Volatility Prediction using Financial Disclosures Sentiments with Word Embedding-based IR models

Navid Rekabsaz[1], Mihai Lupu[1], Artem Baklanov[2,3], Allan Hanbury[1], Alexander Dür[1], Linda Anderson[1]

[1] TU Wien, Vienna, Austria
[2] International Institute for Applied Systems Analysis (IIASA)
[3] N.N. Krasovskii Institute of Mathematics and Mechanics

contact: rekabsaz@ifs.tuwien.ac.at

Volatility Prediction - Research Questions

- *Market volatility* is an essential indicator of financial instability, widely studied using market data.
- *We study* the effectiveness of using sentiment analysis on annual reports for voalitilty forecast.
- *We explore* (1) Using word embedding-based information retrieveal weightings for long documents sentiment analysis (2) Combination methods for text and market data (3) Effect of financial sectors.

Data & Features

- **Data:** *Risk Factors* sections of the 10-K reports of corporations in the US markets from 2006 to 15.
- **Financial Lexicon:** Loughran & McDonald, expanded with a word2vec model *(Tsai & Wang 2014)*
- **Text Features:** BoW with TC and BM25 weightings as welll as their extended forms *(Rekabsaz et al. 2016)*
- **Market Features:** Current volatility (the quartile before the issue date of a report), GARCH, sector.
- **Feature Fusion:** Early fusion, Stacking, Multi Kernel Learning (MKL) for SVM.

Experiments & Results

1 Content Analysis

Using the methods, introduced in Tsai & Wang (2014):
(a) The Cosine similarity of the years' centroid vectors
(b) Performance using the reports from a year to 2015

(a)   (b)
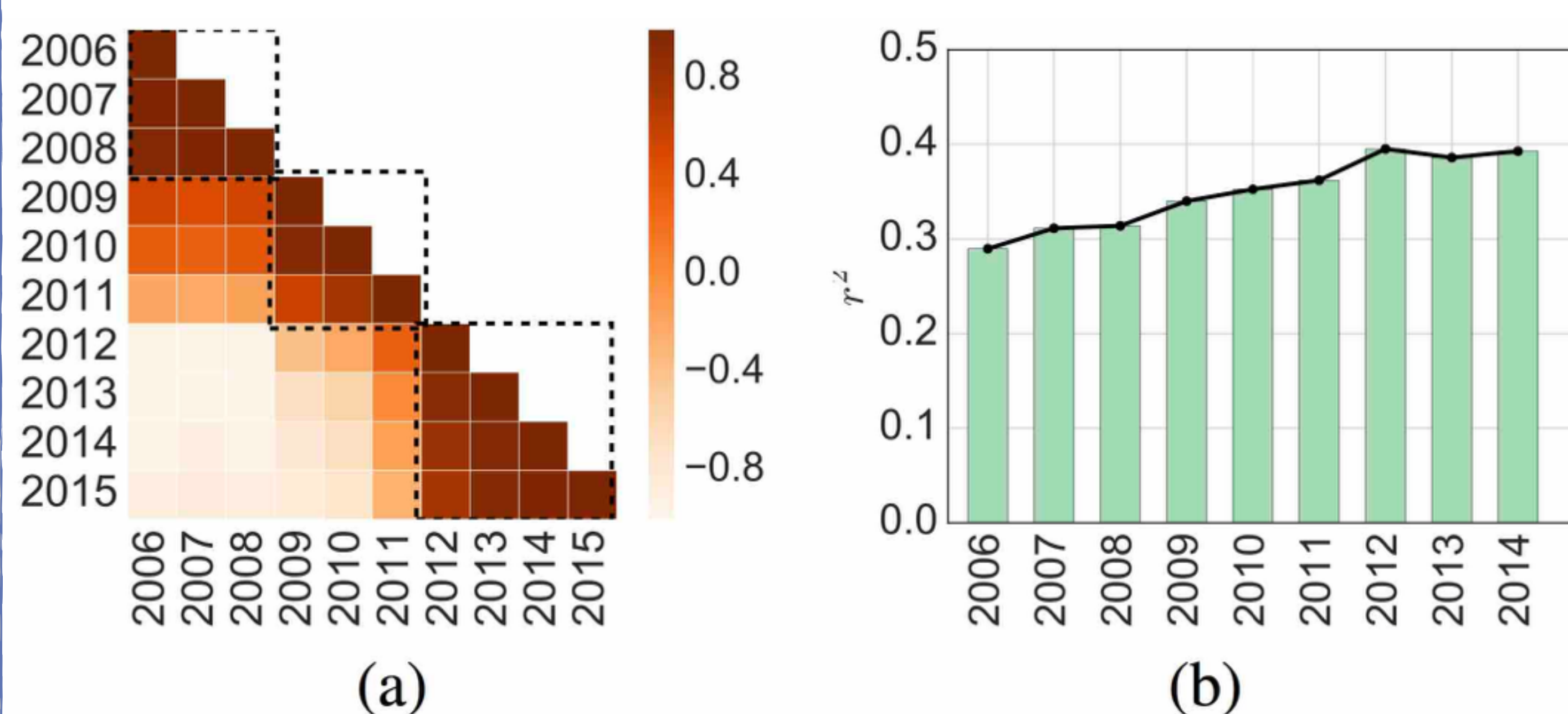
Result: Contextual changes in the reports every three years. Best performance when using data since 2012.

3 Sectors

Training separate models on the reports of each financial sector.

Result: Sector-specific models outperform sector-agnostic, while the models yet suffer from lack of data.


2 Volatility Prediction

Our best performing method shows state-of-the-art results by using the **Extended BM25** weighting model, **SVM with RBF** kernel, and **Stacking** for feature fusion.

Forecast performance of the volatility of the first year after the issue date of reports using 5-fold cross validation:

	Method	(r^2)	(MSE)
	GARCH	0.280	0.170
Text	Wang (2013)	0.345	0.154
	Tsai (2014)	0.395	0.142
	Our method	**0.439**	**0.132**
	Market	0.485	0.122
Text+Market	Wang (2013)	0.499	0.118
	Tsai (2014)	0.484	0.122
	Our method	**0.527**	**0.111**

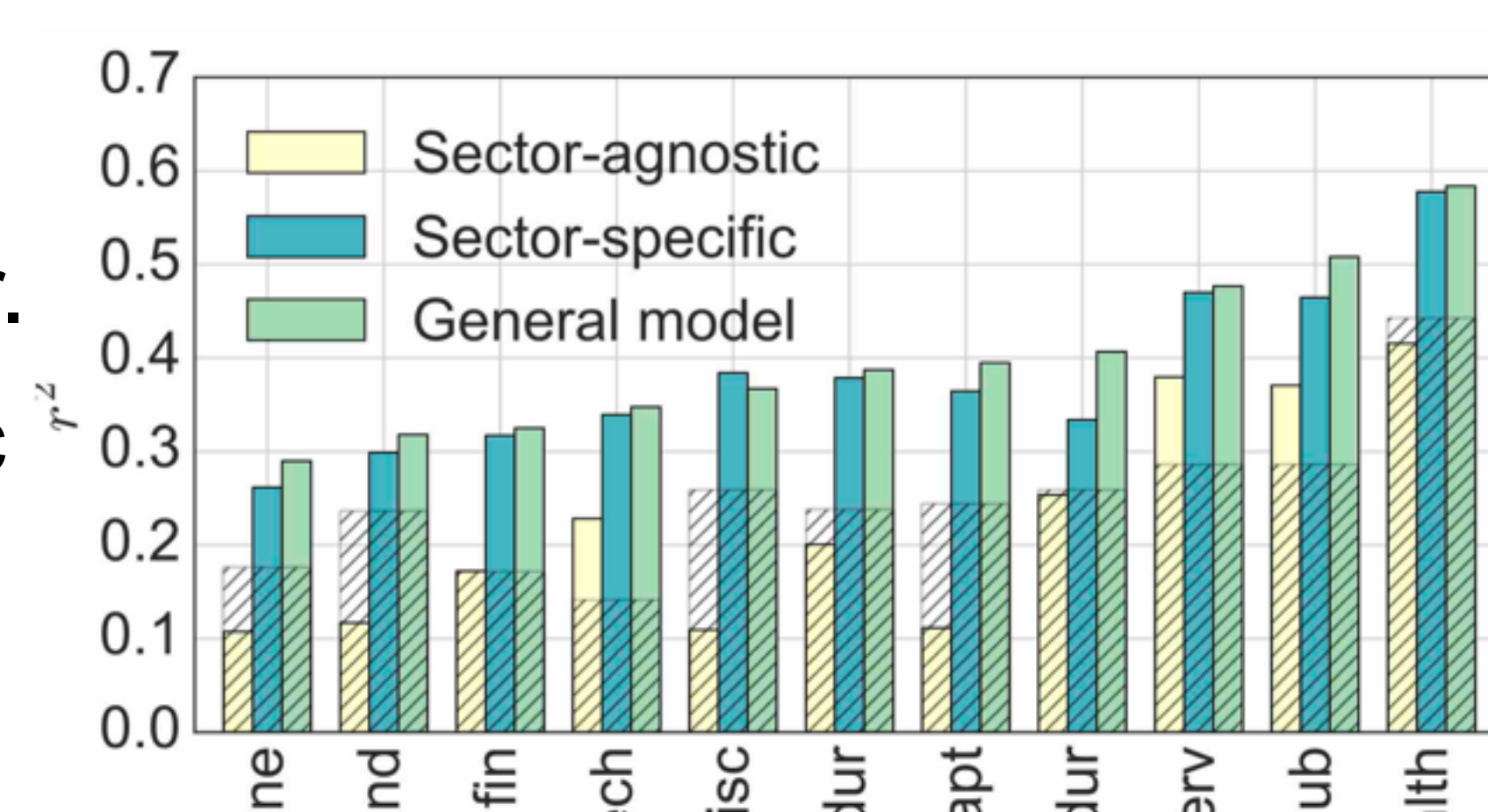Forecast performance of our method till 8 quartiles
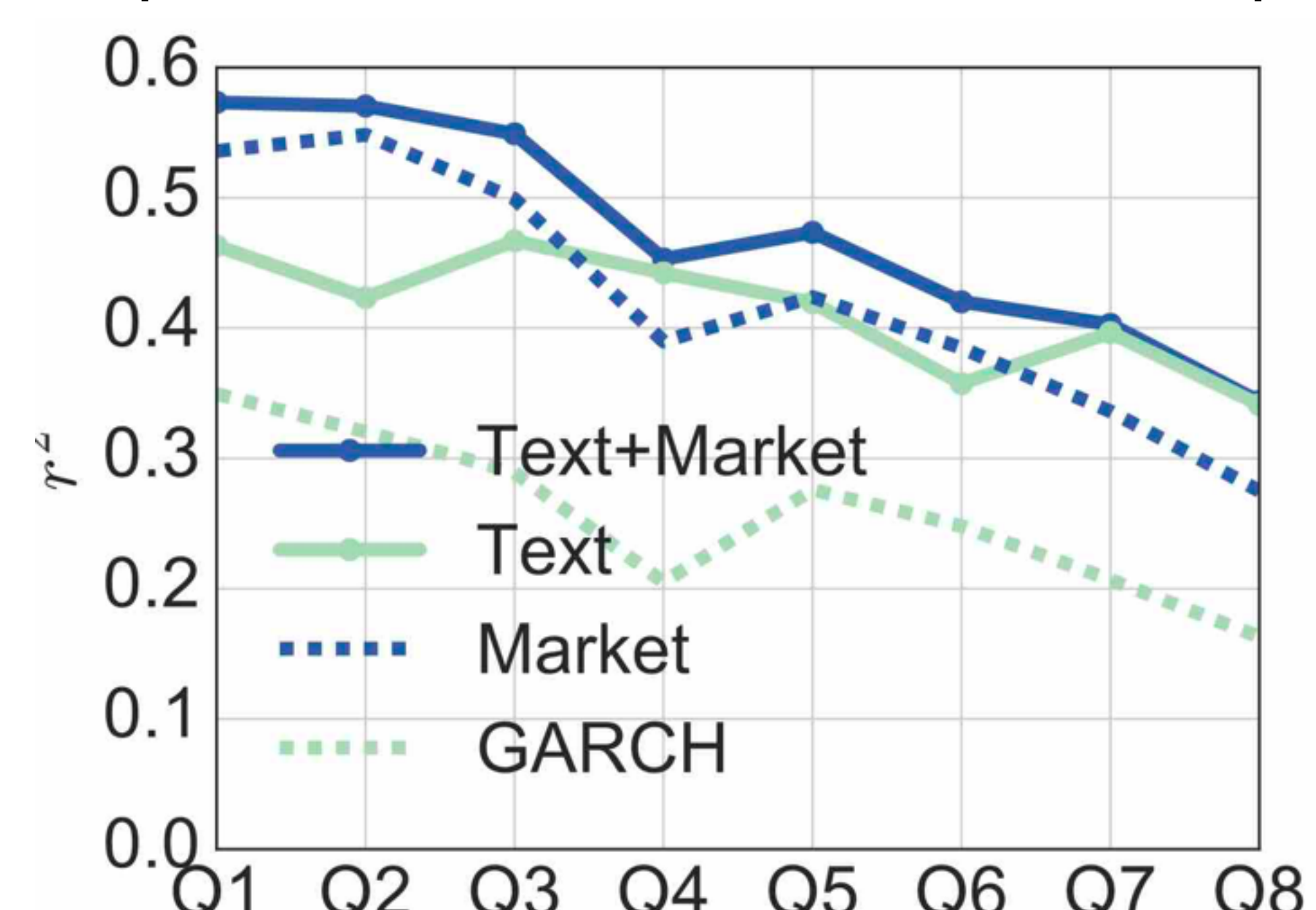
Result: Our SA approach demonstrates a strong and more consistent prediction signal. The effective combination of the features achieves the best results.

Conclusion

- We propose a state-of-the-art sentiment analysis approach for long documents in the financial domain which benefits from the recent word embedding-based IR weighting models.
- We demonstrate the effectiveness of our method in long-term volatility forecasting and the importance of financial sectors in sentiment analysis of 10-K reports.

FACULTY OF !INFORMATICS