PRACE NAUKOWE UNIWERSYTETU EKONOMICZNEGO WE WROCŁAWIU
RESEARCH PAPERS OF WROCŁAW UNIVERSITY OF ECONOMICS **nr 482 • 2017**

Wrocław Conference in Finance: Contemporary Trends and Challenges ISSN 1899-3192
e-ISSN 2392-0041

Aleksandra Rutkowska
Poznań University of Economics and Business
e-mail: aleksandra.rutkowska@ue.poznan.pl

THE INFLUENCE OF INVESTOR SENTIMENT ON SECTOR INDICES – THE INI INDEX ANALYSIS

WPŁYW NASTROJU INWESTORÓW NA INDEKSY SEKTOROWE – ANALIZA INDEKSU INI

DOI: 10.15611/pn.2017.482.18
JEL Classification: G40, G14

Summary: In this paper, we examine the influence of investor sentiment on the WSE sector indices. The stock market indices chosen are based on the industry sector, to distinguish the sectors most susceptible and robust to the effects of sentiment. The Polish Investor Sentiment Index (INI) is used as a sentiment measurement. INI is published every week by the Polish Association of Individual Investors based on the opinions of approx. 350 respondents. Individual investors answer the question about their opinion on the stock exchange trend in the next 6 months, whether the trend will be upward, horizontal, or downward. The aim of this study is to understand the impact of investor sentiment on sector indices. The study covers the 5-year period from June 2011 to June 2016. We examine the bivariate relationship in the mean by using the vector autoregression (VAR) model and Granger causality. The results show that INI does not influence the sector indices except for WIG-food and WIG-basic materials. However, the study identifies strong dependencies in the opposite direction.

Keywords: investor sentiment, sector indices, VAR.

Streszczenie: W artykule analizowany jest wpływ nastrojów inwestorów na indeksy sektorowe GPW. Wybrane indeksy giełdowe opierają się na sektorach, w celu określenia sektorów najbardziej podatnych i silne odpornych na nastroje inwestorów. Jako miarę nastrojów wykorzystano polski Indeks Nastrojów Inwestorów (INI). INI publikowane jest co tydzień przez polskie Stowarzyszenie Inwestorów Indywidualnych, opierając się na opiniach ok. 350 respondentów przeprowadzanej ankiety. Inwestorzy indywidualni odpowiadają na pytanie o przewidywaną tendencję na rynku w ciągu najbliższych sześciu miesięcy. Celem tego badania jest zrozumienie wpływu nastrojów inwestorów na indeksy sektorowe. Badanie obejmuje okres pięciu lat, od czerwca 2011 r. do czerwca 2016 r. Analizuje się relacje dwustronne w średniej przy użyciu modelu wektorowej autoregresji wektora (VAR) i przyczynowości według Grangera. Wyniki pokazują, że INI nie wpływa na indeksy sektorów, z wyjątkiem indeksów WIG-spożywczy i WIG-surowce. Jednakże badanie identyfikuje silne zależności w przeciwnym kierunku.

Słowa kluczowe: nastrój inwestorów, indeksy sektorowe, VAR.

1. Introduction

According to the theory of finance and the efficient market hypothesis, investors make rational valuations and strive to maximize the effectiveness of their investments. If an investor is irrational, his/her individual actions are random in nature and mutually neutralize one another without influencing share prices. However, empirical research of financial markets determined that the assumption concerning the rationality of investors is not reflected, and anomalies observed on the American stock market in the late 1980s and early 1990s became an inspiration for further research. Barberis, Shleifer, and Vishny [1998] introduced the notion of *sentiment*, referring to investor's overreaction and underreaction to appearing information. In recent literature, there are several studies and models regarding the impact of investor sentiment on stock prices and the valuation of assets, as well as the rate of return on such shares, e.g. De Long et al. [1990], Brown and Cliff [2004], and Baker and Wiggler [2006]. The issue of investor sentiment is important when considering current economic conditions since, as research from Nouyrigat et al. [2011] has shown, investor moods can be used for forecasting crises. Uygur and Tas [2014] focus also on the effects of investor sentiment on different kind of economic sectors. They use EGARCH model to test whether a change in the investor sentiment has more influence on the conditional volatility of some sectors than on other and noted that investor sentiment affects mostly the conditional volatility of the key driving sectors of the Turkish economy and Istanbul Stock Exchange: Industry and Banking sectors.

Among the numerous literature positions on the largest markets like the US, there are a few papers concerning the research of the Warsaw Stock Exchange. Sokalska [2015] investigates the apparent co-movement of equity returns in the Czech Republic, Hungary and Poland in relation of international sentiment represented as a two-state Markov chain and makes the stock returns switch between the growth and depression regimes. Brzeszczyński and Welfe [2007] apply ARCH class models to investigate the influence of the international stock market indices. The study indicates the existence of statistically significant interdependence between WIG index returns and the returns of indices from the European markets; however the strongest effect was detected in case of the DJIA index.

There are two approaches to measuring sentiment: direct and indirect. Indirect measurements are based on available information and their correlation to sentiment [Brown, Cliff 2004] or media sentiment [Tetlock 2007], while direct measurements are based on surveys. The results of such surveys are published by individual investor associations, e.g. the American Association of Individual Investors (AAII) or the Polish Association of Individual Investors (SII), as well as investment portals (e.g. CNN Money). Sentiment is also considered in research concerning the investors of commercial companies (e.g. Natixis 2014 Global Survey of Individual Investors, BlackRock U.S. Investor pulse survey 2014).

The Polish Investor Sentiment Index (INI) is published every week by SII, and is based on the opinions of approx. 350 respondents. Individual investors give their opinions on the stock exchange trend over the next 6 months – stating whether the trend will be upward (bullish sentiment), horizontal (neutral sentiment), or downward (bearish sentiment).

The aim of this study is to understand the impact of investor sentiment on the stock market indices that concern the industry sector. The first hypothesis is that some sectors are more robust than other to sentiment. The second hypothesis is that key sectors of the economy are opinion-leaders and influence the sentiment of investors. The study covers the 5-year period from June 2011 to June 2016 and uses the following sector indices: WIG-banking, WIG-construction, WIG-chemicals, WIG-developers, WIG-energy, WIG-IT WIG-media, WIG-oil&gas, WIG-food, WIG-basic materials, WIG-telecom. We examine the bivariate relationship between the stock market indices and INI by using the vector autoregression (VAR) model [Sims 1980], the Granger causality [Granger 1969] and for residual series with an ARCH effect GARCH models [Engle 1982, Bollerslev 1986] are determined.

This paper is organized as follows. First, we describe the data: sentiment index and the chosen market indices. Next, we present a brief overview of the methodology. In Section 4, we describe the empirical results. In the final section, we discuss the results.

2. Data

The study covers the 5-years period from June 2011 to June 2016 and the Market data from the Warsaw Stock Exchange (WSE) concerning industry sector. The INI will be used as the sentiment measurement. The data can be found at https://github.com/uchawi/INI-index-analysis.

2.1. Sentiment index

The INI is a weekly survey conducted by SII. INI measures the percentage of investors who are bullish, bearish and neutral regarding the direction of the stock market over the next 6 months. More than 350 investors per week participate in this survey. The results of the survey are published on Thursdays at 15:00. Fig. 1 presents the INI during the studied period. In the analysis, we take the differences between the percentage response of the bullish and bearish investors, and this way the periods, in which the number of bulls and bears on the market is balanced, are excluded.

2.2. WSE indices

The WSE publishes 25 indices. For this study, we consider indices based on the sector of industry. Sector indices allow evaluating the efficiency of investments of businesses in various sectors of the economy. Sector indices are based on WIG index

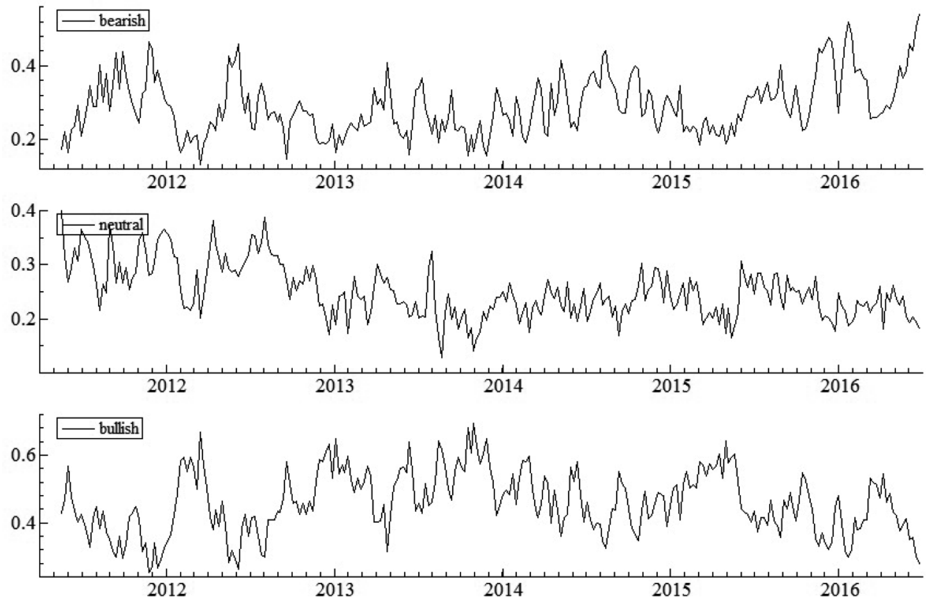

Fig. 1. INI index

Source: own study based on data from AII [SII 2016].

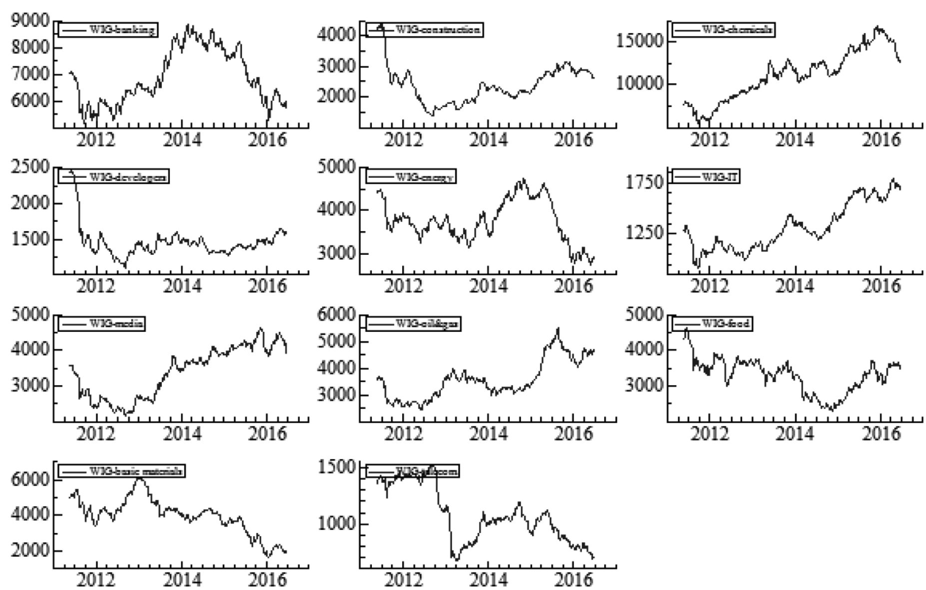

Fig. 2. Sector indices in the study period

Source: own study based on the data from WSE [Stoog.pl 2016].

methodology and account for income from dividend and subscription rights. WSE uses the following sector indices: WIG-banking, WIG-construction, WIG-chemicals, WIG-developers, WIG-energy, WIG-IT, WIG-media, WIG-oil&gas, WIG-food, WIG-basic materials, WIG-telecom[1].

2.3. S&P Global 1200

For robustness check an S&P Global 1200 index was chosen. The S&P Global 1200 Index covers 31 countries and approximately 70 percent of global stock market capitalization. It is composed of seven regional indices: S&P 500 Index (United States), S&P/TSX 60 Index (Canada), S&P Latin America 40 Index (Mexico, Brazil, Colombia, Chile, and Peru), S&P/TOPIX 150 Index (Japan), S&P Asia 50 Index (Hong Kong, Korea, Singapore, Taiwan), and S&P/ASX 50 Index (Australia), S&P Europe 350 Index. The S&P Global 1200 provides efficient exposure to the global equity market, so it captures the global stock market movements which can influence both sentiment and Polish sectoral indices.

3. Methodology

In the study, we use popular time series models with standard test. The VAR model is one of the most successful, flexible, and easy to use models for the analysis of multivariate time series. Within the model, each variable is a linear function of past lags of itself and past lags of the other variables.

This study requires some data pre-processing and formal verification of the properties of the time series. The following steps were conducted:

1. Return rate calculation – the INI is published weekly and data for market indices are calculated daily. Hence, the study covers two cases A and B. In study A, we use the weekly average of the daily closing prices return rate. This is a frequently accepted methodology in literature, because respondents' answers are collected throughout the week. In study B, we use the weekly return rate form day of publication of INI survey results. This approach avoids averaging the dependence and allows observing the impact of the publication of the investors' mood-related information.

2. Unit root tests – the Augmented Dickey-Fuller (ADF) test and the Kwiatkowski–Phillips–Schmidt–Shin test (KPSS) [c.f. Maddala, Lahiri 2009] were used to formally verify the time series' stationarity.

3. Lag selection – the appropriate lags were selected according to the Akaike information criterion (AIC). After the test, if the model was supposed to be rejected,

[1] Detailed descriptions of the WSE indices with calculation methodology can be found at https://www.gpw.pl/plik?ph_content_start=getFile&fwmf_id=4302.

the model was recalculated, considering the lags resulting from the Schwarz (BIC) and Hannan-Quinn (HQC) information criteria [c.f. Maddala, Lahiri 2009].

4. Multivariate VAR model. Let $Y_t = (y_{1t}, y_{2t}, ..., y_{nt})'$ denote a $(n \times 1)$ vector of times series variables. The basic p-lag vector autoregressive (VAR(p)) model has the form:

$$Y_t = c + \Pi_1 Y_{t-1} + \Pi_2 Y_{t-2} + ... + \Pi_p Y_{p-2} + \varepsilon_t, \quad t = 1, 2, ..., T,$$

where Π_i are coefficient matrices and ε_t is an unobservable zero mean white noise vector process (uncorrelated or independent) with a time invariant covariance matrix. The reference for VAR techniques is Lütkepohl [1991, 1994].

5. Verification of the residuals – every model was tested for autocorrelation of residuals, the ARCH effect and normality.

6. Granger causality test [c.f. Granger 2004].

4. Results

All obtained results are available online at https://github.com/uchawi/INI-index--analysis. The raw data time series were non-stationary according to the ADF and KPSS tests. Therefore, for analysis of market indices we used the logarithmic rate of return. For the INI, we use the difference between bullish and bearish sentiment (further marked INI). In effect, all the time series were stationary, so the cointegration of the investigated series was avoided (according to Engle–Granger two-step method).

We present the results of VAR models in Tables 2 (for case A) and 3 (for case B) in Appendix. Granger causality results are summarized in Table 1. All best fitting models with results of statistical tests on the variable and residuals can be found at https://github.com/uchawi/INI-index-analysis. Some of the VAR models have not normally distributed residuals, so we add dummy variable for outliners to ensure normality of residuals.

In study A, the all models indicate a positive statistically significant (at 0.01 levels) impact of index performance (regardless of sector) on sentiment. The coefficient is the biggest for the IT sector (9.13) and then for the sectors developers (8.9) and banking (7.9). In none of the equations where dependent variable is sentiment the wide market variable SP1200 was statistically significant. Only in two models: for the food sector and the basic materials statistically significant (at the level of 0.05) INI coefficients were observed (for food sector absolute value of the coefficient is very low). Interestingly, the coefficient is a negative number. This would mean that with the increase in the difference of the percentage of bulls and bears these indices decrease in return and increase in negative sentiment. All SP1200 coefficients for equations with index returns were statistically significant as a dependent variable. According to study B situation seems similar (see: Table 3 in Appendix). The only one sector that reacts to the publication of INI survey is oil&gas sector – coefficient of INI spread is statistically significant although very low.

Table 1. Granger causality results

H0	Lags		F-value		p-value	
Study	A	B	A	B	A	B
WIG-banking ↛ Spread	2	2	72.159	16.006	0.00***	0.00***
Spread ↛ WIG-banking	2	2	4.0439	1.6683	0.0187	0.1906
WIG-basic mat ↛ Spread	2	2	39.063	11.960	0.00***	0.00***
Spread ↛ WIG-basic mat	2	2	4.1035	0.9527	0.018**	0.3871
WIG-chemicals ↛ Spread	2	2	27.855	11.983	0.00***	0.00***
Spread ↛ WIG-chemicals	2	2	0.0586	0.7587	0.9431	0.4694
WIG-construction ↛ Spread	1	2	61.593	14.771	0.00***	0.00***
Spread ↛ WIG-construction	1	2	0.2923	1.7072	0.5892	0.1835
WIG-developers ↛ Spread	1	2	80.077	11.875	0.00***	0.00***
Spread ↛ WIG-developer	1	2	1.2908	0.9008	0.2570	0.4076
WIG-energy ↛ Spread	2	1	18.980	0.0036	0.00***	0.9524
Spread ↛ WIG-energy	2	1	2.1537	2.5833	0.1182	0.1092
WIG-food ↛ Spread	1	2	34.297	7.4651	0.00***	0.0007***
Spread ↛ WIGfood	1	2	3.8682	0.8678	0.05**	0.4211
WIG-IT ↛ Spread	1	2	59.940	7.1467	0.00***	0.001***
Spread ↛ WIG-IT	1	2	1.6715	0.6345	0.1972	0.5310
WIG-media ↛ Spread	1	2	52.899	14.958	0.00***	0.00***
Spread ↛ WIG-media	1	2	0.8532	1.0869	0.3565	0.3388
WIG-oil&gas ↛ Spread	2	2	28.803	9.4272	0.00***	0.00***
Spread ↛ WIG-oil&gas	2	2	0.3217	5.0307	0.73	0.0072***
WIG-telecom ↛ Spread	1	2	13.959	10.244	0.00***	0.00***
Spread ↛ WIG-telecom	1	2	1.1352	0.4696	0.2877	0.63

Source: own study.

5. Conclusion

We should reject the hypothesis of our study. The results show that all the sectors influence the sentiment of the investors. Moreover, there is no or little (for mean returns of food and basic materials sector and oil & gas sector in study B) impact of the investors' sentiment measured by the INI survey on the sectors.

The results of this study may call into question the INI as a barometer of future sentiment, since it seems to involve a sentiment based on the (past) reflection rather than that based on predictions. Weak dependences may be caused by the low share of individual investors in the main market. This study should be regarded as a preliminary study. In next step, we will examine other measures of sentiment, in particular a sentiment of institutional investors (ZDINEX). The source of the lack of the expected results can be also due to weekly aggregation of information in case of indices based on the survey. Therefore, we plan to carry out the analysis based on indirect measures of sentiment, such as media or web news sentiment. This will allow us to consider daily or higher frequency data.

References

Baker M., Wurgler J., 2006, *Investor sentiment and the crosssection of stock returns*, Journal of Finance, vol. 61 no. 4, p. 1645-1680.

Barberis N, Shleifer A., Vishny R, 1998, *A model of investor sentiment*, Journal of Financial Economics, no. 49, p. 307-343.

Bollerslev T., 1986, *Generalized Autoregressive Conditional Heteroscedasticity*, Journal of Econometrics, vol. 31, p. 307-327.

Brown G.W., Cliff M.T., 2004, *Investor sentiment and the near-term stock market*, Journal of Empirical Finance, vol. 11, p. 1-27.

Brzeszczyński J., Welfe A., 2007, *Are There Benefits from Trading Strategy Based on the Returns Spillovers to the Emerging Stock Markets?: Evidence from Poland*, Emerging Markets Finance and Trade, no. 43(4), p. 74-92.

De Long J.B., Shleifer A., Summers L.H., Waldmann R.J., 1990, *Noise trader risk in financial markets*, Journal of Political Economy, no. 98(4), p. 703-738.

Engle R.F., 1982, *Autoregressive Conditional Heteroscedasticity with Estimates of the Variance of United Kingdom Inflation*, Econometrica, vol. 50, no. 4, p. 987-1007.

Granger C.W., 1969, *Investigating Causal Relations by Econometric Models and Cross-spectral Methods*, Econometrica, vol. 37, no. 3, p. 424-438.

Granger C.W., 2004, *Time Series Analysis, Cointegration, and Applications,* American Economic Review, vol. 94, no. 3, p. 421-425.

Lütkepohl H., 1991, *Introduction to Multiple Time Series Analysis*, Springer-Verlag, Berlin.

Maddala G.S., Lahiri K., 2009, *Introduction to Econometrics*, 4th Edition, Wiley, Chichester.

Nouyrigat G., Zouaoui M., Beer F., 2011, *How does investor sentiment affect stock market crises? Evidence from panel data*, Financial Review, vol. 46, p. 723-747.

Sims C.A., 1980, *Macroeconomics and Reality*, Econometrica, no. 48, p. 1-48.

Sokalska M., 2015. *International Investor Sentiment and Emerging Equity Markets in Central and Eastern Europe,* Journal of Reviews on Global Economics, no. 4, p. 165-176.

Stoog.pl, 2016, *Dane historyczne: Giełda Papierów Wartościowych w Warszawie SA (GPW)*, https://stooq.pl/q/d/?s=gpw (02.07.2016).

Stowarzyszenie Inwestorów Indywidualnych, SII, 2016, *Indeks Nastrojów Inwestorów: Wyniki historyczne INI*, http://www.sii.org.pl/3438/edukacja-i-analizy/indeks-nastrojow-inwestorow.html (02.07.2016).

Tetlock P.C., 2007, *Giving Content to Investor Sentiment: The Role of Media in the Stock Market*, The Journal of Finance, no. 62(3), p. 1139-1168.

Uygur U., Taş O., 2014, *The impacts of investor sentiment on different economic sectors: evidence from Istanbul stock exchange*, Borsa Istanbul Review, no.14 (4), p. 236-241.

Appendix

Table 1. VAR models (study A)

	coeff	std. error	t-ratio	p-value		coeff.	std. error	t-ratio	p-value
Bank sector: Eq. 1 Spread					Bank sector: Eq. 2 WIG-banking				
const	0.0352	0.0078	4.508	0.00***	const	0.0006	0.0005	1.376	0.17
Spread_1	0.5664	0.0577	9.810	0.00***	Spread_1	–0.0033	0.0033	–0.9882	0.324
Spread_2	0.2307	0.0560	4.118	0.00***	Spread_2	–0.0023	0.0032	–0.7246	0.469
WIG banking_1	7.9078	0.8946	8.840	0.00***	WIG banking_1	0.0902	0.0516	1.750	0.081*
WIG banking_2	6.8947	1.0268	6.715	0.00***	WIG banking_2	0.0406	0.0592	0.6864	0.493
SP1200	–1.9917	1.3676	–1.456	0.15	SP1200	0.9009	0.0788	11.43	0.00***
Basic materials sector: Eq. 1 Spread					Basic materials sector: Eq. 2 WIG-bm				
const	0.0426	0.0065	−0.035	0.972	Const	−0.0003	0.0064	−0.052	0.959
Spread_1	0.6357	0.0665	−3.583	0.0004***	Spread_1	−0.2346	0.0636	−3.690	0.000***
Spread_2	0.1448	0.1802	3.236	0.0014***	Spread_2	1.1296	0.2865	3.943	0.000***
WIG--bm_1	4.0222	0.6092	6.603	0.00***	WIG-bm_1	0.1033	0.0476	2.168	0.031**
WIG--bm_2	3.2963	0.6586	5.005	0.00***	WIG-bm_2	0.1157	0.0515	2.248	0.026**
SP1200	–2.2234	1.5240	–1.459	0.146	SP1200	1.4004	0.1191	11.75	0.00***
* in order to ensure normality of residuals dummy variables for dates: 2011-09-22, 2011-11-17, 2015-08-27, 2016-06-02 were added									
Chemicals sector: Eq. 1 Spread					Chemicals sector: Eq. 2 WIG-chemicals				
const	0.0328	0.0088	3.717	0.00***	const	0.0003	0.0006	0.5432	0.588
Spread_1	0.7266	0.0626	11.61	0.00***	Spread_1	0.0008	0.0040	0.2049	0.838
Spread_2	0.0531	0.0610	0.8703	0.385	Spread_2	–0.0013	0.0039	–0.3278	0.743
WIG--chem_1	6.0689	0.8885	6.831	0.00***	WIG--chem_1	0.0869	0.0570	1.527	0.128
WIG--chem_2	2.1883	0.9730	2.249	0.03**	WIG--chem_2	–0.0234	0.0624	–0.3752	0.708
SP1200	–1.4216	1.5513	–0.9164	0.36	SP1200	0.7939	0.0995	7.980	0.00***
Construction sector: Eq. 1 Spread					Construction sector: Eq. 2 WIG-constructions				
Const	0.0471	0.0085	5.517	0.00***	Const	–0.0003	0.0005	–0.6385	0.524
Spread_1	0.7424	0.0360	20.59	0.00***	Spread_1	–0.0012	0.0022	–0.5406	0.589
WIG--constr_1	6.8094	0.8676	7.848	0.00***	WIG--constr_1	0.3248	0.0519	6.251	0.00***
SP1200	–1.7250	1.5302	–1.127	0.26	SP1200	0.6639	0.0916	7.244	0.00***
*in order to ensure normality of residuals (at level 0.1) dummy variables for dates: 2012-05-31, 2013-12-26 were added									

Developers sector: Eq. 1 Spread					Developers sector: Eq.* 2 WIG-developers				
const	0.0435	0.0081	5.319	0.00***	const	–0.0003	0.0004	–0.7167	0.474
Spread_1	0.7644	0.0347	22.03	0.00***	Spread_1	–0.0020	0.0018	–1.136	0.257
WIG--dev_1	8.9721	1.0026	8.949	0.00***	WIG--dev_1	0.2177	0.0512	4.251	0.00***
SP1200	–1.528	1.4851	–1.029	0.30	SP1200	0.7396	0.0758	9.753	0.00***
* in order to ensure normality of residuals dummy variable for 2013-05-23 was added									
Energy sector: Eq. 1 Spread					Energy sector: Eq. 2 WIG-energy				
const	0.0356	0.0092	3.875	0.00***	const	0.0002	0.0004	0.5261	0.599
Spread_1	0.6880	0.0615	11.19	0.00***	Spread_1	–0.0045	0.0029	–1.566	0.119
Spread_2	0.1223	0.0614	1.994	0.047**	Spread_2	0.0011	0.0028	0.3864	0.699
WIG--energy _1	4.8186	1.1499	4.190	0.00***	WIG--energy _1	0.0902	0.0538	1.676	0.095*
WIG--energy _2	4.6057	1.1445	4.024	0.00***	WIG--energy _2	0.0081	0.0536	0.1508	0.880
SP1200	–1.8746	1.6710	–1.122	0.263	SP1200	0.4814	0.0782	6.157	0.00***
* in order to ensure normality of residuals dummy variables for 2011-08-03, 2011-08-11, 2013-06-20 and 2015-12-31 were added									
Food sector: Eq. 1 Spread					Food sector: Eq. 2 WIG-food				
const	0.0368	0.0088	4.181	0.00***	const	0.0004	0.0006	0.6502	0.52
Spread_1	0.7886	0.0374	21.07	0.00***	Spread_1	–0.0047	0.0024	–1.967	0.05**
WIG--food_1	5.1193	0.8742	5.856	0.00***	WIG--food_1	0.0935	0.0562	1.664	0.097*
SP1200	–1.0577	1.5988	–0.6616	0.509	SP1200	0.7914	0.1027	7.706	0.00***
IT sector: Eq. 1 Spread					IT sector: Eq. 2* WIG-IT				
const	0.0348	0.0084	4.117	0.00***	const	0.0004	0.0004	1.097	0.27
Spread_1	0.7800	0.0358	21.79	0.00***	Spread_1	–0.002	0.0015	–1.293	0.2
WIG-IT_1	9.1313	1.179	7.742	0.00***	WIG-IT_1	0.0115	0.0508	0.2271	0.821
SP1200	–1.2483	1.5664	–0.7970	0.426	SP1200	0.6319	0.0675	9.368	0.00***
* in order to ensure normality of residuals dummy variables for 2011-08-03 and 2015-03-05 were added									
Media sector: Eq. 1 Spread					Media sector: Eq. 2 WIG-media				
const	0.0386	0.0085	4.511	0.00***	const	0.0002	0.0005	0.4129	0.68
Spread_1	0.7709	0.0362	21.28	0.00***	Spread_1	–0.0019	0.0021	–0.9237	0.357
WIG--media_1	6.8456	0.9413	7.273	0.00***	WIG-IT_1	0.0259	0.0538	0.4816	0.631
SP1200	–1.6959	1.5864	–1.069	0.29	SP1200	0.6193	0.0906	6.835	0.00***
* in order to ensure normality of residuals dummy variable for 2011-08-03 was added									
Oil&gas sector: Eq. 1 Spread					Oil&gas sector: Eq. 2 WIG-oil&gas				
Const	0.0399	0.0088	4.517	0.00***	const	0	0.0005	–0.1533	0.88
Spread_1	0.6574	0.0611	10.75	0.00***	Spread_1	–0.0028	0.0035	–0.8019	0.42
Spread_2	0.1029	0.0591	1.742	0.08*	Spread_2	0.0022	0.0034	0.6481	0.52

WIG- -oil&gas_1	5.7975	0.9347	6.203	0.00***	WIG- -oil&gas_1	0.1203	0.0542	2.218	0.03**
WIG- -oil&gas_2	3.6145	1.0127	3.569	0.00***	WIG- -oil&gas_2	–0.0110	0.0588	–0.1878	0.85
SP1200	–1.5927	1.5458	–1.030	0.303	SP1200	0.8418	0.0896	9.386	0.00***
Telecommunication sector: Eq. 1 Spread					Telecommunication sector: Eq. 2* WIG-Telecom				
Const	0.0388	0.0091	4.255	0.00***	Const	0	0.0005	0.1736	0.862
Spread_1	0.7828	0.0389	20.13	0.00***	Spread_1	–0.0021	0.0020	–1.065	0.288
WIG- -telecom_1	3.2147	0.8604	3.736	0.00***	WIG- -telecom_1	0.1551	0.0445	3.490	0.00***
SP1200	–1.4640	1.6580	–0.8830	0.378	SP1200	0.4735	0.0857	5.527	0.00***
* in order to ensure normality of residuals dummy variables for 2013-02-07, 2012-10-11 and 2015-01-22 were added									

Source: own study.

Table 2. VAR models (study B)

	Coeff	std. error	*t*-ratio	*p*-value		coeff.	std. error	*t*-ratio	*p*-value
Bank sector: Eq. 1 Spread					Bank sector: Eq. 2 WIG-banking				
const	0.0364	0.0092	3.936	0.00***	const	0.0001	0.0010	0.1406	0.8883
Spread_1	0.7611	0.0593	12.85	0.00***	Spread_1	0.0076	0.0064	1.186	0.2368
Spread_2	0.0235	0.0592	0.3978	0.691	Spread_2	–0.0115	0.0064	–1.800	0.0731
WIG banking_1	–0.1091	0.4769	–0.2289	0.819	WIG banking_1	–0.0374	0.0516	–0.7250	0.4691
WIG banking_2	2.6846	0.4777	5.619	0.00***	WIG banking_2	0.0048	0.05171	0.0937	0.9254
SP1200	0.3882	0.7107	0.5462	0.585	SP1200	0.8447	0.0769	10.98	0.00**
Basic materials sector: Eq. 1 Spread					Basic materials sector: Eq. 2 WIG-bm*				
const	0.0369	0.0093	3.948	0.00***	const	0.0009	0.0015	0.6418	0.5216
Spread_1	0.7419	0.0598	12.40	0.00***	Spread_1	0.0034	0.0097	0.3540	0.7237
Spread_2	0.0460	0.0598	0.7695	0.44	Spread_2	–0.0109	0.0097	–1.126	0.2614
WIG-bm_1	0.2796	0.3175	0.8806	0.38	WIG-bm_1	–0.0641	0.0515	–1.236	0.2176
WIG-bm_2	1.5254	0.3140	4.857	0.00***	WIG-bm_2	0.1546	0.0509	3.036	0.003***
SP1200	0.1218	0.7196	0.1693	0.87	SP1200	1.0865	0.1167	9.314	0.00***
* in order to ensure normality of residuals dummy variable for dates: 2011-11-10 was added									
Chemicals sector: Eq. 1: Spread					Chemicals sector: Eq. 2: *WIG-chemicals				
const	0.0335	0.0096	3.492	0.00***	const	0.0014	0.0013	1.084	0.2795
Spread_1	0.7731	0.0608	12.71	0.00***	Spread_1	0.0092	0.0085	1.076	0.2831
Spread_2	0.0150	0.0604	0.2487	0.80	Spread_2	–0.0103	0.0085	–1.212	0.2268
WIG- -chem_1	–0.3153	0.4172	–0.7559	0.45	WIG- -chem_1	–0.1070	0.0586	–1.826	0.07*
WIG- -chem_2	1.8588	0.4099	4.535	0.00***	WIG- -chem_2	0.0467	0.0576	0.8110	0.4181

SP1200	0.3752	0.7452	0.5035	0.62	SP1200	0.5293	0.1047	5.057	0.00***
* in order to ensure normality of residuals dummy variables for dates: 2011-09-01 and 2011-09-08 were added									
Construction sector: Eq. 1 Spread					Construction sector: Eq. 2* WIG-construction				
Const	0.0442	0.0095	4.680	0.00***	Const	−0.001	0.0012	−0.975	0.3304
Spread_1	0.6999	0.0607	11.53	0.00***	Spread_1	0.0082	0.0068	1.197	0.2325
Spread_2	0.0287	0.0599	0.4790	0.63	Spread_2	0	0.0067	0.0056	0.9955
WIG- -const._1	1.2550	0.5207	2.410	0.01**	WIG- -const._1	0.0068	0.0586	0.1168	0.9071
WIG- -const._2	2.5350	0.5190	4.884	0.00***	WIG- -const._2	−0.012	0.0584	−0.202	0.8399
SP1200	0.2036	0.7179	0.2836	0.78	SP1200	0.4728	0.0808	5.851	0.00***
* the only model without normality of residuals despite the dummy variables									
Developers sector: Eq. 1 Spread					Developers sector Eq. 2 WIG-developers				
const	0.035	0.0095	3.677	0.00***	const	0.0003	0.0009	0.3569	0.7215
Spread_1	0.7336	0.0608	12.07	0.00***	Spread_1	0.0075	0.0057	1.321	0.1876
Spread_2	0.0399	0.0603	0.6629	0.508	Spread_2	–0.0049	0.0056	–0.8649	0.3879
WIG- -dev_1	0.4795	0.5718	0.8386	0.403	WIG- -dev_1	–0.0269	0.0535	–0.5019	0.6162
WIG- -dev_2	2.7714	0.5760	4.812	0.00***	WIG- -dev_2	–0.0623	0.0539	–1.156	0.2489
SP1200	0.2789	0.7328	0.3806	0.704	SP1200	0.4081	0.0686	5.950	0.00***
*in order to ensure normality of residuals dummy variables for dates: 2011-07-21 , 2011-09-22, 2012-09-06, and 2015-11-19 were added									
Energy sector: Eq. 1 Spread					Energy sector: Eq. 2 WIG-energy				
const	0.0388	0.0094	4.124	0.00***	const	–0.0013	0.0011	–1.193	0.2342
Spread_1	0.7681	0.0399	19.26	0.00***	Spread_1	0.0077	0.0048	1.607	0.1092
WIG- -energy _1	0.0293	0.4907	0.0598	0.952	WIG- -energy _1	–0.1087	0.0592	–1.835	0.0676 *
SP1200	0.0699	0.7477	0.0931	0.926	SP1200	0.4549	0.0902	5.041	0.00***
Food sector: Eq. 1 Spread					Food sector: Eq. 2 WIG-food				
const	0.0377	0.0095	3.955	0.00 ***	const	0.0006	0.0013	0.4265	0.6701
Spread_1	0.7336	0.0612	11.99	0.00 ***	Spread_1	0.0026	0.0083	0.3133	0.7543
Spread_2	0.0468	0.0612	0.7643	0.445	Spread_2	–0.0088	0.0083	–1.058	0.2912
WIG- -food_1	0.5308	0.4486	1.183	0.238	WIG- -food_1	–0.0582	0.0610	–0.9537	0.3411
WIG- -food_2	1.6808	0.4511	3.726	0.00 ***	WIG- -food_2	0.0142	0.0614	0.2316	0.8170
SP1200	–0.0231	0.7311	–0.0316	0.97	SP1200	0.4015	0.0995	4.036	0.00***
IT sector: Eq. 1 Spread					IT sector: Eq. 2 WIG-IT				
const	0.0365	0.0096	3.791	0.00***	const	0.0013	0.0010	1.226	0.22
Spread_1	0.7520	0.0617	12.20	0.00***	Spread_1	0.0069	0.0066	1.054	0.29
Spread_2	0.0142	0.0617	0.2306	0.818	Spread_2	–0.0070	0.0066	–1.063	0.29

WIG-IT_1	0.1642	0.5203	0.3156	0.753	WIG-IT_1	–0.1110	0.0555	–2.000	0.05**
WIG_IT_2	1.9730	0.5219	3.781	0.00***	WIG_IT_2	–0.04767	0.0556	–0.8561	0.39
SP1200	0.39	0.7533	0.518	0.61	SP1200	0.4410	0.0804	5.487	0.00***
* in order to ensure normality of residuals dummy variables for dates: 2011-09-01 and 2013-08-29 were added									
Media sector: Eq. 1 Spread					Media sector: Eq. 2 WIG-media				
const	0.0392	0.0094	4.192	0.00***	const	0.0007	0.0012	0.5577	0.5776
Spread_1	0.7488	0.0595	12.58	0.00***	Spread_1	0.0058	0.0079	0.7302	0.4659
Spread_2	0.0220	0.0596	0.3684	0.71	Spread_2	–0.0109	0.0079	–1.381	0.1684
WIG--media_1	0.1486	0.4299	0.3456	0.73	WIG--media_1	–0.1017	0.0571	–1.782	0.0759*
WIG_ media_2	2.3604	0.4318	5.466	0.00***	WIG--media_2	0.0764	0.0573	1.334	0.1834
SP1200	0.1112	0.7126	0.1561	0.876	SP1200	0.5132	0.0946	5.424	0.00***
* in order to ensure normality of residuals dummy variable for date: 2015-12-03 was added									
Oil&gas sector: Eq. 1 Spread					Oil&gas sector: Eq. 2 WIG-oil&gas				
const	0.0394	0.0095	4.157	0.00 ***	const	–0.0012	0.0013	–0.9515	0.3422
Spread_1	0.7399	0.0609	12.14	0.00 ***	Spread_1	0.0260	0.0082	3.167	0.00 ***
Spread_2	0.0263	0.0612	0.4307	0.667	Spread_2	–0.0212	0.0082	–2.558	0.01 **
WIG--oil&gas_1	0.4376	0.4206	1.040	0.299	WIG--oil&gas_1	–0.0580	0.0567	–1.023	0.31
WIG--oils&gas_2	1.7875	0.4192	4.264	0.00 ***	WIG--oils&gas_2	–0.0006	0.0565	–0.012	0.9914
SP1200	0.2655	0.7264	0.365	0.715	SP1200	0.7243	0.0979	7.402	0.00 ***
Telecommunication sector: Eq. 1 Spread					Telecommunication sector: Eq. 2 WIG-telecom				
Const	0.0361	0.0095	3.819	0.00***	Const	0.00	0.0012	0.2443	0.81
Spread_1	0.7502	0.0613	12.24	0.00***	Spread_1	0.0058	0.0075	0.7671	0.44
Spread_2	0.0276	0.0612	0.4502	0.65	Spread_2	–0.0073	0.0075	–0.9687	0.33
WIG--telecom_1	–0.0492	0.4161	–0.1183	0.91	WIG--telecom_1	–0.0156	0.0512	–0.3038	0.76
WIG--telecom_2	1.8730	0.4146	4.517	0.00***	WIG--telecom_2	–0.0391	0.0510	–0.7653	0.44
SP1200	0.1583	0.7475	0.2118	0.83	SP1200	0.3140	0.0921	3.410	0.00***
* in order to ensure normality of residuals dummy variables for dates: 2011-09-01, 2013-02-21, 2013-06-13, 2015-02-05 were added.									

Source: own study.