

February 2020

EXTRACTING THE NEWS(WORTHY) FROM THE NOISE

Central bank topic and sentiment analysis using natural language processing

Executive Summary

Global central banks laboured under increased scrutiny following the Global Financial Crisis (GFC) of 2008. Having embarked on extraordinary monetary policy experiments, it followed that considering shifts in prevailing central bank policy, and extrapolating any likely effects became an expedient tactic.

In the spirit of such goals, and given the European Central Bank (ECB) recently made public a cache of two decades worth of speeches, we introduce the reader to a low-level text analysis using commonly available Natural Language Processing (NLP) tools.

We highlight characteristics of the text data; reveal extractable features of central bank vernacular; identify main themes and their evolution; apply a sentiment extraction engine to measure an aggregate disposition of policy makers; and, finally, test the foretelling ability of sentiment vis-à-vis changes in monetary policy.

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Introduction

In the summer of 2012, the European project was in peril. Its member countries' economies were shaky, and the euro had lost 17.2% against the greenback since its previous high in February of 2011. Then, on 26 July 2012, in a speech widely acknowledged as the most important and influential of his tenure, European Central Bank President Mario Draghi announced that the [ECB] will do "whatever it takes to preserve the euro".¹

Reaction to his remark was immediate and significant – see the intraday euro vs. dollar exchange rate in figure 1. His commitment, in hindsight, provided enough linguistic firepower for markets to take comfort in the longevity of the euro as the single currency made positive gains against the dollar for the next six consecutive months.

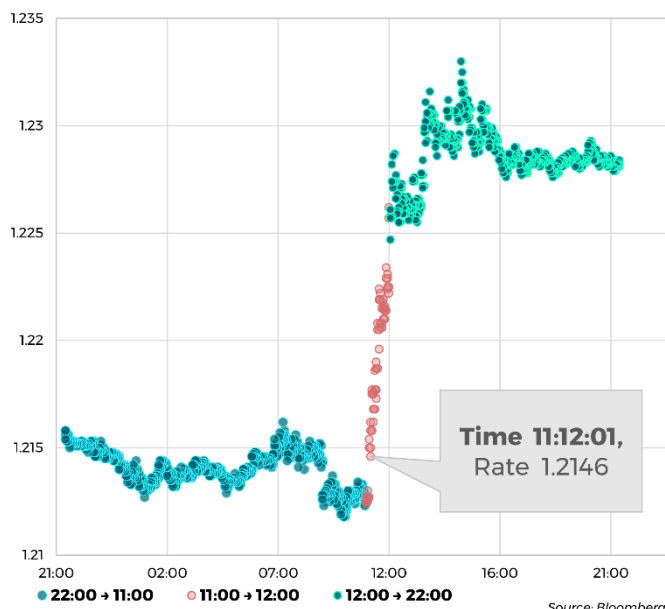


Figure 1: Intraday tick movement of the euro-dollar exchange rate over a 24-hour period from 10pm on 25 July – the day before Mario Draghi's speech, up until 10pm on the day of his speech. The euro immediately jumped on Draghi's "whatever it takes" comments, delivered briefly after the start of his speech. Compare the Bloomberg news reel time-stamps in table 2 in the appendix, and the corresponding market reaction in this figure.

¹ Draghi's speech, entitled "How To Manage Current Global Challenges" was one of 18 speeches and panels during The Global Investment Conference hosted by the UK Department of Trade and Investment on July 26, 2012. Watch his speech in its entirety here: <https://www.youtube.com/watch?v=hMBI50FXDps>

² The recent scandal that purported an advance audio feed of the Bank of England press conferences to traders support this practice, but also shows the importance of 'latency' – having access to potentially market moving information before the rest of the Street (even if only seconds or milliseconds).

³ Of the whole gamut of central bank communications, the most widely scrutinised, however, are post monetary policy meeting press releases (and often the press conferences that follow), as well as minutes of those meetings. There are various academic papers that have attempted to gauge the impact of central bank press conferences. Reeves, R., and Sawicki, M. "Do financial markets react to Bank of England communication?" *European Journal of Political Economy* Volume 23, Issue 1, March 2007; and

Scrutinising central bank press releases, minutes of monetary policy meetings, interviews, and speeches such as Draghi's in London is routine for market professionals.

This preoccupation is in large part owing to the pivotal role central banks have played in markets since the GFC using monetary (and extraordinary monetary) policy to inject liquidity into financial markets to stimulate growth. There is, for example, common agreement that the stellar performance of equity markets, especially in 2019, was in large part due to coordinated monetary policy easing by global central banks.

Having knowledge, or even prior knowledge of monetary policy decisions can be advantageous.^{2,3}

Appreciative of its importance of this information, we explore the efficacy of extracting meaningful information from central bank communications in a systematic process. Such an approach could eliminate bias, and automation will greatly improve productivity given the vast amount of material produced by all global central banks.

In the spirit of the ECB having released a large cache of speeches, and Madame Lagarde having recently taken the reins in Frankfurt, in this note we highlight features of European Central Bank (ECB) speeches⁴ using standard machine learning and NLP tools. We automate the detection of "topics", and extract and aggregate an "off the shelf sentiment" score of the ECB. We finally test the correlation of changes in sentiment to that of key ECB policy rates.

To avoid hampering the reader with excessive technicalities, the note is not intended to comment on, nor give any mathematical details on the tools used.⁵ Computational linguistics is a rich and fast-developing field, and this note is an attempt to showcase some of its uses using a familiar and hotly debated topic in the contemporary economic discourse.

NLP on ECB

In October 2019 the ECB made publicly available a cache of speeches in the hope to "stimulate natural language

Gürkaynak, Refet S. and Sack, Brian P. and Swanson, Eric T., Do Actions Speak Louder than Words? The Response of Asset Prices to Monetary Policy Actions and Statements (November 2004). FEDS Working Paper No. 2004-66, are two papers which shows that BoE and FOMC statements respectively both affect interest rate expectations and asset prices.

⁴ European Central Bank. (31 January 2019). Speeches dataset. Retrieved from: <https://www.ecb.europa.eu/press/key/html/downloads.en.html>. As per the ECB's website, the 'Speeches dataset' will be updated every two months. As of writing, the dataset was last updated on 31 January 2019.

⁵ We will make reference throughout of the tools and techniques used for analysis – many of which are open-source and come with comprehensive documentation. We will refer to these, and a selection of academic journals and blogs where appropriate.

processing research on the impact of our speeches on the market and beyond.”

The dataset holds 2,362 speeches, delivered between February 1997 and January 2020, labelled by *date*, *title* and *subtitle*, name of *speaker*, and *contents* of each entry.⁶ The dataset is substantial: altogether, the speeches total 7,339,742 words, which, for perspective, is approximately 13 times Tolstoy’s War and Peace.

See figures 2.a, 2.b, and 2.c for a breakdown of the number of annual speeches; the average length; and the observed seasonality in the speeches respectively.

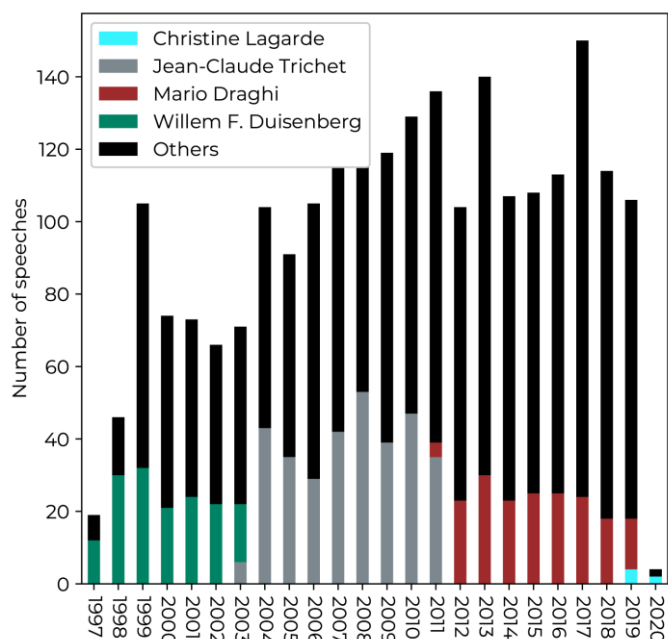


Figure 2a: The total number of speeches per year split between the respective ECB Presidents and rest of the Executive Board. Jean-Claude Trichet was a particularly prolific speaker, with a total of 329 speeches to his name – this might be due to his tenure during the financial crisis. Making up the rest of the podium is Mario Draghi, with 185 and Benoît Cœuré with 184.

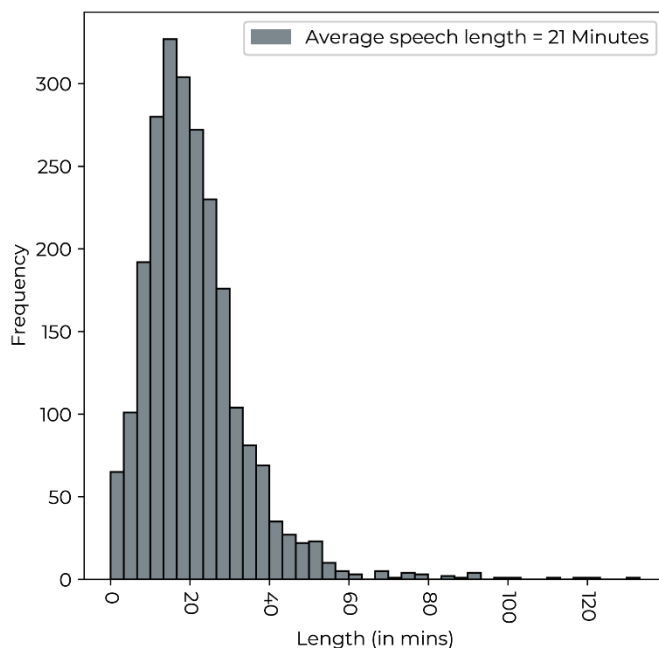


Figure 2b: A histogram of the average length of speeches in minutes. We calculate the length in time from the total word count per speech, assuming an average ~150 words per minute delivery pace. The average ECB speech comes in at 21 minutes, with Mario Draghi averaging 16 minutes. His “Whatever it takes speech”, for instance, lasted only 10.5 minutes.

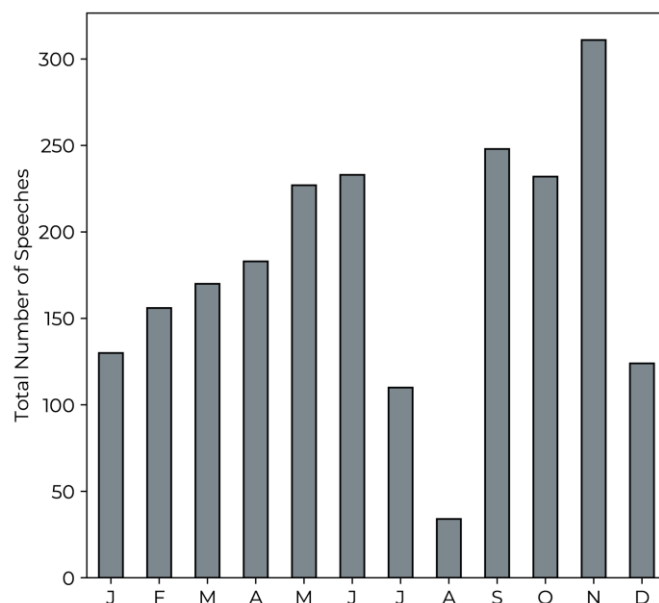


Figure 2c: The frequency of speeches shows a substantial seasonality. The total number of speeches is highest in November, while much lower during the European summer holidays in August.

⁶ The vast majority of speeches are in English (93%). Out of the six remaining languages, the majority is split between German and French with 4% and 2% of the total speeches respectively.

A first step is identifying the major topics habitually discussed by ECB members, and, moreover, how the frequency of these topics fluctuate over time.

After the text is cleaned and standardised,⁷ a word cloud is generated as a first data consistency check. The word cloud in figure 3 confirms a prior expectation of what might be expected from central bank communications.



Figure 3: ‘Monetary policy’, ‘euro area’, ‘price stability’ and ‘interest rate’ are the most frequently used words (or bigrams) – consistent with an a priori expectation of topics in central bank communications.

Whilst a variety of topic modelling algorithms exist, we employ the commonly used ‘Latent Dirichlet Allocation’, or LDA approach. For the purposes of this note, it suffices to know that LDA is an unsupervised learning algorithm that, given a set of text (speeches), is a mathematical method for estimating both 1). The mixture of words that is associated with a topic, while, at the same time, also determining 2). The mixture of topics that best describes each document (speech).

The LDA technique does not automatically detect the number of topics, but this, rather, needs to be determined before analysis. With prior knowledge of central bank documentation, supported by the result of the word

⁷ For topic modelling, we are interested only in the linguistic contents of each speech, and as such discard all other metadata. We strip out all non-English speeches from the text data, as the mixture of other languages will only dilute the process. As the vast majority of speeches are in English (93%), we can safely assume that the topic extraction will not gain much efficacy by an additional translation process. A second step is to remove punctuation and all unnecessary characters. The text is then 'tokenised' into a list of unique words, and 'bi-grams' / 'tri-grams' are formed (those words that are frequently paired together ~ 'monetary policy', 'euro area' etc.). Finally, pre-defined 'stop-words' (as, to, on, etc.) are

cloud, we are confident in limiting the LDA process to *five* topics.

The output is a set of key terms sorted in five individual sets (the five topics), with each set assigned to that speech that corresponds with the highest probability to the terms in the set. We manually interpret and categorise each of these sets of terms – see figure 4.

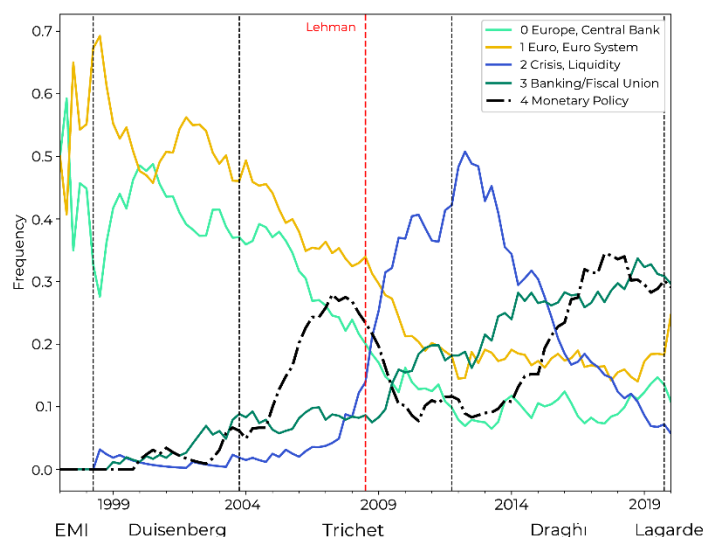


Figure 4: Key topics in ECB speeches since 1997, resampled per quarter. The series is normalised to account for the smaller number of speeches during the period of the EMI (European Monetary Institute) and the formative years of the ECB. Unsurprisingly, topics during and before the establishment of the ECB (1 June 1998) were dominated by and related to the European Union, integration, and the establishment of a central bank. There seems to be a clear transition in the dominant topics around the 2007-2008 financial crisis (the collapse of Lehman Brothers – 15 September 2008 is indicated by the dashed red line) – with many more speeches about ‘credit’ and global risks. At least until 2014, surprisingly, a downward trend in monetary policy related topics is detected. Post GFC and from the beginning of 2014 (when the ECB was exploring QE), however, has been dominated by monetary policy and the debate about closer cooperation between member states, especially around a banking union and closer fiscal alignment – consistent with what we know to be a priority for policy makers.

We conclude that topic modelling is a useful tool to monitor changes in dominant themes and to understand any policy preoccupation or thematic agenda of the ECB. Nevertheless, note that the whole dataset was used for the topic extraction algorithm.⁸ A real time casual exercise would be more difficult and noisy.

removed, and a 'lemmatisation' process (where inflectional endings are removed in order to return only the dictionary form of a word, known as the *lemma*, e.g. 'am', 'are', 'is', becomes 'be') completes the cleaning process.

⁸ For example, we would not have known that banking and Fiscal Union would have been a key topic prior to the GFC.

ECB speech sentiment analysis

In order to extract ‘sentiment’ from ECB speeches, we apply a popular ‘lexical sentiment classifier’, VADER⁹ (Valence Aware Dictionary and Sentiment Reasoner), to discern an aggregate tone or disposition of each individual ECB speech.¹⁰ This classifier relies on a pre-existing, manually constructed ‘lexicon’, i.e. a list of words that are labelled according to their semantic orientation (being, e.g., either positive or negative). We use the ‘Loughran and McDonald’ lexicon that is specifically constructed for use on finance text.¹¹

VADER is sensitive to both the polarity (positive / negative) of words; the intensity of text; and also accounts for contextual features and qualifiers: for example: ‘*not good*’ will invert the valence of ‘*good*’, flipping the polarity (sentiment) from positive to negative.

The VADER analysis outputs a positive, negative, neutral, and compound score for any given set of text. See, for example, the scores for Draghi’s “whatever it takes” speech in table 1.

In figure 5 we respectively plot the positive, negative, neutral, and compound scores of all speeches since 1997. The results are both noisy, and confirm an intuition that the majority of speeches are fairly ‘mundane’, given, as is evident from the plot, the high level of neutrality.

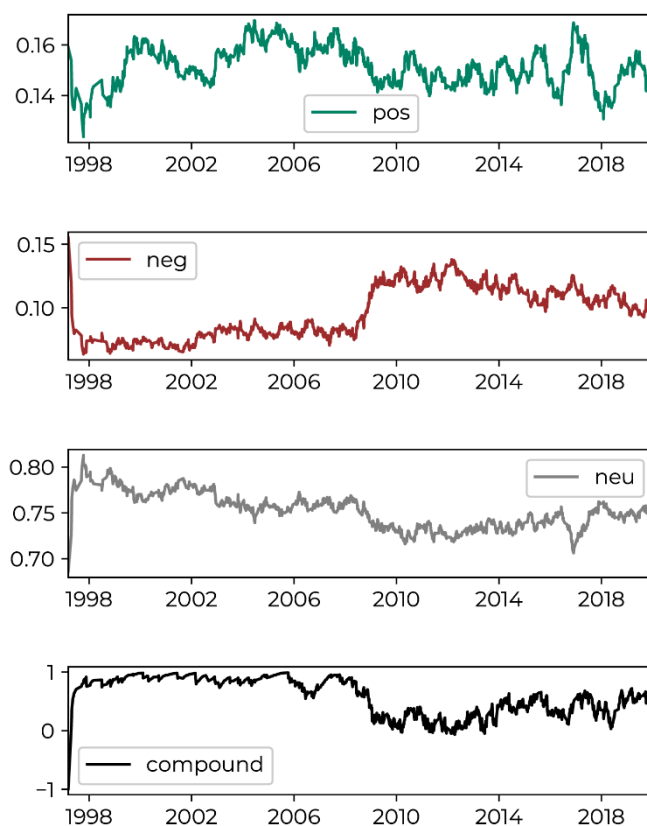


Figure 5: VADER output for each of the positive, negative, neutral, and compound scores applying a 1-month weighted moving average. We can make some initial comments: our intuition that the majority of speeches are balanced is supported, given the high level of neutrality. This neutrality is moreover comparatively persistent (bar the dip during and after the financial crisis). We observe a spike in the level of negative sentiment around 2008 – during the financial crisis, sustained throughout the 2011-2013 European debt crisis, before trending lower post-2014. It is also evident that the positive and negative sentiment scores are not symmetrical, a downward spike (or trend) in either positive or negative sentiment does not necessarily mirror its counterpart.

date	compound	negative	neutral	positive	speaker	title	subtitle	contents
26/07/2012	-0.9924	0.116	0.792	0.093	Mario Draghi	Verbatim of the remarks made by Mario Draghi	Speech by Mario Draghi, President of the European Central Bank at the Global Investment Conference in London 26 July 2012	I asked myself what sort of message I want to give to you; I wouldn't...

Table 1: The positive, negative, and neutral scores all range between 0 (least positive/negative/neutral) and 1 (most positive/negative/neutral). The compound score is a non-linear combination of the three other scores and is ranked from -1 (most negative) to +1 (most positive). Here, for illustrative purposes, we show the output of Mario Draghi’s “whatever it takes” speech. Paradoxically to the events that unfolded, and the commonly agreed significance of his statement, VADER assigned an overall higher negative sentiment to his speech.

⁹ C.J. Hutto and Eric Gilbert. 2014. Vader: A parsimonious rule-based model for sentiment analysis of social media text. InProc. ICWSM-14.

¹⁰ A set of text cleaning procedures similar to those for the topic modelling exercise is affected. The text is moreover converted to lower case and we identify and remove those entries containing less than 100 words – these produce no discernible sentiment, and, a manual study found these often not to be genuine speeches (typically introductions or references).

¹¹ ‘Loughran and McDonald’ is an English sentiment lexicon created for use with financial documents. This lexicon labels words with six possible sentiments important in financial contexts: ‘negative’, ‘positive’, ‘litigious’, ‘uncertainty’, ‘constraining’, or ‘superfluous’. While it is fair to assume that this lexicon is an appropriate benchmark, we can do better by designing our own lexicon, which is uniquely suited to macro topics routinely discussed by central banks. This is however outside the scope of this note which is intended as an introduction to commonly used sentiment analysis tools and procedures. For further details: <https://srafi.nd.edu/textual-analysis/resources/>

As the majority of speeches feature a high level of neutrality, the non-linearly combined VADER compound score regularly produces a highly binary output (slight positivity or negativity tips the balance) – see figure 6 showing the distribution of VADER compounds scores.

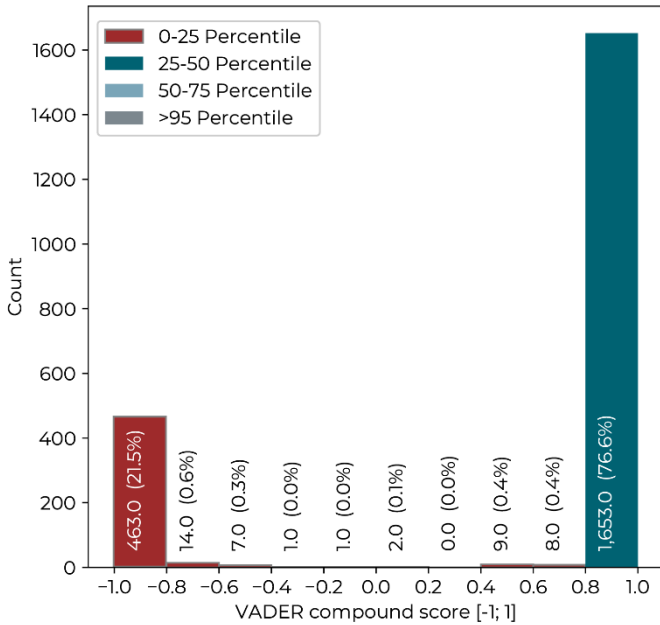


Figure 6: The distribution of the VADER compound score. The VADER sentiment analysis produces an acute binary compound score, and, moreover given the higher average ‘pos’ score (especially up until the GFC), is highly skewed towards being positive.

Given this high polarity, we favour converting the overall ‘pos’ and ‘neg’ scores into our own composite score, by taking the positive sentiment and dividing by the sum of the positive and negative sentiment scores for an output between 0 (most negative) and +1 (most positive).

$$Score_{composite} = \frac{Vader_{pos}}{Vader_{pos} + Vader_{neg}} \quad (1)$$

Also, since the *level* of sentiment is less meaningful than the *change* of the sentiment, we compute an exponentially weighted moving average in the variation of our composite sentiment measure.¹² See the result in figure 7.



Figure 7: The 125-day (6-month) exponentially moving window of the composite sentiment score from one meeting to the next. The sentiment of the ECB is consistent and coherent with market events, but dominated by the substantial drawdown leading up to, and following the GFC. A two-regime state is observed: relatively stable (but decreasing) sentiment before 2008, and relatively stable (but increasing) sentiment after 2013.

We can conclude, given the high ‘neutrality’ score of most ECB speeches that, at least for a sentiment analyser, a neutral score is the most likely result given the majority of speeches typically consist of ‘noise’ and central bank platitudes (and ‘Greenspeak’¹³).

However, this high neutrality is likely an effect of any meaningful messages being ‘hidden’ amongst often verbose text. To test this theory, we extend the analysis by tokenising¹⁴ each speech into its component sentences so as to minimise the dilution of the classifier over larger sections of text. The sentiment analyser is re-run, but, this time, on each unique sentence. As before, this produces distinct positive, negative, neutral, and compound sentiment scores – see table 3 in the appendix.

We use the tokenised sentiment analysis output in two ways:

- We repeat the calculation as in (1) for each sentence, producing a composite ‘sentence score’. We compute the average of all the sentence scores (of each speech), to arrive at a new composite speech score. This is labelled *sentence average*.
- To amplify the polarity even further, we repeat the process in A. above but limit the computation to only

¹² A merely positive or negative score in and of itself is not meaningful without any benchmark or intuition about the level of what constitutes positive or negative.

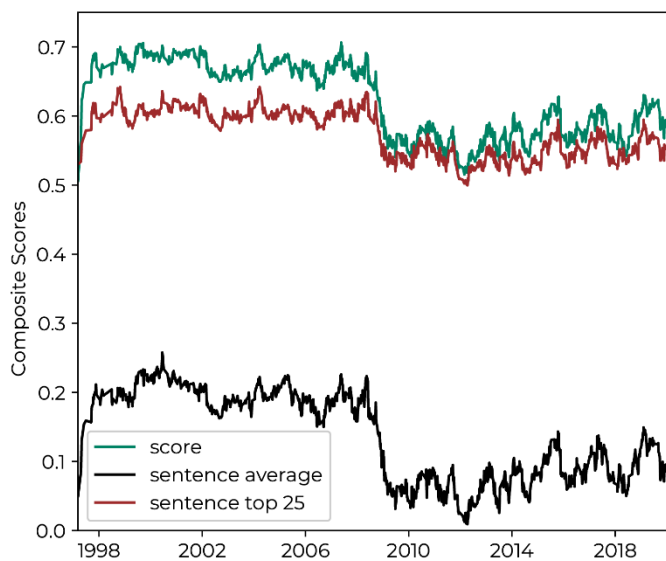
¹³ Fed Chair Alan Greenspan was famous for his often difficult to follow remarks. So skilled in obfuscation – a tactic commonly employed by central bankers – that these types of statements are often referred to as ‘Greenspeak’. Despite policy makers now aiming for less ambiguity, given its particular vernacular and

style, extracting sentiment from central bank communications is still likely to be hampered by this feature.

¹⁴ Tokenisation is a process where text is split into say, words or sentences.

the top 25 *most* positive/negative sentences of each speech, to arrive at a new composite speech score. This is labelled *sentence top 25*.

The results of this additional data wrangling does not yield meaningfully different results from the overall composite score – see figure 8. Given the high level of correlation between the competing composite score computation, we continued the analysis using the original composite score.



	Score	Sentence average	Sentence top 25
Score	1	0.96	0.91
Sentence average	0.96	1	0.89
Sentence top 25	0.91	0.89	1

Figure 8: The 1-month weighted moving average comparison of the three competing approaches of computing the composite scores for each unique speech. The cross correlation is also shown, and is high, ~ 90-96%.¹⁵

Does sentiment predict policy shifts?

Using NLP to extract sentiment from ECB speeches is shown to be consistent with overall market events. Our results, however, beg the question whether changes in aggregate sentiment are indicative of future changes in monetary policy (all else being equal).

We test the correlation between aggregate ECB sentiment and monetary policy changes, using the main composite score along with key ECB policy rates. The correlation between changes in aggregate sentiment of a preceding

year, and changes in policy rates in a successive year is only ~10%, leading us to conclude that sentiment changes, in this particular type of communication, are not indicative of any changes in monetary policy. The result is seen in figure 9.

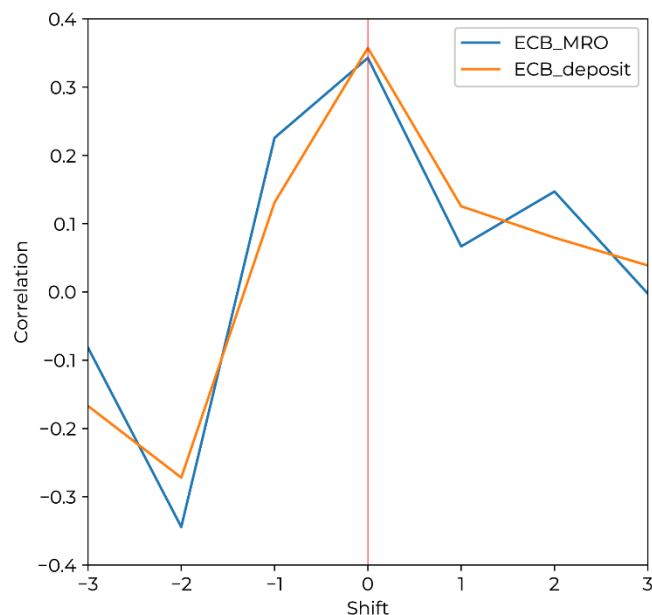


Figure 9: The correlation of the annual difference (over various annual lags on the x-axis) of ECB sentiment and key ECB policy rates. The x-axis indicates the period over which the correlation is tested: during the same annual window ('0' on the x-axis), the changes in sentiment and rates have a nearly 40% correlation – this seems intuitively coherent: when the sentiment is positive, rates are likely to be increased (a hawkish disposition), while negative sentiment is likely to go hand-in-hand with monetary policy easing (a dovish disposition). Shifting by one year (+1 on the x-axis), i.e. testing whether any changes in sentiment one year in the past are likely to be reflected in future interest rate changes shows a non-statistically significant correlation of ~10%. Controlling for the previous year's rate change does not alter the result.

Whatever it takes

We have shown a consistency between historical events and the aggregate evolution of ECB sentiment. VADER, however, is not always effective in capturing the most fitting sentiment.

The “whatever it takes” speech of Draghi is a point in case. Recall that VADER assigned an overall negative score to his speech. Refer again to table 3, noticing the highlighted section (sentences 35-42) where the individual words as per the Loughran and McDonald dictionary are tagged. VADER assigns, for example, a negative sentiment to the sentence “And so we view this, and I do not think we are unbiased observers, we think the euro is irreversible.” In

¹⁵ At this point, we also tested the correlation between speech length and the various sentiment scores and found no meaningful relationship.

the context of the time this speech was given, an informed observer would have recognised this as positive. However, given that the word 'irreversible' is assigned a negative polarity, the sentence is assigned a negative sentiment.

Whilst VADER in this use case is capable of extracting a coherent aggregate, there will be those instances where it will be unable to detect slight nuances in communications, delivered in a particular context, which, moreover, as in the case of a speech like Draghi's, was time dependant. The market reaction was potent, because the simple likelihood is that the markets reacted in accordance to the prevailing economic conditions and market sentiment at the time. A month earlier, in June, the 'sentix Euro Break-up Index' was launched, having showed a perceived probability of 73% that at least one euro-member country would be leaving the single currency within the next 12 months.¹⁶ Moreover a European Commission survey of economic sentiment hit the second lowest ever level leading up to his speech (a level that was, at that point, not seen since the GFC).

The market reaction on the day was a result of savvy, experienced traders and investors able to digest the gravity and importance of his commitment in real-time. An aggregate sentiment extraction algorithm is unable to make such a granular assessment.

Conclusion

The promise of being able to extract useful, actionable information in a fast and systematic fashion is becoming an indispensable asset for asset managers. NLP and related tools are powerful in not only mitigating the need for manual, laborious analysis of large volumes of text, but allow researchers to identify salient and important information without introducing bias or unforced errors.

We have shown in our low-level analysis that it is possible to extract topics and sentiment from ECB speeches that are consistent with history. This type of analysis is therefore, at minimum, useful in forming a global view about policy and policy direction and can be consulted especially if there are meaningful shifts.

However, it is also evident that NLP, in this particular use case, is prone to inaccuracies given the particularities of the corpus, the lexicon used, and the underlying subject matter analysed. It is an aid and not a fool-proof magic solution with results often still in need of interpretation

through an informed and knowledgeable lens. In our use-case, speeches that are likely to have a significant effect on the markets are difficult to identify, and, those which are known to have had substantial effects on the market *a posteriori*, are few and far between, making it difficult to draw any statistically significant conclusions.

Moreover, one could question the relevance of this analysis. Policy rates are expected to remain low¹⁷, and there is wide agreement that any additional liquidity is unlikely to meaningfully change business investment or consumer spending, making monetary policy or central bank actions less relevant. There is equally doubt about the credibility of central banks – a critical component to enforce the effectiveness of monetary policy.

Finally, it is wise to bear in mind that central bank behaviour is not static, communication often responds to the underlying environment, and, moreover, has undergone profound changes – it has become deliberately more transparent (and more frequent). Top positions at central banks also change, with new policy makers bringing their own style and policy convictions.

All of this would necessitate an even shrewder analysis of central bank communications, making an even stronger case for developing a bespoke lexicon.

Further research

While the use of NLP tools applied to central bank speeches does not yield easily actionable insight, there are various extensions and alternatives to this low-level analysis. The first obvious effort is to include and compare the style, sentiment and cadence with other ECB (and other G7 central bank) communications.

There are also more sophisticated methods to improve the sentiment extraction, isolating only certain text that is relevant to the topic, and creation of a targeted and bespoke macroeconomic lexicon – not relying on a catch-all solution.

Moreover, it would be interesting to analyse the evolution of topics of ECB speeches now that Madame Lagarde has taken the reigns in Frankfurt. In her first ECB press conference, she announced her intention to bring her own unique way of communicating to the ECB.¹⁸ She cautioned the gathered audience: "don't over interpret, don't second-guess, don't cross reference". Regime shifts in style, communication methods, patterns, frequency,

¹⁶ The highest level the index ever reached, having fallen significantly in the months after Draghi's speech.

¹⁷ Mario Draghi proclaiming during his final monetary policy meeting as ECB President on 24 October (when the governing council kept rates unchanged), that rates would not rise "until it has seen the inflation outlook robustly converge to a level sufficiently close to, but below, 2 per cent within its

projection horizon". The inflation print for December 2019 came in at 1.3% (same for the core rate that strips out energy prices).

¹⁸ ECB Press Conference, Frankfurt, 12 December 2019: <https://www.ecb.europa.eu/press/pressconf/2019/html/ecb.is191212-c9e1a6ab3e.en.html>

policy strategies¹⁹, as well as changes in the timeliness of updates are all risks of blindly incorporating NLP into an investment process.

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¹⁹ The ECB for instance has launched a wide-ranging 'monetary policy strategy review', including a reassessment of its inflation target.

Appendix

News reel

*DRAGHI SAYS EURO-AREA MUCH STRONGER THAN PEOPLE ACKNOWLEDGE	BN	11:04:26 GMT
*DRAGHI SAYS EURO-AREA MUCH STRONGER THAN PEOPLE ACKNOWLEDGE	BN	11:04:26 GMT
*ECB'S DRAGHI MADE COMMENTS AT CONFERENCE IN LONDON TODAY	BN	11:04:26 GMT
*DRAGHI SAYS EURO-AREA PROGRESS IN PAST SIX MONTHS EXTRAORDINARY	BN	11:05:39 GMT
*DRAGHI SAYS LAST SUMMIT WAS 'REAL SUCCESS'	BN	11:06:59 GMT
Draghi Says Euro-Area Much Stronger Than People Acknowledge	BN	11:07:43 GMT
*DRAGHI SAYS FIREWALLS 'READY TO WORK MUCH BETTER THAN IN PAST'	BN	11:08:40 GMT
*DRAGHI SAYS DON'T UNDERESTIMATE POLITICAL CAPITAL IN THE EURO	BN	11:09:04 GMT
*DRAGHI SAYS THE EURO IS IRREVERSIBLE	BN	11:09:15 GMT
*DRAGHI SAYS THE ECB IS READY TO DO WHATEVER IT TAKES FOR EURO	BN	11:09:34 GMT
*DRAGHI SAYS 'BELIEVE ME, IT WILL BE ENOUGH'	BN	11:09:45 GMT
*DRAGHI SAYS ECB WILL DO WHATEVER NEEDED TO PRESERVE THE EURO	BN	11:10:00 GMT
Draghi Says the Euro is Irreversible	BFW	11:13:07 GMT
European stocks Climb on Draghi Comments; Stoxx 600 Gains 0.4%	BN	11:14:56 GMT
*IRISH TWO-YR NOTE YIELD DROPS BELOW 4%, 1ST TIME SINCE NOV 2010	BN	11:17:28 GMT
U.S. Stock Futures Erase Losses as Draghi Pledges to Defend Euro	BN	11:19:38 GMT
German Stocks Erase Decline as Draghi Pledges Defense of Euro	BN	11:26:53 GMT
Draghi Says Yields That Disrupt Monetary Policy Are In Remit	BN	11:28:02 GMT
*ITALIAN 2-YR NOTES EXTEND ADVANCE: YIELD DROPS 29 BPS TO 4.65%	BN	11:28:36 GMT
Euro Climbs Against Dollar: Draghi Says Currency is Irreversible	BN	11:29:14 GMT
Treasuries Decline; 10-Year yield Rises 2 Basis Points to 1.42%	BN	11:30:34 GMT
U.K. Stocks Climb as Draghi SAYS ECB Will Act to Preserve Euro	BN	11:31:38 GMT
German Bunds Fall, Reversing Gain; 10-Year Yield Rises to 1.30%	BN	11:32:04 GMT
MORE: Yields Disrupting Policy Transmission in ECB Remit: Draghi	BFW	11:33:35 GMT
U.S. Stock-Index Futures Climb as Draghi Pledges to Defend Euro	BN	11:39:54 GMT
Crude Erases Loss in New York as Euro Recovers Against Dollar	BN	11:40:07 GMT
Spain, Italy Bonds Advance After Draghi Pledges to Preserve Euro	BN	11:42:46 GMT
Draghi Says ECB to DO Whatever Needed as Yields Threaten Europe	BN	11:43:09 GMT
European Stocks, Spanish Bonds Rise on Draghi as Dollar Slides	BN	11:44:15 GMT
European stocks Rally as Draghi Pledges to Preserve the Euro	BN	11:48:00 GMT
Crude oil Pares Weekly Loss After ECB Says Euro Will Survive	BN	11:49:45 GMT
Emerging Stocks Rise First Day in 5 on Earnings, Stimulus Hopes	BN	11:56:37 GMT
*EURO EXTENDS GAIN VS DOLLAR TO TRADE 0.6% STRONGER AT \$1.2228	BN	11:58:03 GMT
*DRAGHI COMMENTS 'VERY POSITIVE,' SANTANDER CEO SAENZ SAYS	BN	11:59:04 GMT
European stocks Rally as Draghi Pledges to Preserve the Euro	BN	11:59:39 GMT

Table 2: Extract from all Bloomberg 'Top Stories' restricted to those news pieces referencing news on Mario Draghi and the ECB from 11:00 to 12:00 GMT. (Rolling news banners are also included, but limited from 11:00 to 11:10 GMT. An asterisk indicates the absence of text, i.e. is only a headline.

Whatever it takes speech

document id	compound	neg	neu	pos	sentence id	sentence
1317	0.7582	0	0.908	0.092	0	verbatim of the remarks made by mario dragh...
1317	-0.3612	0.131	0.787	0.082	1	and the first thing that came to mind was some...
1317	0	0	1	0	2	this is a mystery of nature because it shouldn...
1317	0.3384	0	0.821	0.179	3	so the euro was a bumblebee that flew very wel...
1317	0	0	1	0	4	and now – and i think people ask “how come?” –...
1317	-0.6124	0.211	0.789	0	5	now something must have changed in the air, an...
1317	0	0	1	0	6	the bumblebee would have to graduate to a real...
1317	0	0	1	0	7	and that’s what it’s doing.
1317	0.8885	0	0.687	0.313	8	the first message i would like to send, is tha...
1317	0.8674	0	0.813	0.187	9	not only if you look over the last 10 years bu...
1317	-0.7579	0.351	0.649	0	10	then the comparison becomes even more dramati...
1317	-0.872	0.522	0.478	0	11	the euro area has much lower deficit, much low...
1317	-0.5086	0.164	0.836	0	12	and also not less important, it has a balanced...
1317	0.2716	0	0.901	0.099	13	that is a very important ingredient for undert...
1317	0.7579	0	0.755	0.245	14	the second point, the second message i would l...
1317	0.6124	0	0.867	0.133	15	if you compare today the euro area member stat...
1317	0.6124	0	0.6	0.4	16	and this progress has taken different shapes.
1317	0.75	0	0.878	0.122	17	at national level, because of course, while i ...
1317	0.8462	0	0.843	0.157	18	but i would say that over the last six months...
1317	0.5574	0.204	0.408	0.388	19	the progress in undertaking deficit control, s...
1317	0	0	1	0	20	and they will have to continue to do so.
1317	-0.4215	0.123	0.877	0	21	but the pace has been set and all the signals ...
1317	0	0	1	0	22	it’s a complex process because for many years...
1317	0.7579	0	0.621	0.379	23	but a lot of progress has been done at suprana...
1317	0.6124	0	0.714	0.286	24	that’s why i always say that the last summit w...
1317	0	0.08	0.84	0.08	25	the last summit was a real success because for...
1317	-0.2263	0.101	0.899	0	26	a europe that is founded on four building bloc...
1317	-0.2263	0.046	0.954	0	27	these blocks, in two words - we can continue d...
1317	0	0	1	0	28	then in the banking union or financial markets...
1317	0.5093	0	0.867	0.133	29	and to show that there is full determination t...
1317	0	0	1	0	30	so in a month.
1317	0.3167	0	0.828	0.172	31	and i think i can say that works are quite adv...
1317	0.8674	0	0.724	0.276	32	so more europe, but also the various firewalls...
1317	0.6478	0	0.752	0.248	33	the second message is that there is more progr...
1317	0.1154	0	0.884	0.116	34	but the third point i want to make is in a sen...
1317	-0.8402	0.16	0.84	0	35	when people talk about the fragility of the euro and the increasing fragility of the euro, and perhaps the crisis of the euro, very often non-euro area member states or leaders, underestimate the amount of political capital that is being invested in the euro.
1317	-0.6249	0.231	0.769	0	36	and so we view this, and i do not think we are unbiased observers, we think the euro is irreversible .
1317	-0.528	0.15	0.79	0.06	37	and it’s not an empty word now, because i preceded saying exactly what actions have been made, are being made to make it irreversible .
1317	0.1154	0	0.847	0.153	38	but there is another message i want to tell you.
1317	0.3612	0	0.857	0.143	39	within our mandate, the ECB is ready to do whatever it takes to preserve the euro.
1317	0	0	1	0	40	and believe me, it will be enough.
1317	-0.6124	0.333	0.667	0	41	there are some short-term challenges , to say the least.
1317	-0.6124	0.174	0.826	0	42	the short-term challenges in our view relate mostly to the financial fragmentation that has taken place in the euro area.
1317	0	0	1	0	43	investors retreated within their national boun...
1317	0	0	1	0	44	the interbank market is not functioning.
1317	0.4767	0	0.86	0.14	45	it is only functioning very little within each...
1317	-0.6652	0.164	0.792	0.045	46	and i think the key strategy point here is tha...
1317	0	0	1	0	47	there are at least two dimensions to this.
1317	-0.6124	0.118	0.882	0	48	the interbank market is not functioning, becau...
1317	0	0	1	0	49	so the first reason is that regulation has to ...
1317	-0.8402	0.211	0.789	0	50	the second point is in a sense a collective ac...
1317	0	0	1	0	51	and they ring fenced liquidity positions so il...
1317	-0.6124	0.222	0.778	0	52	so even though each one of them may be right, ...
1317	-0.6124	0.308	0.692	0	53	and this situation will have to be overcome of...
1317	-0.6124	0.5	0.5	0	54	and then there is a risk aversion factor.
1317	-0.7269	0.587	0.413	0	55	risk aversion has to do with counterparty risk.
1317	-0.6124	0.174	0.826	0	56	now to the extent that i think my counterparty...
1317	0	0	1	0	57	but it can be because it is short of funding.
1317	0.4939	0	0.882	0.118	58	and i think we took care of that with the two ...
1317	0.4939	0	0.556	0.444	59	we took care of that.
1317	-0.8402	0.308	0.692	0	60	then you have the counterparty recess related ...
1317	0	0	1	0	61	we can do little about that.
1317	-0.2023	0.083	0.917	0	62	then there’s another dimension to this that ha...
1317	-0.631	0.171	0.829	0	63	these premia have to do, as i said, with defau...
1317	0	0	1	0	64	now to the extent that these premia do not hav...
1317	0	0	1	0	65	they come within our remit.
1317	-0.6124	0.148	0.852	0	66	to the extent that the size of these sovereign...
1317	0	0	1	0	67	so we have to cope with this financial fragmen...
1317	-0.296	0.167	0.833	0	68	i think i will stop here, i think my assessmen...
1317	0.3612	0	0.286	0.714	69	thank you.

Table 3: The sentiment output of each individual sentence of Draghi’s “whatever it takes” speech. The computational approach remains unchanged, except VADER assigns the same set of four scores to each sentence individually. An extract of the speech (sentences 35-42) is highlighted, and those words and their affiliations that appear in the Loughran and McDonald dictionary tagged.

Legend: **Negative** **Litigious** **Uncertain**

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