EUROPEAN CENTRAL BANK

EUROSYSTEM

ECBERT: Fine-Tuning ModernBERT for Monetary Policy Sentiment Analysis

Exploiting Textual Data for Inflation Forecasting

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Overview

The (Modern)BERT Architecture

ECBERT

- BERT was Introduced by Google in 2018, and still **one of the most widely-used** NLP models
- It is an Encoder-only Transformer (**focuses on understanding input text** rather than generating text)
- **Ideal for tasks such as text classification** (e.g. sentiment analysis), information retrieval, and entity extraction

- ModernBERT was introduced in **December 2024** by Answer.AI and LightOn (1)
- Supports **longer sequence lengths up to 8k tokens** (vs. 512 in original BERT)
- Incorporates advances learned from large-scale transformer models (e.g., **smarter architecture design**, **larger training data**, code inclusion
- Achieves **faster processing and better accuracy** across multiple tasks

(1) Warner, B., et al. (2024). Smarter, better, faster, longer: A modern bidirectional encoder for fast, memory efficient, and long context finetuning and inference. doi:10.48550/ARXIV.2412.13663

The Task

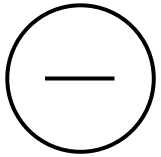
ECBERT

- Monetary policy sentiment analysis allows to **quantify central bank communications**
- By automating sentiment analysis, **stakeholders can rapidly gauge how markets might interpret a shift in language tone**, without sifting through long documents
- By analyzing overall trends and sentiment changes, **we get a comprehensive picture of the likely economic impacts** (e.g., inflation targeting, interest rate adjustments).
- This broad perspective helps economists, investors, and policymakers **spot longer-term implications and align strategies** across multiple sectors of the economy.

The Committee judges that, on balance, the risk of inflation becoming undesirably low remains the predominant concern for the foreseeable future.

dovish

In light of the increasing economic slack here and abroad, the Committee expects that inflation will remain subdued.



neutral

The experience of the last several years has reinforced the conviction that low inflation is essential to realizing the economy's fullest growth potential.

hawkish

The Data and the Models

ECBERT

ModernBERT

Retraining (Masked Language Modeling)

ECB Speeches Dataset (1)				
Date	**Speakers**	**Title**	**Subtitle**	**Contents**
2024-12-16	Christine Lagarde	Monetary Policy in the Euro Area	Speech by Christine Lagarde	…

[ECBERT-base-mlm]

Finetuning

The Voice of Monetary Policy (2)		
ID	**Text**	**Sentiment**
157_1	Readings on the core inflation ..	dovish

[ECBERT-base]

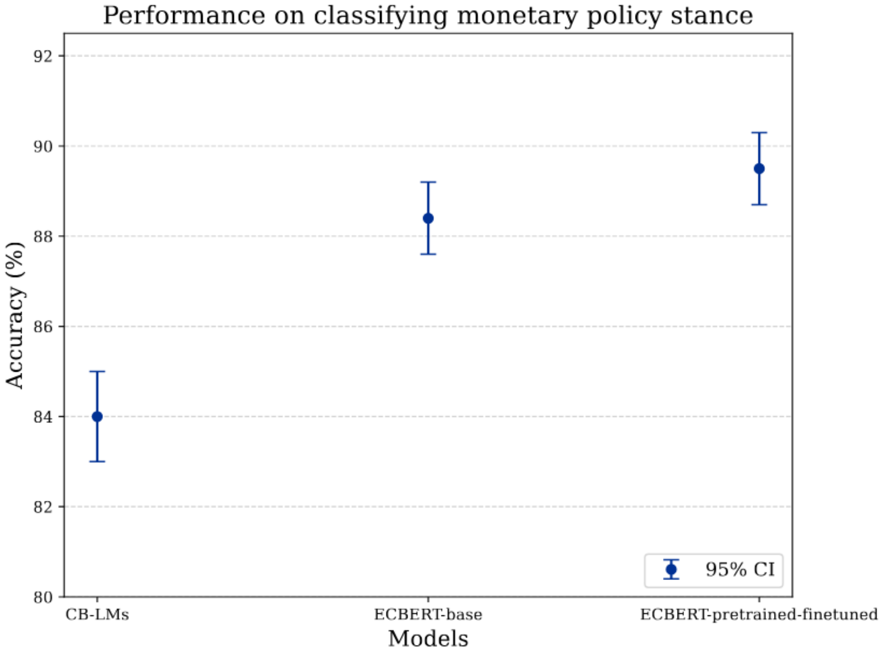
Finetuning

The Voice of Monetary Policy (2)		
ID	**Text**	**Sentiment**
157_1	Readings on the core inflation ..	dovish

[ECBERT-base-pretrained-finetuned]

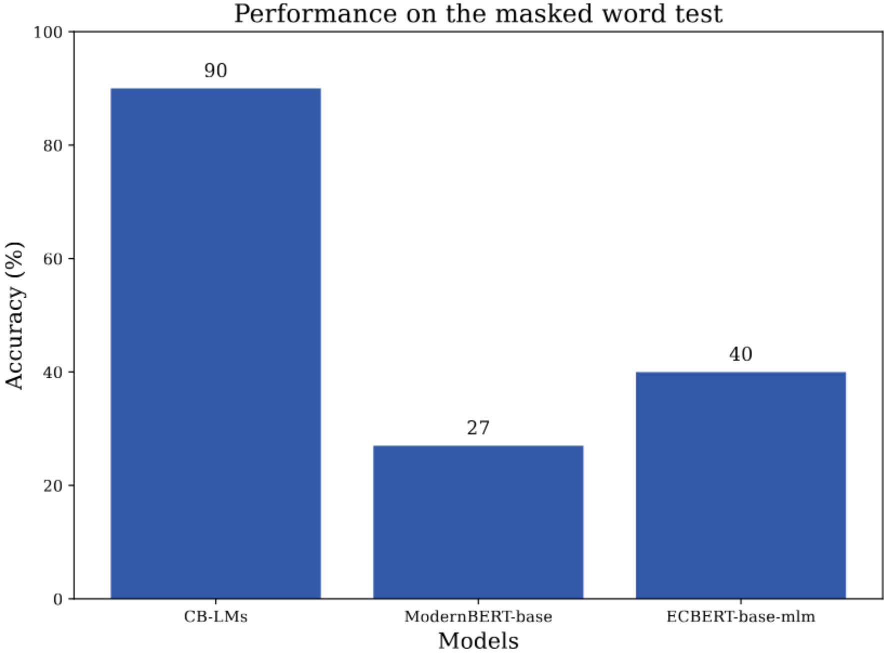
(1) European Central Bank. (25 October 2019). Speeches dataset. Retrieved from: https://www.ecb.europa.eu/press/key/html/downloads.en.html
(2) Gorodnichenko, Y., Pham, T., & Talavera, O. (2023). The Voice of Monetary Policy (Version v1) [Dataset]. https://doi.org/10.3886/E178302V1

Performances and Results



- ECBERT **outperforms the state-of-the-art** Central Banking Language Models (CB-LMs (1)) created by the Bank for International Settlements **for the task of monetary policy sentiment analysis**.

- It underperforms in the task of Masked Language Modeling if compared to the CB-LMs.



(1) Leonardo Gambacorta & Byeungchun Kwon & Taejin Park & Pietro Patelli & Sonya Zhu, October 2024. "CB-LMs: language models for central banking,“. BIS Working Papers 1215, Bank for International Settlements. https://www.bis.org/publ/work1215.pdf

Working with Inflation Forecasting

ECBERT in Action

- A **time-decaying sentiment** measure helps capture the intuition that recent policy communications have a stronger, more immediate effect on inflation expectations, while older statements gradually lose their influence until the next official statement.

Extract Sentiment from Policy Statements

- Apply ECBERT model on central bank statements
- Classify each statement as Hawkish (+1), Neutral (0), or Dovish (-1)

→

Introduce Time-Decay Between Statements

- After a statement at time T_k, its sentiment S_{T_k} decays to $\alpha^{\tau} \times S_{T_k}$ for each week (or day) τ until the next statement

→

Incorporate into Inflation Forecasting

- Optimize α using historical data (e.g., RMSE or MAE minimization)
- Align statement-based sentiment (weekly/daily) with monthly or quarterly inflation data
- Test alternative decay forms (linear, stepwise) and different classification thresholds

Thank you!

Any questions?