# Sentiment and Uncertainty indexes to Forecast the Italian Economic Activity[1]

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[1] The opinions expressed are those of the authors and do not reflect the views of the Bank of Italy or the Eurosystem.

# Motivation

Forecasting faces new hard challenges

- Macroeconomic facts have been changing rapidly (Ng, and Wright, 2013)
- Legacies of the latest deep recessions

But...

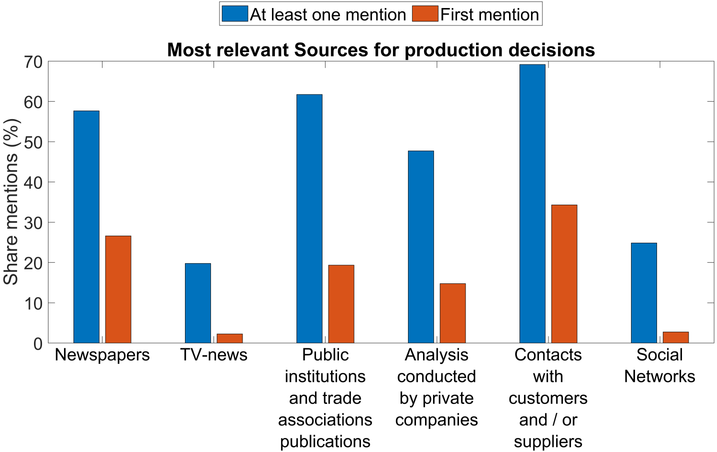
- Big data availability
- Novel sources of *unstructured*, high-dimensional, high-frequency and **timely** information

**Our contribution**

- Build **Sentiment Indicators (TESI)** and **Uncertainty indicators (TEPU)** for Italy from newspaper articles at high frequencies and for different sectors and topics (multi-source)
  - Italian businesses gather information to form their decisions from newspapers
- Use TESI and TEPU to track the short-term evolution of the Italian economic activity (**monthly**)
- Huge benefits in forecasting when used to build a high-frequency nowcasting indicator (**weekly**)

# Motivation: Survey on most relevant source of information

## Bank of Italy's Survey on Inflation and Growth Expectations




Sample size: 1199 respondents.

# Text as Data

- Growing literature exploring the *media-economy-opinion nexus*
- Shapiro et al. (2018), Gentzkow et al. (2019), Thorsrud (JBES, 2020), Kalamara et al. (BoE WP 2020), Ardia et al. (IJF, 2019), Algaba et al. (JES, 2020), Nguyen and La Cava (RBA WP 2020), Garboden (2019), Rogers and Xu (FRB WP 2020)
  - Economic perceptions affect policy preferences but these perceptions are oftenly driven by factors other than the economy, including media [Soroka et al. (2015)]
  - Newspapers catch the mood (and to a certain extent they amplify and propagate pessimism or optimism)
- Unstructured information: transforming text into numerical data (tokenization)
- Documents are not a simple sum of words (*The Library of Babel* by Jorge Luis Borges): extracting the meaning of the sentence

# Factiva's repository

## HTML Screenshot

Metadata

SE PRIMO PIANO
HD Rallenta la crescita, plausibile una manovra da 9 miliardi
BY Nicoletta Picchio
WC 472 words
PD 28 June 2018
SN Il Sole 24 Ore Digital Replica Edition of Print Edition
SC SOLE
PG 02
LA Italian

LP ROMA

Article text

L'**economia** italiana rallenta nel biennio 2018-2019, un calo «anticipato e più ampio» rispetto alle stime di dicembre dell'anno scorso. Frenata che renderebbe «plausibile una manovra correttiva in corso d'anno da 0,5 punti di Pil, pari a 9 miliardi». Il Centro studi Confindustria ieri ha diffuso i nuovi dati: il pil quest'anno salirà dell'1,3% (-0,2 rispetto alle previsioni precedenti) e dell'1,1 nel 2019 (-0,1). Andamento dovuto ad una serie di fattori: a livello internazionale le nuove politiche protezionistiche degli Stati Uniti creano **incertezza** sul futuro degli scambi mondiali e a ciò si aggiungono le tensioni geopolitiche. Già si osserva un rallentamento degli scambi mondiali che si riflette sull'export italiano. Le esportazioni, ha spiegato Andrea Montanino, direttore del Centro studi, aumenteranno meno della domanda mondiale nel 2018 per la prima volta dal 2013. L'Italia, quindi tornerà a perdere quote di mercato.

TD Inoltre si va esaurendo il ciclo degli investimenti a livello nazionale, anche per l'avvicinarsi della fine degli incentivi. In uno scenario in cui cresce il costo del finanziamento: +100 punti base ad oggi rispetto alla media dei primi quattro mesi pesa sul finanziamento dell'**economia** reale, oltre al fatto che l'aumento dello spread rende l'Italia un rischio per l'area euro. L'occupazione, pur continuando a crescere, ha perso slancio: aumenterà dello 0,8% nel 2018 e dello 0,7 nel 2019 contro la media del +1,2 nel 2017. Quella dipendente torna ad essere trainata dal lavoro temporaneo. Il costo del lavoro per unità di prodotto tornerà a crescere nel 2018, +0,4% e balzerà dell'1% nel 2019.

La crescita che rallenta, sottolinea il Csc, si riflette sui conti pubblici: «ci sono pochi spazi di **bilancio** per l'Italia», ha detto Montanino, anche perché il percorso di risanamento negli anni passati è stato debole, a differenza di gran parte dei paesi Ue. L'indebitamento della Pa è previsto all'1,9 nel 2018 e all'1,4 nel 2019, al di sopra dei target di governo e condivisi con l'Europa. È «palusibile» quindi, dice il Csc, la richiesta di una manovra correttiva di 0,5 punti di pil nel 2018 (9 miliardi), che non è stata calcolata nelle previsioni. Nel 2019 la correzione dovrebbe essere di 0,6 punti (quasi 11 miliardi). È stata richiesta e ottenuta molta flessibilità in Europa, quasi 30 miliardi, e le clausole di salvaguardia sono state disinnescate per tre quarti in **deficit**. Ora molto dipenderà, dice il Centro studi, dalle scelte di **politica economica** che saranno adottate sia sulle clausole di salvaguardia sia sull'attuazione del contratto di governo. Pesa anche la gradualità di come saranno realizzate le misure.



Topics

NS e11 : Economic Performance/Indicators | e1108 : Budget Account | e1101 : Economic Growth/Recession | e211 : Government Budget/Taxation | ccat : Corporate/Industrial News | gcat : Political/General News | e21 : Government Finance | ecat : Economic News

RE italy : Italy | eecz : European Union Countries | eurz : Europe | medz : Mediterranean | weurz : Western Europe

PUB Il Sole 24 Ore SpA

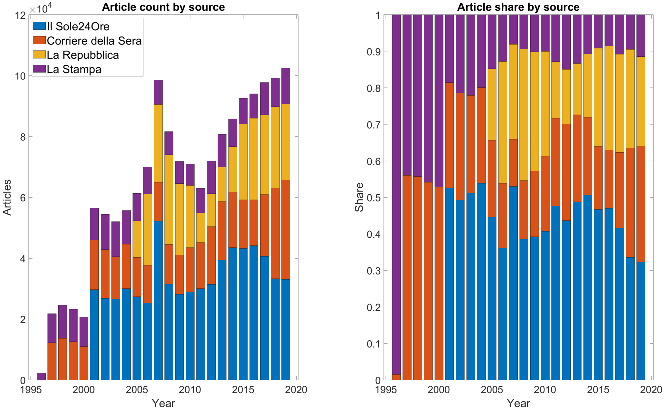
Identifier

AN Document SOLE000020180628ee6s0002r

We downloaded approximately 2 million newspaper articles in the Italian language related to economic news from September 1996 to December 2019.

# The News Corpus

## Number of articles by year and source and share of articles for each source in each year



# Data treatment - Sentiment & Uncertainty

- Pre-processing (removal of stop-words, non-meaningful punctuation, etc.)

**Examples**

*Production fell by 1.2% overall between January and October.* $\rightarrow$ *Production fall overall January October* $\rightarrow SENT_t = -0.2$

- Building a meaningful **dictionary** related to economic topics in Italian (unigrams + n-grams)
  - Polarity (+/-) & weight (#)
  - Valence Shifters tailored to newspapers' jargon
- Constructing sentiment score for article $j$ as $\Rightarrow SENT_{jt} = \frac{\sum_{i=1}^{No\ words} polarity_{ijt} \times shifter_{ijt}}{No\ words_{jt}}$

**Examples**

*Gross Domestic Product has fallen* $\rightarrow SENT_t = -1.0$

*Istat's projections, GDP grew in 2019. Expansion is set to strengthen in 2020* $\rightarrow SENT_t = 0.25$

- Constructing also Economic Policy Uncertainty (EPU) Indicators as the share of articles containing at least an "Uncertainty" word

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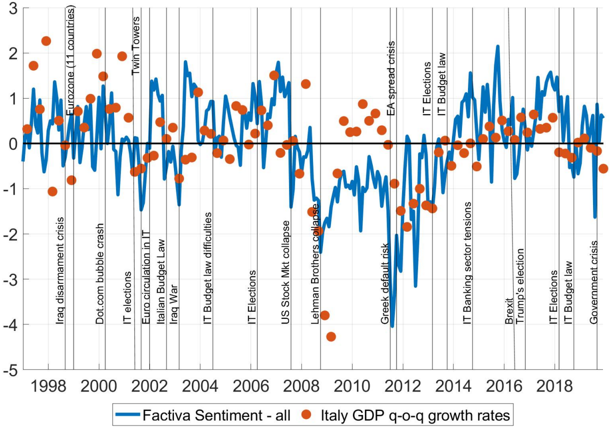
# Sentiment Index

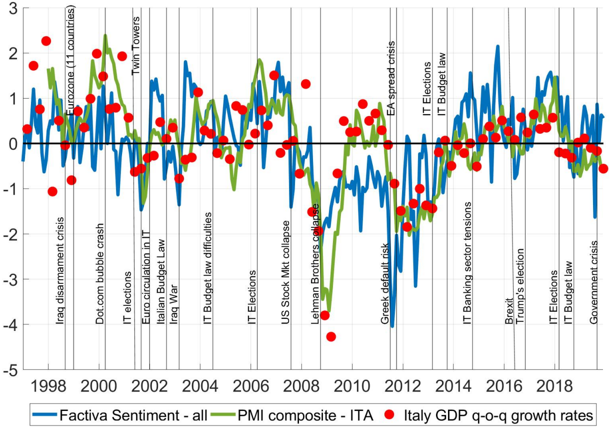
- Typically sentiment indices provided by statistical offices or PMIs are based on information collected up to the mid of the reference month.

- Sentiment based on newspapers' articles accounts for facts and events occurring daily.

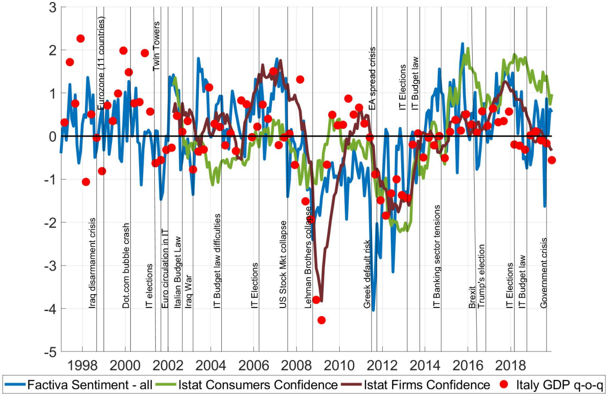
# Sentiment Index and Economic Activity



# Text-based Sentiment Index and PMI



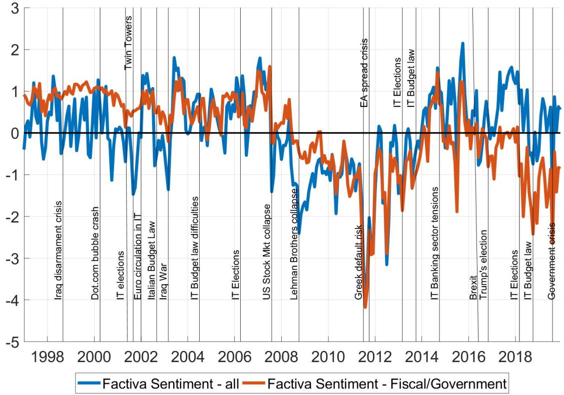
# Text-based Sentiment Index and IESI (from NSI)



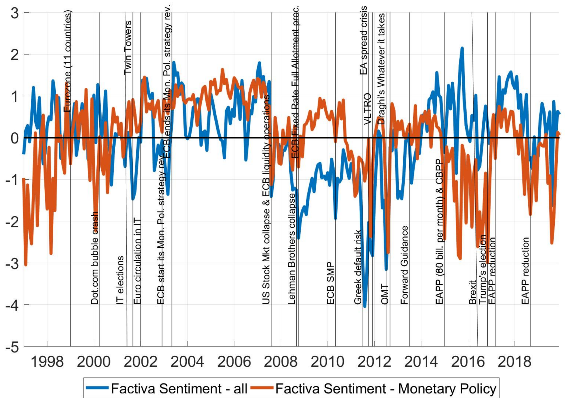
# Sentiment Index - Taxonomy

1. **Sentiment by topics** (# 15), grouping > 300 article pre-labeled categories
   - Fiscal Policy/Government
   - Monetary policy
   - Labor Markets
   - Economic conditions
   - Prices
   - Foreign Policy
   - ...
2. **Sentiment by sector** (# 21)
   - Manufacturing
   - Services
   - Retail
   - ...
3. **Sentiment Heterogeneity across newspaper sources** (# 4)

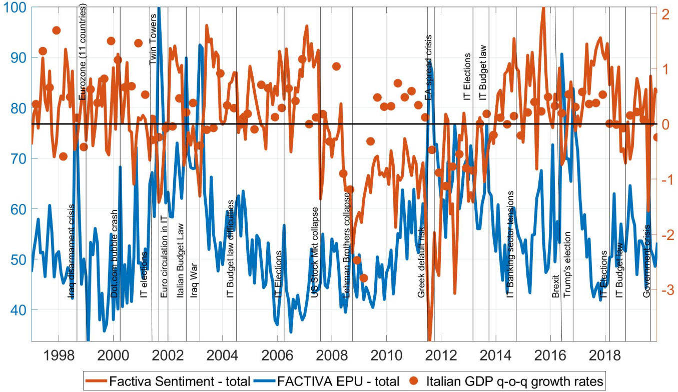
# Sentiment index - by topics (Fiscal/Government)



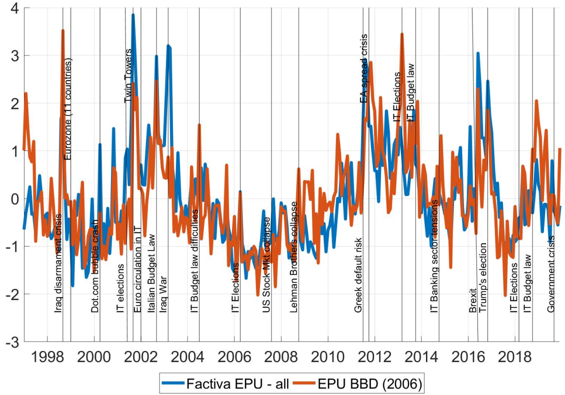
# Sentiment index - by topics (Monetary Policy)



# Economic Policy Uncertainty (EPU)



# Economic Policy Uncertainty - Comparison with Bloom, Baker Davis (2016)



# Empirical application #1 - Bayesian Model Averaging (BMA)

## Short-term forecasting with **monthly data**

- **Target**. q-o-q growth of the Italian **GDP** and of its main **demand/supply components**
- **Model/Method**. Bayesian Model Averaging (BMA) (Bencivelli, Marcellino, and Moretti. EE, 2017)
- **Data**.
  - Baseline model: soft indicators (from business surveys and PMIs), industrial production index;
  - Augmented model: baseline + sentiment from newspapers' articles (overall index)
- Pseudo real-time forecasting exercise with monthly data
- Test the ability of **text-based indicators** (Sentiment and EPU) to forecast the Italian economic activity and its main components (T-model)

# Empirical application - BMA Results on point forecasts

## Short-term forecasting - Relative RMSFE for nowcasting and forecasting

- T-model tends to lower the RMSFE during the most turbulent period (2011-2014), in particular for HHC.

Table: Relative RMSFE for nowcasting (n) and forecasting (f)

| | **2011.1 - 2014.12** | | **2015.1 - 2019.12** | | **2011.1 - 2019.12** | |
|---|---|---|---|---|---|---|
| | n | f | n | f | n | f |
| GDP | **0.93** | **0.91** | 1.17 | 1.16 | 1.00 | 1.00 |
| VAS | **0.97** | 1.21 | 1.08 | 1.08 | 1.00 | 1.00 |
| GFI | 1.03 | **0.94** | 1.13 | 1.08 | 1.03 | 1.00 |
| HHC | **0.83** | **0.79** | 1.46 | 1.29 | **0.99** | 1.00 |

# Empirical application - BMA Results on density forecasts

## Short-term forecasting - Average log score based on WLRT (Amisano & Giacomini, 2007)

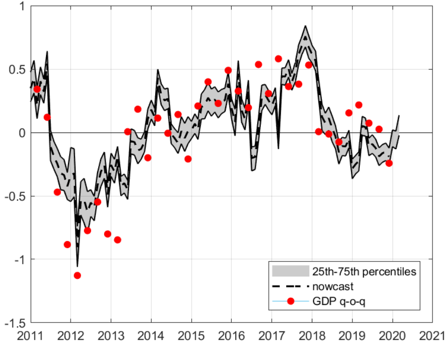
- T-model definitely outperforms the benchmark overall, and in particular during the sovereign debt crisis. Text-based indicators squeeze the uncertainty around nowcasts

Table: Average Log Score for nowcasting (n) and forecasting (f)

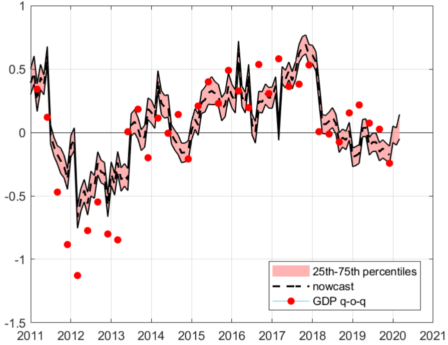
| | 2011.1 - 2014.12 | | 2015.1 - 2019.12 | | 2011.1 - 2019.12 | |
|---|---|---|---|---|---|---|
| | n | f | n | f | n | f |
| GDP | **9.1** | 8.6 | -15.6 | -22.4 | 6.1 | **6.6** |
| VAS | 5.3 | **6.6** | -7.1 | -10.3 | 3.7 | **6.4** |
| GFI | 3.6 | **23.7** | 6.9 | **10.5** | 4.6 | **24.5** |
| HHC | **14.6** | 12.2 | -9.4 | -11.8 | 11.4 | **11.8** |

# Empirical application - Results from BMA

## Nowcast of GDP qoq



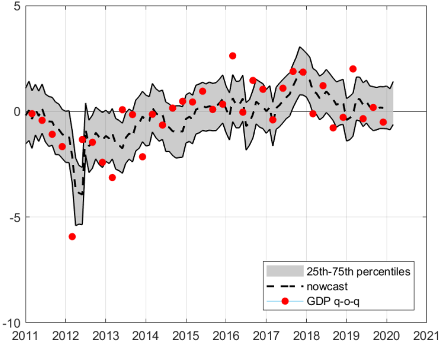

T-model



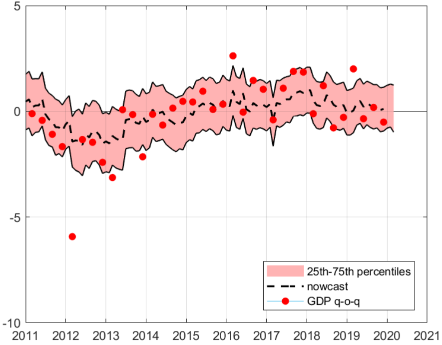

Baseline

# Empirical application - Results from BMA

## Nowcast of GFI qoq



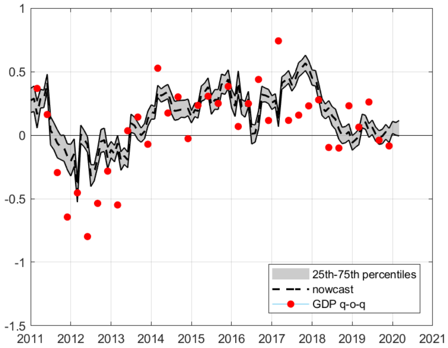

T-model



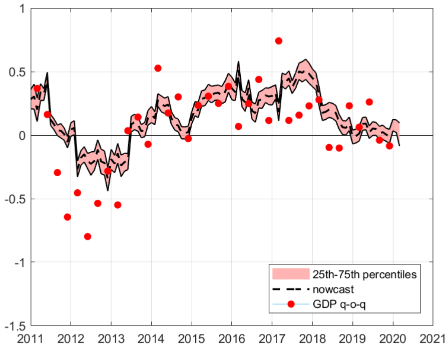

Baseline

# Empirical application - Results from BMA

## Nowcast of VAS qoq



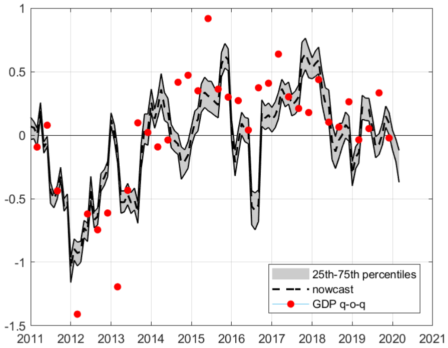

T-model



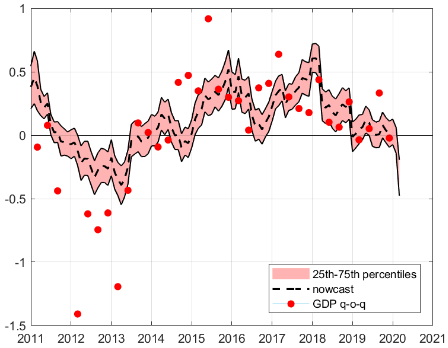

Baseline

# Empirical application - Results from BMA

## Nowcast of HHC qoq



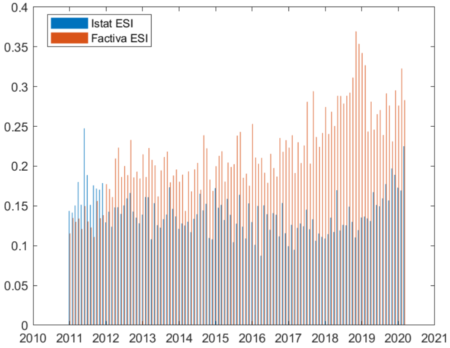

T-model

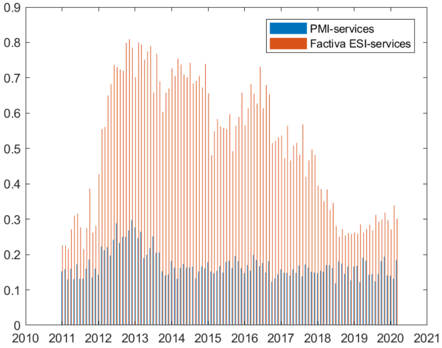



Baseline

# Empirical application - Results from BMA

## Posterior Inclusion Probabilities for GDP qoq Nowcasts

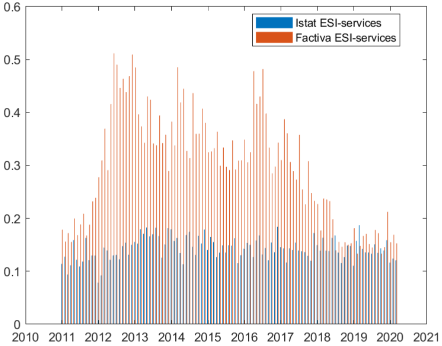


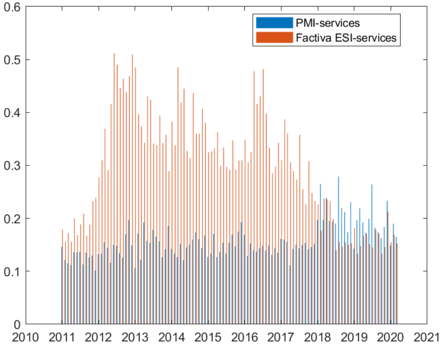




- PIP measures relative importance of each regressor to explain the variance of the target variable. SI is picked more frequently than PMI or Istat ESI.

# Empirical application - Results from BMA

## Posterior Inclusion Probabilities for VAS qoq Nowcasts

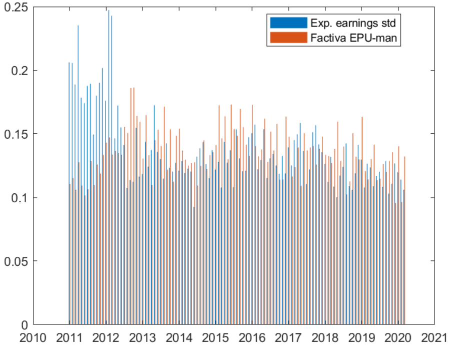


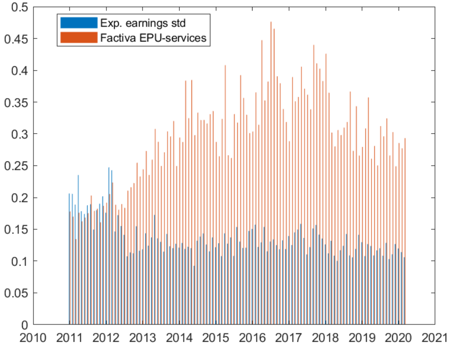




- SI for Services is picked more frequently the corresponding PMI or Istat SI.

# Empirical application - Results from BMA

## Posterior Inclusion Probabilities for GFI qoq Nowcasts

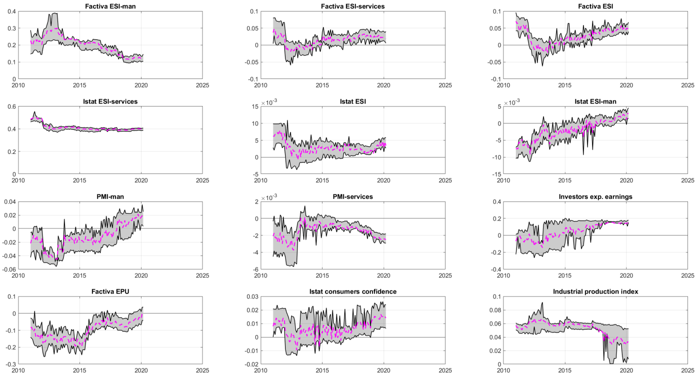



- EPU for Services is picked more frequently the std. dev. of expected earnings.

# Empirical application - Results from BMA

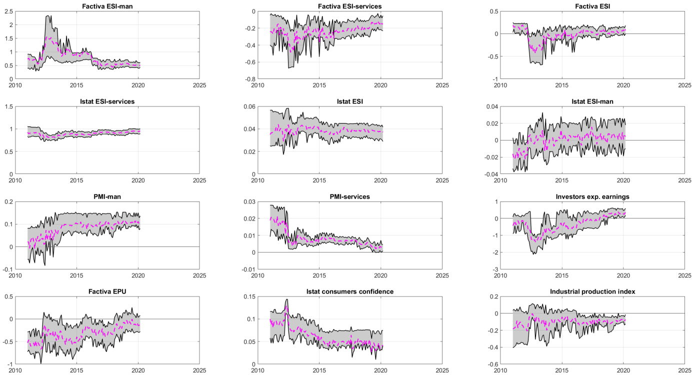
## Regression Coefficients and 25th-75th percentiles for GDP qoq Nowcasts




- TESI and TEPU have expected sign.
- TESI-manufacturing and TEPU outperform.

# Empirical application - Results from BMA

## Regression Coefficients and 25th-75th percentiles for GFI qoq Nowcasts




- SI and EPU weigh more than Istat ESI and PMI with expected sign.
- Text-based SI for Manufacturing outperforms. EPU negative contribution as expected.

# Empirical application - A Weekly economic indicator

Following Stock and Watson (2002) and Lewis, Mertens and Stock (2020), we build a weekly indicator of economic activity

- Explore the role of information timeliness

We find that

- TESI and TEPU help nowcast the GDP (RMSFE reduced by $15 - 17\%$ from baseline)
- Gains seem due to
  - Better tracking than other weekly variables
  - More timely tracking than monthly indicators
- CSSED analysis shows stable gains over most of the out-of-sample period

# The model

We extract the first Principal Component from two different sets of variables:

1. Group 1 (baseline)
   - Electric Consumption, Expected Earnings std (weekly)
   - PMI indices, ISTAT sentiment (monthly, inferred weekly)
2. Group 2 (factiva)
   - Dabatase 1
   - TESI and TEPU indicators (weekly)

We use it to nowcast GDP growth yoy

- Using only pseudo real-time available data

# The model

- We regress GDP yoy variation available at week $\tau$ against the 13-periods-average of the first PC.
  At week $t$ (today) call $T_t < t$ the week at which the latest data is available.

$$\Delta Y_{(yoy),\tau} = \alpha'^{i}_{T_t} + \beta'^{i}_{T_t} \tilde{X}^{i}_{\tau} + \varepsilon_{\tau}, \qquad \tau = t_0, t_0 + 1 \ldots, T_t$$

$$\tilde{X}^{i}_{\tau} = \frac{1}{13} \sum_{s=\tau-12}^{\tau} X^{i}_{s}$$

- At week $t$, compute the index for each past period $\tau \leq t$ using estimate coefficient

$$\Delta \hat{Y}^{i}_{(yoy),t} = \alpha^{i}_{\tau} + \beta^{i}_{\tau} X^{i}_{t}$$

# Forecasting error

- Compute the nowcasting errors by using the ex-post available data on GDP as

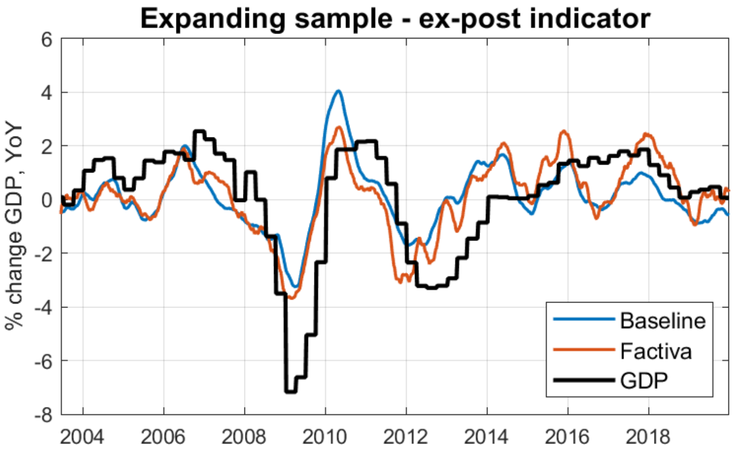
$$E_t^i = \Delta Y_{(yoy),t} - \Delta \hat{Y}^i_{(yoy),t}$$

- $\approx$ 13 nowcasts per quarter
- We find large gains on weekly nowcasts when adding Sentiment and EPU indicators

Table: Relative RMSFE

| | Expanding | Rolling (335 weeks) |
|---|---|---|
| All sample | 0.85 | 0.83 |
| Negative GDP | 0.88 | 0.96 |
| Positive GDP | 0.82 | 0.75 |

# Weekly indicator: last vintage



# Wrap-up

- We developed an Italian economic dictionary with polarity and shifters
- We used Factiva newspapers data to estimate Sentiment and EPU indices at daily and weekly frequencies
- We evaluated their properties in two short-term forecasting exercises
  1. **Monthly**: point-forecast gains in recessions; large density forecast gains overall
  2. **Weekly**: large point-forecast gains across all the sample
- Results seem quite promising
- Further developments:
  - Extend exploration of high-frequency properties and corresponding gains
  - Explore deep learning techniques to handle text data and weight our dictionary

# THANK YOU