Information, Shocks and Market Beliefs: The Effects of Central Bank Communication

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University of Oxford, CEPR & Irish Fiscal Advisory Council

March 16, 2021

This talk represents my views and not necessarily those others including the Irish Fiscal Advisory Council, Central Bank of Ireland (co-authors), or anyone else including co-authors!

Setting the Scene

The Event Invitation

Keynote Speaker at EC's *Big Data and Economic Forecasting 2021*

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What I will cover

1. My ERC-funded research focuses on *the effects of CB communication*
   - I will lay out why this is an important topic
   - I will explain why forecasting and (small) big data are naturally at the heart of this research - Information, Shocks and Market Beliefs
2. I shall outline two work-in-progress projects that exemplify this:
   - 2.1 "The Central Bank Crystal Ball: Understanding temporal information in monetary policy communication"
   - 2.2 "Deafening Cacophony? Information shocks in speeches and the effects of monetary policy"

Monetary Policy is a Key Macro Policy

Financial

Central bankers tell politicians: we've done all we can to grow economies

Public sector worker families worst hit by cuts, says TUC

Nuclear clean-up bill to soar by billions

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Europe quantitative easing + Add to myFT

Heading for the exit: three things to watch at the ECB

End of bond-buying, economic headwinds and Italy will be big talking points

The ECB could say how and when QE will end as soon as Thursday, or it could wait for its July vote © FT montage

Claire Jones in Frankfurt 7 HOURS AGO 13

- Cornerstone of monetary policy to be phased out
- ECB to focus on interest rates and balance sheets
- Draghi to expand on bank's intentions

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- Transparency means
  Open Market Operations $\rightarrow$
  Open *Mouth* Operations

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- Transparency means Open Market Operations $\rightarrow$ Open *Mouth* Operations

My *NewMonEc* Proposal

- A New, Multidisciplinary Approach to Monetary Economics Research

The Nature of Central Bank Transparency has Changed

Pre-1994 in US: No policy announcements, maximum opacity

- **Montagu Norman (1920-44):** *'Never apologise, never explain.'*
- **Alan Greenspan (1987):** *'If I seem unduly clear to you, you must have misunderstood what I said.'*

Fed since 1994: Announcements of policy & increasingly regular speeches

- **Blinder (1996):** *'Greater openness might actually improve the efficiency of monetary policy. . . [because] expectations about future central bank behavior provide the essential link between short rates & long rates.'*

More recently (Effective Lower Bound): Forward guidance

- $\Rightarrow$ Move to Open **Mouth** Operations

What is Central Bank Communication?

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Central bank communication broadly defined as the information that the central bank makes available about its current and future policy objectives, the current economic outlook, and the likely path for future monetary policy decisions (Blinder et al, 2008).

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Central bank communicates about:

Reaction function its current and future policy objectives (+ likely path)

State of Economy the current economic outlook (+ likely path)

Expectations Management is Central to Mon Policy

- **Blinder (1998):**

  "expectations about future central bank behavior provide the essential link between short rates and long rates."

- **Bernanke (2003):**

  "A given [monetary] policy action... can have very different effects on the economy, depending (for example) on what the private sector infers... about the information that may have induced the policymaker to act, about the policymaker's objectives in taking the action..."

- **Gurkayanak, Sack and Swanson (2005):**

  Central bank statements move markets beyond the effect of the change in the current policy rate (event study).

Why Does This New Era of Communication Matter?

1. Raises *new* questions that are of first-order importance.
   - e.g. To whom should central bank communications be targeted?
   - e.g. Does their communication create additional uncertainty?

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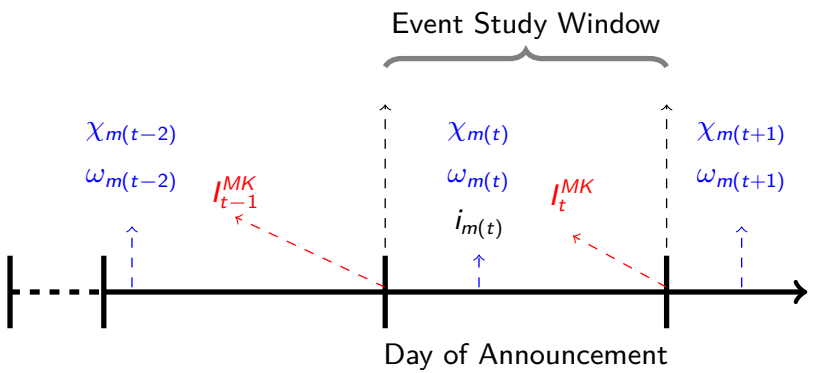
2. We need to *rethink* how we study some fundamental monetary-economics questions empirically.
   e.g. Multidimensional signals (GSS, 2005; Romer & Romer, 2000): Policy action vs. information effect



Why Does Central Bank Communication Matter?

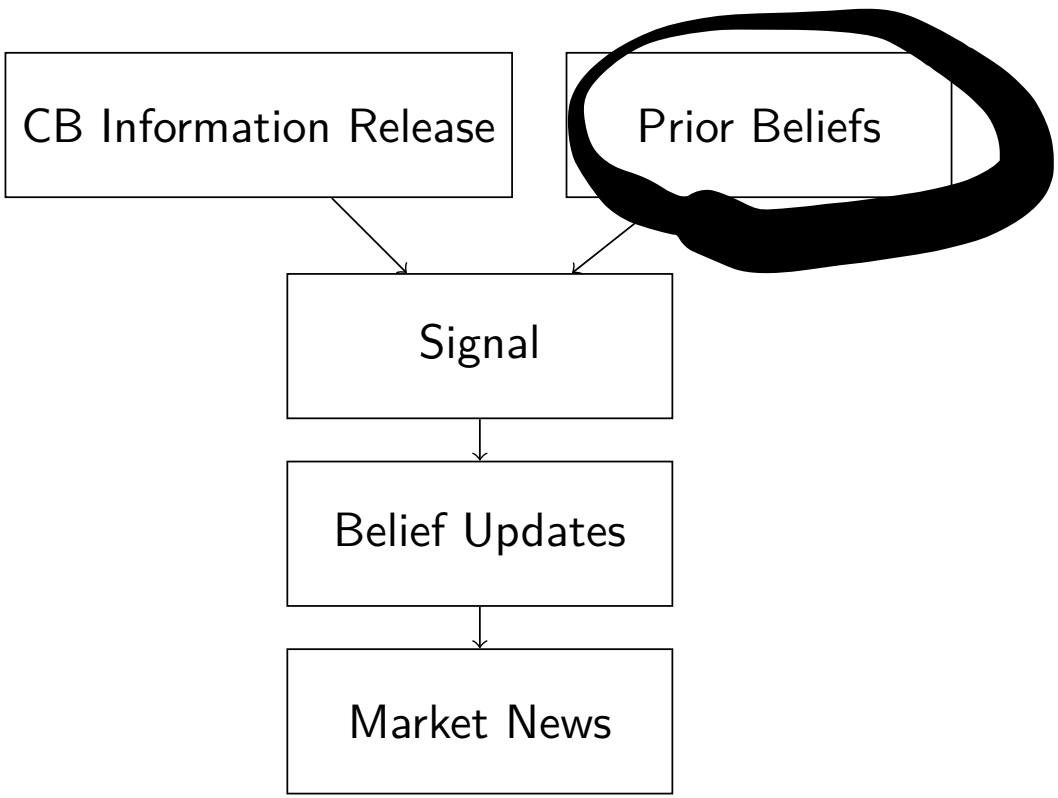
Open questions concern *why CB communication matters*?

1. Does the source of news reflect *an information effect*?
   - Central bank private information on economic conditions
     - **Romer & Romer (2000)**
   - vs. Direct signal of policy action
2. What is the nature of the information deficit? How does it vary over time? How responsive is the central bank in responding it?

Important Distinctions

Important Note

In practice, the mapping between information, signals and updated beliefs is highly complex and multidimensional.



Theme I: Measuring CB Information Communicated

New Research in Progress

The Central Bank Crystal Ball: Understanding temporal information in monetary policy communication
joint with David Byrne (Central Bank of Ireland), Robert Goodhead (Central Bank of Ireland) and Conor Parle (Central Bank of Ireland).

Outline of subsection:

1. Identification problem
2. Why a 3rd T?
3. How to measure the 3rd T?
4. Summary Statistics
5. Analysis of ECB statements
6. Future work (in progress)
    - Speeches analysis

Identification Problem

$$i_m = r_m^* + \pi^* + \phi^T \omega_m + \epsilon_m$$

- r_t^*: equilibrium real interest rate
- $\omega_m = \left(\pi_{m;h}^{CB}, \tilde{y}_{m;h}^{CB}\right)^T$
  - $\pi_{m;h}^{CB} \equiv \mathbb{E}_m^{CB}\left[\pi_{m+h}\right] - \pi^*$
  - $\tilde{y}_{m;h}^{CB} \equiv \mathbb{E}_m^{CB}[\tilde{y}_{m+h}]$

- Information on ω_m can provide signal on r_m^* or ϵ_m
- But can still say something on nature of information
- And smoking gun? Especially if linked to the channel

Adding a T: The 3 Ts of Text Analysis

Topic

Often measured with Latent Dirichlet Allocation (LDA)

Tone

e.g. Dictionary Methods, VADER

Time

Rarely captured explicitly

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Why a 3rd T?

- Monetary policy is inherently forward-looking policy
- Most past and even current information is public
- But the information that fills an information deficit is unclear
  - Does the 3rd T helps with understanding the nature of useful information sent?

Time Tagging

- We want to distinguish discussions of the future from the past/present
- We use 2 approaches to time tagging:
  1. Temporal tagging via SUTime
  2. Tense tagging via TMV

Temporal Tagging: SUTime

- SUTime temporal tagger (Chang and Manning, 2012).
- Rules-based temporal tagger built on regular expression patterns for capturing time in text
  - e.g. regular expressions could be "June 2020" or "2020-06".
  - Rules define the output returned - sixth month of 2020
- Allows a wide range of representations of time
- Resolves relative date formats ("two months from now")
- Outputs are TIMEX3 format (Pustejovsky et al, 2003) temporal tags:
  - Numerical: "June 2020" or "next June" $\Rightarrow$ numeric dates.
  - Categorical: past, present, or future
  - Ranges: We do not use these at present

Temporal Tagging: SUTime

- Tailoring the SUTime rules to the language of central banking.
  - References to the "short-term", "long-run", and similar constructions.
  - Refer to dates and eras by commonly understood shorthand names.
    - "Great Depression" $\Rightarrow$ 1929
    - "Global Financial Crisis" $\Rightarrow$ 2008
- Greater care when cleaning to avoid spurious temporal references:
  - "J. Doe (1999)"
  - Time reference in financial/economic terms - "long term rate"
- Can produce more granular measures of the future:
  - Create categories of short, short-to-medium, medium, medium-to long and long run future; "ambiguous future" is a residual future category.
  - Allows us to examine the horizon into the future about which the central banker is communicating, and how this changes over time.

List of Categorical SUTime Rules with our additions

Time Orientation	Baseline SUTime	Our Additions
Past	past recently at the time once medieval previously	looking back
Present	current currently now	on-going / ongoing at present / the present presently at the moment
Future	future	looking forward short/shorter term/run near term medium term/run long/longer term/run horizon

Temporal Tagging: SUTime Measures

- We construct two measures of future orientation using SUTime:

$$p_s^{f,CAT} = \frac{\sum_{i=1}^{i=N_s^{CAT}} \mathbf{1}\{CAT_{i,s} = Future\}}{N_s^{CAT}}, \quad (1)$$

$$p_s^{f,NUM} = \frac{\sum_{i=1}^{i=N_s^{NUM}} \mathbf{1}\{NUM_{i,s} = Future\}}{N_s^{NUM}}, \quad (2)$$

where N_s^{CAT} is the number of SUTime categorical references in speech s, N_s^{NUM} is the number of SUTime numerical references in speech s, and $\mathbf{1}$ is a dummy variable indicating when a numerical reference $NUM_{i,s}$ or a categorical reference $CAT_{i,s}$ is future.

TMV

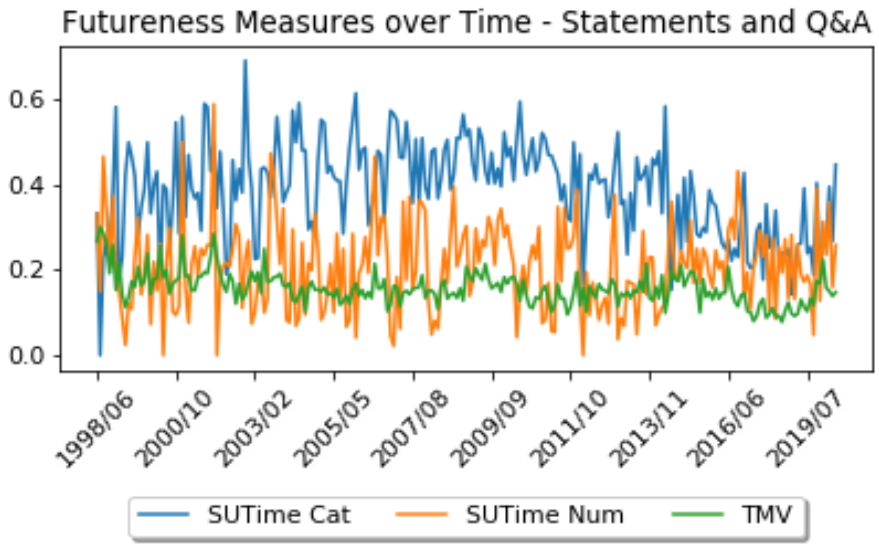
- Applying computational linguistics to assess whether phrases within a given sentence are in the past, present, or future tenses is a non-trivial task.
- Use "part of speech" (POS) tags to tokens (words) from corpora of textual data
- To identify tense: use Tense-Mood-Voice tool (Ramm et al 2017).
  - automatically classify verbal complexes into their tense
- TMV future orientation measure ($p_s^{f,TMV}$):

$$p_s^{f,TMV} = \frac{\sum_{i=1}^{i=N_s^{TMV}} \mathbf{1}\{TMV_{i,s} = Future\}}{N_s^{TMV}}, \tag{3}$$

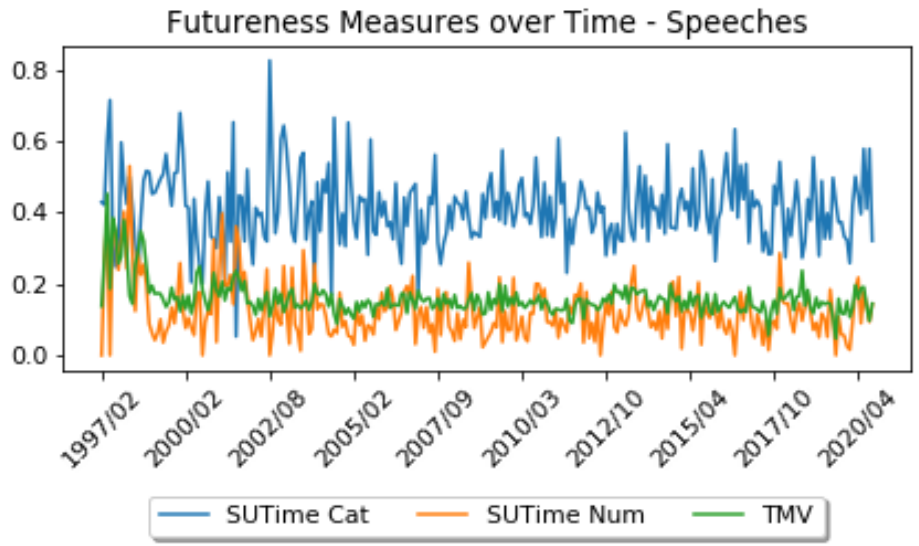
Draghi TMV Example

Sentence	VC	Finite	Tense	Mood	Voice	Negation
Within our mandate ,	takes	yes	present	indicative	active	no
the ECB is ready to do	is	yes	pres	indicative	active	no
whatever it takes	to preserve	no	-	-	-	-
to preserve the euro .	to do	no	-	-	-	-
And believe me ,	will be	yes	futurel	indicative	active	no
it will be enough .						

Future Horizon of ECB Communication



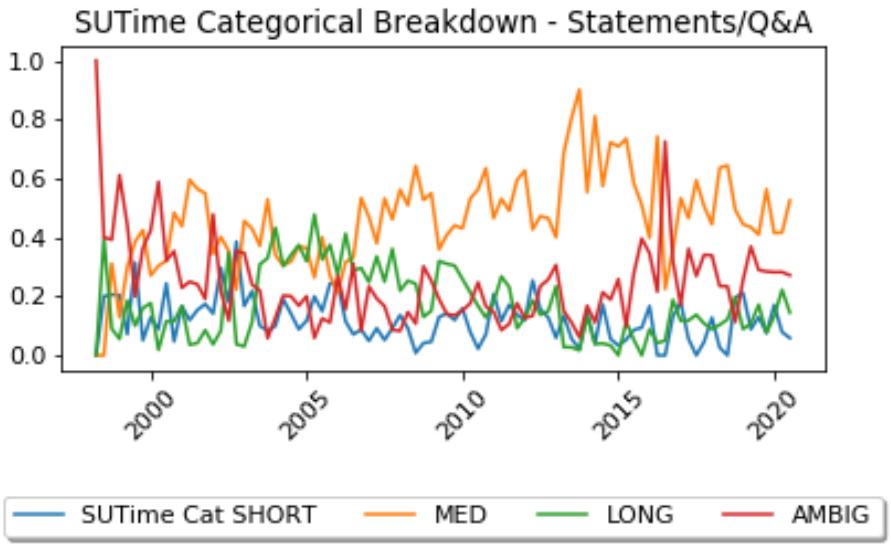
(a) Statements and Press Conference



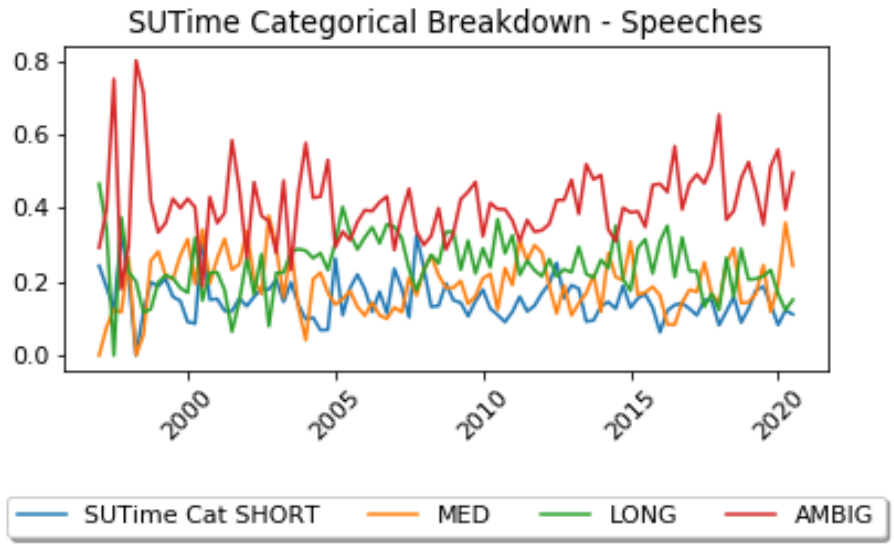
(b) Speeches

Figure: Future horizon: ECB Statements and Q&A, and Speeches I

Speeches - Future Horizon



(a) Speeches



(b) Speeches

Figure: Future horizon: ECB Statements and Q&A, and Speeches II

A simple exercise to show you today

- Regress event news on "narrative signals" - LASSO regression
  - Use yield curve news
  - ABGMR factors
  - Jarocinski Karadi Shocks
- Findings:
  - Find a broad channel - multi-dimensional (need 'big' data to see this)
  - Different types of information systematically predict certain types of reaction.

Measuring Future Topics

In order to measure the topic content of the future statements, we construct topic-specific future orientation measures:

1. Identify future statements using one of the measures outlined above:
   - SUTime Categorical
   - SUTime Numerical
   - TMV
2. Calculate the average topic share within this subset:

$$p_s^{f,CAT}(T_k) = \frac{1}{N_s^{CAT=Future}} \sum_{i=1}^{i=N_s^{CAT}} \mathbf{1}\{CAT_{i,s} = Future\}\, \phi_{k,m(i)} \quad (4)$$

Essentially the measures are the weighted average of topic-shares from the sub-set of sentences associated with the future, according to three different metrics.

Result 1: Expected Interest Rates

Table: Adjusted R-Squared of yield curve by specification

Specification	|OIS 1M|	|OIS 1Y|	|OIS 2Y|	|OIS 3Y|	|DE 5Y|	|DE 10Y|
Topics Only	0.18	0.27	0.24	0.18	0.13	0.09
Topics, Future	0.23	0.28	0.25	0.19	0.15	0.10
Topics, Future, TMV	0.32	0.33	0.32	0.27	0.20	0.16
Topics, Future, SUTime Cat. and Num.	0.29	0.41	0.42	0.37	0.32	0.24
Topics, Future, SUTime Cat. and Num.,TMV	0.40	0.47	0.48	0.45	0.39	0.31

Result 1: ABGMR factors

Table: Adjusted R-Squared of factors by specification

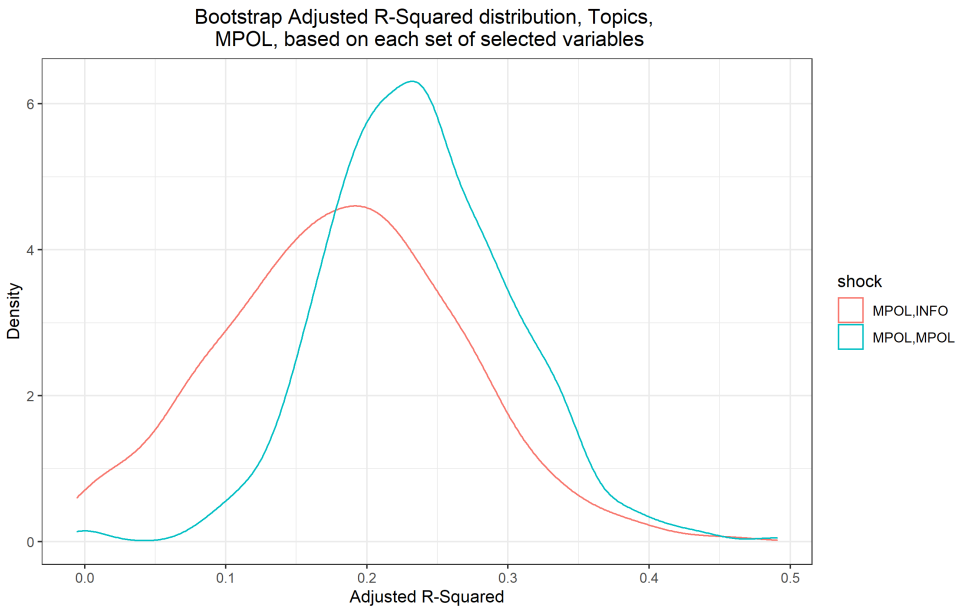
Specification	Target	Timing	FG	QE
Topics Only	0.23	0.21	0.20	0.12
Topics, Future	0.24	0.21	0.20	0.12
Topics, Future, TMV	0.29	0.29	0.27	0.17
Topics, Future, SUTime Cat. and Num.	0.40	0.31	0.35	0.26
Topics, Future, SUTime Cat. and Num.,TMV	0.45	0.37	0.42	0.31

Result 1: Jarocinski Karadi Shocks

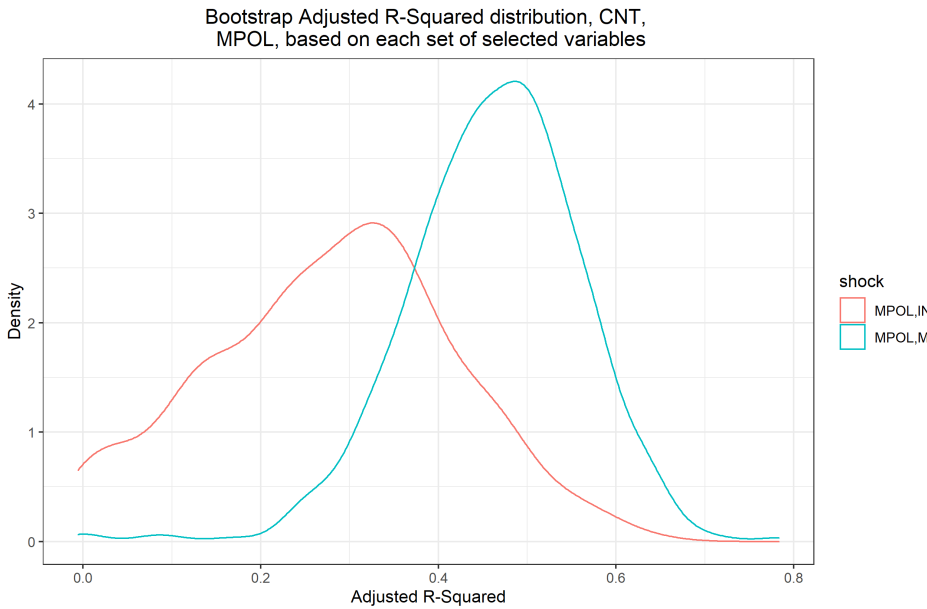
Table: Adjusted R-Squared of shocks by specification

Specification	Information	MPOL
Topics Only	0.16	0.24
Topics, Future	0.19	0.25
Topics, Future, TMV	0.20	0.31
Topics, Future, SUTime Cat. and Num.	0.31	0.42
Topics, Future, SUTime Cat. and Num.,TMV	0.35	0.46

Result 2: Futureness helps distinguish effects



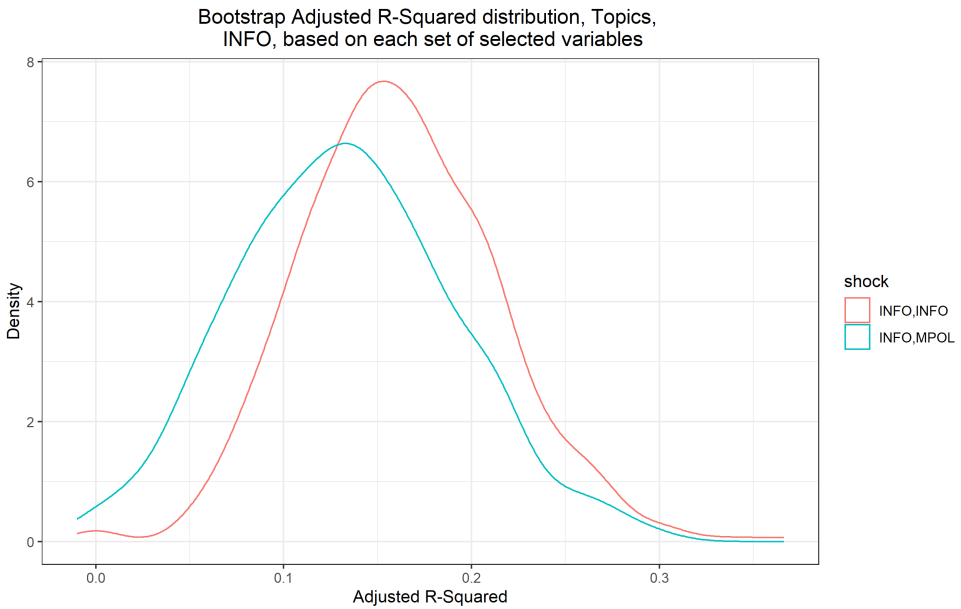
(a) Just Topics



(b) Topics and Futureness Topics

Figure: Mon Pol Effects Explained by Measured Communication

Result 2: Futureness helps distinguish effects



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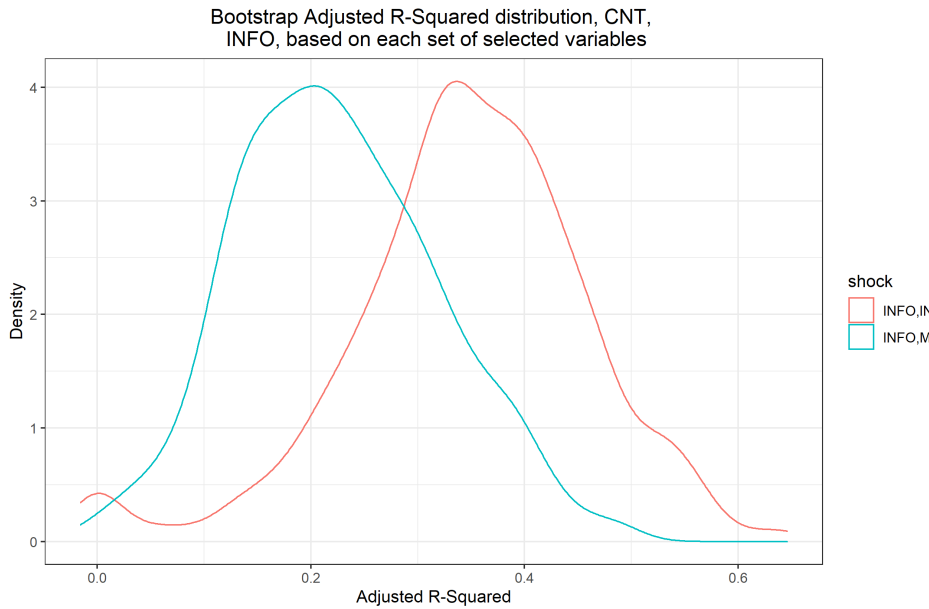

(b) Topics and Futureness Topics

Figure: Info Effects Explained by Measured Communication

On-going Work

1. Studying the effect of speeches
2. Direct measures of the time-varying information deficit
3. Further disaggretation of these results

Project II: Cacophany of Voices

New Research in Progress

Deafening Cacophony? Information shocks in speeches and the effects of monetary policy

joint with Maximilian Ahrens (University of Oxford), Stephen Hansen (Imperial College London), and Omiros Papaspiliopoulos (Universitat Pompeu Fabra)

Outline of Section

1. The Cacophony of Voices Problem
2. Our approach - Prediction^2

Cacophony of Voices I

- Blinder 2004: A central bank that speaks with too many voices may have no voice at all.

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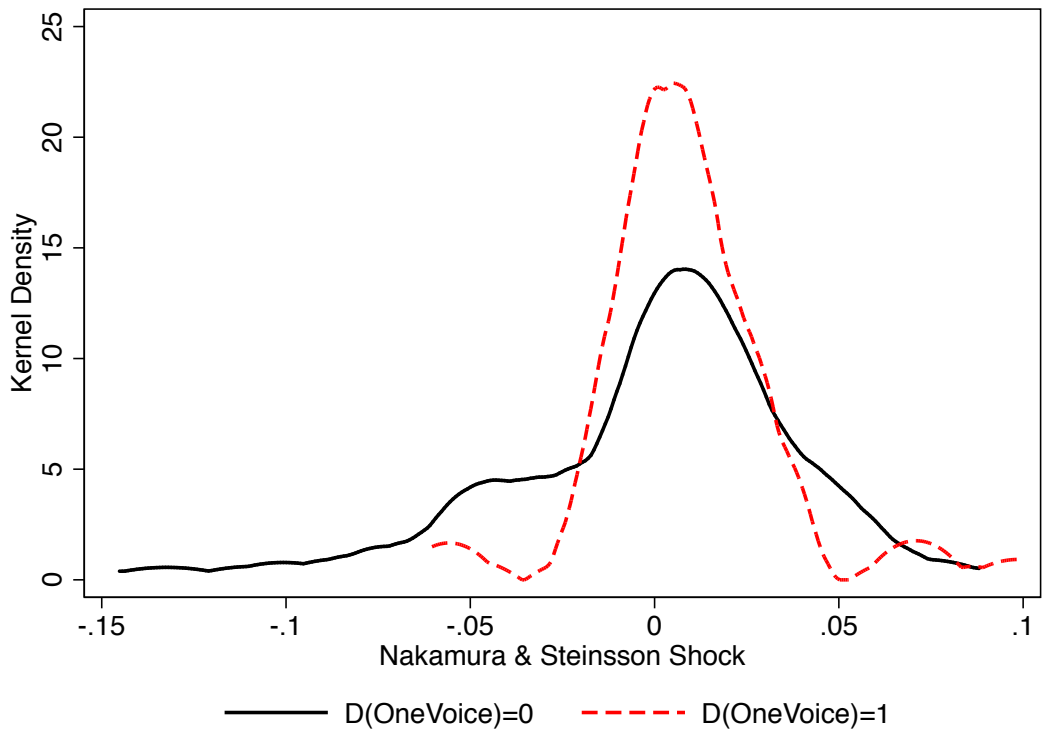
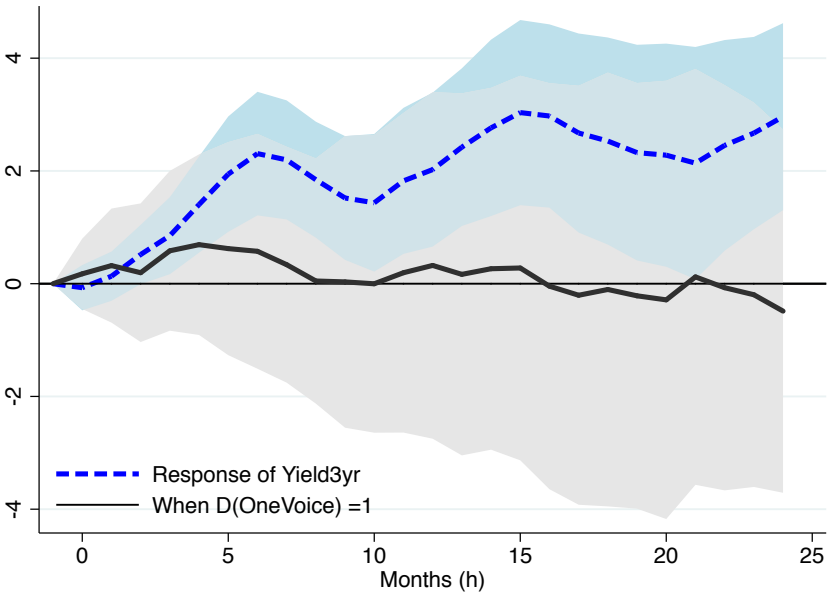
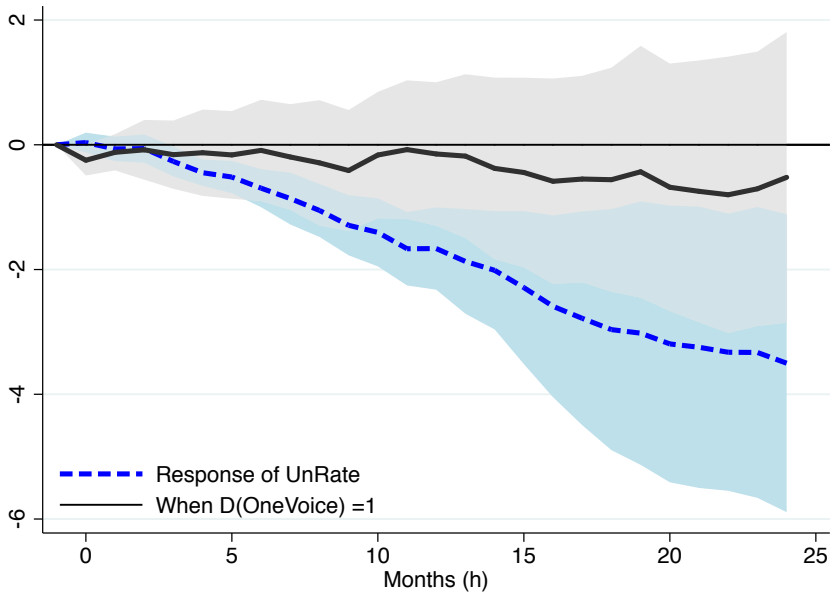


Cacophony of Voices II



(a) IRF - 3-year Yields



(b) IRF - Unemployment

Our Research

The broad idea

1. Monetary policy is forward looking - it realies on prediction
2. Expectations of it rely on predictions of these predictions
   - Prediction^2
3. We develop a mechanism to derive monetary policy shocks from the frequent speeches between FOMC meetings
   - 3.1 Map Greenbook words into Greenbook forecasts using MBTR
   - 3.2 Apply this prediction algorithm to speeches to get measures of economic state outlook from each speech
4. Use these shocks to understand the transmission of monetary policy

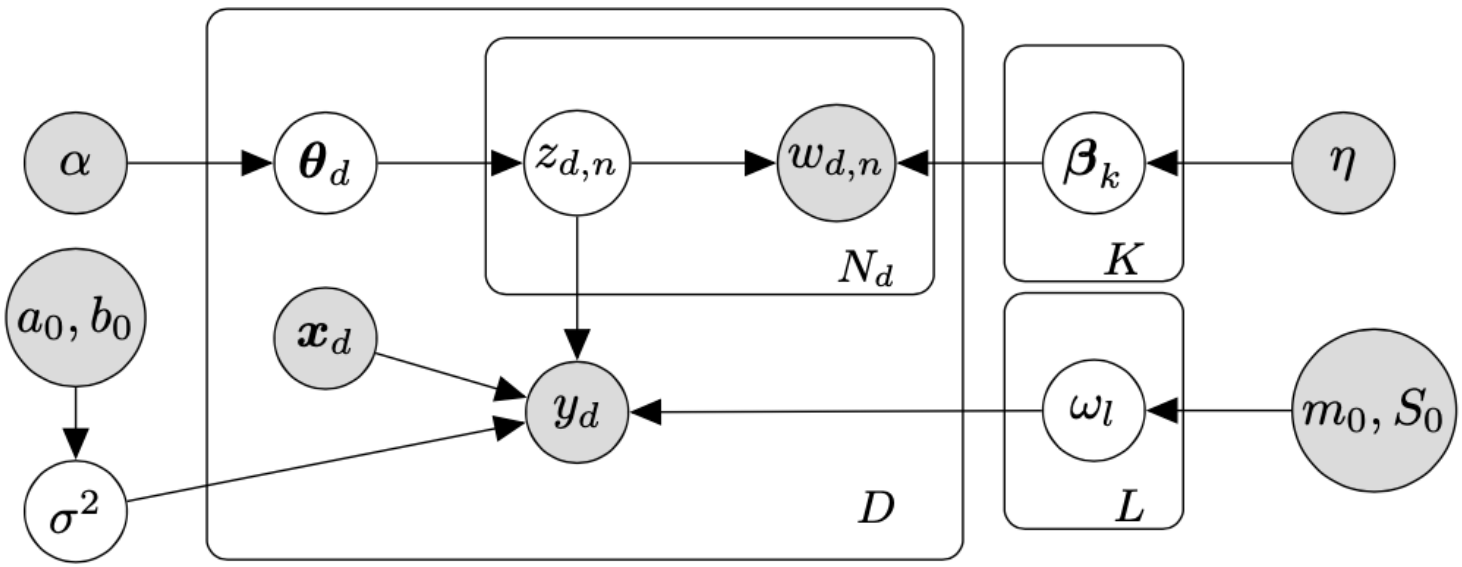
Multimodal Bayesian Topic Regression

Multimodal Bayesian Topic Regression model

by Maximilian Ahrens, Julian Ashwin, Jan-Peter Calliess and Vu Nguyen

1. The joint supervised learning approach of text representation and regression parameters allows for rigorous statistical inference when text as well as numerical features are relevant.
2. This in turn allows to control for potential confounding factors, addressing the problem of omitted variables bias in supervised topic modelling for economic analysis.
3. Incorporating information from numerical features into the topic learning process can yield improved out-of-sample prediction performance.

MBTR Model


α
$\boldsymbol{\theta}_d$
$z_{d,n}$
$w_{d,n}$
N_d
$\boldsymbol{\beta}_k$
K
η
a_0, b_0
$\boldsymbol{x}_d$
y_d
ω_l
m_0, S_0
σ^2
D
L

08/08/2006 GB pt1:

Household spending ⇒ For.HH

We have lowered our projection for real PCE growth in 2007 to 2.0 percent, 1.0 percentage point less than in the June Greenbook. One reason is a downward adjustment to our estimate of permanent income in line with the downward revision to potential GDP; we have also factored in a hit to real disposable income over the projection period from the higher energy prices. As before, the contour of the PCE projection is influenced importantly by the waning of our estimated wealth effects, which are likely to be a small negative for PCE growth in 2007 after adding about 1 percentage point in 2005 and Ãę percentage point in 2006. The lagged effects of earlier increases in interest rates are also likely to restrain the growth of real PCE in 2007.

Our forecast has single-family starts dropping noticeably over the next few quarters as demand softens further and as homebuilders work off excess inventories. By early next year, inventories should be in better shape; with real household incomes rising briskly and mortgage rates flattening out at a level still relatively low by historical norms, we expect starts to level out. All in all, single-family starts are projected to total 1.4 million units in 2007, which would be nearly 20 percent below the level of 2005 but still a reasonably solid pace by historical standards. Real residential investment is projected to fall 3 percent in 2007 after falling 9 percent in 2006; the decline in 2007 is expected to be concentrated in the first part of the year.

08/08/2006 GB pt2:

Prices ⇒ Ec.Prices

Consumer price inflation has continued to move up, on balance, in recent months. The overall PCE price index rose at an annual rate of 3.9 percent during the first six months of the year, 1 percentage point faster than in the twelve months of last year. While rising energy prices have been a major source of the increase in overall consumer price inflation, the prices of core goods and services–particularly housing rents but also other core prices–have accelerated as well. Core PCE prices increased at an annual rate of 2.7 percent during the first half of this year, which is more than 1.0 percentage point higher than during 2005.

Although consumer energy prices declined 0.9 percent in June, PCE energy prices surged at an annual rate of about 25 percent over the first half of this year, up from the 17 percent increase posted in 2005. Furthermore, the downturn in energy prices in June was transitory: Spot prices for crude oil moved back up during July to a level near the peak for the year; weekly survey data on gasoline point to an increase of about 5 percent in July in the PCE price index for gasoline, a rise that would more than reverse the decline in June. Although most of the recent increase in gasoline prices reflected the higher cost of crude oil, the margin between retail gasoline prices and crude prices has moved up somewhat from an already high level despite a 35 percent decline since late June in the price of ethanol used for reformulated gasoline.

....

08/08/2006 GB pt1:

The Longer-Run Outlook for the Economy ⇒ For.MedTerm

Our forecast has real GDP growth slowing from 3.2 percent over the four quarters of 2006 to 2.3 percent in 2007, with significant decelerations in both consumer spending and business fixed investment. Our current projection for growth in 2007 is 0.4 percentage point lower than that in the June Greenbook; most of the change is attributable to the shallower path for potential GDP. With real GDP projected to increase less rapidly than potential, the unemployment rate is expected to rise to 5.2 percent by the end of 2007, a level matching that in the June Greenbook and slightly above our estimate of the NAIRU.

Prediction[2]

- **Regression:**

$$\Delta_{4,0} g_m = \alpha_u u0_{m-1} + \alpha_\pi \pi 0_{m-1} + \alpha_g g0_{m-1} + \sum_{i=1}^{K} \omega_i \theta_{g,i} + \epsilon_m \quad (5)$$

- **Corpus:** Stemmed bigrams (up to 2-word combinations), no numbers
- **Estimation:** MBTR

GDP Prediction Prediction I

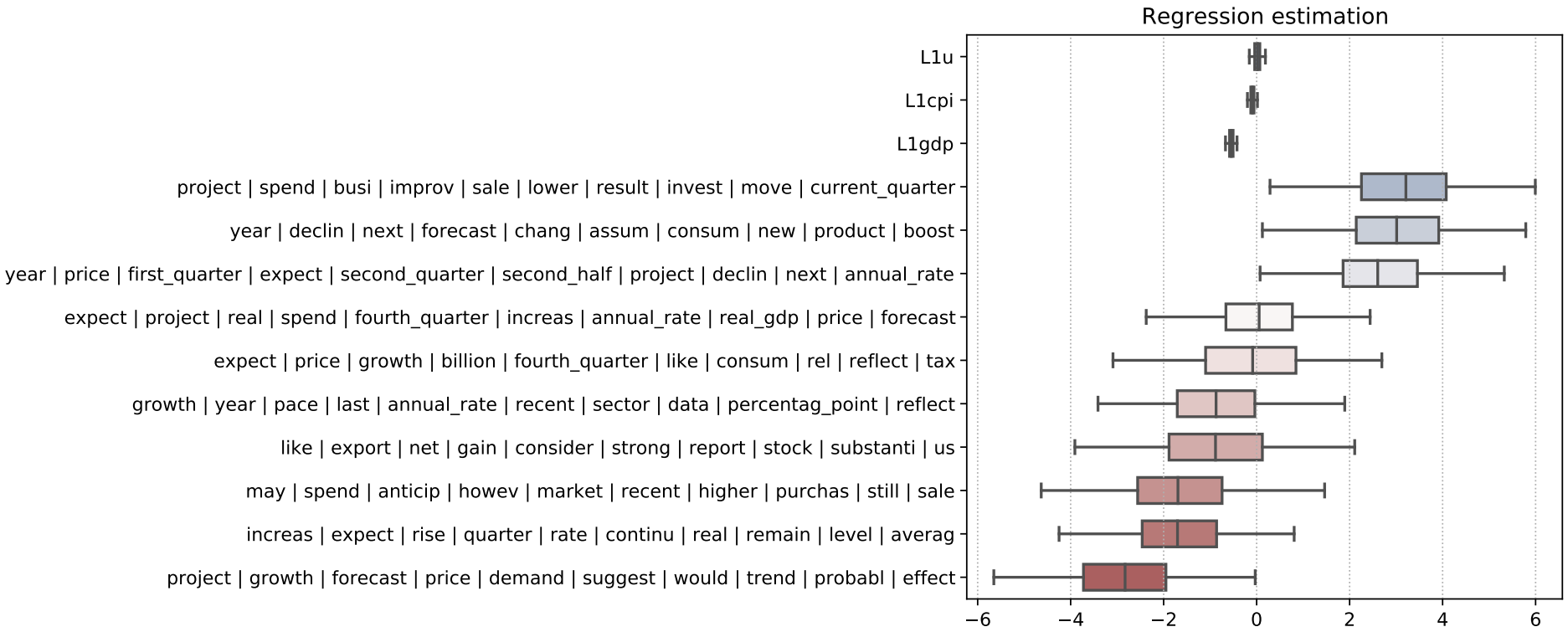


Figure: GDP MBTR Regression: K10, EM iters (50)

GDP Prediction Prediction II

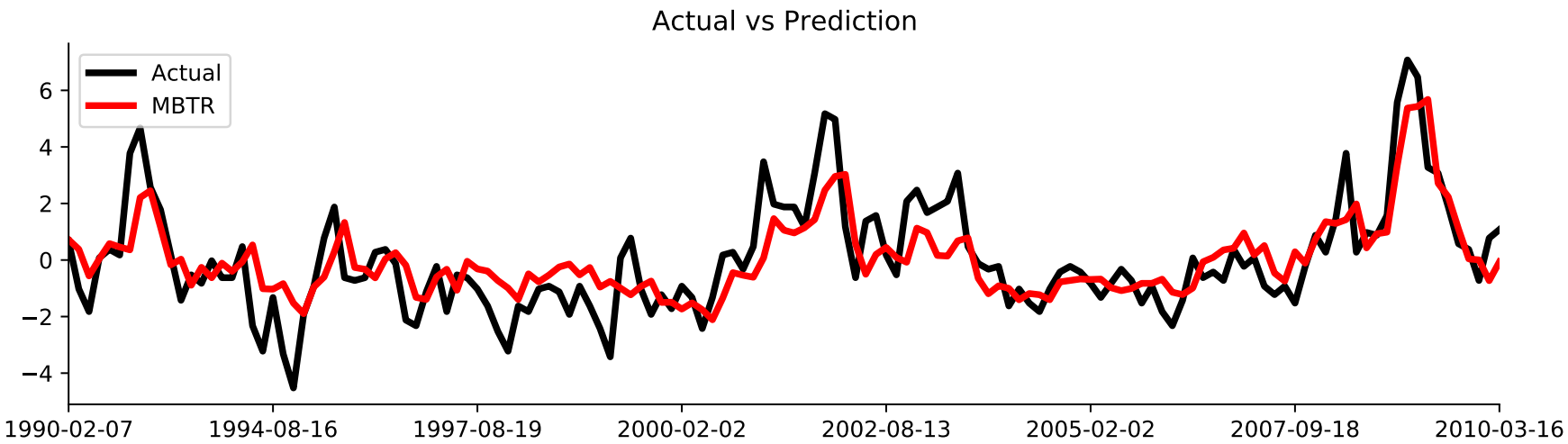


Figure: GDP MBTR Regression: K10, EM iters (50)

CPI Prediction Prediction I

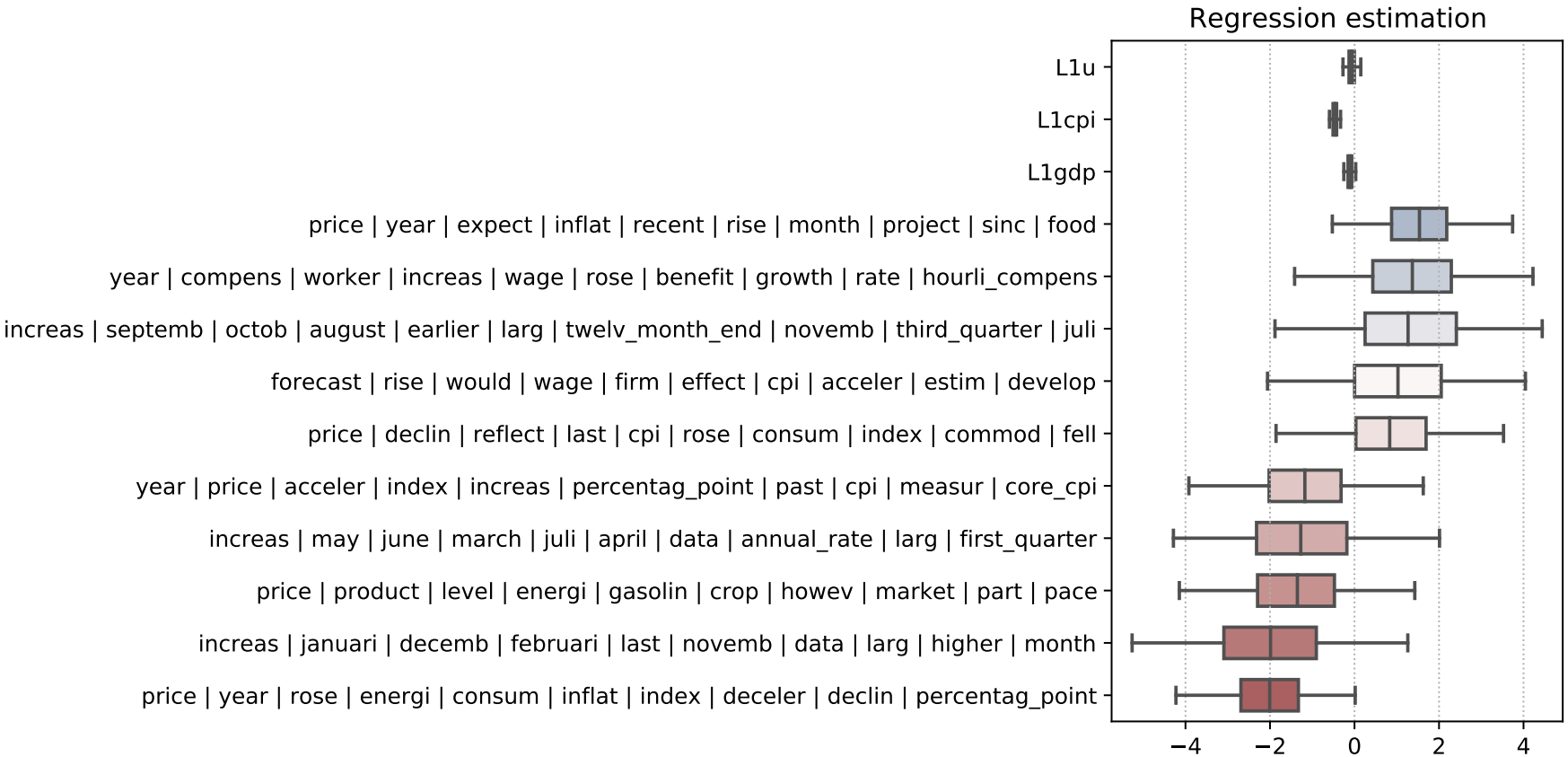


Figure: CPI MBTR Regression: K10, EM iters (50)

CPI Prediction Prediction II

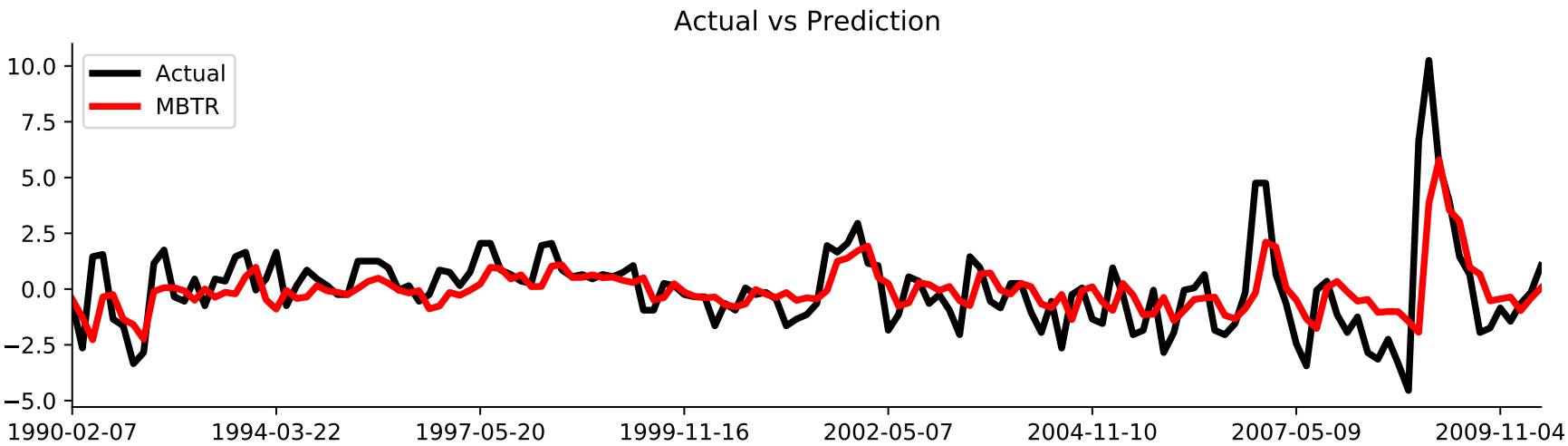


Figure: CPI MBTR Regression: K10, EM iters (50)

UE Prediction Prediction I

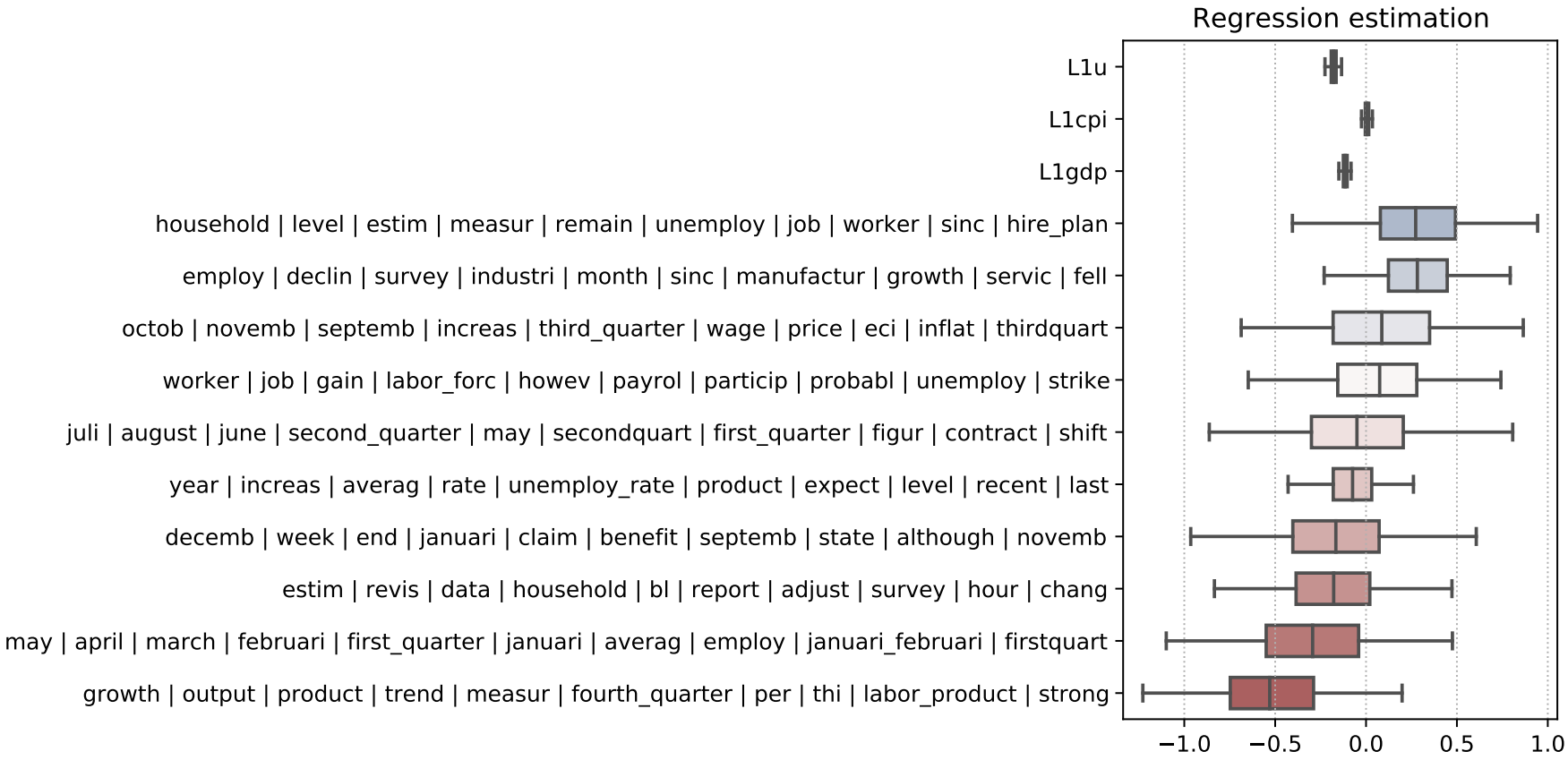


Figure: UE MBTR Regression: K10, EM iters (50)

UE Prediction Prediction II

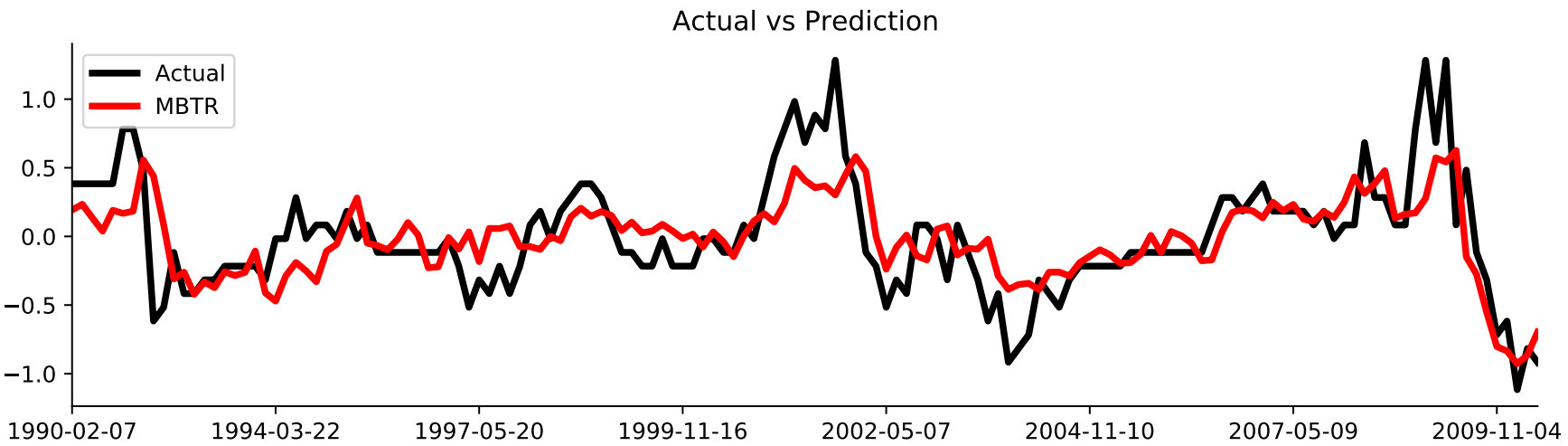


Figure: UE MBTR Regression: K10, EM iters (50)

Still to do

1. Further develop the first stage algorithm
   - BMTR shows lots of promise
2. Full analysis of the speech data
3. Exploration of the effects of the information signals

Conclusion

I ~~don't~~ maybe do some economic forecasting ~~(at least~~ in my research~~)~~

And ~~do~~ I really do use small Big Data!~~?~~

I leave it to others to determine if Maybe there has been some mistake?

Conclusion

I ~~don't~~ maybe do some economic forecasting ~~(at least~~ in my research~~)~~

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END