Erasmus School of Economics

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Investors sentiment and the value, profitability, and investment premia: European market

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**Abstract**

This paper examines whether investors' sentiment is an explanatory factor of the value, profitability, and investment premia in the European stock market. Using the VSTOXX index as a proxy for investors' sentiment, I analyze the effect that sentiment has on small- and large-cap portfolios sorted by book-to-market ratio, operating profitability, and investment, using a two-factor model. I document that investors' sentiment only has explanatory power for small stocks' returns, and all the small-cap portfolio returns are positively related to volatility. Although investors' sentiment is not found to be a determinant factor in explaining the value, profitability, and investment premia in the European stock market, it does bring improvements to the standard CAPM in explaining stock returns, when looking at small firms.

## 1. Introduction

Existing literature widely supports the theory of value premium according to which value stocks have greater risk-adjusted returns compared to growth stocks. Fama and French (1992) first identified this premium by measuring returns of high book-to-market compared to low book-to-market stocks through their HML factor in their three-factor model. At first, this premium was thought to originate from differences in exposure to risk, but further research by Piotroski and So (2012) has identified a misevaluation motive, with the value premium concentrated in firms with biased ex-ante expectation errors. These errors appear to stem from changes in investor sentiment, which would help explain Petkova and Zhang's (2005) findings. They document how time-varying risk help explain this premium in US stock returns, as value betas covary positively with expected market risk premium, whereas the opposite is true for growth betas. Arisoy (2010) has further investigated the effect of volatility risk on the value premium in the French stock market, by looking at returns of value versus growth portfolios using returns on at-the-money straddles written on the CAC40 index as a proxy for volatility risk. He concludes that volatility risk is an important factor that drives the difference in returns between value and growth stocks, as value firms consistently have negative volatility betas, while growth firms consistently have positive volatility betas.

Fama and French (2014) then proceeded to expand their model to five factors, arguing that profitability and investment should be included in order to better explain patterns in average stock returns. Specifically, using the dividend discount model, they provide evidence that high earnings (profitability) lead to high subsequent returns when controlling for book-to-market equity ratio and investment. Meanwhile, higher investments imply lower expected returns, keeping the B/M equity ratio and expected earnings fixed. Such findings are also supported by Novy-Marx (2013) which documents that gross profitability supports the book-to-market equity factor in explaining cross-sectional stock returns. These findings gave birth to the concepts of profitability premium and investment premium, which researchers have since then tried to explain at length. As for the value factor, part of these premia is due to differences in risk. Cooper and Priestley (2011) have shown that the negative relationship between investments and returns is primarily accounted for by the difference in systematic risk between conservative (low investment) and aggressive (high investment) firms, as firms' systematic risk decreases during high investment periods. As such, we would not expect investor sentiment to have a significant role in explaining this relationship. However, they do not rule out the possibility that behavioral fallacies (mispricing) might play a role. With respect to the profitability premium, Lam et Al. (2015) have concluded that macroeconomic risk can only partly explain this positive relationship, with investors' requiring higher rates of return for holding firms with profitable assets. In fact, they show that including a misevaluation factor based on investor sentiment helps explain a significant portion of this premium, arguing that profitability helps explain future returns because of its correlation with investors' ex-ante expectation errors. Additionally, they provide direct evidence that this misevaluation effect is stronger for smaller firms with high profitability, which have significantly higher earnings announcement returns than firms with low profitability but high market valuation. Following these findings, we would expect overvaluation to occur in periods of high sentiment (low volatility) and undervaluation during low-sentiment periods. In line with these findings, Walkshäusl (2016) has proposed a misevaluation factor-augmented model for describing average returns, proposing a combination of risk-based and behavioral mispricing-based aspects for asset pricing models. This research intends to further investigate these findings and analyze the extent to which investor sentiment, measured through volatility, is a determinant of the value, profitability, and investment premia. In particular, by using portfolios sorted by book-to-market equity ratio, profitability, and investment, and controlling for size, I will try to explain how their returns react to changes in investors' sentiment in the European market, and whether it can partly account for these premia.

To test these relationships, a proxy for investors' sentiment that considers their measure of volatility risk is required. Previous research by Smales (2016), which looked at the effect of investors' fear on financial market returns, employed the VIX (Chicago Board Options Exchange Volatility Index) as a proxy for fear (sentiment). He argues that when investors have higher levels of risk aversion, more put options are bought, leading to higher implied volatility. Additionally, the forward-looking nature of option prices allows us to understand investors' expectations of the price dynamics of the underlying. Followingly, this implied volatility index can be considered a good proxy for measuring the level of sentiment in financial markets. As such, I decided to use the European counterpart of the VIX, the VSTOXX index, which measures the 30-days implied volatility based on the EURO STOXX 50 option prices, as a proxy for measuring investors' sentiment.

As I mentioned earlier, in the analysis I will control for size by sorting stocks into two market capitalization groups. The reason for this is that existing literature shows that most factor returns are driven by the smallest firms, and Bauman et Al. (1998) documents a strong firm-size effect when studying the performance of large-cap and small-cap stocks, which I intend to account for. Additionally, small-cap firms are often considered riskier than large firms due to their limited resources and higher exposure to bad economic conditions, which makes them sensitive to changes in market sentiment.

This paper will contribute to the existing literature by strengthening the theory behind the effect of investors' sentiment, measured through volatility, on the performance of value- and growth-stocks in the European market, and testing whether the magnitude of this effect varies depending on firms' size. Additionally, as far as the author knows, there is yet no research that studies the relevance of investors' sentiment in explaining the profitability and investment premia. As such, I will try to fill this gap and test whether volatility affects the performance of portfolios sorted on operating profitability and investment in the European stock market. Finally, the finding of this paper might help to shed light on the exploitability of these premia in investment and hedging strategies.

The rest of the paper if organized as follows. Section 2 defines the research questions and respective hypotheses. Section 3 presents data and methodology used to test the hypotheses of whether volatility risk is a determinant of the value, profitability, and investment premia in the European market. Section 3 reports the associated analysis and empirical results. The final section includes concluding remarks and suggestions for further research.

## 2. Hypotheses

Taking in consideration the existing literature and the scope of this article, I formulate the following research questions, sub-questions, and hypotheses to be tested:

*Q1: Is investors' sentiment a determinant of the value premium in the European stock market?*

$H_{0,1}$: Investors' sentiment, measured through volatility, partly determines the difference in returns between value- and growth-stocks in the European stock market.

*SQ1.1: How does investors' sentiment affect the performance of growth- vs. value-stocks in the European stock market?*

$H_{0,1.1}$: Value-stocks are negatively affected by low sentiment levels, while the opposite is true for growth stocks, which is consistent with a "flight to quality".

*SQ1.2: How does investors' sentiment affect small vs. large value- and growth-stocks?*

$H_{0,1.2}$: Investors' sentiment, proxied by volatility, has a stronger effect on small-cap stocks than large-cap stocks.

*Q2: Is investors' sentiment a determinant of the profitability premium in the European stock market?*

$H_{0,2}$: Investors' sentiment, measured through volatility, partly determines the difference in returns between high profitability and low profitability stocks in the European stock market.

*SQ2.1: How does investors' sentiment affect the performance of high profitability vs. low profitability stocks in the European stock market?*

$H_{0,2.1}$: Highly profitable firms experience significantly higher average returns in periods of low sentiment (high volatility), while the effect is smaller for low profitability firms.

*Q3: Is investors' sentiment a determinant of the investment premium in the European stock market?*

$H_{0,3}$: Investors' sentiment does not play a role in explaining the investment premium in the European stock market.

*SQ3.1: How does investors' sentiment affect the performance of high investment vs. low investment stocks in the European stock market?*

$H_{0,3.1}$: Investors' sentiment, proxied by volatility, does not significantly affect the performance of high and low investment stocks in the European stock market.

## 3. Data and methodology

### *3.1. Data*

The data covers the period from January 2000 to December 2021. In order to test the effect of investors' sentiment on our portfolios, a proxy for measuring this sentiment is required. The volatility index VSTOXX is calculated using real-time option prices on the EURO STOXX 50 index, which tracks the 50 largest Eurozone companies. It measures the squared root of the implied variance across all options with a given time to expiration and reflects the market expectations of short- and long-term volatility by measuring the 30-day implied volatility. The intuition behind it is that when risk aversion is higher, and the demand for put options increases as investors look to hedge their downside price risk, the VSTOXX price increases. As of 2022, the EURO STOXX 50 index represents 55.54% of the total market capitalization of all companies listed on the Euronext stock exchange, which is Europe's largest stock exchange, with a total market capitalization of 3.698 trillion Euros. Historical data on the VSTOXX index price was obtained from Qontigo's website.

Data on historical portfolio returns, as well as the European risk-free rate and Fama and French market factor, which represents the excess return on the market, were obtained from Kenneth French's website. All returns are in US dollars, include dividends and capital gains, and are not continuously compounded. All portfolios were created using the Bloomberg database and include stocks that are sorted by two variables: size, as market capitalization, and either book-to-market ratio, operating profitability, or investment. Two size groups are defined, with big stocks belonging to the top 90% of European stocks' June market capitalization, and small stocks being the ones in the bottom 10%. With respect to book-to-market ratio, operating profitability, and investment, stocks were divided into three groups using breakpoints at the $30^{th}$ and $70^{th}$ percentile of each variable for big European stocks. These independent 2x3 sorts produce three sets of six value-weighted portfolios:

- Value-Growth portfolios (book-to-market ratio): Small/Growth (*S_G*), Small/Neutral (*S_N*), Small/Value (*S_V*), Big/Growth (*B_G*), Big/Neutral (*B_N*), and Big/Value (*B_V*).
- Weak-Robust portfolios (operating profitability): Small/Weak (*S_W*), Small/Neutral (*S_NP*), Small/Robust (*S_R*), Big/Weak (*B_W*), Big /Neutral (*B_NP*), Big /Robust (*B_R*).

- Aggressive-Conservative portfolios (investment): Small/Aggressive (*S_A*), Small/Neutral (*S_NI*), Small/Conservative (*S_C*), Big/Aggressive (*B_A*), Big/Neutral (*B_NI*), and Big/Conservative (*B_C*).

*3.2. Methodology*

As mentioned earlier, the VSTOXX index reflects the 30-day implied volatility calculated through put and call option prices on the EURO STOXX 50 index. Investors often use put options as hedging strategies to protect themselves from their downside price risk during periods of higher uncertainty, which means that there is a higher demand for such options when sentiment is low and risk aversion is high, which drives the VSTOXX upwards. Considering this relationship, which was also reported by Lee et Al. (2002) in studying how conditional volatility is impacted by sentiment, volatility represents a good proxy for measuring market sentiment.

I test my main hypotheses that investors' sentiment, proxied by volatility, is an explanatory factor for the value, profitability, and investment premia in the European stock market by regressing the excess returns of 18 portfolios sorted according to book-to-market ratio, operating profitability, and investment on the VSTOXX index returns, and on the market factor. More specifically, I look at the magnitude with which changes in volatility affect the returns of these value-weighted portfolios through the following two-factor capital asset pricing model:

$$R_{Pt} - r_{ft} = \alpha_i + \beta_{Mi}(R_{Mt} - r_{ft}) + \beta_{Vi}R_{Vt}$$

where $R_{Pt}$ are the realized returns of the 18 test portfolios, $R_{Mt}$ is the market return, $R_{Vt}$ is the return of the VSTOXX index, measured as the monthly percentage change in price, and $r_{ft}$ is the risk-free rate. The analysis is made on monthly portfolio returns, as daily returns might be affected by microstructure effects as well as non-synchronous trading effects.

Tables 1.1 to 1.4 present the monthly average returns and some additional descriptive statistics for the 18 portfolios looked at in this study, as well as for the market factor and the volatility index returns. Consistent with the literature and the concept of value premium, we can see in Table 1.1 that value portfolios outperform growth portfolios, with big value firms averaging 0.16% higher monthly returns than big growth firms. The difference is even larger for small firms, also consistent with existing literature, with value firms outperforming growth firms by 0.77% on average each month.

**Table 1.1**

| Variable | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| S_G | 264 | .355 | 5.9 | -25.39 | 18.02 |
| S_N | 264 | .734 | 5.514 | -26.17 | 19.27 |
| S_V | 264 | 1.126 | 5.286 | -25.49 | 19.7 |
| B_G | 264 | .732 | 5.748 | -25.4 | 17.64 |
| B_N | 264 | .9 | 5.619 | -24.79 | 19.39 |
| B_V | 264 | .894 | 6.469 | -26.82 | 25.89 |

*This table reports the descriptive statistics for the 6 portfolios sorted by book-to-market equity ratio, which include number of observations, average monthly return (percentage), standard deviation, and minimum and maximum monthly return (percentages). S and B stand for small and big, while G, N, and V stand for growth, neutral, and value respectively. The sample period goes from January 2000 to December 2021 (264 months).*

**Table 1.2**

| Variable | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| S_W | 264 | .672 | 5.583 | -25.81 | 19.41 |
| S_NP | 264 | 1.103 | 5.247 | -25.61 | 18.38 |
| S_R | 264 | 1.122 | 5.37 | -25.29 | 19.58 |
| B_W | 264 | .624 | 6.281 | -25.81 | 20.57 |
| B_NP | 264 | .937 | 5.73 | -26.88 | 21.54 |
| B_R | 264 | .936 | 5.539 | -24.22 | 20.35 |

*This table reports the descriptive statistics for the 6 portfolios sorted by operating profitability, which include a number of observations, average monthly return (percentage), standard deviation, and minimum and maximum monthly return (percentages). S and B stand for small and big, while W, NP, and R stand for weak, neutral profitability, and robust respectively. The sample period goes from January 2000 to December 2021 (264 months).*

In Table 1.2 we find evidence of the profitability premium, with the difference in returns between weak and robust firms ranging from 0.31% for large firms, to 0.45% for small firms. Finally, in Table 1.3 one can see that conservative firms, which make low or no investments, perform much better than aggressive firms on average. The difference in monthly average returns is again larger for smaller firms (0.59%) than for larger firms (0.09%).

**Table 1.3**

| Variable | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| S_C | 264 | 1.04 | 5.439 | -24.06 | 18.54 |
| S_NI | 264 | 1.036 | 5.029 | -24.55 | 17.39 |
| S_A | 264 | .452 | 5.957 | -27.64 | 20.94 |
| B_C | 264 | .831 | 5.725 | -23.82 | 19.5 |
| B_NI | 264 | .916 | 5.622 | -23.26 | 19.7 |
| B_A | 264 | .737 | 6.348 | -31.08 | 24.45 |

*This table reports the descriptive statistics for the 6 portfolios sorted by investment, which include a number of observations, average monthly return (percentage), standard deviation, and minimum and maximum monthly return (percentages). S and B stand for small and big, while C, NI, and A stand for conservative, neutral investment, and aggressive respectively. The sample period goes from January 2000 to December 2021 (264 months).*

**Table 1.4**

| Variable | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| Mkt_F | 264 | .469 | 5.294 | -22.02 | 16.62 |
| VSTOXX_R | 264 | 1.892 | 21.992 | -40.3 | 146.22 |

*This table reports the descriptive statistics for the market and volatility factors, which include a number of observations, average monthly return (percentage), standard deviation, and minimum and maximum monthly return (percentages). Mkt_F represents the excess return of the market. VSTOXX_R represents the return of the VSTOXX index. The sample period goes from January 2000 to December 2021 (264 months).*

Tables 2.1 to 2.3 report the correlations between the portfolios’ monthly returns and the VSTOXX index returns for the period starting January 2000 until December 2021. The volatility returns are negatively correlated with all 18 portfolios and the market factor.

**Table 2.1**

| Variables | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|---|---|---|---|---|---|---|---|---|
| (1) VSTOXX_R | 1.000 | | | | | | | |
| (2) S_G | -0.509 | 1.000 | | | | | | |
| (3) S_N | -0.544 | 0.971 | 1.000 | | | | | |
| (4) S_V | -0.493 | 0.920 | 0.971 | 1.000 | | | | |
| (5) B_G | -0.616 | 0.895 | 0.905 | 0.844 | 1.000 | | | |
| (6) B_N | -0.622 | 0.863 | 0.921 | 0.912 | 0.933 | 1.000 | | |
| (7) B_V | -0.599 | 0.827 | 0.897 | 0.915 | 0.869 | 0.968 | 1.000 | |
| (8) Mkt_F | -0.644 | 0.861 | 0.906 | 0.885 | 0.947 | 0.978 | 0.952 | 1.000 |

*This table reports the correlations between the monthly returns of the 6 portfolios sorted with respect to book-to-market ratio, the market factor and VSTOXX index returns. S and B stand for small and big, while G, N, and V stand for growth, neutral, and value respectively. The sample period goes from January 2000 to December 2021 (264 months).*

**Table 2.2**

| Variables | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|---|---|---|---|---|---|---|---|---|
| (1) VSTOXX_R | 1.000 | | | | | | | |
| (2) S_W | -0.503 | 1.000 | | | | | | |
| (3) S_NP | -0.540 | 0.966 | 1.000 | | | | | |
| (4) S_R | -0.533 | 0.968 | 0.988 | 1.000 | | | | |
| (5) B_W | -0.619 | 0.907 | 0.935 | 0.928 | 1.000 | | | |
| (6) B_NP | -0.620 | 0.886 | 0.939 | 0.928 | 0.973 | 1.000 | | |
| (7) B_R | -0.627 | 0.893 | 0.940 | 0.934 | 0.967 | 0.986 | 1.000 | |
| (8) Mkt_F | -0.644 | 0.873 | 0.921 | 0.915 | 0.973 | 0.977 | 0.978 | 1.000 |

*This table reports the correlations between the monthly returns of the 6 portfolios sorted with respect to operating profitability, the market factor and VSTOXX index returns. S and B stand for small and big, while W, NP, and R stand for weak, neutral profitability, and robust respectively. The sample period goes from January 2000 to December 2021 (264 months).*

**Table 2.3**

| Variables | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|---|---|---|---|---|---|---|---|---|
| (1) VSTOXX_R | 1.000 | | | | | | | |
| (2) S_C | -0.500 | 1.000 | | | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| (3) S_NI | -0.524 | 0.974 | 1.000 | | | | | |
| (4) S_A | -0.519 | 0.955 | 0.955 | 1.000 | | | | |
| (5) B_C | -0.620 | 0.904 | 0.940 | 0.880 | 1.000 | | | |
| (6) B_NI | -0.623 | 0.890 | 0.935 | 0.880 | 0.983 | 1.000 | | |
| (7) B_A | -0.610 | 0.878 | 0.918 | 0.922 | 0.935 | 0.956 | 1.000 | |
| (8) Mkt_F | -0.644 | 0.873 | 0.918 | 0.879 | 0.973 | 0.977 | 0.961 | 1.000 |

*This table reports the correlations between the monthly returns of the 6 portfolios sorted with respect to investment, the market factor and VSTOXX index returns. S and B stand for small and big, while C, NI, and A stand for conservative, neutral investment, and aggressive respectively. The sample period goes from January 2000 to December 2021 (264 months).*

## 4. Analysis and empirical results

### *4.1. Value premium*

Table 3.1 documents the estimates of $\alpha_i$ and $\beta_{Mi}$ for the 6 portfolios sorted by book-to-market ratio, with respect to the CAPM. We can state that the standard capital asset pricing model (CAPM) successfully explains the returns of the test portfolios as all regression coefficients are significant at the 1% level and the $R^2$ ranges from 74% to 96%. In particular, we see that the model has higher explanatory power for large stocks compared to small stocks.

**Table 3.1**

| | (1)<br>S_G | (2)<br>S_N | (3)<br>S_V | (4)<br>B_G | (5)<br>B_N | (6)<br>B_V |
|---|---|---|---|---|---|---|
| $\beta_{Mi}$ | .963*** | .946*** | .887*** | 1.031*** | 1.04*** | 1.166*** |
| | (.042) | (.038) | (.041) | (.03) | (.019) | (.033) |
| $\alpha_i$ | -.22 | .166 | .587*** | .125 | .289*** | .223* |
| | (.189) | (.146) | (.153) | (.118) | (.072) | (.121) |
| Observations | 264 | 264 | 264 | 264 | 264 | 264 |
| R-squared | .74 | .82 | .785 | .895 | .958 | .909 |

*This table presents the results of time-series regressions that test whether volatility (proxied returns on the VSTOXX index) is priced as a determinant factor, and whether it can explain the value premium observed in the European stocks. This table reports estimated results with respect to the CAPM. The dependent variable for each regression is the excess return (in percentage) of one of 6 portfolios sorted according to book value-to-market value ratio. Each regression is estimated with monthly data from January 2000 through December 2021 (264 months). $\beta_{Mi}$ are the coefficient estimates for the market factor, while $\alpha_i$ are the regression constants. R-squared represents the quality with which the model explains the observed data. Robust standard errors are in parentheses.*
**** p<.01, ** p<.05, * p<.1*

Table 3.2 presents the estimates of $\alpha_i$, $\beta_{Vi}$, and $\beta_{Mi}$ of the 6 portfolios with respect to our two-factor model. The first thing that comes to notice is that the volatility betas are insignificant at 10% level for all three portfolios containing large stocks, while they are significant for the three small-stocks portfolios. This might suggest that being small stocks often considered more risky than large-cap stocks, they are often more vulnerable to changes in market sentiment, making volatility a significant determinant of their price. The opposite might instead be true for large stocks. Additionally, the two-factor model shows a very small improvement in the $R^2$ for the small-cap portfolios, but no improvement for the large-cap portfolios. Consequently, we can infer that volatility has no explanatory power with respect to the returns of large-cap portfolios looked at in this analysis. As such, I will only look at the effect of volatility on portfolios including small stocks for the rest of this sub-section.

**Table 3.2**

| | (1)<br>S_G | (2)<br>S_N | (3)<br>S_V | (4)<br>B_G | (5)<br>B_N | (6)<br>B_V |
|---|---|---|---|---|---|---|
| $\beta_{Mi}$ | 1.019*** | .992*** | .972*** | 1.024*** | 1.05*** | 1.184*** |
| | (.058) | (.051) | (.055) | (.037) | (.026) | (.045) |
| $\beta_{Vi}$ | .021* | .017* | .032*** | -.003 | .003 | .007 |
| | (.012) | (.01) | (.011) | (.006) | (.004) | (.006) |
| $\alpha_i$ | -.287 | .113 | .487*** | .133 | .278*** | .202 |
| | (.2) | (.155) | (.158) | (.124) | (.077) | (.127) |
| Observations | 264 | 264 | 264 | 264 | 264 | 264 |
| R-squared | .744 | .823 | .796 | .895 | .958 | .909 |

*This table presents the results of time-series regressions that test whether volatility (proxied returns on the VSTOXX index) is priced as a determinant factor, and whether it can explain the value premium observed in the European stocks. This table reports estimated results with respect to the two-factor model developed in this study. The dependent variable for each regression is the excess return (in percentage) of one of 6 portfolios sorted according to book value-to-market value ratio. Each regression is estimated with monthly data from January 2000 through December 2021 (264 months). $\beta_{Mi}$ are the coefficient estimates for the market factor and $\beta_{Vi}$ are the coefficient estimates for the volatility index returns, while $\alpha_i$ are the regression constants. R-squared represents the quality with which the model explains the observed data. Robust standard errors are in parentheses.*
**** p<.01, ** p<.05, * p<.1*

Looking at the regressions' intercepts, we see that including the volatility factor negatively affects the $\alpha_i$ for all portfolios, but their standard errors increase. If the model were to completely capture the expected returns, the intercept should be indistinguishable from zero in the regression. To test this hypothesis, I perform the GRS test developed by Gibbons, Ross, and Shanken (1989). The result statistic easily rejects the model, meaning that it does not fully describe the portfolio's expected returns. In this case, however, we are less interested in the absolute performance of the model then we are in the relative performance with respect to the traditional CAPM. In order to compare these, I obtain from a GRS test the average absolute intercepts for the two models. I can conclude that the two-factor model is a better fit in explaining expected returns of small-cap portfolios, as its average absolute intercept (0.295) is lower than the CAPM's one (0.324).

With respect to the effect that investors' sentiment has on the performance of value and growth stocks, we can see that the sign of the effect is positive for all three portfolios for which the effect is significant, meaning that they benefit from low sentiment (high volatility), and vice versa. The magnitude of the effect, although it might appear to be very small, is not to be considered irrelevant considering the variability of the returns on the VSTOXX index, which has standard deviation of monthly returns of approximately five times that of the portfolios in study.

Followingly, we can reject $H_{0,1.1}$ that value stocks are negatively affected by higher volatility levels, while the opposite is true for growth stocks, as evidence shows that the effect is similar, or rather the opposite, as volatility affects more positively value stocks than growth stocks.

With respect to the main hypothesis that investors' sentiment partly determines the difference in returns between value- and growth-stocks in the European stock market, the empirical results show that both value and growth stocks covary positively with innovations in volatility, with small value stocks increasing by a slightly larger magnitude compared to small growth stocks when volatility increases. These results are inconsistent with the existing literature which reported value stocks as being considered riskier with respect to volatility risk, while growth stocks being instead hedges against volatility risk.

### *4.2. Profitability premium*

In table 4.1 we can see the CAPM regression estimates of $\beta_{Mi}$ and $\alpha_i$ for the 6 portfolios sorted on operating profitability. As for the value/growth portfolios, this model performs well in explaining the returns of these test portfolios. In fact, the regression models explain a minimum of 76% for the small/weak portfolio to a maximum of 96% for the big/robust portfolio, of the variation in returns, and all market factor coefficients are significant at the 1% level.

Consistent with existing theory, the regressions' $\alpha_i$ show that robust firms earn higher average excess returns than weak firms. This difference is largest among firms of small size, which confirms the fact these excess factor returns are mostly driven by small-cap firms.

**Table 4.1**

| | (1)<br>S_W | (2)<br>S_NP | (3)<br>S_R | (4)<br>B_W | (5)<br>B_NP | (6)<br>B_R |
|---|---|---|---|---|---|---|
| $\beta_{Mi}$ | .923*** | .916*** | .931*** | 1.157*** | 1.06*** | 1.027*** |
| | (.041) | (.037) | (.037) | (.02) | (.023) | (.02) |
| $\alpha_i$ | .115 | .55*** | .562*** | -.043 | .316*** | .331*** |
| | (.169) | (.129) | (.137) | (.088) | (.075) | (.07) |
| Observations | 264 | 264 | 264 | 264 | 264 | 264 |
| R-squared | .762 | .849 | .837 | .948 | .956 | .958 |

*This table presents the results of time-series regressions that test whether volatility (proxied returns on the VSTOXX index) is priced as a determinant factor, and whether it can explain the profitability premium observed in the European stocks. This table reports estimated results with respect to the CAPM. The dependent variable for each regression is the excess return (in percentage) of one of 6 portfolios sorted according to operating profitability. Each regression is estimated with monthly data from January 2000 through December 2021 (264 months). $\beta_{Mi}$ are the coefficient estimates for the market factor, while $\alpha_i$ are the regression constants. R-squared represents the quality with which the model explains the observed data. Robust standard errors are in parentheses.*

**** p<.01, ** p<.05, * p<.1*

Table 4.2 documents the estimates of the market ($\beta_{Mi}$) and volatility ($\beta_{Vi}$) betas, as well as regression constant ($\alpha_i$) for the 6 weak/robust portfolios with respect to our two-factor model. As in the first analysis, volatility betas are insignificant at 10% level for all three big portfolios, while they are significant at the 5% level for the three small-stocks portfolios. Again, this suggest that the riskiness of small stocks increases their sensitivity to innovations in volatility, leading to volatility being priced as a factor, while the effect is not relevant for large stocks. This also leads to the $R^2$ having a slight improvement for small firms in the two-factor model. Again, we can infer that volatility has no explanatory power with respect to the returns of large-cap portfolios looked at in this analysis. As such, portfolios of large stocks will not be considered for the rest of the analysis.

**Table 4.2**

| | (1)<br>S_W | (2)<br>S_P | (3)<br>S_R | (4)<br>B_W | (5)<br>B_NP | (6)<br>B_R |
|---|---|---|---|---|---|---|
| $\beta_{Mi}$ | .993*** | .975*** | .994*** | 1.168*** | 1.072*** | 1.031*** |
| | (.056) | (.049) | (.05) | (.026) | (.03) | (.026) |
| $\beta_{Vi}$ | .026** | .022** | .024** | .004 | .004 | .002 |
| | (.011) | (.01) | (.01) | (.005) | (.004) | (.004) |
| $\alpha_i$ | .034 | .481*** | .488*** | -.055 | .303*** | .326*** |
| | (.178) | (.135) | (.144) | (.091) | (.078) | (.073) |
| Observations | 264 | 264 | 264 | 264 | 264 | 264 |
| R-squared | .768 | .854 | .842 | .948 | .956 | .958 |

*This table presents the results of time-series regressions that test whether volatility (proxied returns on the VSTOXX index) is priced as a determinant factor, and whether it can explain the profitability premium observed in the European stocks. This table reports estimated results with respect to the two-factor model developed in this study. The dependent variable for each regression is the excess return (in percentage) of one of 6 portfolios sorted according to operating profitability. Each regression is estimated with monthly data from January 2000 through December 2021 (264 months). $\beta_{Mi}$ are the coefficient estimates for the market factor and $\beta_{Vi}$ are the coefficient estimates for the volatility index returns, while $\alpha_i$ are the regression constants. R-squared represents the quality with which the model explains the observed data. Robust standard errors are in parentheses.*
**** p<.01, ** p<.05, * p<.1*

We see again that the regressions $\alpha_i$ are affected downwards by the inclusion of our additional factor. I test again the hypothesis that the intercepts are indifferent from zero by performing a GRS test. The result tells us that the model does not fully describe the portfolio's expected returns, as such we reject its full validity. However, by looking at the average absolute intercepts of the two models, which allow us to evaluate their relative performance, we can say that including the volatility factor brings an improvement with respect to the CAPM, with the average absolute intercept decreasing from 0.409 to 0.334. Secondly, we can see that volatility affects positively the performance of both the weak and robust portfolios taken into consideration, and the magnitude of this effect is very similar, with weak-portfolio returns increasing by 0.026% for every point increase in the VSTOXX price, and by 0.024% for robust-portfolios. As such, we must reject the hypothesis that robust firms perform significantly better than weak firms in periods of high volatility. Additionally, there is no evidence that arises from this analysis that investors' sentiment is a determinant of the profitability premium in the European stock market, thus we reject our second main hypothesis.

### *4.3. Investment premium*

Table 5.1 shows that the CAPM also efficiently explains the returns of portfolios sorted on investment, with all market beta estimates being positive and significant and r-squared ranging from 76% to 84% for small-cap portfolios, and from 92% to 96% for large-cap portfolios. Additionally, the regressions' constants highlight the difference in abnormal returns between aggressive and conservative firms.

**Table 5.1**

| | (1)<br>S_C | (2)<br>S_NI | (3)<br>S_A | (4)<br>B_C | (5)<br>B_NI | (6)<br>B_A |
|---|---|---|---|---|---|---|
| $\beta_{Mi}$ | .899*** | .875*** | .992*** | 1.055*** | 1.041*** | 1.155*** |
| | (.038) | (.034) | (.045) | (.022) | (.017) | (.034) |
| $\alpha_i$ | .495*** | .502*** | -.138 | .212*** | .304*** | .072 |
| | (.164) | (.125) | (.18) | (.082) | (.072) | (.11) |
| Observations | 264 | 264 | 264 | 264 | 264 | 264 |
| R-squared | .763 | .844 | .772 | .949 | .957 | .924 |

*This table presents the results of time-series regressions that test whether volatility (proxied returns on the VSTOXX index) is priced as a determinant factor, and whether it can explain the investment premium observed in the European stocks. This table reports estimated results with respect to the CAPM. The dependent variable for each regression is the excess return (in percentage) of one of 6 portfolios sorted according to investment. Each regression is estimated with monthly data from January 2000 through December 2021 (264 months). $\beta_{Mi}$ are the coefficient estimates for the market factor, while $\alpha_i$ are the regression constants. R-squared represents the quality with which the model explains the observed data. Robust standard errors are in parentheses*

**** p<.01, ** p<.05, * p<.1*

Looking at the regression estimates of our two-factor model in table 5.2 it is again highlighted that volatility has no significant effect on large-cap stocks, with all volatility betas being insignificant at 10%, while small-cap portfolios seem to be affected by this factor. As for the other small-cap portfolios previously analyzed, volatility positively affects returns. The inclusion of this additional factor also affects the market beta, which increases, and regression constant, which decreases. This signifies an increase in systematic risk and a decrease in abnormal returns, with respect to the estimates of the traditional asset pricing model.

**Table 5.2**

| | (1)<br>S_C | (2)<br>S_NI | (3)<br>S_A | (4)<br>B_C | (5)<br>B_NI | (6)<br>B_A |
|---|---|---|---|---|---|---|
| $\beta_{Mi}$ | .97*** | .945*** | 1.05*** | 1.062*** | 1.048*** | 1.168*** |
| | (.054) | (.045) | (.06) | (.03) | (.023) | (.042) |
| $\beta_{Vi}$ | .027** | .026*** | .022* | .003 | .003 | .005 |
| | (.012) | (.009) | (.011) | (.005) | (.004) | (.007) |
| $\alpha_i$ | .411** | .419*** | -.206 | .203** | .295*** | .057 |
| | (.171) | (.129) | (.19) | (.087) | (.075) | (.113) |
| Observations | 264 | 264 | 264 | 264 | 264 | 264 |
| R-squared | .769 | .852 | .775 | .949 | .957 | .924 |

*This table presents the results of time-series regressions that test whether volatility (proxied returns on the VSTOXX index) is priced as a determinant factor, and whether it can explain the investment premium observed in the European stocks. This table reports estimated results with respect to the two-factor model developed in this study. The dependent variable for each regression is the excess return (in percentage) of one of 6 portfolios sorted according to investment. Each regression is estimated with monthly data from January 2000 through December 2021 (264 months).* $\beta_{Mi}$ *are the coefficient estimates for the market factor and* $\beta_{Vi}$ *are the coefficient estimates for the volatility index returns, while* $\alpha_i$ *are the regression constants. R-squared represents the quality with which the model explains the observed data. Robust standard errors are in parentheses*

**** p<.01, ** p<.05, * p<.1*

Analyzing the regressions' intercepts through the GRS test, I reject the hypothesis that the $\alpha_i$ are indistinguishable from zero, and that the model fully explains the expected returns.

As for the previous analyses, however, I see an improvement from the traditional CAPM as the absolute intercept improves from an average of 0.378 to 0.345.

Looking at volatility betas for small-cap portfolios, they are positive and very similar for both conservative and aggressive stocks, suggesting that there is no significant difference in the effect that this factor has of these portfolios. Considering these results, we can accept our main hypothesis that investors' sentiment is not a determinant of the difference in returns between firms with high and low investment profiles, but we must reject the hypothesis that volatility has no effect on the performance of these portfolios, although it appears to be small.

## 5. Conclusion

Asset pricing literature has gone a long way in identifying patterns in stock markets' behavior and has tried to develop models that are able to explain these stock returns, considering both risk-based and behavioral-based factors. Among these patterns, Fama and French (1992, 2014) first identified the concepts of value, profitability, and investment premium according to which stocks with higher book-to-market ratio, higher profitability, or lower investment have greater risk-adjusted returns. In trying to explain these patterns, existing literature has concluded that macroeconomic risk can only partly explain these relationships, and investors' sentiment, in the form of ex-ante misevaluation and behavioral fallacies, is often an important factor in explaining returns. In this paper, I tested whether investors' sentiment, proxied by volatility (VSTOXX index), is a determinant factor in explaining these premia in the European stock market. I looked at the effect that this factor had on the performance of portfolios sorted on book-to-market ratio, profitability, and investment while controlling for size. Following from my analysis, I document the following. For all portfolios studied, the volatility betas were significant only for those containing small-cap companies, which led to small improvements in the $R^2$, suggesting that small stocks are often considered to be riskier, and thus more vulnerable to shifts in volatility. For such reason, I decided to not consider large-cap portfolios for the rest of the analysis.
The regressions' alphas were proven to be different from zero, meaning that the models did not fully capture the portfolio returns. However, when looking at the relative performance of our two-factor model compared to the traditional CAPM, in all three cases the average absolute intercepts decreased. This proved our two-factor model to be superior in explaining returns of small-cap portfolios.
Finally, looking at the effect that the volatility factor had on the portfolios taken into consideration, we conclude that investors' sentiment is not a determinant factor in explaining the value, profitability, and investment premia. The portfolios were all positively affected by innovations in volatility, with very small magnitude differences, except for small-cap value stocks which were more positively affected by increases in volatility. This result is inconsistent with existing literature and should be a topic for future research on the European stock market.

These results contribute to the asset pricing theory and bring further proof of the importance of considering investors' behavior as a significant explanatory factor.
Future research should focus on identifying different measures of investors' sentiment, which might be more efficient in explaining these patterns in financial markets. Additionally, an analysis should be made on the time-varying sensitivity of these different portfolios during "bullish" and "bearish" periods, as investors' behavior might differ depending on market conditions.

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