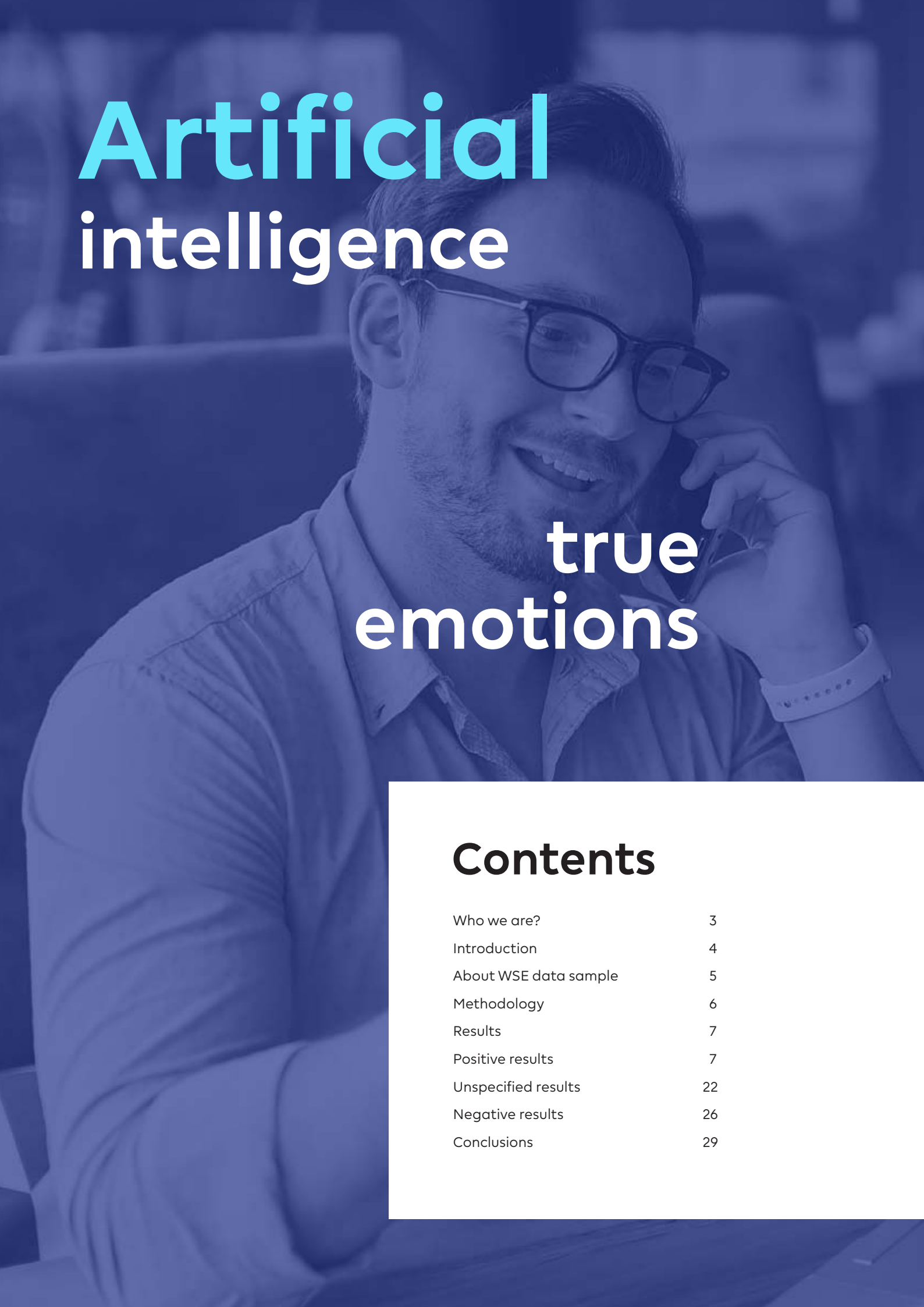
Sentimenti



REPORT

Proof of Concept

Automatic emotions and investor sentiment analysis for stock trends forecasting



Artificial intelligence true emotions

Contents

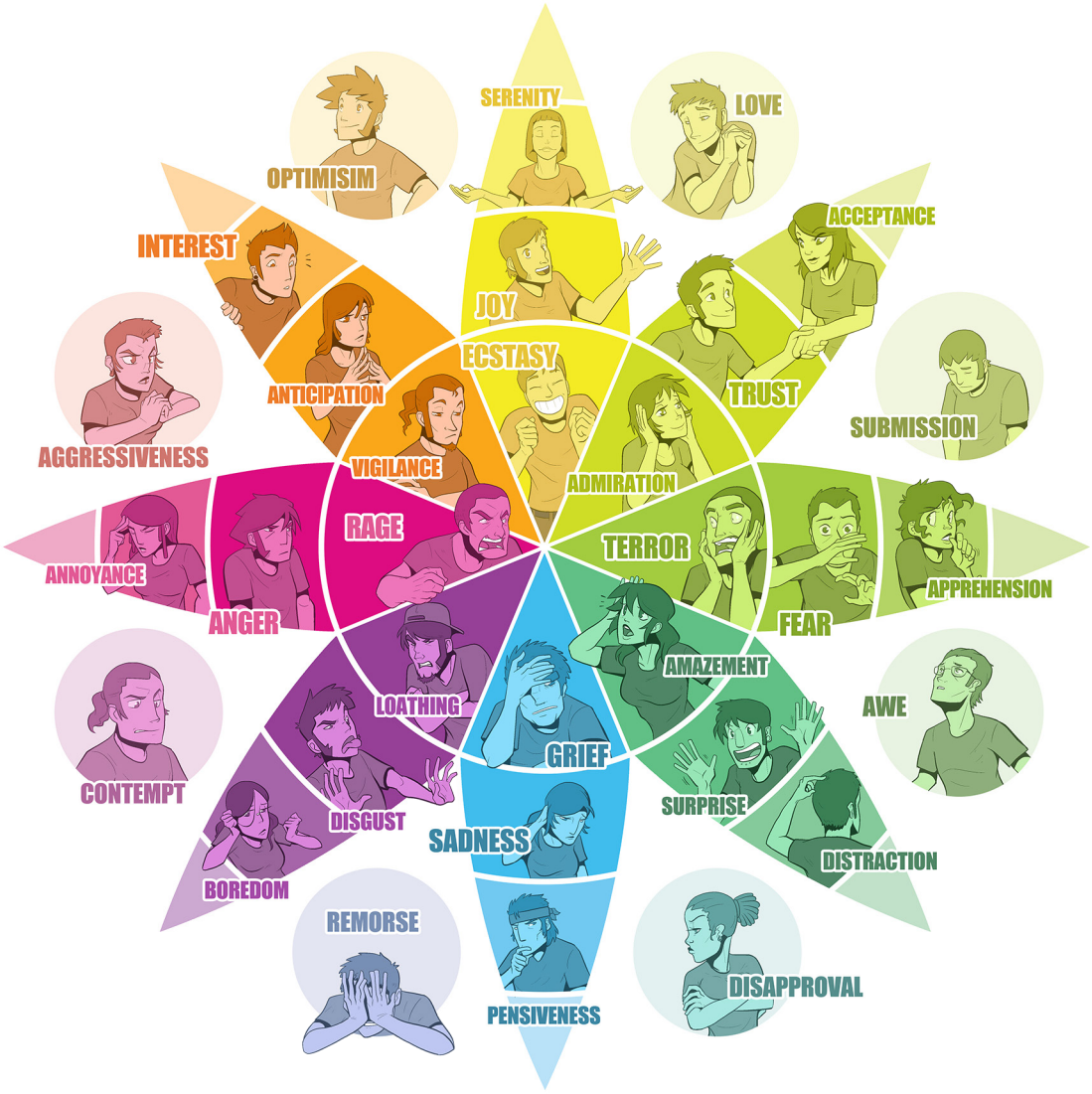
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Who we are?

Sentimenti is the result of a cooperation between linguistic engineering and artificial intelligence specialists. Our solutions use text mining and deep learning.

Models implemented in our algorithms are based on the results of scientific research involving over 20.000 Poles. The syntactic-semantic analysis allows to distinguish language units and establish emotive meanings of not only the words used in any publication but also of phrases and the entire text.

The emotional analysis includes 8 basic emotions and valence defined on two scales (polarization and stimulation) and can be applied to all words and meanings in Polish. The results of our analysis, show which emotions are expressed in all types of texts published about a brand, company or product.



Introduction

There are various tools for automatic analysis of the stock market. One of them, used as a supporting tool in financial decisions, is the so called investor sentiment analysis which comes from the field of behavioural finance.

Analyses of this type include variables based on surveys and opinion polls addressed at professionals from the fields of finances, economy, financial analysis and trade. Some of the best known investor sentiment indexes are:

• **AAII Bull and Bear** – aII survey, one of the most popular questionnaires asking about the Wall Street gathering the opinions of the AAII members. Each week they answer the same questions. Their responses are calculated and published as AII Investor Sentiment Survey that offers insights into moods of different traders. This index is highly valued, followed by the professionals and published in well-known journals like Bloomberg;

• **CNN Fear and Greed index** – according to CNN investors are driven by two emotions: fear and greed. This index is not based on surveys but takes into account broader context: fluctuations of the VIX index (fear index). The aforementioned VIX estimates the variability on the American Stock Exchange expected by the investors in 30-sessions time.[1]

• **Bank of America Merrill Lynch's Bull & Bear Indicator** - investor sentiment index published weekly in Flow Show reports, internal documentation available only for the clients of the bank.[2]

• Polish stock market investor sentiment index is published as **Indeks Nastrojów Inwestorów (Investor Mood Index)**. It is based on research published weekly by Stowarzyszenie Inwestorów Indywidualnych (SII, Association of Individual Investors). This index shows estimations of the percentage of bulls, bears and neutral investors forecasting stock market for the next 6 months.[3]

In this report we evaluate a new tool for inwestor sentyment analysis, SentiStock and check the accuracy of the forecasts based on Sentimenti sentiments analysis. The evaluation covers 10% of the main floor of Warsaw Stock Exchange.

1 *www.xtb.com/pl/edukacja/sentyment-rynkowy-i-pozycjonowanie-inwestorow*

2 *https://strefainwestorow.pl/artykuly/20180206/wskazniki-nastrojow-gieldowych*

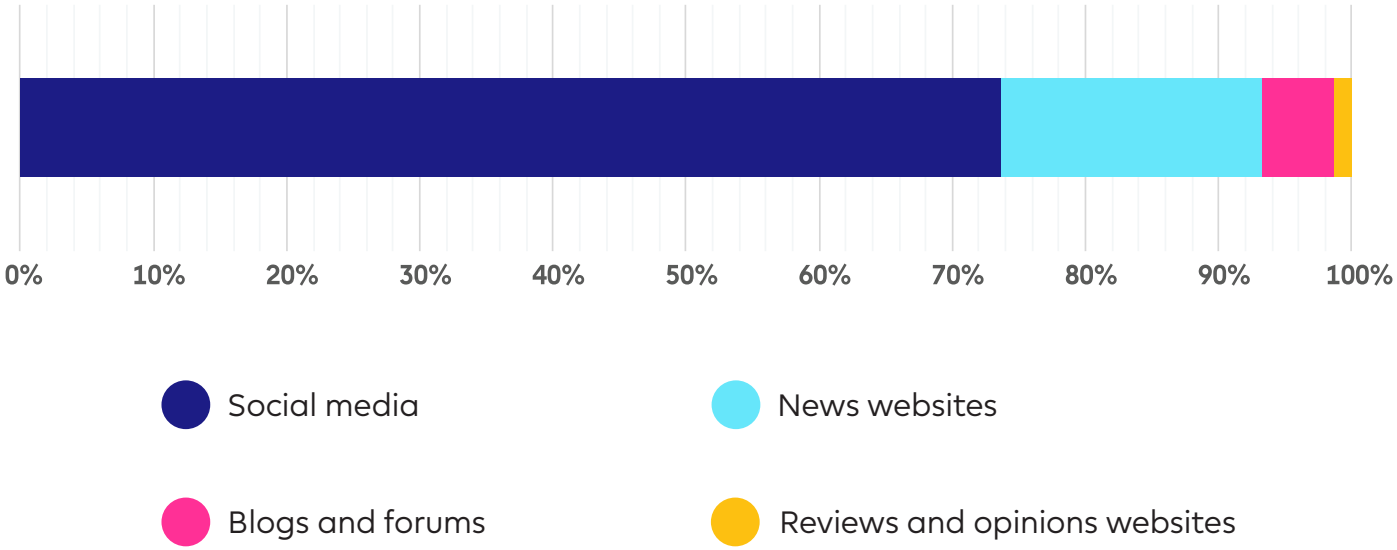
3 *www.sii.org.pl*

About WSE data sample

The report covers 37 companies (8% of the Warsaw Stock Exchange main floor). They were chosen on the basis of brand monitoring results. Crucial was the number of daily mentions (in social media, forums, news portals) – the results are most reliable with at least 50 mentions a day.

50 corporations analysed in the SentiStock project:: *Gino Rossi, Amica, Komputronik, Wittchen, KGHM, PZU, Wojas, 4FUN, Agora, Netia, PKN Orlen, Żywiec, PKO, Monari, CCC, LPP, Alior Bank, BGŻ BNP, CD Projekt, CIECH S.A., COMARCH, Cyfrowy Polsat, Dębica, Enea, ENERGA, Grupa Azoty, Bank Handlowy, Lotos S.A., Orange Polska S.A., Oponeo, PLAY, PKP Cargo, VISTULA, WAWEL, Work Service S.A., ZE PAK, 11 BIT Studios SA, Baltona, Dino Polska,Impel S.A., Indykpol S.A., Intersport Polska, Kania Z-dy Mięsne, Kino Polska TV S.A., Kruszwica, Sfinks Polska S.A., Tarczyński S.A., TS Games, TOYA, FORTE S.A.* Ostatecznie do badania zakwalifikowano 37 spółek (liczba ta stanowi 8% ogólnej liczby spółek z głównego parkietu Giełdy Papierów Wartościowych w Warszawie).[4]

In the chart below, the data gathered over 30 days are presented according to their source: **social media** Facebook, Twitter, YouTube, Instagram), **information portals** (news, articles and comments), blogs and forums (including comments) and reviews (np. Ceneo, GoWork, Google Play, Apple Store). Their contribution may differ between companies depending on their offer and target market.



4 *gpw.pl/statystyki-gpw na dzień 12.04.2019 r.*

Methodology

In this report, we show the effectiveness of SentiStock emotions monitoring in investor sentiment analysis and stock prices forecasting. 8% of the Warsaw Stock Exchange main floor was analysed.

1. 1. SentiStock analysis:

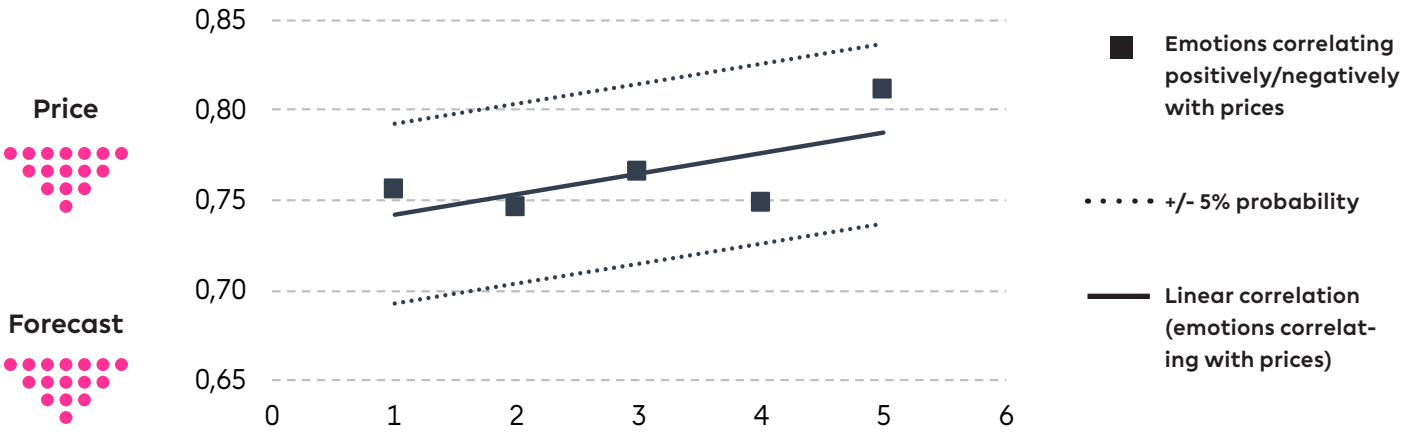
- first stage: automatic sentiment and emotions analysis performed with one of Sentimenti tools that implements **Plutchik's 8 basic emotions model**;[5]
- second stage: analysis of correlations between emotions and stock prices (Pearson's correlation coefficient);
- condition one: the trend (here linear and nonlinear relations are taken into account) has to fit the data with +/- 5% probability ($p<0.05$);
- condition two: the trend line produced by SentiStock has to be saturated **(min. 60% data points)** with the real data points to become a valid indicator of the stock price fluctuation for a given brand and be used for price forecasting.

2. Media monitoring and stock prices data collection: **26 – 30 November 2018**

3. Stock prices forecast: **01 – 05 December 2018**

4. The basis for forecast accuracy assessment was the mean stock price calculated over all the trading days (opening, closing, minimum and maximum price).

Example:



5 *more: https://sentimenti.pl/*

Results

SentiStock forecast can yield three types of results:

- **positive** - when the forecasted trend is in line with the actual mean price noted on Warsaw Stock Exchange,
- **negative** - when the forecasted trend differs from the actual mean price noted on Warsaw Stock Exchange,
- **unspecified** - when it was impossible to calculate the trend.

Among the 37 companies analysed, it was possible to calculate a conclusive stock price forecast on the basis of Sentimenti sentiment and emotions analysis in 31 cases. In 27 cases the forecast result was positive (in line with the actual price trend) and negative in only 4 cases.

Positive results

Price trend forecast - positive results

Company name	Closing price (the end of November)	Closing price (December 5)	Mean price (December 5)	Forecast (price trend) based on emotions and price correlation
Gino Rossi	0,41	0,40	0,44	rise
Amica	113,60	117,40	116,58	rise
Komputronik SA	3,29	3,34	3,38	rise
Wittchen	14,00	14,85	14,84	rise
KGHM Polska Miedź	89,72	92,00	92,46	rise
PZU	42,87	43,97	43,41	rise
Wojas	4,14	3,81	3,86	fall
4FUN TV	13,85	12,95	13,34	fall
Netia SA	4,69	4,75	4,71	rise
PKN Orlen	110,10	110,50	108,96	fall
Grupa Żywiec	462,00	464,00	466,00	rise
PKO BP	40,91	41,80	41,58	rise
Monari	4,81	4,70	4,74	fall
LPP SA	7 820,00	7 990,00	7 764,17	rise
Alior Bank	54,50	57,40	55,90	rise

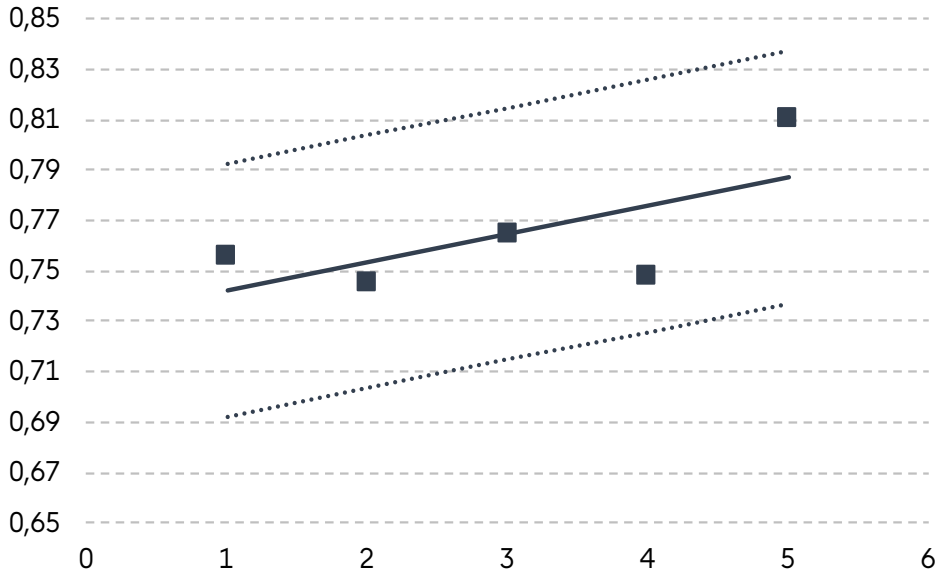
CD Projekt Red	142,20	148,40	151,29	rise
COMARCH	157,00	160,00	158,96	rise
Cyfrowy Polsat	22,46	23,20	22,65	rise
Dębica SA	95,40	96,80	97,18	rise
Enea SA	10,70	10,86	10,98	rise
Grupa Azoty	32,68	34,90	34,56	rise
Grupa LOTOS	82,02	84,18	83,99	rise
Orange Polska	4,78	4,96	4,84	rise
Oponeo SA	22,70	23,00	22,66	rise
PLAY / P4	16,15	18,55	18,16	rise
PKP Cargo	41,50	45,20	43,36	rise
Wawel SA	834,00	868,00	857,50	rise

Explanation:

- **Forecast** - forecast of the price trend (December 1-5);
- **Price** - actual price trend (December 1-5).

4FUN TV

forecast: *price:*



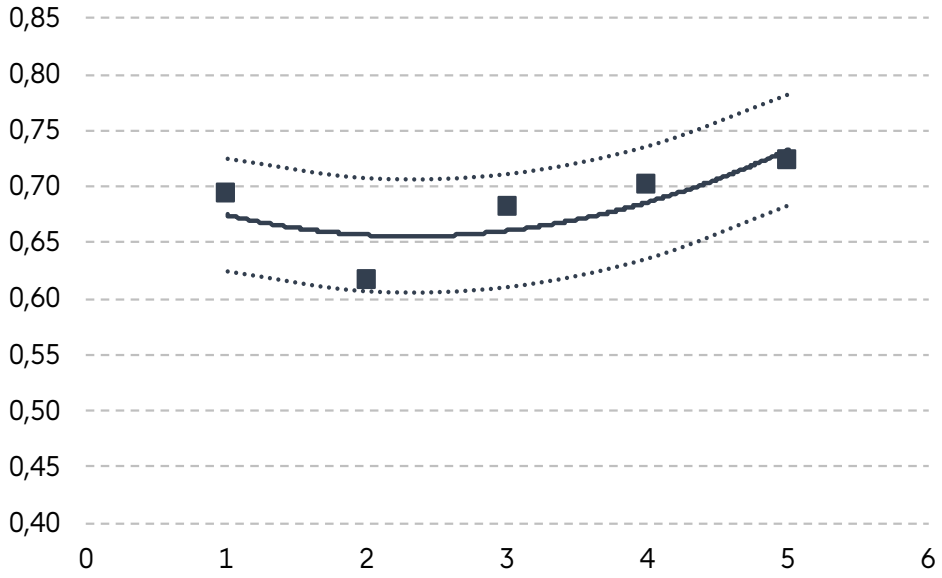
Emotions correlating positively/negatively with prices

+/- 5% probability

Linear correlation (emotions correlating with prices)

Grupa Azoty

forecast: *price:*



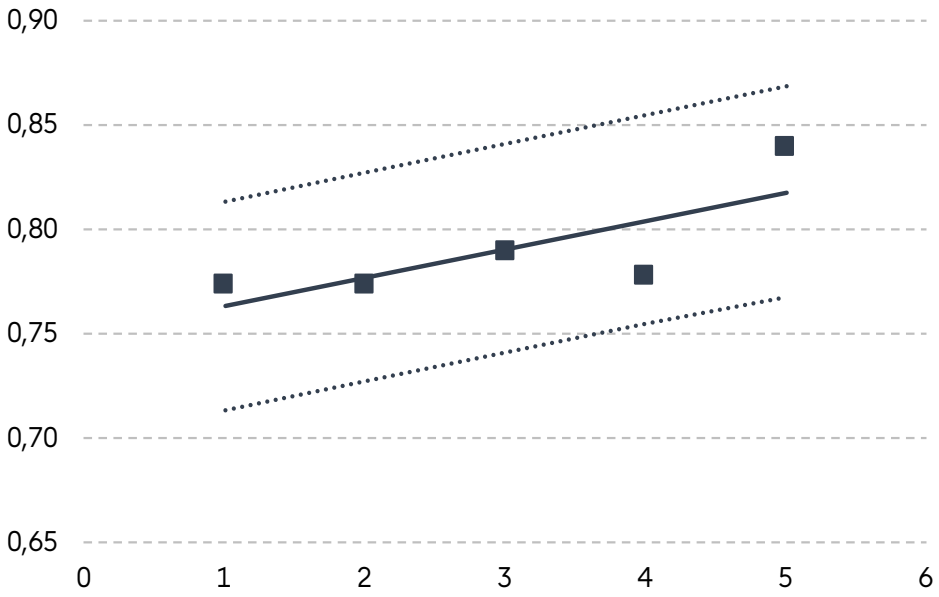
Emotions correlating positively/negatively with prices

+/- 5% probability

Linear correlation (emotions correlating with prices)

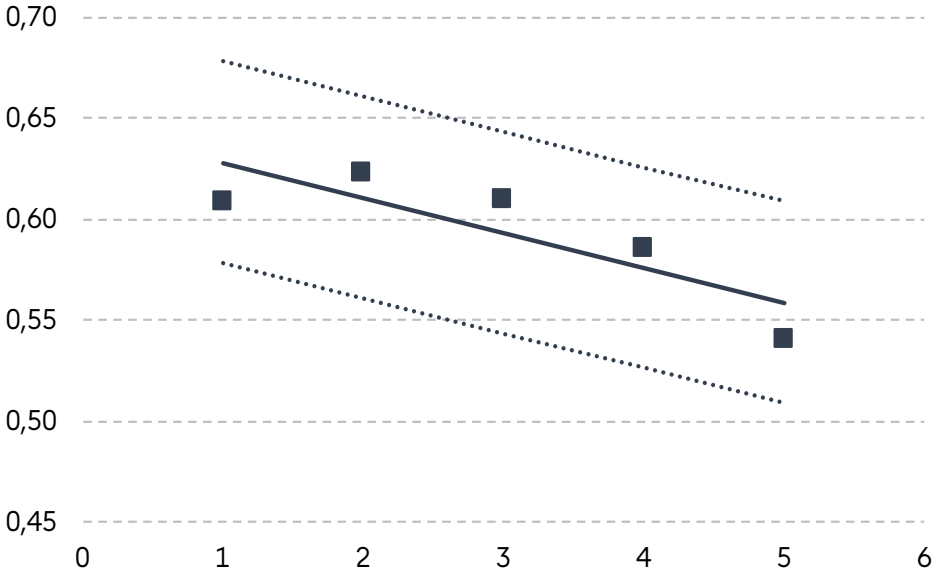
Enea SA

forecast: *price:*



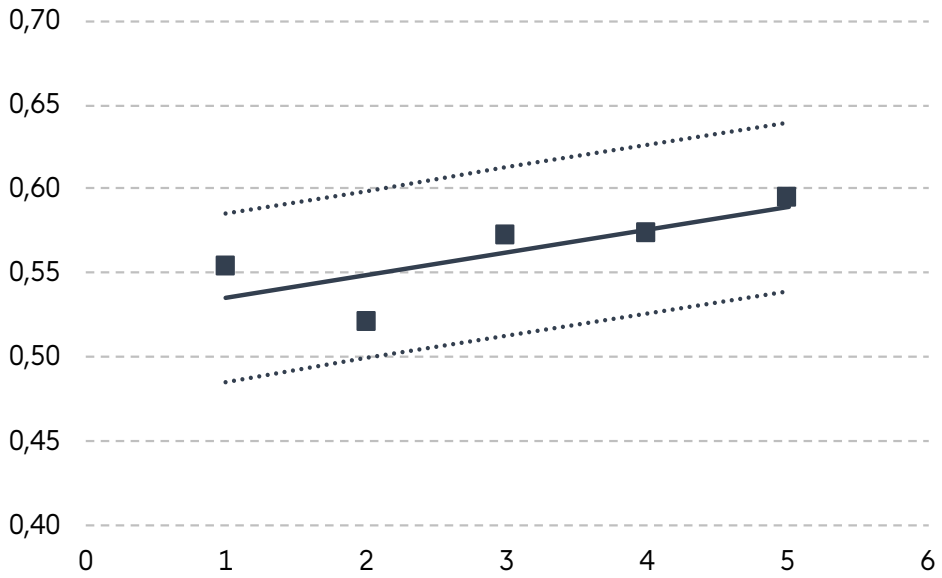
Alior Bank

forecast: *price:*



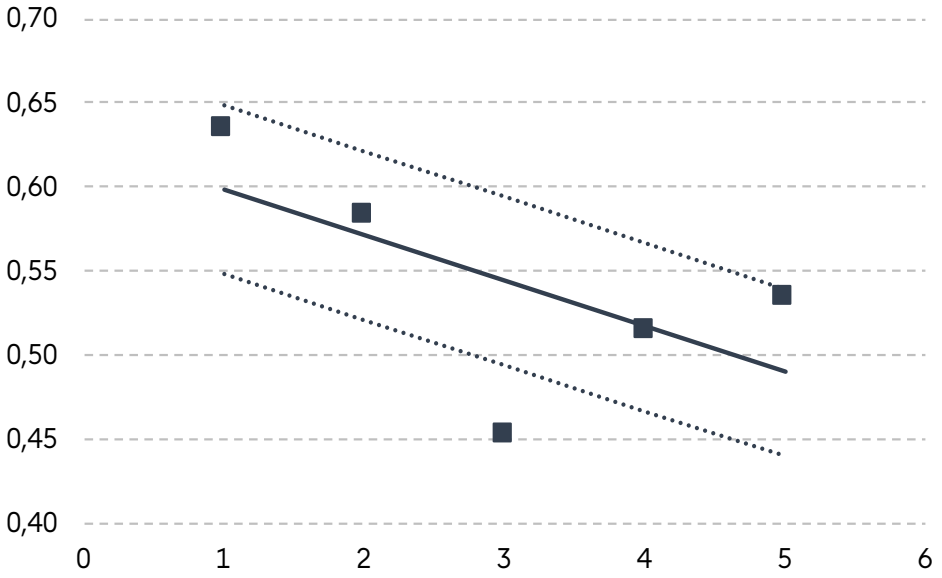
CD Projekt Red

forecast: *price:*



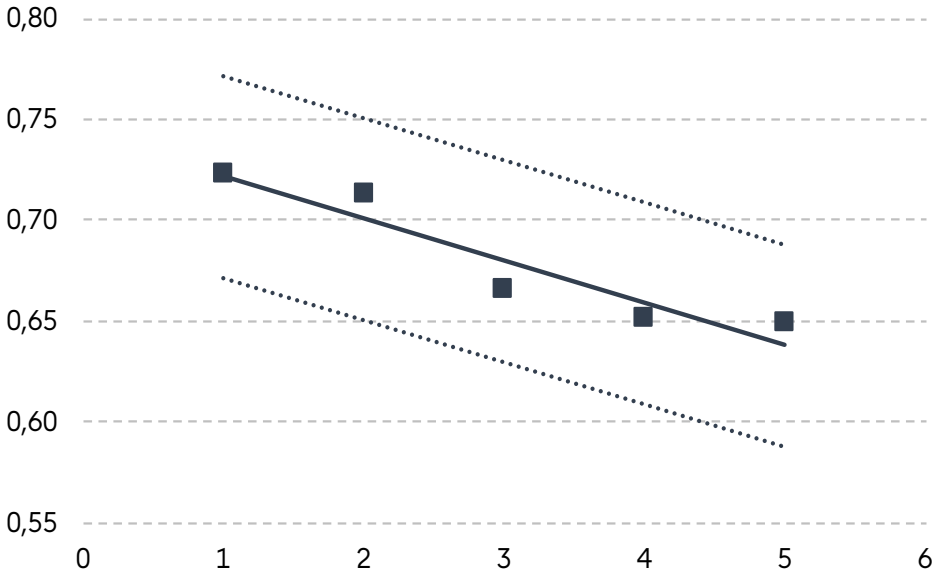
Gino Rossi

forecast: *price:*



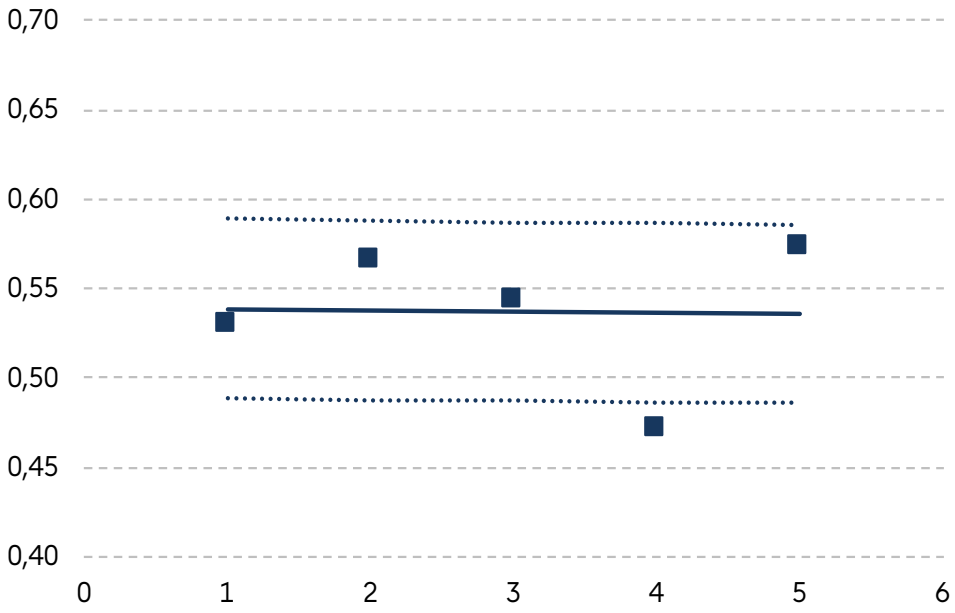
Amica

forecast: *price:*



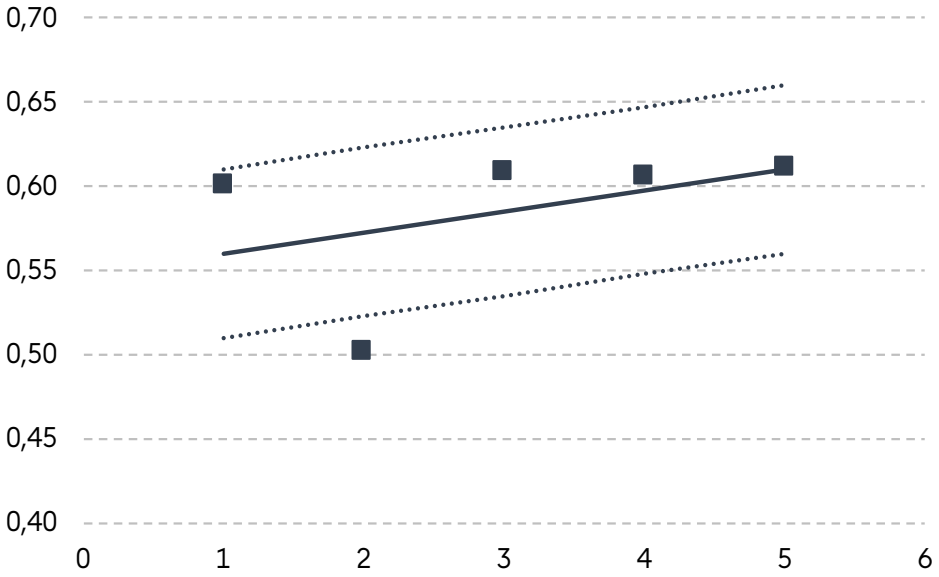
Comarch

forecast: *price:*



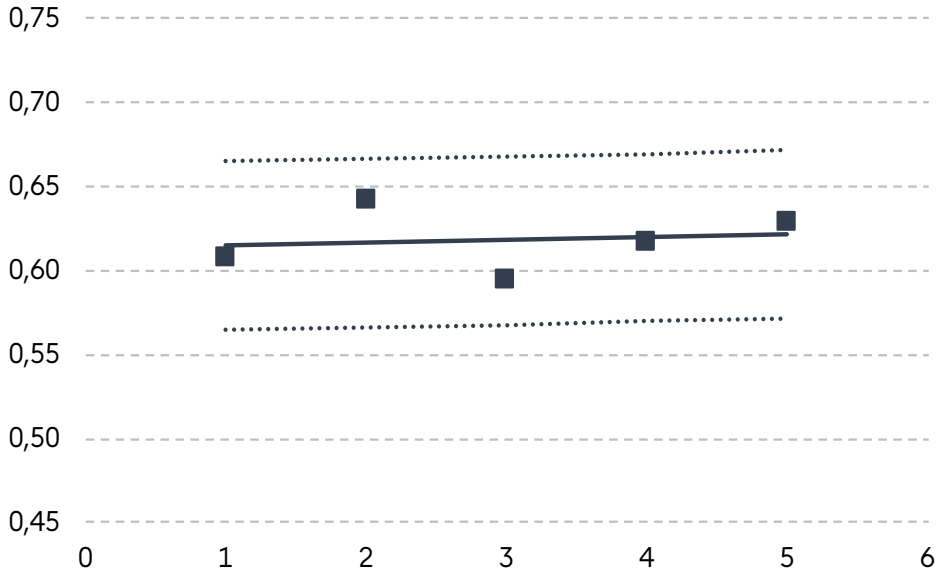
KGHM Polska Miedź

prognoza: *kurs:*



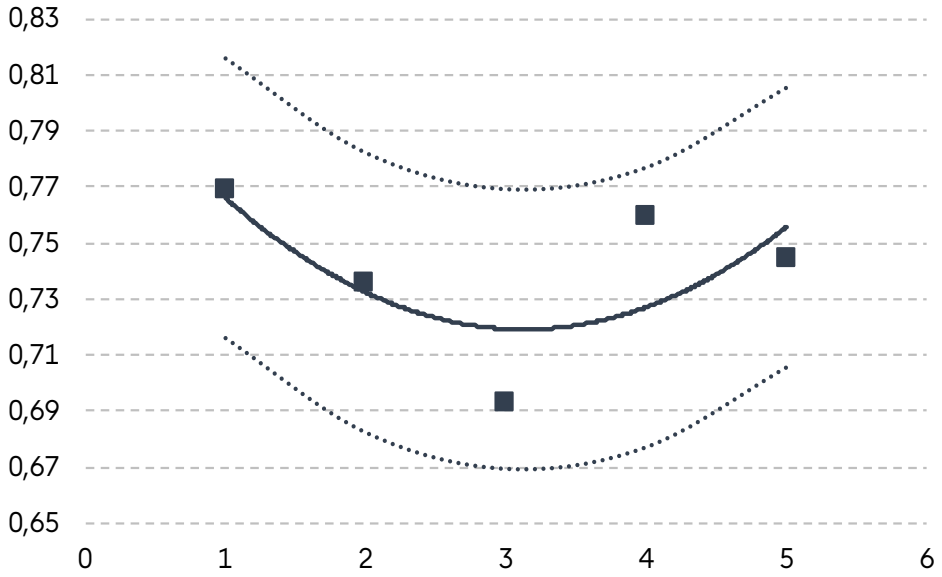
Cyfrowy Polsat

forecast: *price:*



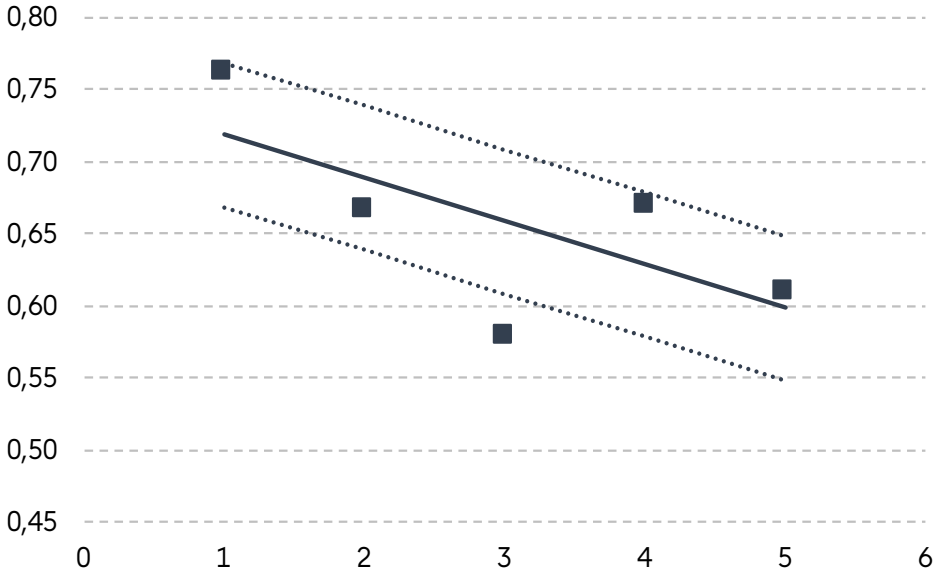
Dębica SA

forecast: *price:*



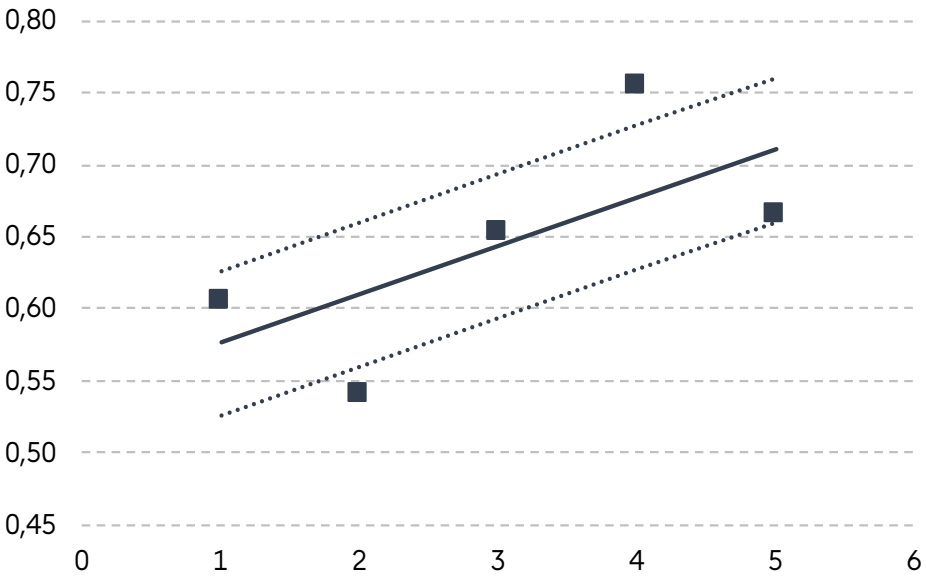
Komputronik SA

forecast: *price:*



Grupa LOTOS

forecast: *price:*



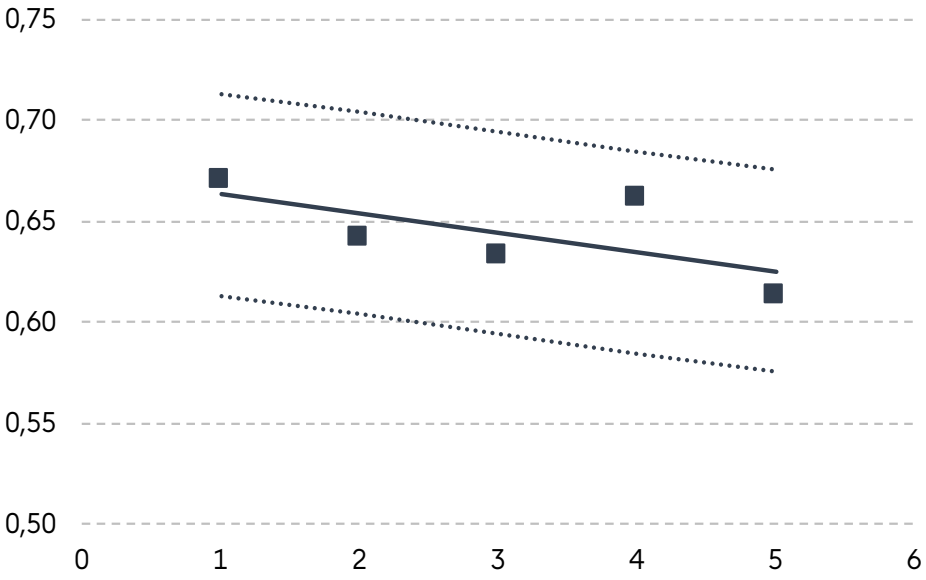
Emotions correlating positively/negatively with prices

+/- 5% probability

Linear correlation (emotions correlating with prices)

LPP SA

forecast: *price:*



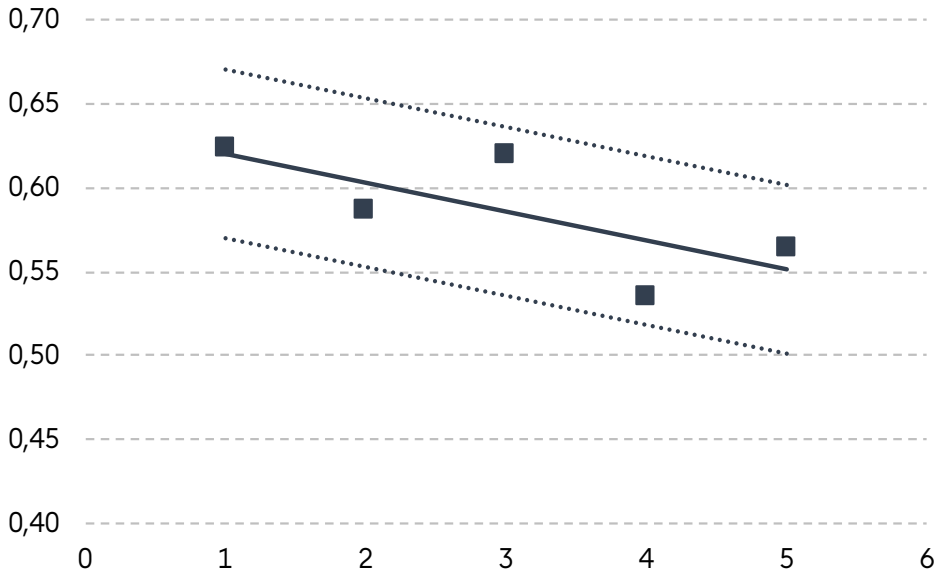
Emotions correlating positively/negatively with prices

+/- 5% probability

Linear correlation (emotions correlating with prices)

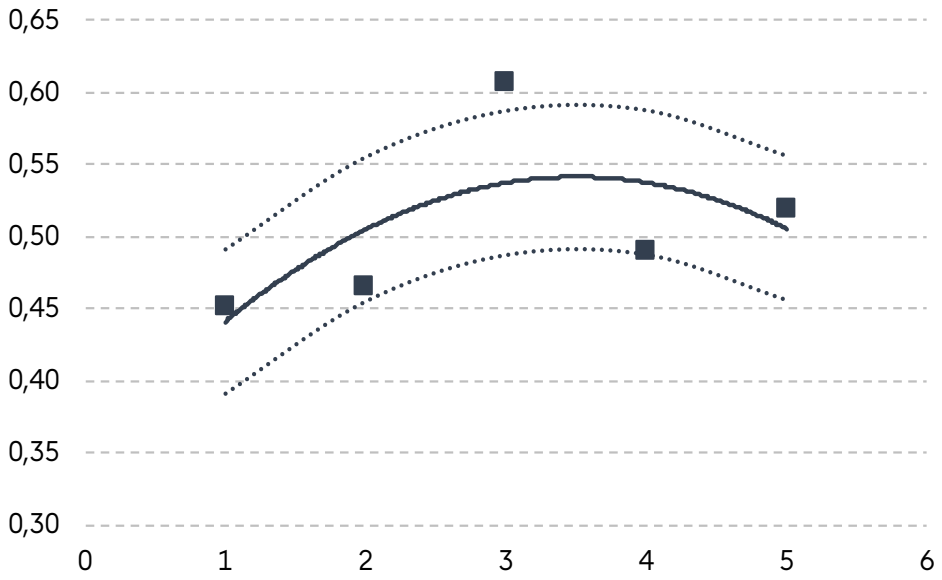
Monari

forecast: *price:*



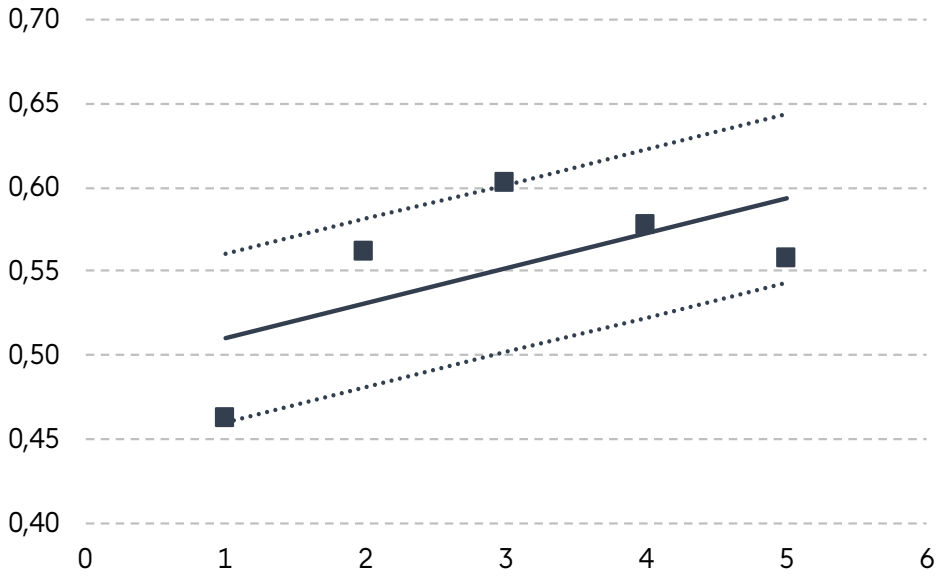
Netia SA

forecast: *price:*



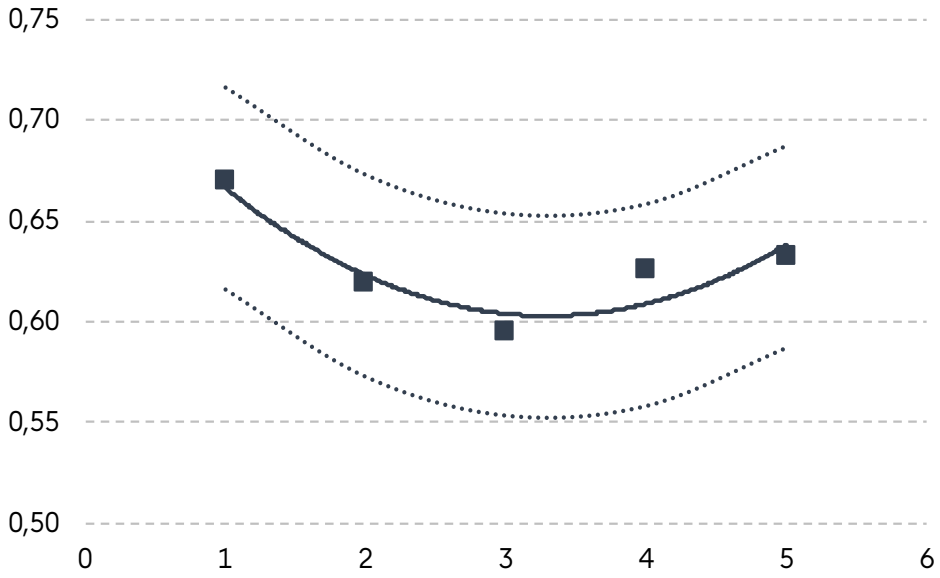
Oponeo SA

forecast: *price:*



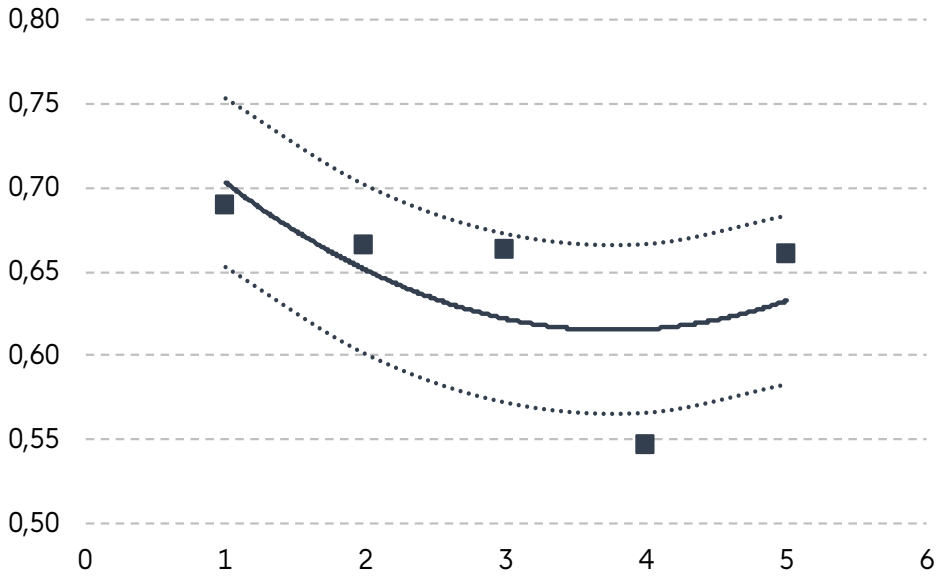
Orange Polska

forecast: *price:*



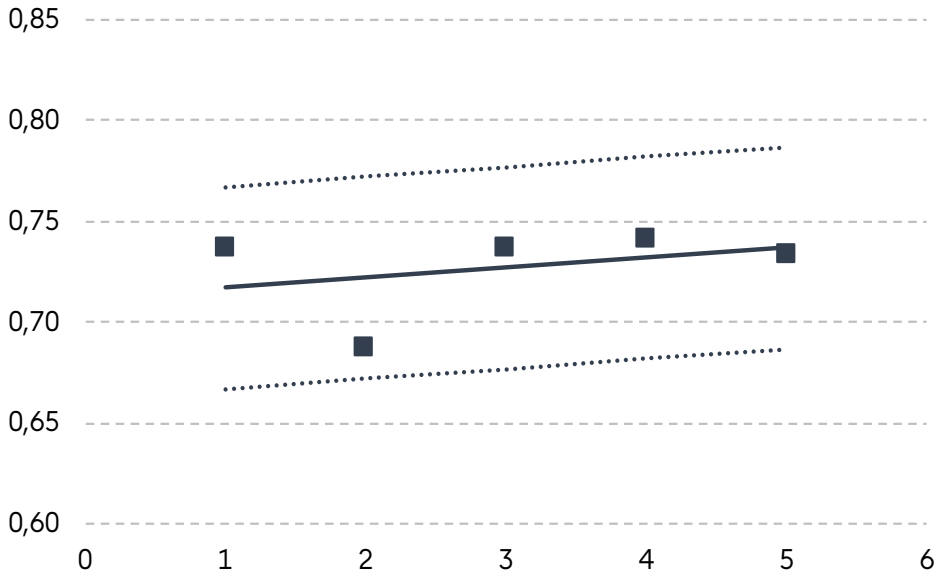
PKN Orlen

forecast: *price:*



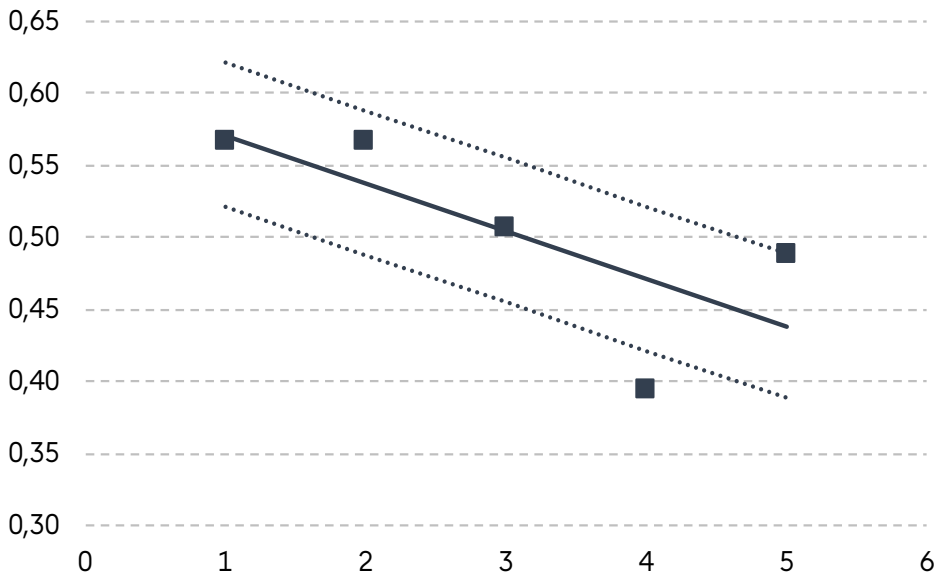
PKO BP

forecast: *price:*



PZU SA

forecast: *price:*



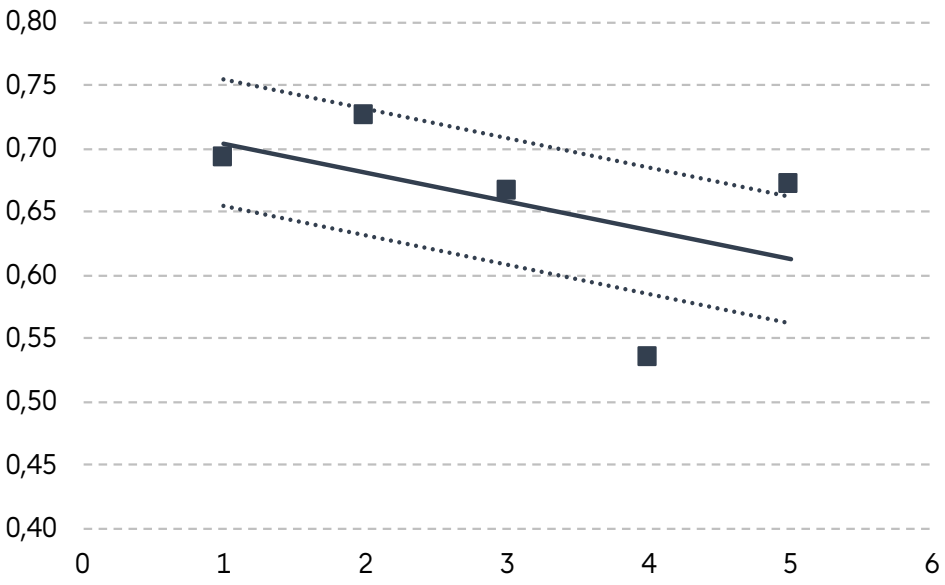
Emotions correlating positively/negatively with prices

+/- 5% probability

Linear correlation (emotions correlating with prices)

Wittchen

forecast: *price:*



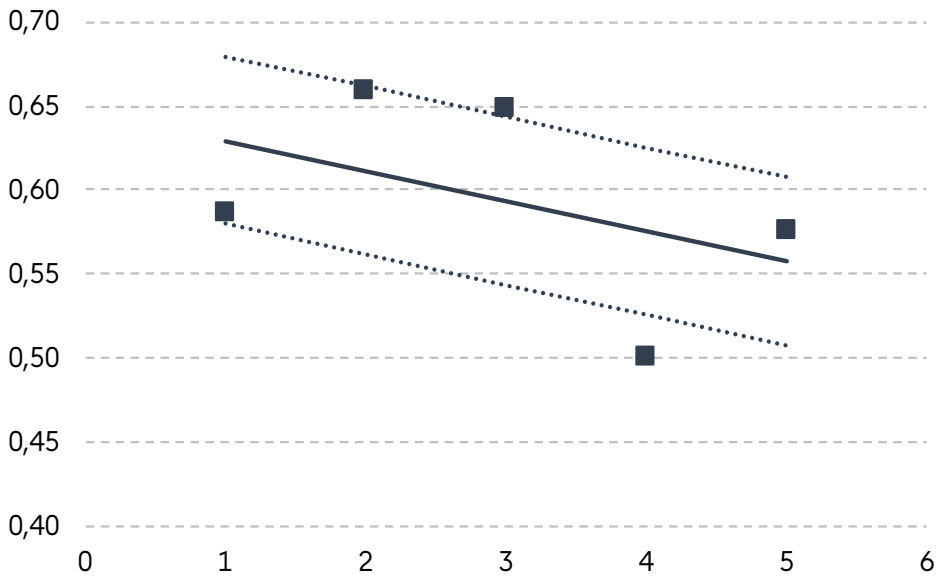
Emotions correlating positively/negatively with prices

+/- 5% probability

Linear correlation (emotions correlating with prices)

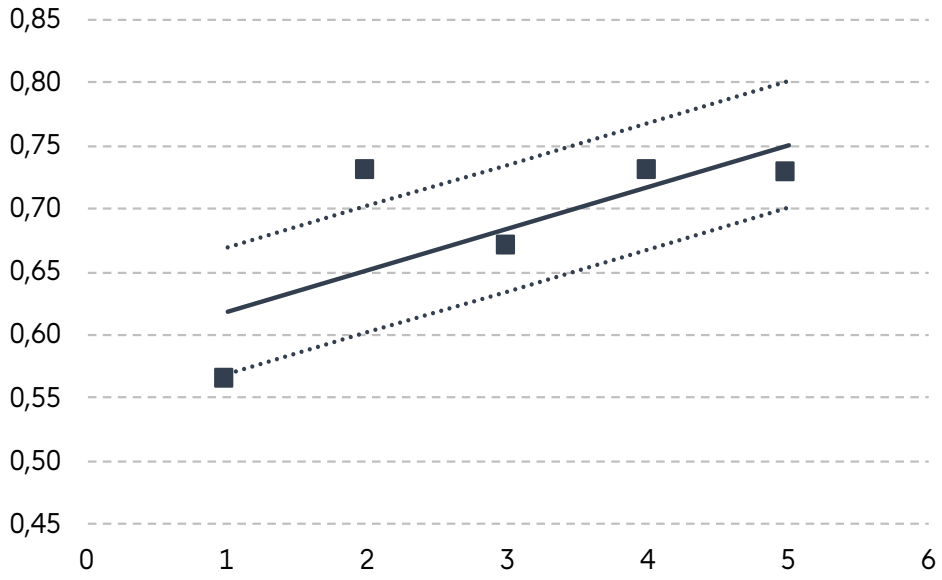
Wojas

forecast: *price:*



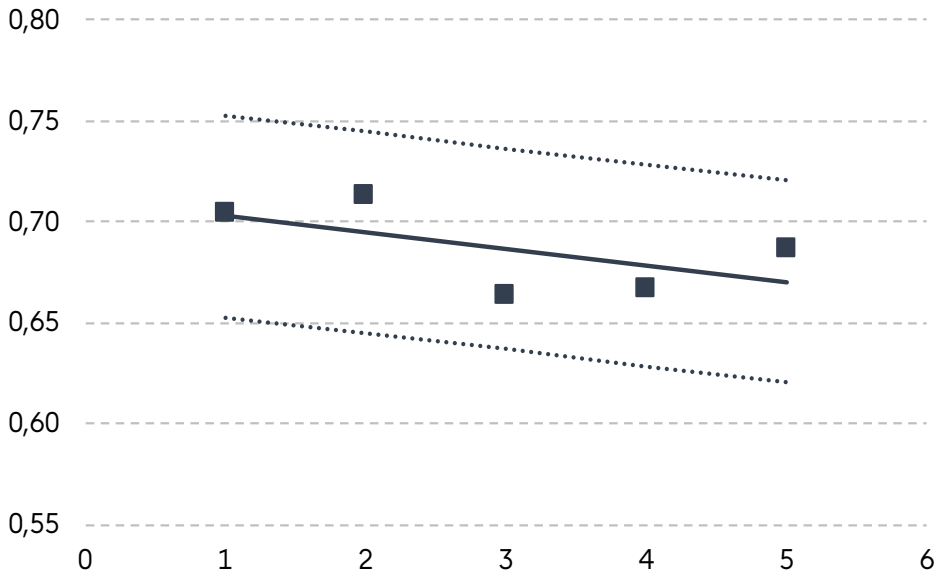
PKP Cargo

forecast: *price:*



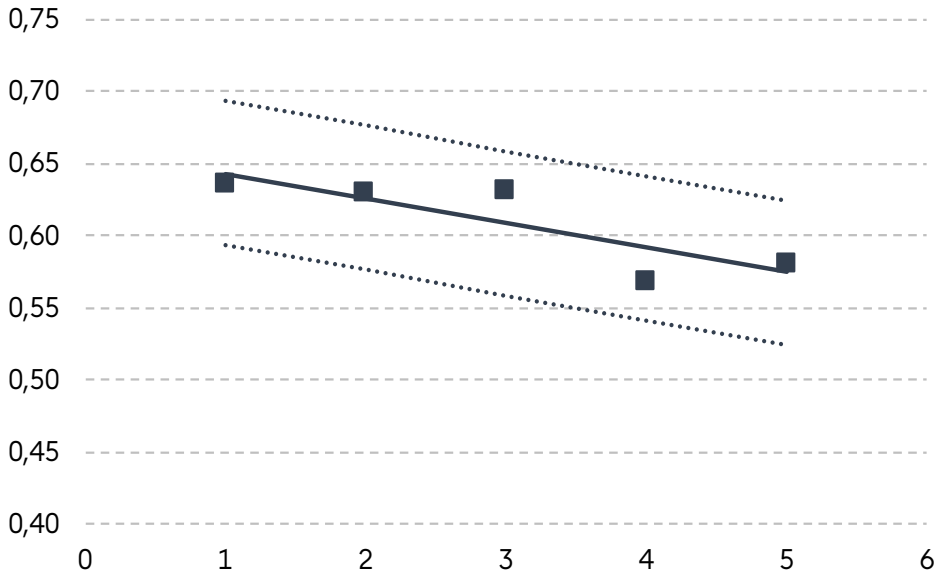
Grupa Żywiec

forecast: *price:*



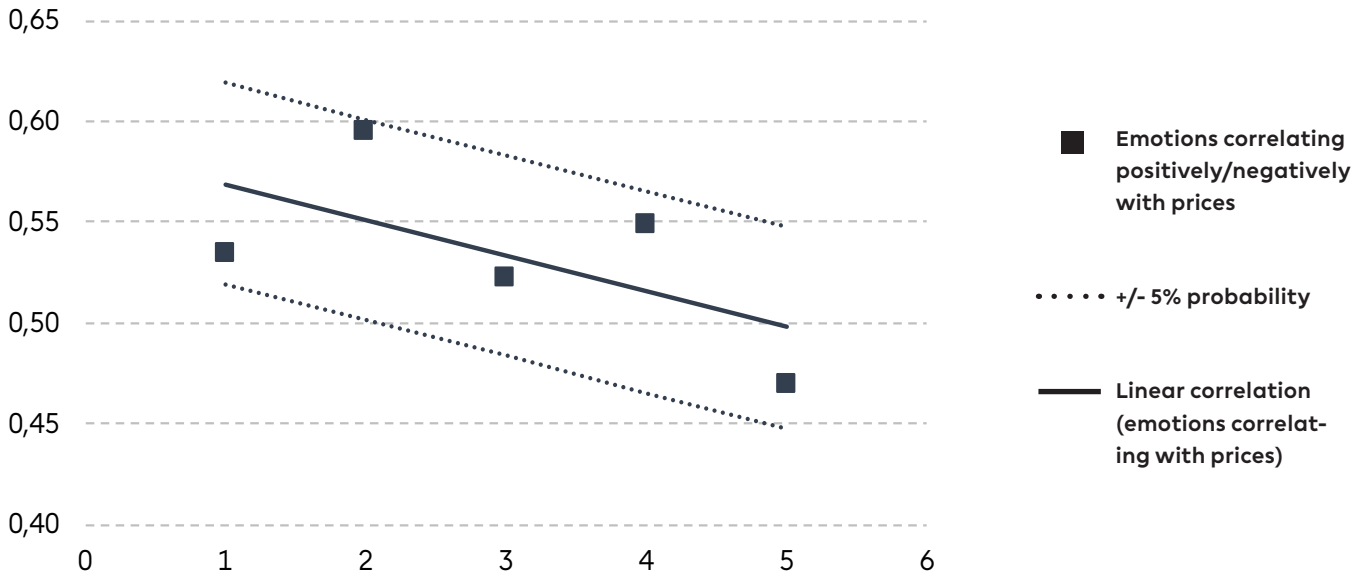
Play / P4

forecast: *price:*



Wawel SA

forecast: *price:*



Unspecified results

In six cases, the trend line saturation condition was not met (less than 60% of the data points covered the trend line determined by the correlation between emotions and stock price). As a result, we have concluded that in those cases SentiStock analysis was not enough to result in a conclusive forecast for the companies listed below.

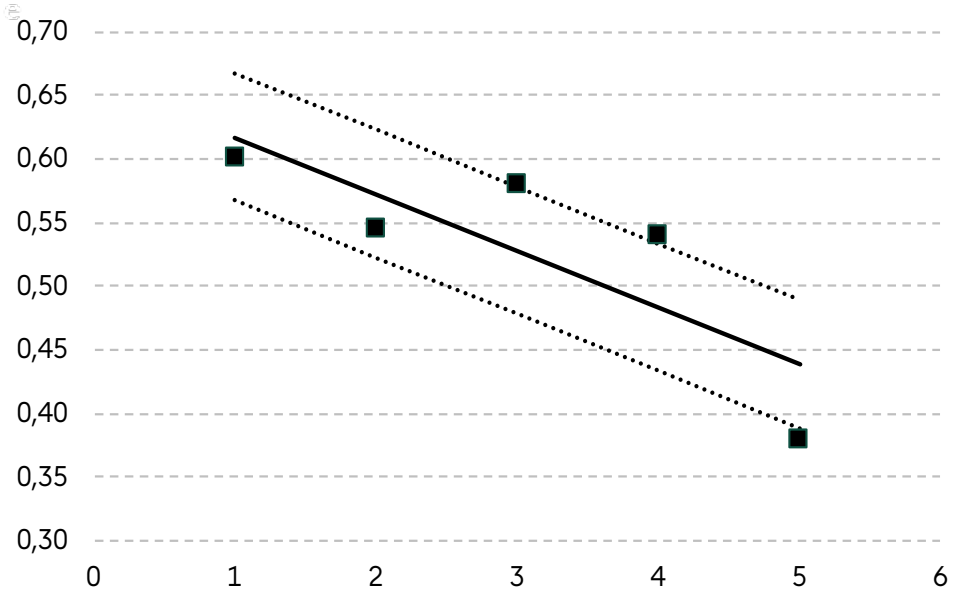
However, it has to be noted that if we ignore the saturation condition, the results of SentiStock analysis would produce accurate trend forecasts in five out of the six cases.

Price trend forecast - unspecified results

Company name	Closing price (the end of November)	Closing price (December 5)	Mean price (December 5)	Forecast (price trend) based on emotions and price correlation
11 bit studios	258,00	263,50	266,79	unspecified
Agora	11,00	11,15	11,37	unspecified
Bank Handlowy	68,80	72,20	70,89	unspecified
CIECH SA	41,00	43,40	43,54	unspecified
Vistula	3,80	3,83	3,81	unspecified
Work Service SA	1,03	1,12	0,96	unspecified

11 bit studios

forecast: *price:*



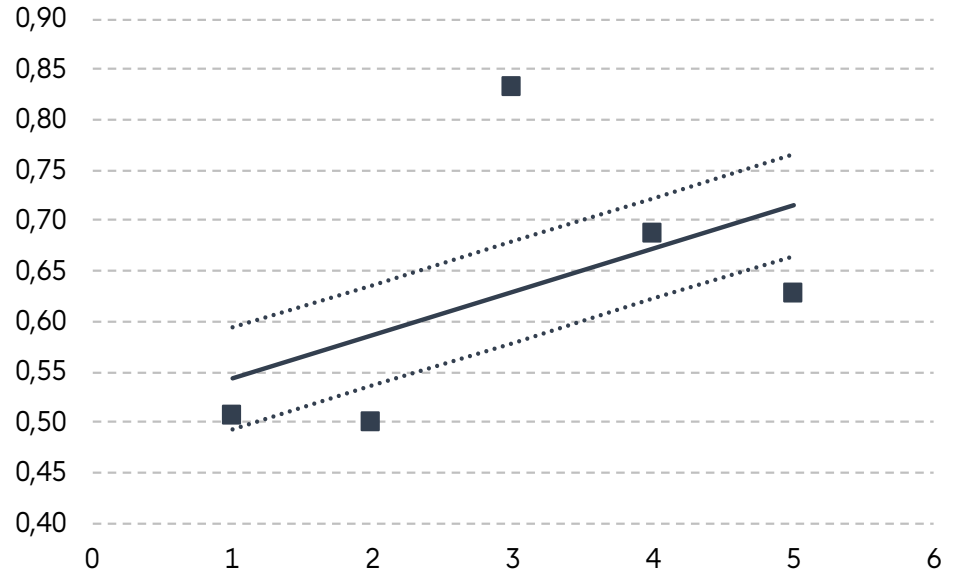
Emotions correlating positively/negatively with prices

+/- 5% probability

Linear correlation (emotions correlating with prices)

AGORA SA

forecast: *price:*



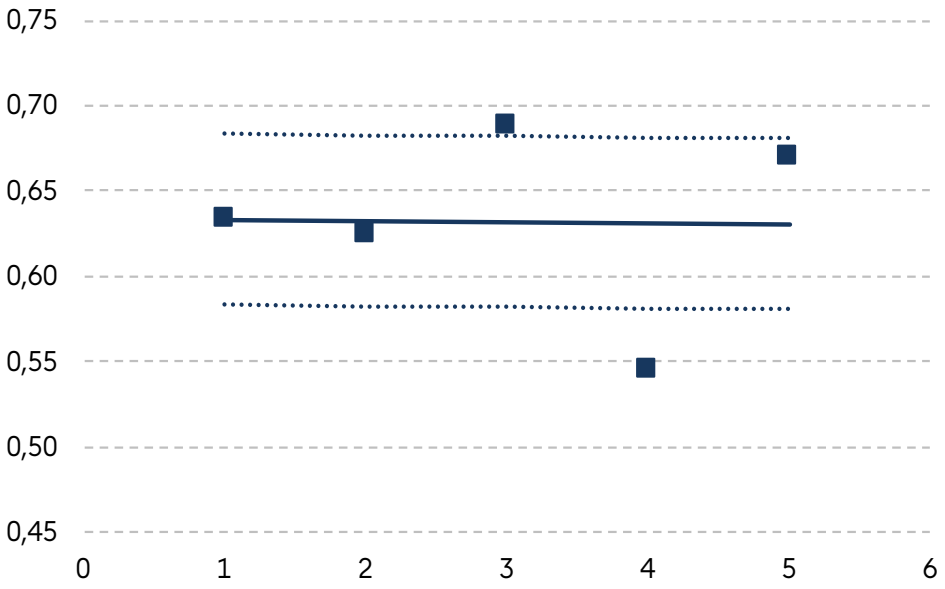
Emotions correlating positively/negatively with prices

+/- 5% probability

Linear correlation (emotions correlating with prices)

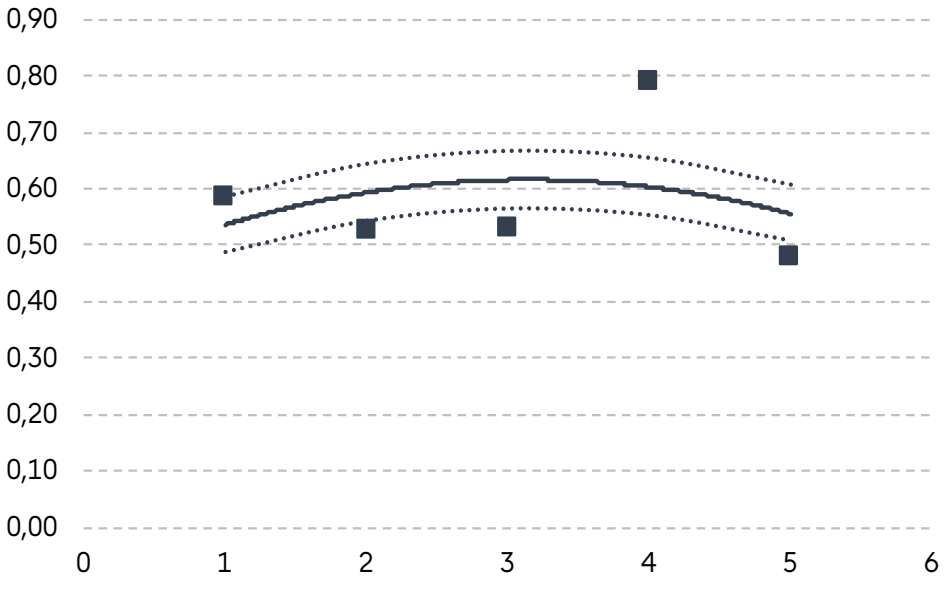
CITI Handlowy

forecast: *price:*



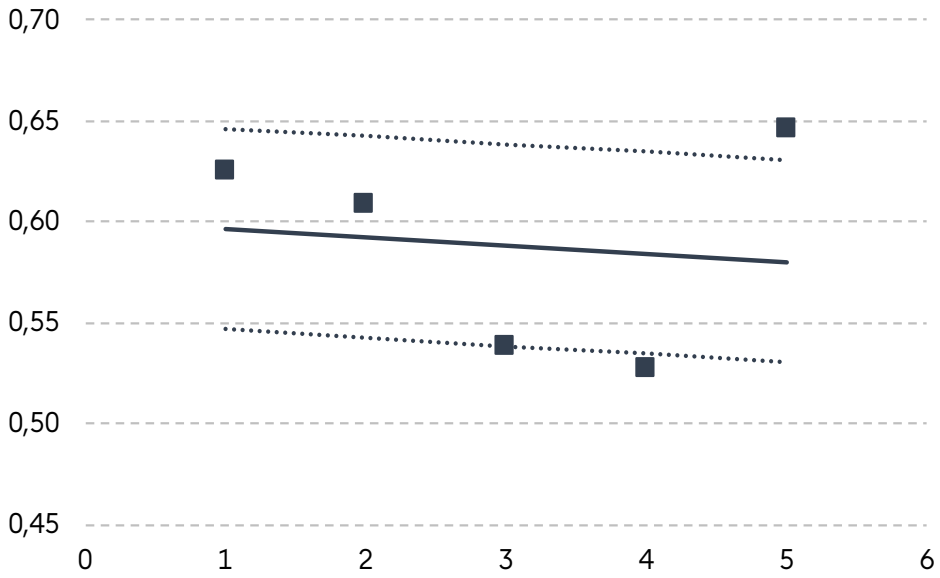
CIECH SA

forecast: *price:*



Vistula

forecast: *price:*



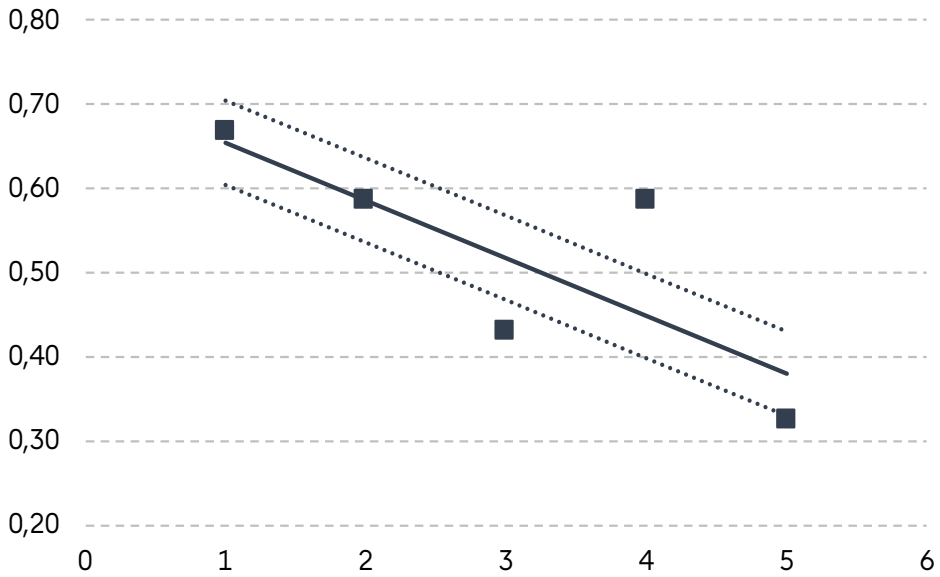
Emotions correlating positively/negatively with prices

+/- 5% probability

Linear correlation (emotions correlating with prices)

Work Service

forecast: *price:*



Emotions correlating positively/negatively with prices

+/- 5% probability

Linear correlation (emotions correlating with prices)

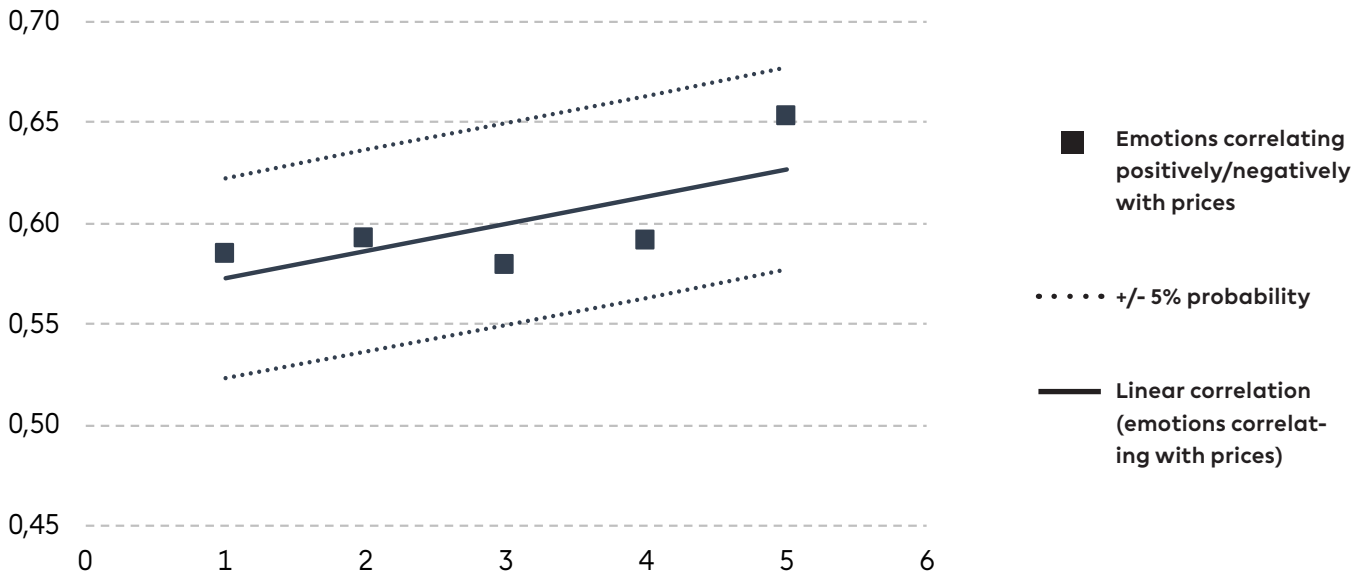
Negative results

Price trend forecast - negative results

Company name	Closing price (the end of November)	Closing price (December 5)	Mean price (December 5)	Forecast (price trend) based on emotions and price correlation
BGŻ BNP Paribas	45,80	45,90	46,29	rise
CCC Shoes & Bags	210,20	208,60	206,77	fall
Grupa Energa	9,09	9,71	9,46	fall
ZE PAK	7,30	7,39	7,39	fall

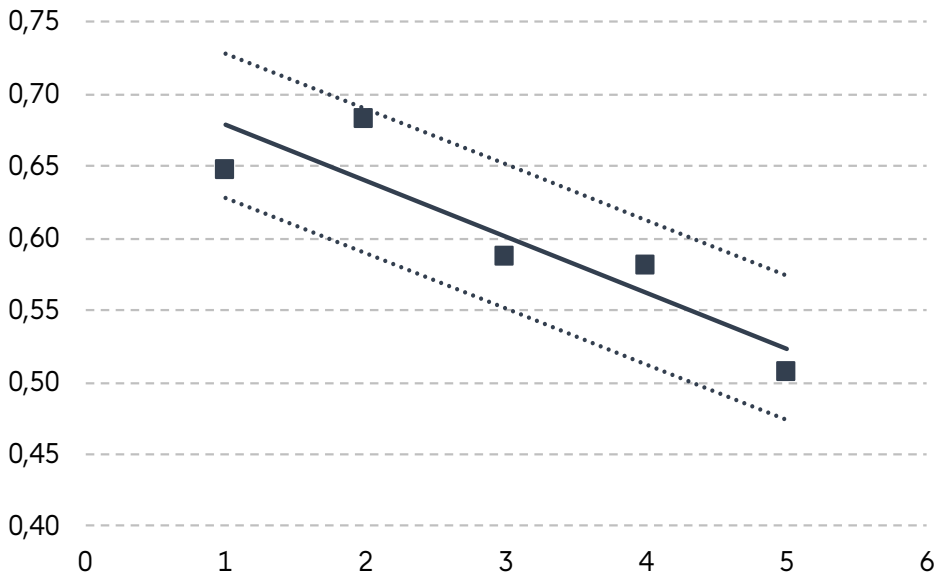
BGŻ BNP Paribas

forecast: *price:*



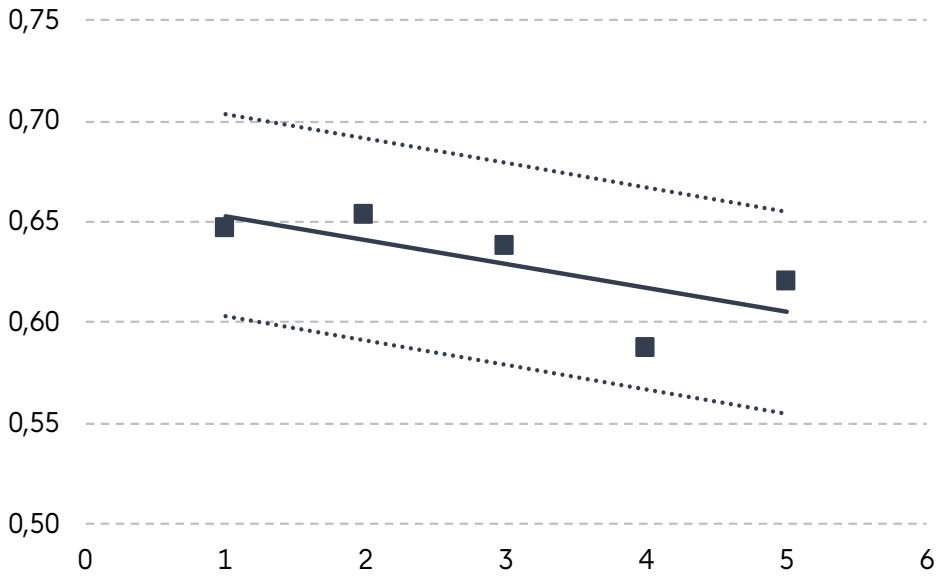
CCC Shoes & Bags

forecast: *price:*



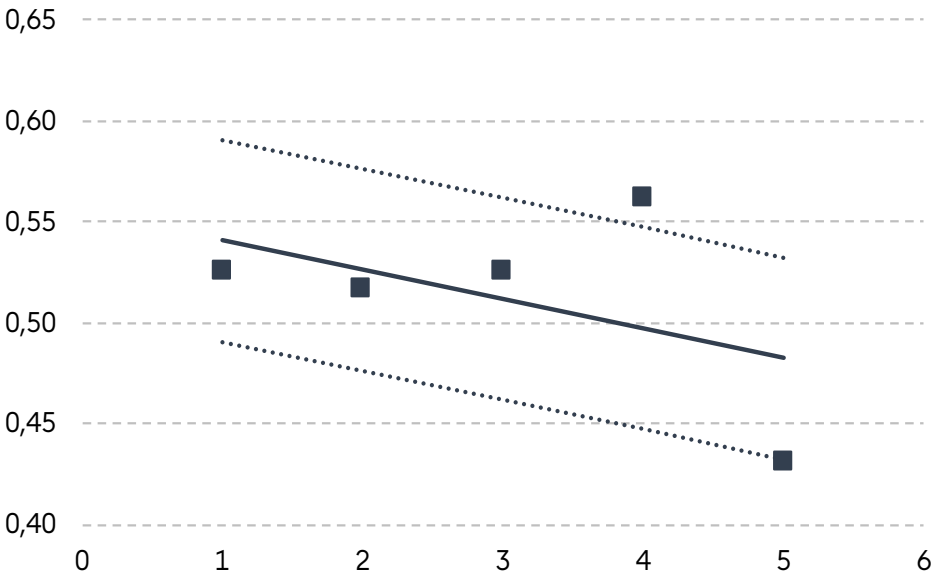
Grupa Energa

forecast: *price:*



ZE Pak

forecast: *price:*



Conclusions

SentiStock automatic emotions and investor sentiment analysis for stock trends forecasting proved to be an effective tool for accurate stock price forecast when applied to some of the biggest companies from the Warsaw Stock Exchange main floor.

1. **37 companies were analysed**, which constitutes 8% of the Warsaw Stock Exchange main floor.

2. **In 31 cases accurate stock price forecast was accomplished** (83,8% of the analysed cases).

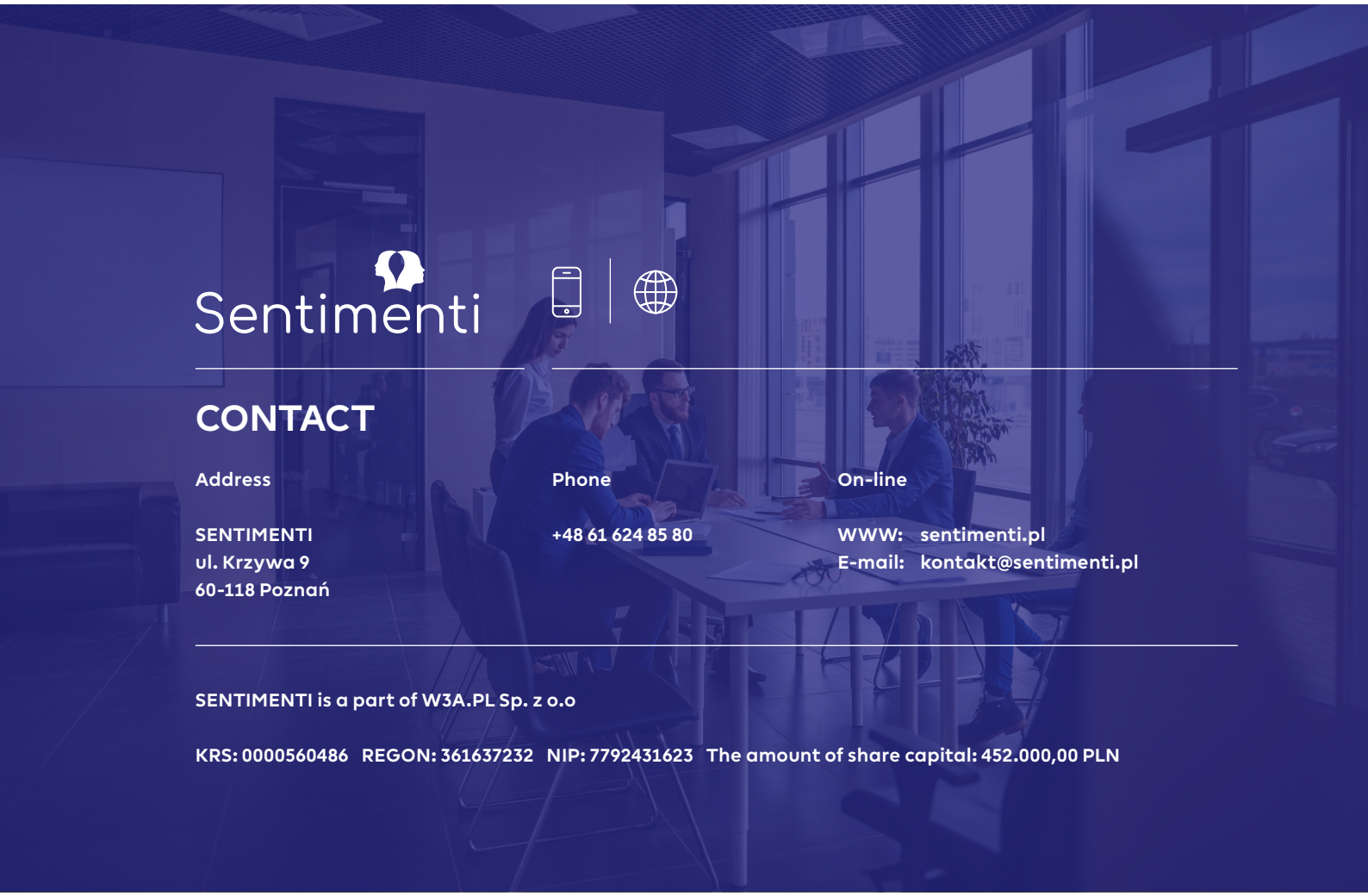
3. **Among the 31, 27 results were positive,** which means that an accurate stock price forecast war determined on the basis of past process and emotions monitoring. This means **87,1% of accurate forecast**. Only **4 cases proved to yield negative results (12,9%).**

87,1%
POSITIVE RESULTS

12,9%
NEGATIVE RESULTS

4. **In 6 cases the results were inconclusive** (16,2% of all the cases).

5. Among the 6 unspecified results in 5 cases the trend lines calculated on the basis of SentiStock emotions and price correlation analysis were in line with the actual stock prices.



Sentimenti

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