BBVA Research

A Big Data approach to understand Central Banks

Big Data Spain 2018

November 2018

Creating Opportunities

Summary

01 Why is the use of NLP important in economics and Monetary policy?

The data and methodology

02 Understanding Central Banks: “What”, “How” and “Who” is talking (or writing) about?

01

Why is the use of NLP important in economics and Monetary policy?

The data and methodology

Why is the use of NLP important in economics and Monetary policy?

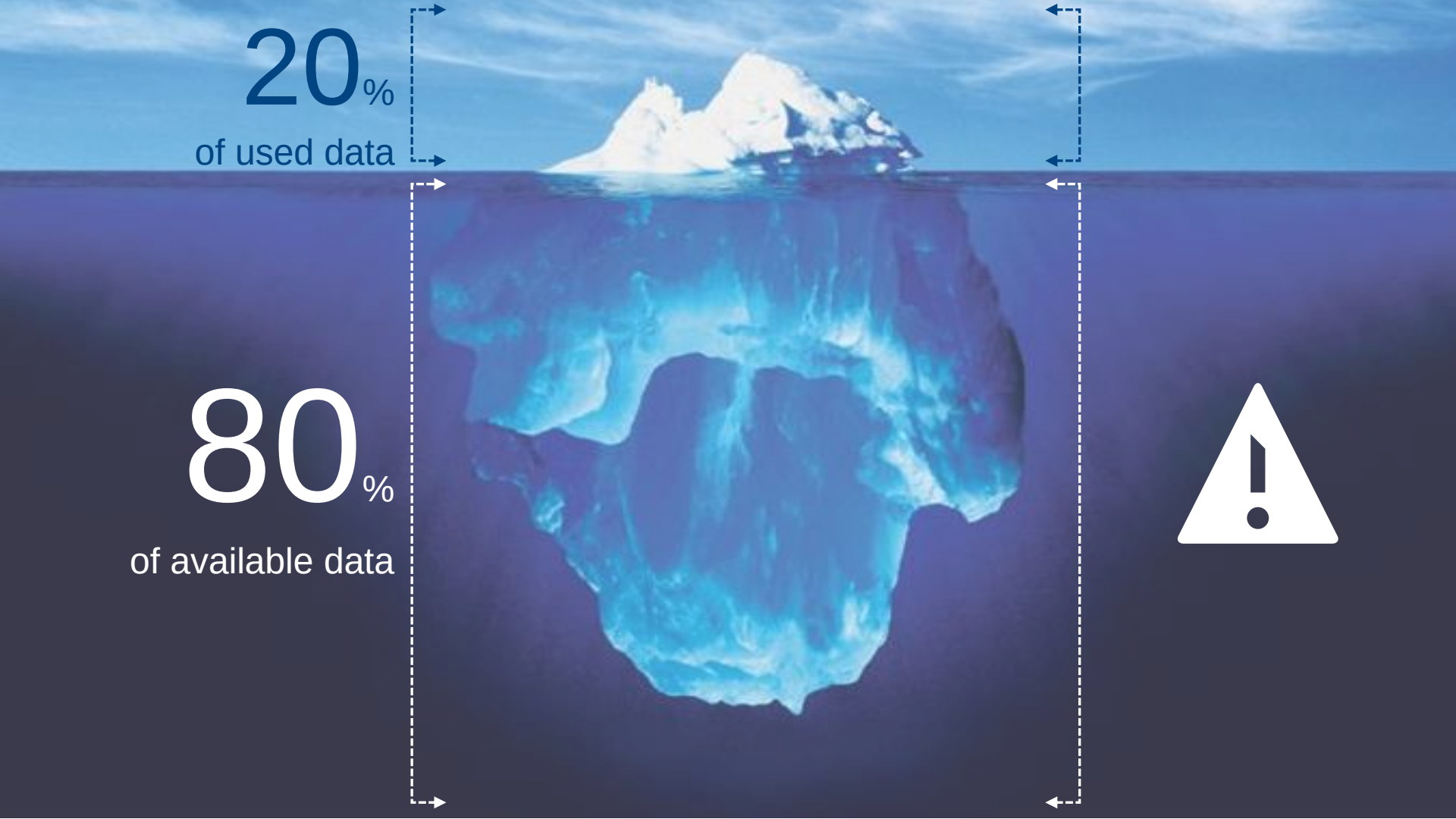
Text as a key source of information to enrich economic analysis

80% of the total amount of web pages on the internet is given by textual or unstructured data

Text mining to extract meaning from strings of letters

The potential use of textual information and text sources improves the understanding of economic and financial systems

It helps us to understand what drives monetary policy decisions


20%
of used data
80%
of available data

The data and methodology

From Extraction to Sentiment Analysis

Information extraction

- Documents
- Web pages

Pre-Processing and text parsing

- Extract words
- Identify parts of speech
- Tokenization and multi-word tokens
- Stopword Removal
- Stemming
- Case-folding

Transformation

- Text filtering
- Indexing to quantify text in lists of term counts
- Create the Document-term matrix
- Weighting matrix
- Factorization (SVD)

Text mining and NPL

- Analysis and Machine learning
- Topics extraction (LDA)
- Clustering
- Modelling (STM and DTM)

Sentiment analysis

- Apply sentiment dictionaries
- Semantic analysis and classification
- Clustering

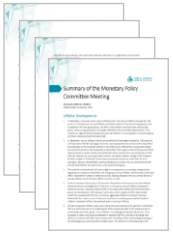
The data and methodology

Analyzing central banks' communication: Examined documents

Information extraction

Statements / Press Releases

Immediately after the meeting on monetary policy, a short report about the decision on interest rates is released. If there's a press conference, the president of the CB explains the decision and answer questions from journalists



Minutes

A more detailed document explaining the monetary policy decision containing an overview of financial market, economic and monetary developments

Speeches

Collection of speeches and articles by senior central bank officials published in the central bank websites

The data and methodology

Analyzing central banks' communication: Cleaning and transforming the text

Pre-Processing and text parsing

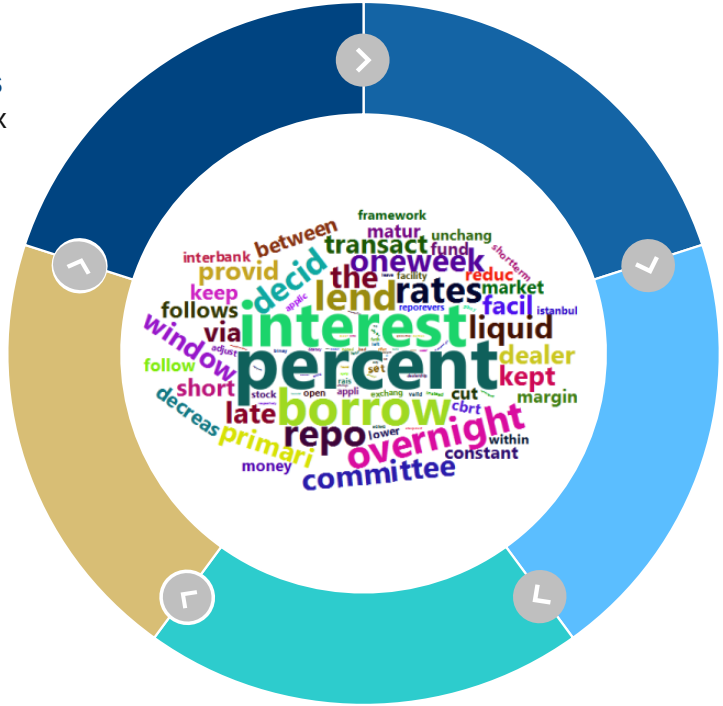
Transformation

Working with text in numbers

- Create the Document-term matrix
- Weighting matrix
- Factorization

Extracting and organizing the data

- Extract words
- Identify parts of speech
- Stopword Removal
- Case-folding



Preparing it for the analysis

- Text filtering
- Indexing to quantify text in lists of term counts

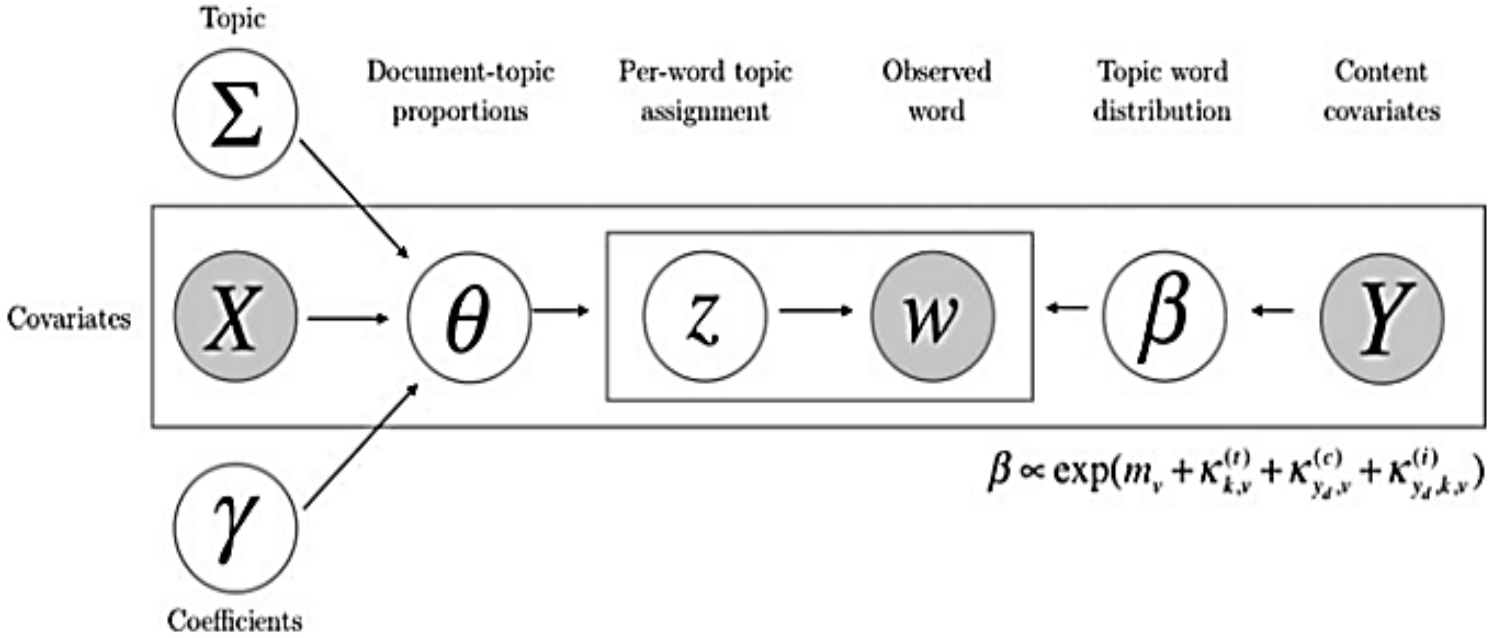
Converting it into numbers

- Stopword Removal
- Stemming
- Tokenization and multi-word tokens

The data and methodology

Analyzing central banks' communication: Dynamic topic models

Text mining and NPL



Latent Dirichlet Allocation (LDA) and Dynamic Topic Model (DTM)

The data and methodology

Analyzing central banks' communication: Sentiment analysis

Sentiment analysis

Loughran and McDonald
(2011)

Positive words		Negative words	
achieve	progress	bankruptcy	fallout
benefit	stabilize	bottleneck	imbalance
efficiency	strength	corrupt	monopolize
outperform	versatility	downgrade	stagnant

FED Financial Stability dictionary
(2017)

Positive words		Negative words	
benefit	improve	adverse	escalate
enhance	upgraded	challenge	stagnation
stabilise	smooth	deteriorate	vulnerability
favorable	strengthened	downgrade	worsen

$$\textbf{Average tone} = \frac{\sum Positive\ words - \sum Negative\ words}{\sum Total\ words}$$

Main outputs

Analyzing the Central Bank of Turkey, European Central Bank and Federal Reserve

Main outputs

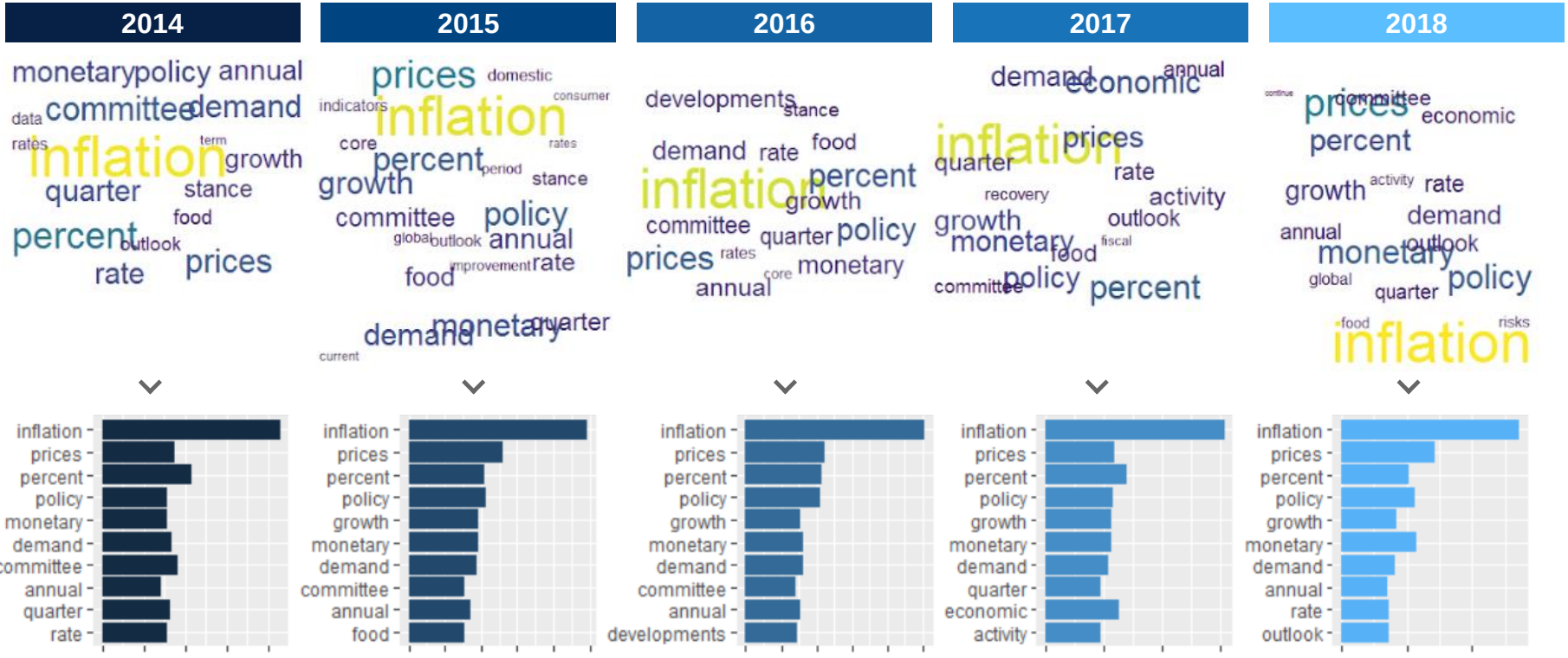
More than words: Getting the relation between words…

In the case of CBRT:

Main outputs

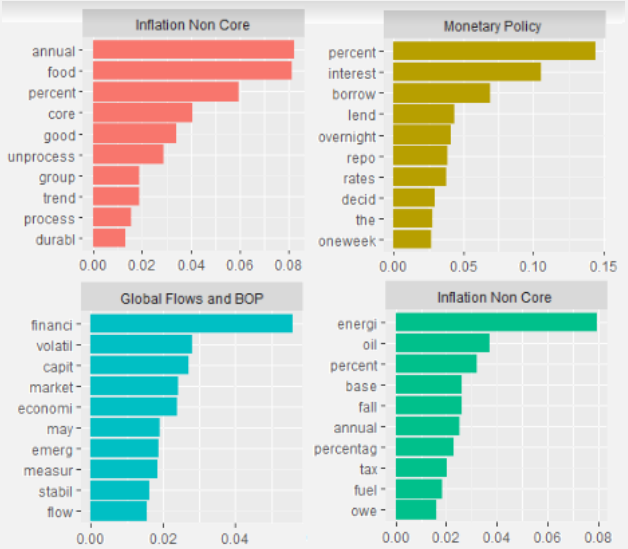
…their evolution over time…

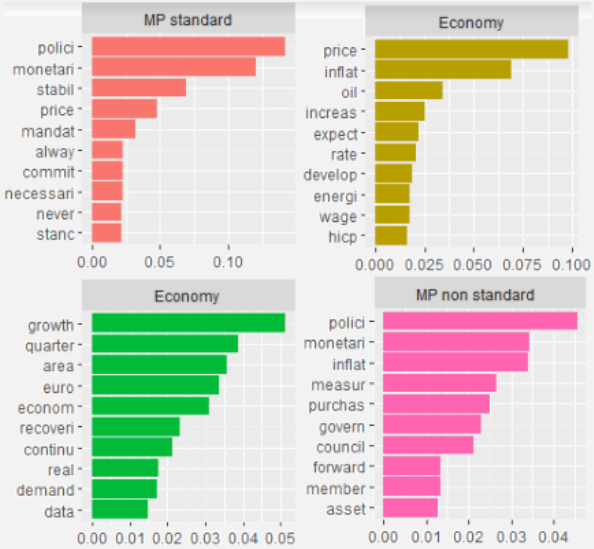
Most frequent words by year in the analyzed documents (the case of CBRT)

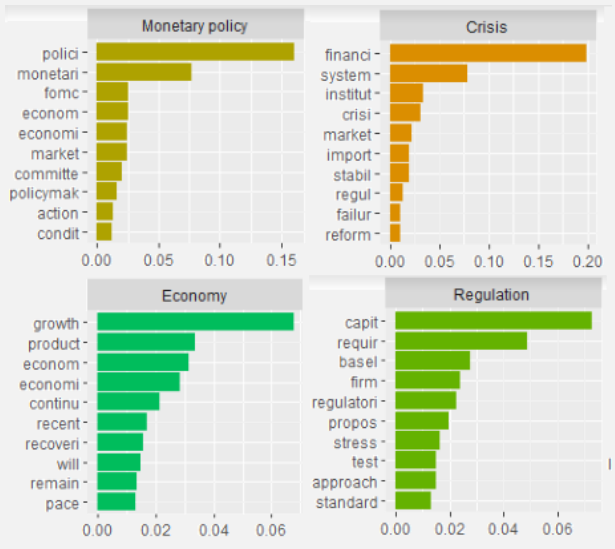


Main outputs

…as well as the topical content covered in the text







02

Understanding Central Banks: "What", "How" and "Who" is talking (or writing) about

We go Inside of the CB Reports to identify the topics using Machine Learning and Dynamic Topic Models. They can be different…

A Big Central Bank (ECB)

Economy

EMU Integration

Monetary Policy

Financial Crisis

Banking Union

Quantitative Easing

A Central Bank of a EM Country as Turkey (CBRT)

Global Flows

Activity

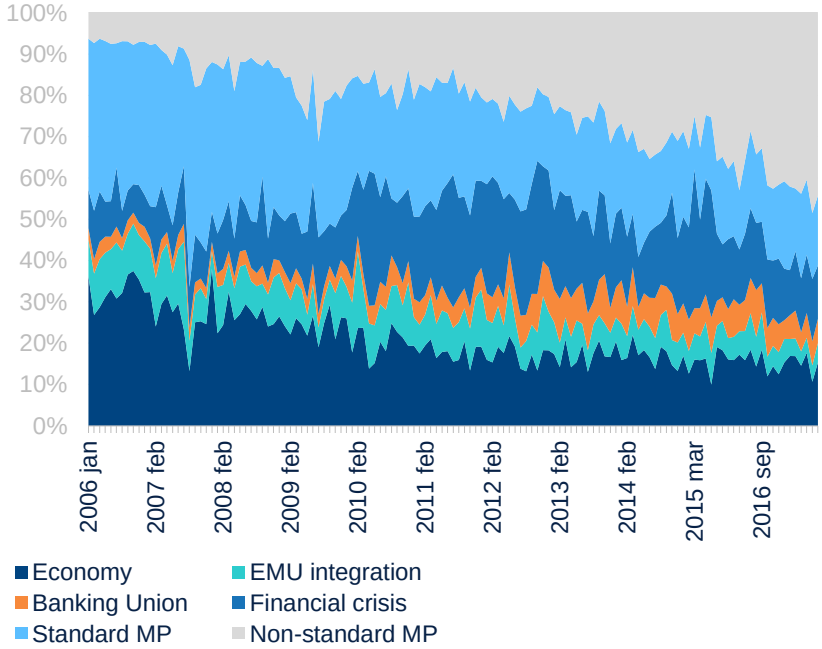
Monetary Policy

Inflation

Source: BBVA Research

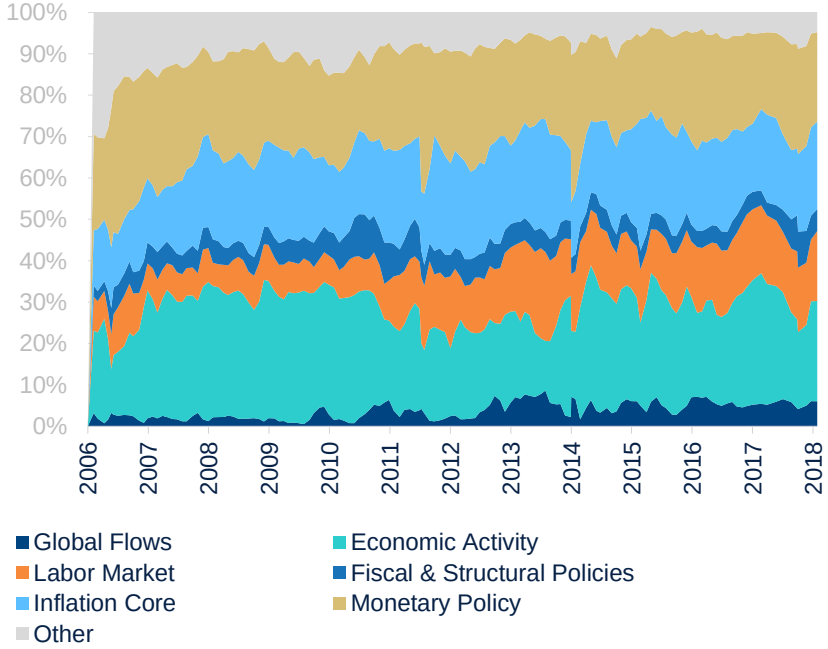
Topics are dynamic and can change over time…and the picture can change…particularly if important events hit the economy

European Central Banks: Evolution of Topics



Source: BBVA Research

Central Bank Of Turkey: Evolution of Topics



Source: BBVA Research

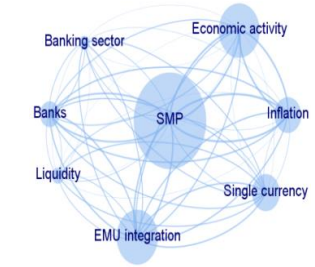
Networks are a useful tool to show the interconnectedness & complexity…helping us to understand "How" the Central Banks talk..

Monetary Policy in the North (ECB) and in the EM (Turkey): Complexity and interconnectedness
(Networks)

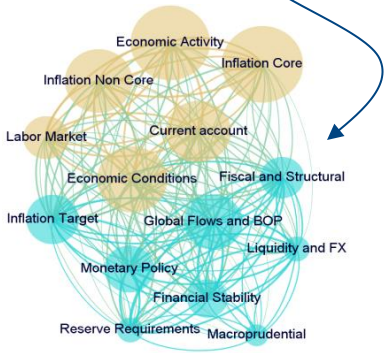
EUROPEAN CENTRAL BANK

TÜRKİYE CUMHURİYET MERKEZ BANKASI

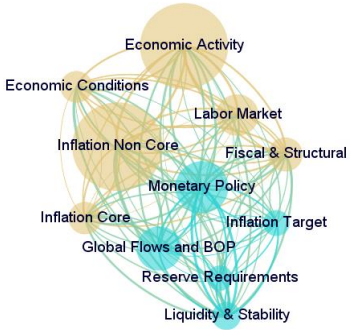
Pre Lehman (1999-2007)



Financial Crisis (2007 -2012)



QE & Post Crisis (2013-2018)

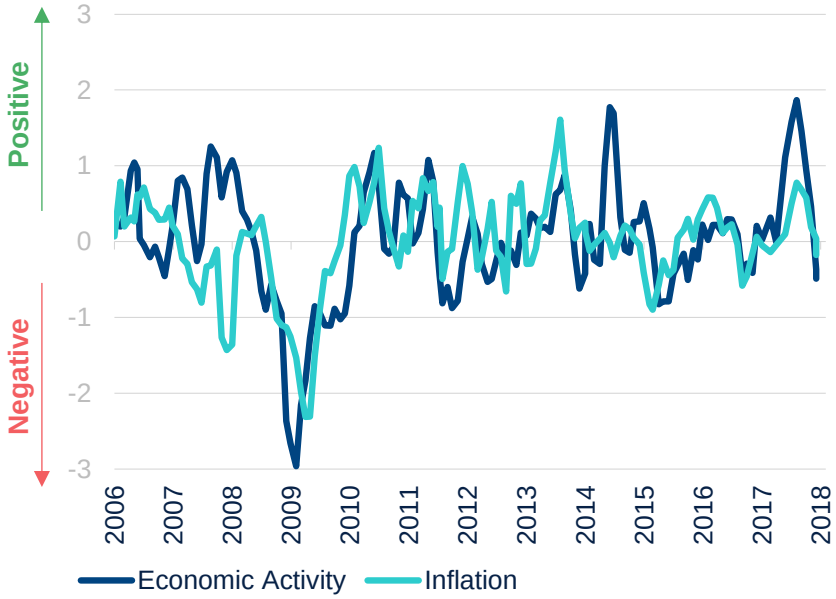


Source: BBVA Research

Sentiment analysis reinforces the analysis by describing "How" the Central Bank talks ("tone")

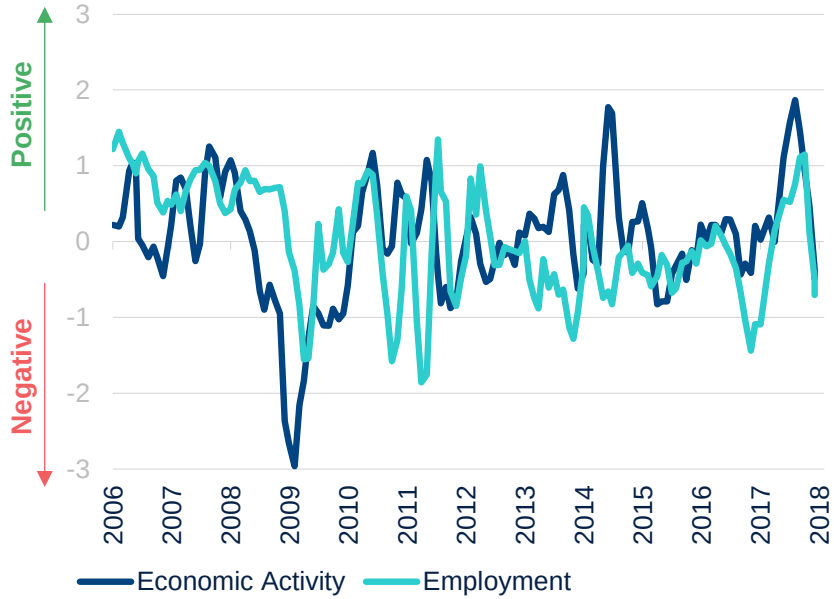
Turkey (CBRT) : Economic Activity & Inflation Tone

(Tone economic activity and Inflation jn the MP Minutes)



Turkey (CBRT): Economic Activity & Employment Tone

(Tone economic activity and employment jn the MP Minutes)



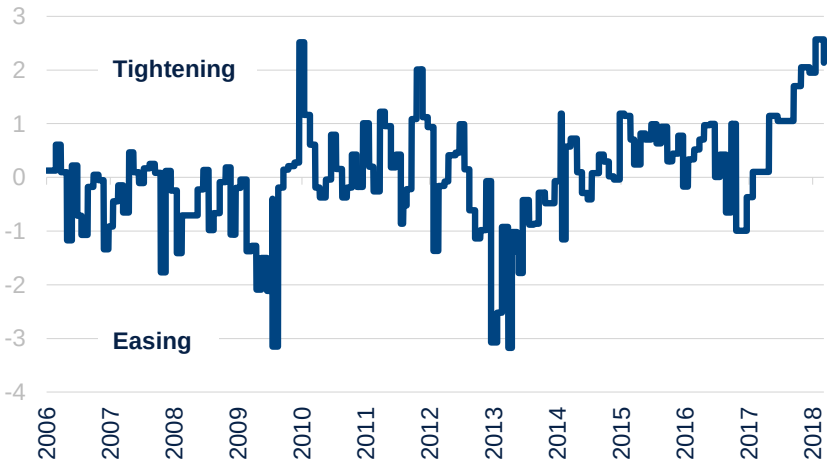
Source: BBVA Research

Through Sentiment Analysis we can check the monetary policy stance… how “Tight” or “Ease” is the Wording of the reports

Central Bank of Turkey: Monetary Policy Sentiment

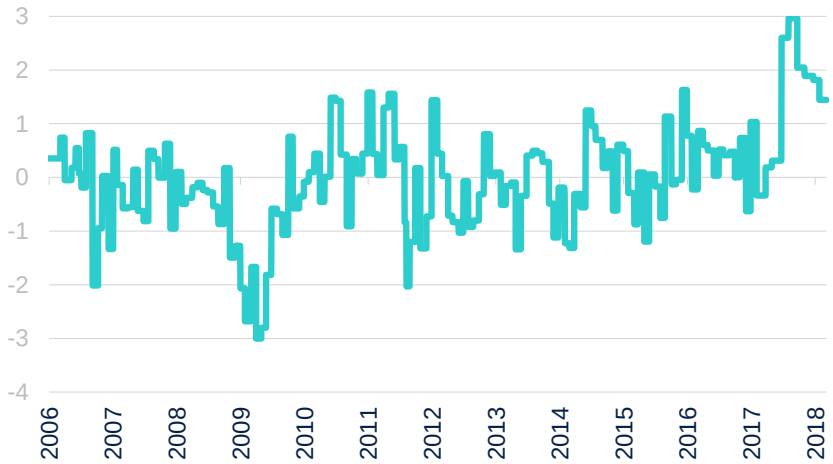
(Standardized, estimated through Big Data LDA and STM Techniques from Minutes & Statements)

Monetary Policy “Statements”



A more formal Statement…

Monetary Policy “Minutes”



More extensive and analytical…

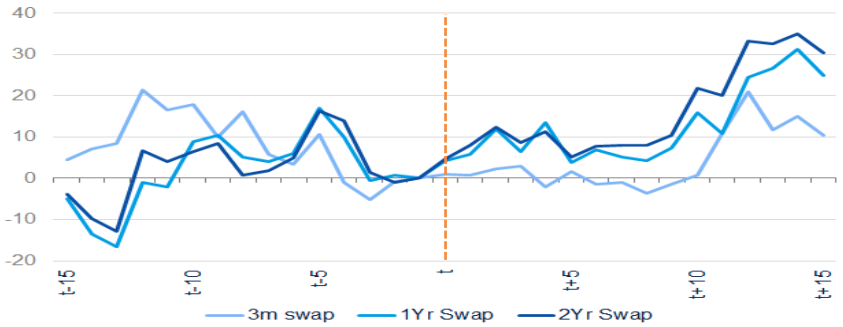
Source: BBVA Research

And how the market rates react to the Central Bank changes in monetary policy sentiment …

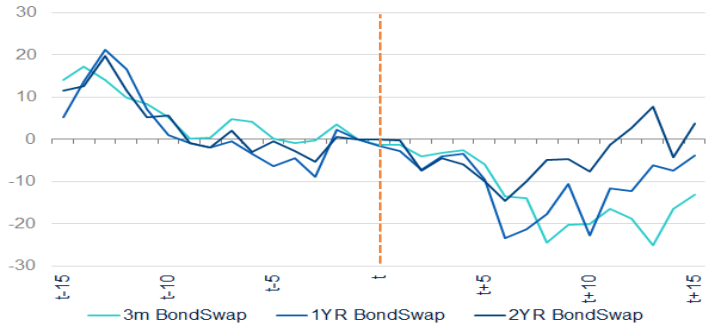
Response to Short term and Long term interest rates to positive/Negative changes in Sentiment CB Turkey

(Response of interbank deposits rates and 2Y BondSwaps to mild and strong chnages in sentiment. Changes relative to t-1. T=event)

Bond Swaps Response to a Positive Change in Sentiment



Bond Swaps Response to Negative Change in Sentiment

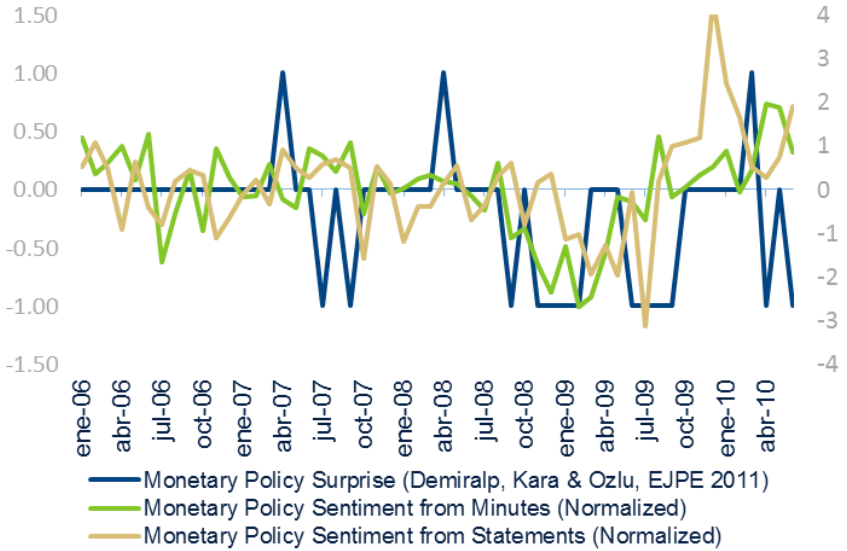


Source: BBVA Research

Remember that in the case of Sentiment Analysis, we are using unsupervised methods so…always cross-check for Robustness

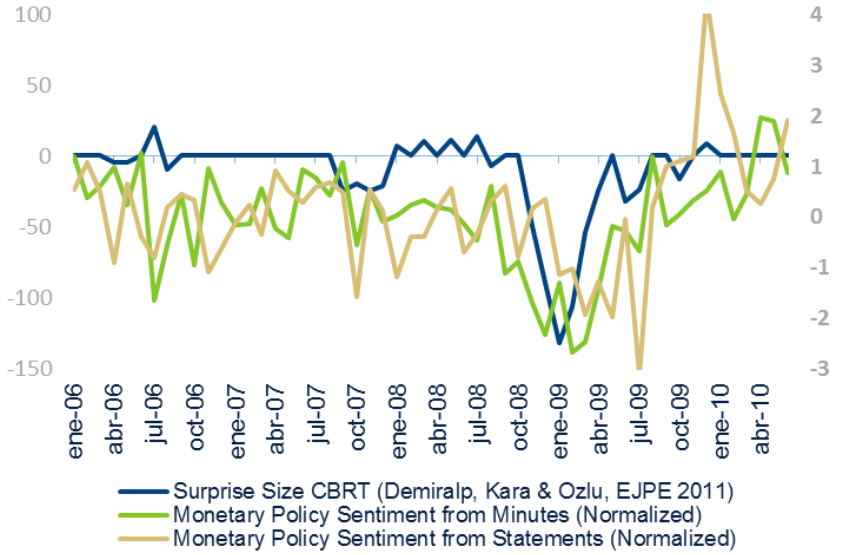
Monetary Policy in Turkey: Experts vs Algorithms

(Sentiments from LDA Algorithm and MP Surprises by Demiralp et Al. 1=Hawkish, 0= Neutral, -1=Dovish)



Experts vs Algorithms in Turkey: Size of Surprises & Sentiments

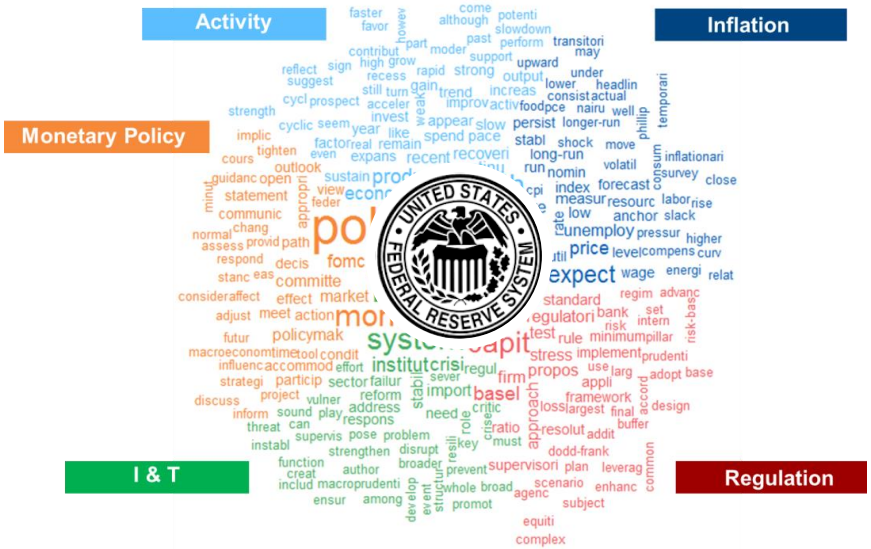
(Sentiments from LDA Algorithm and MP Surprises by Demiralp et Al)



Source: BBVA Research

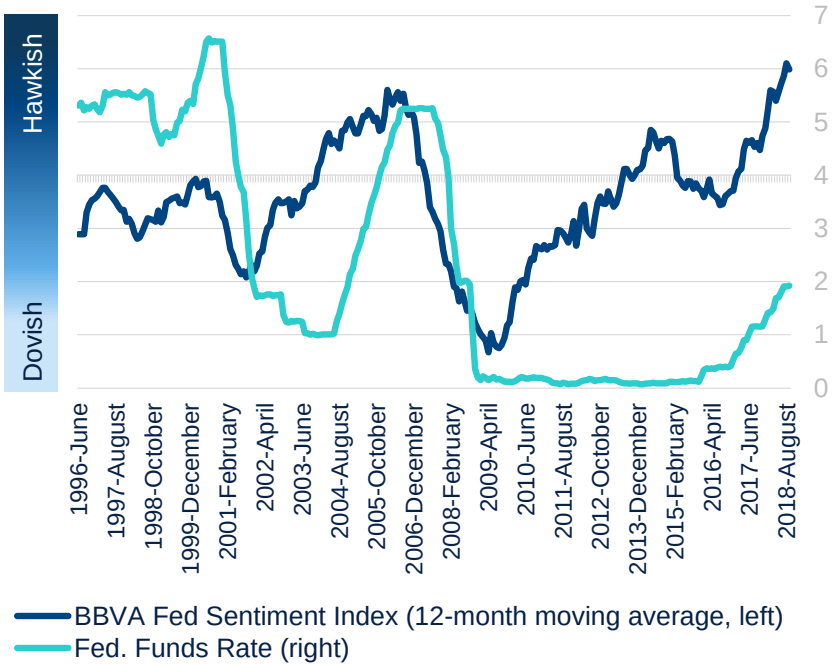
Last… but not least … we are working on the Federal Reserve Board (FED) Topics and Stance…

Federal Reserve Board (FED) Topics definition



FED Hawkish/Dovish index and Fed Funds rate

(Moving average)

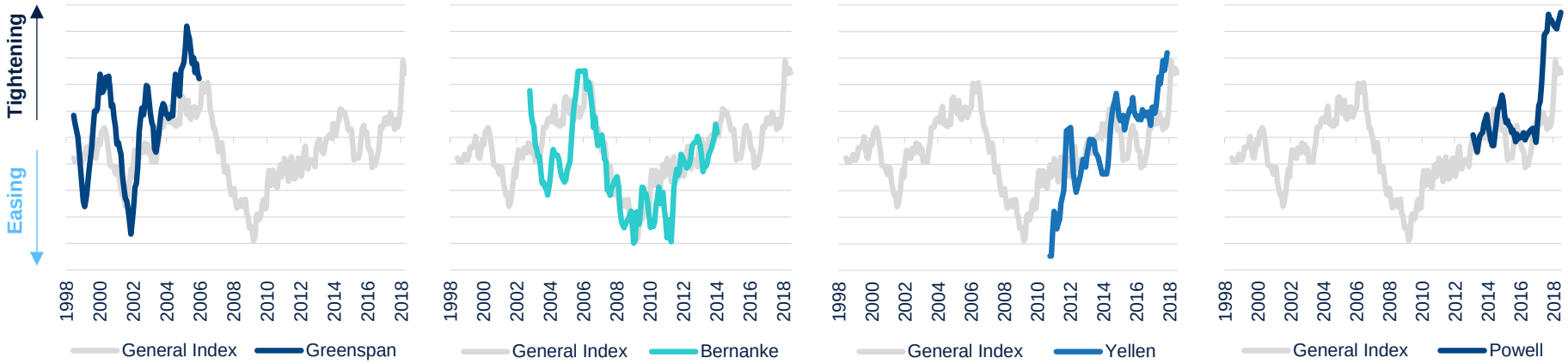


Source: BBVA Research

…complementing our “What” and “How” the Central Banks talk with “who” is talking…

General and Governor FED Hawkish/Dovish index by speaker over time

(Moving average 12 months)



From a EM Crisis Reactive and tigtening… (Mr Greenspan) 1987-2003

To a Governor Managing the crisis… (Mr Bernanke) 2016-2014

To a Lady managing the Exit Strategy… (Mrs Yellen) 2014-2018

To a Normalization Policy (Mr Powell) 2018-

Source: BBVA Research

You can find us at:

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Thank you!

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