The Pricing of Sentiment Risk in European Stock Markets

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Abstract

This paper studies whether sentiment is rewarded with a significant risk premium on the European stock markets. We examine several sentiment proxies and identify the Economic Sentiment Indicator (ESI) from the EU Commission as the most relevant sentiment proxy for our sample. The analysis is performed for the contemporaneous excess returns of eleven euro area (EA-11) stock markets in the period from February 1999 to September 2015. We apply a conditional multiple-beta pricing model in order to track the variation of the sentiment risk premium over time. The results demonstrate a positive significant relationship between sentiment and contemporaneous excess returns which is consistent to the previous studies. The calculated sentiment risk premium is significant as well but of a negative sign implying that an investment in EA-11 countries over the examined time period would have been unattractive to the investors on average.

Keywords: International asset pricing, European risk premia, sentiment risk, conditional asset-pricing model

JEL classification: G12, G15.

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1 Introduction

The European financial markets experienced several major turbulences over the recent decades. The burst of the dotcom bubble in the early 2000s, the global financial crisis 2007/2008 and not least the still ongoing European sovereign debt crisis emphasized the importance of research for a better understanding of the financial markets. The focus of the present study lies in the area of asset pricing and thus contributes to the empirical literature analyzing the underlying pricing models of asset returns. In particular, we examine whether sentiment can be considered a relevant source of risk in explaining the European stock returns and explicitly focus on the risk premium associated with this factor.

In classic finance sentiment is not regarded as systematic – and thus priced – source of risk since it is assumed that rational investors dominate the irrational ones in setting the equilibrium prices. However, in behavioral finance the relevance of sentiment for the prediction of asset returns is gaining in importance and there is a growing body of literature that analyze the role of sentiment for asset returns. There are studies that deal with the theoretical implications and modeling of sentiment (for example Barberis et al., 2012; Hong and Stein, 1999; Dumas et al., 2009) but the majority examines the relationship between sentiment and asset returns empirically (see for example Baker and Wurgler, 2006, 2007; Brown and Cliff, 2005; Baker et al., 2012). In general, these studies report a negative relationship between sentiment and future returns. A large fraction of empirical research focuses on the US (see for example Lee et al., 2002; Da et al., 2015) but there are also papers analyzing the problem in an international setting like Schmeling (2009), Baker et al. (2012) or Bathia and Bredin (2013).

What is common for the most of these studies is that they only examine the influence of sentiment on future returns, i.e. they explore the role of sentiment in the framework of predictive models. Our approach focuses on contemporaneous asset returns and gives special attention to the explicit calculation and examination of the risk premium for sentiment risk, an area that was widely neglected by the academic research so far. The contemporaneous approach can also be found in Lee et al. (2002) or Baker and Wurgler (2007). Usually, the contemporaneous relationship between sentiment and asset returns is found to be positive which can be supported by the results of the present study. However, theoretical considerations support both positive as well as negative correlation depending on the respective dominance of the underlying effects that were first introduced by De Long et al. (1990). In the short run that we are dealing with the 'hold-more' and 'price-pressure' effect are relevant. The 'hold more' effect implies that with higher sentiment more risky assets are held leading to an overall greater market risk and thus to higher returns. Positive betas are a sign that this effect dominates the 'price-pressure' effect which corresponds to negative betas. The intuition behind the 'price pressure' effect is the following: When sentiment is high the demand for risky assets increases which leads to an increase in prices of these assets and consequently to lower returns.

We apply a conditional multiple-beta pricing model with time-varying risk premia in order to be able to observe the development of the risk premia over time. The analysis is performed for the following 11 euro-area countries: Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Portugal and Spain in the period from February 1999 to September 2015. While the main analysis covers the time period from February 1999 to April 2014, the remaining subsample from May 2014 to September 2015 is used for an out-of-sample study. We consider several survey-based sentiment proxies for the euro area, such as the widely used Consumer Confidence Index (CCI), the Economic Sentiment Indicator (ESI) that is also often applied for the academic research regarding European countries and the less known Economic Climate Index (IFO) calculated by the ifo Institute. Additionally, a market-based sentiment proxy, the VSTOXX Volatility Index (VSTOXX) is examined. As a benchmark serves a model with only macroeconomic variables motivated by the previous research (see for example Chen et al., 1986; Ferson and Harvey, 1991, 1995). In order to examine our main research question whether sentiment is a rewarded source of risk on the European markets we add the respective sentiment proxies to the benchmark model and analyze the corresponding risk premia.

There are several studies that work with a model that is closely related to the one used in the present paper (see for example Ferson and Harvey, 1991, 1995; Brown and Otsuki, 1993; Oertmann, 1997; Ferson et al., 1987). However, they restrict only to macroeconomic variables without the inclusion of sentiment. Also in some of these studies both betas and risk premia are modeled in a conditional way. Since our focus lies explicitly on the risk premia the betas are modeled as time-constant. One of the reasons for this decision is the finding of Ferson and Harvey (1991, 1995) and also Evans (1994) that most of the predictability of asset returns can be referred to the time-variation in the risk premia whereas the changes in the betas seem to be less important. Empirical literature analyzing the relationship between sentiment and asset returns is growing steadily: Lee et al. (2002) and Da et al. (2015) for the US, Dash and Mahakud (2013) for India, Schmeling (2009), Baker et al. (2012), Bathia and Bredin (2013) or Keiber and Samyschew (2015, 2016) for an international setting to name just a few. An analysis for the European countries as in our case can be found, for example, by Jansen and Nahuis (2003) who find a positive correlation between stock returns and consumer confidence but also evidence for a reverse relationship between these two variables. Doukas and Milonas (2004) examine the Greek capital market but find no evidence of sentiment being a source of systematic risk. Cibulskienė and Grigaliūnienė (2010) report a negative effect of sentiment on future stock returns for Scandinavian stock markets. Corredor et al. (2013)

investigate which factors, stock characteristics or country-specific ones, drive the effect of sentiment on European stock returns and conclude that both have an effect on the influence of sentiment. The results of Bai (2014) indicate that regional sentiment has a greater influence on European stock markets compared to the local one and that US sentiment is less important for euro-zone countries. Corredor et al. (2015) find evidence that sentiment effect is more pronounced in the emerging EU markets. A conditional model with time-variation in the risk premia can be found by Møller et al. (2014) but they consider a European CAPM where sentiment is applied as conditioning information while our focus is on an APT model with sentiment as an additional risk factor besides the classic macroeconomic factors.

Our main contribution to the existing literature is therefore the analysis of sentiment as a risk factor in a European setting with time-varying risk premia that, to our knowledge, was as yet not addressed by the previous studies. Furthermore, we differentiate between crisis and non-crisis countries[1] within our sample of euro zone stock markets which helps to assess the differences in influence of sentiment depending on the condition of the respective market. Finally, the paper also contributes to the literature examining the significance and explanatory power of different sentiment proxies.

The remainder of the paper is organized as follows. Section 2 outlines the econometric model and the general procedure of the analysis. Section 3 describes the input data. In section 4 the empirical results are presented and compared to a benchmark model with only macroeconomic variables. The results of the robustness check are summarized here as well. Section 5 concludes.

2 Methodology

2.1 The Model

To analyze the influence of sentiment on EA-11 asset returns and to be able to calculate the corresponding risk premium we apply a general multiple-beta pricing model based on Arbitrage Pricing Theory (APT). The APT first introduced by Ross (1976) allows asset returns to be modeled as a function of various risk factors, thus, resulting in a multiple-beta framework:

$$R_{it}^e = E[R_{it}^e] + \sum_{j=1}^{k} \beta_{ij} \cdot f_{jt} + \varepsilon_{it} \tag{1}$$

[1]Since our sample period covers several financial crises, especially the recent European debt crisis, an additional focus on GIIPS countries (Greece, Ireland, Italy, Portugal, Spain) that were most affected is of particular interest.

where

$$E[R^e_{it}] \equiv E[R^e_{it}|\mathbf{Z}_{t-1}] \quad = \quad \sum_{j=1}^{k} \lambda_{jt}(\mathbf{Z}_{t-1}) \cdot \beta_{ij} \tag{2}$$

and

$$\lambda_{jt}(\mathbf{Z}_{t-1}) \quad = \quad \sum_{h=0}^{m} \gamma_{jh} \cdot Z_{h,t-1} \tag{3}$$

The variable R^e_{it} represents the continuously compounded excess return on the ith stock market ($i = 1, 2, \ldots, n$). The β_{ij}-coefficients are the factor loadings or sensitivities of the returns on the ith market to unexpected changes in the mean-zero risk factors f_{jt} ($j = 1, 2, \ldots, k$). As can be observed from the model, we analyze the EA-11 asset returns cross-sectionally under the assumptions of perfectly integrated markets.[2] The assumption of perfectly integrated markets implies that the risk factors and consequently the risk premia are common for all of the considered markets. This rules out arbitrage opportunities as investors are not able to get a higher risk premium for the same risk by simply investing in another country.[3]

Basically the variation in asset returns can be driven by both betas (exposures to unexpected changes of risk factors) and risk premia (compensation for the exposure to this risk). In the present framework we focus on time-varying risk premia so that the expected excess returns $E[R^e_{it}]$ are modeled with conditional risk premia and constant betas. The vector $\mathbf{Z}_{t-1}$ contains conditioning information. It includes a set of euro area specific information variables $Z_{h,t-1}$ ($h = 1, 2, \ldots, m$) that are available to investors at time $t-1$. The expected risk premia for the EA-11 risk factors are represented by λ_{jt} ($j = 1, 2, \ldots, k$) with the coefficients γ_{jh} ($h = 1, 2, \ldots, m$) being the sensitivities of the jth risk premium to the euro area information variables $Z_{h,t-1}$. The constant γ_{j0} stands for that part of the jth risk premium that is invariant over time and $Z_{0,t-1} = 1$. ε_{it} denote zero mean residuals for the respective stock markets.

The constant-beta assumption set for the present analysis has several reasons. Aside from the arguments of Ferson and Harvey (1991, 1995) or Evans (1994) as mentioned in the introduction and our focus on conditional risk premia it also relates to our choice of euro area specific information variables. Basically, the use of global (or regional as in our case) variables as conditioning information is not usual for the modeling of conditional betas. For the analysis of conditional betas country- or even firm-specific variables as conditioning information are more common (see for example Ferson and

[2]In order to test the assumption of integrated markets we analyzed the correlation structure of the EA-11 excess returns. The average correlation amounts to 0.680 for the considered time period which is although not perfect still a considerable interdependence.

[3]Cf. Ferson and Harvey (1994, 1995), Baekert and Harvey (1995), Harvey et al. (2002), Oertmann (1997).

Harvey, 1991, 1995). This is supported by the findings of Ferson and Harvey (1998) who conclude that global information variables have lower influence on conditional betas compared to country-specific ones. Another reason is the problem of statistical limitations. Since we analyze the cross-section of EA-11 returns we estimate our model simultaneously for all the eleven markets. However, applying a model with conditional betas – even with unconditional risk premia – would raise the number of parameters to be estimated close to or even above the number of observations. Consequently, a statistically valid estimation would be impossible.

2.2 Procedure of the Analysis

Equations (1) to (3) comprise the econometric model which allows for estimating time-varying risk premia for a given set of predetermined risk factors. These risk factors represent the systematic risk and are usually described by the unexpected changes in the state of the economy. For our benchmark model only macroeconomic variables that were proven to have an impact on asset returns by the previous studies are used as risk factors. By including sentiment as an additional risk factor and comparing it with such a solely macroeconomic benchmark model we can assess whether the addition of sentiment results in a better fit of the data.

The central research purpose of the paper is therefore to test whether sentiment significantly contributes to the explanation of EA-11 returns and to provide insights about the corresponding time-varying risk premia.

Since only unexpected changes in economic situation can be considered as risk factors we perform a vector autoregression (VAR) analysis in order to extract only the unexpected components of the predetermined risk factors. The VAR method for obtaining unexpected changes in macroeconomic variables is often applied in the literature, for example, by Brown and Otsuki (1993) or Laopodis (2011). It goes without saying that this procedure is even more important for our sentiment proxies. Since sentiment is very difficult to measure there is always a concern that the eventually used proxy may actually capture not only sentiment but also the impact of some other macroeconomic variable. For example, Ferreira et al. (2008) show evidence that a large fraction of the Economic Sentiment Indicator (ESI) can be explained by yield spreads. Furthermore, Møller et al. (2014) report that although sentiment proves to be significant for the future returns this effect disappears if sentiment is orthogonalized with respect to the output gap, a variable representing the business cycle effect. To rule out such a possibility in advance we perform the VAR analysis not only on macroeconomic factors but also on the considered sentiment proxies. The VAR model reads as follows:

$$f_{jt}^{(o)} = a_{j0} + \sum_{\delta=1}^{k} b_{j\delta} f_{\delta,t-1}^{(o)} + \sum_{\gamma=1}^{m} c_{j\gamma} Z_{\gamma,t-1} + f_{jt} \qquad (4)$$

We regress the selected macroeconomic risk factors and sentiment proxies $f_{jt}^{(o)}$ on the past values of these original series and on the past values of information variables $Z_{\gamma,t-1}$. Consequently, the residuals f_{jt} do not contain any information on the other variables in the model and are taken as unexpected changes in the risk factors for the further analysis.

The further procedure of the analysis can be described as follows. In a preliminary step we try to identify only those risk factors that are most relevant for explaining the cross-section of asset returns in the EA-11 markets during the sample period. We then keep only those risk factors that show a significant explanatory power for the EA-11 asset returns. This is done by regressing the asset returns on a set of predetermined risk factors using the generalized method of moments (GMM) of Hansen (1982) for all the considered markets simultaneously. We then perform Wald tests on the estimated beta coefficients in order to assess the relevance of the respective risk factors for EA-11 asset returns.[4] The conditions for a risk factor to be a relevant source of systematic risk are straightforward. First, the estimated betas have to be significantly different from zero for all of the considered markets. Otherwise, the risk factor would have no explanatory power. And second, beta coefficients have to be significantly different from each other in the respective markets. This is necessary since we assume common risk factors (and consequently common risk premia) for all of the EA-11 stock markets and thus, the cross-sectional differences in asset returns can only be explained by the differences in beta coefficients. The following hypothesis tests are applied on the coefficients:

Test 1: $H_0: \ \beta_{ij} = 0$ for all $i = 1, \ldots, n$ stock markets

Test 2: $H_0: \ \beta_{ij} = \beta_j$ for all $i = 1, \ldots, n$ stock markets

After determining the relevant risk factors for the analysis, we estimate the model outlined in section 2.1 using the generalized method of moments (GMM). The idea of the GMM approach is to replace the moment (or orthogonality) conditions of the specified econometric model by the sample moment conditions of the given data. Such conditions are often constructed by assuming that the residuals of the model are orthogonal to a set of observable instruments. To obtain the GMM estimators these sample orthogonality conditions are weighted and minimized such that they become as close as possible to zero. The resulting estimators are the assumed to be close to the true values due to the fact that the model moments must be zero at the true

[4]A similar preliminary analysis with the help of Wald tests is also performed by Ferson and Harvey (1995), for instance.

parameters. The analysis can be performed for a set of regression equations simultaneously. The advantage of this method is that it requires only rather weak statistical assumptions, namely the stationarity and ergodicity of the input data.[5]

As a last step, the risk premia, in particular the sentiment risk premia, are calculated based on the estimated coefficients and analyzed. The same analysis is additionally performed for a sample divided into crisis and non-crisis EA-11 countries. The obtained results are also checked for robustness.

3 Data

The econometric model outlined in section 2.1 requires the following input data: asset excess returns R^e_{it}, unexpected changes in the EA-11 risk factors f_{jt} and EA-11 information variables $Z_{h,t-1}$. The actual analysis is performed for monthly excess returns of the EA-11 countries (Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Portugal and Spain) in the period from February 1999 to April 2014. The remaining observations from May 2014 to September 2015 are used for an out-of-sample study. Since we focus on countries that are all part of the euro area the numeraire currency is naturally the euro. The sources and construction principles of the data are summarized in the Appendix. An overview of the applied risk factors and information variables is provided in Table A1 in the Appendix. All of the summary statistics are presented in Table 1. To test for stationarity – a necessary condition for the implementation of the GMM – the augmented Dickey-Fuller (DF) test was applied.[6]

3.1 Asset Returns

We analyze asset returns based on the Morgan Stanley Capital International (MSCI) country indices for the following 11 countries of the euro area: Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Portugal and Spain. Thus, our focus lies on aggregate asset returns.

The monthly returns are calculated as continuously compounded excess returns from midmonth to midmonth with 1-month Euribor rate representing the risk-free rate. Table 1 summarizes the descriptive statistics of the input data.

– Please insert Table 1 around here –

As can be seen in Table 1, the average monthly returns are negative for all of the considered euro area markets. One of the reasons for this is the

[5] Cf. Hansen (1982) and Harvey et al. (2002) for further details.

[6] Since the analysis covers several lags it would be too space-consuming to present all the values here. These results are available upon request.

presence of three major financial crises within the sample period: the burst of the dot-com bubble in the early 2000s, the global financial crisis 2008 and the European sovereign debt crisis starting 2009. Another explanation arises from the fact that the Euribor rate was rather high until the end of 2008. Hence, negative excess returns for most of our sample period are not surprising.[7] The means are all quite similar and fluctuate around -2% which can be seen as indication of progressive market integration between the euro zone countries. The largest deviation can be observed for Greece (around -3%) and also to a smaller degree for Ireland, Portugal and Italy. Here again, we have countries which suffered the most from the European debt crisis. The only exception within the crisis countries is Spain which displays the smallest negative value across the countries.

The values for standard deviation are also quite similar across the markets and amount to 5%-6% on average. Higher volatility can again be observed for Greece (over 10%) and Ireland as countries strongly affected by the European debt crisis. But also for Austria and Finland there is a high volatility of around 8% and 9%, respectively. Austria experienced a strong increase in its stock market index since 2004, hence, the impact of the global financial crisis in 2007/2008 resulted in a correspondingly strong negative effect on the returns and accordingly higher volatility. Besides the effect of the global financial crisis, the high standard deviation of Finland can be referred to the fact that this country was strongly affected by the burst of the dot-com bubble in the early 2000s. Due to the rapid growth of Nokia Finland experienced substantial positive effects until the end of 2000 for both its economy and the stock market index which was also dominated by Nokia. Consequently, the burst of the dot-com bubble led to an accordingly large negative impact on the stock returns explaining the observed higher volatility.

Finally, the time series for all of the EA-11 countries were found to be stationary and thus fulfilling the necessary condition for the application of the GMM method.

3.2 Risk Factors

The central research question of this paper is to examine whether sentiment can significantly contribute to the explanation of asset returns and to analyze the corresponding time-varying risk premium. Therefore, the sentiment risk factor will be given special attention. Investor sentiment is, however, difficult to measure. Several studies analyzed different variables with respect to their ability to serve as a proxy for investor sentiment (see for example Qiu and Welch, 2004; Baker and Wurgler, 2006, 2007). Generally, investor sentiment measures can be divided in market- and survey-based ones. The market-based measures are those that can be directly observed from the markets.

[7] Calculating only average returns results in positive values for most of the countries, except for Greece, Ireland and Portugal, countries most affected by the recent crisis.

They are identified with respect to their ability to capture investor sentiment. One of the widely-used market-based proxies of investor sentiment introduced by Lee et al. (1991) is the closed-end fund discount. However, the ability of this measure to represent investor sentiment was questioned for example by Qiu and Welch (2004). Furthermore, there is also the concern that market-based measures may represent other economic phenomena that is not related to sentiment (see for example Qiu and Welch, 2004; Da et al., 2015). Therefore, survey-based measures which represent a direct measure of investor sentiment are of higher relevance for the present study. Survey-based measures are obtained by aggregating the responses of polls into a certain index which is then used as a proxy for investor sentiment. The most popular example for this kind of measure that is often used in empirical research is the consumer confidence index (see for example Qiu and Welch, 2004; Schmeling, 2009; Baker et al., 2012).

In the scope of the present study three survey-based sentiment measures and one market-based measure are examined. The survey-based measures include the Consumer Confidence Index (CCI) from OECD and the Economic Sentiment Indicator (ESI) from the EU Commission as well as the Economic Climate Index (IFO) provided by the ifo Institute. While the first two are often used in the literature (see for example Schmeling, 2009; Cibulskienė and Grigaliūnienė, 2010; Baker et al., 2012; Bathia and Bredin, 2013) the IFO index is less known.[8] All of these indices are regional measures aggregated for the euro area. VSTOXX (VSTX) is a European volatility index based on the EURO STOXX 50 Index and represents a market-based sentiment measure as an alternative to survey-based measures. Volatility is examined as sentiment proxy, for example, by Baker and Wurgler (2007).

Since the model outlined in section 2.1 requires unexpected changes in the risk factors we consider the monthly log changes of the selected sentiment proxies as sentiment risk factors. We denote the log changes in these variables by CCCI, CESI, CIFO and CVSTX, respectively. To extract the unexpected component of these time series the VAR method is used as explained in section 2.2. As highlighted in that section, performing the VAR regression allows to eliminate the influence of the selected macroeconomic risk factors and focus only on residual sentiment. Of course, the selection of macroeconomic factors in this study raises no claim to completeness and thus some unconsidered macroeconomic influence may still remain in our residual sentiment factor. However, we achieve a reasonable proxy for investor sentiment by applying the VAR analysis. The application of the VAR method to sentiment can also be found, for example, by Baker and Wurgler (2006) and Baker et al. (2012).

Table 1 displays the summary statistics of our sentiment proxies before

[8] Further information on the indices and their composition are provided in the Appendix.

the VAR transformation.[9] The means for the Consumer Confidence Index (CCCI) and the Economic Sentiment Indicator (CESI) are slightly negative implying that the confidence decreased on average which can be attributed to the presence of the major crises during the sample period. In contrast, the negative mean of the volatility index VSTOXX (CVSTX) reflects a decrease in volatility and thus captures bullish sentiment. The same goes for the positive mean of the ifo Economic Climate Index (CIFO). However, all of the means are rather close to zero and thus a statement about a clear direction is difficult. The high standard deviation of the VSTOXX variable is not surprising for an index capturing the implied volatility of option prices.

Besides sentiment, we consider several macroeconomic variables as risk factors. The risk factors of an APT model are assumed to represent the systematic risk and are usually captured by the unexpected changes in the state of the economy. Unfortunately, there are not any theoretical specifications with regard to the selection of these factors and therefore it is most reasonable to chose those macroeconomic variables that were already proven as relevant by previous studies (for example Chen et al., 1986; Brown and Otsuki, 1993; Ferson and Harvey, 1991, 1995; Oertmann, 1997; Laopodis, 2011). Our set of selected macroeconomic factors include changes in industrial production, inflation and interest rates as well as changes in oil prices and the excess market return. All of the risk factors are measures aggregated for the euro area. An overview on construction principles and data sources is given in Table A1. Equivalent to our sentiment proxies the unexpected components of the macroeconomic risk factors are extracted using the VAR method as explained in section 2.2 and the analysis proceeds with the residuals from these regressions.

As can be seen from Table 1, the changes in euro area (EA) inflation (CIFR), in EA industrial production (CIP) and in oil prices (COIL) have positive means indicating an increase in these macroeconomic factors on average over the analyzed time period. The increase in CIP is, however, of a rather low magnitude which can be referred to the impact of the financial crises during the sample period. The change in EA inflation rate (CIFR) corresponds with a rather low volatility in this factor implying that the distortions on the financial markets and the corresponding effects on the economy had relatively little impact on this variable. On the other hand, the means of the EA market excess return (MR) and of the change in EA short-term interest rate (CSIR) show a negative sign, and thus reflect a strong impact of the major financial crises. The statistics of the overall EA market excess return (MR) are in line with the results of the respective EA-11 excess returns presented in section 3.1.

[9] The variables after the VAR regression (both sentiment and macroeconomic) have zero means and thus the assumption of the econometric model given by equation (1) is automatically fulfilled.

Both the sentiment proxies and the macroeconomic risk factors are found to be stationary. The same applies to the results of the corresponding residuals after the VAR transformation which are available upon request.

3.3 Information variables

The time-variation in the risk premia is captured by their linear dependence on a set of information variables $Z_{h,t-1}$ ($h = 1, 2, ..., m$) as can be seen from equation (3). These variables are assumed to reflect information on the state of the economy which is available to investors at time t. But as in the case of risk factors, the theory does not specify how to select these variables. Therefore, also in this case we rely on the results of the previous studies dealing with conditional information (for example Ferson and Harvey, 1991, 1995; Solnik, 1993; Evans, 1994; De Santis and Gérard, 1997; Moerman and van Dijk, 2010). To our knowledge, there are not any studies analyzing the risk premium of sentiment risk. Thus, the present paper also contributes to the research by analyzing the widely used macroeconomic information variables with respect to their ability to capture the variation of sentiment risk. Our set of information variables includes the dividend yield (IDY) on the Datastream (DS) index for the European monetary union (EMU) because the dividend yield for the MSCI EMU index was not available at Datastream, the short-term interest rate (ISIR) for the euro area, the term spread (ITSP), and the default spread (IDSP) as aggregated variables for the euro area as well as the lagged EA excess market return (IMR). We do not include a January dummy in the main analysis since there are studies reporting a decline in the January effect in the recent years.[10] But we will add this instrument in subsequent robustness checks of our results. The details on the construction of the selected information variables and the sources are provided in Table A1.

Again, Table 1 presents the summary statistics of the considered information variables. Since these variables are constructed as levels and not changes as in the case of risk factors the positive means of the information variables are not surprising. The only exception is the EA excess market return (IMR) which displays the same values as the risk factor MR. Note that the results for the risk factors presented in Table 1 refer to the time series before the VAR transformation and therefore the values of IMR and MR match. However, for the further analysis we consider residuals of the risk factors after the VAR regression and consequently the time series of IMR an MR are not identical anymore.

With the exception of IMR all information variables are nonstationary so that the first difference is taken in order to achieve stationarity.

[10] See, for example, Gu (2003).

4 Empirical Analysis

4.1 Estimation Results

The main research question of the present study is to assess whether sentiment is a priced source of risk on the EA-11 stock markets and to analyze the corresponding time-varying risk premium. For this purpose we add different proxies for sentiment to a benchmark model consisting of classic macroeconomic risk factors that were proven to have explanatory power for asset returns by the previous studies.

In a preliminary step we assess the relevance of the selected risk factors by performing Wald tests as it was described in section 2.2. The applied hypotheses are the following. First, the beta coefficients should be different from zero in order for the corresponding factor to have explanatory power. Second, betas have to be different across the markets in order to be able to explain the differences in asset returns. For these conditions to be fulfilled the null hypotheses of both Wald tests have to be rejected. The results of the Wald tests are provided in Table 2.

– Please insert Table 2 around here –

For our benchmark model both conditions are fulfilled for the factors CIP (change in EA industrial production), COIL (change in oil prices) and MR (excess EA market return). The change in industrial production was found to be significant, for example, by Chen et al. (1986). Oil prices were reported to be significant, for example, by Ferson and Harvey (1995). The significance of market return is often documented (see for example Brown and Otsuki, 1993; Ferson and Harvey, 1995; Oertmann, 1997). Thus, for the subsequent analysis only these three risk factors are kept and yield the benchmark model.

Upon adding different sentiment proxies to the set of macroeconomic factors we can confirm that the same three macroeconomic risk factors remain relevant for the analysis. Independent of which sentiment proxy (CCCI, CIFO, CESI or CVSTX) is included the null hypotheses are rejected for the same factors CIP, COIL and MR.

As for the relevance of our sentiment risk factor the null hypothesis that sentiment does not have any explanatory power is rejected for all of the considered proxies at a 1% level (10% for CIFO). It is important to stress once again that the inclusion of sentiment does not offset the relevance of the macroeconomic factors from the benchmark model. On the contrary, the significance of sentiment is pronounced in addition to the same factors as in the benchmark. However, in the second Wald test only for the change in the Economic Sentiment Indicator (CESI) the null hypothesis of equal sentiment betas across the EA-11 markets can be rejected. The next closest to rejection is the change in the European volatility index VSTOXX (CVSTX) with slightly above 15%. For the sentiment proxies CCCI and CIFO the hypothesis of equal betas across the EA-11 markets cannot be rejected. Thus, among our sentiment proxies only CESI fulfills the necessary conditions for a risk factor to be relevant. Nevertheless, we will also report the results for other sentiment proxies as comparison for our further analysis.

For the actual analysis we therefore estimate the econometric model presented in section 2.1 with three risk factors (CIP, COIL and MR) for the benchmark model and with the same factors but including respective sentiment proxies for the models with sentiment. The estimation is performed with the generalized method of moments (GMM) for all of the EA-11 stock markets simultaneously. In order to preserve clarity and to focus attention on sentiment which is the main research interest of the present study, we only report the results for the factors CIP, COIL and MR for the benchmark model. The estimates of these factors for the models including sentiment are available upon request. However, we refer to these results in parallel to the discussion of the main results. The estimated β- and γ-coefficients are presented in Table 3 along with GMM test and Durbin-Watson test statistic for the evaluation of the goodness of fit of the respective models. The GMM test of overidentifying restrictions examines the null hypothesis that overidentifying restrictions fit the considered model. If the null hypothesis is rejected then the model can be regarded as not suitable to describe the data.

– Please insert Table 3 around here –

Let us first take a look at the reported beta coefficients. The results for the benchmark model given in Table 3 show a consistently strong significance of the euro area market risk (MR) for all of the EA-11 countries. All of the betas are positive which is straightforward since we can assume a positive correlation between the overall EA market excess return and the respective excess returns of the single markets. Although these results are not reported here, the MR factor yields very similar betas in terms of sign, magnitude and significance for all of the models including sentiment as well.

The coefficients representing the sensitivities of EA-11 asset returns to the industrial production risk (CIP) are also all positive implying an corresponding increase in EA-11 stock returns when the industrial production of the euro area increases. For Austria and Spain these estimates are, however, not significant. For the models including sentiment the estimates are again of similar sign and magnitude but for some countries we can observe a decline in the significance of this risk factor. Thus, for the model with CCCI the significance is lost for Germany, Italy, Netherlands and Portugal. In the case of CESI being the additional sentiment risk factor the significance of CIP is lost for Belgium, Germany, Italy and Portugal. For the model with CVSTX only the betas of Finland, France and Ireland preserve their significance with respect to the euro area industrial production (CIP). On the contrary, for the model with CIFO we can observe even an increase in the significance level of this risk factor compared to the benchmark model. This is the case for Belgium, France, Germany and Netherlands.

The last macroeconomic risk factor of our analysis, the change in oil prices (COIL), shows only little significance for our benchmark model. Merely Austria, Finland and Greece display a significant sensitivity to this risk factor. Furthermore, the signs of the betas differ across the countries indicating a varying exposure across the EA-11 countries to oil price shocks. Thus, asset returns in Finland are negatively affected by the unexpected changes in oil prices (COIL) while Austria and Greece show a positive exposure to this risk. However, these exposures are of rather low magnitude in all cases. Considering the models with sentiment included we can report a loss of significance for Finland and Greece but an additional significant negative exposure for Portugal (CCCI, CESI) and Spain (all except CIFO) and also a positive significant beta for Belgium (CVSTX).

Given the focus of our study, special attention should be paid to the beta coefficients of the respective sentiment risk proxies presented in Table 3. All of the examined models with sentiment have positive betas indicating that bearish sentiment corresponds with high contemporaneous EA-11 excess returns. Our findings are consistent with the existing literature. Positive contemporaneous betas are also reported, for example, by Lee et al. (2002) or Brown and Cliff (2005). Jansen and Nahuis (2003) determine a positive correlation between sentiment and contemporaneous asset returns as well, however, they consider correlation coefficients and not regression betas. For the variable CVSTX we would actually expect a negative sign due to the negative correlation between the VSTOXX index and the survey-based confidence indicators CCI, IFO and ESI. A possible explanation for the positive sign may be the following. An increase in CVSTX implies higher volatility and thus corresponds with bearish sentiment. High volatility is, however, a sign to some investors that the market is too bearish and that it is now time to buy stocks.[11] The consequent rise in demand lets prices rise as well and results in lower returns. This is the so-called 'price pressure' effect that was first introduced by De Long et al. (1990). Lee et al. (2002) give a detailed review of this and other effects of sentiment on asset returns. De Long et al. (1990) and Lee et al. (2002) refer this effect to negative betas by arguing that higher sentiment results in higher demand and ultimately lower returns. However, given the negative correlation between sentiment and volatility it can explain the positive sign in our case. The positive sign

[11]An equivalent to our European volatility index VSTOXX is the VIX index that captures the implied volatility of the S&P 500 index options and is also often used in research as the global 'fear' index. An often used phrase associated with VIX is: 'When the VIX is high, it's time to buy, when the VIX is low, it's time to go'. The same can be applied to the VSTOXX index as well.

of the other sentiment proxies (CCCI, CIFO and CESI) is in line with the 'hold-more' effect which implies that with higher sentiment more risky assets are held leading to an overall greater market risk and thus to higher returns. For the change in the Consumer Confidence Index (CCCI) all betas are of rather high magnitude and significant at 1% level. The same goes for the variable CIFO although with a much lower magnitude of the coefficients. The sensitivities of EA-11 asset returns to the CESI sentiment risk factor are not significant for Finland, France and Ireland, for the sentiment proxy CVSTX only Austria displays a nonsignificant beta.

The analysis of the relationship between sentiment and asset returns within the framework presented here is a valuable contribution to the existing literature. However, we would also like to address the issue of corresponding time-varying risk premia for sentiment that was mostly neglected by the academic research so far. Hence, a closer look at the γ-coefficients used to calculate the corresponding risk premia in accordance with equation (3) is of particular importance. γ-coefficients represent the sensitivities of the risk premia to the state of economy described by the euro area information variables. These coefficients are displayed in Table 3 as well. Unfortunately, the results are not very conclusive.

For the macroeconomic risk factors from the benchmark model only the EA market risk premium (MR) is thoroughly described by the selected information variables. Merely the euro area term spread (ITSP) has no significant explanatory power, the remaining γ-coefficients of the information variables are significant. For the industrial production risk (CIP) only the EA default spread (IDSP) and the EA market excess return (IMR) have a significant impact. For the oil price risk premium (COIL) all of the selected information variables are nonsignificant. The results of the macroeconomic risk premia for the models with sentiment which are not displayed in Table 3 are roughly the same. The signs and magnitudes of the coefficients that are significant across the models are very similar. But some of the coefficients lose their significance for some models while other coefficients, on the contrary, gain on explanatory power. Thus, for example the variable IDSP as well as the intercept become significant for the COIL risk premium (except for the model with CVSTX) while the intercept of the market risk premium (MR) becomes nonsignificant for all models with sentiment. The largest loss of significance can be observed for the model with CVSTX. It should be mentioned that there were some convergence problems with the estimation of the model with CVSTX included. Since we apply a nonlinear model such problems are likely to occur. To assure the validity of the results we address this problem by performing several robustness checks with respect to the estimated coefficients. The results of the robustness checks are described in section 4.4.

The sensitivities of the respective sentiment risk premia are of greater interest for our research question. Out of the considered models with included sentiment only the models with CCCI and CESI show some significance of the selected EA information variables. Thus, only the intercept and the dividend yield (IDY) are of sufficient significance for the sentiment risk premia of CCCI and CESI. The sign of the γ-coefficient for the variable IDY is negative for both models which means that the higher the dividend yield the lower will be the risk premium on sentiment. The economic intuition behind this may be that high dividend yields are regarded by investors as a sign of stability thus, decreasing the risk of excessive sentiment. Unfortunately, the remaining information variables are not significant and the models including CIFO and CVSTX seem to be unaffected by the selected information variables at all. A possible explanation may be that the predetermined information variables are not well suited to describe the respective risk premia in the considered time period. However, even these instruments are still able to capture the variability of the risk premia to some extent. The analysis of the corresponding time-varying risk premia and their properties will be presented in section 4.3.

To assess whether the addition of sentiment results in a better description of the data compared to the benchmark model the goodness of fit of the examined models should also be considered. For this purpose the the GMM test of the overidentifying restrictions is performed. The null hypothesis of this test states that the overidentifying restrictions fit the model, i.e. that the model is suitable to describe the data. The χ-statistic with the degrees of freedom and the corresponding p-values are presented in Table 3. The results indicate the null hypothesis cannot be rejected for neither of the examined models but judging from the p-value the models with sentiment, except for the model including CVSTX, seem to fit the data better than the benchmark model. Furthermore, the Durbin-Watson (DW) statistic is reported. The Durbin-Watson test analyzes the autocorrelation of the residuals. The test statistic takes values around 2 when there is no autocorrelation, around zero for positive autocorrelation and around 4 for negative autocorrelation of the residuals. The presence of autocorrelation in the residuals can be interpreted as a sign of a misspecification of the model.[12] With the exception of the model including CIFO as additional sentiment all of the models including different sentiment proxies exhibit DW-statistics that are closer to 2 than those of the benchmark model. Only for Spain the values of the DW test are better for the benchmark model indicating that overall models with sentiment provide a better fit of the data compared to the benchmark. The problem of the model with CIFO as sentiment may be that CIFO is based on a quarterly index which was interpolated to fit our monthly data. Further evaluation statistics will be provided in section 4.4

[12]However, the Durbin-Watson test is designed for linear models. Since we estimate nonlinear models these results should be considered with caution.

4.2 Crisis vs. non-crisis countries

Another aspect that we would like to address in the scope of the present paper is the differentiation between crisis and non-crisis euro area countries within our sample. Since sentiment is a measure of irrational behavior the effect may be more pronounced in countries more strongly affected by a financial crisis. We divide our sample with respect to the impact of the recent European sovereign debt crisis which had the strongest effect on the following countries: Greece, Ireland, Italy, Portugal and Spain. These countries are often referred to as GIIPS countries in the media. The remaining six countries stand for the non-crisis countries of our sample. The results of the corresponding GMM regressions are given in Table 4.

– Please insert Table 3 around here –

Compared to the results for the full sample presented in Table 3 no conclusive improvements can be detected. While for the model with CIFO the DW-statistic is now closer to 2 for nearly all of the countries (except Greece) the results are ambiguous for the remaining models. The beta coefficients of crisis and non-crisis countries show little difference to their counterparts in the full sample as well. The signs and magnitudes are very similar before and after the differentiation. For the model with CESI we can observe that sentiment becomes significant for France, however, for Germany and Greece the betas become nonsignificant after the differentiation. A loss of significance can also be observed for Belgium, Greece and Ireland for the model with CVSTX. As for the γ-coefficients that were already found to be of low significance in the full sample, after the differentiation no significance can be reported at all. Furthermore, there were again convergence problems, in particular for the crisis sample for the models with CESI and CVSTX which may be due to the higher volatility in the data for the crisis countries. The statistic for the GMM test of overidentifying restrictions and the corresponding p-values indicate that the models are suited to describe the data even after the differentiation between crisis and non-crisis countries.

Judging from β- and γ-coefficients alone, no greater impact of sentiment for the crisis countries can be detected. Thus, our assumption of a more pronounced effect cannot be confirmed on this stage of analysis. But we can state that the estimation is more difficult for the crisis countries since convergence problems are more likely to occur.

4.3 Risk Premia and Expected Excess Returns

Based on the results presented in Tables 3 and 4 we are now able to calculate the corresponding risk premia for our examined models in accordance to equation (3). Table 5 summarizes the descriptive statistics for all the risk premia (also macroeconomic) calculated for the benchmark and for the models including sentiment. The results for the sample divided in crisis and non-crisis countries are presented as well. To test for robustness and also to assess the validity of the calculated risk premia in light of the occurred convergence problems for some of the models, we also display the results for the respective risk premia estimated in an unconditional model.

– Please insert Table 5 around here –

Let us first take a closer look at the results of the full sample. The average risk premium for market risk (MR) is significant for the benchmark model as well as for the models with CESI and CVSTX as sentiment risk factors.[13] This risk premium is of similar magnitude across the models (around -1%) and negative. These results are also supported by the estimates of the corresponding unconditional models. The only exception is the time-varying risk premium for the model with CVSTX that is of lower magnitude. However, as we reported earlier this estimation was accompanied by convergence problems so an effect on the results is to be expected and the unconditional version of the model including CVSTX is therefore of particular importance. Keeping in mind that beta coefficients for the exposure to market risk are positive for all of the examined EA-11 markets, a combination of these positive betas with negative risk premium results in a negative compensation for market risk on average. This can probably be referred to the higher uncertainty in the markets resulting from the financial crises during considered time period. However, a negative compensation on average does not imply that it is negative during the whole sample period. This fact once more illustrates the advantage of the conditional approach in asset pricing as applied in the present study. For the models with CCCI and CIFO the risk premium for market risk (MR) was found to be insignificant. The risk premium for industrial production (CIP) is significant for the benchmark model as well as for the model with CESI. Again, the risk premium is negative and of very similar magnitude across the models. Here too, the findings are supported by the estimates of the corresponding unconditional models. Given the positive betas for the CIP risk factor as can be observed in Table 3 the overall negative compensation for industrial production risk is negative for the case of the benchmark and the model with CESI. For the model with CVSTX the calculated risk premium is also significant but of positive sign. However, this result does not match with the estimate of the unconditional model with CVSTX. As for the price of the oil price risk (COIL) we can observe a change in the sign between the benchmark model and models with sentiment. While the risk premium for COIL is negative for the benchmark model it becomes

[13]To assess the significance of the time-varying risk premia several tests for location were performed. In addition to the usual t-test for location, which requires normal distribution that is not necessarily given here, the sign test and the Wilcoxon signed-rank test were performed as well.

positive for the models including sentiment. The only exception is the model with CVSTX which also displays a negative time-varying risk premium for COIL but again without the support of the unconditional model. The same goes for the negative sign of the COIL risk premium in the benchmark model, here too the estimate of the corresponding unconditional model has a positive sign but not on a high enough significance level. What is also striking is the high standard deviation oil price risk premium which may be a reason for the deviating results.

The sentiment risk premia of the respective models are, however, of higher priority for the research question of the present study. As it can be seen from Table 5, the risk premium for the change in the Consumer Confidence Index (CCCI) is negative and of a rather low magnitude but still significant for both the conditional and unconditional versions of the estimated model. However, keeping in mind that the risk premium for market risk was found to be insignificant in this model the significance of CCCI sentiment risk premium may have been achieved at the cost of the market risk. The time-varying sentiment risk premia for CIFO and CVSTX are found to be significant as well, however, these results are not supported by the corresponding unconditional models.

The most conclusive results are obtained for the model including CESI as sentiment proxy which is especially reassuring since our preliminary analysis identified only ESI as a relevant risk factor among other sentiment proxies. Again, the risk premium for CESI is very similar between the conditional and unconditional versions of the model and also significant on a 1% level in both cases. More important, however, is that the addition of ESI as sentiment does not offset the relevance of other risk premia. On the contrary, even an increase in significance (for COIL risk premium) can be reported. The negative sign is common for the risk premia of all of the examined models with sentiment. Thus, combined with the positive betas of the EA-11 countries on sentiment factors there is again a negative compensation for sentiment risk in EA-11 countries during the considered sample period. This implies that an investment in EA-11 countries would have been unfavorable on average during the examined time period. Again, a negative risk premium on average does not mean that it was negative during the whole sample period and thus, the depiction of the respective risk premia may yield better insights into this issue. Figure 1 shows the time-variation in the respective sentiment risk premia over the whole sample period.

– Please insert Figure 1 around here –

It is striking that the variation of the survey-based risk premia (CCCI, CIFO, CESI) is very similar among each other, the only difference is the magnitude of the respective risk premium. Greater deviations in the risk premium for CVSTX can be referred to the higher volatility of this risk premium and to the convergence problems associated with this estimation. It can also be seen that the there are greater swings during the times of crises implying that the variation of the risk premium was still captured despite the fact that the majority of γ-coefficients for information variables was found to be insignificant. Figure 1 also clearly shows that there are definitely times when sentiment risk was rewarded with a positive risk premium, as for example, in 2009.

Splitting the sample in crisis and non-crisis countries leads to further insights regarding the European sentiment risk premium, however, these results are not very consistent. The results for the CCCI risk premium seem to be unaffected by the differentiation as the signs and the magnitudes of the calculated risk premium remain similar to those of the full sample. But the results for the models including CIFO and CVSTX are more interesting. Here, the respective sentiment risk premia display a positive sign for non-crisis countries (although not enhanced by the unconditional version of the model with CIFO) while the results for the same proxies for crisis countries are negative. These results may indicate that the non-crisis countries could be a hedge for sentiment risk against the crisis countries. Unfortunately, the estimation of the model with CVSTX for crisis countries was again accompanied by convergence problems.[14] Furthermore, although unconditional models show the same signs the unconditional estimates are insignificant for either of the two models. The results for the model with CESI correspond to those of model with CCCI. Here too, we have negative risk premia of similar magnitude for both crisis and non-crisis countries. However, the corresponding unconditional estimates are not significant and the significant positive sign for the CESI risk premium in the crisis countries should be treated with caution due to the convergence problems that occurred during the estimation. Thus, the results observed for the models with CIFO and CVSTX are not the same as for the models with CCCI and CESI and drawing conclusions is therefore rather ambiguous.

We are also reporting the results for the expected excess returns from the respective models in accordance with equation (2). The results for the means and standard deviations of the expected returns both for the full sample and for the subsamples of crisis and non-crisis countries are summarized in Table 6.

– Please insert Table 6 around here –

As it can be seen from Table 6 the obtained results are very similar across all of the examined models. As there were some convergence problems during the estimation of the models with CESI and CVSTX for the crisis countries

[14] We also ran into convergence problems estimating the model with CESI for the crisis countries and consequently the results obtained through these estimations should be considered with caution.

the results for these cases should be considered with caution. However, judging from the values only the results for the model with CESI for the crisis countries display striking differences compared to the figures of the other models. The values from the model with CVSTX calculated for the crisis countries seems to be consistent with other models. The similarity of the results is not surprising. For the macroeconomic factors the beta coefficients across the models are quite similar and due to the setting of our model the corresponding risk premia are equal across the countries. The only considerable differences in betas can be observed for the different sentiment proxies. Thus, the model with CCCI has quite large betas while the model with CVSTX displays beta coefficients of a rather low magnitude. However, these coefficients correspond to relatively low risk premium for sentiment in the model with CCCI and a high risk premium for the CVSTX risk. Hence, the overall compensation for sentiment risk is similar across the examined models and consequently results in similar expected excess returns.

All of the expected excess returns take values around -2%. The means for the subsample of crisis countries are of greatest absolute value, especially for Greece and Ireland (around -3%). This may reflect the higher volatility in the data resulting and higher uncertainty for the investors regarding the stocks of these markets. The consistently negative sign is also not surprising given the results in Table 5. As we have positive betas but negative average risk premia for most of the risk factors the resulting expected excess returns are likely to be negative. The negative sign implies that an investment in the EA-11 country indices would have been unfavorable on average to the investors over the considered time period compared to a risk-free alternative. This can be explained by the impact of the three major financial crises on the stock markets and economies of the EA-11 countries during our sample period.[15]

To sum up, our full sample results indicate that sentiment is indeed rewarded with a significant risk premium for the considered sentiment proxies. The results for CCCI and CESI are also supported by the corresponding unconditional estimates. For the CESI risk premium, this result is especially pronounced since it does not affect the significance of other (macroeconomic) risk premia in the model. Although negative on average the sentiment risk premia also take positive values which can be observed in Figure 1. Thus, an inclusion of sentiment, especially in a conditional approach with time-varying risk premia is a valuable enhancement to the traditional asset pricing and could offer a more helpful foundation for asset allocation. The results obtained after differentiation in crisis and non-crisis countries are, however, less reliable due to the occurrence of convergence problems. The resulting ex-

[15]The impact of our risk-free rate, Euribor, may also play a role for the negative sign similar to its impact on the EA-11 excess returns. See section 3.1 for a discussion on this issue.

pected excess returns are negative on average for all of the examined models, one possible reason may be the influence of the major financial crises during the sample period on the EA-11 countries.

4.4 Further evaluation statistics and robustness check

Tables 3 and 4 presented the statistics from the GMM test of overidentifying restrictions and the Durbin-Watson statistic for the autocorrelation of the residuals in order to assess the goodness of fit of the examined models and to check whether the inclusion of sentiment results in a better fit of the data compared to the benchmark. Although the findings indicate a slight dominance of the models with sentiment these results are not unambiguous. Therefore, further evaluation statistics shall be provided in the present section.

In addition to the evaluation measures mentioned above, an in-sample and an out-of-sample analysis is performed. For both analyses the mean absolute error (MAE) and the root mean square error (RMSE) are calculated. Our in-sample analysis includes the whole sample of 182 observations. However, as predictions based on an in-sample estimation tend to overfit the data by minimizing the prediction errors we also perform an out-of-sample analysis. The out-of-sample estimation is performed using the actual data for macroeconomic and sentiment risk factors as well as information variables in the period from May 2014 to September 2015. The values for the EA-11 excess returns are then estimated using the dynamic forecasting method[16] and compared to the actual realizations of the EA-11 returns during this period. Table 7 shows the MAEs and RMSEs from the in-sample (Panel A) and out-of-sample (Panel B) analyses.

– Please insert Table 7 around here –

The mean absolute error (MAE) is the absolute value of the average difference between the actual and the predicted value. A value close to zero indicates a low bias of the forecasts and thus a good forecasting ability of the model. The results in Panel A of Table 7 show relatively small values for MAEs for all models. In particular, the differentiation between crisis and non-crisis countries reduces the mean errors considerably. For most of the countries we have lower MAE for at least one (or even all) sentiment models compared to the benchmark. This effect is especially pronounced for the crisis countries – in both the full sample and the split sample – but also the non-crisis countries show the slight dominance of the sentiment models. The only exceptions are Finland and France as well as Italy (in the subsample of crisis countries) where the benchmark model yields lower MAE.

[16]Dynamic forecasting means that the previous forecast of the endogenous variable is used to compute the next one. However, as long as actual values are available (prior to May 2014) those are used.

However, there is still the concern that low MAEs result from an overfitting of the models and thus a closer look at the values based on the out-of-sample analysis (Panel B) is necessary. As expected, the MAEs for the out-of-sample forecasts are of a much greater magnitude. Especially for Greece the values are quite large (over 10%). The results can be justified by the fact that Greece was most affected by the recent European debt crisis. The dominance of the sentiment models over the benchmark is now less pronounced in the full sample compared to the in-sample analysis. For Austria, France, Ireland, Italy and Portugal the benchmark yields lower MAE values. After splitting the sample, at least one of the examined sentiment models dominates the benchmark for most of the countries, the only exceptions are Austria and Portugal. However, the MAE values are very close to each other across the models so that a clear dominance cannot be stated.

The results for the root mean square error (RMSE) lead to similar conclusions. In contrast to MAE, the values of RMSE are slightly smaller for the out-of-sample analysis for most of the countries. The most considerable exception is again Greece with values over 13% in the out-of-sample analysis. While the in-sample analysis shows a dominance of the benchmark model (only Austria, Greece, Portugal in Spain display values for sentiment models that are lower or at least equal to those of the benchmark) the results out-of-sample favor the models with sentiment (lower RMSE for the benchmark only for Austria and Portugal). As the values are again very similar to each other across different models a clear conclusion cannot be drawn. However, the results presented in Table 7 still indicate that an inclusion of sentiment leads to a slightly better fit of the data compared to the benchmark model with only fundamentals.

The remainder of this section will be dedicated to the robustness of our estimates. Since the presentation of all the results from the additional analyses would be too space-consuming only the findings will be summarized, the results are however available upon request.

The estimates are considered as robust if they are not severely affected by the addition or removal of regressors to or from the model. Robustness also implies that the application of alternative measures for the regressors does not change the results considerably as well. The four models based on the alternative measures for our sentiment risk factor, i.e. the respective proxies CCCI, CIFO, CESI and CVSTX, already provided first findings on the robustness of the estimates. Although we obtain different beta and gamma coefficients for our sentiment variables the coefficients of other factors do not change much across the models. Those that are significant in several versions of our model (benchmark and sentiment) remain of the same sign and a similar magnitude. Thus, the robustness of the estimates for macroeconomic factors had already been confirmed in course of the main analysis. To assess the validity of the respective sentiment related coefficients following different specifications of the models were tested. Of course, these specifications provide further robustness check for our macroeconomic variables as well.

First, we performed the analysis using the Datastream Global Equity Indices for the EA-11 countries instead of MSCI indices. The monthly excess returns were calculated based on these alternative indices and used for a new estimation. For another two specifications, we tried adding and removing regressors within the scope of our analysis. As additional risk factor the change in the short-term EA interest rate (CSIR) from our original set of risk factors was included. This factor was found to be not relevant by the Wald tests in the preliminary analysis but an inclusion can still serve as a check of robustness for the other estimates. For the removal we decided to renounce the change in oil prices (COIL) due to the fact that only few of the EA-11 countries had significant beta estimates for this factor. We also added a completely new information variable, the January dummy, as another variation to our base models. Furthermore, the unconditional versions of our examined models were tested to assess the robustness of the results. The estimates for the risk premia of theses unconditional regressions are presented in Table 5. Here, we will also shortly discuss the corresponding beta coefficients of these regressions.

The results obtained from these different specifications to our base models confirm the robustness of our findings. For several specifications some coefficients (macroeconomic as well as sentiment) gained or lost on significance but these cases were not frequent. For example, in our full sample there were only a few losses in significance for the sentiment betas. Thus, CESI lost in significance for Germany upon adding CSIR and for Greece when analyzing DS returns but gained on significance for France and Ireland in almost all specifications applied for robustness. For CVSTX we could only observe a loss in significance for Belgium (unconditional model, DS returns and addition of CSIR). The remaining beta coefficients remained significant and of the same sign and similar magnitude. The findings are similar for the macroeconomic risk factors.

The robustness of the γ-coefficients of the information variables is more difficult to assess since the majority of these estimates was already found insignificant in our base models.[17] However we can still confirm that those estimates that were found significant for the different robustness specifications of our models display the same sign and similar magnitude compared to those of the base models.

Overall, we can conclude that the significant results presented in section 4 are robust to various changes of the original setting.

[17] See Tables 3 and 4.

5 Conclusion

The main focus of the present study is the European sentiment risk premium. For this purpose we analyze several sentiment risk proxies with respect to their ability to explain the contemporaneous euro area asset returns. The analysis is performed in the framework of a conditional multiple-beta pricing model with time-varying risk premia and focuses on the aggregate excess returns of the EA-11 stock markets for the period from February 1999 to September 2015. The estimation is performed for all of the EA-11 markets simultaneously using the GMM method. We apply the following regional sentiment proxies that reflect sentiment in the euro area. The survey-based measures include the Consumer Confidence Index (CCCI) from OECD, the Economic Climate Index (CIFO) calculated by the ifo Institute and the Economic Sentiment Indicator (CESI) provided by the EU Commission. All of these proxies are aggregated indices for the euro area. Additionally, a market-based measure, the European volatility index VSTOXX (CVSTX) is analyzed as well.

The applied model is a variation of the classical APT model with only macroeconomic variables as can be found, for example, in Ferson and Harvey (1995). This model is extended with sentiment as additional risk factor and the obtained results are compared to a benchmark model with only fundamentals. Various studies examine the influence of sentiment on future asset returns but an explicit focus on the time-varying risk premium for sentiment as in the present paper was – to our knowledge – neglected in academic research so far. Furthermore, our research contributes to the literature examining the significance and the explanatory power of different sentiment proxies for European stock markets.

The preliminary analysis of the risk factors via the Wald tests identifies the market excess return, the change in industrial production and the change in oil prices as relevant macroeconomic risk factors. Among the sentiment proxies only CESI is determined to be relevant. Hence, the results for the model including CESI are the most conclusive. However, there also some insights that can be gained from analyzing the other sentiment factors. Thus, all sentiment proxies are found to have a significant positive impact on EA-11 asset returns which is consistent with the results of the previous studies. Furthermore, the calculated risk premia are found to be significant as well, although of negative sign on average. For CESI and also for CCCI the results for the corresponding risk premia are confirmed even by the unconditional versions of the respective models. However, the selected information variables chosen as conditioning information for the time-varying risk premia turn out to be not significant for the most part. Hence, a possible issue for the future research may be the identification of an alternative set of information variables that may be better suited to capture the variation in sentiment from an aggregate pan-European perspective.

Splitting the sample into crisis and non-crisis countries does not display much discrepancy with respect to the beta coefficients although a higher impact of sentiment for the crisis countries could be expected. But, there is evidence that non-crisis countries may have served as a hedge for sentiment risk against the crisis countries since the risk premia are positive for non-crisis and negative for the crisis subsample for the models including CIFO and CVSTX as sentiment risk factor. Unfortunately, several estimations for the crisis countries show ambiguous results and are subject to convergence problems probably due to the higher volatility in the data of these countries. Thus, the results obtained for the two subsamples are not very conclusive. It should be emphasized, however, that convergence problems do not imply that the respective model is economically unreasonable but just refer to technical difficulties arising from the nonlinearity of the underlying econometric model.

To assess the goodness of fit of the examined models the results for the GMM test of overidentifying restrictions, the Durbin-Watson statistic and the MAE and RMSE from in-sample and out-of-sample predictions are provided. The results indicate a slight dominance of the models including sentiment against the benchmark model with only macroeconomic variables. However, the observed statistics are very close to each other and thus a clear conclusion is difficult.

The robustness of the results could be confirmed after testing different specifications of the base models.

Overall, the results of our study show that sentiment indeed is a significant priced source of risk on the euro area markets. However, as sentiment is difficult to measure an analysis of several proxies is recommendable in order to identify the appropriate proxy for the respective sample. We also report a significant risk premium for the proxies CESI and CCCI which is negative on average. This implies that an investment in EA-11 country indices would have been unattractive to the investors during the examined time period on average. One possible explanation is the presence of three major financial crises during our sample period. We could also observe a time-variation in the respective sentiment risk premia although the selected information variables used as conditioning information lack in significance. Nevertheless, the results indicate that sentiment, especially in connection with time-varying risk premia could be a valuable addition to the traditional asset pricing models and offer a more helpful foundation for asset allocation.

Appendix: Data sources and construction principles

The excess returns for the analysis are based on the MSCI country indices available from Datastream. These indices cover around 85% of free float-adjusted market capitalization in each market. For each country, every listed security in the market is identified and classified in accordance with the

Global Industry Classification Standard (GICS®), thus the indices are constructed using the same principles and are fully comparable with each other. For the analysis the total return indices with included dividend payments are used.[18] The applied risk-free rate, the 1-month Euribor, is taken from Datastream as well.

The data sources and construction principles of the risk factors and information variables are given in Table A1.

– Please insert Table A1 around here –

The sentiment proxy CCCI is available on a monthly basis as aggregated measure for the euro area (18 countries). OECD uses the respective national consumer confidence indicators which are standardized by smoothing, centering, and amplitude adjusting as basis for aggregation.[19] This index is not attached to a base year instead 100 is fixed as the long-term mean.

The Economic Sentiment Indicator (CESI) is a composite measure published on a monthly basis by the EU Commission. It is based on harmonized surveys for different sectors of the economies in the European Union (EU) which are conducted by the Directorate General for Economic and Financial Affairs (DG ECFIN). The underlying indices are: Industrial confidence indicator (40%), Services confidence indicator (30%), Consumer confidence indicator (20%), Retail trade confidence indicator (5%) and Construction confidence indicator (5%).[20]

The index for the economic climate in the euro area (CIFO) is based on the results of the World Economic Survey (WES) designed by the Center for Economic Studies of the ifo Institute (CESifo). This survey polls more than 1000 economic experts in over 100 advanced, developing or emerging economies. The survey primarily consists of qualitative questions aimed at the assessments and expectations of the survey participants regarding the economic situation in the next six months. The data is available since January 1990 on the quarterly basis as the survey is conducted quarterly. For the aggregated index (for example, for the euro area as in our case) the country results are weighted according to the country's share in total world trade.[21]

The VSTOXX index (CVSTX) is based on EURO STOXX 50 realtime options prices and reflects the market expectations of near-term up to long-

[18] Further details on the indices and their construction can be found on `http://www.mscibarra.com/products/indices/international_equity_indices/` and `http://www.mscibarra.com/eqb/methodology/meth_docs/MSCI_Sep2010_IndexCalcMethodology.pdf`.

[19] Cf. the URL `http://stats.oecd.org/mei/default.asp?lang=e&subject=7` for further details.

[20] The respective country weights as well as a user guide are available on `http://ec.europa.eu/economy_finance/db_indicators/surveys/time_series/index_en.htm`.

[21] For further details: `https://www.cesifo-group.de/ifoHome/facts/Survey-Results/World-Economic-Survey/WES-Design.html`.

term volatility by measuring the square root of the implied variance across all options of a given time to expiration (in our case 1 month).

The Datastream indices used as alternative for the MSCI indices in the robustness check belong to the group of Thomson Reuters Global Equity Indices and are available on Datastream. These indices are free float adjusted and market capitalization weighted. For the analysis total return indices are used.

The additional information variable January dummy for the robustness section is constructed as a dummy variable which takes value 1 for January and 0 for other months.

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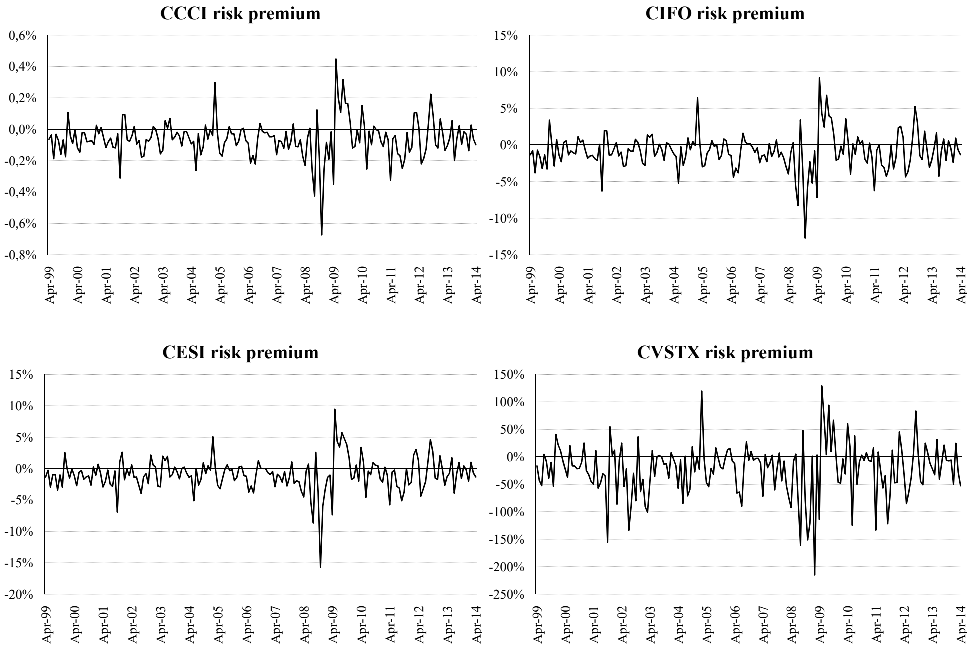
Figure 1: Time-variation in the calculated sentiment risk premia for the EA-11 markets from Feb. 1999 to Apr. 2014



Note: The risk premia are calculated in accordance with equation (3) using the estimates provided in Table 3. The symbols for the sentiment risk factors are explained in Table A1.

Table 1: Descriptive statistics for the input data (EA-11 stock markets from February 1999 to April 2014)

Variables	Mean in %, monthly	SD in %, monthly	Stationarity
Excess returns			
Austria	-2.040	7.803	stationary
Belgium	-2.184	7.032	stationary
Finland	-2.044	9.030	stationary
France	-1.967	5.892	stationary
Germany	-1.962	6.642	stationary
Greece	-2.978	10.618	stationary
Ireland	-2.618	7.613	stationary
Italy	-2.269	6.657	stationary
Netherlands	-2.062	6.227	stationary
Portugal	-2.329	5.950	stationary
Spain	-1.917	6.573	stationary
Risk factors			
Inflation rate (CIFR)	0.163	0.162	stationary
Industrial production (CIP)	0.022	1.039	stationary
Short-term interest rate (CSIR)	-1.294	15.379	stationary
Oil price (COIL)	1.150	8.139	stationary
Market return (MR)	-2.037	5.959	stationary
Sentiment proxies:			
CCI (CCCI)	-0.006	0.187	stationary
IFO (CIFO)	0.084	3.811	stationary
ESI (CESI)	-0.021	1.880	stationary
VSTOXX (CVSTX)	-0.370	20.848	stationary
Information variables			
Dividend yield (IDY)	3.100	0.952	nonstationary
Short-term interest rate (ISIR)	2.301	1.520	nonstationary
Term spread (ITSP)	1.843	1.105	nonstationary
Default spread (IDSP)	5.907	4.086	nonstationary
Market return (IMR)	-2.037	5.959	stationary

Note: This table reports the basic statistics of the input data. The variables and their construction principles are explained in Table A1. The displayed sentiment proxies for the Euro Area are the Consumer Confidence Index (CCI), the Economic Climate Index of the ifo Institute (IFO), the Economic Sentiment Indicator (ESI) and the VSTOXX Volatility Index (VSTOXX). The excess returns and the risk factors are constructed as changes whereas information variables are taken as levels. The acronyms in the brackets represent the abbreviations used for the respective variables throughout the paper. The displayed results for the risk factors are based on the time series for these risk factors before the VAR transformation.

Table 2: Wald test results for the risk factors (EA-11 stock markets from February 1999 to April 2014)

	Benchmark model (without sentiment)		With CCCI as sentiment risk factor		With CIFO as sentiment risk factor	
Risk factor	Test 1 (p-values)	Test 2 (p-values)	Test 1 (p-values)	Test 2 (p-values)	Test 1 (p-values)	Test 2 (p-values)
CIFR	0.1039	0.1713	0.2174	0.2427	0.0986	0.2265
CIP	0.0056	0.0090	0.0448	0.0331	0.0127	0.0144
CSIR	0.4897	0.5254	0.3431	0.4141	0.6661	0.5844
COIL	0.0069	0.0070	0.0040	0.0034	0.0471	0.0311
MR	<.0001	0.0021	<.0001	0.0031	<.0001	0.0005
CCCI	–	–	0.0033	0.4413	–	–
CIFO	–	–	–	–	0.0893	0.3017
CESI	–	–	–	–	–	–
CVSTX	–	–	–	–	–	–

	With CESI as sentiment risk factor		With CVSTX as sentiment risk factor	
Risk factor	Test 1 (p-values)	Test 2 (p-values)	Test 1 (p-values)	Test 2 (p-values)
CIFR	0.0699	0.2073	0.0921	0.1875
CIP	0.0065	0.0109	0.0122	0.0130
CSIR	0.6541	0.6183	0.5880	0.5440
COIL	0.0100	0.0078	0.0140	0.0110
MR	<.0001	0.0017	<.0001	0.0139
CCCI	–	–	–	–
CIFO	–	–	–	–
CESI	0.0024	0.0425	–	–
CVSTX	–	–	0.0017	0.1529

Note: This table displays results on the significance of the chosen risk factors for the EA-11 countries. The Wald test hypotheses are the following. For Test 1: $H_0:\ \beta_{ij} = 0$ and for Test 2: $H_0:\ \beta_{ij} = \beta_j$ for all $i = 1, \ldots, 11$ stock markets and all $j = 1, \ldots, 6\,(5)$ risk factors. The symbols of the risk factors are explained in Table A1.

Table 3: GMM-estimates for the β- and γ-coefficients for the EA-11 stock markets (Feb. 1999 – Apr. 2014)

The reported estimates are the results from the model: $R^e_{it} = \sum_{j=1}^{k}\sum_{h=0}^{m}\gamma_{jh}\cdot Z_{h,t-1}\cdot\beta_{ij} + \sum_{j=1}^{k}\beta_{ij}\cdot f_{jt} + \varepsilon_{it}$ presented in section 2.1 (for $i = 11$; $k = 4\,(3)$ and $m = 5$) where the input data consists of EA-11 country excess returns R^e_{it}, EA risk factors f_{jt} and EA information variables $Z_{h,t-1}$. The estimated coefficients are the sensitivities of the EA-11 excess returns to the relevant risk factors β_{ij} and the sensitivities of the corresponding risk premia to the respective information variables γ_{jh}. For the benchmark model all of the results are presented. For the models with sentiment only the estimates for the respective sentiment risk factor (CCCI, CIFO, CESI and CVSTX) are reported, results for the macro variables as in the benchmark model are available upon request. The symbols of the risk factors and information variables are explained in Table A1. ***/**/* symbolize significance on 1%/5%/10% level, respectively. t-statistics are given in the brackets. To assess the goodness of fit of the model the results on the GMM test for overidentifying restrictions (DF values in the brackets denote the degrees of freedom) and the Durbin-Watson (DW) statistic for the autocorrelation of the residuals are provided.

	Time-constant β-coefficients											
	Benchmark model				Model with CCCI		Model with CIFO		Model with CESI		Model with CVSTX	
Stock markets	MR	CIP	COIL	DW	CCCI	DW	CIFO	DW	CESI	DW	CVSTX	DW
Austria	1.142***	0.075	0.130***	1.697	31.520***	1.764	2.787***	1.182	0.843***	1.734	0.0003	1.804
	(13.95)	(0.22)	(3.46)		(4.84)		(3.72)		(3.88)		(0.01)	
Belgium	1.056***	0.540**	0.019	1.329	26.611***	1.453	2.246***	1.040	0.391***	1.358	0.035*	1.467
	(13.49)	(2.08)	(0.66)		(4.51)		(3.82)		(2.62)		(1.96)	
Finland	1.311***	1.113***	-0.064*	1.639	29.555***	1.631	2.486***	1.410	0.009	1.777	0.134***	1.783
	(18.93)	(3.02)	(-1.74)		(4.42)		(4.02)		(0.04)		(4.52)	
France	1.172***	0.531**	-0.003	1.051	22.570***	1.282	2.015***	0.752	0.194	1.289	0.062***	1.282
	(40.97)	(2.55)	(-0.13)		(4.76)		(4.26)		(1.44)		(4.58)	
Germany	1.295***	0.415*	0.011	1.403	23.786***	1.605	2.083***	0.890	0.314**	1.512	0.073***	1.522
	(28.97)	(1.77)	(0.44)		(5.01)		(4.22)		(2.13)		(4.94)	
Greece	1.240***	0.867**	0.075**	1.622	36.991***	1.756	2.884***	1.351	0.752***	1.678	0.082**	1.652
	(14.89)	(2.09)	(2.10)		(5.13)		(3.68)		(2.81)		(2.15)	
Ireland	1.063***	1.202***	-0.039	1.501	30.693***	1.595	2.372***	1.239	0.285	1.548	0.087***	1.623
	(12.98)	(3.69)	(-1.06)		(4.78)		(3.78)		(1.55)		(3.60)	
Italy	1.281***	0.508**	-0.003	1.486	25.224***	1.474	1.976***	1.015	0.426***	1.518	0.085***	1.593
	(25.59)	(2.04)	(-0.13)		(5.83)		(3.97)		(2.91)		(5.44)	
Netherlands	1.158***	0.577**	-0.007	1.349	23.603***	1.444	1.997***	0.975	0.245*	1.429	0.066***	1.468
	(29.56)	(2.54)	(-0.27)		(4.94)		(4.10)		(1.78)		(4.38)	
Portugal	0.848***	0.787***	0.003	1.672	23.424***	1.624	1.724***	1.259	0.534***	1.677	0.075***	1.781
	(15.61)	(3.16)	(0.13)		(5.52)		(3.36)		(3.07)		(4.40)	
Spain	1.147***	0.282	0.006	1.779	20.199***	1.558	1.453***	1.346	0.493**	1.579	0.069***	1.759
	(23.24)	(1.22)	(0.25)		(4.61)		(2.99)		(2.54)		(4.11)	

(continued)

Table 3: GMM-estimates for the β- and γ-coefficients for the EA-11 stock markets (Feb. 1999 – Apr. 2014) (continued)

	γ-coefficients						
	Benchmark model			Model with CCCI	Model with CIFO	Model with CESI	Model with CVSTX
INFORMATION VARIABLES	MR	CIP	COIL	CCCI	CIFO	CESI	CVSTX
Intercept	-0.005**	-0.005	-0.015	-0.001**	-0.012	-0.011*	-0.207
	(-1.98)	(-1.64)	(-0.57)	(-2.08)	(-1.27)	(-1.88)	(-0.82)
IDY	10.497***	-2.957	-35.758	-0.791**	-16.285	-13.070**	-307.899
	(5.29)	(-1.04)	(-1.54)	(-2.00)	(-1.43)	(-2.07)	(-0.93)
ISIR	-2.915***	1.194	-5.908	-0.149	-3.167	-3.211	43.858
	(-2.81)	(0.79)	(-0.54)	(-0.95)	(-0.94)	(-1.21)	(0.84)
ITSP	-0.684	0.734	-6.125	-0.129	-4.282	-3.352	22.292
	(-0.81)	(0.55)	(-0.59)	(-0.91)	(-1.33)	(-1.33)	(0.52)
IDSP	-0.650***	0.583*	-2.945	0.007	0.125	-0.396	25.307
	(-3.43)	(1.89)	(-1.12)	(0.24)	(0.20)	(-0.77)	(1.28)
IMR	0.365***	0.189**	0.479	-0.008	-0.180	-0.093	-0.639
	(6.63)	(2.02)	(0.67)	(-0.89)	(0.372)	(-0.60)	(-0.20)
GMM test χ-stat. (DF)	33.7363 (48)			22.5637 (42)	23.6788 (42)	24.2440(42)	39.4519 (42)
p-value	0.9408			0.9939	0.9899	0.9872	0.5834

Table 4: GMM-estimates for the β- and γ-coefficients – Differentiation between non-crisis and crisis EA-11 countries (Feb. 1999 – Apr. 2014)

The reported estimates are the results from the model presented in section 2.1: $R^e_{it} = \sum_{j=1}^{k}\sum_{h=0}^{m}\gamma_{jh}\cdot Z_{h,t-1}\cdot\beta_{ij}+\sum_{j=1}^{k}\beta_{ij}\cdot f_{jt}+\varepsilon_{it}$ (for $i = 6$ (non-crisis countries) and $i = 5$ (crisis countries); $k = 4$ and $m = 5$). Presented results are the estimates for the respective sentiment risk factor (CCCI, CIFO, CESI and CVSTX) of the corresponding model. The symbols of the risk factors and information variables are explained in Table A1. ***/**/* symbolize significance on 1%/5%/10% level, respectively. t-statistics are given in the brackets. To assess the goodness of fit of the model the results on the GMM test for overidentifying restrictions and the Durbin-Watson (DW) statistic for the autocorrelation of the residuals are provided.

	Time-constant β-coefficients							
	Model with CCCI		Model with CIFO		Model with CESI		Model with CVSTX	
	CCCI	DW	CIFO	DW	CESI	DW	CVSTX	DW
Non-crisis								
Austria	34.789***	1.732	2.565***	1.233	1.361***	1.790	0.018	1.827
	(4.53)		(3.15)		(4.42)		(0.56)	
Belgium	31.931***	1.481	2.205***	1.059	0.886**	1.394	-0.0002	1.447
	(3.63)		(3.24)		(2.57)		(-0.01)	
Finland	30.959***	1.620	2.446***	1.410	-0.256	1.726	0.152***	1.770
	(3.27)		(3.20)		(-0.65)		(3.84)	
France	24.897***	1.299	1.933***	0.764	0.346*	1.253	0.040*	1.195
	(3.82)		(3.63)		(1.69)		(1.95)	
Germany	23.637***	1.582	2.185***	0.905	0.267	1.469	0.082***	1.534
	(4.03)		(3.99)		(1.22)		(4.08)	
Netherlands	26.139***	1.442	2.002***	0.986	0.535**	1.423	0.044*	1.428
	(3.82)		(3.50)		(1.99)		(1.89)	
Crisis								
Greece	41.689***	1.767	3.227**	1.303	0.568	1.653	0.067	1.625
	(2.72)		(2.43)		(1.21)		(1.27)	
Ireland	27.938***	1.582	1.885**	1.299	0.574	1.573	0.060	1.586
	(2.93)		(2.09)		(1.30)		(1.63)	
Italy	27.356***	1.477	1.747***	1.045	0.662***	1.470	0.066***	1.536
	(4.45)		(2.96)		(2.65)		(2.85)	
Portugal	24.525***	1.664	1.754**	1.285	0.505**	1.710	0.056*	1.842
	(3.52)		(2.61)		(2.23)		(1.88)	
Spain	23.250***	1.559	1.147**	1.421	0.667**	1.576	0.067**	1.764
	(3.22)		(1.97)		(2.40)		(2.46)	

(continued)

Table 4: GMM-estimates for the β- and γ-coefficients – Differentiation between non-crisis and crisis EA-11 countries (Feb. 1999 – Apr. 2014) (continued)

	γ-coefficients							
	Model with CCCI		Model with CIFO		Model with CESI		Model with CVSTX	
	CCCI		CIFO		CESI		CVSTX	
	NC	C	NC	C	NC	C	NC	C
Intercept	-0.001	-0.001	0.011	-0.006	-0.011	0.106	0.061	-1.314
	(-0.47)	(-1.50)	(0.66)	(-1.50)	(-0.78)	(0.15)	(1.27)	(-0.14)
IDY	0.868	-0.246	-13.810	-4.447	6.467	65.770	-73.837	-460.77
	(0.44)	(-0.81)	(-0.58)	(-1.28)	(0.45)	(0.16)	(-0.94)	(-0.14)
ISIR	0.217	0.028	-4.679	-0.280	1.712	0.185	-10.576	12.200
	(0.25)	(0.14)	(-0.53)	(-0.13)	(0.20)	(0.00)	(-0.32)	(0.02)
ITSP	-0.235	0.112	2.362	-1.082	-4.150	-8.417	13.121	11.838
	(-0.40)	(0.58)	(0.35)	(-0.60)	(-0.71)	(-0.12)	(0.52)	(0.02)
IDSP	-0.026	0.030	-0.207	0.304	-0.752	-6.596	0.207	65.405
	(-0.19)	(0.87)	(-0.13)	(0.84)	(-0.69)	(-0.17)	(0.03)	(0.15)
IMR	0.006	0.016	0.002	0.111	0.038	-3.679	-1.773	53.731
	(0.18)	(1.05)	(0.01)	(0.67)	(0.11)	(-0.15)	(-0.97)	(0.14)
GMM test χ-stat. (DF)	8.5725 (12)	2.5115 (6)	5.4260 (12)	2.7126 (6)	7.9823 (12)	4.5436 (6)	7.4322 (12)	2.4958 (6)
p-value	0.7389	0.8672	0.9422	0.8440	0.7865	0.6035	0.8278	0.8689

Note: NC stands for non-crisis, C for crisis countries. Unfortunately, we ran into convergence problems in estimating the conditional models with CESI and with CVSTX for the crisis countries of EA-11. Therefore, the results displayed for these two cases should be treated with caution.

Table 5: Summary for the risk premia for the EA-11 stock markets (Feb. 1999 – Apr. 2014)

The risk premia are calculated in accordance with equation (3) using the estimates provided in Tables 3 and 4. The symbols for the risk factors are explained in Table A1. SENT stands for the respective sentiment risk premium of the corresponding models (CCCI, CIFO, CESI, CVSTX). To see whether the calculated risk premia are significantly different from zero we performed the usual t-test for location and also the sign test and the Wilcoxon signed-rank test. ***/**/* symbolize significance on 1%/5%/10% level of the t-test, respectively. Results of the sign test and the Wilcoxon signed-rank test are available upon request. The corresponding t-statistics are given in brackets.

		Risk premia in %, monthly									
		Benchmark model		Model with CCCI		Model with CIFO		Model with CESI		Model with CVSTX	
		time-varying	uncon-ditional	time-varying	uncon-ditional	time-varying	uncon-ditional	time-varying	uncon-ditional	time-varying	uncon-ditional
Full sample											
MR	*mean*	-1.116***	-1.837***	-0.158	-0.361	0.076	-0.433	-1.056***	-1.128***	-0.448***	-1.154***
	t-statistic	(-11.90)	(-9.71)	(-1.08)	(-0.65)	(0.35)	(-0.79)	(-11.35)	(-3.29)	(-3.14)	(-4.33)
	SD	1.265	–	1.972	–	2.900	–	1.255	–	1.929	–
CIP	*mean*	-0.970***	-0.809***	-0.154	-0.110	-0.008	-0.284	-0.663***	-0.440*	0.426***	-0.348
	t-statistic	(-9.21)	(-3.06)	(-1.56)	(-0.39)	(-0.07)	(-1.04)	(-9.93)	(-1.84)	(3.38)	(-1.34)
	SD	1.421	–	1.331	–	1.573	–	0.902	–	1.704	–
COIL	*mean*	-2.531***	1.482	4.094***	4.029*	6.696***	5.536**	4.187***	3.471**	-9.711***	0.870
	t-statistic	(-2.75)	(1.01)	(10.65)	(1.96)	(10.42)	(5.91)	(13.74)	(2.19)	(-5.26)	(0.52)
	SD	12.417	–	5.185	–	8.670	–	4.111	–	24.912	–
SENT	*mean*	–	–	-0.063***	-0.056**	-0.911***	-0.382	-0.957***	-0.765***	-22.57***	-8.752
	t-statistic	–	–	(-6.97)	(-2.52)	(-4.87)	(-1.23)	(-4.95)	(-2.82)	(-6.31)	(-1.45)
	SD	–	–	0.121	–	2.524	–	2.605	–	48.277	–
Non-crisis											
MR	*mean*	-1.569***	-1.797***	0.175	-1.279*	-3.444***	-2.250**	-1.140***	-1.583***	-1.811***	-1.806***
	t-statistic	(-14.28)	(-10.67)	(0.52)	(-1.93)	(-9.01)	(-2.60)	(-8.49)	(-5.75)	(-16.35)	(-5.84)
	SD	1.482	–	4.531	–	5.155	–	1.811	–	1.495	–
CIP	*mean*	-0.229***	-0.301	0.439***	-0.185	-0.460***	-0.308	-0.076*	-0.266	-0.217***	-0.250
	t-statistic	(-6.95)	(-0.92)	(4.11)	(-0.50)	(-7.10)	(-0.76)	(-1.96)	(-0.88)	(-5.93)	(-0.73)
	SD	0.444	–	1.440	–	0.874	–	0.528	–	0.495	–
COIL	*mean*	1.257	0.105	5.080***	0.542	-3.277***	-1.306	8.837***	0.500	1.144	-0.221
	t-statistic	(1.41)	(0.06)	(3.06)	(0.28)	(-7.78)	(-0.49)	(4.53)	(0.22)	(1.02)	(-0.13)
	SD	12.050	–	22.403	–	5.683	–	26.321	–	15.110	–
SENT	*mean*	–	–	-0.092***	-0.018	1.074***	0.233	-1.180***	-0.271	9.590***	9.516*
	t-statistic	–	–	(-7.39)	(-0.77)	(4.17)	(0.57)	(-10.45)	(-0.81)	(13.29)	(1.93)
	SD	–	–	0.167	–	3.472	–	1.524	–	9.733	–

(continued)

Table 5: Summary for the risk premia for the EA-11 stock markets (Feb. 1999 – Apr. 2014) (continued)

		Risk premia in %, monthly									
		Benchmark model		Model with CCCI		Model with CIFO		Model with CESI		Model with CVSTX	
		time-varying	uncon-ditional	time-varying	uncon-ditional	time-varying	uncon-ditional	time-varying	uncon-ditional	time-varying	uncon-ditional
Crisis											
MR	*mean*	-2.011***	-1.947***	0.282**	-0.504	-0.538***	-0.809	-11.54***	-0.186	9.674***	-1.129*
	t-statistic	(-15.56)	(-7.06)	(2.09)	(-0.75)	(-8.58)	(-1.43)	(-8.99)	(-0.12)	(8.30)	(-1.88)
	SD	1.744	–	1.822	–	0.845	–	17.308	–	15.721	–
CIP	*mean*	-0.376***	-0.933**	-0.193***	-0.319	-0.048	-0.229	0.023	-0.364	-0.878***	-0.425
	t-statistic	(-7.27)	(-2.28)	(-5.06)	(-0.83)	(-1.07)	(-0.51)	(0.43)	(-0.62)	(-10.15)	(-0.81)
	SD	0.699	–	0.514	–	0.605	–	0.726	–	1.167	–
COIL	*mean*	-18.15***	3.053	3.622***	3.164	4.598***	2.438	-198.3***	1.634	-10.717***	1.992
	t-statistic	(-6.91)	(0.71)	(8.67)	(0.78)	(8.97)	(0.66)	(-453.7)	(0.33)	(-7.84)	(0.49)
	SD	35.428	–	5.638	–	6.916	–	5.898	–	18.431	–
SENT	*mean*	–	–	-0.090***	-0.052**	-0.886***	-0.523	18.650***	-1.886	-246.3***	-11.950
	t-statistic	–	–	(-9.52)	(-2.20)	(-8.74)	(-1.36)	(8.17)	(-1.28)	(-9.00)	(-0.91)
	SD	–	–	0.128	–	1.367	–	30.813	–	369.34	–

Note: Unfortunately, we ran into convergence problems in estimating the conditional models with CESI and with CVSTX for the crisis countries of EA-11. Therefore, the results displayed for these two cases should be treated with caution.

Table 6: Summary for the expected excess returns for the EA-11 stock markets (Feb. 1999 – Apr. 2014)

		Expected excess returns in %, monthly											
		Bench-mark	With CCCI	With CIFO	With CESI	With CVSTX			Bench-mark	With CCCI	With CIFO	With CESI	With CVSTX
Full sample							**Non-crisis**						
Austria	*mean*	-1.676	-1.664	-1.514	-1.477	-1.785	Austria	*mean*	-1.837	-2.184	-1.996	-2.026	-2.102
	SD	2.582	2.807	2.700	2.975	2.931		*SD*	3.066	3.070	3.019	3.263	3.244
Belgium	*mean*	-1.750	-1.831	-1.730	-1.774	-1.734	Belgium	*mean*	-2.076	-2.345	-2.237	-2.274	-2.331
	SD	1.850	2.046	1.900	2.095	2.328		*SD*	2.290	2.058	1.937	2.128	2.216
Finland	*mean*	-2.381	-2.462	-2.378	-2.455	-2.557	Finland	*mean*	-2.463	-2.343	-2.326	-2.125	-2.295
	SD	2.080	2.262	2.188	2.488	2.778		*SD*	2.398	2.052	2.240	2.104	2.382
France	*mean*	-1.815	-1.722	-1.655	-1.776	-1.803	France	*mean*	-1.964	-2.100	-2.069	-1.968	-2.081
	SD	1.797	1.728	1.660	2.016	2.073		*SD*	1.900	1.668	1.607	1.730	1.906
Germany	*mean*	-1.875	-1.799	-1.731	-1.867	-2.024	Germany	*mean*	-2.055	-2.110	-2.024	-1.976	-2.065
	SD	1.949	1.789	1.757	2.133	2.189		*SD*	1.997	1.934	1.978	1.996	2.180
Netherlands	*mean*	-1.836	-1.825	-1.741	-1.851	-1.884	Netherlands	*mean*	-2.030	-2.163	-2.131	-2.104	-2.127
	SD	1.796	1.755	1.673	1.966	2.085		*SD*	1.981	1.751	1.672	1.819	1.972
							Crisis						
Greece	*mean*	-2.413	-2.489	-2.155	-2.273	-2.742	Greece	*mean*	-3.248	-3.146	-3.031	-16.511	-3.150
	SD	2.922	2.793	2.816	3.122	3.371		*SD*	3.473	3.193	3.212	4.298	3.142
Ireland	*mean*	-2.252	-2.443	-2.380	-2.288	-2.225	Ireland	*mean*	-2.468	-2.703	-2.496	6.343	-2.603
	SD	2.084	2.206	2.173	2.156	2.587		*SD*	2.105	2.063	1.833	1.353	2.195
Italy	*mean*	-1.913	-2.057	-1.923	-2.088	-2.148	Italy	*mean*	-2.301	-2.203	-2.112	-0.703	-2.157
	SD	1.903	1.716	1.735	2.131	2.169		*SD*	1.764	1.529	1.493	1.469	1.664
Portugal	*mean*	-1.718	-1.941	-1.901	-1.965	-1.855	Portugal	*mean*	-1.989	-2.272	-2.239	14.752	-2.300
	SD	1.759	1.578	1.888	1.915	1.878		*SD*	1.761	1.935	1.995	0.707	2.080
Spain	*mean*	-1.569	-1.691	-1.547	-1.713	-1.738	Spain	*mean*	-1.833	-1.966	-1.887	15.699	-1.955
	SD	1.638	1.423	1.407	1.783	1.636		*SD*	1.348	1.413	1.341	0.966	1.567

Note: The expected excess returns are calculated in accordance with equation (3) using the estimates provided in Tables 3 and 4. The symbols for the risk factors are explained in Table A1. Unfortunately, we ran into convergence problems in estimating the conditional models with CESI and with CVSTX for the crisis countries of EA-11. Therefore, the results displayed for these two cases should be treated with caution.

Table 7: Evaluation measures for the prediction of EA-11 stock market returns (Feb. 1999 – Sep. 2015)

		Panel A: in-sample (Feb. 1999–Apr. 2014; 182 obs.), in %											
		Bench-mark	With CCCI	With CIFO	With CESI	With CVSTX			Bench-mark	With CCCI	With CIFO	With CESI	With CVSTX
Full sample							**Non-crisis**						
Austria	*MAE*	0.391	0.447	0.496	0.598	0.283	Austria	*MAE*	0.229	0.067	0.014	0.053	0.032
	RMSE	5.215	6.285	7.280	5.225	5.167		*RMSE*	5.310	6.550	7.190	5.422	5.244
Belgium	*MAE*	0.433	0.392	0.406	0.417	0.456	Belgium	*MAE*	0.109	0.115	0.104	0.081	0.148
	RMSE	4.990	6.017	6.701	5.128	5.225		*RMSE*	5.263	6.356	6.812	5.339	5.196
Finland	*MAE*	0.261	0.298	0.314	0.330	0.410	Finland	*MAE*	0.349	0.176	0.265	0.002	0.146
	RMSE	6.768	7.503	7.785	7.071	6.935		*RMSE*	6.848	7.576	7.810	7.021	6.943
France	*MAE*	0.176	0.305	0.292	0.221	0.202	France	*MAE*	0.029	0.069	0.121	0.033	0.079
	RMSE	2.985	4.195	4.583	3.362	3.225		*RMSE*	3.028	4.290	4.483	3.302	3.121
Germany	*MAE*	0.095	0.211	0.194	0.112	0.035	Germany	*MAE*	0.081	0.096	0.096	0.007	0.072
	RMSE	3.332	4.583	4.775	3.592	3.450		*RMSE*	3.286	4.539	4.899	3.507	3.406
Netherlands	*MAE*	0.227	0.275	0.279	0.219	0.193	Netherlands	*MAE*	0.035	0.059	0.115	0.032	0.054
	RMSE	3.606	4.764	5.099	3.860	3.821		*RMSE*	3.755	4.899	5.167	3.924	3.795
							Crisis						
Greece	*MAE*	0.680	0.657	0.880	0.827	0.372	Greece	*MAE*	0.151	0.007	0.004	0.057	0.043
	RMSE	8.672	9.274	10.050	8.894	8.672		*RMSE*	8.614	9.381	10.296	8.894	8.724
Ireland	*MAE*	0.426	0.280	0.251	0.398	0.467	Ireland	*MAE*	0.207	0.019	0.141	0.036	0.090
	RMSE	5.831	6.848	7.294	5.916	6.140		*RMSE*	5.891	6.738	6.907	6.058	6.050
Italy	*MAE*	0.369	0.268	0.320	0.204	0.156	Italy	*MAE*	0.019	0.121	0.128	0.137	0.139
	RMSE	3.987	4.796	5.128	4.050	4.123		*RMSE*	3.886	4.909	4.889	4.037	4.050
Portugal	*MAE*	0.635	0.454	0.424	0.402	0.520	Portugal	*MAE*	0.366	0.126	0.083	0.116	0.074
	RMSE	4.219	4.889	5.320	4.219	4.324		*RMSE*	4.195	4.980	5.348	4.266	4.301
Spain	*MAE*	0.373	0.292	0.371	0.243	0.229	Spain	*MAE*	0.114	0.020	0.034	0.011	0.010
	RMSE	4.290	4.690	5.060	4.171	4.324		*RMSE*	4.207	4.848	4.837	4.171	4.347

(continued)

Table 7: Evaluation measures for the prediction of EA-11 stock market returns (Feb. 1999 – Sep. 2015) (continued)

		Panel B: out-of-sample (May 2014–Sep. 2015; 17 obs.), in %											
		Bench-mark	With CCCI	With CIFO	With CESI	With CVSTX			Bench-mark	With CCCI	With CIFO	With CESI	With CVSTX
Full sample							**Non-crisis**						
Austria	*MAE*	3.622	3.848	3.852	4.262	3.938	Austria	*MAE*	3.622	3.856	3.886	4.309	3.785
	RMSE	4.270	4.697	4.388	4.998	4.672		*RMSE*	4.375	4.797	4.424	5.139	4.512
Belgium	*MAE*	3.671	3.605	3.451	3.654	3.806	Belgium	*MAE*	3.968	3.839	3.525	3.874	4.142
	RMSE	4.434	4.351	4.333	4.521	4.840		*RMSE*	4.743	4.548	4.466	4.786	5.202
Finland	*MAE*	3.789	3.686	3.179	3.897	3.839	Finland	*MAE*	3.896	3.298	3.113	3.768	3.790
	RMSE	4.386	4.317	3.982	4.526	4.312		*RMSE*	4.457	3.908	3.934	4.466	4.324
France	*MAE*	2.715	2.789	2.718	2.759	2.892	France	*MAE*	2.719	2.932	2.694	2.885	2.790
	RMSE	3.203	3.114	3.085	3.265	3.493		*RMSE*	3.259	3.254	3.124	3.387	3.490
Germany	*MAE*	3.029	3.079	2.732	2.962	3.027	Germany	*MAE*	3.218	3.034	2.887	3.014	3.059
	RMSE	3.420	3.554	3.158	3.468	3.672		*RMSE*	3.614	3.517	3.317	3.541	3.715
Netherlands	*MAE*	3.123	3.225	2.920	3.108	3.279	Netherlands	*MAE*	3.258	3.251	2.864	3.231	3.376
	RMSE	3.872	3.791	3.561	3.934	4.146		*RMSE*	3.991	3.801	3.599	4.054	4.211
							Crisis						
Greece	*MAE*	11.391	10.844	11.229	11.075	11.528	Greece	*MAE*	11.442	11.002	11.017	11.141	11.329
	RMSE	13.868	13.691	14.042	13.615	14.103		*RMSE*	14.066	13.901	13.869	13.831	14.023
Ireland	*MAE*	4.218	4.284	4.287	4.631	4.321	Ireland	*MAE*	4.457	4.604	4.442	4.725	4.512
	RMSE	4.766	4.654	4.750	5.159	4.863		*RMSE*	4.977	4.979	4.854	5.297	5.070
Italy	*MAE*	3.603	4.146	3.764	4.286	3.978	Italy	*MAE*	4.018	4.130	3.976	4.409	4.216
	RMSE	4.328	4.732	4.252	4.847	4.550		*RMSE*	4.713	4.803	4.413	4.995	4.756
Portugal	*MAE*	4.741	5.252	4.925	4.773	4.929	Portugal	*MAE*	4.754	5.128	4.844	4.797	5.155
	RMSE	6.475	6.924	6.881	6.698	6.578		*RMSE*	6.519	6.901	6.694	6.726	6.790
Spain	*MAE*	2.648	2.695	2.145	2.842	2.563	Spain	*MAE*	2.953	2.924	2.093	3.051	2.789
	RMSE	3.291	3.564	3.007	3.801	3.250		*RMSE*	3.788	3.810	3.058	4.024	3.674

Note: The symbols for the risk factors are explained in Table A1. MAE is the mean absolute error and RMSE is the root mean square error.

Table A1: Overview of EA-11 risk factors and information variables

Symbol	Definition/Construction principle	Source
CIFR	*Change in the EA inflation rate*: monthly log change in the Harmonized Index of Consumer Prices (HICP)[a] of the Euro area (changing composition).	Eurostat
CIP	*Change in the EA industrial production*: monthly log change in the Industrial Production Index of the Euro area (18 countries).	Eurostat
CSIR	*Change in the EA short-term interest rate*: monthly log change in the the 3-months Euroeuro rate.	Datastream
COIL	*Change in the oil price*: log change in the monthly average price of Brent crude oil.	European Central Bank
MR	*Return on the EA market portfolio*: continuously compounded monthly return on the MSCI EMU Total Return Index in excess of the 1-month Euribor rate.	Datastream
CCCI	*Change in the Consumer Confidence Index*: monthly log change in the Consumer Confidence Index for the Euro area (18 countries).	OECD
CIFO	*Change in the Economic Climate Index*: monthly log change in the Economic Climate Index for the Euro area available from the ifo Institute[b].	ifo Institute
CESI	*Change in the Economic Sentiment Indicator*: monthly log change in the Economic Sentiment Indicator for the Euro area.	EU Commission
CVSTX	*Change in the VSTOXX Volatility Index*: monthly log change in the VSTOXX Volatility Index.	Datastream
IDY	*EA dividend yield*: the dividend yield on the Datastream (DS) EMU market index[c].	Datastream
ISIR	*EA short-term interest rate*: the 1-month Euroeuro rate.	Datastream
ITSP	*EA term spread*: the difference between the long-term government bond yield for the Euro area and the 1-month Euroeuro rate.	Datastream
IDSP	*EA default spread*: the difference between the BofA Merrill Lynch Euro High Yield Index effective yield and the long-term government bond yield for the Euro area.	Datastream, FED Economic Data
IMR	*Return on the EA market portfolio*: continuously compounded monthly return on the MSCI EMU Total Return Index in excess of the 1-month Euribor rate.	Datastream

[a] Seasonally adjusted, the adjustment was accomplished by means of X-12-ARIMA method in SAS.
[b] The Economic Climate Index is only available on a quarterly basis. To obtain monthly observations the data series was interpolated using SAS.
[c] Unfortunately, the dividend yield for the MSCI EMU Index was not available on Datastream therefore the dividend yield on the DS EMU Index was used. Due to the strong correlation between the MSCI EMU Index and the DS EMU Index (97,57%) we can assume a similar correlation between the dividend yields of these indices.