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# *Sentiment Analysis for Credit Risk and Portfolio Construction*

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# Overview



## I Eurostars project SENRISK

- I Aim and Purpose

- I Partners and Product



This project has received funding from the Eurostars-2 joint programme with co-funding from the European Union Horizon 2020 research and innovation programme

## I News-enhanced bond modelling and forecasting

- I Use and system requirements, data management and processing

- I News and sentiment evaluation

- I Development of sentiment-enhanced key figures

## I Sentiment Analysis for Portfolio Construction





## *SENRISK - Aim and purpose*

- | Project aim:
  - | Development of an automated credit risk assessment tool
  - | Innovative Decision Support System for risk assessment of Fixed Income products incorporating news sentiments
- | Purpose:
  - | Valuation of sovereign and corporate bonds incorporating news-based information from the market.
  - | Predictive risk models shall be enhanced through information such as interest rates and macroeconomic factors as well as sentiments from firm-specific or macroeconomic news and social media sentiment

# SENRISK - Consortium



# SENRISK - Products

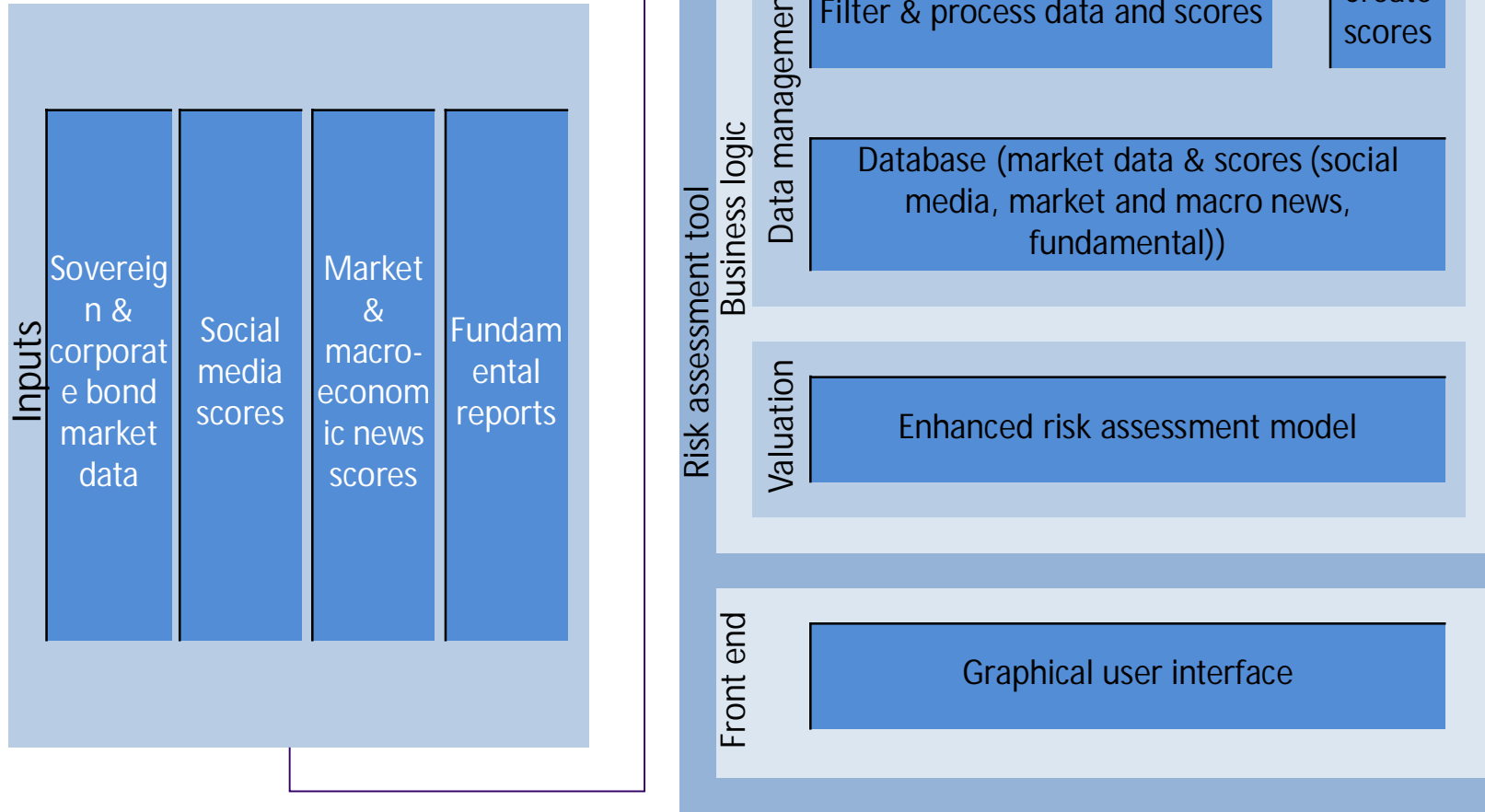


## Products

- Credit Risk DSS platform
- Consulting Services

- | The sentiment of macroeconomic news and social media items are combined with historical time series to construct a generic credit risk assessment tool.
- | Monitoring sovereign and corporate bonds is made more informative and efficient, the creditworthiness of sovereigns is assessed.
- | With our tool, all investors shall be able to handle the vast amount of information on European sovereigns
- | Combined with the analysis of sentiment, accurate and relevant information is included in investment decisions.

# DSS Platform





## *User and System requirements*

- | User requirements have been established through interviews with expert users and feedback on our proposed credit risk assessment tool.
  
- | The data requirements have been specified in terms of markets and instruments needed as well as in terms of solutions for news and sentiment sources.
  - | Markets: European mainland countries, UK and US
  - | Short and long term bonds
  - | Sovereign and corporate bonds
  - | Source: Datascope (Thomson Reuters)

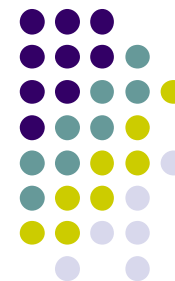


# User and System requirements

- | News and sentiment sources:
  - | Sentiment data for relevant instruments
  - | Macroeconomic news sentiment
    - | Source: Ravenpack
    - | Relevance and Sentiment considered, economic news item concerning the issuing country
  - | Social media sentiment
    - | Source: Stockpulse



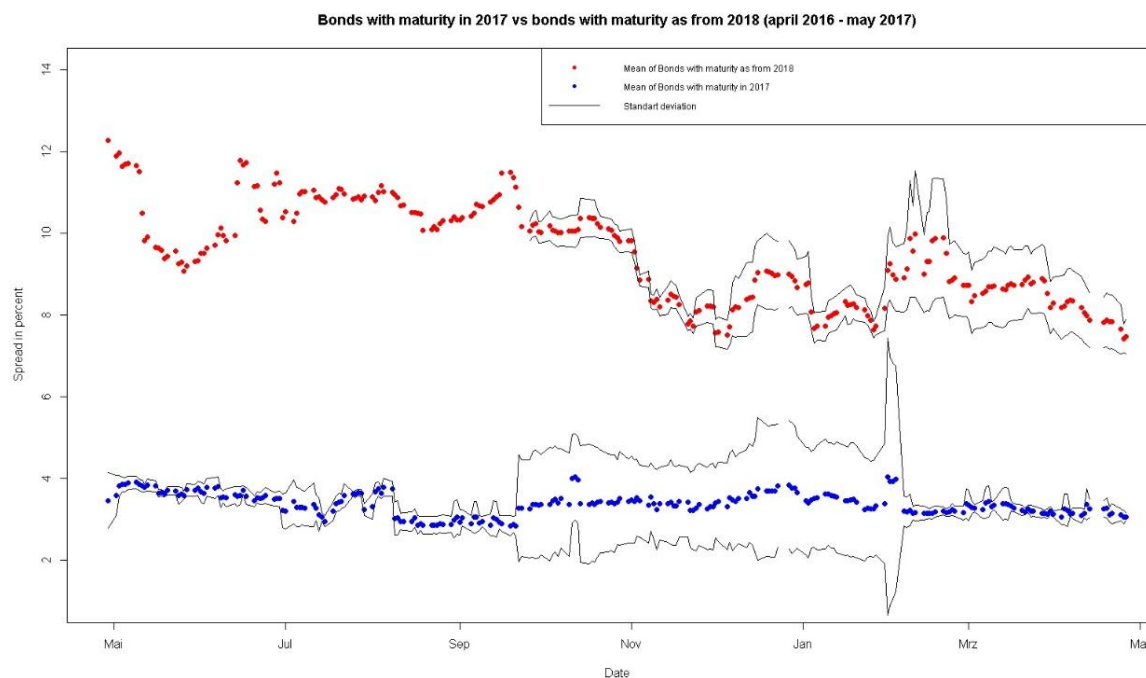




# Bond data: term structure specification

- Calculate term structure from bonds of specific country
  - Through the Svensson model calculate spread with (AAA) Eurobond from ECB

- Example: Greece
  - April 2016-May 2017
  - Short and long term maturity



# *Data management and (pre-) processing*



- | Input: News and social media sentiment score data, macroeconomic and market data
- | Information is retrieved via APIs. After aggregating, filtering and processing, data is stored in the database.
- | MySQL Server is the Database Management System, multi-user access to databases.



# News and sentiment evaluation: news and social media contents



Ontology definition and Event research: macroeconomic news

Example: Macronews Germany (Ravenpack)

A	B	C	D	E	J	K	L	M	P	Q
year	date	hour	relevance	ess	topic	groupCategory	category	typeEvent	factLevel	newsType
2007	20070102	2600	7	0.46	economy	balance-of-payments	exports-up-exporter	exports	fact	FULL-ARTICLE
2007	20070102	2800	30	-0.53	economy	consumption	consumer-confidence-down	consumer-confidence	fact	FULL-ARTICLE
2007	20070102	60213	1	0	economy	employment	unemployment-guidance	unemployment-guidance	forecast	FULL-ARTICLE
2007	20070102	60309	1	0	economy	employment	unemployment-guidance	unemployment-guidance	forecast	FULL-ARTICLE
2007	20070102	64556	1	0	economy	employment	unemployment-guidance	unemployment-guidance	forecast	FULL-ARTICLE
2007	20070102	73700	100	0.57	economy	employment	employment-up	employment	fact	NEWS-FLASH
2007	20070102	92000	13	-0.53	economy	consumption	consumer-confidence-down	consumer-confidence	fact	FULL-ARTICLE
2007	20070102	92000	29	-0.53	economy	consumption	consumer-confidence-down	consumer-confidence	fact	FULL-ARTICLE
2007	20070102	92500	2	0.6	economy	employment	unemployment-down	unemployment	fact	FULL-ARTICLE
2007	20070102	123800	1	-0.48	business	products-services	market-exit-location	market-exit	fact	FULL-ARTICLE
2007	20070102	125800	3	0	economy	consumption	retail-sales	retail-sales	fact	FULL-ARTICLE
2007	20070102	141900	38	-0.53	economy	consumption	consumer-confidence-down	consumer-confidence	fact	FULL-ARTICLE
2007	20070102	141900	38	0.51	economy	consumption	retail-sales-up	retail-sales	fact	FULL-ARTICLE
2007	20070102	141900	38	0.6	economy	domestic-product	economic-growth-up	economic-growth	fact	FULL-ARTICLE
2007	20070102	142200	100	-0.51	business	labor-issues	layoffs-location	layoffs	fact	FULL-ARTICLE



# News and sentiment evaluation: news and social media contents



- | Sentiment classification, trustworthiness and relevance analysis for social media sentiment
- | StockPulse sentiment for EuroStoxx 50 companies
- | Daily sentiment is analysed and a relationship to bonds investigated



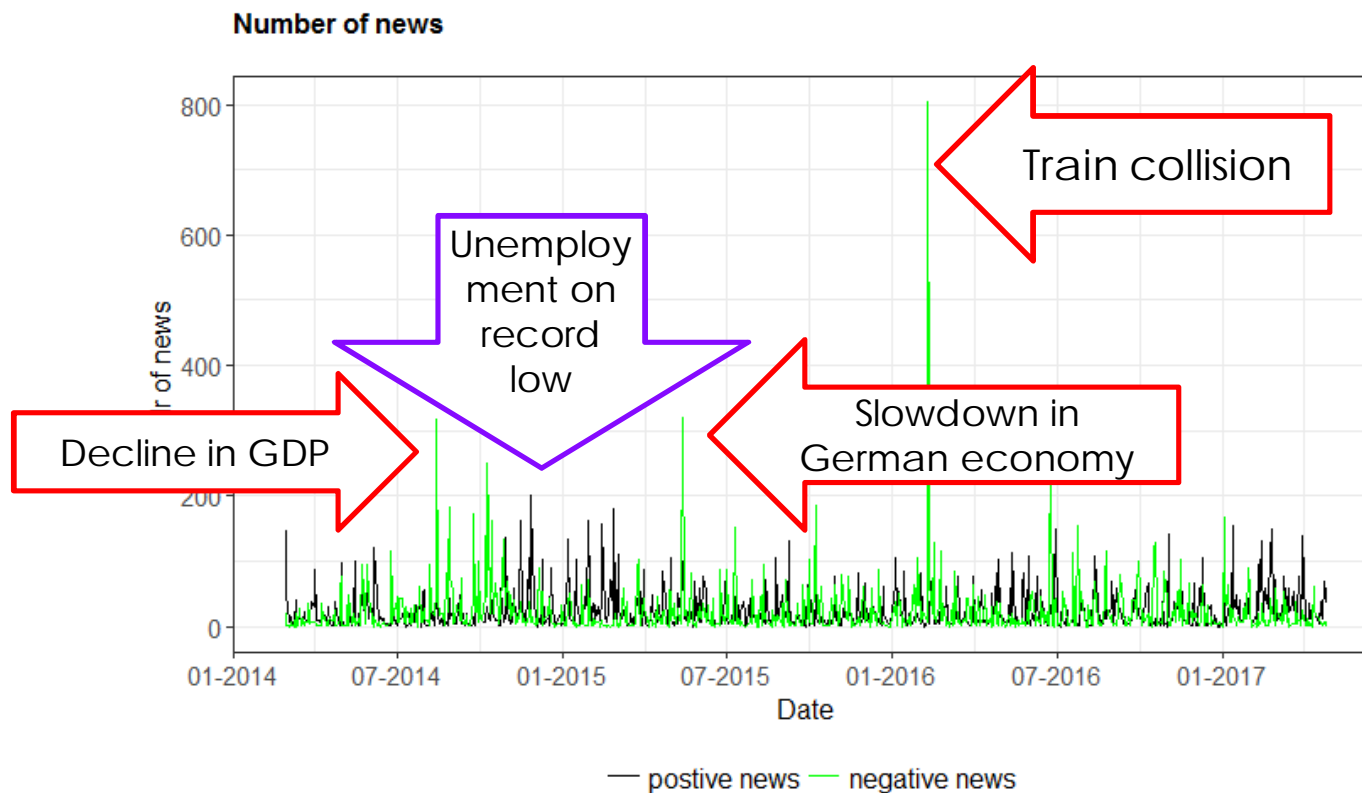
# *Development of sentiment-enhanced key figures*



- | Analysis of country-specific macroeconomic news sentiment as well as firm-specific sentiment
- | Aggregation of intra-day sentiment to daily sentiment and impact values
- | Distinguish between positive and negative news, creation of daily impact scores with decay
- | Analysis of volume of news



# Sentiment-enhanced key figures

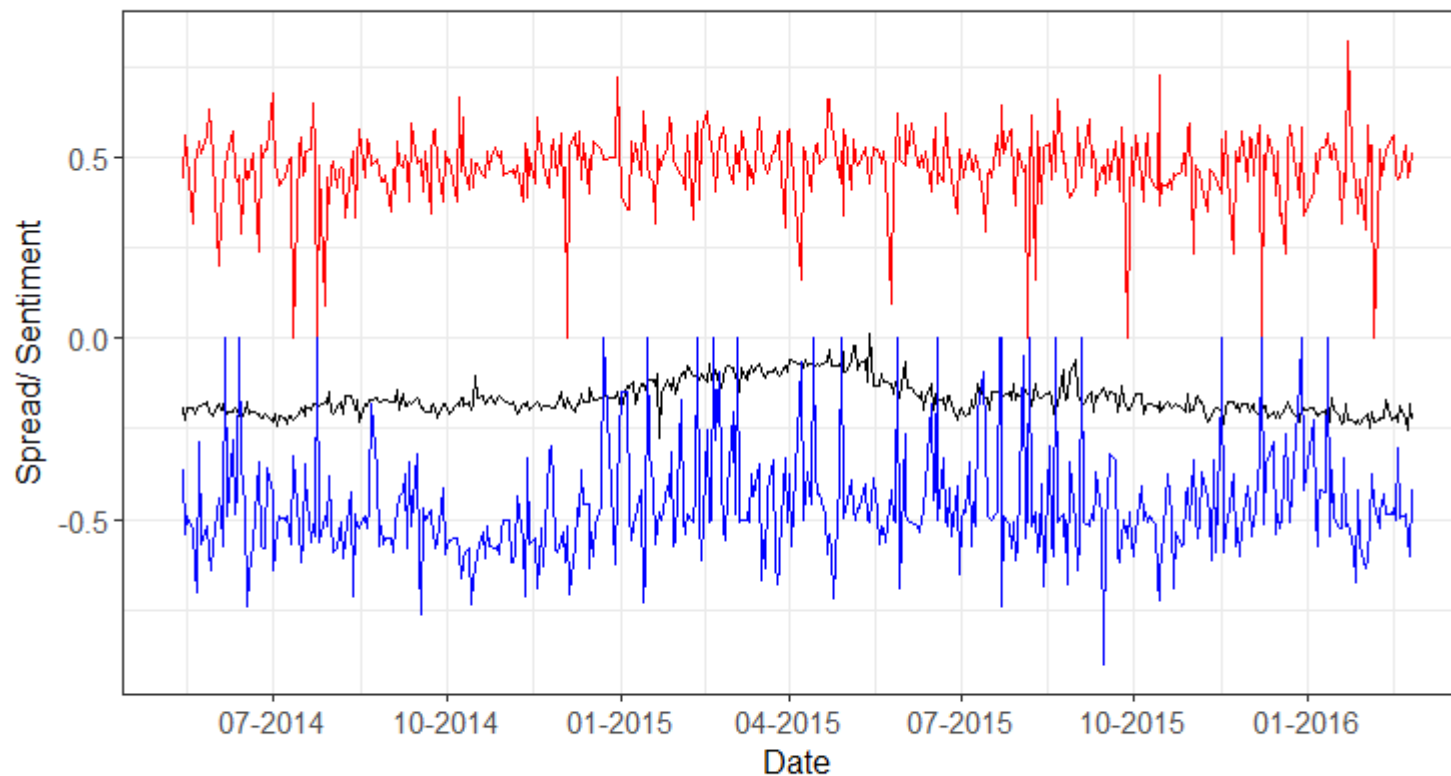


Number of positive and negative news (2014 – 2017)

# Sentiment-enhanced key figures



Spread and Sentiment

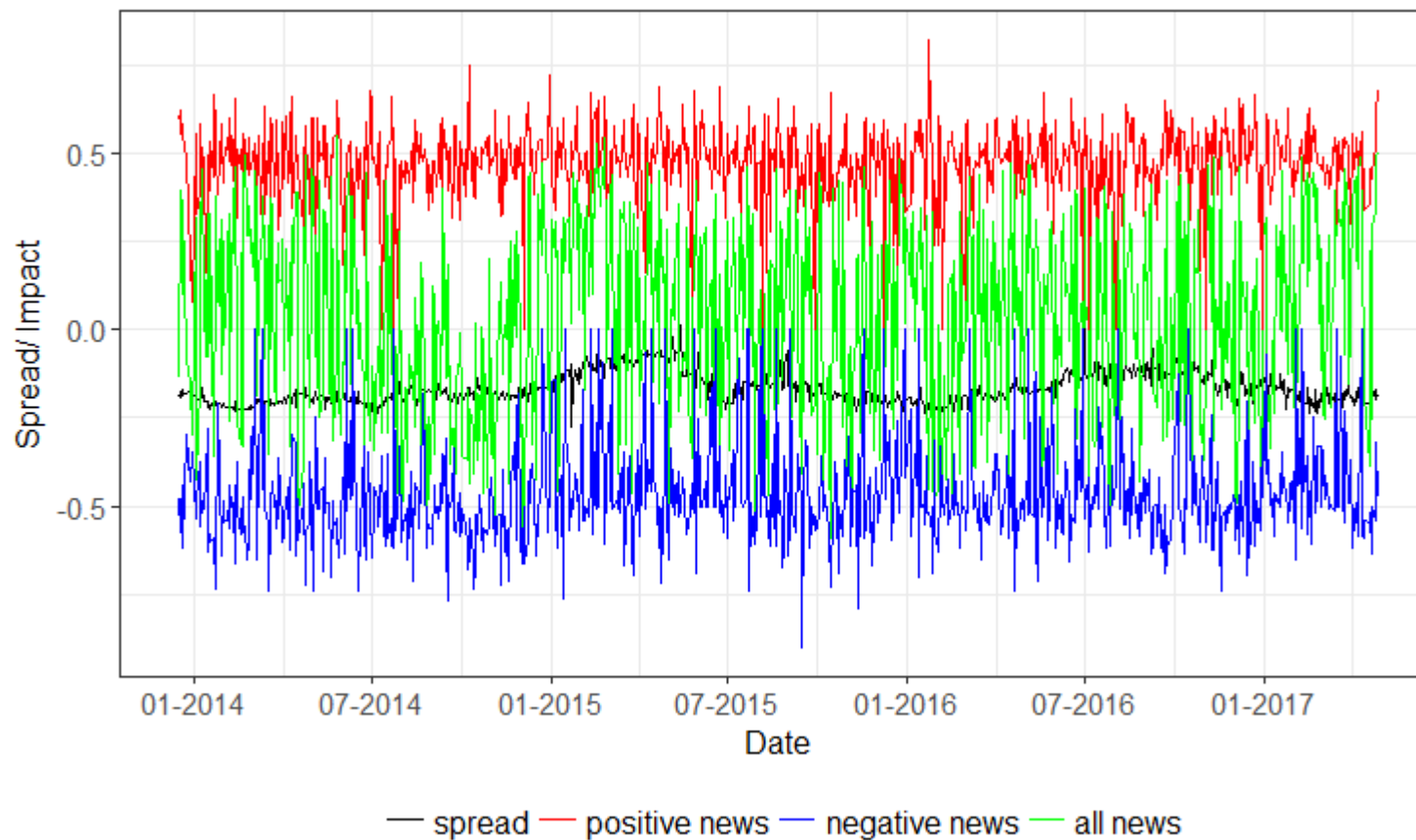


— spread — positive news — negative news

# Sentiment-enhanced key figures



Spread and Impact

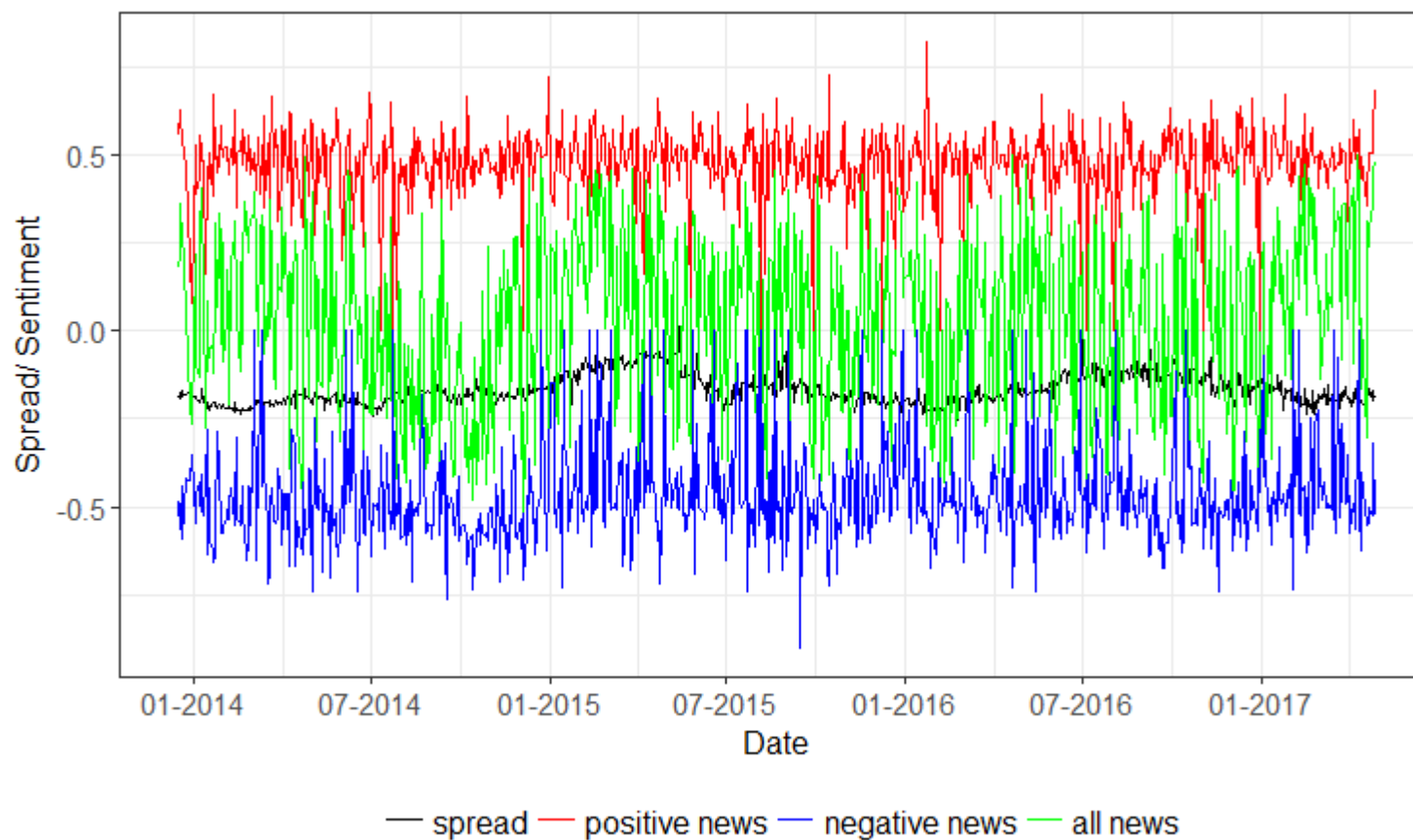




# Sentiment-enhanced key figures



Spread and Sentiment



# Development of sentiment-enhanced key figures



Effect research: inference of news events and bond prices

- | Sentiment impact evaluation
- | Integration of sentiments to spread and volatility prediction of Fixed Income products
- | Integration of sentiments to default probabilities and rating migration



# Development of sentiment-enhanced key figures



Modelling bond closing yield series:

- | Create spread with benchmark (AAA ECB rate)
- | Correlation between sentiment series and spread series low but significant
- | Granger causality between spread and sentiment series
- | Linear regression analysis points to most relevant regressors being "number of all news", "positive sentiment", negative sentiment"
- | Modelling closing yields through ARIMA model with external regressor

# Development of sentiment-enhanced key figures

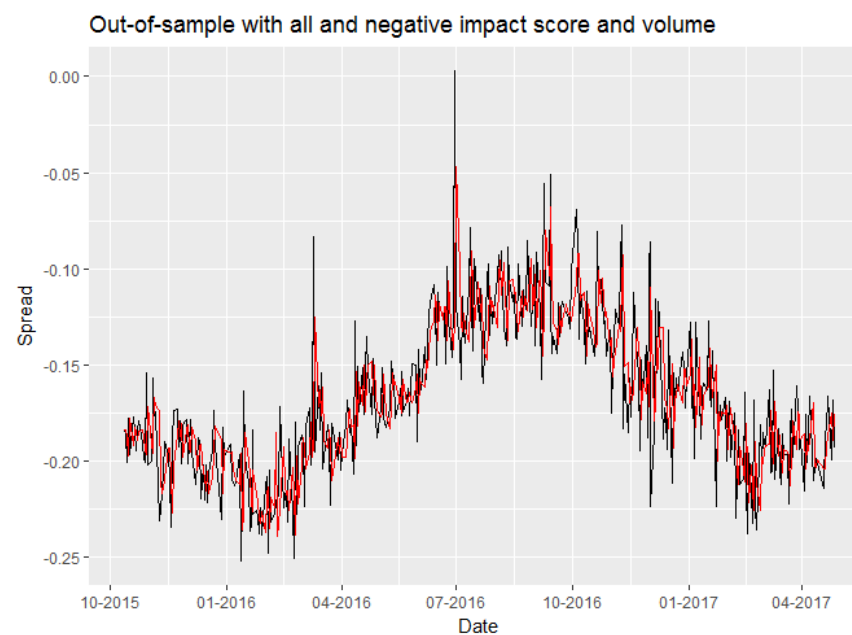
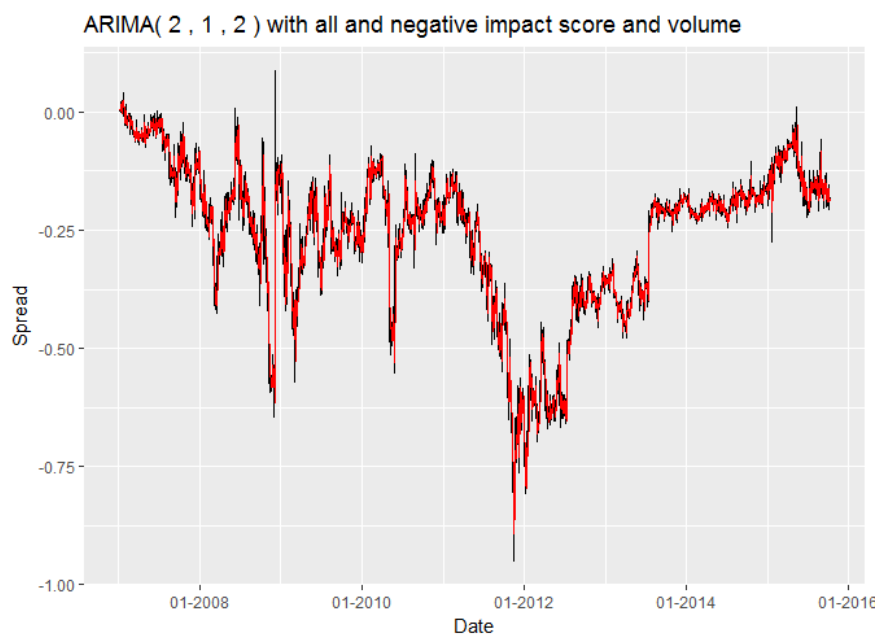


- | Model order: ARIMA(2,1,2)
- | Fit and Forecast without external regressor and with positive/negative sentiment scores, impact values and news counts
- | Fit and Forecast are improved when including external regressors (w.r.t. various error measures)
- | Choice of best regressor seems to be dependent on yield series, however, negative series have a higher impact than positive ones



# Development of sentiment-enhanced key figures

1<sup>st</sup> example: 30-year, issue date: 5. January 2007



# Development of sentiment-enhanced key figures



## I Error measures: Fit

	RMSE	MAE	MPE	MAPE	MASE
Without regressor	0.03740	0.02443	-1.57051	22.1638	0.92294
Nr of all and pos news, all and pos impact	0.03734	0.02436	-1.82358	22.0655	0.92043
Nr of all and negative news, all and neg sentiment	0.03732	0.02440	-2.6035	22.9045	0.92179
All, pos and neg sentiment	0.03733	0.02434	-2.2642	22.5730	0.91962
Pos and Neg Impact	0.03735	0.02434	-2.4722	22.9108	0.91962
Pos Sentiment	0.03737	0.02438	-1.2208	21.6723	0.92125
All Impact	0.03738	0.024397	-1.7513	22.1099	0.92174
Nr of all news	0.03741	0.024434	-1.6730	22.2419	0.92313

# Development of sentiment-enhanced key figures



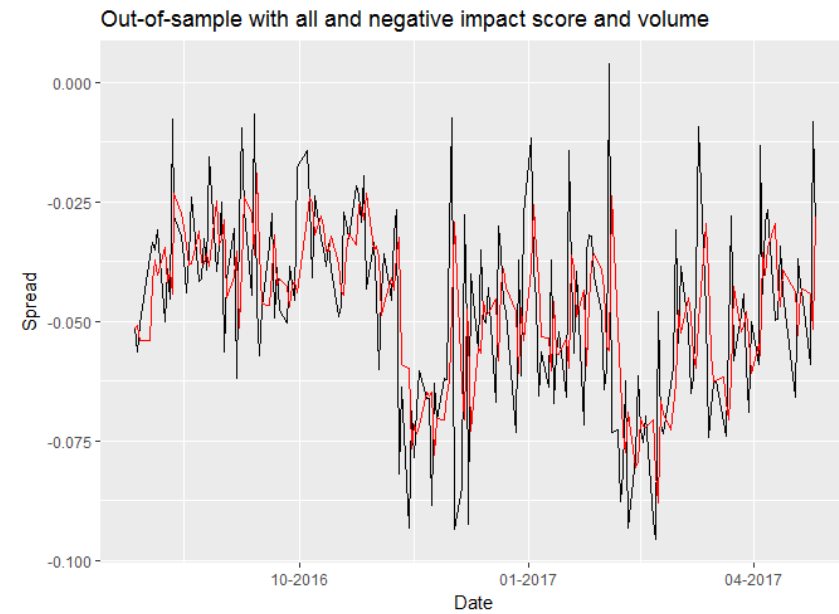
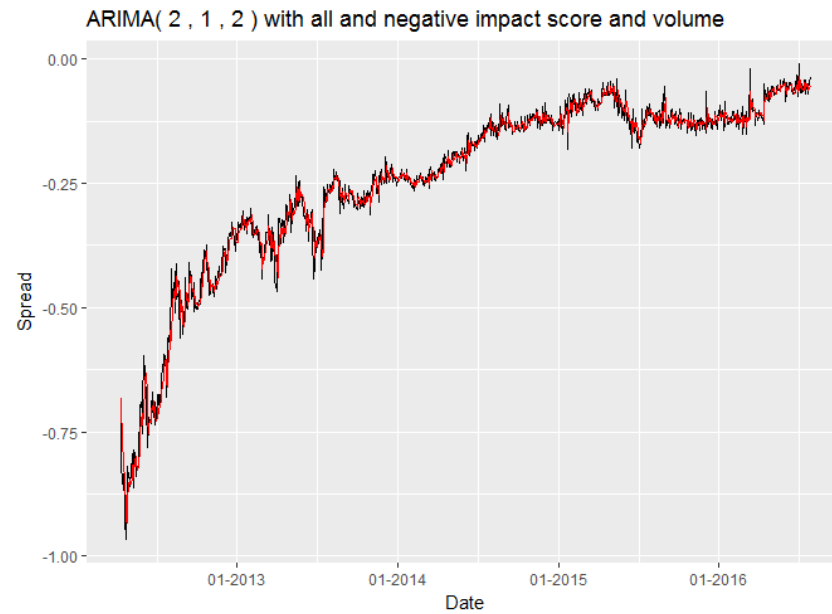
## I Error measures: Forecast

	RMSE	MAE	MPE	MAPE	MASE
Without regressor	0.02720	0.02051	10.0162	25.7071	0.8407
Nr of all and pos news, all and pos impact	0.02724	0.02070	9.9764	25.7434	0.84857
Nr of all and negative news, all and neg sentiment	0.02758	0.02105	10.17211	26.2114	0.86287
All, pos and neg sentiment	0.02729	0.02062	10.05487	25.7888	0.84543
Pos and Neg Impact	0.02728	0.02063	10.1321	25.8617	0.84551
Pos Sentiment	0.02714	0.02044	9.9308	25.5419	0.8380
All Impact	0.02722	0.02063	9.8114	25.5686	0.8457
Nr of all news	0.02716	0.02051	9.9525	25.6486	0.84077



# Development of sentiment-enhanced key figures

1 2<sup>nd</sup> example: 10-year bond, issued on 12<sup>th</sup> April 2012





# Development of sentiment-enhanced key figures



## I Error measures: Fit

	RMSE	MAE	MPE	MAPE	MASE
Without regressor	0.023123	0.015898	-2.7025	9.9953	0.8868
Nr of all and pos news, all and pos impact	0.023110	0.015885	-2.6970	9.9788	0.8861
Nr of all and negative news, all and neg sentiment	0.023107	0.015876	-2.7075	9.9844	0.8856
All, pos and neg sentiment	0.023110	0.015872	-2.7139	9.9933	0.8854
Pos and Neg Impact	0.023117	0.015889	-2.6991	9.9905	0.8863
Pos Sentiment	0.023121	0.015891	-2.7045	9.9894	0.8865
All Impact	0.023118	0.015887	-2.6832	9.9877	0.8862
Nr of all news	0.023121	0.015899	-2.6972	9.9854	0.8869

# Development of sentiment-enhanced key figures



## I Error measures: Forecast

	RMSE	MAE	MPE	MAPE	MASE
Without regressor	0.018507	0.013773	-14.406	53.788	0.9315
Nr of all and pos news, all and pos impact	0.018404	0.013699	-14.108	53.577	0.82930
Nr of all and negative news, all and neg sentiment	0.018466	0.013737	-14.406	53.579	0.83160
All, pos and neg sentiment	0.018462	0.013721	-14.420	53.448	0.83075
Pos and Neg Impact	0.018447	0.013719	-14.278	53.616	0.83051
Pos Sentiment	0.018463	0.013728	-14.312	53.642	0.83101
All Impact	0.018470	0.013747	-14.309	53.636	0.83216
Nr of all news	0.018490	0.013758	-14.348	53.836	0.83285



## Further steps

- | Development of news-enhanced risk control decision model for Fixed Income Products
- | Decision Support System: integration and system validation



# SENRIK DSS

Please visit our project page [www.senrisk.eu](http://www.senrisk.eu) for more information



# *Sentiment Analysis for Portfolio construction*

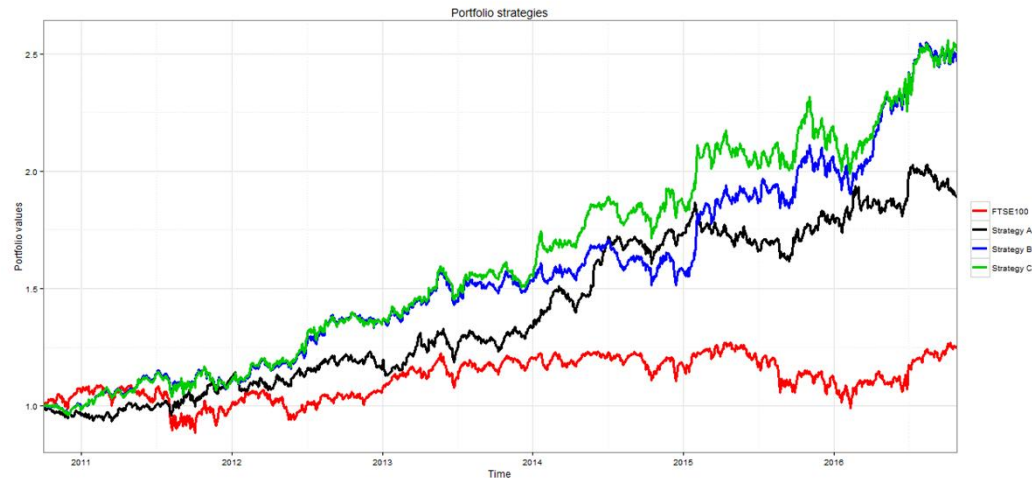


- | News Sentiment is utilised to
  - | Improve scenario generation for portfolio construction
  - | Choose suitable asset universe prior to run portfolio optimisation
- | Sentiment input: firm-specific impact time series
- | Impact series is built w.r.t. time span and market place, decaying importance of news

# Sentiment Analysis for Portfolio construction



Portfolio performance of Second-order Stochastic Dominance portfolio with news sentiment



Reference:

Mitra, G., Erlwein-Sayer, C., Valle, C. and Yu, X., „Using Market Sentiment to Enhance Second Order Stochastic Dominance Trading Models” (to appear in Dempster, M., Kanniainen, J., Keane, J and Vynckier, E (eds.) “High Performance Computing in Finance”, Chapman & Hall, 2017.





*Thank you very much for your attention!*

*Any questions?*

