17	-0,2322	58,4163	<,0001*
18	-0,0657	59,1113	<,0001*
19	0,0314	59,3492	<,0001*
20	0,0037	59,3559	<,0001*

Financial leverage (first difference)

Lag	AutoCorr	Ljung-Box Q	p-Value
0	1,0000	.	.
1	0,1457	0,4917	0,4832
2	-0,0757	0,6317	0,7292
3	0,0579	0,7183	0,8689
4	-0,1675	1,4898	0,8284
5	0,1206	1,9164	0,8606
6	-0,1110	2,3036	0,8898
7	0,0320	2,3382	0,9388
8	0,1513	3,1778	0,9227
9	-0,1280	3,8336	0,9220
10	0,0485	3,9373	0,9501
11	-0,0238	3,9649	0,9709
12	-0,0174	3,9816	0,9838
13	0,0546	4,1692	0,9893
14	-0,1359	5,5233	0,9771
15	-0,0086	5,5298	0,9866
16	-0,1844	9,2710	0,9018
17	-0,2595	19,1443	0,3203
18	-0,0000	19,1443	0,3830
19	0,0011	19,1449	0,4476
20	0,0000	.	.

Financial leverage (second difference)

Lag	AutoCorr	Ljung-Box Q	p-Value
0	1,0000	.	.
1	-0,3696	3,0281	0,0818
2	-0,2036	4,0012	0,1353
3	0,2025	5,0233	0,1701
4	-0,2996	7,4108	0,1157
5	0,3116	10,1771	0,0704
6	-0,2313	11,8196	0,0661
7	0,0152	11,8272	0,1064
8	0,2407	13,9281	0,0837
9	-0,2593	16,6116	0,0552
10	0,1459	17,5548	0,0630
11	-0,0540	17,7000	0,0888
12	-0,0455	17,8181	0,1213
13	0,1526	19,3660	0,1122
14	-0,1744	21,7944	0,0829
15	0,1707	24,6994	0,0541
16	-0,0604	25,1843	0,0666
17	-0,1882	32,2472	0,0140*
18	0,1470	40,8721	0,0016*
19	0,0000	.	.
20	0,0000	.	.

P/E

Lag	AutoCorr	Ljung-Box Q	p-Value
0	1,0000	.	.
1	0,3085	2,2989	0,1295
2	-0,2804	4,2982	0,1166
3	-0,2130	5,5155	0,1377
4	-0,1355	6,0369	0,1964
5	-0,1356	6,5916	0,2528
6	0,0644	6,7252	0,3470
7	-0,0053	6,7262	0,4579
8	-0,1196	7,2575	0,5091
9	-0,2065	8,9744	0,4396
10	-0,2051	10,8207	0,3717
11	0,0603	10,9965	0,4436
12	0,4110	20,0619	0,0659
13	0,1905	22,2521	0,0516
14	-0,1081	23,0584	0,0593
15	-0,0644	23,3926	0,0762
16	-0,0668	23,8235	0,0934
17	-0,0719	24,4476	0,1078
18	0,0417	24,7279	0,1326
19	0,0523	25,3890	0,1481
20	-0,0166	25,5219	0,1822

P/E (first difference)

Lag	AutoCorr	Ljung-Box Q	p-Value
0	1,0000	.	.
1	-0,0120	0,0033	0,9540
2	-0,4730	5,4734	0,0648
3	-0,0555	5,5531	0,1355
4	0,0564	5,6405	0,2277
5	-0,1632	6,4222	0,2673
6	0,1270	6,9290	0,3275
7	0,0680	7,0856	0,4200
8	0,0310	7,1209	0,5236
9	-0,0661	7,2955	0,6064
10	-0,2090	9,2182	0,5115
11	-0,0724	9,4747	0,5782
12	0,4210	19,2237	0,0833
13	0,1050	19,9163	0,0973
14	-0,2125	23,2271	0,0567
15	-0,0208	23,2650	0,0787
16	-0,0117	23,2801	0,1064
17	-0,0913	24,5024	0,1064
18	0,0154	24,5544	0,1377
19	0,0638	26,3459	0,1208
20	0,0000	.	.

P/E (second difference)

Lag	AutoCorr	Ljung-Box Q	p-Value
0	1,0000	.	.
1	-0,2231	1,1031	0,2936
2	-0,3694	4,3051	0,1162
3	0,0831	4,4774	0,2143
4	0,1892	5,4295	0,2460
5	-0,2439	7,1243	0,2116
6	0,1018	7,4424	0,2819
7	-0,0155	7,4504	0,3835
8	0,0783	7,6725	0,4661
9	0,0181	7,6856	0,5661
10	-0,1211	8,3362	0,5960
11	-0,2193	10,7350	0,4657
12	0,3527	17,8271	0,1210
13	0,0203	17,8544	0,1631
14	-0,1054	18,7417	0,1751
15	0,0077	18,7476	0,2254
16	0,0287	18,8569	0,2762
17	-0,0551	19,4628	0,3026
18	-0,0270	19,7547	0,3468
19	0,0000	.	.
20	0,0000	.	.

ROIC

Lag	AutoCorr	Ljung-Box Q	p-Value
0	1,0000	.	.
1	0,5992	8,6696	0,0032*
2	0,2262	9,9704	0,0068*
3	0,1285	10,4133	0,0154*
4	-0,1469	11,0265	0,0263*
5	-0,2927	13,6132	0,0183*
6	-0,3313	17,1477	0,0088*
7	-0,3789	22,1003	0,0024*
8	-0,3141	25,7667	0,0012*
9	-0,2351	27,9922	0,0010*
10	-0,2024	29,7914	0,0009*
11	-0,1560	30,9664	0,0011*
12	0,0398	31,0513	0,0019*
13	0,2098	33,7083	0,0013*
14	0,2053	36,6172	0,0008*
15	0,1348	38,0605	0,0009*
16	0,0770	38,6532	0,0012*
17	0,0435	38,8814	0,0019*
18	-0,0143	38,9141	0,0029*
19	-0,0624	39,8539	0,0034*
20	-0,0299	40,2849	0,0046*

ROIC (first difference)

Lag	AutoCorr	Ljung-Box Q	p-Value
0	1,0000	.	.
1	-0,0637	0,0940	0,7591
2	-0,2531	1,6605	0,4359
3	0,2506	3,2864	0,3495
4	-0,1738	4,1170	0,3904
5	-0,0041	4,1175	0,5326
6	0,0389	4,1651	0,6543
7	-0,1718	5,1642	0,6399
8	-0,0748	5,3691	0,7175
9	-0,0749	5,5935	0,7798
10	0,0144	5,6026	0,8475
11	-0,1530	6,7468	0,8192
12	-0,0695	7,0124	0,8568
13	0,1418	8,2759	0,8252
14	0,0348	8,3648	0,8695
15	-0,0082	8,3707	0,9081
16	0,0496	8,6412	0,9274
17	0,0211	8,7063	0,9490
18	0,0016	8,7069	0,9662
19	-0,0059	8,7221	0,9778
20	0,0000	.	.

ROIC (second difference)

Lag	AutoCorr	Ljung-Box Q	p-Value
0	1,0000	.	.
1	-0,3826	3,2449	0,0716
2	-0,3628	6,3339	0,0421*
3	0,4521	11,4306	0,0096*
4	-0,2478	13,0641	0,0110*
5	0,0166	13,0720	0,0227*
6	0,1280	13,5749	0,0348*
7	-0,1400	14,2263	0,0473*
8	0,0051	14,2272	0,0760
9	-0,0136	14,2346	0,1142
10	0,1390	15,0907	0,1288
11	-0,1190	15,7968	0,1488
12	-0,0918	16,2772	0,1789
13	0,1632	18,0478	0,1557
14	-0,0116	18,0586	0,2041
15	-0,0746	18,6135	0,2318
16	0,0494	18,9377	0,2719
17	0,0106	18,9600	0,3308
18	-0,0201	19,1215	0,3844
19	0,0000	.	.
20	0,0000	.	.

Turnover rate

Lag	AutoCorr	Ljung-Box Q	p-Value
0	1,0000	.	.
1	0,4455	4,7920	0,0286*
2	0,1522	5,3810	0,0678
3	0,0706	5,5147	0,1378
4	-0,0080	5,5165	0,2383
5	0,0483	5,5869	0,3485
6	0,0095	5,5898	0,4707
7	-0,0402	5,6456	0,5817
8	-0,1242	6,2189	0,6227
9	-0,0783	6,4656	0,6926
10	-0,0998	6,9027	0,7346
11	-0,2030	8,8937	0,6317
12	-0,2595	12,5088	0,4057
13	-0,1523	13,9097	0,3802
14	-0,0613	14,1691	0,4372
15	-0,0498	14,3684	0,4978
16	-0,0260	14,4338	0,5664
17	-0,0285	14,5321	0,6291
18	-0,0408	14,8003	0,6756
19	-0,0362	15,1163	0,7152
20	-0,0181	15,2743	0,7605

Turnover rate (first difference)

Lag	AutoCorr	Ljung-Box Q	p-Value
0	1,0000	.	.
1	-0,2502	1,4496	0,2286
2	-0,1865	2,3000	0,3166
3	0,0178	2,3082	0,5110
4	-0,1511	2,9359	0,5686
5	0,0660	3,0636	0,6902
6	0,0224	3,0794	0,7988
7	-0,0169	3,0891	0,8766
8	-0,1474	3,8853	0,8673
9	0,1239	4,4993	0,8756
10	0,0959	4,9039	0,8975
11	-0,0570	5,0626	0,9281
12	-0,0107	5,0690	0,9556
13	-0,0034	5,0697	0,9736
14	-0,0085	5,0750	0,9847
15	0,0021	5,0754	0,9915
16	0,0048	5,0779	0,9954
17	-0,0004	5,0779	0,9975
18	-0,0010	5,0782	0,9987
19	0,0002	5,0782	0,9994
20	0,0000	.	.

Turnover rate (second difference)

Lag	AutoCorr	Ljung-Box Q	p-Value
0	1,0000	.	.
1	-0,5250	6,1091	0,0134*
2	-0,0561	6,1830	0,0454*
3	0,1480	6,7290	0,0811
4	-0,1546	7,3645	0,1178
5	0,1056	7,6821	0,1746
6	-0,0047	7,6828	0,2623
7	0,0382	7,7312	0,3569
8	-0,1560	8,6138	0,3759
9	0,1159	9,1500	0,4235
10	0,0500	9,2606	0,5076
11	-0,0759	9,5478	0,5715
12	0,0108	9,5544	0,6550
13	0,0033	9,5552	0,7298
14	-0,0033	9,5560	0,7939
15	0,0019	9,5564	0,8467
16	0,0033	9,5578	0,8887
17	-0,0005	9,5579	0,9211
18	-0,0009	9,5582	0,9454
19	0,0000	.	.
20	0,0000	.	.

Interest rate

Lag	AutoCorr	Ljung-Box Q	p-Value
0	1,0000	.	.
1	0,8186	16,1846	<,0001*
2	0,5828	24,8176	<,0001*
3	0,3847	28,7890	<,0001*
4	0,2508	30,5765	<,0001*
5	0,1708	31,4571	<,0001*
6	0,1157	31,8882	<,0001*
7	0,0731	32,0724	<,0001*
8	-0,0075	32,0745	<,0001*
9	-0,0976	32,4576	0,0002*
10	-0,1533	33,4894	0,0002*
11	-0,1792	35,0408	0,0002*
12	-0,2067	37,3328	0,0002*
13	-0,2742	41,8733	<,0001*
14	-0,3360	49,6618	<,0001*
15	-0,3927	62,0738	<,0001*
16	-0,4002	77,5473	<,0001*
17	-0,3743	94,4684	<,0001*
18	-0,2732	106,487	<,0001*
19	-0,1431	111,435	<,0001*
20	-0,0585	113,089	<,0001*

Interest rate (first difference)

Lag	AutoCorr	Ljung-Box Q	p-Value
0	1,0000	.	.
1	0,0504	0,0589	0,8083
2	-0,4323	4,6262	0,0990
3	-0,1595	5,2846	0,1521
4	0,0070	5,2860	0,2592
5	-0,1312	5,7910	0,3271
6	0,0804	5,9943	0,4238
7	0,3329	9,7457	0,2034
8	-0,0952	10,0779	0,2596
9	-0,3395	14,6881	0,0999
10	0,0595	14,8439	0,1379
11	0,2248	17,3151	0,0989
12	0,0400	17,4030	0,1351
13	-0,1443	18,7125	0,1323
14	0,1276	19,9065	0,1331
15	-0,0820	20,4975	0,1537
16	-0,1644	23,4704	0,1017
17	0,0225	23,5446	0,1323
18	0,0774	24,8629	0,1287
19	0,0257	25,1531	0,1556
20	0,0000	.	.

Interest rate (second difference)

Lag	AutoCorr	Ljung-Box Q	p-Value
0	1,0000	.	.
1	-0,2637	1,5416	0,2144
2	-0,3403	4,2594	0,1189
3	0,0620	4,3552	0,2256
4	0,1335	4,8293	0,3053
5	-0,1638	5,5941	0,3477
6	-0,0202	5,6066	0,4687
7	0,3097	8,7950	0,2677
8	-0,1104	9,2368	0,3227
9	-0,2815	12,3983	0,1918
10	0,1330	13,1826	0,2136
11	0,1353	14,0963	0,2277
12	0,0024	14,0966	0,2946
13	-0,2103	17,0385	0,1976
14	0,2528	22,1381	0,0758
15	-0,0970	23,0761	0,0825
16	-0,0712	23,7506	0,0951
17	0,0312	23,9445	0,1210
18	-0,0015	23,9454	0,1568
19	0,0000	.	.
20	0,0000	.	.

Autocorrelation plots for variables, 2013-2018

Excess return

Lag	AutoCorr	Ljung-Box Q	p-Value
0	1,0000	.	.
1	0,0529	0,0788	0,7789
2	0,0987	0,3646	0,8333
3	0,2313	2,0058	0,5712
4	-0,1209	2,4755	0,6490
5	-0,0030	2,4758	0,7801
6	-0,0277	2,5031	0,8681
7	-0,1909	3,8695	0,7947
8	0,0434	3,9445	0,8621
9	-0,2526	6,6365	0,6749
10	-0,0488	6,7437	0,7494
11	0,1138	7,3679	0,7686
12	-0,1647	8,7767	0,7219
13	0,2132	11,3336	0,5829
14	0,0109	11,3409	0,6591
15	-0,1965	13,9477	0,5295
16	0,0823	14,4553	0,5648
17	-0,0798	14,9924	0,5960
18	-0,0630	15,3757	0,6360
19	-0,1119	16,7844	0,6045
20	-0,1132	18,5146	0,5535
21	-0,0286	18,6522	0,6074
22	0,0090	18,6704	0,6656
23	-0,0563	19,7420	0,6574
24	0,1025	26,8345	0,3122
25	0,0000	.	.

Excess return (first difference)

Lag	AutoCorr	Ljung-Box Q	p-Value
0	1,0000	.	.
1	-0,4786	6,2155	0,0127*
2	-0,0211	6,2280	0,0444*
3	0,2575	8,1983	0,0421*
4	-0,3045	11,0911	0,0256*
5	0,1637	11,9717	0,0352*
6	0,0969	12,2969	0,0557
7	-0,2125	13,9537	0,0520
8	0,2804	17,0203	0,0299*
9	-0,2084	18,8271	0,0267*
10	-0,0565	18,9695	0,0407*
11	0,1690	20,3405	0,0409*
12	-0,2277	23,0373	0,0274*
13	0,2060	25,4448	0,0202*
14	0,0516	25,6108	0,0290*
15	-0,1687	27,5849	0,0243*
16	0,0667	27,9318	0,0322*
17	-0,0468	28,1273	0,0435*
18	0,0440	28,3285	0,0572
19	-0,0059	28,3327	0,0772
20	-0,0726	29,1560	0,0847
21	0,0423	29,5282	0,1019
22	0,0014	29,5287	0,1304
23	-0,0761	33,1402	0,0787
24	0,0000	.	.
25	0,0000	.	.

Excess return (second difference)

Lag	AutoCorr	Ljung-Box Q	p-Value
0	1,0000	.	.
1	-0,6274	10,2882	0,0013*
2	0,0442	10,3416	0,0057*
3	0,3130	13,1588	0,0043*
4	-0,3889	17,7364	0,0014*
5	0,2096	19,1400	0,0018*
6	0,0773	19,3422	0,0036*
7	-0,2612	21,7937	0,0028*
8	0,2618	24,4212	0,0019*
9	-0,1254	25,0674	0,0029*
10	-0,0434	25,1506	0,0051*
11	0,1313	25,9761	0,0065*
12	-0,1728	27,5377	0,0065*
13	0,1123	28,2629	0,0083*
14	0,0123	28,2726	0,0131*
15	-0,0757	28,6845	0,0177*
16	0,0481	28,8748	0,0248*
17	-0,0471	29,0872	0,0337*
18	0,0377	29,2508	0,0454*
19	0,0242	29,3348	0,0609
20	-0,0919	30,9519	0,0558
21	0,0512	31,7060	0,0627
22	0,0108	31,7724	0,0814
23	0,0000	.	.
24	0,0000	.	.
25	0,0000	.	.

Book-to-market

Lag	AutoCorr	Ljung-Box Q	p-Value
0	1,0000	.	.
1	0,4862	6,6480	0,0099*
2	0,1819	7,6188	0,0222*
3	0,0730	7,7823	0,0507
4	-0,0950	8,0722	0,0890
5	0,0583	8,1869	0,1462
6	-0,0583	8,3077	0,2164
7	-0,1455	9,1013	0,2455
8	-0,0812	9,3634	0,3126
9	-0,2182	11,3724	0,2510
10	-0,0591	11,5294	0,3178
11	0,1148	12,1645	0,3514
12	0,1768	13,7867	0,3145
13	0,3077	19,1132	0,1196
14	0,0894	19,6038	0,1431
15	-0,0929	20,1862	0,1649
16	-0,1118	21,1237	0,1738
17	-0,1015	21,9926	0,1850
18	-0,0724	22,4985	0,2106
19	-0,1937	26,7176	0,1114
20	-0,2729	36,7715	0,0125*
21	-0,1922	43,0043	0,0031*
22	-0,1744	49,8468	0,0006*
23	-0,1272	55,3055	0,0002*
24	0,0082	55,3508	0,0003*
25	0,0000	.	.

Book-to-market (first difference)

Lag	AutoCorr	Ljung-Box Q	p-Value
0	1,0000	.	.
1	-0,1832	0,9106	0,3399
2	-0,2660	2,9179	0,2325
3	-0,0050	2,9186	0,4043
4	-0,1196	3,3646	0,4988
5	0,3407	7,1765	0,2078
6	-0,0821	7,4101	0,2846
7	-0,2069	8,9821	0,2539
8	0,1486	9,8427	0,2762
9	-0,1910	11,3611	0,2518
10	-0,0007	11,3611	0,3301
11	0,0239	11,3885	0,4113
12	-0,0473	11,5046	0,4862
13	0,2897	16,2642	0,2352
14	-0,0158	16,2797	0,2966
15	-0,1667	18,2066	0,2520
16	-0,0441	18,3581	0,3033
17	0,0683	18,7744	0,3416
18	0,1702	21,7873	0,2416
19	-0,0208	21,8414	0,2922
20	-0,2646	32,7673	0,0358*
21	0,0767	33,9919	0,0363*
22	0,0468	34,6758	0,0419*
23	-0,0511	36,3060	0,0384*
24	0,0000	.	.
25	0,0000	.	.

Book-to-market (second difference)

Lag	AutoCorr	Ljung-Box Q	p-Value
0	1,0000	.	.
1	-0,3995	4,1706	0,0411*
2	-0,1379	4,6917	0,0958
3	0,0964	4,9588	0,1748
4	-0,2772	7,2845	0,1216
5	0,4638	14,1557	0,0146*
6	-0,1532	14,9493	0,0207*
7	-0,1726	16,0201	0,0249*
8	0,2435	18,2928	0,0191*
9	-0,2140	20,1735	0,0169*
10	0,0937	20,5616	0,0244*
11	-0,0403	20,6395	0,0373*
12	-0,1091	21,2618	0,0467*
13	0,2108	23,8158	0,0329*
14	-0,0218	23,8462	0,0478*
15	-0,0619	24,1219	0,0631
16	-0,1153	25,2146	0,0661
17	0,0321	25,3137	0,0879
18	0,1177	26,9072	0,0808
19	0,0698	27,6083	0,0913
20	-0,1809	33,8798	0,0269*
21	0,0146	33,9411	0,0368*
22	0,0414	34,9255	0,0394*
23	0,0000	.	.
24	0,0000	.	.
25	0,0000	.	.

EPS-growth

Lag	AutoCorr	Ljung-Box Q	p-Value
0	1,0000	.	.
1	-0,0506	0,0720	0,7884
2	-0,0013	0,0720	0,9646
3	-0,1856	1,1285	0,7702
4	-0,0188	1,1399	0,8879
5	-0,1621	2,0270	0,8454
6	-0,1725	3,0836	0,7983
7	-0,0355	3,1308	0,8726
8	-0,1307	3,8086	0,8740
9	-0,0326	3,8534	0,9208
10	0,1621	5,0355	0,8888
11	0,3048	9,5156	0,5744
12	0,0949	9,9835	0,6174
13	-0,1478	11,2130	0,5930
14	0,0585	11,4231	0,6525
15	-0,0953	12,0366	0,6763
16	-0,0306	12,1070	0,7366
17	-0,0757	12,5907	0,7631
18	0,0062	12,5944	0,8151
19	-0,0173	12,6282	0,8571
20	-0,0660	13,2156	0,8679
21	0,0386	13,4668	0,8914
22	0,0236	13,5924	0,9153
23	0,0198	13,7242	0,9345
24	0,0139	13,8551	0,9499
25	0,0000	.	.

EPS-growth (first difference)

Lag	AutoCorr	Ljung-Box Q	p-Value
0	1,0000	.	.
1	-0,5266	7,5236	0,0061*
2	0,1142	7,8932	0,0193*
3	-0,1745	8,7981	0,0321*
4	0,2050	10,1090	0,0386*
5	-0,1168	10,5573	0,0609
6	-0,0525	10,6527	0,0997
7	0,0932	10,9713	0,1399
8	-0,0678	11,1508	0,1933
9	-0,0464	11,2404	0,2596
10	0,0128	11,2476	0,3386
11	0,1590	12,4615	0,3300
12	0,0080	12,4648	0,4091
13	-0,2087	14,9364	0,3113
14	0,1848	17,0678	0,2526
15	-0,0931	17,6689	0,2805
16	0,0527	17,8853	0,3307
17	-0,0866	18,5538	0,3547
18	0,0697	19,0585	0,3882
19	-0,0065	19,0638	0,4528
20	-0,0213	19,1345	0,5131
21	0,0023	19,1356	0,5764
22	-0,0001	19,1356	0,6369
23	-0,0005	19,1358	0,6933
24	0,0000	.	.
25	0,0000	.	.

EPS-growth (second difference)

Lag	AutoCorr	Ljung-Box Q	p-Value
0	1,0000	.	.
1	-0,7100	13,1766	0,0003*
2	0,3055	15,7314	0,0004*
3	-0,2245	17,1804	0,0006*
4	0,2388	18,9066	0,0008*
5	-0,1326	19,4681	0,0016*
6	-0,0229	19,4858	0,0034*
7	0,0961	19,8174	0,0060*
8	-0,0580	19,9465	0,0105*
9	-0,0103	19,9508	0,0182*
10	-0,0286	19,9870	0,0294*
11	0,0971	20,4385	0,0397*
12	0,0199	20,4593	0,0589
13	-0,2003	22,7660	0,0446*
14	0,2198	25,8531	0,0270*
15	-0,1384	27,2305	0,0269*
16	0,0966	27,9970	0,0316*
17	-0,1012	28,9790	0,0347*
18	0,0798	29,7113	0,0403*
19	-0,0282	29,8258	0,0541
20	-0,0002	29,8258	0,0727
21	0,0020	29,8270	0,0955
22	-0,0003	29,8270	0,1227
23	0,0000	.	.
24	0,0000	.	.
25	0,0000	.	.

Firm size

Lag	AutoCorr	Ljung-Box Q	p-Value
0	1,0000	.	.
1	0,9159	23,5925	<,0001*
2	0,8040	42,5612	<,0001*
3	0,6835	56,8944	<,0001*
4	0,5776	67,6188	<,0001*
5	0,4647	74,9057	<,0001*
6	0,3313	78,8043	<,0001*
7	0,1962	80,2475	<,0001*
8	0,0640	80,4099	<,0001*
9	-0,0475	80,5049	<,0001*
10	-0,1374	81,3548	<,0001*
11	-0,2245	83,7847	<,0001*
12	-0,3019	88,5162	<,0001*
13	-0,3500	95,4079	<,0001*
14	-0,3976	105,111	<,0001*
15	-0,4313	117,667	<,0001*
16	-0,4506	132,894	<,0001*
17	-0,4398	149,212	<,0001*
18	-0,4058	165,094	<,0001*
19	-0,3640	179,999	<,0001*
20	-0,3147	193,365	<,0001*
21	-0,2754	206,166	<,0001*
22	-0,2159	216,649	<,0001*
23	-0,1305	222,393	<,0001*
24	-0,0502	224,095	<,0001*
25	0,0000	.	.

Firm size (first difference)

Lag	AutoCorr	Ljung-Box Q	p-Value
0	1,0000	.	.
1	0,0192	0,0100	0,9203
2	-0,2248	1,4429	0,4861
3	-0,0039	1,4433	0,6954
4	0,2323	3,1274	0,5367
5	0,0718	3,2966	0,6544
6	-0,1137	3,7447	0,7112
7	-0,0883	4,0308	0,7762
8	-0,1678	5,1295	0,7436
9	0,0115	5,1350	0,8224
10	-0,0793	5,4154	0,8618
11	-0,0050	5,4166	0,9093
12	-0,2584	8,8900	0,7123
13	0,1239	9,7610	0,7133
14	0,0438	9,8808	0,7708
15	-0,1863	12,2864	0,6572
16	-0,0536	12,5101	0,7082
17	0,0426	12,6721	0,7578
18	0,1411	14,7431	0,6795
19	0,0066	14,7486	0,7384
20	-0,0441	15,0526	0,7734
21	-0,0364	15,3281	0,8061
22	0,0902	17,8671	0,7138
23	-0,0216	18,1574	0,7489
24	0,0000	.	.
25	0,0000	.	.

FCF-yield

Lag	AutoCorr	Ljung-Box Q	p-Value
0	1,0000	.	.
1	0,4581	5,9026	0,0151*
2	0,0891	6,1356	0,0465*
3	-0,0644	6,2628	0,0995
4	-0,0099	6,2660	0,1801
5	0,2562	8,4821	0,1316
6	0,0779	8,6978	0,1913
7	-0,3349	12,9044	0,0745
8	-0,3733	18,4373	0,0182*
9	-0,2970	22,1580	0,0084*
10	-0,0586	22,3128	0,0136*
11	0,0571	22,4702	0,0210*
12	-0,1234	23,2611	0,0256*
13	-0,1974	25,4540	0,0201*
14	-0,1342	26,5585	0,0220*
15	-0,0555	26,7665	0,0307*
16	0,0443	26,9136	0,0425*
17	0,0141	26,9303	0,0591
18	-0,0208	26,9719	0,0795
19	-0,0146	26,9958	0,1048
20	0,0093	27,0075	0,1351
21	0,0609	27,6324	0,1509
22	0,0575	28,3772	0,1635
23	0,0524	29,3042	0,1704
24	0,0070	29,3371	0,2077
25	0,0000	.	.

FCF-yield (first difference)

Lag	AutoCorr	Ljung-Box Q	p-Value
0	1,0000	.	.
1	-0,1329	0,4795	0,4886
2	-0,1714	1,3131	0,5186
3	-0,1709	2,1812	0,5357
4	-0,1759	3,1467	0,5336
5	0,3711	7,6685	0,1755
6	0,2422	9,7016	0,1378
7	-0,2956	12,9094	0,0743
8	-0,0482	12,9999	0,1119
9	-0,1450	13,8740	0,1269
10	0,0817	14,1712	0,1653
11	0,0818	14,4920	0,2070
12	0,0142	14,5025	0,2698
13	-0,1499	15,7770	0,2614
14	-0,0301	15,8335	0,3236
15	-0,0245	15,8752	0,3904
16	0,0631	16,1856	0,4401
17	0,0216	16,2271	0,5078
18	-0,0024	16,2277	0,5767
19	-0,0487	16,5242	0,6221
20	-0,0109	16,5428	0,6824
21	0,0078	16,5555	0,7377
22	0,0069	16,5704	0,7866
23	0,0163	16,7372	0,8219
24	0,0000	.	.
25	0,0000	.	.

FCF-yield (second difference)

Lag	AutoCorr	Ljung-Box Q	p-Value
0	1,0000	.	.
1	-0,4797	6,0153	0,0142*
2	-0,0214	6,0279	0,0491*
3	0,0121	6,0321	0,1101
4	-0,2350	7,7033	0,1031
5	0,2945	10,4746	0,0629
6	0,1544	11,2813	0,0801
7	-0,3442	15,5391	0,0297*
8	0,1790	16,7668	0,0326*
9	-0,1443	17,6218	0,0398*
10	0,1381	18,4654	0,0476*
11	-0,0376	18,5331	0,0700
12	0,0457	18,6421	0,0975
13	-0,0654	18,8879	0,1266
14	0,0172	18,9069	0,1685
15	-0,0350	18,9950	0,2140
16	0,0324	19,0810	0,2645
17	-0,0152	19,1032	0,3226
18	0,0385	19,2735	0,3752
19	-0,0320	19,4207	0,4302
20	-0,0003	19,4208	0,4946
21	-0,0018	19,4217	0,5581
22	-0,0000	19,4217	0,6192
23	0,0000	.	.
24	0,0000	.	.
25	0,0000	.	.

Financial leverage

Lag	AutoCorr	Ljung-Box Q	p-Value
0	1,0000	.	.
1	0,6319	11,2312	0,0008*
2	0,4830	18,0779	0,0001*
3	0,2938	20,7263	0,0001*
4	0,1581	21,5298	0,0002*
5	0,0299	21,5599	0,0006*
6	-0,0859	21,8223	0,0013*
7	-0,1286	22,4426	0,0021*
8	-0,2227	24,4123	0,0020*
9	-0,3366	29,1920	0,0006*
10	-0,3252	33,9522	0,0002*
11	-0,3506	39,8793	<,0001*
12	-0,3538	46,3790	<,0001*
13	-0,3125	51,8720	<,0001*
14	-0,2161	54,7367	<,0001*
15	-0,1703	56,6954	<,0001*
16	-0,1393	58,1509	<,0001*
17	-0,0502	58,3635	<,0001*
18	0,0026	58,3641	<,0001*
19	0,0053	58,3673	<,0001*
20	0,0824	59,2838	<,0001*
21	0,1531	63,2418	<,0001*
22	0,2249	74,6178	<,0001*
23	0,0559	75,6711	<,0001*
24	0,0711	79,0832	<,0001*
25	0,0000	.	.

Financial leverage (first difference)

Lag	AutoCorr	Ljung-Box Q	p-Value
0	1,0000	.	.
1	-0,0645	0,1130	0,7368
2	-0,1056	0,4294	0,8068
3	-0,0413	0,4801	0,9232
4	0,0983	0,7815	0,9409
5	0,0588	0,8952	0,9706
6	-0,0933	1,1972	0,9770
7	0,0740	1,3983	0,9856
8	0,0956	1,7548	0,9876
9	-0,1315	2,4743	0,9816
10	0,0306	2,5159	0,9906
11	-0,0108	2,5215	0,9957
12	-0,0635	2,7314	0,9972
13	-0,1207	3,5580	0,9950
14	0,0491	3,7086	0,9970
15	0,0244	3,7498	0,9984
16	-0,1460	5,4131	0,9933
17	-0,0112	5,4243	0,9963
18	0,0688	5,9165	0,9965
19	-0,1230	7,8032	0,9885
20	-0,1728	12,4638	0,8992
21	-0,2012	20,8852	0,4660
22	0,3122	51,2980	0,0004*
23	-0,0262	51,7263	0,0005*
24	0,0000	.	.
25	0,0000	.	.

P/E

Lag	AutoCorr	Ljung-Box Q	p-Value
0	1,0000	.	.
1	0,4670	6,1334	0,0133*
2	-0,0093	6,1360	0,0465*
3	-0,1139	6,5338	0,0883
4	-0,0923	6,8076	0,1464
5	-0,0972	7,1262	0,2114
6	-0,0543	7,2310	0,3000
7	0,0290	7,2625	0,4021
8	0,2441	9,6278	0,2921
9	0,2916	13,2146	0,1531
10	-0,0261	13,2453	0,2103
11	-0,1545	14,3969	0,2118
12	-0,1574	15,6824	0,2062
13	-0,1495	16,9396	0,2021
14	-0,1473	18,2704	0,1947
15	-0,1411	19,6137	0,1873
16	-0,0245	19,6589	0,2360
17	0,1225	20,9243	0,2297
18	-0,0036	20,9256	0,2832
19	-0,1970	25,2932	0,1511
20	-0,1812	29,7241	0,0744
21	-0,0610	30,3524	0,0851
22	-0,0247	30,4892	0,1071
23	-0,0174	30,5916	0,1332
24	-0,0019	30,5939	0,1658
25	0,0000	.	.

P/E (first difference)

Lag	AutoCorr	Ljung-Box Q	p-Value
0	1,0000	.	.
1	-0,1028	0,2869	0,5922
2	-0,3346	3,4632	0,1770
3	-0,0862	3,6838	0,2977
4	0,0277	3,7078	0,4470
5	-0,0389	3,7576	0,5848
6	-0,0375	3,8063	0,7029
7	-0,1296	4,4229	0,7300
8	0,1497	5,2969	0,7254
9	0,3479	10,3329	0,3242
10	-0,2047	12,1999	0,2719
11	-0,0948	12,6312	0,3181
12	-0,0042	12,6321	0,3963
13	0,0093	12,6371	0,4762
14	0,0047	12,6385	0,5552
15	-0,1114	13,4985	0,5639
16	-0,0267	13,5539	0,6319
17	0,2551	19,3536	0,3086
18	0,0449	19,5635	0,3579
19	-0,1957	24,3432	0,1833
20	-0,0812	25,3729	0,1875
21	0,0832	26,8127	0,1771
22	0,0286	27,0674	0,2087
23	-0,0028	27,0724	0,2529
24	0,0000	.	.
25	0,0000	.	.

ROIC

Lag	AutoCorr	Ljung-Box Q	p-Value
0	1,0000	.	.
1	0,8278	19,2739	<,0001*
2	0,6657	32,2809	<,0001*
3	0,4850	39,4986	<,0001*
4	0,3149	42,6864	<,0001*
5	0,1496	43,4420	<,0001*
6	-0,0118	43,4469	<,0001*
7	-0,1258	44,0406	<,0001*
8	-0,1971	45,5835	<,0001*
9	-0,1713	46,8220	<,0001*
10	-0,1696	48,1170	<,0001*
11	-0,1144	48,7474	<,0001*
12	-0,0926	49,1928	<,0001*
13	-0,0912	49,6603	<,0001*
14	-0,0814	50,0671	<,0001*
15	-0,1360	51,3148	<,0001*
16	-0,1815	53,7843	<,0001*
17	-0,2344	58,4219	<,0001*
18	-0,2479	64,3478	<,0001*
19	-0,2495	71,3510	<,0001*
20	-0,2250	78,1851	<,0001*
21	-0,1937	84,5197	<,0001*
22	-0,1930	92,9006	<,0001*
23	-0,1474	100,235	<,0001*
24	-0,0794	104,492	<,0001*
25	0,0000	.	.

ROIC (first difference)

Lag	AutoCorr	Ljung-Box Q	p-Value
0	1,0000	.	.
1	0,2359	1,5100	0,2191
2	0,1932	2,5684	0,2769
3	0,0726	2,7248	0,4360
4	-0,2033	4,0138	0,4041
5	-0,1442	4,6966	0,4540
6	-0,2282	6,5014	0,3694
7	-0,2085	8,0963	0,3242
8	-0,4941	17,6189	0,0243*
9	-0,0911	17,9639	0,0356*
10	-0,1656	19,1859	0,0380*
11	-0,1184	19,8592	0,0473*
12	0,1751	21,4539	0,0441*
13	0,0621	21,6726	0,0606
14	0,2264	24,8699	0,0359*
15	0,2785	30,2495	0,0111*
16	0,1186	31,3459	0,0122*
17	-0,0004	31,3459	0,0181*
18	0,0277	31,4255	0,0257*
19	0,0081	31,4337	0,0362*
20	-0,0642	32,0768	0,0425*
21	0,0293	32,2551	0,0552
22	-0,0849	34,5023	0,0436*
23	-0,1247	44,2008	0,0050*
24	0,0000	.	.
25	0,0000	.	.

ROIC (second difference)

Lag	AutoCorr	Ljung-Box Q	p-Value
0	1,0000	.	.
1	-0,4355	4,9580	0,0260*
2	0,1435	5,5218	0,0632
3	0,0909	5,7594	0,1239
4	-0,2203	7,2283	0,1243
5	0,0923	7,5004	0,1860
6	-0,1187	7,9772	0,2398
7	0,3062	11,3471	0,1242
8	-0,3549	16,1765	0,0399*
9	0,2379	18,5005	0,0298*
10	-0,0526	18,6231	0,0453*
11	-0,2826	22,4509	0,0211*
12	0,2085	24,7226	0,0162*
13	-0,2585	28,5662	0,0075*
14	0,0181	28,5872	0,0119*
15	0,0535	28,7928	0,0171*
16	0,0858	29,3971	0,0214*
17	-0,0527	29,6634	0,0289*
18	-0,0141	29,6864	0,0406*
19	0,0408	29,9262	0,0527
20	-0,0748	30,9999	0,0552
21	0,0561	31,9040	0,0599
22	0,0315	32,4741	0,0697
23	0,0000	.	.
24	0,0000	.	.
25	0,0000	.	.

Turnover rate

Lag	AutoCorr	Ljung-Box Q	p-Value
0	1,0000	.	.
1	-0,0087	0,0021	0,9631
2	0,1251	0,4615	0,7939
3	0,3149	3,5040	0,3203
4	-0,3756	8,0383	0,0902
5	-0,0571	8,1485	0,1482
6	-0,1966	9,5219	0,1463
7	-0,1705	10,6122	0,1565
8	0,1740	11,8146	0,1597
9	-0,0633	11,9836	0,2142
10	0,1056	12,4850	0,2539
11	0,2622	15,8005	0,1487
12	-0,1940	17,7539	0,1234
13	0,0329	17,8149	0,1647
14	-0,0854	18,2626	0,1951
15	-0,3142	24,9247	0,0510
16	-0,0311	24,9972	0,0699
17	-0,2113	28,7651	0,0368*
18	0,0190	28,8000	0,0509
19	0,0594	29,1968	0,0630
20	-0,0087	29,2071	0,0838
21	0,0956	30,7498	0,0779
22	0,0285	30,9320	0,0975
23	0,0089	30,9587	0,1238
24	-0,0095	31,0202	0,1532
25	0,0000	.	.

Turnover rate (first difference)

Lag	AutoCorr	Ljung-Box Q	p-Value
0	1,0000	.	.
1	-0,5629	8,5956	0,0034*
2	-0,0640	8,7117	0,0128*
3	0,4853	15,7104	0,0013*
4	-0,5150	23,9853	<,0001*
5	0,2298	25,7195	0,0001*
6	-0,0020	25,7197	0,0003*
7	-0,2153	27,4216	0,0003*
8	0,2808	30,4962	0,0002*
9	-0,1821	31,8752	0,0002*
10	-0,0195	31,8922	0,0004*
11	0,3128	36,5885	0,0001*
12	-0,3595	43,3106	<,0001*
13	0,1672	44,8974	<,0001*
14	0,1015	45,5406	<,0001*
15	-0,2833	51,1037	<,0001*
16	0,2092	54,5180	<,0001*
17	-0,1032	55,4676	<,0001*
18	-0,0230	55,5226	<,0001*
19	0,0861	56,4468	<,0001*
20	-0,0573	56,9591	<,0001*
21	0,0097	56,9785	<,0001*
22	-0,0008	56,9787	<,0001*
23	0,0055	56,9976	0,0001*
24	0,0000	.	.
25	0,0000	.	.

Turnover rate (second difference)

Lag	AutoCorr	Ljung-Box Q	p-Value
0	1,0000	.	.
1	-0,6505	11,0582	0,0009*
2	-0,0281	11,0798	0,0039*
3	0,5042	18,3895	0,0004*
4	-0,5615	27,9317	<,0001*
5	0,2969	30,7483	<,0001*
6	0,0235	30,7670	<,0001*
7	-0,2404	32,8432	<,0001*
8	0,3033	36,3686	<,0001*
9	-0,1915	37,8750	<,0001*
10	-0,0598	38,0333	<,0001*
11	0,3244	43,0767	<,0001*
12	-0,3847	50,8116	<,0001*
13	0,1799	52,6723	<,0001*
14	0,1144	53,5091	<,0001*
15	-0,2810	59,1829	<,0001*
16	0,2330	63,6425	<,0001*
17	-0,0814	64,2768	<,0001*
18	-0,0422	64,4819	<,0001*
19	0,0838	65,4903	<,0001*
20	-0,0468	65,9096	<,0001*
21	0,0047	65,9159	<,0001*
22	-0,0004	65,9160	<,0001*
23	0,0000	.	.
24	0,0000	.	.
25	0,0000	.	.

Interest rate

Lag	AutoCorr	Ljung-Box Q	p-Value
0	1,0000	.	.
1	0,7931	17,6888	<,0001*
2	0,6464	29,9522	<,0001*
3	0,4373	35,8202	<,0001*
4	0,2887	38,4994	<,0001*
5	0,2076	39,9536	<,0001*
6	0,1095	40,3795	<,0001*
7	0,0529	40,4844	<,0001*
8	-0,0214	40,5026	<,0001*
9	-0,0667	40,6902	<,0001*
10	-0,1131	41,2655	<,0001*
11	-0,2045	43,2822	<,0001*
12	-0,2715	47,1103	<,0001*
13	-0,2507	50,6446	<,0001*
14	-0,2373	54,0990	<,0001*
15	-0,1672	55,9867	<,0001*
16	-0,1606	57,9203	<,0001*
17	-0,2088	61,6005	<,0001*
18	-0,2351	66,9302	<,0001*
19	-0,2731	75,3207	<,0001*
20	-0,2338	82,7026	<,0001*
21	-0,2174	90,6759	<,0001*
22	-0,1795	97,9294	<,0001*
23	-0,1123	102,186	<,0001*
24	-0,0825	106,775	<,0001*
25	0,0000	.	.

Interest rate (first difference)

Lag	AutoCorr	Ljung-Box Q	p-Value
0	1,0000	.	.
1	0,0057	0,0009	0,9761
2	-0,0640	0,1172	0,9431
3	-0,2397	1,8247	0,6096
4	-0,2631	3,9839	0,4082
5	0,0183	3,9949	0,5501
6	0,0500	4,0815	0,6657
7	0,2990	7,3630	0,3921
8	0,0658	7,5316	0,4805
9	-0,1840	8,9400	0,4428
10	-0,1355	9,7588	0,4619
11	0,0102	9,7637	0,5518
12	-0,2633	13,3685	0,3428
13	0,1464	14,5851	0,3340
14	0,0234	14,6194	0,4047
15	0,0110	14,6278	0,4785
16	0,0234	14,6706	0,5489
17	-0,0564	14,9542	0,5988
18	0,1624	17,6986	0,4757
19	-0,1152	19,3541	0,4343
20	-0,0135	19,3826	0,4971
21	0,0191	19,4583	0,5558
22	-0,0093	19,4853	0,6152
23	0,0093	19,5390	0,6695
24	0,0000	.	.
25	0,0000	.	.

Appendix D: Augmented Dickey-Fuller Table

(Zaiontz, 2019, p.1)

	Model 0 - no constant, no trend				Model 1 - constant, no trend				Model 2 - constant, trend			
	0.01	0.025	0.05	0.10	0.01	0.025	0.05	0.10	0.01	0.025	0.05	0.10
t	-2.56574	-2.22213	-1.941	-1.61682	-3.43035	-3.1175	-2.86154	-2.56677	-3.95877	-3.65722	-3.41049	-3.12705
u	-2.2358	-1.15384	-0.2686	0.2656	-6.5393	-4.53235	-2.8903	-1.5384	-9.0531	-6.48862	-4.3904	-2.5856
v	-3.627	-3.4829	-3.365	-2.714	-16.786	-9.8824	-4.234	-2.809	-28.428	-17.7624	-9.036	-3.925
w	0	17.17265	31.223	25.364	-79.433	-57.7669	-40.04	0	-134.155	-85.3255	-45.374	-22.38

Appendix E: Critical values for Engle Granger test

(The Department of Economics at the University of Toronto, 2019, p. 3, original source is Engle and Yoo (1987))

Number of Variables $N+1$	Sample Size	Critical Values 10%	5%	1%
2	50	3.28	3.67	4.32
	100	3.03	3.37	4.07
	200	3.02	3.37	4.00
3	50	3.73	4.11	4.84
	100	3.59	3.93	4.45
	200	3.47	3.78	4.35
4	50	4.02	4.35	4.94
	100	3.89	4.22	4.75
	200	3.89	4.18	4.70
5	50	4.42	4.76	5.41
	100	4.26	4.58	5.18
	200	4.18	4.48	5.02
6	500	4.43	4.71	5.28

Appendix F: Backward elimination

Entire period, 2008-2018

$$2008 - 2018: Excess\ return = \beta_0 + \beta_1 \cdot Book-to-market + \beta_2 \cdot EPS-growth + \beta_3 \cdot Firm\ Size + \beta_4 \cdot FCF-yield + \beta_5 \cdot Financial\ Leverage + \beta_6 \cdot P/E + \beta_7 \cdot ROIC + \beta_8 \cdot Turnover\ Rate + \beta_9 \cdot Interest\ Rate + \varepsilon_t$$

1. Full model

Summary of Fit

RSquare	0,35959
RSquare Adj	0,194913
Root Mean Square Error	0,071695
Mean of Response	-0,04511
Observations (or Sum Wgts)	45

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	9	0,10101757	0,011224	2,1836
Error	35	0,17990687	0,005140	Prob > F
C. Total	44	0,28092444		0,0477*

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	-0,032936	0,267454	-0,12	0,9027
Book-to-Market Ratio	-0,012648	0,147897	-0,09	0,9323
EPS-growth	6,8038e-5	7,119e-5	0,96	0,3458
Firm Size	-3,86e-12	6,53e-12	-0,59	0,5586
FCF-yield	-0,003397	0,002557	-1,33	0,1925
Financial Leverage	0,0268413	0,075874	0,35	0,7256
P/E	-0,000246	0,000548	-0,45	0,6562
ROIC	-0,000238	0,013229	-0,02	0,9858
Turnover Rate	21,530441	25,97628	0,83	0,4128
Interest Rate	-3,797295	1,601454	-2,37	0,0234*

2. Removing ROIC

Summary of Fit

RSquare	0,359584
RSquare Adj	0,217269
Root Mean Square Error	0,070693
Mean of Response	-0,04511
Observations (or Sum Wgts)	45

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	8	0,10101591	0,012627	2,5267
Error	36	0,17990853	0,004997	Prob > F
C. Total	44	0,28092444		0,0271*

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	-0,034132	0,255413	-0,13	0,8944
Book-to-Market Ratio	-0,012964	0,144794	-0,09	0,9292
EPS-growth	0,0000677	6,777e-5	1,00	0,3244
Firm Size	-3,95e-12	4,13e-12	-0,96	0,3459
FCF-yield	-0,003408	0,002441	-1,40	0,1711
Financial Leverage	0,0272101	0,072022	0,38	0,7078
P/E	-0,000246	0,00054	-0,46	0,6509
Turnover Rate	21,477497	25,44764	0,84	0,4042
Interest Rate	-3,794299	1,570475	-2,42	0,0209*

3. Removing book-to-market ratio

Summary of Fit

RSquare	0,359441
RSquare Adj	0,238255
Root Mean Square Error	0,069739
Mean of Response	-0,04511
Observations (or Sum Wgts)	45

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	7	0,10097585	0,014425	2,9660
Error	37	0,17994859	0,004863	Prob > F
C. Total	44	0,28092444		0,0143*

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	-0,041343	0,23911	-0,17	0,8637
EPS-growth	6,8583e-5	6,615e-5	1,04	0,3066
Firm Size	-3,86e-12	3,96e-12	-0,97	0,3359
FCF-yield	-0,003467	0,002321	-1,49	0,1438
Financial Leverage	0,0259463	0,069673	0,37	0,7117
P/E	-0,000244	0,000532	-0,46	0,6495
Turnover Rate	22,041984	24,32152	0,91	0,3707
Interest Rate	-3,74936	1,468024	-2,55	0,0149*

4. Removing P/E

Summary of Fit

RSquare	0,355807
RSquare Adj	0,254092
Root Mean Square Error	0,06901
Mean of Response	-0,04511
Observations (or Sum Wgts)	45

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	6	0,09995482	0,016659	3,4981
Error	38	0,18096962	0,004762	Prob > F
C. Total	44	0,28092444		0,0075*

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	-0,036768	0,236405	-0,16	0,8772
EPS-growth	6,8238e-5	6,545e-5	1,04	0,3037
Firm Size	-4,7e-12	3,47e-12	-1,35	0,1844
FCF-yield	-0,003503	0,002296	-1,53	0,1354
Financial Leverage	0,0245783	0,068881	0,36	0,7232
Turnover Rate	23,240965	23,92765	0,97	0,3375
Interest Rate	-3,870514	1,428924	-2,71	0,0101*

5. Removing financial leverage

Summary of Fit

RSquare	0,353648
RSquare Adj	0,270783
Root Mean Square Error	0,068233
Mean of Response	-0,04511
Observations (or Sum Wgts)	45

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	5	0,09934847	0,019870	4,2677
Error	39	0,18157597	0,004656	Prob > F
C. Total	44	0,28092444		0,0034*

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	0,0458898	0,046651	0,98	0,3313
EPS-growth	7,2752e-5	6,35e-5	1,15	0,2589
Firm Size	-5,01e-12	3,32e-12	-1,51	0,1394
FCF-yield	-0,003607	0,002252	-1,60	0,1173
Turnover Rate	25,032508	23,13172	1,08	0,2858
Interest Rate	-4,173444	1,136451	-3,67	0,0007*

6. Removing turnover rate

Summary of Fit

RSquare	0,33424
RSquare Adj	0,267664
Root Mean Square Error	0,068379
Mean of Response	-0,04511
Observations (or Sum Wgts)	45

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	4	0,09389609	0,023474	5,0204
Error	40	0,18702836	0,004676	Prob > F
C. Total	44	0,28092444		0,0022*

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	0,057616	0,045472	1,27	0,2125
EPS-growth	6,5721e-5	6,33e-5	1,04	0,3054
Firm Size	-4,39e-12	3,28e-12	-1,34	0,1883
FCF-yield	-0,004046	0,002219	-1,82	0,0758
Interest Rate	-3,848822	1,098489	-3,50	0,0011*

7. Removing EPS-growth

Summary of Fit

RSquare	0,316297
RSquare Adj	0,266269
Root Mean Square Error	0,068444
Mean of Response	-0,04511
Observations (or Sum Wgts)	45

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	3	0,08885544	0,029618	6,3225
Error	41	0,19206900	0,004685	Prob > F
C. Total	44	0,28092444		0,0013*

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	0,0632865	0,045186	1,40	0,1689
Firm Size	-4,42e-12	3,28e-12	-1,35	0,1857
FCF-yield	-0,004374	0,002199	-1,99	0,0534
Interest Rate	-3,933876	1,096472	-3,59	0,0009*

8. Removing firm size

Summary of Fit

RSquare	0,286089
RSquare Adj	0,252093
Root Mean Square Error	0,069102
Mean of Response	-0,04511
Observations (or Sum Wgts)	45

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	2	0,08036932	0,040185	8,4154
Error	42	0,20055512	0,004775	Prob > F
C. Total	44	0,28092444		0,0008*

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	0,0069538	0,017192	0,40	0,6879	-0,027741	0,0416484
FCF-yield	-0,003919	0,002194	-1,79	0,0812	-0,008346	0,0005079
Interest Rate	-2,845131	0,747313	-3,81	0,0005*	-4,35327	-1,336991

Subperiod, 2008-2012

$$2008-2012: \delta 2Excess\ return = \beta_0 + \beta_1 \cdot \delta 2Book-to-market + \beta_2 \cdot \delta 2EPS-growth + \beta_3 \cdot \delta 2Firm\ Size + \beta_4 \cdot \delta 2FCF-yield + \beta_5 \cdot \delta 2Financial\ Leverage + \beta_6 \cdot \delta 2P/E + \beta_7 \cdot \delta 2ROIC + \beta_8 \cdot \delta 2Turnover\ Rate + \beta_9 \cdot \delta 2Interest\ Rate + \varepsilon_t$$

1. Full model

Summary of Fit

RSquare	0,728063
RSquare Adj	0,456126
Root Mean Square Error	0,098461
Mean of Response	-0,00158
Observations (or Sum Wgts)	19

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	9	0,23360091	0,025956	2,6773
Error	9	0,08725172	0,009695	Prob > F
C. Total	18	0,32085263		0,0793

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	-0,005254	0,022754	-0,23	0,8226
Book-to-market (second-order)	-0,199761	0,268642	-0,74	0,4761
EPS-growth (second-order)	-0,000132	0,000121	-1,09	0,3030
Firm size (second-order)	1,81e-10	1,14e-10	1,59	0,1464
FCF-yield (second-order)	0,0019089	0,012551	0,15	0,8825
Financial leverage (second-order)	-0,137667	0,30419	-0,45	0,6616
P/E (second-order)	-0,000283	0,001444	-0,20	0,8492
ROIC (second-order)	0,0005181	0,038209	0,01	0,9895
Turnover rate (second-order)	-61,66498	49,78546	-1,24	0,2468
Interest rate (second-order)	5,6516008	5,184821	1,09	0,3040

2. Removing ROIC

Summary of Fit

RSquare	0,728057
RSquare Adj	0,510503
Root Mean Square Error	0,09341
Mean of Response	-0,00158
Observations (or Sum Wgts)	19

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	8	0,23359913	0,029200	3,3466
Error	10	0,08725351	0,008725	Prob > F
C. Total	18	0,32085263		0,0388*

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	-0,005243	0,021574	-0,24	0,8129
Book-to-market (second-order)	-0,199997	0,254323	-0,79	0,4499
EPS-growth (second-order)	-0,000132	0,000104	-1,26	0,2356
Firm size (second-order)	1,807e-10	1,05e-10	1,72	0,1170
FCF-yield (second-order)	0,0019227	0,011868	0,16	0,8745
Financial leverage (second-order)	-0,137312	0,287515	-0,48	0,6432
P/E (second-order)	-0,000284	0,001364	-0,21	0,8390
Turnover rate (second-order)	-61,39612	43,32356	-1,42	0,1868
Interest rate (second-order)	5,6547348	4,913913	1,15	0,2766

3. Removing FCF-yield

Summary of Fit

RSquare	0,727344
RSquare Adj	0,553835
Root Mean Square Error	0,089179
Mean of Response	-0,00158
Observations (or Sum Wgts)	19

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	7	0,23337012	0,033339	4,1920
Error	11	0,08748251	0,007953	Prob > F
C. Total	18	0,32085263		0,0173*

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	-0,005126	0,020585	-0,25	0,8079
Book-to-market (second-order)	-0,177444	0,203201	-0,87	0,4012
EPS-growth (second-order)	-0,000123	8,439e-5	-1,45	0,1738
Firm size (second-order)	1,706e-10	8,1e-11	2,11	0,0591
Financial leverage (second-order)	-0,162134	0,232275	-0,70	0,4997
P/E (second-order)	-0,000441	0,000921	-0,48	0,6415
Turnover rate (second-order)	-59,22041	39,3241	-1,51	0,1602
Interest rate (second-order)	6,1967512	3,436069	1,80	0,0987

4. Removing P/E

Summary of Fit

RSquare	0,721664
RSquare Adj	0,582496
Root Mean Square Error	0,086267
Mean of Response	-0,00158
Observations (or Sum Wgts)	19

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	6	0,23154783	0,038591	5,1856
Error	12	0,08930481	0,007442	Prob > F
C. Total	18	0,32085263		0,0076*

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	-0,004455	0,019867	-0,22	0,8264
Book-to-market (second-order)	-0,186624	0,195688	-0,95	0,3591
EPS-growth (second-order)	-0,000118	0,000081	-1,46	0,1712
Firm size (second-order)	1,541e-10	7,09e-11	2,17	0,0506
Financial leverage (second-order)	-0,199353	0,211727	-0,94	0,3650
Turnover rate (second-order)	-59,36471	38,03896	-1,56	0,1446
Interest rate (second-order)	6,5706272	3,236861	2,03	0,0651

5. Removing financial leverage

Summary of Fit

RSquare	0,701101
RSquare Adj	0,58614
Root Mean Square Error	0,08589
Mean of Response	-0,00158
Observations (or Sum Wgts)	19

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	5	0,22495017	0,044990	6,0986
Error	13	0,09590246	0,007377	Prob > F
C. Total	18	0,32085263		0,0040*

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	-0,004277	0,019779	-0,22	0,8322
Book-to-market (second-order)	-0,2435	0,185318	-1,31	0,2116
EPS-growth (second-order)	-0,000162	6,63e-5	-2,44	0,0300*
Firm size (second-order)	1,729e-10	6,78e-11	2,55	0,0242*
Turnover rate (second-order)	-81,95875	29,38592	-2,79	0,0153*
Interest rate (second-order)	5,3236437	2,940603	1,81	0,0934

6. Removing book-to-market ratio

Summary of Fit

RSquare	0,661405
RSquare Adj	0,564664
Root Mean Square Error	0,08809
Mean of Response	-0,00158
Observations (or Sum Wgts)	19

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	4	0,21221367	0,053053	6,8368
Error	14	0,10863896	0,007760	Prob > F
C. Total	18	0,32085263		0,0029*

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	-0,005906	0,020246	-0,29	0,7748
EPS-growth (second-order)	-0,000154	6,773e-5	-2,27	0,0395*
Firm size (second-order)	2,205e-10	5,88e-11	3,75	0,0021*
Turnover rate (second-order)	-79,82563	30,09269	-2,65	0,0189*
Interest rate (second-order)	4,6032439	2,963051	1,55	0,1426

7. Removing interest rate

Summary of Fit

RSquare	0,603034
RSquare Adj	0,523641
Root Mean Square Error	0,092148
Mean of Response	-0,00158
Observations (or Sum Wgts)	19

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	3	0,19348499	0,064495	7,5955
Error	15	0,12736764	0,008491	Prob > F
C. Total	18	0,32085263		0,0026*

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-0,005942	0,021178	-0,28	0,7829	-0,051083	0,0391981
EPS-growth (second-order)	-0,000171	6,987e-5	-2,45	0,0270*	-0,00032	-2,229e-5
Firm size (second-order)	2,479e-10	5,86e-11	4,23	0,0007*	1,23e-10	3,729e-10
Turnover rate (second-order)	-82,50188	31,42704	-2,63	0,0191*	-149,487	-15,51674

Subperiod, 2013-2018

$$2013 - 2018: Excess\ return = \beta_0 + \beta_1 \cdot Book - to - market + \beta_2 \cdot EPS - growth + \beta_3 \cdot Firm\ Size + \beta_4 \cdot FCF - yield + \beta_5 \cdot Financial\ Leverage + \beta_6 \cdot P/E + \beta_7 \cdot ROIC + \beta_8 \cdot Turnover\ Rate + \beta_9 \cdot Interest\ Rate + \varepsilon_t$$

1. Full model

Summary of Fit

RSquare	0,432238
RSquare Adj	0,091581
Root Mean Square Error	0,055488
Mean of Response	-0,0132
Observations (or Sum Wgts)	25

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	9	0,03516000	0,003907	1,2688
Error	15	0,04618400	0,003079	Prob > F
C. Total	24	0,08134400		0,3283

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	0,1228706	0,645619	0,19	0,8516
Book-to-Market Ratio	-0,287952	0,322562	-0,89	0,3861
EPS-growth	2,3613e-5	0,000107	0,22	0,8285
Firm Size	3,417e-13	7,57e-12	0,05	0,9646
FCF-yield	-0,004082	0,002598	-1,57	0,1370
Financial Leverage	0,0292131	0,121347	0,24	0,8130
P/E	-0,000215	0,000515	-0,42	0,6819
ROIC	-0,011189	0,014401	-0,78	0,4493
Turnover Rate	24,90598	51,17494	0,49	0,6335
Interest Rate	3,1839861	4,52983	0,70	0,4929

2. Removing firm size

Summary of Fit

RSquare	0,432161
RSquare Adj	0,148242
Root Mean Square Error	0,05373
Mean of Response	-0,0132
Observations (or Sum Wgts)	25

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	8	0,03515372	0,004394	1,5221
Error	16	0,04619028	0,002887	Prob > F
C. Total	24	0,08134400		0,2256

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	0,1293249	0,609651	0,21	0,8347
Book-to-Market Ratio	-0,291534	0,30275	-0,96	0,3499
EPS-growth	2,2249e-5	0,0001	0,22	0,8259
FCF-yield	-0,004136	0,002228	-1,86	0,0819
Financial Leverage	0,0290115	0,117422	0,25	0,8080
P/E	-0,000212	0,000493	-0,43	0,6733
ROIC	-0,010746	0,010212	-1,05	0,3083
Turnover Rate	23,888869	44,49663	0,54	0,5987
Interest Rate	3,0606203	3,499014	0,87	0,3947

3. Removing EPS-growth

Summary of Fit

RSquare	0,430387
RSquare Adj	0,195841
Root Mean Square Error	0,052207
Mean of Response	-0,0132
Observations (or Sum Wgts)	25

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	7	0,03500944	0,005001	1,8350
Error	17	0,04633456	0,002726	Prob > F
C. Total	24	0,08134400		0,1451

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	0,128733	0,592366	0,22	0,8305
Book-to-Market Ratio	-0,294352	0,293914	-1,00	0,3306
FCF-yield	-0,004279	0,002075	-2,06	0,0548
Financial Leverage	0,0302204	0,113973	0,27	0,7941
P/E	-0,000216	0,000478	-0,45	0,6569
ROIC	-0,010682	0,009919	-1,08	0,2966
Turnover Rate	23,668263	43,2248	0,55	0,5911
Interest Rate	3,1380274	3,383152	0,93	0,3666

4. Removing financial leverage

Summary of Fit

RSquare	0,428032
RSquare Adj	0,237376
Root Mean Square Error	0,050841
Mean of Response	-0,0132
Observations (or Sum Wgts)	25

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	6	0,03481781	0,005803	2,2450
Error	18	0,04652619	0,002585	Prob > F
C. Total	24	0,08134400		0,0858

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	0,2759533	0,201049	1,37	0,1867
Book-to-Market Ratio	-0,342284	0,225683	-1,52	0,1467
FCF-yield	-0,004462	0,001904	-2,34	0,0308*
P/E	-0,000248	0,000451	-0,55	0,5893
ROIC	-0,012508	0,006952	-1,80	0,0888
Turnover Rate	23,511606	42,0898	0,56	0,5833
Interest Rate	2,5341567	2,436337	1,04	0,3120

5. Removing P/E

Summary of Fit

RSquare	0,418429
RSquare Adj	0,265384
Root Mean Square Error	0,049898
Mean of Response	-0,0132
Observations (or Sum Wgts)	25

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	5	0,03403671	0,006807	2,7340
Error	19	0,04730729	0,002490	Prob > F
C. Total	24	0,08134400		0,0504

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	0,2429756	0,188334	1,29	0,2125
Book-to-Market Ratio	-0,315083	0,21611	-1,46	0,1612
FCF-yield	-0,004488	0,001868	-2,40	0,0267*
ROIC	-0,013013	0,006763	-1,92	0,0694
Turnover Rate	28,469275	40,35024	0,71	0,4890
Interest Rate	2,8394068	2,328245	1,22	0,2376

6. Removing turnover rate

Summary of Fit

RSquare	0,403192
RSquare Adj	0,28383
Root Mean Square Error	0,049268
Mean of Response	-0,0132
Observations (or Sum Wgts)	25

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	4	0,03279724	0,008199	3,3779
Error	20	0,04854676	0,002427	Prob > F
C. Total	24	0,08134400		0,0288*

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	0,3049273	0,164508	1,85	0,0786
Book-to-Market Ratio	-0,36036	0,203755	-1,77	0,0922
FCF-yield	-0,004849	0,001774	-2,73	0,0128*
ROIC	-0,013369	0,006659	-2,01	0,0584
Interest Rate	2,5291836	2,257464	1,12	0,2758

7. Removing interest rate

Summary of Fit

RSquare	0,365736
RSquare Adj	0,275126
Root Mean Square Error	0,049567
Mean of Response	-0,0132
Observations (or Sum Wgts)	25

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	3	0,02975040	0,009917	4,0364
Error	21	0,05159360	0,002457	Prob > F
C. Total	24	0,08134400		0,0206*

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	0,2903155	0,164984	1,76	0,0930
Book-to-Market Ratio	-0,296005	0,196675	-1,51	0,1472
FCF-yield	-0,004418	0,001743	-2,54	0,0193*
ROIC	-0,015383	0,006451	-2,38	0,0266*

8. Removing book-to-market ratio

Summary of Fit

RSquare	0,297321
RSquare Adj	0,233441
Root Mean Square Error	0,050972
Mean of Response	-0,0132
Observations (or Sum Wgts)	25

Analysis of Variance

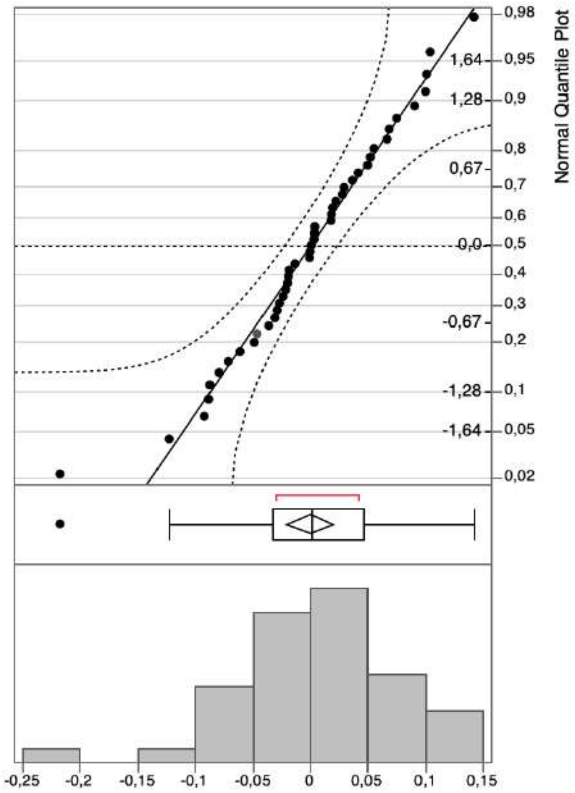
Source	DF	Sum of Squares	Mean Square	F Ratio
Model	2	0,02418528	0,012093	4,6544
Error	22	0,05715872	0,002598	Prob > F
C. Total	24	0,08134400		0,0206*

Parameter Estimates

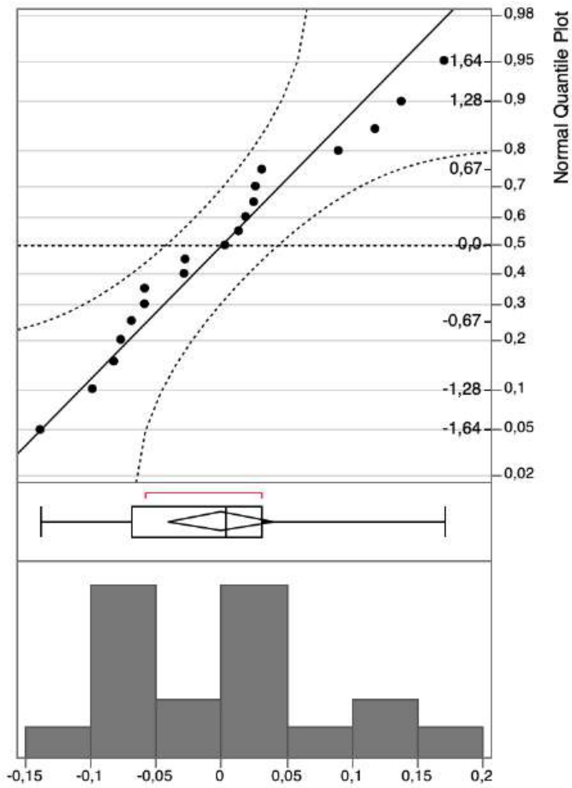
Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	0,0467402	0,032965	1,42	0,1702	-0,021625	0,1151054
FCF-yield	-0,004612	0,001787	-2,58	0,0170*	-0,008318	-0,000906
ROIC	-0,010115	0,005572	-1,82	0,0831	-0,021672	0,0014412

Appendix G: Normality of residuals

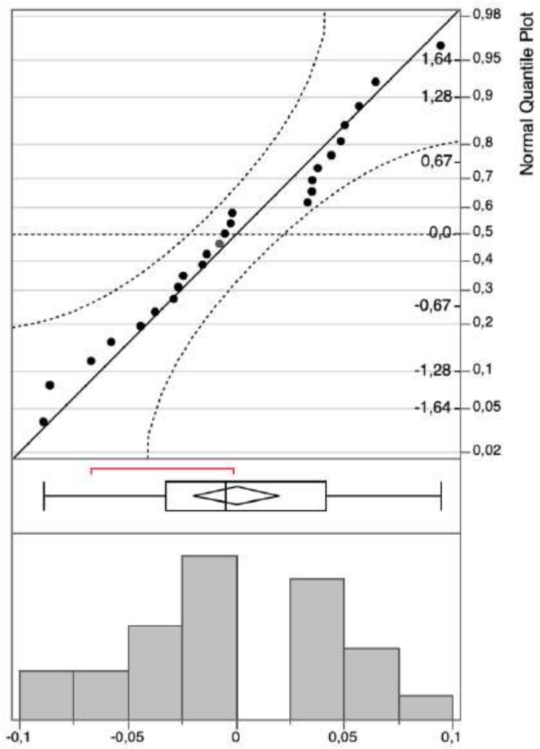
(A) Sample period, 2008-2018



(B) Subperiod, 2008-2012



(C) Subperiod, 2013-2018



Appendix H: Adjusted backward elimination and normality of residuals

Adjusted backward elimination: subperiod, 2008-2012

$$2008-2012: \delta 2Excess\ return = \beta_0 + \beta_1 \cdot \delta 2Book-to-market + \beta_2 \cdot \delta 2Firm\ Size + \beta_3 \cdot \delta 2FCF-yield + \beta_4 \cdot \delta 2Financial\ Leverage + \beta_5 \cdot \delta 2P/E + \beta_6 \cdot \delta 2ROIC + \beta_7 \cdot \delta 2Interest\ Rate + \varepsilon_t$$

1. Full model (w/o EPS-growth and turnover rate)

Summary of Fit

RSquare	0,681647
RSquare Adj	0,479059
Root Mean Square Error	0,096363
Mean of Response	-0,00158
Observations (or Sum Wgts)	19

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	7	0,21870835	0,031244	3,3647
Error	11	0,10214428	0,009286	Prob > F
C. Total	18	0,32085263		0,0357*

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	-0,004984	0,02225	-0,22	0,8269
Book-to-market (second-order)	-0,096689	0,242047	-0,40	0,6972
Firm size (second-order)	1,2e-10	8,3e-11	1,44	0,1764
FCF-yield (second-order)	-0,002254	0,01048	-0,22	0,8337
Financial leverage (second-order)	-0,348697	0,238811	-1,46	0,1722
P/E (second-order)	-0,000728	0,001338	-0,54	0,5973
ROIC (second-order)	-0,018587	0,033839	-0,55	0,5938
Interest rate (second-order)	8,2571073	4,160306	1,98	0,0727

2. Removing FCF-yield

Summary of Fit

RSquare	0,680309
RSquare Adj	0,520463
Root Mean Square Error	0,092454
Mean of Response	-0,00158
Observations (or Sum Wgts)	19

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	6	0,21827888	0,036380	4,2560
Error	12	0,10257375	0,008548	Prob > F
C. Total	18	0,32085263		0,0158*

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	-0,005037	0,021346	-0,24	0,8174
Book-to-market (second-order)	-0,120566	0,206357	-0,58	0,5699
Firm size (second-order)	1,26e-10	7,5e-11	1,68	0,1188
Financial leverage (second-order)	-0,326692	0,207028	-1,58	0,1405
P/E (second-order)	-0,000537	0,000959	-0,56	0,5861
ROIC (second-order)	-0,020937	0,030726	-0,68	0,5085
Interest rate (second-order)	7,7648236	3,333038	2,33	0,0381*

3. Removing P/E

Summary of Fit

RSquare	0,671967
RSquare Adj	0,5458
Root Mean Square Error	0,089979
Mean of Response	-0,00158
Observations (or Sum Wgts)	19

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	5	0,21560224	0,043120	5,3260
Error	13	0,10525039	0,008096	Prob > F
C. Total	18	0,32085263		0,0070*

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	-0,004379	0,020743	-0,21	0,8361
Book-to-market (second-order)	-0,129158	0,200275	-0,64	0,5302
Firm size (second-order)	1,111e-10	6,82e-11	1,63	0,1274
Financial leverage (second-order)	-0,37878	0,179971	-2,10	0,0553
ROIC (second-order)	-0,016741	0,028999	-0,58	0,5736
Interest rate (second-order)	8,1531228	3,172715	2,57	0,0233*

4. Removing ROIC

Summary of Fit

RSquare	0,663557
RSquare Adj	0,56743
Root Mean Square Error	0,08781
Mean of Response	-0,00158
Observations (or Sum Wgts)	19

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	4	0,21290402	0,053226	6,9030
Error	14	0,10794861	0,007711	Prob > F
C. Total	18	0,32085263		0,0028*

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	-0,004963	0,020219	-0,25	0,8097
Book-to-market (second-order)	-0,110167	0,192793	-0,57	0,5768
Firm size (second-order)	1,187e-10	6,53e-11	1,82	0,0907
Financial leverage (second-order)	-0,411905	0,166468	-2,47	0,0268*
Interest rate (second-order)	8,1933005	3,095501	2,65	0,0191*

5. Removing book-to-market ratio

Summary of Fit

RSquare	0,65571
RSquare Adj	0,586852
Root Mean Square Error	0,085816
Mean of Response	-0,00158
Observations (or Sum Wgts)	19

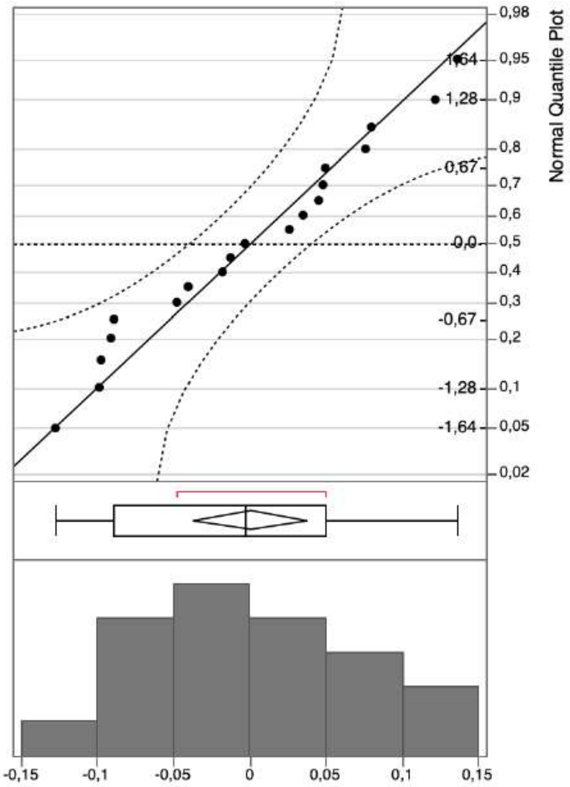
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	3	0,21038630	0,070129	9,5226
Error	15	0,11046633	0,007364	Prob > F
C. Total	18	0,32085263		0,0009*

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-0,005666	0,019723	-0,29	0,7778	-0,047705	0,0363725
Firm size (second-order)	1,397e-10	5,28e-11	2,65	0,0183*	2,717e-11	2,522e-10
Financial leverage (second-order)	-0,431456	0,159214	-2,71	0,0161*	-0,770814	-0,092099
Interest rate (second-order)	7,9601379	2,998814	2,65	0,0180*	1,5683174	14,351958

Normality of residuals (of adj. regression model)



Appendix I: Durbin-Watson tests

(A) Sample period, 2008-2018

Durbin-Watson

Durbin-Watson	Number of Obs.	AutoCorrelation	Prob<DW
1,3791352	45	0,2719	0,0084*

(B) Subperiod, 2008-2012

Durbin-Watson

Durbin-Watson	Number of Obs.	AutoCorrelation	Prob<DW
1,8523832	19	0,0389	0,4712

(C) Subperiod, 2013-2018

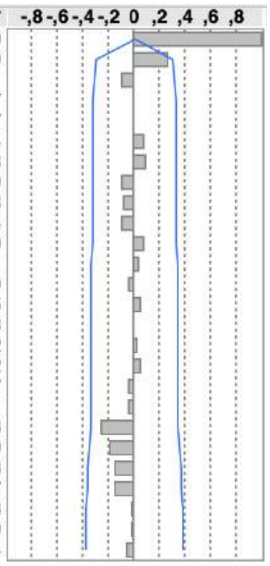
Durbin-Watson

Durbin-Watson	Number of Obs.	AutoCorrelation
2,0039447	25	-0,1348

Appendix J: Autocorrelation between residuals

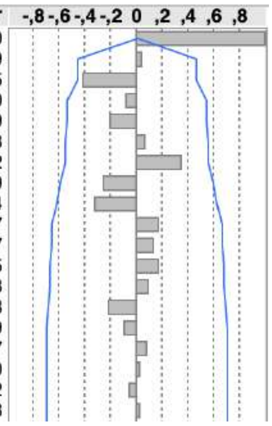
(A) Sample period, 2008-2018

Lag	AutoCorr
0	1,0000
1	0,2719
2	-0,0951
3	-0,0027
4	-0,0057
5	0,0864
6	0,0998
7	-0,0939
8	-0,0818
9	-0,0894
10	0,0800
11	0,0401
12	-0,0419
13	0,0525
14	-0,0038
15	0,0202
16	0,0492
17	-0,0447
18	-0,0421
19	-0,2573
20	-0,1879
21	-0,1503
22	-0,1427
23	-0,0083
24	-0,0109
25	-0,0524



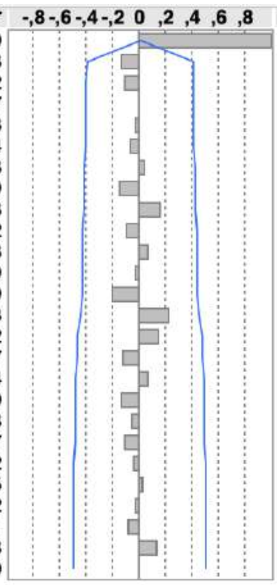
(B) Subperiod, 2008-2012

Lag	AutoCorr
0	1,0000
1	0,0389
2	-0,4215
3	-0,0870
4	-0,1959
5	0,0693
6	0,3432
7	-0,2609
8	-0,3234
9	0,1697
10	0,1327
11	0,1755
12	0,0903
13	-0,2163
14	-0,0989
15	0,0837
16	0,0220
17	-0,0472
18	0,0258



(C) Subperiod, 2013-2018

Lag	AutoCorr
0	1,0000
1	-0,1348
2	-0,1072
3	-0,0037
4	-0,0288
5	-0,0644
6	0,0343
7	-0,1509
8	0,1623
9	-0,0902
10	0,0643
11	-0,0319
12	-0,1949
13	0,2253
14	0,1472
15	-0,1267
16	0,0684
17	-0,1350
18	-0,0503
19	-0,1117
20	-0,0342
21	0,0305
22	-0,0262
23	-0,0741
24	0,1328
25	0,0000



Appendix K: Durbin-Watson significance table

(University of Notre Dame, 2019, p. 6)

Durbin-Watson Statistic: 5 Per Cent Significance Points of dL and dU

	k'*=1		**k'=2**		**k'=3**		**k'=4**		**k'=5**		**k'=6**		**k'=7**		**k'=8**		**k'=9**		**k'=10**	
n	dL	dU	dL	dU	dL	dU	dL	dU	dL	dU	dL	dU	dL	dU	dL	dU	dL	dU	dL	dU
6	0.610	1.400	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
7	0.700	1.356	0.467	1.896	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
8	0.763	1.332	0.559	1.777	0.367	2.287	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
9	0.824	1.320	0.629	1.699	0.455	2.128	0.296	2.588	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
10	0.879	1.320	0.697	1.641	0.525	2.016	0.376	2.414	0.243	2.822	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
11	0.927	1.324	0.758	1.604	0.595	1.928	0.444	2.283	0.315	2.645	0.203	3.004	-----	-----	-----	-----	-----	-----	-----	-----
12	0.971	1.331	0.812	1.579	0.658	1.864	0.512	2.177	0.380	2.506	0.268	2.832	0.171	3.149	-----	-----	-----	-----	-----	-----
13	1.010	1.340	0.861	1.562	0.715	1.816	0.574	2.094	0.444	2.390	0.328	2.692	0.230	2.985	0.147	3.266	-----	-----	-----	-----
14	1.045	1.350	0.905	1.551	0.767	1.779	0.632	2.030	0.505	2.296	0.389	2.572	0.286	2.848	0.200	3.111	0.127	3.360	-----	-----
15	1.077	1.361	0.946	1.543	0.814	1.750	0.685	1.977	0.562	2.220	0.447	2.471	0.343	2.727	0.251	2.979	0.175	3.216	0.111	3.438
16	1.106	1.371	0.982	1.539	0.857	1.728	0.734	1.935	0.615	2.157	0.502	2.388	0.398	2.624	0.304	2.860	0.222	3.090	0.155	3.304
17	1.133	1.381	1.015	1.536	0.897	1.710	0.779	1.900	0.664	2.104	0.554	2.318	0.451	2.537	0.356	2.757	0.272	2.975	0.198	3.184
18	1.158	1.391	1.046	1.535	0.933	1.696	0.820	1.872	0.710	2.060	0.603	2.258	0.502	2.461	0.407	2.668	0.321	2.873	0.244	3.073
19	1.180	1.401	1.074	1.536	0.967	1.685	0.859	1.848	0.752	2.023	0.649	2.206	0.549	2.396	0.456	2.589	0.369	2.783	0.290	2.974
20	1.201	1.411	1.100	1.537	0.998	1.676	0.894	1.828	0.792	1.991	0.691	2.162	0.595	2.339	0.502	2.521	0.416	2.704	0.336	2.885
21	1.221	1.420	1.125	1.538	1.026	1.669	0.927	1.812	0.829	1.964	0.731	2.124	0.637	2.290	0.546	2.461	0.461	2.633	0.380	2.806
22	1.239	1.429	1.147	1.541	1.053	1.664	0.958	1.797	0.863	1.940	0.769	2.090	0.677	2.246	0.588	2.407	0.504	2.571	0.424	2.735
23	1.257	1.437	1.168	1.543	1.078	1.660	0.986	1.785	0.895	1.920	0.804	2.061	0.715	2.208	0.628	2.360	0.545	2.514	0.465	2.670
24	1.273	1.446	1.188	1.546	1.101	1.656	1.013	1.775	0.925	1.902	0.837	2.035	0.750	2.174	0.666	2.318	0.584	2.464	0.506	2.613
25	1.288	1.454	1.206	1.550	1.123	1.654	1.038	1.767	0.953	1.886	0.868	2.013	0.784	2.144	0.702	2.280	0.621	2.419	0.544	2.560
26	1.302	1.461	1.224	1.553	1.143	1.652	1.062	1.759	0.979	1.873	0.897	1.992	0.816	2.117	0.735	2.246	0.657	2.379	0.581	2.513
27	1.316	1.469	1.240	1.556	1.162	1.651	1.084	1.753	1.004	1.861	0.925	1.974	0.845	2.093	0.767	2.216	0.691	2.342	0.616	2.470
28	1.328	1.476	1.255	1.560	1.181	1.650	1.104	1.747	1.028	1.850	0.951	1.959	0.874	2.071	0.798	2.188	0.723	2.309	0.649	2.431
29	1.341	1.483	1.270	1.563	1.198	1.650	1.124	1.743	1.050	1.841	0.975	1.944	0.900	2.052	0.826	2.164	0.753	2.278	0.681	2.396
30	1.352	1.489	1.284	1.567	1.214	1.650	1.143	1.739	1.071	1.833	0.998	1.931	0.926	2.034	0.854	2.141	0.782	2.251	0.712	2.363
31	1.363	1.496	1.297	1.570	1.229	1.650	1.160	1.735	1.090	1.825	1.020	1.920	0.950	2.018	0.879	2.120	0.810	2.226	0.741	2.333
32	1.373	1.502	1.309	1.574	1.244	1.650	1.177	1.732	1.109	1.819	1.041	1.909	0.972	2.004	0.904	2.102	0.836	2.203	0.769	2.306
33	1.383	1.508	1.321	1.577	1.258	1.651	1.193	1.730	1.127	1.813	1.061	1.900	0.994	1.991	0.927	2.085	0.861	2.181	0.796	2.281
34	1.393	1.514	1.333	1.580	1.271	1.652	1.208	1.728	1.144	1.808	1.079	1.891	1.015	1.978	0.950	2.069	0.885	2.162	0.821	2.257
35	1.402	1.519	1.343	1.584	1.283	1.653	1.222	1.726	1.160	1.803	1.097	1.884	1.034	1.967	0.971	2.054	0.908	2.144	0.845	2.236
36	1.411	1.525	1.354	1.587	1.295	1.654	1.236	1.724	1.175	1.799	1.114	1.876	1.053	1.957	0.991	2.041	0.930	2.127	0.868	2.216
37	1.419	1.530	1.364	1.590	1.307	1.655	1.249	1.723	1.190	1.795	1.131	1.870	1.071	1.948	1.011	2.029	0.951	2.112	0.891	2.197
38	1.427	1.535	1.373	1.594	1.318	1.656	1.261	1.722	1.204	1.792	1.146	1.864	1.088	1.939	1.029	2.017	0.970	2.098	0.912	2.180
39	1.435	1.540	1.382	1.597	1.328	1.658	1.273	1.722	1.218	1.789	1.161	1.859	1.104	1.932	1.047	2.007	0.990	2.085	0.932	2.164
40	1.442	1.544	1.391	1.600	1.338	1.659	1.285	1.721	1.230	1.786	1.175	1.854	1.120	1.924	1.064	1.997	1.008	2.072	0.952	2.149
45	1.475	1.566	1.430	1.615	1.383	1.666	1.336	1.720	1.287	1.776	1.238	1.835	1.189	1.895	1.139	1.958	1.089	2.022	1.038	2.088
50	1.503	1.585	1.462	1.628	1.421	1.674	1.378	1.721	1.335	1.771	1.291	1.822	1.246	1.875	1.201	1.930	1.156	1.986	1.110	2.044

Appendix L: Tests for homoscedasticity

Breusch-Pagan test

(A) Sample period, 2008-2018

Summary of Fit

RSquare	0,085906
RSquare Adj	0,042378
Root Mean Square Error	0,007721
Mean of Response	0,004457
Observations (or Sum Wgts)	45

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	2	0,00023533	0,000118	1,9736
Error	42	0,00250410	0,000060	Prob > F
C. Total	44	0,00273944		0,1516

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	0,0023658	0,001921	1,23	0,2250	-0,001511	0,0062425
FCF-yield	0,0003723	0,000245	1,52	0,1363	-0,000122	0,000867
Interest Rate	0,1154156	0,083505	1,38	0,1742	-0,053104	0,2839353

(B) Subperiod, 2008-2012

Summary of Fit

RSquare	0,02911
RSquare Adj	-0,16507
Root Mean Square Error	0,006252
Mean of Response	0,005814
Observations (or Sum Wgts)	19

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	3	0,00001758	5,86e-6	0,1499
Error	15	0,00058634	0,000039	Prob > F
C. Total	18	0,00060392		0,9281

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	0,0057872	0,001437	4,03	0,0011*	0,0027245	0,00885
Firm size (second-order)	1,169e-12	3,85e-12	0,30	0,7654	-7,03e-12	9,365e-12
Financial leverage (second-order)	0,0072287	0,0116	0,62	0,5425	-0,017495	0,0319525
Interest rate (second-order)	-0,007618	0,218478	-0,03	0,9726	-0,473294	0,458057

(C) Subperiod, 2013-2018

Summary of Fit

RSquare	0,046416
RSquare Adj	-0,04027
Root Mean Square Error	0,002581
Mean of Response	0,002286
Observations (or Sum Wgts)	25

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	2	0,00000713	3,5664e-6	0,5354
Error	22	0,00014654	6,6609e-6	Prob > F
C. Total	24	0,00015367		0,5929

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	0,0028168	0,001669	1,69	0,1056	-0,000645	0,0062783
FCF-yield	8,457e-5	9,048e-5	0,93	0,3601	-0,000103	0,0002722
ROIC	-0,000105	0,000282	-0,37	0,7126	-0,00069	0,0004799

White test

(A) Sample period, 2008-2018

Summary of Fit

RSquare	0,071648
RSquare Adj	0,027441
Root Mean Square Error	0,007781
Mean of Response	0,004457
Observations (or Sum Wgts)	45

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	2	0,00019628	0,000098	1,6207
Error	42	0,00254316	0,000061	Prob > F
C. Total	44	0,00273944		0,2099

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	0,0022278	0,001697	1,31	0,1964	-0,001197	0,0056525
Predicted values of multiple regression, 2008-2018	-0,048977	0,053325	-0,92	0,3636	-0,156591	0,0586379
Predicted values squared, 2008-2018	0,0051247	0,531341	0,01	0,9924	-1,067165	1,0774141

(B) Subperiod, 2008-2012

Summary of Fit

RSquare	0,04538
RSquare Adj	-0,07395
Root Mean Square Error	0,006003
Mean of Response	0,005814
Observations (or Sum Wgts)	19

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	2	0,00002741	0,000014	0,3803
Error	16	0,00057651	0,000036	Prob > F
C. Total	18	0,00060392		0,6897

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	0,0044198	0,00212	2,08	0,0535	-7,516e-5	0,0089148
Predicted values of multiple regression, 2008-2012	-0,003932	0,013357	-0,29	0,7722	-0,032247	0,0243826
Predicted values squared, 2008-2012	0,1253227	0,145181	0,86	0,4008	-0,182448	0,4330936

(C) Subperiod, 2013-2018

Summary of Fit

RSquare	0,912986
RSquare Adj	0,905075
Root Mean Square Error	0,00078
Mean of Response	0,002286
Observations (or Sum Wgts)	25

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	2	0,00014030	0,000070	115,4160
Error	22	0,00001337	6,078e-7	Prob > F
C. Total	24	0,00015367		<,0001*

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	0,0009481	0,000188	5,05	<,0001*	0,000559	0,0013372
Predicted values of multiple regression, 2013-2018	-0,00464	0,005022	-0,92	0,3656	-0,015055	0,0057756
Predicted values squared, 2013-2018	112,26798	7,443765	15,08	<,0001*	96,830553	127,7054