THE SMALL FIRM EFFECT IN THE DUTCH STOCK MARKET

A Thesis Presented To

The School of Business and Economics

Department of Finance

Universiteit Utrecht

Utrecht, The Netherlands

In Partial Fulfillment

Of the Requirements for the Degree

Master of Financial Management

By

Sylvan Evers

April 2022

JEL classification: C13 • C22 • G11 • G12

Keywords: Small firm effect, Abnormal returns, Three Factor Model

Contact: sylvanevers21@gmail.com

ABSTRACT

The phenomenon that small firms have higher risk-adjusted returns than large firms is known as the small firm effect. The main goal of this thesis is to give a waterproof statement about the existence of the small firm effect in the Dutch stock market. The research question is therefore formulated as follows: do small firms have higher abnormal stock returns than large firms in the Dutch stock market? The sample consists of all firms listed on the Dutch stock exchange Euronext Amsterdam from 2008 to 2021, divided in ten value-weighted yearly-adjusted portfolios. After the risk adjustment for the non-synchronous trading bias, stock returns are observed with an OLS regression based on the extended Three-Factor Model. The Three-Factor Model is extended with a liquidity factor and the dividend yield. The empirical results of this thesis indicate the existence of the small firm effect and the January effect in the Dutch stock market, but only for the smallest decile of firms. The smallest decile of firms in the Dutch stock market has persistently higher risk-adjusted returns than large firms, but the cause is still largely unexplained.

TABLE OF CONTENTS

1. INTRODUCTION **5**

2. LITERATURE REVIEW **7**

2.1 The Small Firm Effect *7*

2.2 Risk *12*

2.3 The January Effect *13*

2.4 Causes of the Small Firm Effect *15*

3. METHODOLOGY **17**

3.1 Data *17*
3.1.2 Stock Returns 19
3.1.3 The Size and Value Premium 20
3.1.4 Liquidity Factor and Dividend Yield 22

3.2 Model *24*
3.2.1 The Three-Factor Model 24
3.2.3 The Yearly-adjusted Three-Factor Model 25
3.2.2 The January-adjusted Three-Factor Model 26

4. RESULTS **27**

4.1 Scholes & Williams beta *27*

4.2 The Size and Value Premium *29*

4.3 Jensen's Alpha *30*

4.4 Yearly Analysis *31*

4.5 The January Effect *32*

4.6 Liquidity *34*

4.7 Dividend Yield *35*

4.8 Robustness of the results *37*
4.8.1 Heteroskedasticity test 37
4.8.2 Autocorrelation test 37
4.8.3 Test for Unit Root 38

5. CONCLUSION **39**

6. Limitations **40**

7. Further Research **41**

8. REFERENCES **41**

9. APPENDIX **48**

LIST OF TABLES

Table 1. Portfolio 1-10 Description of Excess Returns……………………………………..20

Table 2. Portfolio 1-10 Description of SMB and HML…………………….………………….22

Table 3. Portfolio 1-10 Description of Liquidity Factor…………………….…………………22

Table 4. Portfolio 1-10 Description of Dividend Yield……………………………………..23

Table 5. Portfolio 1-10 Scholes & Williams beta ……………………….…………………28

Table 6. Portfolio 1-10 Size and Value Premium ……………………….…………………30

Table 7. Portfolio 1-10 Jensen's alpha……………………………………………………...31

Table 8. Portfolio 1 Yearly Analysis of Stock Returns…………………..…………………32

Table 9. Portfolio 1-10 January Effect……………………………………………..…….33

Table 10. Portfolio 1-10 Liquidity factor……………………………………….………..35

Table 11. Portfolio 1-10 Dividend yield……………………………………..………..36

Appendix A. List of firms……………………………………………………………..…48

Appendix B - Portfolio 1 Seasonal Analysis of Stock Returns………………………………...50

Appendix C. Portfolio 1-10 Interaction term……………………………………….…….….…...51

Appendix D. Correlation Between Liquidity Factor and Size and Value Premium………..….51

Appendix E. White's general test……………………………………………………….….52

Appendix F. Breusch-Godfrey test……………..…………………………………………..53

Appendix G. Augmented Dickey Fuller tests for unit root……...……………………………..54

1. INTRODUCTION

Some prominent economists, such as Roll (1981) and Horowitz (2000), claim that the small firm effect vanished, while others, such as Duy & Phuoc (2016) and Reinganum (1981), claim that the small firm effect still significantly influences the stock market. The small firm effect is a theory that concludes that smaller firms have higher risk-adjusted returns than large firms (Banz, 1981). This theory received considerable attention throughout the past years since many economists disagree on the existence and causes of the higher risk-adjusted returns of small firms (van Dijk, 2011).

This thesis aims to prove the presence of the small firm effect in the Dutch stock market. Although a lot of research is done to prove the presence of the small firm effect, there is still no waterproof statement of this phenomenon. While the Dutch stock market is characterized by being small in market capitalization, with a small group of companies making up most of the value of the 25 companies of the AEX, almost none of the research regarding the small firm effect focuses on the Dutch stock market (Jansen, 2019).

Banz (1981) was the first to find that smaller firms have had higher risk-adjusted returns, on average, than larger firms. This results in the fact that excess returns of small firms relative to large firms cannot be explained by the Capital Asset Pricing Model, which indicates that the small firm effect is a market anomaly (Lynch, 2018). Over the years, new theories and pricing models were developed and the small firm effect became a notable paradox. The development of several theoretical models in which the small firm effect arises endogenously as a result of systematic risk contrast with the empirical research that suggests that the small firm effect disappeared in the early 1980s (Van Dijk, 2011).

Therefore, there is still no waterproof statement about the presence of the small firm effect. Reinganum (1981) found that portfolios of small firms earn on average 20% per year more than portfolios of large firms. However, the riskiness of small firms may be improperly measured, and the small firm effect is possibly caused by incorrect methods or biases (Roll, 1981). And even if the small firm exists, the causes of the anomaly are still mysterious. Yet, Horowitz (2000) stated that small firms underperformed compared to large firms in the US and the UK stock market exchange between 1980 and 1996. Therefore, many economists proclaim the disappearance of the small firm effect, while others claim that it is premature to draw conclusions.

More empirical and theoretical research is needed to evaluate the existence and cause of the small firm effect since the current evidence is inconclusive (van Dijk, 2011). This lays the foundation of the research problem of this thesis. The main goal of this thesis is to give a waterproof statement about the existence of the small firm effect in the Dutch stock market. The research question is therefore formulated as follows: do small firms have higher abnormal stock returns than large firms in the Dutch stock market? As a consequence, this thesis can validate a well-established theory in the field of economics and will be one of the first to examine the cause of the small firm effect. The validation of the small firm effect can be used as a guideline for Dutch investors and portfolio managers to help them in making more deliberate decisions regarding their investment strategies.

The remainder of this thesis is therefore structured as follows. In section 2 of this thesis, the existing literature regarding the small firm effect is critically reviewed which is used to formulate and motivate the related research questions and hypotheses. The data characteristics and the methodology are described in section 3. The empirical results are presented and discussed in section 4. Section 5 answers the research questions and presents the overall conclusion. The limitations of this thesis are discussed in section 6. In section 7, recommendations are made for further research. Section 8 shows the references that are used to conduct this empirical research. The appendix can be found in section 9.

2. LITERATURE REVIEW

2.1 The Small Firm Effect

According to Banz (1981) the common stock of small firms had, on average, higher risk-adjusted returns than the common stock of large firms. This is known as the small firm effect. The small firm effect is a theory that predicts that small firms yield higher returns compared to large firms, even after an adjustment of risk (Banz, 1981).

Banz (1981) extended the Capital Asset Pricing Model (CAPM) to allow the expected risk premiums on assets to be a function of systematic risk and firm size, where the latter is based on total market value. The CAPM is an asset pricing model that is a statement of the relation between the expected risk premiums on assets and their systematic risk, or beta (Jensen et al, 1972). Jensen et al. (1972) developed the Capital Asset Pricing Model based on the positive relationship between market risk and stock return. During the period 1926-1975, small NYSE-listed firms have had significantly larger risk-adjusted returns than large NYSE-listed firms (Banz, 1981). The smallest firms in the sample tend to have the largest size effect. These findings suggest the misspecification of the original CAPM (Banz, 1981).

Fama and French (1993) state that small-cap firms and high-book-to-market equity value firms are riskier than large-cap firms and low high-to-book-to-market equity value firms, and therefore yield higher returns. As a result, Fama and French (1993) developed the Three-Factor Model, which describes the cross-section of expected stock returns. The model states that stock returns are related to excess return on a market portfolio (Rm-Rf), a size premium (SMB), and a value premium (HML). The size premium is the difference between the return on a portfolio of small firms and the return on a portfolio of large firms and the value premium is the difference between the return on a portfolio of firms with a high book to market value and the return on a portfolio of firms with a low book to market value (Milius, 2012). The size premium (SMB) represents the negative relationship between firm size and risk, while the value premium (HML) represents the positive relationship between book-to-market equity value and risk. In contrast to the findings of Banz (1981), Fama & French (1993) did not find any evidence to consider the small firm effect as a market anomaly since the higher returns are compensation for higher risk.

According to Duy & Phuoc (2016), small firms are riskier than big firms because of difficulties to approach financing sources, lower market share, or less reputable brand names. In addition, small firms are less diversified, and they cannot absorb negative financial events as well as large firms can (Milius, 2012). As stated by the Capital Asset Pricing Model, more risk will lead to higher returns. However, the CAPM is unable to account for the small firm effect due to a lack of explanatory power caused by the exclusion of the size and value premiums (Moor & Sercue, 2013). The Three-Factor Model has more explanatory power than CAPM as beta alone cannot predict much of the variation in cross-section return (Sattar, 2017). Unlike CAPM, the Three-Factor Model takes account of market risk and financial distress. The value premium and size premium are proxies for systematic risk and can interpret the abnormal stock returns in the stock market (Fama & French, 1993). According to Pandey & Sehgal (2016), the value premium and size premium explain a large proportion of the returns of small firms. So, the Three-Factor Model is a better descriptor of asset returns compared to CAPM (Pandey & Sehgal, 2016).

Later, Carhart (1997) developed the Carhart four-factor model, which includes momentum risk. However, momentum risk seems to play no meaningful role in the explanation of the size premium in presence of the variables of the Three-Factor Model (Moor & Sercue, 2013). Therefore, there is no incentive to use the Carhart four-factor model instead of the Three-Factor Model in empirical research regarding the small firm effect. The use of the Three-Factor Model for research related to the small firm effect is consistent with the procedures of Pandey & Sehgal (2016), Duy & Phuoc (2016), and Moor & Sercue (2013).

Duy & Phuoc (2016) constructed ten one-dimensionally sorted portfolios of Vietnamese firms based on total assets and used the Three-Factor Model to find evidence in favor of the small firm effect. The focus on one stock market yields the advantage that differences in market characteristics are excluded (Amel-Zaded, 2011). In addition, the construction of arbitrage portfolios that contain stocks of very large and small firms has the advantage that no assumptions about the exact functional relationship between firm size and expected return need to be made (Banz, 1981). Furthermore, working with one-dimensionally sorted portfolios ensures that there is enough dispersion in size across portfolios to reliably estimate the expected returns (Moor & Sercue, 2013).

The results of Duy & Phuoc (2016) show that small firms have higher returns in the Vietnamese market from 2009 till 2014, which is partly explained by the size premium of Fama & French. However, their results also show that small firms delivered a statistically significant and positive Jensen’s alpha, or in other words, have higher returns than what is expected due to the higher risk of these firms. Jensen's alpha is a measure of the risk-adjusted abnormal return of a portfolio (Jensen, 1967). This means that small firms have higher risk-adjusted returns than large firms and are overcompensated for their riskiness. Therefore, the findings of their study support the presence of the small firm effect in the Vietnamese market. These findings contradict the claim of Fama & French (1993) that the small firm effect is not a market anomaly. However, large firms in Vietnam may be relatively small compared to other countries. According to van Dijk (2011), these large firms in Vietnam should earn relatively high returns if the small firm effect holds and financial markets are integrated.

In addition, the small firm effect possibly appears in one year and disappears in other years (Duy & Phuoc, 2016). Yet, their research did not perform a yearly analysis to support this claim. According to Amihud (2002), small firms listed on the NYSE in the period 1964-1980 were significantly influenced by the small firm effect, while in the years after the small firm effect disappeared. More specifically, Amel-Zaded (2011) claims that a bearish market conceals the small firm effect, while the opposite is true for a bull market. However, no empirical evidence is provided to support this claim. A yearly analysis is necessary to get more insight into the gradient of the small firm effect.

In contrast to the results of Duy & Phuoc (2016), Horowitz (2000) claimed the death of the small firm effect by presenting evidence of the underperformance of small firms compared to large firms in the US and the UK stock market exchange between 1980 and 1996. Yet, Moor and Sercue (2013) proved that the small firm effect did not disappear but existed only for the smallest decile of firms. It comes as no surprise that the small firm effect is conditional on the market, market characteristics, and the firm's past performance (Amel-Zaded, 2011). Thus, the abovementioned results need to be interpreted carefully and there is no guarantee that the results apply to the Dutch stock market. In addition, different measurements of company size may explain the contradictive results. To rule this out, firm size should be represented by total assets rather than market capitalization since this prevents the effect of inflation or deflation of securities (Moore, 2000). The definition of firm size is then based on proportions of 10%, where the lowest 10% of firms as measured by total assets is the smallest size portfolio and the highest 10% of firms as measured by total assets is the largest size portfolio (Moor & Sercue, 2013).

Further research is necessary to provide evidence for the existence of the small firm effect in the Dutch stock market. The first sub-question and related hypothesis are formulated to observe whether small firms systematically have higher risk-adjusted returns compared to large firms. The null hypothesis is rejected when Jensen’s alpha (the intercept) is positive and statistically significant for the small size portfolios since alpha represents the abnormal return on the portfolio.

RQ1: Do small firms have higher risk-adjusted returns than large firms?

H0: Small firms do not have higher risk-adjusted returns than large firms

H1: Small firms have higher risk-adjusted returns than large firms

Furthermore, as the literature suggests, it is possible that the small firm effect appears and disappears over the years. The second sub-question and related hypothesis are formulated to observe whether the risk-adjusted returns of small firms are persistent over the years. This will give more insight into the persistency and gradient of the small firm effect. The null hypothesis is rejected when at least one of the coefficients of the year dummies is statistically significant.

RQ2: Is the small firm effect persistent?

H0: The abnormal risk-adjusted returns of small firms are persistent

H2: The abnormal risk-adjusted returns of small firms are not persistent

2.2 Risk

Small firms are inherently riskier than large firms which may be reflected by the higher sensitivity of their returns to those on the market factor (Pandey & Sehgal, 2016). To be specific, a portfolio consisting of small firms will have a higher beta compared to a portfolio consisting of large firms. Beta is a measure of a portfolio's historic volatility to the underlying market and is therefore a measure of systematic risk (Corporate Finance Institute, 2021). However, Roll (1981) stated that the systematic riskiness of small firms may be improperly measured. According to Roll (1981), the shares of small firms are the most infrequently traded while the shares of large firms are the most frequently traded. As a consequence, small firm stocks are generally less liquid which may lead to a non-synchronous trading bias vis a vis the market index (Pandey & Sehgal, 2016). This may cause an upward bias of risk for large firms and a downward bias of risk for small firms. Since small-size firms tend to trade infrequently, their betas are underestimated and their alphas are overestimated (Pandey & Sehgal, 2016).

To avoid this bias, beta estimates that adjust for non-synchronous trading and trading infrequency should be employed (Keim, 1982). Betas computed using the Scholes and Williams (1997) procedure adjust for the effect of non-synchronous trading and trading infrequency, by including the additional linear regressions of the portfolio return and the lagged and leading values of the market return, and the estimation of the first-order autocorrelation coefficient of the market return (Cowan & Sergeant, 1996).

An estimation of abnormal returns using risk estimates that are not adjusted for trading infrequency may yield the observed effect (Roll, 1981). According to Keim (1982), the effects of improperly estimated betas on the small firm effect may indicate that the small firm effect is a measurement error of risk. It is therefore important to adjust for risk since an overestimation of Jensen's alpha caused by an underestimation of beta will result in invalid conclusions regarding abnormal stock returns of small firms. Further research is necessary to observe whether the small firm effect still exists with the correct measurement of risk, since former research is potentially biased.

2.3 The January Effect

The small firm effect can, to a large extent, be attributed to the extraordinary performance of small firms in January (van Dijk, 2011). Nearly fifty percent of the higher risk-adjusted returns of small firms are concentrated in the first month of the year (Keim, 1982). According to van Dijk (2011), the strong January effect primarily shows up in the returns on the smallest size quintile, while the returns on the largest size quintile exhibit little seasonal variation.

Moor & Sercue (2013) extend the CAPM and Three-Factor Model with a January and non-January dummy to observe the extraordinary performance of small firms. The January-adjusted CAPM shows that the January effect is more pronounced the smaller the firm, while after adding the factors of Fama & French only the portfolio that consists of the smallest firms is affected by the January dummy (Moor & Sercue, 2013).

Towards the end of the year, some individual investors have a tax incentive to sell stocks that declined in price during the year, because capital losses are tax-deductible (Moor & Sercue, 2013). According to Keim (1982), the magnitude and significance of the measured January effect should vary with the level of personal income tax rates, if the January effect is the result of year-end tax-loss selling. In January prices recover because of a lack of selling pressure. This effect can be especially important for portfolios of small stocks since these are biased toward shares that have experienced large price declines (Moor & Sercue, 2013). In addition, small firms are often illiquid and are therefore more sensitive to demand shocks (Keim 1982).

Another theory that could explain seasonality in the risk-adjusted returns of small firms is the window dressing hypothesis. According to Thaler (1987), the tax-loss selling hypothesis does not entirely explain the January effect. The window dressing hypothesis states that institutional investors have an incentive to buy winners or low-risk stocks and sell losers at the end of the year, to present sound portfolio holdings (van Dijk, 2011). Afterward, in January, investors reallocate their portfolios using more speculative assets, which typically include small firms.

Since the literature suggests that seasonality explains the small firm effect, the third sub-question and related hypothesis are formulated to observe whether the risk-adjusted returns of small firms contain a seasonal effect. The null hypothesis is rejected when the coefficient of the January dummy is positive and statistically significant.

RQ3: Are risk-adjusted returns for small firms higher in January than in other months?

H0: The risk-adjusted abnormal returns of small firms are not higher in January compared to other months

H3: The risk-adjusted abnormal returns of small firms are higher in January compared to other months

2.4 Causes of the Small Firm Effect

The absence of an explanation for the small firm effect spurred a lot of research into explaining the causes of the anomaly (Tamakloe, 2014). Explanations for the small firm effect that are based on economic theory are essential for our understanding of the effect (van Dijk, 2011). According to van Dijk (2011), liquidity risk can potentially account for the small firm effect, because small firms have lower average liquidity and higher exposure to liquidity risk factors. As proven by Jensen et al. (1972) there is a positive relationship between risk and stock return. Therefore, small firms possibly yield higher returns because they are riskier with regard to liquidity. In addition, Moor & Sercue (2013) claim that there is a negative relation between the size of a portfolio and its illiquidity measure. Small firms tend to exhibit large positive or negative returns because their limited liquidity can lead to price manipulations (Pandey & Sehgal, 2016). Therefore, liquidity may be a possible explanation for the small firm effect.

Pandey & Sehgal (2016) extend the Three-Factor Model with an additional risk factor regarding liquidity risk to investigate the relationship between liquidity risk and risk-adjusted returns of small firms. Besides the claim that the value premium and size premium of the Three-Factor Model largely explains the stock returns of small firms, adding additional risk factors increases the explanatory power of the model (Pandey & Sehgal, 2016). The additional risk factor regarding liquidity risk is based on share turnover. However, their findings do not show a statistically significant relationship between the liquidity factor and risk-adjusted returns. To investigate the relationship between liquidity risk and risk-adjusted returns of small firms, the liquidity factor should be based on the monthly trading volume since this ensures that both liquidity and illiquidity is included (Amihud & Mendelson, 1986). Yet, the liquidity factor may be absorbed by the size and value premium, since these possibly proxy for the liquidity factor (Amihud & Mendelson, 1986). However, this remains to be seen.

Another possible explanation of the small firm effect is the relationship between firm size and dividend yield. Naranjo, Nimanlendran, and Ryngaert (1998) formulate dividend yield as the monthly dividend frequency times the last declared dividend, divided by the price at T-1, because this ensures that any short-term changes are included. Dividend yield influences the returns of stock of large and small firms (Moor & Sercue, 2013). The dividend yield is negatively correlated with stock prices which means that an increase in dividend yield results in decreasing stock prices and vice versa (Arslan, 2014). However, small firms provide less information about dividends than large firms, but once the announcement is made, a positive overreaction of the market follows (Arnott & Hsu, 2006). While most firms are affected negatively by the dividend yield, small firms may be positively exposed to the dividend yield (Moor & Sercue, 2013). Yet, there is no empirical evidence to prove this claim.

The fourth sub-question and related hypothesis are formulated to find the cause of the small firm effect by investigating the factors that influence the stock returns of small firms. This will help establish the relationship between risk-adjusted stock return and firm size. The null hypothesis is rejected when the coefficients of the dividend yield and liquidity factor or the incremental factor are positive and statistically significant.

RQ4: What are possible explanations of the small firm effect?

H0: Liquidity does not increase the risk-adjusted returns of small firms

H4.1: Liquidity increases the risk-adjusted returns of small firms

H0: Dividend yield does not increase the risk-adjusted returns of small firms

H4.2: Dividend yield increases the risk-adjusted returns of small firms

3. METHODOLOGY

3.1 Data

This section describes the collection of data and the construction of variables. Factset is used as the main data source for the stock market variables. Factset is a large database for stock markets worldwide. These variables include stock return, market return, total assets, and the risk-free rate from 2008 to 2021. The market return is based on the All-Share index of the Dutch stock market to provide the best representation of the market. The market return is then used as a reference point for evaluating the performance of the portfolios. Appendix A shows a list of all included firms.

3.1.1 Scholes & Williams Beta

Scholes and Williams betas are employed to ensure that the systematic risk of the portfolios is properly measured, by correcting for non-synchronous trading and trading infrequency. The Scholes & Williams betas are calculated by dividing the sum of the lagged, continuous and leading betas by the autocorrelation coefficient. The continuous beta is calculated by dividing the covariance between the portfolio return and the market return by the variance of the market return. The lagged beta is calculated by dividing the covariance between the portfolio return and the lagged market return by the variance of the lagged market return. The leading beta is calculated by dividing the covariance between the portfolio return and the leading market return by the variance of the leading market return. The autocorrelation coefficient is calculated by dividing the covariance between the market return and the lagged market return by the standard error of the market return times the standard error of the lagged market return.

The calculation of the Scholes & Williams beta is described below:

1)

$$\beta_i^s = \frac{\mathrm{cov}(R_{it}^s, R_{Mt}^s)}{\mathrm{var}(R_{Mt}^s)}$$

2)

$$\beta_i^{s-} = \frac{\mathrm{cov}(R_{it}^s, R_{Mt-1}^s)}{\mathrm{var}(R_{Mt-1}^s)}$$

3)

$$\beta_i^{s+} = \frac{\mathrm{cov}(R_{it}^s, R_{Mt+1}^s)}{\mathrm{var}(R_{Mt+1}^s)}$$

4)

$$P_M^s = \frac{\mathrm{cov}(R_{Mt}^s, R_{Mt-1}^s)}{\mathrm{std}(R_{Mt}^s)\mathrm{std}(R_{Mt-1}^s)}$$

5)

$$\beta_n^* = \frac{\beta_i^{s-} + \beta_i^s + \beta_i^{s+}}{1 + 2P_M^s}$$

where

- β is beta
- β_n^* is the adjusted beta, or Scholes & Williams beta
- P_M^s is the autocorrelation coefficient
- R_{it} is the return on the portfolio

- R_{Mt} is the return on the market portfolio

- std ( ) is the standard error

3.1.2 Stock Returns

To analyze the difference between abnormal risk-adjusted returns of small firms and large firms, portfolios will be constructed based on the firm size. The firm size is represented by the total amount of assets to prevent the effect of inflation or deflation of securities. The sample consists of all firms listed on the Dutch stock exchange Euronext Amsterdam, including delisted firms to prevent survivorship bias. The sample period will be from 2008 to 2021 to ensure that various phases of the market are included. All stocks are yearly ranked based on total assets and then divided into ten portfolios to ensure that there is enough dispersion in size across portfolios. Portfolio 1 (the smallest decile) contains the lowest 10% of firms as measured by total assets, while portfolio 10 (the biggest decile) contains the highest 10% of firms as measured by total assets. The first five portfolios are classified as small in ascending order and the last five portfolios are classified as large in ascending order. The portfolios are adjusted each year (2008 to 2021) based on the new ranking of total assets to ensure that each portfolio can be distinguished through size. The value-weighted monthly returns are estimated for each portfolio afterward by taking the natural log of the current price divided by the price in the period before. Logarithmic returns are easier to compare and more accurate due to the assumption of constant compounding of the returns. These returns will be referred to as unadjusted returns. In addition, using value-weighted returns results in mimicking portfolios that capture the different return behaviors of small and big stocks in a way that corresponds to realistic investment opportunities (Fama & French, 1993)

The market risk premium is the first factor of the Three-Factor Model and is the excess return on the market, which is calculated by the logarithmic return of the market minus the risk-free rate, where the latter is based on the logarithmic return on Dutch T-bills since these contain a full guarantee from the government. The adjusted return or excess return of the portfolios is the unadjusted return of the portfolio minus the risk-free rate. Table 1 shows a data description of the excess returns on the portfolios, the market risk premium, and the risk-free rate. As can be seen, seven portfolios have positive average stock returns and the market risk premium is, on average, positive.

Table 1 - Portfolio 1-10 Description of Excess Returns

Data description of excess returns (Observations, minimum, maximum, mean, and standard deviation)

Variable	*Observations*	*Minimum*	*Maximum*	*Mean*	*Std. Deviations*
P1 – Excess returns	168	-0.3189	0.4264	0.0055	0.0756
P2 – Excess returns	168	-0.3313	0.2255	0.0007	0.0784
P3 – Excess returns	168	-0.3785	0.1979	0.0015	0.0789
P4 – Excess returns	168	-0.3924	0.2753	0.0033	0.0845
P5 – Excess returns	168	-0.3292	0.3183	-0.0038	0.0854
P6 – Excess returns	168	-0.3611	0.2290	0.0098	0.0798
P7 – Excess returns	168	-0.1583	0.1492	-0.0049	0.0608
P8 – Excess returns	168	-0.1975	0.1135	0.0057	0.0540
P9 – Excess returns	168	-0.1761	0.1649	-0.0039	0.0487
P10 – Excess returns	168	-0.3371	0.1933	0.0043	0.0724
Market risk premium	168	-0.2801	0.1760	0.0018	0.0562
Risk-free rate	168	-0.0307	0.0443	0.0031	0.0131

Note: P1 is the smallest size portfolio, while P10 is the largest size portfolio. Excess return is the return on a portfolio minus the risk-free rate. The market risk premium is the return on the market minus the risk-free rate. The risk-free rate is the return on Dutch T-bills.

3.1.3 The Size and Value Premium

The size premium is the second factor of the Three-Factor Model and the value premium is the third factor of the Three-Factor Model. To generate the size premium of the Three-Factor Model, all firms in the sample are yearly ranked on market equity (stock price times the total amount of outstanding shares). The median market equity of the sample of each year is then used to divide the firms into two yearly adjusted value-weighted portfolios, a small size portfolio (S) and a big size portfolio (B). In addition, all firms in the sample are yearly ranked on book-to-market equity value (BE/ME) as well. To generate the value premium of the Three-Factor Model, all firms are divided into three yearly adjusted value-weighted portfolios, the bottom 30% (L), the middle 40% (M), and the top 30% (H). However, a negative book-to-market equity value has no obvious interpretation, since the firm's limited liability structure means that shareholder's value cannot be negative. (Brown, 2008). Therefore, firms with negative book-to-market equity value are excluded from the three value portfolios.

What follows is the construction of six size/book-to-market equity value portfolios, based on the intersection between these two characteristics (S/L, S/M, S/H, B/L, B/M, and B/H). For example, the S/L portfolio contains the firms in the small size portfolio that are also in the low book-to-market equity value portfolio, and the B/H portfolio contains the firms in the big size portfolio that are also allocated in the high book-to-market equity value portfolio (Fama & French, 1993).

SMB (small minus big) mimics the risk factor in returns related to size and is the monthly difference between the average of the returns on the three small-stock portfolios (S/L, S/M, and S/H) and the average of the returns on the three big-stock portfolios (B/L, B/M, and B/H) (Fama & French, 1993). HML (high minus low) mimics the risk factor in returns related to book-to-market equity value and is the monthly difference between the average of the returns on the two high BE/ME portfolios (S/H and B/H) and the average of the returns on the two low BE/ME portfolios (S/L and B/L) (Fama & French, 1993). Table 2 shows the data description of SMB and HML. The data description shows that, on average, small firms (high BE/ME firms) have higher returns than large firms (low BE/ME firms).

Table 2 – Portfolio 1-10 Description of SMB and HML

Data description (Observations, minimum, maximum, mean, and standard deviation)

Variable	*Observations*	*Minimum*	*Maximum*	*Mean*	*Std. Deviations*
SMB	168	-0.1017	0.0900	0.0012	0.0342
HML	168	-0.2525	0.2319	0.0006	0.0916

Note: SMB is the size premium, or the difference between stock returns of small-stock portfolios and large-stock portfolios. HML is the value premium, or the difference between stock returns of high BE/ME portfolios and low BE/ME portfolios.

3.1.4 Liquidity Factor and Dividend Yield

The liquidity factor and dividend yield are used to extend the Three-Factor Model to find the cause of the small firm effect. The liquidity factor is created by using the average monthly trading volume of the portfolio, which is retrieved from Yahoo! Finance. Table 3 shows the data description of the liquidity factor. The numbers are in thousands of euros. As can be seen, the small stock portfolios have, on average, lower liquidity than large stock portfolios.

Table 3 - Portfolio 1-10 Description of Liquidity Factor

Data description of liquidity (Observations, minimum, maximum, mean, and standard deviation)

Variable	*Observations*	*Minimum*	*Maximum*	*Mean*	*Std. Deviations*
P1 – Liquidity	168	13	378	79	53
P2 – Liquidity	168	206	3654	960	457
P3 – Liquidity	168	304	7382	1581	994
P4 – Liquidity	168	1686	45602	8763	4950
P5 – Liquidity	168	1836	36200	7678	525
P6 – Liquidity	168	3232	18925	7639	2587
P7 – Liquidity	168	21698	215065	69386	33449

P8 – Liquidity	168	33300	301290	85828	39770
P9 – Liquidity	168	37800	305104	122397	51240
P10 – Liquidity	168	108394	702185	240309	89103

Note: P1 is the smallest size portfolio, while P10 is the largest size portfolio. Liquidity is the average monthly trading volume of the portfolio. The numbers are in thousands of euros, except for the number of observations.

Data regarding dividends is retrieved from Yahoo! Finance as well. The dividend yield is then calculated as follows:

$$DY_t = \frac{F * D}{P_{t-1}}$$

Where

- DY_t is the monthly dividend yield (check)
- F is the monthly dividend frequency
- D is the last declared dividend
- P_{t-1} is the price at t-1

Table 4 shows the data description of the dividend yield. As can be seen, smaller firms have, on average, a lower dividend yield than larger firms. To put things into perspective, the dividend yield of the largest decile of firms is five times larger than the dividend yield of the smallest decile of firms.

Table 4 - Portfolio 1-10 Description of Dividend Yield

Data description of dividend yield (Observations, minimum, maximum, mean, and standard deviation)

Variable	*Observations*	*Minimum*	*Maximum*	*Mean*	*Std. Deviations*
P1 – Dividend yield	168	0	0.0292	0.0019	0.0038
P2 – Dividend yield	168	0	0.0256	0.0028	0.0051
P3 – Dividend yield	168	0	0.0273	0.0026	0.0047
P4 – Dividend yield	168	0	0.1282	0.0029	0.0124

P5 – Dividend yield	168	0	0.0698	0.0031	0.0080
P6 – Dividend yield	168	0	0.0278	0.0032	0.0046
P7 – Dividend yield	168	0	0.0659	0.0034	0.0072
P8 – Dividend yield	168	0	0.0258	0.0046	0.0046
P9 – Dividend yield	168	0	0.4305	0.0055	0.0351
P10 – Dividend yield	168	0	0.7823	0.0095	0.0613

Note: P1 is the smallest size portfolio, while P10 is the largest size portfolio. The monthly dividend yield is the monthly dividend frequency times the last declared dividend divided by the price at t-1.

3.2 Model

3.2.1 The Three-Factor Model

The risk-adjusted returns of firms are estimated by the Three-Factor Model. The Three-Factor Model describes stock returns through three factors: market risk, the outperformance of small-cap stocks relative to large-cap stocks, and the outperformance of high book-to-market value stocks relative to low book-to-market value stocks (Corporate Finance Institute, 2019). The explanatory power of the Three-Factor Model is increased by an extension of two additional risk factors to estimate the relationship between these factors and the risk-adjusted returns of firms. The first additional risk factor is the dividend yield because Moor & Sercue (2013) claim that smaller firms are positively influenced by the dividend yield, while larger firms are negatively influenced by the dividend yield. The second additional risk factor is liquidity because Moor & Sercue (2013) claim that there is a negative relation between the size of a firm and its liquidity measure. It is possible that the two additional risk factors only have an incremental effect on the return of small firms. Therefore, an interaction term between dividend yield and liquidity is included as well. The Three-Factor Model can be estimated by an Ordinary Least Square (OLS) time series regression. The dependent variable in this regression is the adjusted or excess return on the portfolio. The independent variables are the market return, size premium, value premium, dividend yield, liquidity and the interaction term. The intercept is Jensen's alpha, a measure of abnormal stock performance. The model is formulated as follows:

$$(R_{it} - R_{ft}) = \alpha_{it} + \beta_i \, [(R_{mt} - R_{ft})] + s_i SMB_t + h_i HML_t + + d_i DY_t + l_i LQ_t + d_i DY_t * l_i LQ_t + \varepsilon_{it} \qquad \text{Eq. (1)}$$

where

- $(R_{it} - R_{ft})$ is the adjusted or excess return on the portfolio, or the unadjusted return on the portfolio minus the risk-free rate
- α_i is the intercept or Jensen's alpha, which is the abnormal return of the portfolio
- β_i is the Scholes & Williams beta
- $(R_{mt} - R_{ft})$ is the market risk premium, or the market return minus the risk-free rate
- SMB is the size premium
- HML is the value premium
- DY_t is the dividend yield
- LQ_t is the liquidity factor
- $DY_t * LQ_t$ is the interaction term between the liquidity factor and the dividend yield
- ε_{it} is the error term

3.2.3 The Yearly-adjusted Three-Factor Model

Second, the persistency of the abnormal risk-adjusted returns of small firms is estimated by the Yearly-adjusted Three-Factor Model. The inclusion of dummy variables for each year in the observed period ensures that a yearly analysis is conducted. The dummy variable for 2021 is used as a reference point.

The model is formulated as follows:

$$R_{it} - R_{ft} = \alpha_{it} + \beta_i \, [(R_{mt} - R_{ft})] + s_i SMBt + h_i HML_t + d_i DY_t + l_i LQ_t + d_i DY_t * l_i LQ_t + \delta_1 2008 + \delta_2 2009 + \delta_3 2010 + \delta_4 2011 + \delta_5 2012 + \delta_6 2013 + \delta_7 2014 + \delta_8 2015 + \delta_9 2016 + \delta_{10} 2017 + \delta_{11} 2018 + \delta_{12} 2019 + \delta_2 2020 + \varepsilon_{it} \quad \text{Eq. (2)}$$

where

- (Rit – Rft) is the adjusted or excess return on the portfolio, or the unadjusted return on the portfolio minus the risk-free rate
- αi is the intercept or Jensen's alpha, which is the abnormal return of the portfolio
- *βi* is the Scholes & Williams beta
- (Rmt – Rft) is the market risk premium, or the market return minus the risk-free rate
- SMB is the size premium
- HML is the value premium
- DYt is the dividend yield
- LQt is the liquidity factor
- DYt * LQt is the interaction term between the liquidity factor and the dividend yield
- 2008 is a dummy variable for the year 2008, etc.
- εit is the error term

3.2.2 The January-adjusted Three-Factor Model

Lastly, the seasonality of risk-adjusted returns of small firms is estimated by the January-adjusted Three-Factor Model. The January-adjusted Three-Factor Model extends the Three-Factor Model with a January dummy.

The model is formulated as follows:

$$R_{it} - R_{ft} = \alpha_{it} + \beta_i \, [(R_{mt} - R_{ft})] + s_i SMBt + h_i HML_t + d_i DY_t + l_i LQ_t + d_i DY_t * l_i LQ_t + \delta_1 \text{January} + \varepsilon_{it} \quad \text{Eq. (3)}$$

where

- $(R_{it} – R_{ft})$ is the adjusted or excess return on the portfolio, or the unadjusted return on the portfolio minus the risk-free rate
- α_i is the intercept or Jensen's alpha, which is the abnormal return of the portfolio
- β_i is the Scholes & Williams beta
- $(R_{mt} – R_{ft})$ is the market risk premium, or the market return minus the risk-free rate
- SMB is the size premium
- HML is the value premium
- DY_t is the dividend yield
- LQ_t is the liquidity factor
- $DY_t * LQ_t$ is the interaction term between the liquidity factor and the dividend yield
- January is a dummy variable with a value of 1 for all first months of the year and with a value of 0 for all other months
- ε_{it} is the error term

4. RESULTS

This section describes the relevant empirical results. The empirical regression results that are not discussed can be found in the appendix. The hypotheses are tested at a significance level of 0.05. Interestingly, the adjusted R-squared of almost all regressions is above 0.70. This indicates that the Three-Factor Model is a suitable descriptor of stock returns in the Dutch stock market.

4.1 Scholes & Williams beta

The Scholes & Williams procedure for adjusted betas is applied to find out whether small firms are indeed riskier than large firms. According to the literature, small firms are assumed to be riskier than large firms which is reflected by a higher correlation between their returns and the market return. This means that a portfolio with small firms must have a higher beta compared to a portfolio with large firms. This is confirmed by following the Scholes & Williams procedure for computing betas that are adjusted for non-synchronous trading and trading infrequency. The beta is now to be interpreted as the sum of the beta coefficients of coincident, lagged, and lead values of the market factor (Pandey & Sehgal, 2016). Table 5 shows that portfolios containing larger firms exhibit lower betas than portfolios containing small firms. In other words, small firms are riskier because they are more volatile compared to the market than large firms. In addition, table 5 shows that the beta coefficients for all portfolios are statistically significant (P<0.05). The unadjusted betas of the five small portfolios are underestimated while the unadjusted betas of the five large portfolios are overestimated. This confirms that there is an upward bias of risk for large firms and a downward bias of risk for small firms, just as the theory predicted. To conclude, small firms are indeed riskier than large firms.

Table 5 - Portfolio 1-10 Scholes & Williams beta

Descriptive statistics of Scholes & Williams beta (coefficients, t values and p values)

Portfolio	*Unadjusted beta*	*Adjusted beta*	*t*	*P* >|*t*|
Portfolio 1	1.2508	1.3498	6.77	0.000
Portfolio 2	1.1400	1.2190	15.62	0.000
Portfolio 3	1.1059	1.1676	12.48	0.000
Portfolio 4	1.0514	1.1555	13.22	0.000
Portfolio 5	1.0864	1.1043	7.07	0.000
Portfolio 6	1.0822	1.0258	8.83	0.000
Portfolio 7	0.9561	0.8914	10.45	0.000
Portfolio 8	0.8343	0.7552	7.29	0.000
Portfolio 9	0.7699	0.6814	9.93	0.000
Portfolio 10	0.6145	0.5877	9.01	0.000

Note: P1 is the smallest size portfolio, while P10 is the largest size portfolio. This table presents the unadjusted betas and the coefficients (Coef.), t-values (t), and p-values (*P* >|*t*|) of the adjusted betas for each portfolio. The unadjusted beta is the standard deviation of the portfolio's returns divided by the standard deviation of the market return multiplied by the correlation between the portfolio's return and the market return. The adjusted beta is the Scholes & Williams beta.

4.2 The Size and Value Premium

The regression results of the extended Three-Factor Model are used to observe whether there is a size premium and whether there is a value premium, to explain the stock returns of small firms and large firms. The value and size premium proxy for systematic risk and hence explain the stock returns of small and large firms. Table 6 shows that the size premium is positive and statistically significant for the smallest three portfolios, while the size premium is negative and statistically significant for portfolios 6, 7, 9, and 10 ($P<0.05$). This indicates that small firms have higher returns due to higher systematic risk, while large firms have lower returns due to lower systematic risk. The positive size premium is strongest for the smallest decile of firms and the negative size premium is strongest for the largest decile of firms. This confirms the existence of the size premium as stated by the literature, which means that small firms have higher returns than large firms due to higher systematic risk. In contrast to the size premium, there is not much evidence in favor of the value premium. A possible explanation can be that the value premium disappeared due to the introduction of zero interest rates and quantitate easing by the central bank (Maloney & Moskowitz, 2020). Table 6 shows that the value premium is not statistically significant for most portfolios ($P>0.05$), except P6 and P9 ($P<0.05$). To conclude, there is a size premium since small firms have higher returns than large firms due to higher systematic risk. In addition, there appears to be no value premium.

Table 6 - Portfolio 1-10 Size and Value Premium

Descriptive statistics of SMB and HML for all portfolios (coefficients, t values and p values)

Portfolio	*SMB Coef.*	*t*	*P* >|*t*|	*HML Coef.*	*t*	*P* >|*t*|
Portfolio 1	0.4460	2.32	0.022	0.0616	0.45	0.654
Portfolio 2	0.1448	2.15	0.033	0.0448	0.84	0.402
Portfolio 3	0.1922	2.23	0.027	0.0231	0.36	0.716
Portfolio 4	-0.0917	-1.00	0.321	0.0597	0.89	0.375
Portfolio 5	0.1051	0.80	0.426	-0.1737	-1.96	0.052
Portfolio 6	-0.2090	-2.23	0.027	-0.1799	-2.66	0.009
Portfolio 7	-0.1867	-2.02	0.045	0.1209	1.96	0.052
Portfolio 8	-0.0911	-1.17	0.245	0.0587	1.10	0.274
Portfolio 9	-0.1501	-2.25	0.026	0.0921	2.04	0.043
Portfolio 10	-0.2698	-3.26	0.001	-0.0554	-0.94	0.348

Note: P1 is the smallest size portfolio, while P10 is the largest size portfolio. This table presents the coefficients (Coef.), t-values (t), and p-values ($P > |t|$) of SMB and HML in the Three-Factor Model for each portfolio. SMB is the size premium. HML is the value premium.

4.3 Jensen's Alpha

The regression results of the extended Three-Factor Model are used to observe whether small firms have higher risk-adjusted returns than large firms. The Three-Factor Model implies that all the risks are captured by the market risk premium, size premium, and value premium (Tamakloe, 2017). Jensen's alpha is a measure of abnormal stock return and thereby represents the percentage of stock return that is not explained by the risk factors (Jensen, 1967). Table 7 shows that the intercept value or Jensen's alpha of portfolio 1 is positive and statistically significant (P<0.05). This indicates that the returns on portfolio 1 are not fully explained by the risk factors and that the smallest decile of firms is overcompensated for their riskiness. Therefore, the portfolio that contains the smallest decile of firms delivers Jensen's alpha and has positive risk-adjusted abnormal returns. The positive risk-adjusted abnormal returns are on average 0.92% per month or 11.04% per year. Table 9 shows that the intercept values of all other portfolios are not statistically significant (P>0.05). So, there seems to be no evidence in favor of positive risk-adjusted abnormal returns in all other portfolios. In contrast to the smallest decile of firms, the returns on larger deciles of firms are fully explained by the risk factors. Thus, the null hypothesis that small firms do not have higher risk-adjusted abnormal returns than large firms is rejected but only for the smallest decile of firms. The regression results of the extended Three-Factor Model prove that small firms have higher risk-adjusted returns than large firms.

Table 7 - Portfolio 1-10 Jensen's alpha

Descriptive statistics of Jensen's alpha for all portfolios (coefficients, t values and p values)

Portfolio	*Coef.*	*t*	*P* >|*t*|
Portfolio 1	0.0092	1.10	0.001
Portfolio 2	0.0014	0.29	0.775
Portfolio 3	0.0089	0.99	0.324
Portfolio 4	0.1063	1.73	0.086
Portfolio 5	-0.0005	-0.05	0.959
Portfolio 6	-0.0020	-0.26	0.794
Portfolio 7	-0.1120	-1.26	0.209
Portfolio 8	0.0080	1.22	0.224
Portfolio 9	0.0082	1.57	0.119
Portfolio 10	-0.0028	-0.37	0.710

Note: P1 is the smallest size portfolio, while P10 is the largest size portfolio. This table presents the coefficients (Coef.), t-values (t), and p-values (*P* >|*t*|) of the intercept of the Three-Factor Model for each portfolio. The intercept represents Jensen's alpha, which is a measure of abnormal stock return of a portfolio.

4.4 Yearly Analysis

Since the smallest decile of firms has higher risk-adjusted returns than large firms, the persistency of these returns is tested. The regression results of the Yearly-adjusted are used to observe whether the risk-adjusted abnormal returns of small firms are persistent. Prior research shows that the small firm effect possibly disappears and appears over the years. The yearly analysis is only conducted for portfolio 1 since this is the only portfolio that exhibits abnormal risk-adjusted returns. Table 8 shows the regression results of the yearly analysis. As can be seen, none of the year dummy variables are statistically significant (P>0.05). Therefore, there is no evidence in favor that the smallest decile of firms has statistically significantly higher or lower returns in any year compared to 2021. Thus, the small firm effect does not disappear over the years and the null hypothesis that the abnormal risk-adjusted returns of small firms are persistent is not rejected.

Table 8 - Portfolio 1 Yearly Analysis of Stock Returns

Descriptive statistics of the yearly dummy variables (coefficients, t values, and p values)

Variable	*Coef.*	*t*	*P* >|*t*|
2008	0.0356	1.03	0.307
2009	0.0138	0.53	0.598
2010	0.0018	0.07	0.944
2011	-0.0042	-0.15	0.883
2012	0.0046	0.17	0.867
2013	-0.0097	-0.42	0.672
2014	-0.0216	-0.86	0.393
2015	-0.0137	-0.53	0.598
2016	0.0081	0.31	0.754
2017	-0.0091	-0.41	0.684
2018	-0.0524	-1.86	0.065
2019	-0.0057	-0.20	0.839
2020	0.0428	1.76	0.080

This table presents the coefficients (Coef.), t-values (t), and p-values (*P* >|*t*|) of the yearly dummy variables in the Yearly-adjusted Three-Factor Model for the smallest size portfolio (portfolio 1). 2008 is a dummy variable for the year 2008, and so on.

4.5 The January Effect

The regression results of the January-adjusted Three-Factor Model are used to observe whether the risk-adjusted abnormal returns of small firms are higher in January compared to other months to explain the small firm effect. Prior research shows that the small firm effect can partly be explained by the January effect. Table 9 shows that only portfolio 1 is affected by the January dummy. The portfolio that contains the smallest decile of firms has statistically significant higher returns in January compared to all other months, since the January dummy is positive and statistically significant ($P<0.05$). The excess returns of portfolio 1 are on average 5.78% higher in January than in the rest of the year. Thus, the mean stock returns of portfolio 1 are not identical across months and seasonality in stock returns is present for the smallest firms. In contrast, the January effect does not show up in other portfolios, since the January dummy is not statistically significant for these portfolios ($P>0.05$). This confirms the claim of van Dijk (2011) that the January effect primarily shows up in the smallest size quintile. To conclude, the risk-adjusted abnormal returns of small firms are higher in January compared to other months.

Table 9 - Portfolio 1-10 January Effect

Descriptive statistics of the January dummy for all portfolios (coefficients, t values and p values)

Portfolio	*Coef.*	*t*	*P* >|*t*|
Portfolio 1	0.0578	4.69	0.000
Portfolio 2	-0.0147	-1.65	0.102
Portfolio 3	-0.0137	-1.33	0.185
Portfolio 4	0.0038	0.37	0.714
Portfolio 5	0.0268	1.32	0.188
Portfolio 6	-0.0092	-0.87	0.385
Portfolio 7	0.0056	0.57	0.572
Portfolio 8	0.0044	0.52	0.604
Portfolio 9	0.0100	1.30	0.194
Portfolio 10	-0.0201	-1.27	0.205

Note: P1 is the smallest size portfolio, while P10 is the largest size portfolio. This table presents the coefficients (Coef.), t-values (t), and p-values ($P>|t|$) of the January dummy in the January-adjusted Three-Factor Model for each portfolio.

Appendix B shows the regression results of the January-adjusted Three-Factor Model of portfolio 1. To find out whether the January effect explains the small firm effect, the value and significance of Jensen's alpha of portfolio 1 in the extended Three-Factor Model and the January-adjusted Three-Factor Model are compared. After the inclusion of the January dummy, Jensen's alpha drops 28% and is still statistically significant (P<0.05).[1] This indicates that the small firm effect is partly explained by the January effect. Possible explanations are the window dressing hypothesis and tax-loss selling hypothesis.[2] To conclude, the January effect explains 28% of the positive risk-adjusted abnormal returns of small firms and the small firm effect is therefore still largely unexplained.

4.6 Liquidity

The regression results of the extended Three-Factor Model are used to observe whether liquidity increases the risk-adjusted returns of small firms since the January effect only partly explains the small firm effect. Table 10 shows that the liquidity factor is not statistically significant for all portfolios (P>0.05), except portfolio 4 which shows a statistically significant and negative relationship between excess returns and liquidity (P<0.05). This indicates that for almost all portfolios the liquidity factor is not priced. Appendix C shows that the same applies to the interaction term (P>0.05). Therefore, the null hypothesis that liquidity does not increase the abnormal risk-adjusted returns of small firms is not rejected. A possible explanation can be that the value or size premium proxy for the liquidity factor (Moor & Sercue, 2013). Appendix D shows that there is a correlation between the liquidity factor and the value premium. The correlation between the liquidity factor and the size premium is neglectable. This indicates that the liquidity factor is subsumed by the value premium. This may be due to the fact that low price-to-book-value stocks are generally

---

[1] The coefficient of Jensen's alpha is 0.0092 for portfolio 1 in the extended Three-Factor Model and 0.0066 in the January-adjusted Three-Factor Model.

[2] The window dressing hypothesis states that institutional investors have an incentive to buy winners or low-risk stocks and sell losers at the end of the year, to present sound portfolio holdings (van Dijk, 2011). The tax-loss selling hypothesis states that at the end of the year, individual investors have a tax incentive to sell stocks that declined in price during the year because capital losses are tax-deductible (Moor & Sercue, 2013). At the end of the year, prices recover because of a lack of selling pressure.

neglected owing to lower public information and less analyst coverage (Pandey & Sehgal, 2016). To conclude, no evidence was found to prove that liquidity increases the risk-adjusted returns of small firms.

Table 10 - Portfolio 1-10 Liquidity factor

Descriptive statistics of liquidity for all portfolios (coefficients, t values, and p values)

Portfolio	*Coef.*	*t*	*P* >|*t*|
Portfolio 1	0.0017	1.59	0.113
Portfolio 2	0.0047	0.87	0.387
Portfolio 3	-0.0018	-0.48	0.631
Portfolio 4	-0.0067	-1.98	0.049
Portfolio 5	0.0086	0.11	0.916
Portfolio 6	0.0022	0.00	0.998
Portfolio 7	0.0014	1.26	0.209
Portfolio 8	0.0043	-0.48	0.630
Portfolio 9	-0.0097	-1.70	0.090
Portfolio 10	-0.0062	0.11	0.913

Note: P1 is the smallest size portfolio, while P10 is the largest size portfolio. This table presents the coefficients (Coef.), t-values (t), and p-values (*P* >|*t*|) of the liquidity factor in the Three-Factor Model for each portfolio. The liquidity factor is the average monthly trading volume of the portfolio.

4.7 Dividend Yield

The regression results of the extended Three-Factor Model are used to observe whether the dividend yield increases the risk-adjusted returns of small firms since the liquidity factor does not explain the small firm effect and the January effect only partly explains the small firm effect. According to the literature, there may be a positive relationship between stock returns of small firms and the dividend yield. This is in contrast to the relationship between stock returns of large firms and the dividend yield. Table 11 shows that the dividend yield is statistically negative for the biggest three portfolios ($P<0.05$). This confirms the statistically significant and negative relationship between stock returns of large firms and the dividend yield. For example, a 1% increase in the dividend yield decreases the excess returns of portfolio 10 by 1.42%. In contrast to these results, the dividend yield is not statistically significant for all other portfolios and seems to play no meaningful role in explaining the excess returns of small firms (P>0.05). Thus, the positive relationship between the stock returns of small firms and the dividend yield is not confirmed. The null hypothesis that dividend yield does not increase the abnormal risk-adjusted returns of small firms is not rejected. A possible explanation is that many small firms do not pay any dividends since they use their earnings for reinvestment rather than to distribute it as dividend, while larger firms are more mature and have a higher dividend yield (Nylander & Reinberg, 2013). The difference in dividend yield between small firms and large firms is confirmed for this sample in section 4.1.1, which shows that the dividend yield of the largest decile of firms is five times larger than the dividend yield of the smallest decile of firms. To conclude, no evidence was found to prove that the dividend yield increases the risk-adjusted returns of small firms.

Table 11 - Portfolio 1-10 Dividend yield

Descriptive statistics of dividend yield for all portfolios (coefficients, t values, and p values)

Portfolio	*Coef.*	*t*	*P* >|*t*|
Portfolio 1	0.2309	0.07	0.947
Portfolio 2	0.4913	0.44	0.661
Portfolio 3	-0.1217	-0.07	0.945
Portfolio 4	-0.7637	-1.07	0.288
Portfolio 5	-1.0030	-2.43	0.016
Portfolio 6	-1.9832	-2.03	0.044
Portfolio 7	-0.5556	-0.42	0.673
Portfolio 8	-1.5337	-2.13	0.035
Portfolio 9	-1.3969	-3.67	0.000
Portfolio 10	-1.4163	-3.88	0.000

Note: P1 is the smallest size portfolio, while P10 is the largest size portfolio. This table presents the coefficients (Coef.), t-values (t), and p-values (*P* >|*t*|) of the dividend yield in the Three-Factor Model for each portfolio. The dividend yield is the monthly dividend frequency times the last declared dividend divided by the price at t-1.

4.8 Robustness of the results

To ensure that the above-mentioned results can be interpreted consistently and that the results are valid, heteroskedasticity tests, autocorrelation tests, and augmented Dickey-Fuller tests are performed. The results are shown in the appendix and are described below.

4.8.1 Heteroskedasticity test

When the variance of the error term is not constant as the OLS estimation technique assumes, the standard errors of the coefficient estimates will be inconsistent (Achola & Muri, 2016). This is known as heteroskedasticity. In contrast, homoskedasticity means constant variance of the error term. To observe whether the standard errors are valid, testing for heteroskedasticity is necessary. White's general test is used to test for heteroskedasticity. White's general test is superior to the competing test since it makes few assumptions about the likely form of heteroskedasticity (Brooks, 2008). The null hypothesis assumes homoskedasticity, while the alternative hypothesis assumes heteroskedasticity.

Appendix E shows the results of White's general test for the Three-Factor Model, the January-Adjusted Three Factor Model, and the Yearly-Adjusted Three Factor Model for each portfolio. For most regressions, the null hypothesis of homoscedasticity is not rejected. However, for some regressions, the residuals are not constant over time and the standard errors are invalid. The standard errors of these regressions are corrected for heteroskedasticity by using robust standard errors.

4.8.2 Autocorrelation test

When the covariance between the error terms is uncorrelated with one another, the standard errors of the OLS coefficient estimates will be inconsistent (Achola & Muri, 2016).

This will result in invalid standard error estimates and is known as autocorrelation. The Breusch-Godfrey test for autocorrelation is used to test for this phenomenon. The advantage of this test is that it can test for higher order autocorrelation (Achola & Muri, 2016). The null hypothesis assumes no autocorrelation of any order, while the alternative hypothesis assumes the presence of autocorrelation. Appendix F shows the results of the Breusch-Godfrey test for the Three-Factor Model, the January-Adjusted Three Factor Model, and the Yearly-Adjusted Three Factor Model for each portfolio. For most regressions, the null hypothesis of no autocorrelation is not rejected. However, for some regressions, the residuals are autocorrelated with their lagged values. The regression results of these portfolios are corrected for autocorrelation by using Newey-West standard errors.

4.8.3 Test for Unit Root

The OLS estimation technique relies on stationarity over time for the time series regression. The stationarity of a time series implies that its mean and variance do not change over time (Achola & Muri, 2016). The shocks of a stationary time series are mean reverting and are expected to be constant (Gujarati, 2004). If the series are non-stationary, there is a unit root in the variables and OLS will provide a spurious regression with meaningless estimates. In addition, the results of non-stationary series will be time specific, meaning that no inference can be made based on the estimation of the non-stationary series (Achola & Muri, 2016). To test for the stationarity of the variables, the Augmented Dickey Fuller test is employed. The null hypothesis is the existence of a unit root in the variables. The alternative hypothesis is that the variables do not have a unit root. The critical value at 5% is equal to -3.447. Appendix G shows the results of the Augmented Dickey Fuller test. As can be seen, the null hypothesis for all variables is rejected. Therefore, these results suggest that the variables are stationary and there is no evidence in favor of a spurious regression. In other words, the variables are all mean-reverting and valid estimations using OLS can be carried out (Achola & Muri, 2016).

5. CONCLUSION

This thesis aims to establish a waterproof statement about the existence of the small firm effect in the Dutch stock market in the period from 2008 to 2021. First of all, the Scholes & Williams betas show that the riskiness of small firms is indeed improperly measured, as claimed by Roll (1981). However, the results of this thesis confirm the negative relationship between firm size and risk, even after a correction for the non-synchronous trading. As stated by the Capital Asset Pricing Model, more risk means higher returns. The results of this thesis prove that there is a size premium since small firms have higher returns than large firms due to higher systematic risk. However, the results also show that the smallest decile of firms is overcompensated for their riskiness. It has been proven that the portfolio that contains the smallest firms has positive risk-adjusted abnormal returns. Therefore, it can be concluded that the small firm effect exists for the smallest decile of firms, even after proper measurement of risk. This contradicts the findings of Roll (1981), who stated that the small firm effect is caused by incorrect measurements of risk. Furthermore, the small firm effect is proven to be persistent for the smallest decile of stocks. While the literature suggests that the small firm effect disappears and appears over the years, no evidence is found to prove this phenomenon. The small firm effect is partly explained by seasonality since the stock returns on the smallest decile of firms are higher in January compared to other months. This is consistent with the findings of Moor & Sercue (2013). The January effect partly explains the small firm effect but does not tell the whole story. While the literature suggests that the dividend yield and liquidity potentially account for the small firm effect, no evidence is found to prove this relationship. None of the risk factors considered in the relevant literature can fully explain the small firm effect. Therefore, the cause of the small firm effect is still not certain. To sum up, the small firm effect exists in the Dutch stock market and is proven to be persistent, while the cause is still largely unexplained. This thesis can therefore be used as a guideline for size-based investment strategies. This guideline is pertinent for Dutch investors and portfolio managers since size-based strategies provide extraordinal economic value. To elaborate, it is possible to exploit the small firm effect by constructing portfolios that invest in the smallest decile of firms. Yet, the most important conclusion is that the empirical results of this thesis validate a well-established theory in the field of economics by giving a waterproof statement about the existence of the small firm effect in the Dutch stock market.

6. Limitations

First of all, dividends were not included in calculating the stock return of the portfolios. Although this could have made this thesis more informative, it did not invalidate the empirical results. In addition, ignoring dividends in calculating stock returns has a negligible effect on empirical results (Tamakloe, 2014). Furthermore, the sample consists of 68 firms and the portfolios are made out of a small number of firms. Although sorting firms into portfolios reduce the measurement error and enhance the power of the tests, grouping securities by some characteristics can lead to incorrect rejections of the null hypothesis (van Dijk, 2011). In addition, the portfolios are yearly adjusted in the first month of the year. However, investors might delay investment decisions till more accounting information is obtained. To continue, the sample period includes the COVID-19 pandemic. During this pandemic, several small firms where provided with financial support to recover from financial problems (Ministerie van Algemene Zaken, 2020). This may have caused the extraordinary stock performance of small firms by reducing the risk of going bankrupt. Due to the intervention of the government, it is not sure whether the results of this thesis are representative of the market. Furthermore, the small firm effect may differ with different measurements of firm size (Duy & Phuoc, 2016). It is not sure whether the results of this thesis hold if firm size is not based on total assets. Lastly, large firms in the Netherlands may be relatively small compared to other countries. As stated before, the small firm effect is conditional on market characteristics. Thus, it is likely that the results of this thesis do not apply to other financial markets and need to be interpreted carefully.

7. Further Research

Since this thesis is one of the first to investigate the small firm effect in the Dutch stock market, further research is necessary. Mainly because the results of this thesis are unable to fully explain the cause of the small firm effect. The January effect partly explains the small firm effect and needs to be examined more thoroughly. Further research should investigate whether the January effect is caused by the tax-loss selling hypothesis and/or the window dressing hypothesis. Since the January effect only partly explains the small firm effect, further research is necessary to find the cause of this phenomenon. This thesis establishes a negative relationship between the dividend yield and stock returns of large firms. A similar relationship is not found for smaller firms and this may be a part of the cause of the small firm effect. Lastly, to find out whether the small firm effect is indeed conditional on market characteristics, further research should focus on other markets as well.

8. REFERENCES

Achola, Nayema Kevin, and Peter W Muri. “Testing the Three Factor Model of Fama and French: Evidence from an Emerging Market.” *European Scientific Journal, ESJ*, vol.

12, no. 16, 28 June 2016, p. 211, 10.19044/esj.2016.v12n16p211. Accessed 10 July 2019.

Amel-Zadeh, Amir. "The Return of the Size Anomaly: Evidence from the German Stock Market." *Papers.ssrn.com*, 9 Dec. 2010, papers.ssrn.com/sol3/papers.cfm?abstract_id=1732959.

Amihud, Yakov. "Illiquidity and Stock Returns: Cross-Section and Time-Series Effects." *Journal of Financial Markets*, vol. 5, no. 1, Jan. 2002, pp. 31–56, www.sciencedirect.com/science/article/pii/S1386418101000246, 10.1016/s1386-4181(01)00024-6.

Amihud, Yakov, and Haim Mendelson. "Asset Pricing and the Bid-Ask Spread." *Journal of Financial Economics*, vol. 17, no. 2, Dec. 1986, pp. 223–249, 10.1016/0304-405x(86)90065-6.

Arnott, Robert D., et al. "Can Noise Create the Size and Value Effects?" *Management Science*, vol. 61, no. 11, 2015, pp. 2569–2579, www.jstor.org/stable/24551546. Accessed 31 Mar. 2022

Arslan, Muhammad, and Rashid Zaman. "Impact of Dividend Yield and Price Earnings Ratio on Stock Returns: A Study Non-Financial Listed Firms of Pakistan." *Research Journal of Finance and Accounting*, vol. 5, no. 19, 2014, p. 68, www.iiste.org/Journals/index.php/RJFA/article/view/16844. Accessed 24 May 2022.

Banz, Rolf W. "The Relationship between Return and Market Value of Common Stocks." *Journal of Financial Economics*, vol. 9, no. 1, Mar. 1981, pp. 3–18, 10.1016/0304-405x(81)90018-0.

Brooks, C. Introductory Econometrics for Finance. New York. Cambridge University Press, January 2019.

Brown, Stephen J., et al. "Going Negative: What to Do with Negative Book Equity Stocks." *Papers.ssrn.com*, 9 June 2008, papers.ssrn.com/sol3/papers.cfm?abstract_id=1142649. Accessed 14 May 2022.

Carhart, Mark M. "On Persistence in Mutual Fund Performance." *The Journal of Finance*, vol. 52, no. 1, Mar. 1997, pp. 57–82, onlinelibrary.wiley.com/doi/full/10.1111/j.1540-6261.1997.tb03808.x, 10.1111/j.1540-6261.1997.tb03808.x.

Corporate Finance Institute. "Alpha and Beta: How to Use These Terms for a Better Investment Portfolio." *Standard Chartered Singapore*, 23 Feb. 2021, www.sc.com/sg/stories/alpha-and-beta/. Accessed 23 June 2022.

Corporate Finance Institute. "Fama-French Three-Factor Model - Components, Formula & Uses." *Corporate Finance Institute*, 2019, corporatefinanceinstitute.com/resources/knowledge/finance/fama-french-three-factor-model/.

Cowan, Arnold R., and Anne M.A. Sergeant. "Trading Frequency and Event Study Test Specification." *Journal of Banking & Finance*, vol. 20, no. 10, Dec. 1996, pp. 1731–1757, 10.1016/s0378-4266(96)00021-0.

Duy, N. T., & Phuoc, N. P. H. The relationship between firm sizes and stock returns of service sector in Ho Chi Minh City stock exchange. *Review of European Studies*, 8(4), 210-219, Feb. 2016

Fama, Eugene F., and Kenneth R. French. "Common Risk Factors in the Returns on Stocks and Bonds." *Journal of Financial Economics,* vol. 33, no. 1, Feb. 1993, pp. 3–56, www.sciencedirect.com/science/article/pii/0304405X93900235, 10.1016/0304-405x(93)90023-5.

Gujarati, D. N., Basic Econometrics, Fourth Edition. New York. McGraw-Hill Education, August 2004. http://zalamsyah.staff.unja.ac.id/wpcontent/uploads/sites/286/2019/11/7-Basic-Econometrics-4th-Ed.-Gujarati.pdf

Handa, Puneet, et al. "The Relation between the Return Interval and Betas: Implications for the Size Effect." *Journal of Financial Economics*, vol. 23, no. 1, 1989, pp. 79–100, econpapers.repec.org/article/eeejfinec/v_3a23_3ay_3a1989_3ai_3a1_3ap_3a79-100.htm. 25 Feb. 2022.

Horowitz, Joel L, et al. "Three Analyses of the Firm Size Premium." *Journal of Empirical Finance,* vol. 7, no. 2, Aug. 2000, pp. 143–153, 10.1016/s0927-5398(00)00008-6. Accessed 31 May 2019.

Jansen, Eduard Th. J. ‘’The five-factor model in the Netherlands.’’, August 2019. ttps://webcache.googleusercontent.com/search?q=cache:J5xI4X_VVgJ:https://thesis.eur.nl/pub/49650/Bsc-Thesis-Eduard-Th.J.-Jansen.pdf+&cd=1&hl=nl&ct=clnk&gl=nl

Jensen, Michael C, et al. “The Capital Asset Pricing Model: Some Empirical Tests.” *Ssrn.com*, 2019, papers.ssrn.com/sol3/papers.cfm?abstract_id=908569.

Jensen, Michael C. “The Performance of Mutual Funds in the Period 1945-1964.” *Papers.ssrn.com*, 1 May 1967, papers.ssrn.com/sol3/papers.cfm?abstract_id=244153.

Lynch, Ryan. “High Returns and Low Volatility: The Case for Mid-Cap Stocks.” *Undergraduate Honors Theses*, 1 May 2018, dc.etsu.edu/honors/450/. Accessed 8 Apr. 2022.

Keim, Donald B. “Size-Related Anomalies and Stock Return Seasonality.” *Journal of Financial Economics*, vol. 12, no. 1, June 1983, pp. 13–32, 10.1016/0304-405x(83)90025-9.

Maloney, Thomas, and Tobias J. Moskowitz. “Value and Interest Rates: Are Rates to Blame for Value’s Torments?” *Papers.ssrn.com*, 22 May 2020, papers.ssrn.com/sol3/papers.cfm?abstract_id=3608155. Accessed 21 June 2022.

Mghendi, Florence. “Testing the Small Firm Effect on Stock Market Returns at the Nairobi Securities Exchange.” *Undefined*, vol. 12, no. 2, 2014, www.semanticscholar.org/paper/Testing-the-small-firm-effect-on-stock-market-at-Mghendi/f627c92a45f5b99e9d2ca83579dec97dd497d698. Accessed 29 June 2022.

Milius, Luuk. *The Three Factor Model for Dutch Equities*. University of Twente, 12 Feb.2012.http://webcache.googleusercontent.com/search?q=cache:UwtyofFtwJ:arno.uvt.nl.c3d%3D2+&cd=2&hl=nl&ct=clnk&gl=nl

Ministerie van Algemene Zaken. "Overzicht Steun- En Herstelpakket - Coronavirus: Financiële Regelingen - Rijksoverheid.nl." *Www.rijksoverheid.nl*, 9 Apr. 2020, www.rijksoverheid.nl/onderwerpen/coronavirus-financiele-regelingen/overzicht-financiele-regelingen.

De Moor, Lieven, and Piet Sercu. "The Smallest Firm Effect: An International Study." *Journal of International Money and Finance*, vol. 32, no. 2, 1 Feb. 2013, pp. 129–155, www.sciencedirect.com/science/article/pii/S0261560612000794, 10.1016/j.jimonfin.2012.04.002.

Moore, C. "Unraveling the Size Effect." *Www.semanticscholar.org*, 2000, www.semanticscholar.org/paper/Unraveling-the-Size-Effect-Moore/ae5abdda68a719abd057b5385af151ed1229d5a4. Accessed 31 Mar. 2022.

Naranjo, Andy, et al. "Stock Returns, Dividend Yields, and Taxes." *The Journal of Finance*, vol. 53, no. 6, 1998, pp. 2029–2057, www.jstor.org/stable/117460. Accessed 31 Mar. 2022.

Nylander, Cecilia, and Sandra Reinberg. *The Relationship between Changes in Cash Dividends and Volatility of Stock Returns -A Study of the Swedish Stock Market Authors: Supervisor: Catherine Lions*. 2013.

Pandey, Asheesh, and Sanjay Sehgal. "Explaining Size Effect for Indian Stock Market." *ResearchGate*, Springer Verlag, Mar. 2016, www.researchgate.net/publication/288905006_Explaining_Size_Effect_for_Indian_Stock_Market. Accessed 31 Mar. 2022.

Reinganum, Marc R. "The Arbitrage Pricing Theory: Some Empirical Results." *The Journal of Finance*, vol. 36, no. 2, May 1981, pp. 313–321, 10.1111/j.1540-6261.1981.tb00444.x.

Roll, Richard. "A Possible Explanation of the Small Firm Effect." *The Journal of Finance*, vol. 36, no. 4, 1981, pp. 879–888, www.jstor.org/stable/2327553?seq=1#metadata_info_tab_contents, 10.2307/2327553.

Sattar, Mahnoor. "CAPM vs Fama-French Three-Factor Model: An Evaluation of Effectiveness in Explaining Excess Return in Dhaka Stock Exchange." *International Journal of Business and Management*, vol. 12, no. 5, 27 Apr. 2017, p. 119, 10.5539/ijbm.v12n5p119.

Strong, Norman, and Martin Walker. "The Explanatory Power of Earnings for Stock Returns." *The Accounting Review*, vol. 68, no. 2, 1993, pp. 385–399, www.jstor.org/stable/248407. Accessed 31 Mar. 2022.

Tamakloe, M. “The Small Firm Effect: The Case of Ghana Stock Exchange.” *Afribary*, 12 Apr. 2017, afribary.com/works/the-small-firm-effect-the-case-of-ghana-stock-exchange. Accessed 29 June 2022.

Thaler, Richard H. “Anomalies: The January Effect.” *Journal of Economic Perspectives*, vol. 1, no. 1, Aug. 1987, pp. 197–201, 10.1257/jep.1.1.197.

van Dijk, Mathijs A. “Is Size Dead? A Review of the Size Effect in Equity Returns.” *Journal of Banking & Finance*, vol. 35, no. 12, Dec. 2011, pp. 3263–3274, 10.1016/j.jbankfin.2011.05.009.

9. APPENDIX

Appendix A - List of firms

List of firms in the sample with corresponding ISIN code

Firm	*ISIN code*
Aalberts	NL0000852564
Accel Group N.V.	NL0009767532
Accsys Technologies	GB00BQQFX454
Aegon	NL0000303709
Ahold Delhaize	NL0011794037
Air France-KLM	FR0000031122
AFC Ajax N.V.	NL0000018034
AkzoNobel	NL0013267909
Alumexx N.V.	NL0012194724
AMG Advanced Metallurigcal	NL0000888691
Amsterdam Commodities	NL0000313286
Aperam	LU0569974404
Arcadis	NL0006237562

ArcelorMittal	LU1598757687
ASM International	NL0000334118
ASML Holding	NL0010273215
BAM	NL0000337319
Besi	NL0012866412
Beter Bed Holding N.V.	NL0000339703
Boskalis	NL0000852580
Brunel	NL0010776944
Corbion	NL0010583399
Ctac N.V.	NL0000345577
Ease2pay N.V.	NL0000345627
Eurocommercial Properties	NL0000288876
Fagron	BE0003874915
Fugron	NL00150003E1
Galapagos	BE0003818359
HAL Trust	BMG455841020
Heijmans	NL0009269109
Heineken	NL0000009165
Holland Colours N.V.	NL0000440311
Hydratec Industries	NL0009391242
IEX Group N.V.	NL0010556726
ING Group N.V.	NL0011821202
Kendrion	NL0008525531
Koninklijke Brill N.V.	NL0000442523
Koninklijke DSM N.V.	NL0000009827
KPN	NL0000009082
MKB NedSense N.V.	NL0013649452
N.V. Bever Holding	NL0000285278
N.V. Koninklijke Porceleyne Fles	NL0000378669
Nedap N.V.	NL0000371243
Neway Electronics International	NL0000440618
Nieuwe Steen Investments	NL0000292324
Ordina	NL0000440584

Pharming Group	NL0010391025
Philips	NL0000009538
PostNL	NL0009739416
Randstad Holding	NL0000379121
RELX	GB00B2B0DG97
Roodmicrotec N.V.	NL0011556972
Royal Vopak N.V.	NL0009432491
SBM Offshore	NL0000360618
Shell PLC	GB00BP6MXD84
Sligro Food Group	NL0000817179
TIE Kinetix N.V.	NL0010389508
TomTom	NL0013332471
Unibail-Rodamco Westfield	FR0013326246
Unilever	NL0000009355
Van Lanschot	NL0000302636
Vastned Retail	NL0000288918
VEON Ltd.	BMH9349W1038
WDP	BE0974349814
Wereldhave	NL0000440980
Wolters Kluwer	NL0000395903

Appendix B - Portfolio 1 Seasonal Analysis of Stock Returns

Descriptive statistics (coefficients, t values and p values)

Variable	*Coef.*	*t*	*P* >|*t*|
Beta	1.3910	6.23	0.000
SMB	0.3235	2.08	0.040
HML	0.1132	1.28	0.202
Dividend yield	1.5976	0.62	0.538
Liquidity	0.0017	1.64	0.103
Interaction term	0.0003	1.78	0.077
January	0.0578	4.69	0.000
Jensen’s alpha	0.0066	2.41	0.017

This table presents the coefficients (Coef.), t-values (t), and p-values ($P > |t|$) of the January-adjusted Three-Factor Model for the smallest size portfolio. SMB is the size premium. HML is the value premium. Dividend yield is the monthly dividend frequency times the last declared dividend divided by the price at t-1. Liquidity is the average monthly trading volume. Interaction term is the interaction term between the dividend yield and liquidity. January is the January dummy. Jensen´s alpha is the intercept and a measure of abnormal stock returns.

Appendix C - Portfolio 1-10 Interaction term

Descriptive statistics of interaction term for all portfolios (coefficients, t values, and p values)

Portfolio	*Coef.*	*t*	$P > \|t\|$
Portfolio 1	0.0033	0.95	0.343
Portfolio 2	-0.0011	-0.71	0.481
Portfolio 3	0.0031	0.42	0.673
Portfolio 4	0.0091	0.26	0.795
Portfolio 5	0.0075	1.73	0.086
Portfolio 6	0.0042	0.39	0.696
Portfolio 7	0.0093	1.32	0.188
Portfolio 8	-0.0023	-0.03	0.975
Portfolio 9	0.0012	0.58	0.563
Portfolio 10	-0.0076	-0.11	0.909

Note: P1 is the smallest size portfolio, while P10 is the largest size portfolio. This table presents the coefficients (Coef.), t-values (t), and p-values ($P > |t|$) of the interaction term in the Three-Factor Model for each portfolio. The interaction term represents the interaction between dividend yield and liquidity.

Appendix D - Correlation Between Liquidity Factor and Size and Value Premium

Correlation (correlation coefficients)

Variable	*SMB*	*HML*
P1 – Liquidity factor	0.0797	0.0238
P2 – Liquidity factor	0.0939	0.0053
P3 – Liquidity factor	0.0331	0.3107
P4 – Liquidity factor	0.0861	0.1537
P5 – Liquidity factor	0.0139	0.2880
P6 – Liquidity factor	0.0176	0.0979
P7 – Liquidity factor	0.0270	0.2628
P8 – Liquidity factor	0.0151	0.2136
P9 – Liquidity factor	0.0773	0.3813
P10 – Liquidity factor	0.0956	0.0186

Note: P1 is the smallest size portfolio, while P10 is the largest size portfolio. This table presents the correlation between the liquidity factor and SMB and HML. SMB is the size premium. HML is the value premium. Liquidity is the average monthly trading volume.

Appendix E - White's general test

Test results for heteroskedasticity (Chi-square statistics and p values)

Variable	*Chi-square Statistic*	*P value*
Portfolio 1	0.14	0.7042
Portfolio 2	0.12	0.7256
Portfolio 3	2.90	0.0884
Portfolio 4	0.67	0.4129
Portfolio 5	4.25	0.0393
Portfolio 6	0.50	0.4778
Portfolio 7	0.33	0.5666
Portfolio 8	7.82	0.0052
Portfolio 9	0.04	0.8504
Portfolio 10	0.16	0.6859
Portfolio 1 – January	0.13	0.7160
Portfolio 2 – January	0.18	0.6685
Portfolio 3 – January	3.56	0.0594
Portfolio 4 – January	0.58	0.4466
Portfolio 5 – January	4.75	0.0293
Portfolio 6 – January	0.45	0.5001
Portfolio 7 – January	0.35	0.5564
Portfolio 8 – January	7.89	0.0050
Portfolio 9 – January	0.05	0.8307
Portfolio 10 – January	0.96	0.3264
Portfolio 1 – Yearly analysis	26.10	0.0000

Note: P1 is the smallest size portfolio, while P10 is the largest size portfolio. This table presents the regression results of the White's general test for heteroskedasticity. E.g., Portfolio 1 refers to the heteroskedasticity test for the Three-Factor Model regression of portfolio 1. Portfolio 1 – January refers to the heteroskedasticity test for the Three-Factor Model regression of portfolio 1. Portfolio 1 – Yearly analysis refers to the heteroskedasticity test for the Three-Factor Model regression of portfolio 1.

Appendix F - Breusch-Godfrey test

Test results for autocorrelation (Chi-square statistics and p values)

Variable	*Chi-square Statistic*	*P value*
Portfolio 1	0.060	0.8062
Portfolio 2	0.562	0.4536
Portfolio 3	1.148	0.2839
Portfolio 4	0.459	0.4983
Portfolio 5	0.340	0.5599
Portfolio 6	1.705	0.1916
Portfolio 7	1.262	0.2612
Portfolio 8	0.803	0.3701
Portfolio 9	1.307	0.2530
Portfolio 10	1.177	0.2779
Portfolio 1 – January	1.289	0.2562
Portfolio 2 – January	0.331	0.5653
Portfolio 3 – January	1.767	0.1837
Portfolio 4 – January	0.422	0.5160
Portfolio 5 – January	0.382	0.5368
Portfolio 6 – January	1.733	0.1880
Portfolio 7 – January	1.466	0.2260
Portfolio 8 – January	0.714	0.3982
Portfolio 9 – January	1.126	0.2886
Portfolio 10 – January	1.852	0.1735
Portfolio 1 – Yearly analysis	0.049	0.8250

Note: P1 is the smallest size portfolio, while P10 is the largest size portfolio. This table presents the regression results of the Breusch-Godfrey test for autocorrelation. E.g., Portfolio 1 refers to the autocorrelation test for the Three-Factor Model regression of portfolio 1. Portfolio 1 – January refers to the autocorrelation test for the Three-Factor Model regression of portfolio 1. Portfolio 1 – Yearly analysis refers to the autocorrelation test for the Three-Factor Model regression of portfolio 1.

Appendix G - Augmented Dickey Fuller tests for unit root

Augmented Dickey Fuller test statistics (t-values)

Variable	*ADF test statistic*	*Order of integration*
SMB	-11.661	I (0)
HML	-7.901	I (0)
MRP	-9.043	I (0)
P1 – Excess return	-8.247	I (0)
P1 – Dividend yield	-9.264	I (0)
P1 - Liquidity	-6.396	I (0)
P2 – Excess return	-7.872	I (0)
P2 – Dividend yield	-10.416	I (0)
P2 - Liquidity	-6.515	I (0)
P3 – Excess return	-7.348	I (0)
P3 – Dividend yield	-8.271	I (0)
P3 - Liquidity	-4.683	I (0)
P4 – Excess return	-9.745	I (0)
P4 – Dividend yield	-9.396	I (0)
P4 - Liquidity	-4.350	I (0)
P5 – Excess return	-7.610	I (0)
P5 – Dividend yield	-9.684	I (0)
P5 - Liquidity	-5.332	I (0)
P6 – Excess return	-8.751	I (0)
P6 – Dividend yield	-9.823	I (0)
P6 - Liquidity	-5.785	I (0)
P7 – Excess return	-10.225	I (0)
P7 – Dividend yield	-9.720	I (0)
P7 - Liquidity	-5.021	I (0)
P8 – Excess return	-9.824	I (0)
P8 – Dividend yield	-9.707	I (0)
P8 - Liquidity	-3.544	I (0)
P9 – Excess return	-8.076	I (0)
P9 – Dividend yield	-9.233	I (0)
P9 - Liquidity	-4.322	I (0)

P10 – Excess return	-8.187	I (0)
P10 – Dividend yield	-9.245	I (0)
P10 - Liquidity	-3.639	I (0)

Note: P1 is the smallest size portfolio, while P10 is the largest size portfolio. This table presents the regression results of the Augmented Dickey Fuller test for unit root. E.g., Portfolio 1 refers to the unit root test for the Three-Factor Model regression of portfolio 1. Portfolio 1 – January refers to the unit root test for the Three-Factor Model regression of portfolio 1. Portfolio 1 – Yearly analysis refers to the unit root test for the Three-Factor Model regression of portfolio 1.