International Central Bank Communication

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Organization

<u>Overview</u>

1. **Central bank speech archive.**

   ▶ Maintained by Bank for International Settlements (BIS).

2. **Methods and models for text feature extraction.**

   ▶ Collection of large language models (LLMs).

   ▶ Introduced in Bertsch, Hull, Lumsdaine, and Zhang (2022).

3. **Description and visualization of text features from speeches.**

Textual Data

Textual Data

Overview

- ► **BIS speech archive.**
    - ► Central bank speeches translated into English.
    - ► >18,000 speeches; >90 institutions.
    - ► Covers late 1996 to present.

- ► **Our coverage.**
    - ► 53 institutions with >50 speeches.
    - ► Extract text features using LLMs at paragraph level.
    - ► Aggregate to quarterly or annual features.

Textual Data

Database Coverage
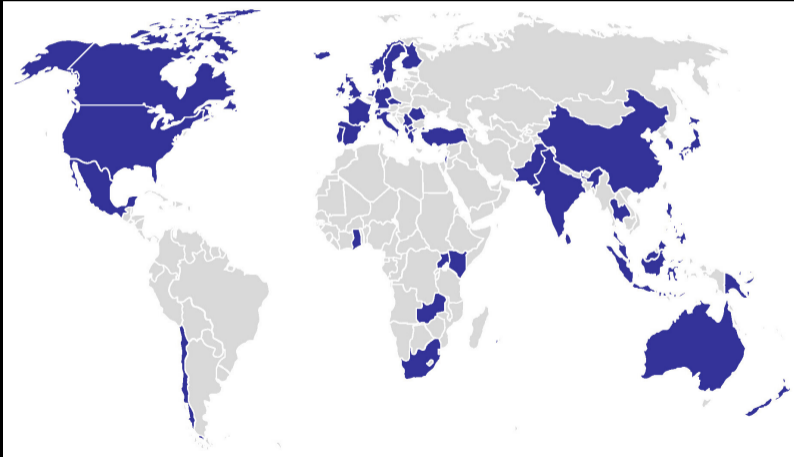
Methods and Models

Methods and Models

Reference

Bertsch, C., Hull, I., Lumsdaine, R. L., & Zhang, X. (2022). Central Bank Mandates and Monetary Policy Stances: through the Lens of Federal Reserve Speeches. Available at SSRN 4255978.

Methods and Models

Text Feature Extraction: LLMs and Methods

1. **Transformer model.**

   ▶ Maps sequence of embeddings to sequence of contextualized embeddings.

2. **Sentence transformer model**.

   ▶ Maps sequence of embeddings to single embedding.

3. **Feature extraction methods.**

   ▶ Zero shot classification (ZSC), extractive question answering (EQA), and semantic textual similarity (STS).

Methods and Models

Zero Shot Classification

Sequence: "Banks continue to play this role but it has become more challenging today to do so because some lenders find themselves capital constrained as a result of recent losses and or sizable unanticipated additions to their balance sheets of formerly off balance sheet instruments."

Candidate Classes: ['financial stability', 'output', 'inflation', 'labor market']

Scores: [0.718, 0.203, 0.048, 0.031]

Zero Shot Classification: Attention Mechanism Performance

Extractive Question Answering

Query 1: What is the most significant concern in the passage?

Context 1: "The suspension of the convertibility of the dollar into gold and the imposition of a 10 percent import surcharge last summer ran the risk of mass foreign retaliation in the form of destructive trade barriers."

Output 1: mass foreign retaliation

Methods and Models

Semantic Textual Similarity

► **Use contextualized sentence embeddings and semantic textual similarity.**

  ► Kiros et al. (2015), Conneau et al. (2017), Cer et al. (2018), Reimers and Gurevych (2019).

  ► Train using Siamese and triplet networks (Schroff et al., 2015).

► **Compare sequences from speeches with descriptions of policy objectives or preferences.**

  ► *"Monetary policy should be used to achieve financial stability."*

  ► *"Banking regulation should be used to achieve financial stability."*

Methods and Models

Extended Pretraining with TSDAE

text without noise
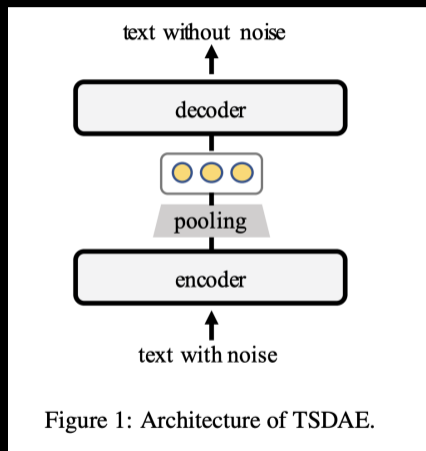
decoder

pooling

encoder

text with noise

Figure 1: Architecture of TSDAE.

Figure taken from Wang et al. (2021).

Methods and Models

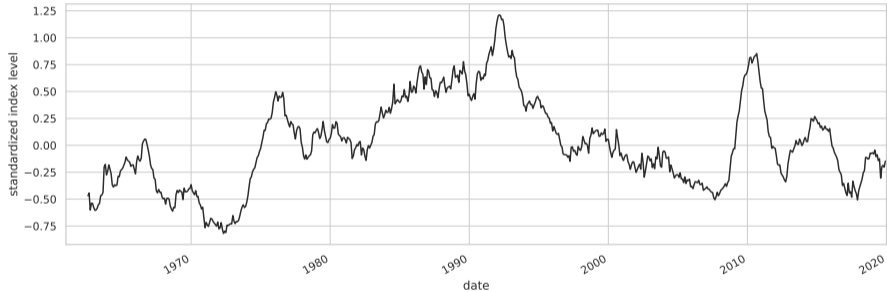**Refine STS Performance with Fine-Tuning**

1. Use S2ORC abstracts (Lo et al. 2020).

2. Randomly draw *similar* sequence pairs from the same paper abstract.

3. Randomly draw *dissimilar* sequence pairs from different abstracts.

4. Train on STS and compare using cosine similarity.

$$sim(S_i, S_j) = \frac{S_i \cdot S_j}{\|S_i\|\|S_j\|} \tag{1}$$

Methods and Models

<u>Non-Dual Mandate Content: 1984-2020</u>

▶ <u>Methods:</u> Zero shot classification and extractive question answering.

Methods and Models

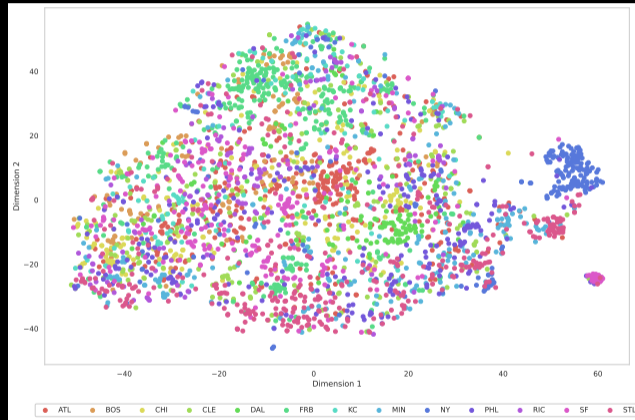**Cosine similarity: Banking Regulation and Financial Stability**

▶ <u>Methods:</u> Zero shot classification and semantic textual similarity.

Methods and Models

t-SNE Plot: Speech Embeddings for Financial Stability Content

► <u>Methods:</u> Zero shot classification and semantic textual similarity.

Dataset

Dataset

Textual Features

- **Text classification.**

    - Financial stability, output and employment, inflation, and exchange rate.

- **Semantic textual similarity.**

    1. Individual features: Monetary policy, financial crisis, bank regulation, bank capital and liquidity, U.S. dollar, international trade, hawkish sentiment.

    2. Policy advocacy: monetary policy and financial stability, bank regulation and financial stability.

Dataset

Documentation

| Sheet Name	Coverage	Description	Method	Transformation	Reference
bankreg_finstab	1996-2023	This feature measures the extent to w	Semantic textual similarity.	Standardized using mean and standard deviation for 1996-2010 period.	Bertsch, Hull
monetary_finstab	1996-2023	This feature measures the extent to w	Semantic textual similarity.	Standardized using mean and standard deviation for 1996-2010 period.	Bertsch, Hull
financial_crisis	1996-2023	This feature measures the extent to w	Semantic textual similarity.	Standardized using mean and standard deviation for 1996-2010 period.	Bertsch, Hull
united_states_dollar	1996-2023	This feature measures the extent to w	Semantic textual similarity.	Standardized using mean and standard deviation for 1996-2010 period.	Bertsch, Hull
bank_regulation	1996-2023	This feature measures the extent to w	Semantic textual similarity.	Standardized using mean and standard deviation for 1996-2010 period.	Bertsch, Hull
monetary_policy	1996-2023	This feature measures the extent to w	Semantic textual similarity.	Standardized using mean and standard deviation for 1996-2010 period.	Bertsch, Hull
hawkish_sentiment	1996-2023	This feature measures the extent to w	Semantic textual similarity.	Standardized using mean and standard deviation for 1996-2010 period.	Bertsch, Hull
bank_concern	1996-2023	This feature measures the extent to w	Semantic textual similarity.	Standardized using mean and standard deviation for 1996-2010 period.	Bertsch, Hull
international_trade	1996-2023	This feature measures the extent to w	Semantic textual similarity.	Standardized using mean and standard deviation for 1996-2010 period.	Bertsch, Hull
output_employment	1996-2023	This feature measures the extent to w	Zero shot classification.	Standardized using mean and standard deviation for 1996-2010 period.	Bertsch, Hull
financial_stability	1996-2023	This feature measures the extent to w	Zero shot classification.	Standardized using mean and standard deviation for 1996-2010 period.	Bertsch, Hull
inflation	1996-2023	This feature measures the extent to w	Zero shot classification.	Standardized using mean and standard deviation for 1996-2010 period.	Bertsch, Hull
exchange_rate	1996-2023	This feature measures the extent to w	Zero shot classification.	Standardized using mean and standard deviation for 1996-2010 period.	Bertsch, Hull

Dataset

<u>Documentation</u>

- **Text features standardized using mean and standard deviation calculated over 1996-2010 period.**
  - Updates to series will not affect past values.

- **Central banks split into annual and quarterly groups.**
  - Quarterly features provided for institutions that give at least two speeches per quarter on average.

- **No data imputation.**
  - Many central banks lack sufficient number of speeches over 1996-2023 period to yield text features for all periods.
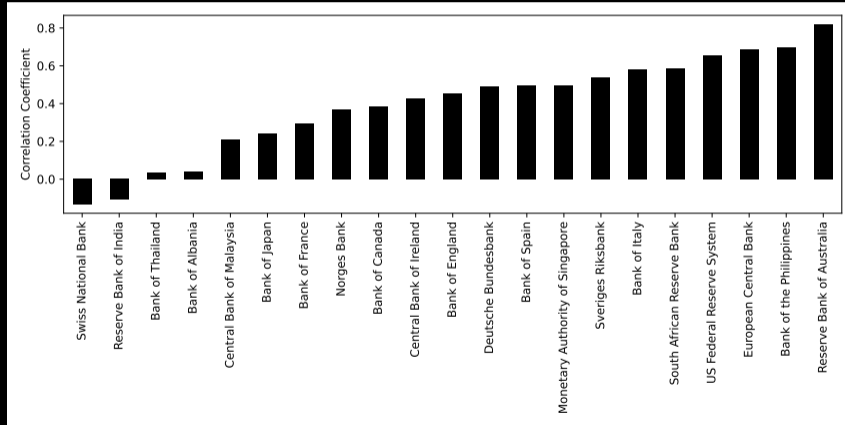
Dataset

Heatmap of Exchange Rate Discussion

Dataset
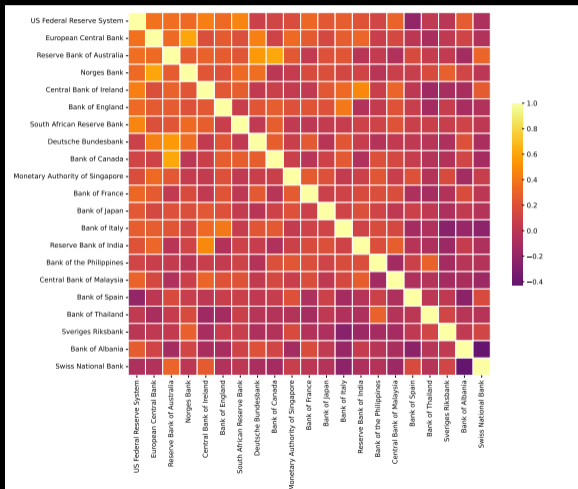
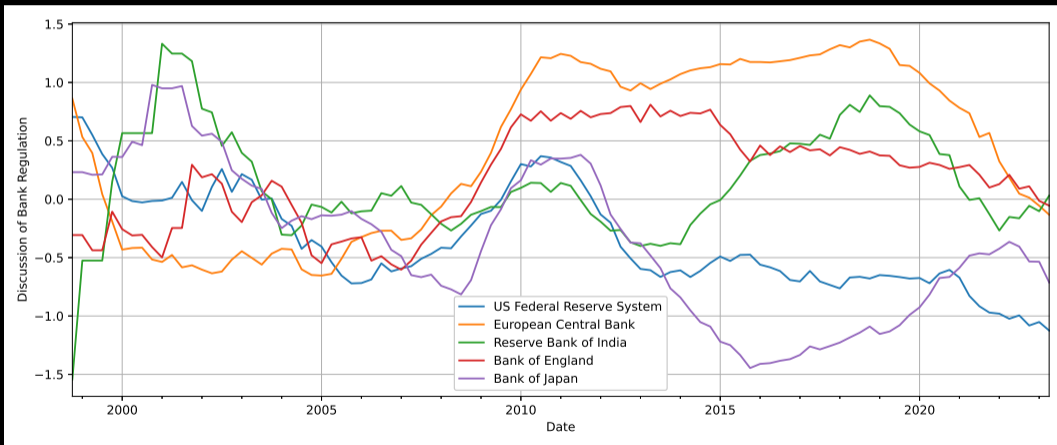## **Inflation Feature Principal Components**

Dataset
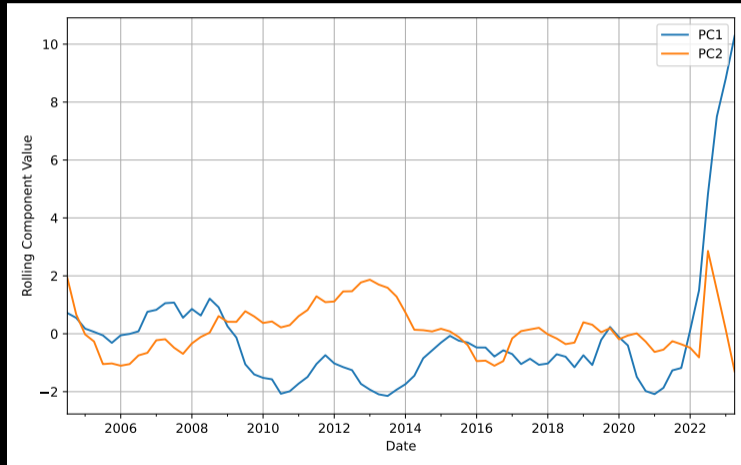
Inflation Feature Correlation with PC1

Dataset

Bank Regulation Text Feature

Next Steps

Discussion

▶ **Models and methods can be applied broadly to extract features from central bank texts.**

   ▶ Text classification, extractive question answering, semantic textual similarity.

▶ **Additional policy advocacy features under development and available on request.**

   ▶ Capital controls and exchange rates, capital controls and financial stability, monetary policy and exchange rate.

▶ **Open to accepting input for features to extract from texts.**

   ▶ Can make features available in updates.