Forecasting with Economic News

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2020 Banca d'Italia and Federal Reserve Board

Joint Conference on Nontraditional Data & Statistical Learning

[1]The views expressed are purely those of the writer and may not in any circumstance be regarded as stating an official position of the European Commission.

Sentiment Analysis

Consider news as additional data source for economic forecasting:

- Build **fine-grained aspect-based** economic sentiment indicators
- Forecast/nowcast in **real-time** major economic variables in the US
- **In-sample** and **out-of-sample** performance assessment
- Explore the performance at **different quantile** levels

Fine-Grained Aspect-Based Sentiment analysis

	Frequency	Sentiment
Term selection	Baker et al. (2016)	Shapiro et al. (2020)
Topic modeling	Bybee et al. (2019)	Thorsrud (2016)

Our *sentiment analysis* approach is:

Aspect-based : sentiment computed only about a token-of-interest (ToI)
→ identify words that characterizes the ToI based on some **semantic rules**

Fine-grained : assign a sentiment score between $[-1, 1]$ to a sentence based on dictionary customized for economic applications
→ **human-annotated scores** of the Loughran & McDonald (2011) lexicon

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Natural Language Processing (NLP) pipeline

If the sentence contains the token of interest, apply this NLP pipeline:

- Tokenization and stop word filtering
  - text is split into words
  - removed common words or punctuation (e.g., the, a, :, !, ;-)
- Lemmatization: transform a word in its base form (e.g., is $\rightarrow$ be)
- Part-Of-Speech and Dependency tagging via SPACY
- Negation handling
- Tense (present, past, future, NA) and location detection
- Assign a sentiment to the words using a set of **semantic rules** and a customised **economic dictionary**

Advantages

News data

Data from Dow Jones Data News Analytics (DNA):

- Articles from January 1984 to end of December 2019
- DNA categories: Commodity/Financial Market, Economic and Corporate/Industrial, Political/General
- **6.6 million articles** and 4.2 billion words
- **Major US outlets**:
  - New York Times
  - Wall Street Journal
  - Washington Post
  - Dallas Morning News
  - San Francisco Chronicle
  - The Chicago Sun-Times
- 24 economic sentiment indicators (6 **topics** and 4 **tenses**)

Tokens-of-Interest (ToI)

We construct **six indicators of economic sentiment** that capture different aspect of economic activity and policy:

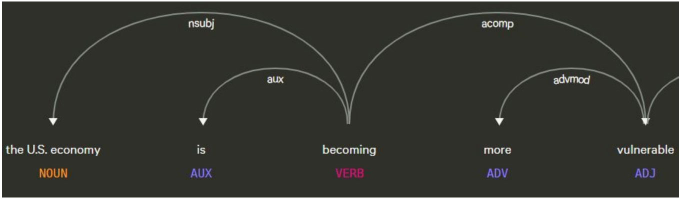
- *Economy*: economy
- *Financial Sector*: bank, derivatives, lending, borrowing and permutations of [banking, financial] with [sector, commercial, and investment]
- *Inflation*: inflation
- *Output*: manufacturing and permutations of [industrial, manufacturing, construction, factory, auto] with [sector, production, output, activity]
- *Monetary Policy*: central bank, federal reserve, money supply, monetary policy, federal funds, base rate, and interest rate
- *Unemployment*: unemployment

World Bank Onthology

Example from *Wall Street Journal*, February 11th, 2016

"Her comments played into the concern that after years of uneven growth, **the US economy is becoming more vulnerable** to the global slowdown"

- ToI & location : *economy* & *US*
- Rule : verb followed by adjectival complement and adverbial modifier
- Verb: become (sentiment: 0; present tense)
- Adjectival complement: vulnerable (sentiment: -0.5)
- Adverbial modifier: more (sentiment: 0.4)
- **overall sentiment** : -0.5 + (-0.5*0.4) = **- 0.7**



Economic Sentiment Measures

Smoothed with a a 30−day MA. Grey area: NBER recessions

Densities

Forecasting setup

The goal is to predict the *first release* in day d in period t

- In-sample and out-of-sample with expanding window 2002-19
- Consider forecast horizons h from 1 week to 1 year
- Include all available information at time $d - h$

Real-time variables[2]:

- Dependent variables: GDPC1, INDPRO, PAYEMS and CPIAUCSL
- additional regressors: Chicago Fed National Activity Index (CFNAI) and National Financial Condition Index (NFCI)
- 24 economic sentiment indicators added one at the time

[2]Source of macro variables: Saint Louis Fed ALFRED

Forecasting models augmented with sentiment

Unrestricted MIDAS approach (Marcellino Schumacher, 2010)

$$Y_t^d = \sum_{p=1}^{P} \beta_{h,p} Y_{t-p}^{d-h} + \sum_{q=1}^{Q} \gamma_{h,q} CFNAI_{t-q}^{d-h} + \sum_{w=1}^{W} \delta_{h,w} NFCI_{t,w}^{d-h} + \eta_h S_{d-h} + \epsilon_t^d$$

The forecasting models:

- **AR** : $\gamma_{h,q}, \delta_{h,w}, \eta_h = 0$ for all w, q
- **ARS**: the AR model augmented with sentiment ($\gamma_{h,q}, \delta_{h,w} = 0$)
- **ARX**: the model that includes lags, CFNAI and NFCI ($\eta_h = 0$)
- **ARXS**: ARX model with sentiment

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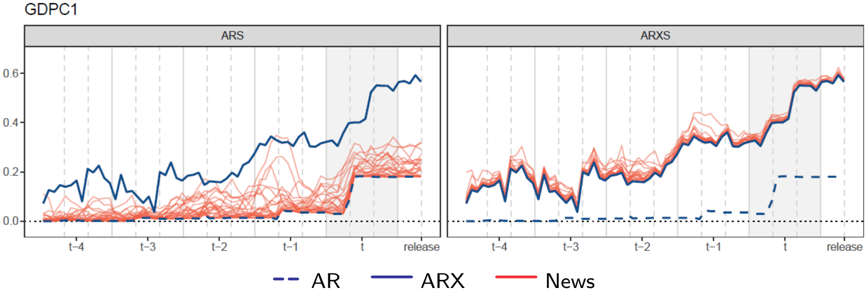
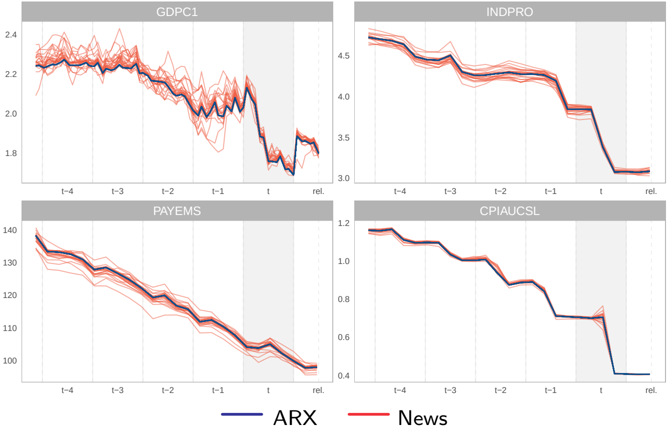
In-sample R^2



- Upward slope R^2 curves: effect of the information flow
- Augmenting AR always useful, in particular at forecasting horizons
- Sentiment useful also in ARX with CFNAI and NFCI

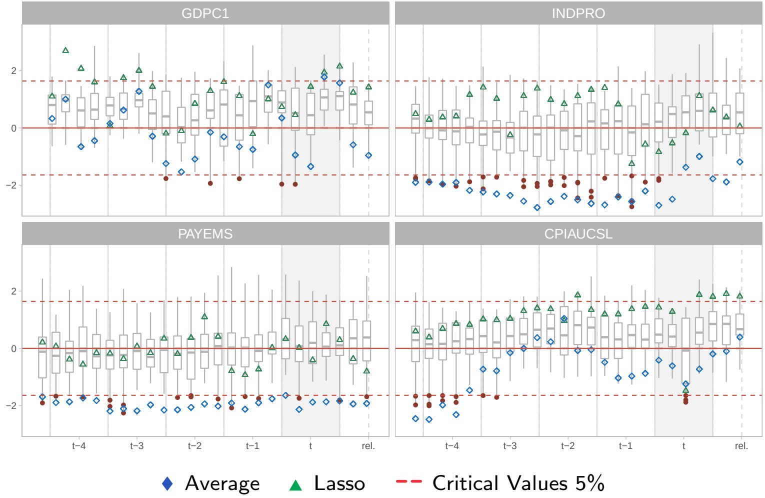
Variable selection

Out-of-sample: RMSPE



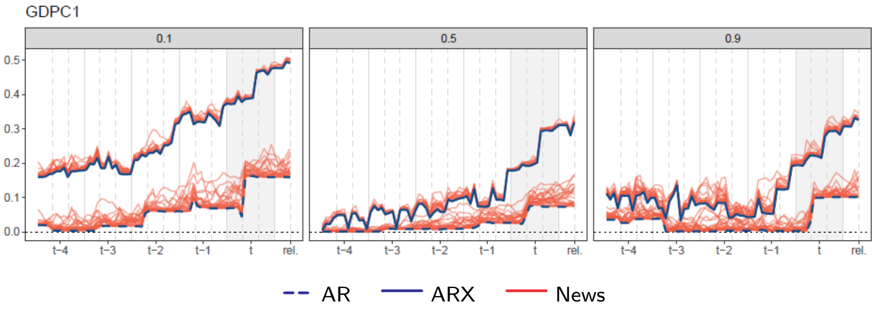
- Macroeconomic releases decrease RMSPE (largest decline in t)
- GDPC1: *Economy* (fu), *Financial Sector* (pr/pa) $\rightarrow$ max gain 11.4%
- INDPRO: *Unemployment* (pr), *Output* (pa) $\rightarrow$ average gain 1.3%

Out-of-sample: DM test statistics



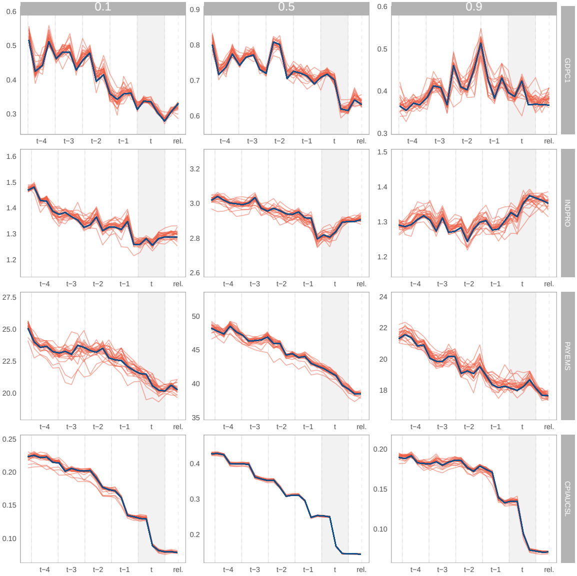
Negative statistics below the critical value: model outperforms the ARX

In-sample: Pseudo-R^2 quantile regression

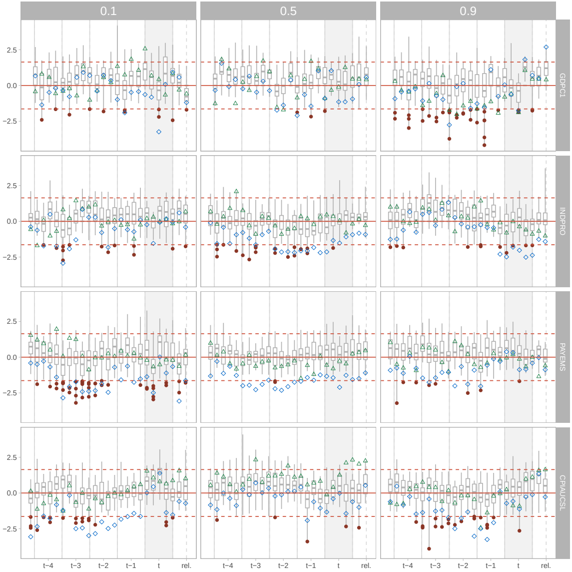


- QARX better than QAR in particular for **low quantiles**
- *Economy* and *Output* most relevant in for median and low quantiles
- *Inflation* and *Financial sector* selected for high quantiles

Out-of-sample quantile regression: RMSPE



Out-of-sample quantile regression: DM test



Conclusions

- Advanced NLP to extract **economic sentiment** from news
- Sentiment is useful in **forecasting**, while marginally in **nowcasting**
- *Possible explanation*: reporting of economic news is not only about the past events, but also discusses future scenarios
- Other works:
  - Explore the **narrative** aspect of our sentiment algorithm
  - Application to EU (translate news to *English*)
  - Compare with other approaches: EPU, LMD, ...

References

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- Thorsrud (2020). Words are the new numbers: A newsy coincident index of the business cycle. *JBES*, 38(2), 393-409.

Our **working papers** is available at:

- Barbaglia, Consoli, Manzan (2020) “Forecasting with Economic News” Available at SSRN: `https://ssrn.com/abstract=3698121`

Sentiment analysis: benefits and costs

Advantages

- easy to interpret and create a narrative
- sentiment is expressed as a number in $[-1, 1]$

Disadvantages

- the set of rules mapped by the algorithm is limited
- this approach works only with the English language
  $\rightarrow$ we rely on the machine learning *eTranslation* service by the European Commission

main

World Bank Ontology

Selection of economic synonyms of an economic concept with SPARQL queries on the **World Bank Group Ontology**[3]:

- Classification schema of economic concepts to **describe** and **link** language and terminology
- Concepts are stored and linked in a **logical hierarchy** and can relate across subject areas

For instance, Industrial Production:

$\Rightarrow$ manufacturing; industrial output; secondary sector; industry productivity; manufacturing development; industrial growth; manufacturing productivity ...

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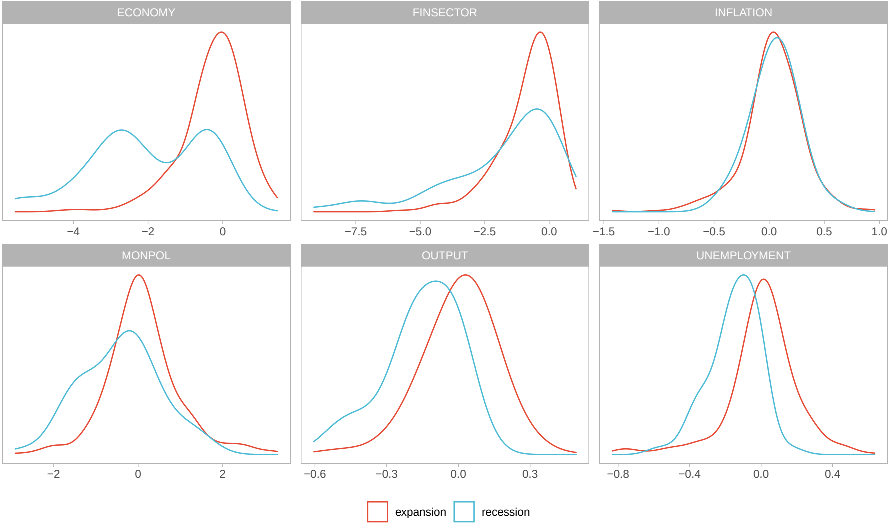
[3] `http://vocabulary.worldbank.org/thesaurus.html`

Kernel density of the economic sentiment measures



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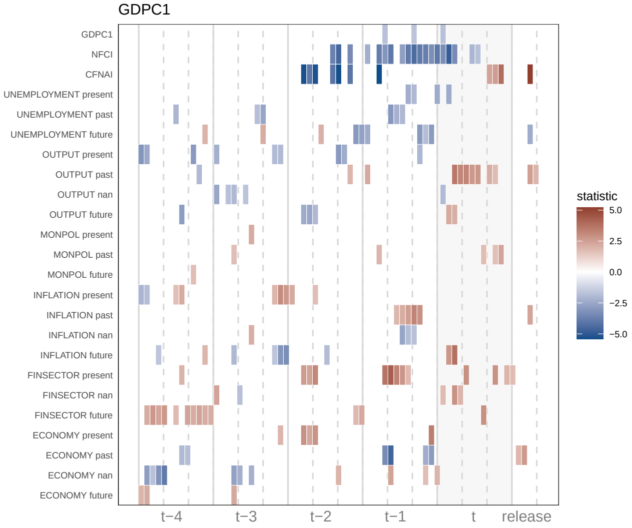
In-sample Lasso variable selection



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