FedBERT

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Why the Fed?

- The Fed plays an increasing role in the economy, with its massive liquidity facilities boosting markets

- The Fed conducts its policies with its speech, notably during its FOMC meetings and Jackson Hole

- Fed speech has certain structures that might lend itself to NLP analysis, including specific word usage

- Many useful downstream tasks including sentiment analysis and prediction of Fed actions & the market

Problem Statement

- Can we use FinBERT with Fed Data ? Like Fed speeches ?

- Which model out of BERT, FinBERT-Prime, FinBERT-Pre2K and FinBERT-Combo does a better job of predicting masked words in Fed Data ?

- Finally, train BERT with Fed Data - FedBERT and compare results.

Data extraction

- Web scraping from Fed website.

- We extract FOMC statements, FOMC minutes and board member speeches using Selenium.

- Around 4 millions words, most of them coming from the minutes and speeches.

|	Number	Period	Total words (M)
Statements	206	1994-2020	78 806
Minutes	243	1993-2020	1 539 020
Speeches	890	1996-2020	2 781 519
			4 399 345

Data cleaning

- Count the frequency of each word from the corpus and pick some intuitively reasonable ones as fed-keywords
- Filter out non-relevant and short sentences by checking whether the sentence contain keywords in dictionary
- Transform to line by line text file for further processing
- Tokenizes the input (converting from string to numbers) using BertTokenizer (WordPiece)

Tokenizing and masking

[CLS] following the [MASK] plunge since the great depression , employment [MASK] activity rebounded faster and more sharply than anticipated . [SEP] but [MASK] recent resurgence in [MASK] cases is a [MASK] reminder that the pandemic remains the key [MASK] of the economy's course . [SEP]

BERT (Bidirectional Encoder Representations from Transformers)
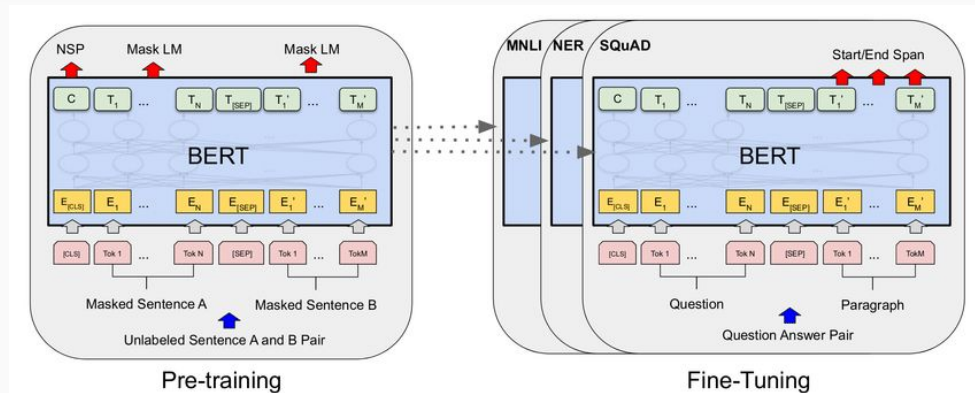
- State-of-the-art performances, published by Google in 2018
- Bidirectionality gives context, training done by masking out words & predicting next sentence. Transformer-based, works on long sentences.
- Allows fine-tuning for specific tasks on the same model once pre-trained.

Architecture

3 Models:

- FedBERT-BERT: Fine-tune with BERT as baseline
- FedBERT-Fin: Fine-tune with FinBERT as baseline
- FedBERT-Prime: Trained from scratch (time constraint, did not complete)

Model parameters

Vocab size = 30522, Hidden size = 768, Hidden layers = 12, dropout = 0.1

Training parameters

Learning rate = 1e-4, weight_decay = 0.001, batch_size = 16

Experiment - predicting masked words

Financial

We adjust our **earnings** for items that we believe do not reflect the underlying operations of the **company**. These are non **cash** items consisting of primarily the loss on financial **instruments** at fair value and income **taxes**.

Fed

The **recovery** is likely to face headwinds even if the downside risks do not materialize. **Fiscal** support will remain vital. It will be **appropriate** to shift the focus of monetary policy from stabilization to **accommodation** by supporting a full recovery in **employment** and a sustained return of **inflation** to its objective .

Results - Financial

Ground truth

We adjust our **earnings** for items that we believe do not reflect the underlying operations of the **company**. These are non **cash** items consisting of primarily the loss on financial **instruments** at fair value and income **taxes**.

Google BERT

We adjust our **judgement** for items that we believe do not reflect the underlying operations of the **system**. These are non **financial** items consisting of primarily the loss on financial **assets** at fair value and income **level**.

FedBERT BERT

We adjust our **expectations** for items that we believe do not reflect the underlying operations of the **bank**. These are non **bank** items consisting of primarily the loss on financial **asset** at fair value and income **growth**.

FinBert

We adjust our **earnings** for items that we believe do not reflect the underlying operations of the **business**. These are non **cash** items consisting of primarily the loss on financial **instruments** at fair value and income **taxes**.

FedBert Fin

We adjust our **estimates** for items that we believe do not reflect the underlying operations of the **firm**. These are non **-** items consisting of primarily the loss on financial **instruments** at fair value and income **taxes**.

Results - Fed

Ground truth

The **recovery** is likely to face headwinds even if the downside risks do not materialize. **Fiscal** support will remain vital. It will be **appropriate** to shift the focus of monetary policy from stabilization to **accommodation** by supporting a full recovery in **employment** and a sustained return of **inflation** to its objective .

Google BERT

The **economy** is likely to face headwinds even if the downside risks do not materialize. **Financial** support will remain vital. It will be **possible** to shift the focus of monetary policy from stabilization to **recovery** by supporting a full recovery in **debt** and a sustained return of **GDP** to its objective .

FedBERT BERT

The **economy** is likely to face headwinds even if the downside risks do not materialize. **Fiscal** support will remain vital. It will be **important** to shift the focus of monetary policy from stabilization to **investment** by supporting a full recovery in **output** and a sustained return of **inflation** to its objective .

FinBERT

The **company** is likely to face headwinds even if the downside risks do not materialize. **Government** support will remain vital. It will be **important** to shift the focus of monetary policy from stabilization to **inflation** by supporting a full recovery in **2018** and a sustained return of **capital** to its objective .

FedBERT Fin

The **economy** is likely to face headwinds even if the downside risks do not materialize. **Policy** support will remain vital. It will be **important** to shift the focus of monetary policy from stabilization to **stabilization** by supporting a full recovery in **employment** and a sustained return of **inflation** to its objective .

Out of sample performance

Using Fed statements as test set (we used speech as training set), and masking out 10% of the words, the top 1 predictive accuracy is

Model	Accuracy
Google BERT	0.359
FedBERT-BERT	0.429
FinBERT	0.406
FedBERT-Fin	0.469

Next steps

- FedBERT-prime is a from-scratch model that still needs to be trained (FinBERT took some days)
- Add more metrics : From masked language models to next-sentence prediction, downstream fine-tuning (predicting the next meeting guidances a lot more useful than the next sentence during a meeting)
- Other applications : Does FedBERT also work well on ECB speeches or would we need to train a specific ECB-BERT ?

Q&A