EVALUATION OF THE UNEMPLOYMENT RATE ANNOUNCEMENT IMPACT ON EURO STOXX 50 INDEX RETURNS BASED ON SEMI-STRONG EFFICIENT MARKET HYPOTHESIS

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Abstract: In this paper are evaluating the impact of unemployment rate announcement on the Euro Stoxx 50 index returns on the basis of a semi-strong efficient market hypothesis. Analyzing and summarizing previous researches of semi-strong market efficiency find, that there are various studies analyzing the returns of stock market depending on corporate financial statements announcement, but there are only a few that analyze the returns of stock market of macroeconomic announcement, and especially announcement about the unemployment rate. In this study the semi-strong effective market hypothesis is determined in a very short time interval of 5 minutes from 11:00 to 11:04, therefore the MKAR, RAR methods to determine the Euro Stoxx 50 index returns are used. The originality of the study is that the values of the models were calculated on the basis of high frequency data, not daily data. In this empirical research non-zero values of MKAR, RAR models were obtained, which indicate that in the analyzed 4/4/2018 - 1/4/2019 period the Euro Stoxx 50 index is not a semi-strong effective based on of unemployment rate announcement. It was also found that Euro Stoxx 50 index returns on the fifth minute (11:04) after the unemployment rate announcement realize (11:00) can earn more, or less than the comparable stock market indexes returns.

Keywords. Unemployment rate, Euro Stoxx 50, abnormal returns, stock, semi-strong efficient market hypothesis.

Introduction

All researches on the topic of an effective market hypothesis (EMH) until 1965 can be called the theory of random walk. The first empirical studies in this direction were performed by Regnault (1863), Rayleigh (1880), Venn (1888), Bachelier (1900), Barriol (1908), Dibblee (1912), Keynes (1923), Cowles (1933), Working (1934).), Osborne (1959), Cootner (1964), Fama (1965), who tested the theory of random walk and found that stock price changes were independent. The above-mentioned studies led to the defined of an EMH theory. The first scientist to did that was Eugene Fama in year 1965. Based on his study in "The Behavior of Stock Market Prices", scientist says that stock prices reflect all the information, and trading on the basis of this information will not produce abnormal returns.

In year 1970 Fama in his work "Efficient capital markets: a theoretical and empirical review of work" according to critic's remarks, EMH has divided into three forms of efficiency: weak, semi-strong and strong. According to Klimašauskienė and Moščinskienė (1998) these forms differ from each other in terms of the amount of information and possibilities to get it.

In this work the semi-strong efficiency in Euro Stoxx 50 market will be studied. This semi - strong hypothesis says that stock prices already reflect all historical data along with all publicly available information. According to Klimašauskienė and Moščinskienė (1998), if the market is semi-strong efficient, its participants will not be able to earn abnormal returns by using all historical data and publicly available information (information on dividends, income, stock shedding, balance sheet items, etc.).

Recently reasearches (Logeswary, Thirunavukkarasu (2019), Alekneviciene, Kviedaraitiene, Alekneviciute (2018), Andrade, Santos (2017), Mackey, Macon (2017), Woodard, Bacon (2015), Mallikarjunappa, Dsouza (2014), Ferrara, Bacon (2014), Westfall (2010), Sharma (2009), Mallikarjunappa, Manjunatha (2009)) has shown that there are various studies analyzing the returns of stock market depending on corporate financial statements announcement, but there are only a few that analyze the returns of stock market of macroeconomic announcement, and especially announcement about the unemployment rate.

The problem of the research. What kind of models can be used to determine semi - strong efficient market and what is the abnormal returns of the Euro Stoxx 50 after 5 minutes when unemployment rate announcements occurs?

The purpose of the research. Determine whether Euro Stoxx 50 index is semi - strong efficient when unemployment rate announcements occurs and calculate its abnormal returns after 5 minutes

The objectives of the research:

1. Determine which models can be used to check whether the stock market is semi - strong efficient.
2. Determine whether Euro Stoxx 50 index is semi - strong efficient when unemployment rate announcements occurs.
3. Calculate Euro Stoxx 50 abnormal returns after 5 minutes when unemployment rate announcements occur.

The methods of the research:

1. Systematic analysis of the scientific literature. 2. Comparative analysis. 3. The method of multicriteria evaluation. 4. Correlation analysis. 5. Analytical-logical method. 6. High frequency data analysis

1. Analysis of scientific literature of the semi-strong efficient market hypothesis

According to Fama (1991) semi – strong efficient hypotheses can be divided into two groups:

1. Research to predict future stock price changes using historical and publicly available information. The most common method of this analysis is time series analysis.

2. Event studies that analyze how quickly stock prices adjust to new information about important economic events in the selected market. Cleary, Atkinson and Drake (2013) are saying that event research is conducted by comparing the expected profitability model with the real return on assets after the company announces new information. If the difference between expected and actual profitability is statistically significant, it will be considered that the market responds quickly to new information and investment decisions based on this information after it has entered the market.

Below is an overview of event studies.

Table 1. Semi-strong market efficiency recent researches

Years	Authors	Research stock market	Research Object	Is market semi –strong efficiency?
2019	Logeswary, Thirunavukkarasu	Sri Lanka	FS* of companies	No
2018	Alekneviciene, Kviedaraitiene, Alekneviciute	Baltic States	FS* of companies	No
2017	Andrade, Santos	Brazil	FS* of companies	Yes
2017	Mackey, Macon	USA	Stock repurchase & issue	Yes
2015	Woodard, Bacon	USA	Unemployment rate	No
2014	Mallikarjunappa, Dsouza	India	FS* of companies	No
2014	Ferrara, Bacon	USA	Merger of companies	Yes
2010	Westfall	USA	Stock split of companies	Yes
2009	Sharma	India	Consolidation, change of managers, acquisitions	No
2009	Mallikarjunappa, Manjunatha	India	Dividends of companies	No

*Financial statements

Source: compiled by the author based on the above sources

In these researches the semi-strong efficiency market hypothesis is both confirmed and rejected (see Table 1). In some markets, stock prices move according by random walk theory (YES), so the financial market participants will not earn abnormal returns. In other markets stock prices are moving according to certain trends that can generate abnormal returns (NO).

In order to confirm or deny the existence of a semi-strong efficiency hypothesis in a stock markets, it is necessary to select research methods that can prove empirically whether financial market participants can earn abnormal returns in the stock market. It is therefore appropriate to learn the methods used by scientists in their recent research.

Table 2. Methods for determining the semi-strong efficiency market in recent researches

Years	Authors	Models in the research
2019	Logeswary, Thirunavukkarasu	- Average abnormal returns model (AAR) - Cumulative average abnormal returns model (CAAR) - Parametric T test
2018	Alekneviciene, Kviedaraitiene, Alekneviciute	- Average abnormal returns model (AAR) - Cumulative average abnormal returns model (CAAR) - Patell's, BMP tests
2017	Andrade, Santos	- Regression model
2017	Mackey, Macon	- Risk adjusted model (RAR) - Parametric T test
2015	Woodard, Bacon	- Risk adjusted model (RAR)
2014	Mallikarjunappa, Dsouza	- Market adjusted model (MAR) - Parametric T test
2014	Ferrara, Bacon	- Risk adjusted model (RAR)
2010	Westfall	- Risk adjusted model (RAR)
2009	Sharma	- Market-adjusted model (MAR)
2009	Mallikarjunappa, Manjunatha	- Average abnormal returns model (AAR) - Cumulative average abnormal returns model (CAAR)

Source: compiled by the author based on the above sources

A comprehensive scientific literature review found that average abnormal returns (AAR), cumulative average abnormal returns (CAAR), market adjusted returns (MKAR), risk adjusted returns (RAR), regression models are the most commonly used in the stock markets to check the existence of a semi-strong market efficiency hypothesis. The Student's T-test is used to check the statistical significance of the results obtained. Since in this study the semi-strong effective market hypothesis is determined in a very short time interval of 5 minutes from 11:00 to 11:04 therefore the MKAR, RAR methods were chosen. Student's T-test was chosen for statistical significance.

2. Evaluation of the unemployment rate announcement impact on Euro Stoxx 50 index returns based on semi-strong efficient market hypothesis methodology

The Euro Stoxx 50 index was chosen for this study. It is one of the most liquid indices in the world, consisting of shares in the 50 largest capitalized euro area companies from Australia, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal and Spain.

Determining whether the Euro Stoxx 50 index is a semi-strong effective was chosen **the Euro area** unemployment rate announcements.

In this research unemployment rate data was obtained from Bloomberg terminal. Data period from **4 April 2018 to April 4 2019 (13 Month)**.

Table 3: Distribution of the statistical data intervals for the analyzed determinants

Variable	**Data frequency (GMT +2)**	**Number of data**
Unemployment rate (%)	11:00	26
Euro Stoxx 50 (€)	Open 11:00 and 11:04 Close	512
Euro Stoxx Total market (€)	Open 11:00 and 11:04 Close	512

Source: compiled by the author

In the next step, zero and alternative hypotheses are raised. Hypothesis H_0 states that there are no abnormal returns in the event window, while alternative H_1 indicates that there is an abnormal return in the event window.

$H_0: MKAR_{it} = 0$
$H_1: MKAR_{it} \neq 0$

$H_0: RAR_{it} = 0$
$H_1: RAR_{it} \neq 0$

Event window starts at 11:00 and ends at 11:04 (5-minute time interval).

Then we process the resulting data from Table 3 and calculate the MKAR and RAR values for each event window according to the formulas in Table 4. All calculations are performed using Excel platform.

Table 4: Types and explanation of semi - strong EHR determination models

Model	Purpose of the model according to scientific literature	The purpose of the model in this study
$MKAR_{it} = LOG(R_{it}) - LOG(R_{mt})$	The purpose is to determine whether the change in the return on securities on the day of the event is higher / lower than the change in the market (index) return on the day of the event.	Determines whether the Euro Stoxx 50 index returns after 5 min when the news of the unemployment rate appears to be higher / lower than the Euro Stoxx Total market index returns in the previous days within the same 5 min interval.
$RAR_{it} = LOG(R_{it}) - LOG(\alpha_i + \beta_i \times R_{mt})$	The purpose is to determine whether the change in the return on securities on the day of the event is higher / lower than the change in the market (index) return on the day of the event with additional elements in the regression model.	Determines whether the Euro Stoxx 50 index returns after 5 min when the news of the unemployment rate appears is higher / lower than the return of the Euro Stoxx Total market index in the previous days, taking into account the regression model elements within the same 5 min interval.

(R_{it}) - Close 11:04/open 11:00 of Euro Stoxx 50 index prices changes (%) event day

(R_{mt}) - Mean (Close 11:04/open 11:00) of Euro Stoxx Total Market index prices changes (%) starts after next day and end till next unemployment event day

α_i - Values obtained between Euro Stoxx 50 and Euro Stoxx Total Market starts after next day and end till next unemployment event day

β_i - Values obtained between Euro Stoxx 50 and Euro Stoxx Total Market starts after next day and end till next unemployment event day

Source: compiled by the author according table 2

Models values are calculated by logarithmic returns on the Euro Stoxx 50 and Euro Stoxx Total Market indices.

The statistical significance of the obtained model values is checked using the Student's t-test. If Student's t-test with 95% confidence intervals greater than 2.093 (19 df) or less than -2.093 (19 df) are obtained, then the null hypothesis is rejected and the alternative is accepted. This means that the MKARs and RARs values received in the event window are unequal to zero and are statistically significant.

At the end of this empirical study, it was assumed that the short-term returns volatility of the Euro Stoxx 50 index is driven by unemployment rate announcements surprises. This assumption is tested by calculating the correlation coefficient between the returns after 5 minutes on the day then event occurred and the difference between the actual and forecasted unemployment rate values.

3. Results of empirical research

The Euro Stoxx 50 abnormal return analysis (see Table 5) shows that none of the MKAR, RAR values are zero during the analysis period. This means that market participants could earn more or less than the market average. However, checking the statistical significance of these values revealed that the values of the models on the event days - 02.05.2018, 31.05.2018, 2018.11.11 are not statistically significant. Therefore, it can be argued that on these days, the semi-strong market hypothesis for the Euro Stoxx 50 market when the unemployment rate appears is valid, so market participants could not earn more or less than the market average.

Table 5: MKAR, RAR and Student's t-test values

Announcement date	Times open	Times close	MKAR	T-test	RAR	T-test
4/4/2018	11:00	11:04	-0,071%	-6,44	-0,074%	-6,67
2/5/2018	11:00	11:04	0,004%	**0,46**	0,003%	**0,37**
31/5/2018	11:00	11:04	-0,011%	**-0,94**	-0,009%	**-0,79**
2/7/2018	11:00	11:04	0,033%	3,33	0,028%	2,85
31/7/2018	11:00	11:04	0,077%	10,90	0,077%	10,88
31/8/2018	11:00	11:04	-0,033%	-5,11	-0,036%	-5,56
1/10/2018	11:00	11:04	0,077%	9,56	0,080%	9,98
31/10/2018	11:00	11:04	0,104%	7,10	0,102%	6,97
30/11/2018	11:00	11:04	0,019%	**1,42**	0,019%	**1,47**

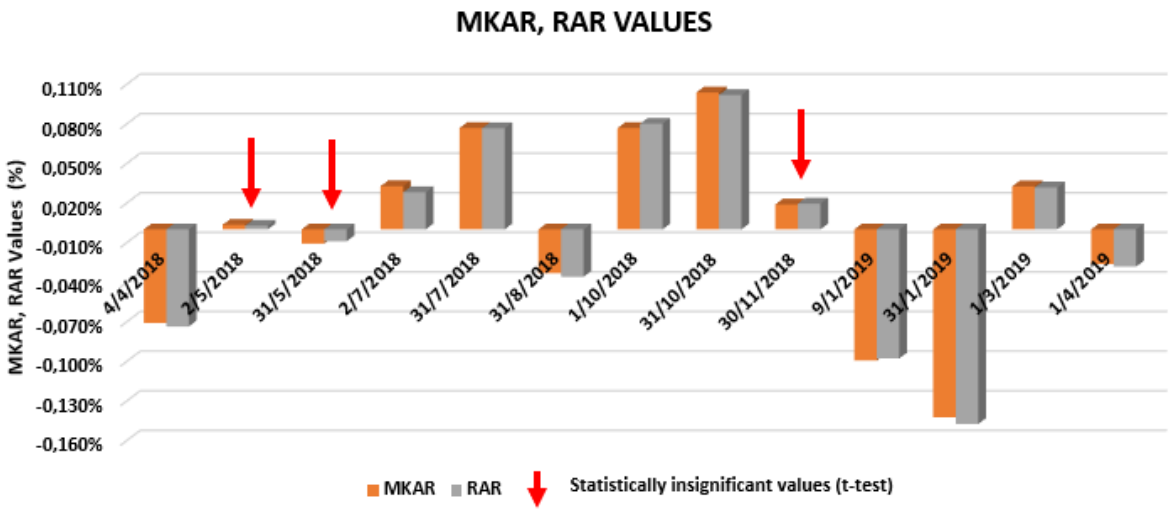
9/1/2019	11:00	11:04	-0,099%	-7,08	-0,098%	-6,97
31/1/2019	11:00	11:04	-0,142%	-13,14	-0,147%	-13,60
1/3/2019	11:00	11:04	0,033%	3,87	0,032%	3,77
1/4/2019	11:00	11:04	-0,026%	-3,58	-0,028%	-3,85

Index price data is distributed by normal distribution.

Source: compiled by the author.

The contents of Table 5 can also be represented by figure 1.

Figure 1: MKAR, RAR values

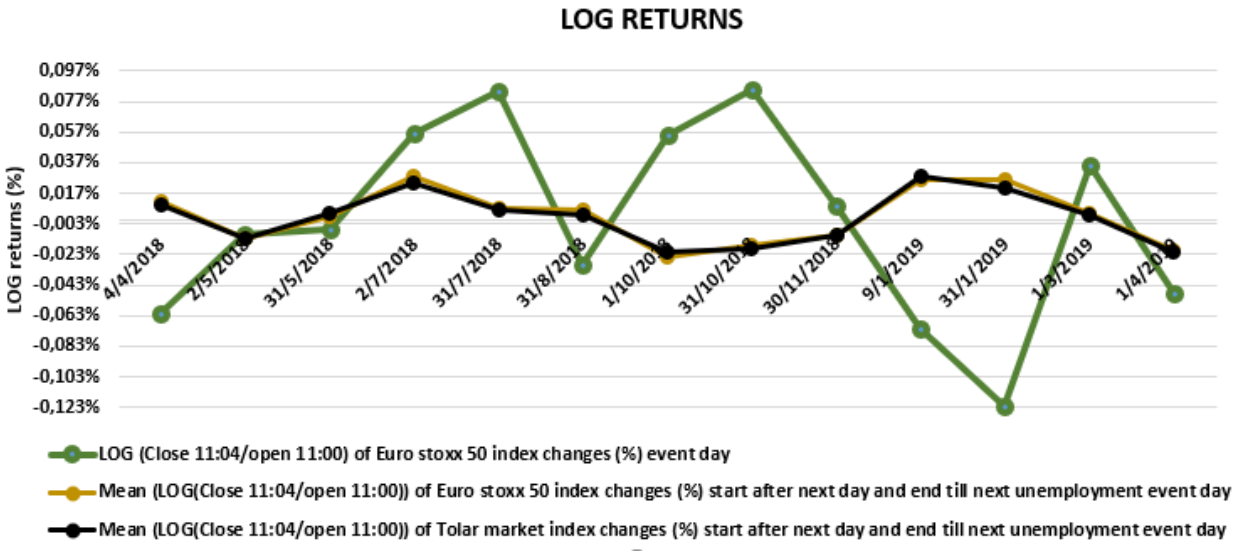


Source: compiled by the author.

From the figure 1 it is more evident that on days when MKAR, RAR values are very low, their statistical significance is accordingly insignificant. Thus, on these dates 02/05/2018, 31/05/2018, 30/11/2018, MKAR, RAR null hypothesis is not rejected, and on other days null hypothesis is rejected and the alternative hypothesis is rejected

Figure 2 shows the returns of the Euro Stoxx 50 index on the day of the event, 5 minutes after the news of the unemployment rate appears, and the average returns of the Euro Stoxx 50 and Euro Stoxx Total market indices until the next news release of the unemployment rate.

Figure 2: Comparison of indexes LOG returns

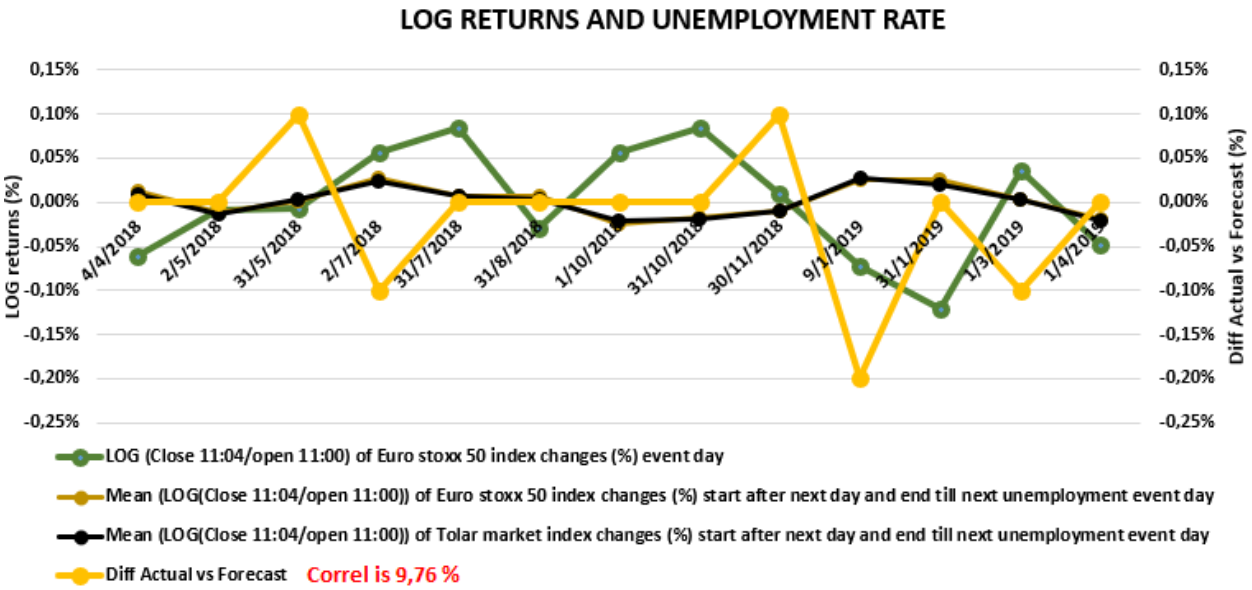


Source: compiled by the author.

Figure 2 shows that on the day of the event, 5 minutes after the news of the unemployment rate appears, trading on the Euro Stoxx 50 index can earn more or less than the comparable market indices. From the author's point of view, according to the results of previously named scientists, such differences in returns may be driven by market expectations, with the news of the unemployment rate appearing at the time. For example, economists and analysts could predict the unemployment rates values before the news appeared. Published forecasts shape the perception of other financial market participants about the significance of unemployment. Therefore, when the actual value of the news comes out, which does not fully meet the expectations of the market participants, one can expect larger or smaller fluctuations in the price of the Euro Stoxx 50 index than usual.

In order to confirm or reject this approach, the calculations referred to in appendix I and II have been carried out. The results are shown in Figure 3.

Figure 3: Comparison between indexes LOG returns and unemployment rate announcements surprises



In this figure, the yellow curve shows the difference between the actual and the forecast value of the unemployment rate. It is not clear from the figure how much unemployment rate surprises can explain the price returns of the Euro Stoxx 50 index, so it is appropriate to determine the correlation coefficient of these variables. The resulting correlation coefficient is 9.76% (calculation on Appendix 2), which means that the surprises analysis performed during the analyzed period explains about ~ 10% movement of Euro Stoxx 50 returns. The significance of the correlation coefficient is low, hence the view that surprises in this paper can explain why Euro Stoxx 50 returns are higher or lower than market averages can be ruled out.

Conclusions and recommendations

1. A comprehensive scientific literature review found that average abnormal returns (AAR), cumulative average abnormal returns (CAAR), market adjusted returns (MKAR), risk adjusted returns (RAR), regression models are the most commonly used in the stock markets to check the existence of a semi-strong market efficiency hypothesis. The purpose of these models is to determine whether the change in the stock return on the day of the event is greater or less than the day of the market return on the event day. In this study the semi-strong effective market hypothesis is determined in a very short time interval of 5 minutes from 11:00 to 11:04, therefore the MKAR, RAR methods to determine the Euro Stoxx 50 index returns are used. The Student's T-test was selected for statistical significance

2. In the empirical research we show that none of the MKAR, RAR values are zero during the analysis period. This means that market participants could earn more or less than the market average. However, checking the statistical significance of these values revealed that the values of the models on the event days - 02.05.2018, 31.05.2018, 2018.11.11 are not statistically significant. Therefore, it can be argued that on these days, the semi-strong market hypothesis for the Euro Stoxx 50 market when the unemployment rate appears is valid, so market participants could not earn more or less than the market average.

3. The analysis of Euro Stoxx 50 index returns shows that the average return of the index in the fifth minute (11:04) is 0.004% lower than on other days in same index or about on average 0.003% lower than the selected Euro Stoxx Total Market index. However, analyzing each event separately, one can see a large gap between the Euro Stoxx 50 and the Euro Stoxx Total Market index returns. From the author's point of view such differences in returns can be driven by market surprises with the news of the unemployment rate appearing at the time. Calculations showed that the unemployment rate surprises explain only ~ 10% of the Euro Stoxx 50 index return movement. Hence the approach that surprises may explain why the Euro Stoxx 50 returns are higher or lower than the market averages in this study is rejected. It is recommended continue research on a similar topic by expanding sample of the year to include other economic news or capturing index returns within 10 or 15 minutes.

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Appendix 1

Unemployment rate values

Date	Unemployment rate (%) Actual	Unemployment rate (%) Forecast (median)	Surprises (Actual – Forecast)
4/4/2018	8,50%	8,50%	0,00%
2/5/2018	8,50%	8,50%	0,00%
31/5/2018	8,50%	8,40%	0,10%
2/7/2018	8,40%	8,50%	-0,10%
31/7/2018	8,30%	8,30%	0,00%
31/8/2018	8,20%	8,20%	0,00%
1/10/2018	8,10%	8,10%	0,00%
31/10/2018	8,10%	8,10%	0,00%
30/11/2018	8,10%	8,00%	0,10%
9/1/2019	7,90%	8,10%	-0,20%
31/1/2019	7,90%	7,90%	0,00%
1/3/2019	7,80%	7,90%	-0,10%
1/4/2019	7,80%	7,80%	0,00%

Source: compiled by the author.

Appendix 2

Correlation between Euro Stoxx 50 returns and unemployment rate surprises

Date	LOG (Close 11:04/open 11:00) of Euro Stoxx 50 index returns (%) event day	Unemployment rate Surprises (Actual – Forecast)
4/4/2018	-0,061%	0,00%
2/7/2018	0,056%	0,10%
31/7/2018	0,084%	-0,10%
31/8/2018	-0,030%	0,00%
1/10/2018	0,056%	0,00%
31/10/2018	0,085%	0,00%
9/1/2019	-0,072%	-0,20%
31/1/2019	-0,122%	0,00%
1/3/2019	0,035%	-0,10%
1/4/2019	-0,048%	0,00%
Correlation *	**9,76%**	

* Correlation is calculated only for statistically significant MKAR, RAR values.

Source: compiled by the author.