WORKING PAPER NO: 640

Whose speeches impact European markets: ECBs' or the national central banks'?

Abhinav Anand
Assistant Professor
Finance & Accounting
Indian Institute of Management Bangalore
Bannerghatta Road, Bangalore – 5600 76
abhinav.anand@iimb.ac.in

Sankarshan Basu
Professor
Finance & Accounting
Indian Institute of Management Bangalore
Bannerghatta Road, Bangalore – 5600 76
sankarshan.basu@iimb.ac.in

Jalaj Pathak
Assistant Professor
Finance & Accounting
Great Lakes Institute of Management
Chennai
jalaj.p@greatlakes.edu.in

Ashok Thampy
Professor
Finance & Accounting
Indian Institute of Management Bangalore
Bannerghatta Road, Bangalore – 5600 76
ashok.thampy@iimb.ac.in

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Abstract

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Keywords: Central Bank Communication, Tone Analysis, Financial Text Analysis, Federal Reserve speeches

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Abstract

We quantify the tone from the speeches of the ECB as well as that from the national central banks of six leading European nations, and analyze its role in explaining the returns of their respective stock market indices. Using innovations in financial text analysis introduced in Anand et al. (2021), we find evidence that except for France, all nations' stock indices are significantly associated with the tone of speeches delivered by either the national or the European Central Bank (or both). For France, the national stock index volatility is found to be associated with its national central bank speech tone.

1 Introduction

While the effect of central bank policies on stock markets is an actively studied area of research, the European Union provides a unique opportunity to compare the market impact of actions undertaken by national central banks to that of a supranational entity: the European Central Bank (ECB). In this study, we quantify the effect of speeches delivered by both national central banks as well as those by the ECB on the respective national stock market indices of six leading European nations: France, Germany, Italy, Spain, Ireland and Finland.

Central bank communication has been found to be significantly associated with an array of economic variables such as interest rate (Kohn & Sack 2003, Demiralp & Jorda 2004, Lucca & Trebbi 2009, Smales & Apergis 2017); money supply (Gerlach 2007); currency market (Dossani 2018) and stock return and volatility (Ehrmann & Fratzscher 2004, Savor & Wilson 2013, Schmeling & Wagner 2019, Apergis & Pragidis 2019). Hubert & Labondance (2021) report that that the FOMC statements explain monetary surprises beyond policy announcements. Baranowski et al. (2021) use survey data to analyze the expectation channel of monetary policy and find significant impact on interest rate and inflation expectations. As specified by Schmeling & Wagner (2019), the central bank communication impacts market expectations and thus can be associated with market return. This could be due to the information content of the communication which in turn impacts the asset prices (Savor & Wilson 2013). On similar lines, Doukas & Han (2021) report that the sentiment impacts the beta and the market risk premium of the conditional version of the CAPM.

Although a majority of previous literature has examined press releases and FOMC statements (Lucca & Trebbi 2009, Hansen & McMahon 2016, Gonzalez & Tadle 2021), we examine another important yet understudied tool in the central bank communication toolkit—speeches delivered by senior functionaries of central banks. Central bank speeches intend to convey

to the markets, its desires and wishes, regarding future paths of relevant policy variables such as inflation, short term rates, unemployment numbers etc. For functionaries of the central bank, it is vital that their message broadcasted to the market participants in the form of speeches reaches their intended audience; and (even more importantly) is interpreted in the same way that the bank intends them to be interpreted. Any miscommunication or misinterpretation in this regard can prove costly to the economy which can then be used to infer that the central bank failed in fulfilling its mandate. Thus, a study of how central bank speeches impact markets is vital for the central banker who wishes to convey accurate, unambiguous information to market participants. Moreover, insofar as central bank communication can itself be used for policy implementation as suggested in Guthrie & Wright (2000), any evidence which connects the impact of central bank speeches to movements in the market helps the central bank in gauging whether it is successfully transmitting its message.

For the investors also the applications of studies connecting central bank speech impact to the markets is essential. For example, a large part of central banks' mandate is to implement the nation's monetary policy. In particular, several studies cited above show central bank communication to be significantly associated with interest rates and inflation expectations.[1] Stock market securities are generally priced at a premium to risk-free assets whose yields are directly influenced by both benchmark interest rates as well as future inflation expectations—an important subject matter for about 35% speeches on average for our study. Clearly, investors should (and do) pay a lot of attention to speeches delivered by central banks.

The methodology used to extract the tone of central bank communication is borrowed from Anand et al. (2021), using polar words (negative/positive) from the Loughran and McDonald Dictionary (LM hereafter) (Loughran &

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[1]In our study 14%–55% of different nations' central bank speeches are focused on interest rates or related variables such as money supply, short term rates, quantitative easing etc.

McDonald 2011) and polar phrases extracted in line with Apel & Grimaldi (2014) and Apergis & Pragidis (2019), along with appropriately weighed valence shifters (adjectives and adverbs) which modify the meaning of words but have not been given weightage in the LM dictionary.

To the best of our knowledge this is the first study which analyzes speeches delivered by the European national central banks as well as those by the ECB and compares their putative influence on the movement of European stock markets of their member nations. Further, our adaptation of the novel tone quantification methodology of Anand et al. (2021) which proposes usage of the sentence as a unit of analysis; and assigns proper weights to valence shifters—adverbs and adjectives which modify the meaning of a sentence (such as "but", "slight", "very", "despite" etc.)—has not been applied to study central bank speeches in prior studies.

One of several, non-equivalent ways of categorizing existing literature on central bank communication is by means of its tone quantification methodology. Based on this criterion, there are two popular techniques for analyzing communication from central banks. The first category includes the studies in which the central bank's communications' reaction is quantified into a dummy classification (e.g., +1, 0, -1) based on the authors' subjective assessment or a dictionary based analysis of its content by the researcher. For example, Guthrie & Wright (2000) use central bank communication to show how central bank statement (rather than open market operations) can be used to implement monetary policy in New Zealand. The communication is classified into categories (+1,0,-1) based on the authors' subjective assessment and it is shown that the communication, rather than open market operations causes the large changes in interest rates. The second category includes studies that analyze the importance of speech days based on a dummy variable for the presence/absence of the speech. For example, Savor & Wilson (2013) show how macroeconomic announcements affect market returns and Sharpe ratio.

However, there are drawbacks to both categories of studies. For the first

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category, if the communication is classified on the basis of researchers' intent, the results cannot be agreed upon to be standard. On similar lines, the second category of studies classify the communication on the basis of its presence/absence and ignore its content.

The methodology of tone quantification, using polar dictionaries, ngram phrases and/or "bag-of-words" approach largely overcomes the limitations pertaining to the above two strands of literature on central bank communication. Moreover, in this paper, we further improve the tone quantification process by following the novel approach introduced in Anand et al. (2021) and divide a speech into a set of sentences and extract the tone for each sentence considering both the polar words (negative/positive) from the LM dictionary as well as ngram phrases using the approach specified in Apel & Grimaldi (2014). These polar words/phrases are then used in conjunction with adverbs and adjectives (valence shifters) to extract the accurate tone of the central bank communication (Polanyi & Zaenen 2006, Schulder et al. 2018).

We employ the union of two lexicons in this study: the LM dictionary for financial text proposed by Loughran & McDonald (2011), and the Apel & Grimaldi (2014) dictionary which characterizes the tone quantification with respect to central bank communication. Their joint usage ensures that our tone quantification method assigns proper weights to words used from the perspective of both financial and central bank text classification.

The valence shifters can be divided into four categories: adversative conjunction (e.g. "although", "however"), negator (e.g. "nor", "not"), amplifier (e.g. "very") and de-amplifier (e.g. "few") and can alter the tone of the sentence. For example, for the sentence below: (taken from a speech given by a member of German Central bank on 28th April 2012)

> "assets can always be held to maturity, which is why the central
> bank is only exposed to credit risk, but not to liquidity or interest
> rate risk."

the tone using LM dictionary and "bag-of-words" approach is -0.076, whereas

using the modified tone extraction approach of Anand et al. (2021) is calculated as: -0.012, since the word "but" is not given appropriate weightage in the existing method and the LM dictionary. Thus, using both the polar words and ngram phrases along with valence shifters leads to an improved tone quantification for central bank communication.

Our main finding is that except for France, all nations' stock markets are significantly associated with speech tones from either the national central bank or the ECB or both. For the case of France, its index's volatility shows contemporaneous influence of speeches delivered by its national central bank. We corroborate our findings by an array of auxiliary tests and specifications.[2] These include the insertion of additional macroeconomic control variables; intraday return analysis of 30-minute interval returns; panel estimations with fixed effects and robust clustered standard errors; and examination of speech impact on daily index realized volatilities. Our results also survive a battery of robustness exercises such as the examination of speech tone impact on smallcap indices; subsample analysis featuring speeches in English or those with official English translations; inclusion of central bank speeches of non-Eurozone nations such as Sweden and UK; Latent Dirichlet Allocation based topic analysis for examining the joint impact of speeches by NCB and ECB on similar topics; and examining the impact of ECB speeches on the Euro Stoxx 50 Index.

The paper is organized as follows: section 2 is the Literature Review for central bank speeches, European Central Bank and text analysis in finance, section 3 specifies the data and methodology for tone calculation followed by section 4 which presents the analysis and results. Next, section 5 provides discussion of the results. Section 6 is for robustness analysis and finally, section 7 offers concluding remarks.

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[2]We thank an anonymous reviewer for suggesting these exercises.

2 Literature Review

We divide relevant prior literature into three categories: central bank communication, the European Central Bank and text analysis in finance.

2.1 Central Bank Communication

Due to the perceived economic and financial importance of the central bank, the work analyzing their impact has been ample as well as diverse. For example, Guthrie & Wright (2000) study how central bank statement rather than open market operations can be used to implement monetary policy in New Zealand. On the other hand, Kohn & Sack (2003), Demiralp & Jorda (2004), Ehrmann & Fratzscher (2004) and Jansen & De Haan (2006) are among the studies which categorize days as a dummy variable based on the presence or absence of central bank communication. Jansen & De Haan (2006) also study the comments by central bankers on the interest rate, inflation, and economic growth in Eurozone. The statements are categorized into dummies based on subjective analysis by the authors. Similarly, Gerlach (2007) discuss the interest rate related statements made by the ECB and their respective impact using subjective dummy classification of the statement by the authors. Lucca & Trebbi (2009) analyze FOMC annoucements using Google search and Factiva based news articles in an ngram approach. Savor & Wilson (2013) check whether investors care about macroeconomic announcements and find that the average market return and Sharpe ratio are significantly higher on important announcement days. Hansen & McMahon (2016) use a topic analysis approach on FOMC communication to analyze its impact on the market using a FAVAR framework. On similar lines, Smales & Apergis (2017) examine the impact of readability of monetary policy statements (proxied by Flesch-Kincaid index) on the 10 year T-bill. Dossani (2018) examines how the central bank press conferences impact the risk premia in the currency markets and finds significant results. Schmeling & Wagner (2019) and Apergis & Pragidis (2019) also quantify central bank tone and analyze

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its impact on market return and volatility. More recently, Hubert & Labondance (2021) and Gonzalez & Tadle (2021) quantify and examine the impact of the tone of FOMC statements and press releases respectively. Hubert & Labondance (2021) report that that the FOMC statements explain monetary surprises beyond policy announcements and Gonzalez & Tadle (2021) find that the press releases of most central banks converge during periods of international crises. Baranowski et al. (2021) use survey data to analyze the expectation channel of monetary policy and find that the impact differs for interest rate and inflation expectations.

2.2 European Central Bank

The literature on ECB has been quite diverse, analyzing its perceived competence, accountability, market impact and trust of member nations in it. For example, Velthuis (2015) studies the role of the media in the production of a transparent market order with respect to ECB communication. Horvath & Katuscakova (2016) analyze the link between the transparency of ECB's monetary policy and trust of the European Union citizens using responses of Eurobarometer. Alexander (2016) throws light on the ECB's supervising role for banking institutions in the Single Supervisory Mechanism (SSM) and argues that the ECB under EU treaty and SSM regulation does not have adequate competence and institutional capacity to conduct macroprudential supervision. Similarly, Schmidt (2016) illustrates the different pathways taken by member countries for legitimization of the ECB and European Commission. Further, Verdun (2017) studies the role played by the ECB in EU governance regarding the sovereign debt crisis. Using speeches and interviews she finds that by the usage of the Securities Market Program (SMP) and "doing whatever it takes" ECB presidents Jean-Claude Trichet and Mario Draghi exercised transformative leadership during the crisis. Picault & Renault (2017) use ngram and term weighing approach to quantify ECB communication and analyze its impact on market return and volatility. Claeys et al. (2018) analyze the monetary policy framework of

the ECB in light of declining long-term rates in advanced countries and the flattening of the Phillips curve. Hartmann & Smets (2018) provide a comprehensive view of the ECB's monetary policy over two decades since its inception. Högenauer & Howarth (2019) analyze the democratic legitimacy of the ECB since the sovereign crisis of 2010 and show how the ECB policy-making can benefit from depoliticization due to its improved redistributive implications. Fraccaroli et al. (2020) investigate the accountability of the ECB, the Bank of England and the Federal Reserve by analyzing the parliamentary hearings for all three from 1999 to 2019. Bergbauer et al. (2020) study the relationship between the Euro and the ECB and find that the support for Euro is value-based whereas that for the ECB is more through perceived performance. Cross & Greene (2020) use topic modelling via nonnegative matrix factorization of ECB speeches from 1999-2018 and study its impact in light of the General Punctuation Hypothesis.[3] They find that unlike policy outputs from other policymaking systems, ECB communications (due to its information processing capacities) evolve in a more proportional manner. Moschella & Diodati (2020) study the impact of political factors in disagreement within the monetary policy committee of ECB and find that the ideological inclinations of the member nations do impact policy decisions.

2.3 Text based Measures

With respect to quantification of tone from financial text, Antweiler & Frank (2004) extract tone from message activity in chat rooms and analyze its impact on trading volume. Tetlock (2007); Engelberg (2008); Li (2008, 2010) and Tetlock et al. (2008) are some of the other important studies which have used "bag-of-word" as well as Machine Learning approaches to classify financial texts as positive or negative. These studies have used 10-K reports, newspaper articles, message boards, and press releases as sources of the text.

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[3]The general punctuation thesis postulates that political systems are subject to multiple streams of information on problems that could require addressing, yet they are also subject to a great deal of resistance to acting on those problems (Jones & Baumgartner (2012)).

Loughran & McDonald (2011) specify a new dictionary and show its importance in comparison to the Harvard IV dictionary for analyzing financial texts. On similar lines, Garcia (2013) and Jegadeesh & Wu (2013) study the impact of tone, calculated from news stories and by introducing a new method for tone calculation (alternate term weighing process) respectively. Kearney & Liu (2014) provide a survey of methods in text analysis in finance. Sprenger et al. (2014) examine the relationship between tone/sentiment of tweets about stocks and their return, trading volume etc. and find significant results. Solomon et al. (2014) show how media coverage of fund holdings affects investors' fund allocation. Kim & Kim (2014) study the relationship between investment tone calculated from message postings in Yahoo! Finance and stock returns. Chen et al. (2014) analyze the impact of social media calculated tone on stock returns and earnings surprises. Further, Loughran & McDonald (2015) study the different dictionaries and their suitability for analyzing financial documents. Loughran & McDonald (2016) do a survey of the textual analysis in Accounting and Finance. Altanlar et al. (2019) investigate how cognitive dissonance arising from interactions between sentiment and culture affects momentum and post-earnings-announcement-drift (PEAD). Fan et al. (2020) find significant relations between bot tweets and the return and volatility of the 55 companies in the FTSE 100 composites. Bajo et al. (2020) find that newspaper coverage of firms in conflict of interest is greater, with fewer negative and uncertain words. Among recent studies, Cathcart et al. (2020) analyze the impact of media tone (proxied from Thomson Reuters News Analytics database) on credit default swaps and find significant results. Gao et al. (2020) find that the institutional investor sentiment assists to tilt the stock prices towards the intrinsic value. Recently, Doukas & Han (2021) examine the conditional version of the CAPM on sentiment and find that the beta and the market risk premium vary over time across different sentiment indices and portfolios.

3 Data and Methodology

3.1 Data

There are three broad sources of the data used in this study. The speeches are downloaded automatically from the official website of each country's central bank. The data include speeches by the governor, deputy governors and members.[4] There are 19 EU nations for which we could download historical central bank speech data. We need to ensure a representative, large-enough speech sample to enable our methodology to correctly draw inferences regarding central bank speech tones. To this end, we impose the data requirement of at least 100 available speeches. The countries which survive this data filtration requirement are Germany, France, Italy, Spain, Finland and Ireland. This also leads to the disqualification of two major Eurozone economies (Belgium and Netherlands) from the sample, even though they are bigger than Ireland and Finland in economic terms. Among the six nations, Ireland has all the national central bank speeches in English whereas for France, Germany, Italy, Spain and Finland approximately 50% of total number of speeches are either available in English or with an official English Translation from the respective central bank website. The number of total speeches and details thereof are specified in table 1 for all six nations. Also, for analyzing intraday trends we use data from https://firstrate.com/.

Insert table 1 about here.

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[4]One of the reasons why speeches are downloaded from the official website and not as reported in the news articles (from Reuters or Bloomberg News) is to ensure that the content is in its original form. This is so because, in most cases, news articles, in addition to the reported speech, also have the journalists' opinion which could bias our tone quantification analysis.

3.2 Tone Quantification

The speeches are downloaded from the official website of the central bank of each country and for instances where there are multiple speeches on the same day, the content for all is analyzed as one speech. Next, the downloaded content is parsed and converted to all lower cases. Following Anand et al. (2021), we quantify tone while considering the sentence as a base unit. In order to do so, all possible punctuation marks in the text are identified in the following three ways: first between two full stops; second, between a full stop and a question mark; and finally between two question marks. Thus each speech is broken into a collection of sentences. The words in each sentence, in turn, are classified into two categories: polar words/ngram phrases and valence shifters (adjectives and adverbs). Since the valence shifters (amplifiers, de-amplifiers, adversative conjunction and negators) can lead to a change in meaning of the sentence, all four categories are given appropriate weightage.[5] The amplifiers (positive), de-amplifiers (negative), and adversative conjunction are given a weight of 0.8—negative for the words before adversative conjunction and positive for the words after adversative conjunction. The weight, 0.8, is as per the existing literature (Polanyi & Zaenen (2006) and Schulder et al. (2018)). We vary the weights from 0.5 to 0.9 and verify that our results continue to hold. For illustration, results with valence shifter weight 0.5 are presented in tables A.3 and A.4 and they are the same as tables 12 and 13 which have default weights 0.8. The negators are given a value of -1. For each sentence, first the polar words/phrases are identified followed by identification of valence shifters around these polar words. Thus each sentence is broken down into smaller clusters of polar words/phrases and valence shifters. We explain the process in detail below:

*what is required is greater co-ordination of national policies, a mobilisation of european savings which are **very** abundant - what i call a financing*

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[5]Tables A.1 and A.2 in the appendix presents the list of valence shifters along with associated category and weight.

union for investment and innovation - and a common budget for the euro area.[6]

Using the "bag-of-words" approach and existing tone dictionary (LM) the tone of the above sentence is calculated as:

$$\frac{(+1)[=\text{greater}] + (+1)[=\text{abundant}] + (+1)[=\text{innovation}]}{23} = 0.130$$

Now, using the methodology borrowed from Anand et al. (2021), the tone is calculated as below:

Firstly, polar words/phrases are identified from the sentence followed by valence shifters around these polar words/phrases. Thus each sentence is divided into clusters with respect to polar words/phrases such as:

1. *what is required is greater co-ordination of national policies, a mobilisation of european savings which are **very** abundant -*

2. *what i call a financing union for investment and innovation - and a common budget for the euro area.*

Thus, the above sentence is divided into two clusters with **very** being a valence shifter (amplifier) to the polar word "abundant" in the first cluster.

The tone calculated is as follows:

$$(+1)[=\text{greater}] = 1$$

$$(+0.8)[=\text{very}] + (+1)[=\text{abundant}] = +1.8$$

$$(+1)[=\text{innovation}] = +1$$

$$\frac{(+1)[=\text{first cluster}] + (+1.8)[=\text{second cluster}] + (+1)[=\text{third cluster}]}{24} = 0.158$$

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[6]The sentence is taken from the communication by François Villeroy de Galhau, Governor Central Bank of France, delivered on 31st October, 2017.

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The number of non stop-words in the denominator is higher in case of new methodology due to the introduction of the valence shifters.

Tables 2 and 3 present the distribution and examples for the presence of various types of valence shifters in the speeches of the six nations as well as the ECB along the difference in tone quantification using the LM method and new method.

Insert tables 2 and 3 about here.

To further examine the difference between tone calculated using the methodology introduced in this study and the LM dictionary-based "bag-of-words" approach we plot the tone of sentences (containing valence shifters) calculated by both methods. Figures 1, 2, 3, 4, 5 and 6 present the boxplots for the distributions of speech tone calculated using the two methodologies. Such visual evidence suggests that the existing methodology ignores outliers and tends to underestimate the full range of speech tones.

Insert figures 1, 2, 3, 4, 5 and 6 about here.

Table 4 presents the difference in speech tone statistics for sentences with valence shifters, using the existing methodology ("bag-of-words" and LM dictionary) and the new methodology introduced in this study. From the figures 1-6, as well as from table 4, it is clear that the range of the speech tones is higher for the new methodology (NM) i.e., the minimum is lower and the maximum is higher in NM and the standard deviations (and inter-quartile ranges) are higher under the new method.

This suggests that the full variability of speech tones is systematically underestimated when valence shifters are ignored—as is done in the LM dictionary based "bag-of-words" methodology. We also examine the difference between the speech tone distributions using the Kolmogorov Smirnov (KS) test, the results of which are presented in table 5. It can be seen that the distance between the two speech tone distributions (D statistic) is significantly different for all six nations.

Insert tables 4 and 5 about here.

To further verify the impact of the speech tone calculated using the methodology specified in this study in comparison to the existing methodology, we repeat the analysis presented in tables 12, 13 and 14 in the presence of both measures of tone (calculated using the existing methodology (EM) as well as the new methodology (NM)). We only present the results for the impact of the national central bank speech tone (table 12) for the sake of brevity in table A.5 in the appendix. It can be seen that the speech tone calculated using the new methodology is significant for 5 out of 6 nations even in the presence of speech tone calculated using the existing methodology. We get similar results for the impact of ECB and joint impact of the national central bank and the ECB.

3.3   Empirical Design

Return is calculated as per the below formula:

$$R_i = \frac{P_i - P_{i-1}}{P_i}$$

where i denotes the respective day.

In the past, Vector Autoregression (VAR) has been used to analyze the relationship between tone and market index and also to guage if and when the impact reverses (Tetlock (2007)). We however use OLS with heteroskedasticity and autocorrelation consistent (HAC) errors in this study since the speeches are spread intermittently and are also missing for certain days as well as months. Thus, since speeches are spread highly intermittently, the use of VAR leads to a drastic fall in the number of observations. Also, since the impact of tone can be delayed due to socio-economic reasons it is tested for up to five lags.[7]

Thus, the below equation is tested for all nations' stock market indices:

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[7]The lags are kept in accordance with Tetlock (2007).

$$R_t = c_0 + a_n Tone_{t-n} + \sum_{i=1}^{3} b_i R_{t-i} + d_1 * Controls + d_2 * SpeechControls + \gamma_t \quad (1)$$

Where n ranges from 0 to 5 and controls include the day of the week and month dummy and speech controls include average words per sentence (awps) and percentage of complex words (per_CW), in line with the methodology outlined in Anand et al. (2021).

4   Results and Analysis

We first look at the summary statistics for index returns as well as speech variables for all nations. Tables 6 and 7 specify the speech statistics for the central bank of each country as well as that for the ECB. The longest time period of availability is for Italy and Finland. Germany has the highest number of daily speeches along with the highest number of average speeches per month. On the other hand, Spain has the lowest number of average speeches per month and France has the least number of total speeches. Additionally, the ECB has the highest number of speeches as well as the longest history as compared to all six nations. The mean speech tone is negative for all nations except France, as well as for the ECB.

Insert tables 6 and 7 about here.

Table 8 below shows the index and return statistics for each country. The average number of trading days is broadly the same for all nations.

Insert table 8 about here.

4.1   Market indices and central bank speeches

Figures 7, 8, 9, 10, 11 and 12 show the movement of monthly speech tone extracted from national central bank speeches and the main index return

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across time for all six nations.[8] It can be conjectured from an initial visual inspection that for Italy, Spain, Ireland and Finland, the variables tend to co-move.

Insert figures 7, 8, 9, 10, 11 and 12 about here.

Thus based on preliminary visual verification, we expect to see a significant relationship between speech tone and return for Italy, Spain, Ireland and Finland. To verify the patterns in the plots, we do regression analysis for each of the six nations where we regress the national stock market's index returns on the lags of the speech tone and controls in line with the specification in equation 1.[9] The results are presented in table 9. It is evident that speech tone affects the index returns with a lag of three and four days for Ireland and Italy respectively. Similarly, the impact on Spain and Finland is seen at a lag of 5 days. For Italy, Spain and Finland the coefficient is positive and one standard deviation increase in speech tone leads to 0.11, 0.12 and 0.15 standard deviation increase in market return respectively. On the other hand, in case of Ireland, the coefficient is negative and hence one standard deviation increase in speech tone leads to a fall of 0.07 standard deviation in index return. Thus, we find that for four out of six nations in this study the national central bank speech tone significantly impacts the respective stock market indices.

Insert table 9 about here.

4.2   Market indices and the ECB speeches

Next, we analyze the putative effects on market indices by the speeches made by the ECB. This is presented in figures 13, 14, 15, 16, 17 and 18. It can be seen that for Germany, Spain, Ireland and Finland, the variables seem to

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[8]We take the monthly speech tone instead of daily since the monthly movements are more discernible visually.

[9]All standard errors reported in this study are HAC robust.

co-move. Thus, we expect to see a significant relationship between speech tone and return for Germany, Spain, Ireland and Finland.

Insert figures 13, 14, 15, 16, 17 and 18 about here.

Similar to the analysis with the national central banks, we conduct regressions for each of the six nations with the ECB speech tone in place of central bank speech tone. The results are presented in table 10. We find that ECB speech tone affects the return with a lag of three and five days for Germany and with a lag of five days for Finland and Spain. The coefficients are positive for all three nations and one standard deviation increase in the ECB speech tone leads to 0.06, 0.07 and 0.11 standard deviation increase in index return for Germany, Spain and Finland respectively. However, we find no significant results for Ireland, France and Italy. Thus, the lags of the ECB speech tone are significantly associated with the market return for three of the six countries in our sample.

Further, since for Finland and Spain, both the ECB and the national central bank speech tones are significantly associated with market returns it becomes imperative to examine the impact of both economic institutions together.

Insert table 10 about here.

4.3 Joint impact of national central bank and ECB speeches

We plot both the ECB and Central Bank speech tone for each nation to see the relationship in their movement. This is presented in figures 19, 20, 21, 22, 23 and 24. We find that the ECB and the national central banks' speech tone tends to co-move for all nations.

Insert figures 19, 20, 21, 22, 23 and 24 about here.

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To test the joint effect of ECB and national central bank (NCB) speech tones we include both their tones and respective lags in the estimating equation as shown below:[10]

$$R_t = c_0 + a_n NCBTone_{t-n} + b_n ECBTone_{t-n} + \sum_{i=1}^{3} c_i R_{t-i}$$

$$+d_1 * Controls + d_2 * SpeechControls + \gamma_t \qquad (2)$$

The results are presented in table 11. For Spain, both the national central bank and the ECB tone were significant in explaining market returns individually as shown in tables 9 and 10. However, when both the ECB and national central bank tone are analyzed together, neither institutions' speech tones turn out to be significantly associated with market returns. However, for Italy the central bank tone is still significant in explaining index return while the ECB speech tone is not. On the other hand, for Ireland and Finland, the ECB tone assumes significance and renders the national central bank speech tone insignificant. Similar to Spain, we find that neither the ECB nor the national central bank is significant in explaining the index return for Germany. Finally, for France, where the national central bank speech tone was not significant when tested individually, both the ECB and the national central bank show significance in explaining market return when they are analyzed together.

Insert table 11 about here.

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[10]We also analyse speeches on similar topics delivered on the same day by the ECB and the respective national central banks using Latent Dirichlet Analysis and Latent Semantic Analysis. However, since the number of observations fall below 30 for each country, we do not report the results in this paper.

4.4 Impact of national central bank and ECB speeches: Addtional Macro Controls

There are an array of macroecnomic variables, such as exchange rate, oil prices and economic surprise, which on account of being correlated with the central bank tone, can also impact the index returns. Thus, to ensure that the results in this study are not due to the absence of these variables, we include the exchange rate (USD/EUR), crude oil price and Bloomberg Economic Surprise Index (ESI). Bloomberg ESI calculates the surprise element as the percentage point difference between analyst forecasts of a wide variety of economic variables such as jobless claims, pending home sales, consumer confidence, index of industrial production etc and the published value of economic data. The variables are added to equations 1 and 2 as macro controls and the results are presented in tables 12, 13 and 14 for the National central bank, the ECB and the combined impact respectively.

Table 12 shows the updated impact of NCBs on market returns. In the absence of macro controls, excepting France and Germany, the others (4 out of the 6 nations) displayed NCB speech tone impact. However, the inclusion of macro controls reduces the number of impacted countries to 3. This is due to Spain and Ireland showing no significance in the presence of macro controls, while Germany assuming significance which it previously did not exhibit.

Insert table 12 about here.

Table 13 shows the updated impact of ECB speeches on market returns. In the absence of macro controls, excepting France, Italy and Ireland, the others (3 out of 6) displayed ECB speech tone impact. The inclusion of macro controls also yields the same result: 3 out of 6 countries display ECB speech tone imapct; but this is due to Spain losing significance, and Italy assuming significance.

Insert table 13 about here.

Table 14 shows the updated joint impact of ECB and NCB speeches. In the absence of macro controls, 2 out of 6 countries show NCB impact (France and Italy); while in the presence of macro controls, 2 out of 5 countries display impact (Germany and Italy).[11] On the other hand, in the absence of macro controls 3 out of 6 countries display impact of ECB speeches (France, Ireland and Finland); while 4 out of 5 countries display impact after macro controls' inclusion (all except Italy).

Insert table 14 about here.

4.5 Impact of national central bank and ECB speeches: Intraday Analysis

In order to examine the speech tone impact exhibiting lags at days 4 and 5 in more detail we collect intra-day index returns and investigate movements therein in response to central bank speeches. We are able to collect intra-day return data for Germany and France—the two biggest Eurozone economies (and due to unavailability for intra-day index data for the others)—and subject them to regression analysis. We include macro controls throughout all subsequent analyses. We examine the effect of speech tones on 30 minute interval returns for France and Germany in tables 15 and 16. Further, since our dataset on central bank speeches does not carry a time-stamp we examine its effect on the market on both the day the speech was delivered, as well as the next day. This is because, if the speech was delivered, for example, at 3 PM, the markets will be able to react to its content only after 3 PM on the same day and during the early hours of trading on the subsequent day. This is exactly what we observe. For both NCB and ECB speeches the tones are significantly associated with market returns for both Germany and France. Further, the impact on day 0 is concentrated on later 30 minute intervals, while that on day 1 is on earlier 30 minute intervals. We also note that the

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[11]France drops out of the sample when testing for joint impact since it has too few observations after inclusion of macroeconomic controls.

market response during 30 minute intervals on day 0 and day 1 are of opposite signs. For example, during the later parts of day 0 German markets react negatively to the NCB speeches while in the early parts of day 1, the coefficient shows positive significance. This could also be one reason why the effects of such opposing movements tend to cancel out when viewing results at the daily frequency.

Insert tables 15 and 16 about here.

4.6   Panel Analysis

To get a unified perspective on the impact of speech tone on the whole sample, we conduct panel estimation with the respective national stock market indices' returns as the dependent variable. We employ the methodology of fixed-effects panel estimation with clustered, robust standard errors. Our fixed-effects-based methodology subsumes a variety of possible omitted variables which are time-invariant and are specific to the countries in the sample as well as factors pertaining to unique institutional central bank features. The results are presented in table 17. It is found that the both national central bank and the ECB speech tone significantly impacts market return individually as well as when examined together.

Insert table 17 about here.

4.7   Impact of national central bank and ECB speeches on realised volatility

For one country in our sample: France, we find no impact of either the national central bank speech tone or the ECB speech tone, either individually or jointly. Since France is, along with Germany, among the two most important Eurozone nations, we find this result somewhat puzzling. To clarify this issue further, we examine the impact of speech tone for another important market variable—the daily volatility. We calculate the realised return

volatility by demeaning the squared residual returns and then calculating the mean of the demeaned residual over five days (Tetlock (2007)). We then analyze the impact of speech tone on this realised volatility and the results are presented in tables 18 and 19. We observe that the speech tone impacts the realised return volatility on the same day as the speeches are delivered in France. Since France was the only country with no effects of NCB or the ECB speeches, this result is able to show that while the French index returns do not move with speeches, contemporaneous volatility does respond to the French national central bank speeches. Additionally, there is significant association between national central bank speech tone and return volatility for Germany, Spain and Ireland. We also find that the ECB speech tone is also significantly associated with the return volatility of Germany and Ireland, albeit with a lag of 2 days.

5 Discussion of Results

We offer the following possible interpretations for the results. They are explained in detail below:

5.1 Political Stance

Moschella & Diodati (2020) write "The dimensions that structure political conflict in the EP and the EU Council might also influence political conflict in the Eurosystem via the channels that link domestic governments and parties to central banks". The monetary policy council of ECB constitutes 25 members, 19 of which are the governors of central bank of participating nations who are in turn accountable to the government and/or national legislature. Thus, based on the rational partisanship theory, as specified in Hibbs (1977), governments led by political parties which have left wing inclinations are more likely to favour expansionary policies which aim at keeping unemployment in check at the expense of higher inflation and deficits. Thus, the left wing inclination of nations can also throw light on their interaction

and impact with ECB communication. We use the right-left index to verify this conjecture. The data are taken from the Comparative Manifesto Project (CMP) database. It characterizes each political party's stance based on content analysis of its election manifesto. The right-left index specifies the political inclination of the majority winning political party, with left wing inclination ordered on the negative scale and right wing inclination on the positive scale.[12] It can be seen in figure 25 that except Finland and Italy, the leading political parties for the other five nations have been mostly left centered (on the negative scale). Italy especially has been the most right aligned pre 2014. We verify whether the political stance variable is a significant predictor for all six nations along with the ECB speech tone by adding an interaction term for the Political Stance Index with the ECB speech tone in table 10 and the results are presented in table 20. It can be seen that the interaction term is significant for Italy (with a negative coefficient) and Finland (with a positive coefficient). Thus, since Italy has been most right aligned among the nations in this study, its political stance leads to significant reduction in the impact of the ECB speech tone. Also, Italy is one nation for which the national central bank had significantly impacted the market return individually as well as in the presence of the ECB as shown in tables 9 and 11. Similarly, a positive and significant interaction term in the case of Finland argues for an increase in impact of the ECB speech tone on market return in light of the political stance interaction term.

Insert figure 25 about here.

Insert table 20 about here.

5.2   EU-Inclination

Similar to left wing inclination, the EU inclination is also an indication of the relation between the ECB and the six nations. The EU inclination index is

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[12]The dataset is available online at https://manifesto-project.wzb.eu/.

calculated as a difference of variable 108 (Euro Community/Union Positive) and variable 110 (Euro Community/Union Negative) from the Comparative Manifesto Project (CMP) data. Both the variables "Euro Community/Union Negative" and "Euro Community/Union Positive" can take positive as well as negative values and hence the resulting variable "EU Inclination" can be either positive or negative. A higher positive number implies a higher inclination towards EU. Figure 26 presents the EU inclination index for all six nations. It can be seen that the inclination towards EU experienced a major drop for all nations post 2010 (sovereign debt crisis). However, we note that Italy has had the lowest inclination towards EU for the majority of the duration.[13] This can also be a possible explanation for the insignificance of the ECB speech tone on Italy's index return both individually as well as in the presence of national central bank speech tone as an additional control.

Insert figure 26 about here.

5.3 ECB Macroeconomic Goals

There are three broad aims of the ECB with respect to monetary and fiscal goals in the Eurozone: i) that inflation be kept below but close to 2%, ii) the government budget deficit be less than 3% of the GDP and iii) the government debt to be less than 60% of the GDP. Although, there are specific goals outlined for each nation in light of their economic atmosphere, these goals constitute the broad guidelines of the ECB for the Eurozone. All these goals are covered in the Stability and Growth Pact (SGP) and are outlined on the official EU website (https://europa.eu/). It can be expected that the countries which are aligned with these goals are among the ones which for which the ECB speech tone can be expected to be significant. The figures 27, 28 and 29 present the budget deficit, government debt and the inflation rate for the six nations in our study. It can be seen from the figures that Finnish economy had levels above the prescribed limit for all three parameters

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[13]Except for a brief period between 2014 and 2016 when it is the highest.

(budget deficit, government debt and inflation) whereas France and Ireland have met the budget deficit and inflation targets durng the majority of the time period. These are also the nations for which the ECB speech tone has been significant either individually or in the presence of national central bank as an added control. On the other hand, Italy does not meet the set goals for any of the three variables and features prominently among the nations for which the ECB speech tone is not significant either individually or in the presence of the national central bank speech tone.

Insert figures 27, 28 and 29 about here.

5.4   Trust in the European Central Bank

Yet another important factor in explaining the link between market return and ECB communication is the trust of the country's populace towards the institution. Eurobarometer survey data (https://data.europa.eu/euodp/en/home) throws light on the publics' opinion of the ECB. Figure 30 shows what percentage of people trust the ECB in each country in our sample. It can be inferred from the figure that the general populace of Italy has the least trust in ECB as compared to other nations in this study. This is also reflected in the results as the ECB speech tone is not a significant factor in explaining returns of the Italy market index. Additionally, for Finland, France and Germany the index is the highest as well as most stable as compared to other nations.

Insert figure 30 about here.

Limitation of the study

As specified in table 1, except for Ireland all other nations in our sample have approximately 50% of speeches in English/official English translation. There is a scope of true meaning being lost in translation due to the peculiar idiosyncracy of each language. Thus, to ensure results are not affected due to loss of meaning from the translation process we ensure robustness by

repeating the analysis for English only and officially translated speeches in section 6.2.

6 Robustness

We ensure robustness of the results in multiple ways. First, we repeat the analysis for sections 4.1, 4.2 and 4.3 with respect to smallcap indices to ensure that the results are not just applicable to the main index. Second, we analyze the impact of central bank communication for English only speeches as well as speeches for which official English translation are availble as specified in table 1. Third, we investigate the impact of speech tone for two nations — U.K. and Sweden — which are not officially a part of the Eurozone but still might be affected by ECB speeches due to economic and geographical proximities. We note that for the case of Sweden all speeches by its national central bank have official translations into English and hence the "lost in translation" limitation of the study does not apply to its results. Then, we examine the joint impact of the national central bank and the ECB speech tone for speeches given on the same day as well as concerning similar topics. Finally, we examine the impact of ECB speech tone on the Euro Stoxx 50 Index.

6.1 Impact of Central Bank Communication Tone on Smallcap Indices

Tables 21, 22 and 23 present the results for the effect of speeches of the national central bank and the ECB — both individually and jointly — on the smallcap index returns. It can be seen that results are broadly similar as that for the main index.

Insert table 21, 22 and 23 about here.

27

6.2 Impact of Central Bank Speech Tone (English/official translation) on Main Indices

The results for the impact of central bank speeches (English/official translation) is presented in Tables 24 and 25. The results are similar to tables 9, 10 and 11 and it can be seen that the national central bank speech tone significantly impacts the market returns of Italy and Spain when examined individually. On the other hand, when the national central bank and the ECB speech tone are tested together, the ECB speech tone significantly impacts the index returns for Germany, Italy, Spain and Finland and the national central bank impacts the index return for Italy.

Insert table 24 and 25 about here.

6.3 Impact on UK and Sweden

Further, we analyze the impact of the national central bank and the ECB speech tone on UK and Sweden since these two nations are officially not part of EU but still might get affected by EU institutions such as ECB due to their geo-political proximity to the EU nations. Tables 27 and 28 present the impact of speech tone for UK and Sweden respectively and we find that for both the nations, both the national central bank and the ECB speech tone are significant in explaining variation in index return.

Insert tables 27 and 28 about here.

Further, we also examine the intraday impact of national central bank and the ECB speech tone for U.K. (similar to France and Germany) and the results are presented in table 29. The results are similar to France and Germany, with both the national central bank as well as the ECB speech tone being significantly associated with various 30 minute interval returns.

Insert table 29 about here.

6.4 Joint impact of national central bank and ECB: Topic similarity

It is possible that for speeches delivered on the same day by the ECB and the NCB, the topics of the speeches are different and hence their impacts are dissimilar. To allay such concerns, we examine the joint impact of the NCB and the ECB with respect to the speeches given on the same day and on similar topics. All the speeches for the national central banks and the ECB classified into one of the two categories: "macroeconomic" and "financial markets" using the Latent Dirichlet Allocation (LDA) (Blei et al. 2003, Quinn et al. 2010, Hansen et al. 2018). The number of topics are kept at two in light of the number of observations with respect to speeches and the joint impact. Due to very few observations post LDA categorization, the analysis is done only for three nations in the sample: Germany, Italy and Finland and the results are presented in the table 30. The results are quite similar to table 14 with ECB speech tone being significantly associated with German and Italian index return. However, for Finland, we find that the central bank speech tone is significant, instead of the ECB. Additionally, we also match the speeches given on the same day for NCB and the ECB using cosine similarity and the results are the same as table 30 and thus are not presented for the sake for brevity.

Insert table 30 about here.

6.5 Impact of ECB speeches on EURO STOXX 50 Index

Further, to get an overall perspective of the impact of ECB communication on Euro area stock markets, we examine the impact of ECB speech tone on the Euro Stoxx 50 Index. The analysis is done for both daily as well as intraday (30 minute return interval) level. Further, for daily analysis, we examine the impact of speeches categorized as "financial markets" using

the Latent Dirichlet Allocation (LDA). This is done in light of the recent study, Doukas & Han (2021), in which the authors report that the sentiment impacts the beta and the market risk premium of the conditional version of the CAPM. The results for daily and intraday level are presented in tables 31 and 32 respectively. We find that for daily frequency, the "financial markets" speeches impact the Euro Stoxx 50 Index returns on the next day as the speeches are delivered. For intraday analysis, we analyze all the speeches and find that the impact is observed on both day 0 (Interval 11) as well as day 1 (Interval 10, 11 and 15).

Insert tables 31 and 32 about here.

7 Conclusion

Our study quantifies and compares the impact of national and European central bank speeches on the stock markets of six leading European nations—France, Germany, Italy, Spain, Ireland and Finland. We find that the sample nations' stock market indices are significantly associated with central bank speech tones of either the national central bank, or the European Central Bank or both. We run a large collection of auxiliary tests to confirm our findings and apply a comprehensive battery of robustness exercises to corroborate our results. For future applications, the methodology used in this study can be used in the native languages for non-English speaking nations to resolve the lost in translation limitation of this study.

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Appendices

A   List of Valence Shifters

The tables A.1 and A.2 below specifies all the valence shifters used in this study.

Table A.1: List of Valence Shifters

Word	Classification	Weight	Word	Classification	Weight
almost	de-amplifier	0.8	not	negator	-1
although	adversative-conjuction	0.8	only	de-amplifier	0.8
barely	de-amplifier	0.8	particular	amplifier	0.8
but	adversative-conjuction	0.8	particularly	amplifier	0.8
cannot	negator	-1	partly	de-amplifier	0.8
certain	amplifier	0.8	purpose	amplifier	0.8
certainly	amplifier	0.8	quite	amplifier	0.8
colossal	amplifier	0.8	rarely	de-amplifier	0.8
considerably	amplifier	0.8	real	amplifier	0.8
deep	amplifier	0.8	really	amplifier	0.8
deeply	amplifier	0.8	seldom	de-amplifier	0.8
definitely	amplifier	0.8	serious	amplifier	0.8
dont	negator	-1	seriously	amplifier	0.8
enormous	amplifier	0.8	severe	amplifier	0.8
enormously	amplifier	0.8	severely	amplifier	0.8
especially	amplifier	0.8	significant	amplifier	0.8
extreme	amplifier	0.8	significantly	amplifier	0.8
extremely	amplifier	0.8	slightly	de-amplifier	0.8

Note: This table presents the list of valence shifters along with their classification and weight.

Table A.2: List of Valence Shifters

Word	Classification	Weight	Word	Classification	Weight
few	de-amplifier	0.8	somewhat	de-amplifier	0.8
greatly	amplifier	0.8	sure	amplifier	0.8
hardly	de-amplifier	0.8	surely	amplifier	0.8
heavily	amplifier	0.8	totally	amplifier	0.8
heavy	amplifier	0.8	true	amplifier	0.8
high	amplifier	0.8	truly	amplifier	0.8
highly	amplifier	0.8	vast	amplifier	0.8
however	adversative-conjuction	0.8	very	amplifier	0.8
huge	amplifier	0.8	whereas	adversative-conjuction	0.8
hugely	amplifier	0.8	decidedly	amplifier	0.8
least	de-amplifier	0.8	definite	amplifier	0.8
little	de-amplifier	0.8	immense	amplifier	0.8
massive	amplifier	0.8	immensely	amplifier	0.8
massively	amplifier	0.8	incalculable	amplifier	0.8
more	amplifier	0.8	incredibly	de-amplifier	0.8
most	amplifier	0.8	sparsely	de-amplifier	0.8
much	amplifier	0.8	vastly	amplifier	0.8
neither	negator	-1	uber	amplifier	0.8
never	negator	-1	cant	negator	-1
majorly	amplifier	0.8	faintly	de-amplifier	0.8
none	negator	-1	wont	negator	-1

Note: This table presents the list of valence shifters along with their classification and weight.

Table A.3: National Central Bank Speech Impact on Market Indices with Macro controls
- Valence Shifter weight (0.5)

Country/Variable	Speech Tone Lag 0	Speech Tone Lag 1	Speech Tone Lag 2	Speech Tone Lag 3	Speech Tone Lag 4	Speech Tone Lag 5
France	0.0008 (0.014)	−0.0002 (0.017)	0.035 (0.023)	−0.020 (0.019)	−0.001 (0.019)	0.009 (0.016)
Germany	−0.001 (0.013)	0.005 (0.018)	−0.007 (0.016)	−0.007 (0.012)	−0.013 (0.019)	0.029** (0.013)
Italy	−0.00002 (0.016)	−0.001 (0.015)	−0.020 (0.014)	0.009 (0.014)	0.041** (0.017)	0.024 (0.014)
Spain	−0.002 (0.009)	0.003 (0.012)	0.009 (0.010)	0.004 (0.011)	0.012 (0.009)	0.018 (0.012)
Ireland	−0.008 (0.011)	0.001 (0.010)	−0.013 (0.009)	−0.010 (0.008)	−0.005 (0.008)	−0.003 (0.010)
Finland	−0.006 (0.014)	−0.018 (0.012)	−0.006 (0.013)	0.003 (0.012)	−0.012 (0.012)	0.028** (0.012)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Macro Controls	Yes	Yes	Yes	Yes	Yes	Yes
Speech Controls	Yes	Yes	Yes	Yes	Yes	Yes

Note: This table presents the results from the regression on daily national central bank speech tone. The dependent variable is the daily index return. The results are reported in line with equation 1 with addtional macroeconomic controls. The number of observations are the same as number of speech-days for each country. The standard errors, reported in brackets, are Heteroskedasticity and Autocorrelation (HAC) robust. The controls include three lags of return, day of the week and month dummy. ***, ** and * indicate that the coefficient estimate are significantly different from zero at the 1 percent, 5 percent and 10 percent levels respectively.

Table A.4: ECB Speech impact on Market Indices with Macro controls - Valence Shifter weight (0.5)

Country/Variable	Speech Tone Lag 0	Speech Tone Lag 1	Speech Tone Lag 2	Speech Tone Lag 3	Speech Tone Lag 4	Speech Tone Lag 5
France	−0.0006 (0.007)	0.007 (0.008)	−0.0007 (0.008)	−0.010 (0.007)	−0.003 (0.008)	0.011 (0.007)
Germany	−0.003 (0.007)	0.002 (0.009)	0.003 (0.008)	−0.014* (0.007)	−0.003 (0.008)	0.012 (0.007)
Italy	0.0005 (0.007)	−0.0002 (0.009)	−0.006 (0.008)	−0.014* (0.008)	−0.0004 (0.008)	0.010 (0.008)
Spain	0.004 (0.007)	0.001 (0.008)	0.005 (0.008)	−0.008 (0.007)	0.0003 (0.008)	0.015* (0.008)
Ireland	0.002 (0.007)	0.004 (0.009)	−0.013 (0.009)	−0.007 (0.008)	−0.008 (0.008)	0.003 (0.008)
Finland	−0.002 (0.007)	0.008 (0.008)	−0.005 (0.008)	−0.008 (0.007)	−0.003 (0.008)	0.013* (0.007)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Macro Controls	Yes	Yes	Yes	Yes	Yes	Yes
Speech Controls	Yes	Yes	Yes	Yes	Yes	Yes

Note: This table presents the results from daily regression on the ECB speech tone. The dependent variable is the daily index return. The results are reported in line with equation 1 with addtional macroeconomic controls. The number of observations are the same as the number of speech-days for each country. The standard errors, reported in brackets, are Heteroskedasticity and Autocorrelation (HAC) robust. The controls include three lags of return, day of the week and month dummy. ***, ** and * indicate that the coefficient estimate are significantly different from zero at the 1 percent, 5 percent and 10 percent levels respectively.

Table A.5: National central bank speech impact on Market Indices with Macro controls (New and Existing Methodology)

Country/Variable	Lag 0		Lag 1		Lag 2		Lag 3		Lag 4		Lag 5	
	NM	EM	NM	EM	NM	EM	NM	EM	NM	EM	NM	EM
France	0.0002 (0.026)	0.009 (0.032)	0.038 (0.040)	−0.033 (0.043)	0.040 (0.035)	−0.004 (0.039)	−0.006 (0.048)	−0.006 (0.050)	0.011 (0.024)	−0.003 (0.031)	0.038 (0.037)	−0.038 (0.043)
Germany	0.003 (0.024)	−0.013 (0.029)	0.009 (0.024)	−0.0004 (0.028)	−0.012 (0.028)	0.007 (0.033)	0.010 (0.027)	−0.006 (0.031)	−0.002 (0.022)	−0.013 (0.027)	−0.040* (0.021)	0.064** (0.026)
Italy	−0.057 (0.043)	0.067 (0.045)	−0.021 (0.033)	0.024 (0.039)	−0.067* (0.039)	0.061 (0.042)	0.017 (0.037)	−0.008 (0.047)	−0.001 (0.036)	0.046 (0.037)	0.006 (0.038)	0.005 (0.039)
Spain	−0.031 (0.034)	0.037 (0.039)	−0.051 (0.036)	0.056 (0.037)	0.021 (0.032)	−0.021 (0.033)	0.099*** (0.037)	−0.102*** (0.038)	0.049* (0.028)	−0.045 (0.030)	0.012 (0.034)	0.005 (0.043)
Ireland	−0.001 (0.018)	−0.005 (0.018)	0.009 (0.025)	−0.018 (0.027)	−0.044* (0.023)	0.039 (0.025)	0.005 (0.021)	−0.018 (0.022)	−0.022 (0.020)	0.015 (0.023)	0.008 (0.023)	−0.013 (0.026)
Finland	−0.010 (0.030)	0.023 (0.032)	−0.012 (0.028)	−0.001 (0.025)	−0.012 (0.027)	0.005 (0.030)	0.040 (0.025)	−0.057** (0.028)	−0.018 (0.027)	0.019 (0.031)	0.035* (0.019)	−0.022 (0.021)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Macro Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Speech Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: This table presents the results from daily regression on national central bank speech tone derived using both the existing methodology (EM) (LM dictionary with "bag-of-words" approach) and the new methodology (NM) specified in this study. The dependent variable is the daily index return. The results are reported in line with equation 2 with addtional macroeconomic controls. The number of observations are fewer compared to tables 9 and 10 since only days when both the ECB and national central bank have a speech are included in the analysis. The standard errors, reported in brackets, are Heteroskedasticity and Autocorrelation (HAC) robust. The controls include three lags of return, day of the week and month dummy. ***, ** and * indicate that the coefficient estimate are significantly different from zero at the 1 percent, 5 percent and 10 percent levels respectively.

Table 1: Speech Statistics

Variable/Country	Time Period	Total Number of Speeches	Number of Speeches after combining for same day	Number of Speeches in English or with an official English Translation available
France	Jan 2015 - May 2020	156	146	68
Germany	Jan 2012 - May 2020	599	480	201
Italy	Apr 1998 - June 2020	544	507	166
Spain	Nov 2000 - Jul 2020	444	406	274
Ireland	Jan 2009 - Jul 2020	553	486	486
Finland	Jan 2000 - Jun 2020	515	478	213
ECB	Feb 1997 - Apr 2020	2278	1721	1721

Note: This table presents the summary statistics for speech frequency with respect to daily levels for the six nations. The 5th column shows the number of speeches which are in English or have an official English translation available on the respective central bank website.

Table 2: Valence Shifter Statistics

Country	% of Sentences containing valence shifters	% of Adversative Conjunction	% of Amplifier	% of De-amplifier	% of Negator
France	45.62%	21.09%	47.22%	9.91%	21.77%
Germany	43.93%	19.04%	41.60%	14.01%	25.35%
Italy	38.36%	14.94%	51.01%	12.89%	21.14%
Spain	45.69%	16.94 %	54.61%	9.83%	18.60%
Ireland	36.70%	16.14%	51.84%	8.59%	23.41%
Finland	38.84%	18.66%	46.70%	12.04%	22.58%
ECB	36.63%	15.79%	49.08%	11.04%	24.07%

Note: This table presents the distribution of valence shifters in the speeches for all six nations and the ECB.

Table 3: Speech Valence Shifters

Country	Valence Shifter Type	Valence Shifter Word	Sentence	Date and Speaker	Tone LM	Tone New Methodology	Comment
France	Adversative Conjunction	"but"	"it must be clear: the brexit is bad news **but** its economic consequences are now only being felt in the united kingdom, where both domestic and foreign investment has receded."	François Villeroy de Galhau, Governor, 16-10-2017	-0.0714	-0.0006	The presence of "but" captures accurately, the impact of the phrase "consequences are now only being felt in the united kingdom", thus lowering the negative coefficient of the tone.
France	Amplifier	"very"	"what is required is greater co-ordination of national policies, a mobilisation of european savings which are **very** abundant - what i call a financing union for investment and innovation - and a common budget for the euro area."	François Villeroy de Galhau, Governor, 16-10-2017	0.130	0.191	The presence of "very" accentuates the impact of the "european savings", thus raising the positive coefficient of the tone.
Germany	Adversative Conjunction	"but"	"assets can always be held to maturity, which is why the central bank is only exposed to credit risk, **but** not to liquidity or interest rate risk."	Member, Central Bank, 28-04-2012	-0.076	-0.012	The "but" before the phrase "not to liquidity or interest rate risk" decreases the negative connotation of the sentence.
Ireland	De-amplifier	"somewhat"	"the increased affordability of borrowing and improving incomes enabled the private sector to assume **somewhat** higher borrowings for investment and consumption purposes."	Tom O'Connell, Member, 29-07-2009	0.133	0.026	Usage of "somewhat" leads to accurate tone of the phrase "higher borrowings for investment and consumption purposes" by decreasing the positive connotation of sentence.

Note: This table presents the examples for the valence shifters used in the central bank speeches of the six nations in this study.

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Table 4: New Methodology vs Existing Methodology Statistics

Methodology/Country	France		Germany		Italy		Spain		Ireland		Finland	
New vs Existing Methodology	New Methodology	Existing Methodology	New Methodology	Existing Methodology	New Methodology	Existing Methodology	New Methodology	Existing Methodology	New Methodology	Existing Methodology	New Methodology	Existing Methodology
Min	-1.039	-0.942	-1.443	-1.229	-2.325	-1.414	-1.825	-1.419	-2.134	-1.400	-3.443	-1.270
Max	2.121	0.998	1.423	1.125	1.002	0.760	1.626	0.887	1.557	0.954	1.423	0.953
Mean	0.011	-0.041	0.069	0.007	-0.072	-0.068	-0.068	-0.082	0.008	-0.026	-0.056	-0.075
SD	0.505	0.335	0.502	0.331	0.497	0.331	0.550	0.379	0.519	0.339	0.540	0.357
IQR	0.740	0.454	0.766	0.493	0.670	0.474	0.736	0.502	0.709	0.449	0.796	0.523

Note: This table presents the summary statistics for the speech tone of the sentences calculated using the "bag-of-words" approach and the LM dictionary and the new methodology specified in this study.

Table 5: KS Test

Country	D Statistic	P Value
France	0.17164	0.0386
Germany	0.20493	4.885e-10
Italy	0.12869	0.0007
Spain	0.15608	0.0002
Ireland	0.20459	3.921e-09
Finland	0.18427	5.48e-07

Note: This table presents the statistics for the Kolmogorov Smirnov test to examine the difference between the speech tone distribution calculated using the "bag-words-approach" and the LM dictionary and the new methodology specified in this study. The D statistic specifies the distance between the two tone distributions and the p-value is for the null hypothesis that there is no difference between the two distributions.

Table 6: Speech characteristics

Variable/Country	Time Period	Total Number of Speeches	Number of Speeches after combining for same day	No. of Positive Tone Speeches (Daily)	No. of Negative Tone Speeches (Daily)	Avg. No. of Speeches per month
France	Jan 2015 - May 2020	156	146	80	66	2.2
Germany	Jan 2012 - May 2020	599	480	130	350	4.7
Italy	Apr 1998 - June 2020	544	507	127	380	1.8
Spain	Nov 2000 - Jul 2020	444	406	140	266	1.7
Ireland	Jan 2009 - Jul 2020	553	486	110	375	3.4
Finland	Jan 2000 - Jun 2020	515	478	148	329	1.9
ECB	Feb 1997 - Apr 2020	2278	1721	708	1012	6.1

Note: This table presents the summary statistics for speech frequency with respect to daily and monthly levels for the six nations. The data are obtained from the official central bank website for each nation and from the ECB website for the ECB speeches. The 4th column shows the number of speeches after combining all speeches in a day into one.

Table 7: Speech Tone Statistics

Country	Time Period	Min (Daily)	Max(Daily)	Mean (Daily)	SD(Daily)
France	Jan 2015 - May 2020	-0.1661	0.3401	0.0083	0.0685
Germany	Jan 2012 - May 2020	-0.2849	0.1648	-0.0222	0.0596
Italy	Apr 1998 - June 2020	-0.3562	0.1743	-0.0376	0.0733
Spain	Nov 2000 - Jul 2020	-0.2778	0.2489	-0.0264	0.0904
Ireland	Jan 2009 - Jul 2020	-0.3105	0.4574	-0.0417	0.0787
Finland	Jan 2000 - Jun 2020	-0.2886	0.3121	-0.0260	0.0766
ECB	Feb 1997 - Apr 2020	-0.2745	0.3354	-0.0091	0.0738

Note: This table presents the summary statistics for daily speech tone for the six nations. The data are obtained from official the central bank website for each nation. The daily variables are reported after combining all speeches on the same day into one.

Table 8: Index Return Statistics

Country	Main Index	Smallcap Index	Mean Return Main Index (Daily - %)	Mean Return Smallcap Index (Daily - %)	Trading days per year
France	CAC Index	CAC Smallcap	0.00709	0.01786	255
Germany	DAX Index	DAX Smallcap	0.02279	0.03205	253
Italy	MIB Index	MSCI Italy Smallcap Index	0.00864	0.02749	253
Spain	IBEX Index	IBEX Smallcap Index	0.02318	-0.00069	253
Ireland	ISEQ Index	ISEQ Smallcap Index	0.01375	0.01883	253
Finland	OMXH Index	OMXH Smallcap Index	0.01597	0.02512	251

Note: This table presents the summary statistics for return for the six nations. The data are obtained from Bloomberg for each nation.

Table 9: National Central Bank Speech Impact on Market Indices

Country/Variable	Speech Tone Lag 0	Speech Tone Lag 1	Speech Tone Lag 2	Speech Tone Lag 3	Speech Tone Lag 4	Speech Tone Lag 5
France	0.002 (0.013)	0.010 (0.012)	0.011 (0.013)	0.010 (0.019)	0.019 (0.014)	0.004 (0.013)
Germany	−0.009 (0.008)	−0.010 (0.013)	−0.001 (0.009)	0.007 (0.009)	0.001 (0.013)	0.001 (0.009)
Italy	0.0005 (0.011)	−0.005 (0.012)	−0.012 (0.011)	−0.001 (0.011)	0.021** (0.010)	0.011 (0.009)
Spain	0.002 (0.008)	0.005 (0.008)	0.008 (0.008)	−0.003 (0.010)	0.005 (0.007)	0.015* (0.008)
Ireland	−0.010 (0.007)	0.002 (0.007)	0.003 (0.007)	−0.012* (0.007)	−0.002 (0.007)	−0.008 (0.008)
Finland	−0.005 (0.011)	0.008 (0.010)	−0.009 (0.010)	0.002 (0.010)	−0.007 (0.010)	0.017* (0.009)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Speech Controls	Yes	Yes	Yes	Yes	Yes	Yes

Note: This table presents the results from the regression on daily national central bank speech tone. The dependent variable is the daily index return. The results are reported in line with equation 1. The number of observations are the same as number of speech-days for each country. The standard errors, reported in brackets, are Heteroskedasticity and Autocorrelation (HAC) robust. The controls include three lags of return, day of the week and month dummy. ***, ** and * indicate that the coefficient estimate are significantly different from zero at the 1 percent, 5 percent and 10 percent levels respectively.

Table 10: ECB Speech impact on Market Indices

Country/Variable	Speech Tone Lag 0	Speech Tone Lag 1	Speech Tone Lag 2	Speech Tone Lag 3	Speech Tone Lag 4	Speech Tone Lag 5
France	−0.0008 (0.004)	0.003 (0.005)	−0.003 (0.005)	−0.007 (0.005)	−0.003 (0.005)	0.006 (0.005)
Germany	−0.001 (0.005)	0.001 (0.005)	−0.002 (0.005)	−0.009* (0.005)	−0.005 (0.005)	0.011** (0.005)
Italy	0.001 (0.005)	0.0008 (0.006)	−0.003 (0.005)	−0.004 (0.005)	−0.0006 (0.005)	0.008 (0.005)
Spain	0.004 (0.004)	0.002 (0.005)	0.0007 (0.005)	−0.005 (0.005)	−0.0001 (0.005)	0.010** (0.005)
Ireland	0.002 (0.005)	0.003 (0.005)	−0.008 (0.005)	−0.004 (0.005)	−0.005 (0.005)	0.004 (0.005)
Finland	−0.007 (0.005)	0.001 (0.005)	−0.004 (0.005)	−0.009 (0.005)	−0.004 (0.005)	0.013** (0.005)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Speech Controls	Yes	Yes	Yes	Yes	Yes	Yes

Note: This table presents the results from daily regression on the ECB speech tone. The dependent variable is the daily index return. The results are reported in line with equation 1. The number of observations are the same as the number of speech-days for each country. The standard errors, reported in brackets, are Heteroskedasticity and Autocorrelation (HAC) robust. The controls include three lags of return, day of the week and month dummy. ***, ** and * indicate that the coefficient estimate are significantly different from zero at the 1 percent, 5 percent and 10 percent levels respectively.

Table 11: National central bank and the ECB speech joint impact on Market Indices

Country/Variable	Lag 0 CB	Lag 0 ECB	Lag 1 CB	Lag 1 ECB	Lag 2 CB	Lag 2 ECB	Lag 3 CB	Lag 3 ECB	Lag 4 CB	Lag 4 ECB	Lag 5 CB	Lag 5 ECB
France	0.005 (0.020)	0.036* (0.021)	0.009 (0.018)	0.013 (0.018)	0.009 (0.020)	0.042 (0.036)	−0.020 (0.024)	0.004 (0.034)	0.052** (0.029)	−0.024 (0.034)	0.015 (0.024)	0.013 (0.029)
Germany	−0.003 (0.012)	−0.014 (0.009)	−0.004 (0.012)	0.005 (0.010)	−0.008 (0.015)	0.020 (0.013)	0.016 (0.014)	−0.003 (0.011)	−0.011 (0.013)	0.005 (0.012)	−0.001 (0.015)	0.007 (0.017)
Italy	0.024* (0.013)	−0.012 (0.014)	−0.001 (0.015)	0.014 (0.019)	−0.010 (0.019)	0.0001 (0.020)	−0.001 (0.017)	−0.019 (0.021)	0.021 (0.017)	−0.026 (0.017)	0.004 (0.014)	0.014 (0.017)
Spain	0.004 (0.010)	−0.001 (0.014)	0.005 (0.013)	0.014 (0.017)	0.013 (0.015)	0.018 (0.018)	−0.0007 (0.014)	0.016 (0.017)	0.009 (0.012)	0.020 (0.022)	0.010 (0.011)	−0.003 (0.019)
Ireland	−0.012 (0.009)	−0.012 (0.014)	0.0000 (0.010)	0.050*** (0.015)	0.001 (0.008)	0.015 (0.009)	−0.005 (0.008)	−0.023* (0.012)	−0.001 (0.009)	0.016 (0.012)	−0.010 (0.012)	0.0003 (0.013)
Finland	−0.015 (0.019)	0.032** (0.016)	0.017 (0.014)	0.0001 (0.020)	−0.021 (0.018)	−0.003 (0.018)	0.002 (0.014)	−0.020 (0.017)	−0.011 (0.019)	0.025 (0.024)	0.007 (0.015)	0.015 (0.016)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Speech Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: This table presents the results from daily regression on national central bank and the ECB speech tone. The dependent variable is the daily index return. The results are reported in line with equation 2. The number of observations are fewer compared to tables 9 and 10 since only days when both the ECB and national central bank have a speech are included in the analysis. The standard errors, reported in brackets, are Heteroskedasticity and Autocorrelation (HAC) robust. The controls include three lags of return, day of the week and month dummy. ***, ** and * indicate that the coefficient estimate are significantly different from zero at the 1 percent, 5 percent and 10 percent levels respectively.

Table 12: National Central Bank Speech Impact on Market Indices with Macro controls

Country/Variable	Speech Tone Lag 0	Speech Tone Lag 1	Speech Tone Lag 2	Speech Tone Lag 3	Speech Tone Lag 4	Speech Tone Lag 5
France	−0.0008 (0.013)	0.019 (0.017)	0.034 (0.025)	−0.017 (0.017)	−0.001 (0.018)	0.008 (0.017)
Germany	−0.001 (0.013)	0.007 (0.017)	−0.006 (0.015)	−0.005 (0.011)	−0.013 (0.019)	0.027** (0.012)
Italy	−0.00002 (0.016)	−0.001 (0.015)	−0.020 (0.014)	0.009 (0.014)	0.041** (0.017)	0.024 (0.014)
Spain	−0.014 (0.011)	0.008 (0.014)	0.019 (0.012)	0.009 (0.012)	0.003 (0.009)	0.023 (0.015)
Ireland	−0.008 (0.011)	0.001 (0.010)	−0.013 (0.009)	−0.010 (0.008)	−0.005 (0.008)	−0.003 (0.010)
Finland	−0.006 (0.014)	−0.018 (0.012)	−0.006 (0.013)	0.003 0.012)	−0.012 0.012)	0.028** 0.012)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Macro Controls	Yes	Yes	Yes	Yes	Yes	Yes
Speech Controls	Yes	Yes	Yes	Yes	Yes	Yes

Note: This table presents the results from the regression on daily national central bank speech tone. The dependent variable is the daily index return. The results are reported in line with equation 1 with addtional macroeconomic controls. The number of observations are the same as number of speech-days for each country. The standard errors, reported in brackets, are Heteroskedasticity and Autocorrelation (HAC) robust. The controls include three lags of return, day of the week and month dummy. ***, ** and * indicate that the coefficient estimate are significantly different from zero at the 1 percent, 5 percent and 10 percent levels respectively.

Table 13: ECB Speech impact on Market Indices with Macro controls

Country/Variable	Speech Tone Lag 0	Speech Tone Lag 1	Speech Tone Lag 2	Speech Tone Lag 3	Speech Tone Lag 4	Speech Tone Lag 5
France	−0.0007 (0.006)	0.007 (0.008)	−0.001 (0.007)	−0.010 (0.007)	−0.002 (0.008)	0.009 (0.006)
Germany	−0.003 (0.007)	0.003 (0.008)	0.002 (0.007)	−0.013* (0.006)	−0.003 (0.007)	0.010 (0.007)
Italy	0.0006 (0.007)	−0.0003 (0.008)	−0.005 (0.008)	−0.014* (0.007)	−0.0002 (0.008)	0.009 (0.007)
Spain	0.006 (0.007)	−0.0005 (0.008)	0.004 (0.008)	−0.007 (0.008)	−0.002 (0.008)	0.011 (0.008)
Ireland	0.001 (0.007)	0.003 (0.008)	−0.013 (0.008)	−0.007 (0.007)	−0.007 (0.008)	0.002 (0.007)
Finland	−0.002 (0.006)	0.008 (0.007)	−0.006 (0.008)	−0.008 (0.007)	−0.002 (0.007)	0.011* (0.007)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Macro Controls	Yes	Yes	Yes	Yes	Yes	Yes
Speech Controls	Yes	Yes	Yes	Yes	Yes	Yes

Note: This table presents the results from daily regression on the ECB speech tone. The dependent variable is the daily index return. The results are reported in line with equation 1 with addtional macroeconomic controls. The number of observations are the same as the number of speech-days for each country. The standard errors, reported in brackets, are Heteroskedasticity and Autocorrelation (HAC) robust. The controls include three lags of return, day of the week and month dummy. ***, ** and * indicate that the coefficient estimate are significantly different from zero at the 1 percent, 5 percent and 10 percent levels respectively.

Table 14: National central bank and the ECB speech joint impact on Market Indices with Macro controls

Country/Variable	Lag 0		Lag 1		Lag 2		Lag 3		Lag 4		Lag 5	
	CB	ECB	CB	ECB	CB	ECB	CB	ECB	CB	ECB	CB	ECB
Germany	-0.003 (0.012)	-0.014 (0.009)	0.006 (0.016)	-0.022 (0.017)	-0.032 (0.026)	0.035** (0.016)	0.021 (0.018)	-0.017 (0.012)	-0.032* (0.018)	0.007 (0.016)	0.027 (0.026)	-0.019 (0.021)
Italy	0.024* (0.013)	-0.012 (0.014)	-0.001 (0.015)	0.014 (0.019)	-0.010 (0.019)	0.0001 (0.020)	-0.001 (0.017)	-0.019 (0.021)	0.021 (0.017)	-0.026 (0.017)	0.004 (0.014)	0.014 (0.017)
Spain	-0.011 (0.021)	0.006 (0.019)	0.009 (0.025)	0.059 (0.041)	0.017 (0.019)	0.058* (0.029)	0.025 (0.016)	0.045* (0.024)	0.002 (0.018)	-0.037** (0.016)	-0.008 (0.034)	0.007 (0.027)
Ireland	-0.013 (0.015)	-0.052*** (0.018)	0.016 (0.020)	0.052*** (0.019)	-0.005 (0.010)	0.006 (0.015)	-0.007 (0.008)	-0.014 (0.018)	-0.014 (0.010)	0.021 (0.016)	-0.013 (0.019)	0.006 (0.019)
Finland	-0.015 (0.019)	0.032** (0.016)	0.013 (0.014)	-0.0006 (0.020)	-0.014 (0.019)	-0.0006 (0.019)	-0.0002 (0.015)	-0.019 (0.017)	-0.014 (0.019)	0.017 (0.023)	0.003 (0.015)	0.020 (0.016)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Macro Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Speech Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: This table presents the results from daily regression on national central bank and the ECB speech tone. The dependent variable is the daily index return. The results are reported in line with equation 2 with additional macroeconomic controls. The number of observations are fewer compared to tables 9 and 10 since only days when both the ECB and national central bank have a speech are included in the analysis. The standard errors, reported in brackets, are Heteroskedasticity and Autocorrelation (HAC) robust. The controls include three lags of return, day of the week and month dummy. ***, ** and * indicate that the coefficient estimate are significantly different from zero at the 1 percent, 5 percent and 10 percent levels respectively.

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Table 15: National central bank speech impact on Market Indices (Intraday)

	France		Germany	
	Speech Tone	Speech Tone	Speech Tone	Speech Tone
Country/Variable	Lag 0	Lag 1	Lag 0	Lag 1
Interval 1	0.006 (0.009)	0.007 (0.013)	−0.0005 (0.008)	0.005 (0.013)
Interval 2	−0.002 (0.003)	−0.0008 (0.004)	0.002 (0.003)	−0.002 (0.003)
Interval 3	−0.003 (0.002)	−0.001 (0.003)	0.002 (0.002)	0.0003 (0.003)
Interval 4	0.001 (0.002)	0.002 (0.003)	−0.001 (0.002)	0.00005 (0.002)
Interval 5	0.0005 (0.001)	0.004* (0.002)	−0.002 (0.002)	0.003* (0.002)
Interval 6	0.002 (0.001)	−0.001 (0.002)	0.002 (0.002)	−0.001 (0.002)
Interval 7	−0.002 (0.001)	0.002 (0.002)	−0.002 (0.002)	−0.002 (0.002)
Interval 8	0.001 (0.001)	0.002 (0.001)	−0.003* (0.001)	0.001 (0.001)
Interval 9	−0.0007 (0.001)	0.0008 (0.002)	0.002 (0.001)	0.003* (0.001)
Interval 10	0.0002 (0.001)	−0.008*** (0.002)	0.001 (0.002)	0.002 (0.002)
Interval 11	−0.0005 (0.001)	0.003 (0.001)	−0.003* (0.001)	0.001 (0.001)
Interval 12	−0.00001 (0.001)	−0.002 (0.003)	0.005** (0.002)	0.003 (0.003)
Interval 13	0.0005 (0.001)	0.005** (0.002)	−0.0005 (0.001)	0.003 (0.002)
Interval 14	0.002 (0.002)	−0.002 (0.004)	0.001 (0.002)	−0.00007 (0.002)
Interval 15	0.002 (0.001)	0.001 (0.004)	0.005* (0.003)	0.001 (0.002)
Interval 16	−0.003* (0.001)	0.010* (0.005)	−0.010*** (0.003)	0.0001 (0.003)
Interval 17	0.002 (0.003)	0.0005 (0.004)	−0.002 (0.002)	0.0005 (0.003)
Controls	Yes	Yes	Yes	Yes
Macro Controls	Yes	Yes	Yes	Yes
Speech Controls	Yes	Yes	Yes	Yes

Note: This table presents the results from the regression on daily national central bank speech tone. The dependent variable is the intraday 30 min index returns. The results are reported in line with equation 1 with addtional macroeconomic controls. The standard errors, reported in brackets, are Heteroskedasticity and Autocorrelation (HAC) robust. The controls include three lags of return, day of the week and month dummy. ***, ** and * indicate that the coefficient estimate are significantly different from zero at the 1 percent, 5 percent and 10 percent levels respectively.

Table 16: ECB speech impact on Market Indices (Intraday)

	France		Germany	
Country/Variable	Speech Tone Lag 0	Speech Tone Lag 1	Speech Tone Lag 0	Speech Tone Lag 1
Interval 1	−0.002 (0.003)	0.004 (0.003)	0.001 (0.004)	0.007 (0.004)
Interval 2	−0.001 (0.001	0.001 (0.001)	−0.003* (0.001)	0.003** (0.001)
Interval 3	0.004 (0.002)	0.0007 (0.002)	0.0003 (0.001)	−0.0008 (0.001)
Interval 4	0.0007 (0.001)	0.002* (0.001)	−0.001 (0.001)	0.0008 (0.001)
Interval 5	−0.001 (0.001)	0.001 (0.001)	−0.001 (0.001)	0.0001 (0.001)
Interval 6	−0.0002 (0.001)	−0.0008 (0.001)	−0.0003 (0.001)	−0.0007 (0.001)
Interval 7	−0.0008 (0.001)	0.0005 (0.001)	−0.0002 (0.001)	0.001 (0.001)
Interval 8	−0.0004 (0.001)	0.001 (0.001)	−0.0002 (0.001)	0.001 (0.001)
Interval 9	−0.0001 (0.001)	−0.001 (0.001)	0.0005 (0.001)	−0.001 (0.001)
Interval 10	−0.001 (0.001)	−0.0003 (0.001)	−0.001 (0.001)	0.001 (0.001)
Interval 11	0.0006 (0.001)	−0.001 (0.001)	0.002** (0.001)	−0.001 (0.001)
Interval 12	0.001 (0.001)	0.002* (0.001)	0.0007 (0.001)	0.0006 (0.001)
Interval 13	0.001 (0.001)	−0.0004 (0.001)	−0.0003 (0.001)	−0.0009 (0.001)
Interval 14	−0.002 (0.001)	0.00006 (0.001)	−0.002 (0.001)	−0.004** (0.002)
Interval 15	0.001 (0.001)	−0.001 (0.001)	−0.001 (0.001)	−0.002 (0.001)
Interval 16	−0.0008 (0.001)	−0.003 (0.002)	0.001 (0.001)	−0.002 (0.001)
Interval 17	−0.003* (0.001)	−0.002 (0.001)	−0.001 (0.001)	0.0006 (0.001)
Controls	Yes	Yes	Yes	Yes
Macro Controls	Yes	Yes	Yes	Yes
Speech Controls	Yes	Yes	Yes	Yes

Note: This table presents the results from daily regression on the ECB speech tone. The dependent variable is the intraday 30 min index returns. The results are reported in line with equation 1 with addtional macroeconomic controls. The standard errors, reported in brackets, are Heteroskedasticity and Autocorrelation (HAC) robust. The controls include three lags of return, day of the week and month dummy. ***, ** and * indicate that the coefficient estimate are significantly different from zero at the 1 percent, 5 percent and 10 percent levels respectively.

Table 17: Panel Analysis

Variable	NCB Coefficient	ECB Coefficient	Combined Impact		Controls		Fixed Effects
Speech Tone Lag	NCB Speech Tone Coefficient	ECB Speech Tone Coefficient	NCB Speech Tone Coefficient	ECB Speech Tone Coefficient	Controls	Speech Controls	Fixed Effects
Lag 0	0.007*** (0.002)	−0.001 (0.004)	0.0004 (0.005)	−0.007 (0.007)	Yes	Yes	Yes
Lag 1	−0.001 (0.003)	0.002 (0.004)	0.006 (0.004)	0.017** (0.007)	Yes	Yes	Yes
Lag 2	0.007* (0.004)	−0.003 (0.004)	0.001 (0.005)	0.008 (0.017)	Yes	Yes	Yes
Lag 3	0.003 (0.002)	−0.006 (0.004)	0.010*** (0.002)	−0.0003 (0.009)	Yes	Yes	Yes
Lag 4	0.001 (0.003)	−0.002 (0.004)	0.0003 (0.006)	−0.007 (0.008)	Yes	Yes	Yes
Lag 5	0.001 (0.002)	0.009** (0.004)	−0.00009 (0.006)	−0.002 (0.011)	Yes	Yes	Yes

Note: This table presents the results from panel regression on national central bank and the ECB speech tone for the main stock index of the six nations. Column 2 and 3 present the impact of the national central bank and ECB speech tone respectively whereas column 4 presents the combined impact of both NCB and the ECB. The standard errors are reported in the parentheses and are all Heteroskedasticity and Autocorrelation (HAC) robust. The controls include three lags of return, day of the week, month dummy as well as speech level controls (average words per sentence and percentage of complex words) along with macro controls and fixed effects. ***, ** and * indicate that the coefficient estimate are significantly different from zero at the 1 percent, 5 percent and 10 percent levels respectively.

Table 18: National Central Bank Speech Impact on Market Volatility with Macro controls

Country/Variable	Speech Tone Lag 0	Speech Tone Lag 1	Speech Tone Lag 2	Speech Tone Lag 3	Speech Tone Lag 4	Speech Tone Lag 5
France	0.0004* (0.0002)	−0.0005* (0.0002)	−0.0001 (0.0002)	−0.0001 (0.0004)	0.001 (0.0007)	0.000006 (0.0003)
Germany	0.0001 (0.0002)	0.00003 (0.0007)	−0.0004 (0.0002)	0.0004** (0.0001)	0.002 (0.001)	−0.0001 (0.0003)
Italy	−0.0001 (0.0003)	−0.0004 (0.0007)	−0.00005 (0.0003)	−0.00008 (0.0005)	−0.00003 (0.0008)	−0.0001 (0.0005)
Spain	0.00002 (0.0002)	−0.0004 (0.0003)	−0.0002 (0.0003)	−0.0006 (0.0007)	0.0005** (0.0002)	−0.00007 (0.0005)
Ireland	−0.00007 (0.0001)	0.0002 (0.0002)	0.0004** (0.0001)	0.00005 (0.0001)	0.00003 (0.0001)	−0.0005* (0.0003)
Finland	0.0003 (0.0005)	−0.0003 (0.0002)	−0.0002 (0.0002)	−0.00009 (0.0004)	0.0002 (0.0003)	−0.00006 (0.0004)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Macro Controls	Yes	Yes	Yes	Yes	Yes	Yes
Speech Controls	Yes	Yes	Yes	Yes	Yes	Yes

Note: This table presents the results from the regression on daily national central bank speech tone. The dependent variable is the daily return volatility. The results are reported in line with equation 1. The number of observations are the same as number of speech-days for each country. The standard errors, reported in brackets, are Heteroskedasticity and Autocorrelation (HAC) robust. The controls include three lags of return, day of the week and month dummy. ***, ** and * indicate that the coefficient estimate are significantly different from zero at the 1 percent, 5 percent and 10 percent levels respectively.

Table 19: ECB Speech impact on Market Volatility with Macro controls

Country/Variable	Speech Tone Lag 0	Speech Tone Lag 1	Speech Tone Lag 2	Speech Tone Lag 3	Speech Tone Lag 4	Speech Tone Lag 5
France	−0.0001 (0.0001)	−0.0001 (0.0002)	0.0002 (0.0002)	0.0002 (0.0001)	0.0000 (0.0002)	−0.0001 (0.0002)
Germany	−0.0002 (0.0002)	−0.0006 (0.0003)	0.0003* (0.0001)	0.0001 (0.0001)	0.00008 (0.0002)	−0.0002 (0.0002)
Italy	−0.0001 (0.0002)	−0.0002 (0.0003)	0.0001 (0.0002)	0.0003 (0.0002)	0.00002 (0.0002)	−0.00007 (0.0003)
Spain	0.0001 (0.0001)	−0.00004 (0.0002)	0.00006 (0.0002)	0.0002 (0.0002)	0.00002 (0.0001)	−0.001 (0.0002)
Ireland	0.0003 (0.0001)	0.0001 (0.0002)	0.0004* (0.0002)	−0.0002 (0.0002)	0.0003 (0.0002)	0.0002 (0.0002)
Finland	−0.0001 (0.0002)	−0.0003 (0.0002)	0.0001 (0.0002)	0.00009 (0.0001)	0.0002 (0.0002)	0.0002 (0.0002)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Macro Controls	Yes	Yes	Yes	Yes	Yes	Yes
Speech Controls	Yes	Yes	Yes	Yes	Yes	Yes

Note: This table presents the results from daily regression on the ECB speech tone. The dependent variable is the daily return volatility. The results are reported in line with equation 1. The number of observations are the same as the number of speech-days for each country. The standard errors, reported in brackets, are Heteroskedasticity and Autocorrelation (HAC) robust. The controls include three lags of return, day of the week and month dummy. ***, ** and * indicate that the coefficient estimate are significantly different from zero at the 1 percent, 5 percent and 10 percent levels respectively.

Table 20: Political Stance - Interaction Term

Country/Variable	Lag 0	Lag 1	Lag 2	Lag 3	Lag 4	Lag 5
France	−0.0002 (0.0005)	−0.0004 (0.0008)	−0.0004 (0.0008)	0.0000 (0.0006)	−0.0002 (0.0008)	0.0004 (0.0009)
Germany	0.0003 (0.0007)	0.0004 (0.0007)	0.0001 (0.0007)	0.0001 (0.0006)	0.0002 (0.0007)	−0.0009 (0.0007)
Italy	0.0001 (0.0003)	0.0004 (0.0003)	−0.0002 (0.0003)	−0.0004 (0.0003)	−0.0007* (0.0003)	−0.0003 (0.0003)
Spain	0.0009 (0.0009)	0.001 (0.001)	−0.0008 (0.0009)	−0.0004 (0.001)	−0.0004 (0.001)	−0.0004 (0.001)
Ireland	−0.001 (0.001)	−0.0006 (0.001)	−0.001 (0.001)	−0.001 (0.001)	0.001 (0.001)	−0.001 (0.001)
Finland	0.001* (0.0006)	−0.0001 (0.0004)	0.0009 (0.0009)	−0.0001 (0.0004)	−0.0000 (0.0005)	0.0002 (0.0004)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Speech Controls	Yes	Yes	Yes	Yes	Yes	Yes

Note: This table presents the results from daily regression on the ECB speech tone. The dependent variable is the daily index return. The results are reported for the interaction term of Political Stance Index and Speech tone from ECB. The interaction term is added as an additional control variable to table 10. The number of observations are the same as the number of speech-days for each country. The standard errors, reported in brackets, are Heteroskedasticity and Autocorrelation (HAC) robust. The controls include three lags of return, day of the week and month dummy. ***, ** and * indicate that the coefficient estimate are significantly different from zero at the 1 percent, 5 percent and 10 percent levels respectively.

Table 21: National Central Bank Speech Impact on Smallcap Market Indices

Country/Variable	Speech Tone Lag 0	Speech Tone Lag 1	Speech Tone Lag 2	Speech Tone Lag 3	Speech Tone Lag 4	Speech Tone Lag 5
France	0.001 (0.009)	0.011 (0.008)	0.008 (0.011)	0.007 (0.013)	0.017 (0.011)	0.017** (0.008)
Germany	−0.003 (0.008)	−0.017 (0.010)	−0.001 (0.008)	0.009 (0.008)	0.002 (0.011)	0.003 (0.008)
Italy	0.003 (0.009)	−0.010 (0.011)	−0.006 (0.009)	−0.002 (0.010)	0.022** (0.010)	0.002 (0.009)
Spain	0.007 (0.006)	0.001 (0.007)	0.006 (0.006)	−0.0003 (0.008)	−0.002 (0.007)	0.007 (0.007)
Ireland	−0.016** (0.007)	0.003 (0.007)	0.007 (0.008)	−0.012* (0.006)	−0.013 (0.009)	−0.004 (0.007)
Finland	−0.0003 (0.006)	0.002 (0.007)	−0.001 (0.007)	−0.0006 (0.005)	0.0008 (0.005)	0.008 (0.005)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Speech Controls	Yes	Yes	Yes	Yes	Yes	Yes

Note: This table presents the results from daily regression on national central bank speech tone. The dependent variable is the daily index return for smallcap index. The results are reported in line with equation 1. The number of observations are the same as the number of speech-days for each country.The standard errors, reported in brackets, are all Heteroskedasticity and Autocorrelation (HAC) robust. The controls include three lags of return, day of the week and month dummy. ***, ** and * indicate that the coefficient estimate are significantly different from zero at the 1 percent, 5 percent and 10 percent levels respectively.

Table 22: ECB Speech impact on Smallcap Market Indices

Country/Variable	Speech Tone Lag 0	Speech Tone Lag 1	Speech Tone Lag 2	Speech Tone Lag 3	Speech Tone Lag 4	Speech Tone Lag 5
France	−0.001 (0.003)	0.006* (0.003)	−0.001 (0.003)	−0.004 (0.003)	−0.001 (0.003)	0.007** (0.003)
Germany	−0.004 (0.003)	0.002 (0.004)	−0.004 (0.003)	−0.006* (0.003)	−0.001 (0.003)	0.005 (0.003)
Italy	0.0003 (0.004)	0.0005 (0.005)	0.001 (0.005)	−0.003 (0.005)	0.0009 (0.005)	0.008 (0.005)
Spain	−0.001 (0.004)	0.002 (0.004)	−0.002 (0.004)	−0.005 (0.004)	0.002 (0.004)	0.004 (0.004)
Ireland	0.007 (0.004)	−0.001 (0.004)	0.0009 (0.004)	0.0006 (0.004)	−0.0001 (0.004)	−0.006 (0.004)
Finland	−0.004 (0.004)	−0.00005 (0.003)	−0.005 (0.003)	−0.001 (0.003)	−0.001 (0.003)	0.008** (0.003)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Speech Controls	Yes	Yes	Yes	Yes	Yes	Yes

Note: This table presents the results from daily regression on the ECB speech tone. The dependent variable is the smallcap daily index return. The results are reported in line with equation 1. The number of observations are the same as number of speech-days for each country. The standard errors, reported in brackets, are Heteroskedasticity and Autocorrelation (HAC) robust. The controls include three lags of return, day of the week and month dummy. ***, ** and * indicate that the coefficient estimate are significantly different from zero at the 1 percent, 5 percent and 10 percent levels respectively.

Table 23: National central bank and the ECB speech joint impact on Smallcap Market Indices

Country/Variable	Lag 0 CB	Lag 0 ECB	Lag 1 CB	Lag 1 ECB	Lag 2 CB	Lag 2 ECB	Lag 3 CB	Lag 3 ECB	Lag 4 CB	Lag 4 ECB	Lag 5 CB	Lag 5 ECB
France	−0.010 (0.016)	0.064*** (0.016)	0.015 (0.021)	0.037 (0.029)	0.016 (0.019)	0.046* (0.027)	−0.018 (0.027)	−0.012 (0.040)	0.033 (0.023)	0.003 (0.028)	0.038** (0.015)	−0.012 (0.023)
Germany	0.005 (0.010)	−0.012 (0.009)	−0.006 (0.012)	−0.001 (0.011)	−0.011 (0.012)	0.010 (0.011)	0.023* (0.013)	−0.003 (0.010)	−0.0001 (0.011)	0.003 (0.011)	0.001 (0.013)	−0.0004 (0.013)
Italy	0.028** (0.012)	−0.020 (0.015)	0.002 (0.016)	0.005 (0.020)	0.002 (0.017)	0.001 (0.020)	0.004 (0.016)	−0.009 (0.021)	0.022 (0.016)	−0.028* (0.014)	0.010 (0.015)	0.019 (0.015)
Spain	0.004 (0.009)	−0.006 (0.013)	0.0003 (0.012)	−0.0005 (0.011)	0.023** (0.010)	0.017 (0.013)	0.003 (0.009)	0.007 (0.014)	−0.011 (0.015)	−0.003 (0.016)	0.001 (0.008)	−0.001 (0.015)
Ireland	−0.009 (0.010)	−0.017 (0.011)	−0.005 (0.009)	0.021** (0.009)	0.018* (0.010)	0.007 (0.011)	−0.006 (0.009)	0.003 (0.012)	−0.006 (0.011)	0.016 (0.017)	−0.009 (0.011)	0.004 (0.011)
Finland	−0.010 (0.009)	0.001 (0.013)	−0.019 (0.016)	−0.003 (0.015)	0.001 (0.010)	−0.020** (0.009)	−0.004 (0.006)	−0.003 (0.010)	−0.003 (0.008)	0.031** (0.012)	−0.002 (0.009)	0.019 (0.012)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Speech Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: This table presents the results from daily regression on the ECB and national central bank speech tone. The dependent variable is the smallcap daily index return. The results are reported in line with equation 2. The number of observations are the same as number of speech-days for each country. The standard errors, reported in brackets, are all Heteroskedasticity and Autocorrelation (HAC) robust. The controls include three lags of return, day of the week and month dummy. ***, ** and * indicate that the coefficient estimate are significantly different from zero at the 1 percent, 5 percent and 10 percent levels respectively.

Table 24: National Central Bank Speech Impact on Market Indices - English/official translations

Country/Variable	Speech Tone Lag 0	Speech Tone Lag 1	Speech Tone Lag 2	Speech Tone Lag 3	Speech Tone Lag 4	Speech Tone Lag 5
France	0.008 (0.014)	0.012 (0.010)	0.017 (0.020)	0.016 (0.023)	0.006 (0.022)	0.002 (0.014)
Germany	−0.002 (0.016)	−0.021 (0.023)	−0.005 (0.014)	0.018 (0.013)	−0.010 (0.021)	−0.005 (0.013)
Italy	0.004 (0.018)	0.032 (0.021)	−0.029 (0.020)	−0.017 (0.024)	0.032 (0.019)	0.046*** (0.016)
Spain	−0.006 (0.009)	0.010 (0.009)	0.007 (0.011)	0.008 (0.013)	0.001 (0.008)	0.017* (0.010)
Ireland	−0.010 (0.007)	0.002 (0.007)	0.003 (0.007)	−0.012* (0.007)	−0.002 (0.007)	−0.008 (0.008)
Finland	−0.007 (0.017)	0.024 (0.014)	−0.010 (0.016)	−0.005 0.012)	−0.014 0.015)	0.015 0.014)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Speech Controls	Yes	Yes	Yes	Yes	Yes	Yes

Note: This table presents the results from regression on daily national central bank speech tone (for speeches in English or with an official English translation). The dependent variable is the daily index return. The results are reported in line with equation 1. The number of observations are the same as number of speech-days for each country. The standard errors, reported in brackets, are Heteroskedasticity and Autocorrelation (HAC) robust. The controls include three lags of return, day of the week and month dummy. ***, ** and * indicate that the coefficient estimate are significantly different from zero at the 1 percent, 5 percent and 10 percent levels respectively.

Table 25: National central bank and the ECB speech joint impact on Market Indices - Speeches in English/official translation

Country/Variable	Lag 0 CB	Lag 0 ECB	Lag 1 CB	Lag 1 ECB	Lag 2 CB	Lag 2 ECB	Lag 3 CB	Lag 3 ECB	Lag 4 CB	Lag 4 ECB	Lag 5 CB	Lag 5 ECB
Germany	−0.010 (0.022)	−0.013 (0.018)	−0.014 (0.020)	0.0008 (0.013)	−0.031 (0.022)	0.043** (0.020)	0.013 (0.024)	0.004 (0.021)	−0.004 (0.015)	−0.009 (0.015)	0.011 (0.016)	−0.023 (0.016)
Italy	0.045 (0.038)	0.011 (0.031)	−0.005 (0.035)	0.004 (0.041)	−0.062 (0.046)	0.051 (0.039)	0.025 (0.036)	−0.031 (0.050)	0.099*** (0.033)	−0.072* (0.036)	0.090** (0.032)	−0.038 (0.035)
Spain	−0.002 (0.010)	0.0006 (0.018)	0.007 (0.011)	0.035* (0.018)	0.023 (0.019)	0.026 (0.028)	0.023 (0.020)	0.025 (0.023)	−0.012 (0.014)	−0.009 (0.020)	0.011 (0.017)	−0.016 (0.016)
Ireland	−0.012 (0.009)	−0.012 (0.014)	0.0000 (0.010)	0.050*** (0.015)	0.001 (0.008)	0.015 (0.009)	−0.005 (0.008)	−0.023* (0.012)	−0.001 (0.009)	0.016 (0.012)	−0.010 (0.012)	0.0003 (0.013)
Finland	−0.038 (0.027)	0.025 (0.021)	0.020 (0.025)	0.033 (0.030)	−0.001 (0.025)	−0.012 (0.034)	0.020 (0.017)	−0.041** (0.020)	−0.024 (0.027)	0.033 (0.031)	0.023 (0.022)	−0.014 (0.027)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Speech Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: This table presents the results from daily regression on national central bank and the ECB speech tone (for speeches in English or with an official English translation). The dependent variable is the daily index return. The results are reported in line with equation 2. The number of observations are fewer compared to tables 9 and 10 since only days when both the ECB and national central bank have a speech are included in the analysis. For France, the results are not presented since the number of observations are less than 20. The standard errors, reported in brackets, are Heteroskedasticity and Autocorrelation (HAC) robust. The controls include three lags of return, day of the week and month dummy. ***, ** and * indicate that the coefficient estimate are significantly different from zero at the 1 percent, 5 percent and 10 percent levels respectively.

Table 26: Speech statistics for Sweden and UK

Variable/Country	Time Period	Total Number of Speeches	Number of Speeches after combining for same day	No. of Positive Tone Speeches (Daily)	No. of Negative Tone Speeches (Daily)	Avg. No. of Speeches per month
Sweden	Jan 1996 - Jun 2020	570	535	76	458	1.8
UK	Apr 1996 - May 2020	1074	648	62	586	3.4

Note: This table presents the summary statistics for speech frequency with respect to daily levels for UK and Sweden. Also, for Sweden all speeches are in English/official translations.

Table 27: UK Speech Tone Impact

Variable	NCB	ECB	NCB & ECB Combined Impact		Controls	
Speech Tone	NCB Coefficient	ECB Coefficient	NCB	ECB	Controls	Speech Controls
Speech Tone Lag 0	-0.0006 (0.006)	-0.002 (0.004)	0.001 (0.008)	-0.008 (0.007)	Yes	Yes
Speech Tone Lag 1	0.009 (0.006)	0.0007 (0.004)	0.0003 (0.010)	0.006 (0.010)	Yes	Yes
Speech Tone Lag 2	0.017^{**} (0.008)	-0.007^{*} (0.004)	-0.007 (0.035)	-0.026 (0.029)	Yes	Yes
Speech Tone Lag 3	0.014^{**} (0.007)	-0.004 (0.004)	0.0005 (0.020)	0.035^{**} (0.018)	Yes	Yes
Speech Tone Lag 4	0.003 (0.006)	-0.003 (0.004)	0.067^{**} (0.026)	-0.008 (0.018)	Yes	Yes
Speech Tone Lag 5	-0.001 (0.007)	0.002 (0.004)	-0.028 (0.022)	0.009 (0.020)	Yes	Yes

Note: This table presents the results from daily regression on national central bank and the ECB speech tone. The dependent variable is the daily return of the FTSE 100 index. The standard errors, reported in brackets, are Heteroskedasticity and Autocorrelation (HAC) robust. The controls include three lags of return, day of the week and month dummy. ***, ** and * indicate that the coefficient estimate are significantly different from zero at the 1 percent, 5 percent and 10 percent levels respectively.

Table 28: Sweden Speech Tone Impact

Variable	NCB	ECB	NCB & ECB Combined Impact		Controls	
Speech Tone	NCB Coefficient	ECB Coefficient	NCB	ECB	Controls	Speech Controls
Speech Tone Lag 0	−0.001 (0.012)	−0.0009 (0.005)	−0.002 (0.025)	−0.023 (0.016)	Yes	Yes
Speech Tone Lag 1	−0.003 (0.013)	0.003 (0.005)	0.011 (0.022)	0.012 (0.018)	Yes	Yes
Speech Tone Lag 2	−0.005 (0.012)	−0.006 (0.005)	0.024 (0.020)	0.016 (0.015)	Yes	Yes
Speech Tone Lag 3	0.015 (0.013)	−0.004 (0.005)	0.032 (0.026)	0.050** (0.022)	Yes	Yes
Speech Tone Lag 4	0.0004 (0.013)	−0.003 (0.005)	0.032 (0.022)	−0.006 (0.018)	Yes	Yes
Speech Tone Lag 5	0.006 (0.013)	0.006 (0.005)	0.050* (0.027)	−0.0009 (0.020)	Yes	Yes

Note: This table presents the results from daily regression on national central bank and the ECB speech tone. The dependent variable is the daily return of the OMX index. The standard errors, reported in brackets, are Heteroskedasticity and Autocorrelation (HAC) robust. The controls include three lags of return, day of the week and month dummy. ***, ** and * indicate that the coefficient estimate are significantly different from zero at the 1 percent, 5 percent and 10 percent levels respectively.

Table 29: National central bank and ECB speech impact on UK Market Indices (Intraday)

Variables	National Central Bank		ECB	
Interval	Speech Tone Lag 0	Speech Tone Lag 1	Speech Tone Lag 0	Speech Tone Lag 1
Interval 1	−0.012* (0.006)	0.005 (0.009)	0.004 (0.006)	0.010 (0.008)
Interval 2	−0.003 (0.003)	0.004 (0.002)	0.0007 (0.002)	0.005** (0.002)
Interval 3	−0.0003 (0.002)	−0.002 (0.002)	−0.0004 (0.001)	0.003* (0.002)
Interval 4	−0.002 (0.002)	0.003* (0.002)	−0.001 (0.001)	−0.003 (0.002)
Interval 5	−0.0005 (0.001)	−0.001 (0.001)	0.0002 (0.001)	0.0005 (0.001)
Interval 6	0.0003 (0.001)	−0.001 (0.001)	0.001 (0.001)	0.0004 (0.001)
Interval 7	0.002 (0.001)	−0.001 (0.001)	−0.0009 (0.002)	−0.0009 (0.001)
Interval 8	−0.0004 (0.001)	−0.001 (0.001)	−0.0008 (0.001)	−0.0003 (0.001)
Interval 9	−0.0002 (0.002)	−0.001 (0.002)	0.001 (0.001)	−0.001 (0.001)
Interval 10	0.0007 (0.001)	−0.004* (0.002)	−0.001 (0.001)	0.002 (0.001)
Interval 11	0.001 (0.001)	−0.001 (0.001)	0.0002 (0.001)	0.00001 (0.001)
Interval 12	−0.00003 (0.002)	−0.0004 (0.001)	0.0001 (0.001)	0.001 (0.001)
Interval 13	0.002 (0.001)	−0.001 (0.001)	0.002 (0.001)	−0.001 (0.001)
Interval 14	−0.003 (0.002)	−0.001 (0.002)	0.0004 (0.001)	0.005* (0.002)
Interval 15	−0.0004 (0.002)	−0.001 (0.003)	−0.002 (0.002)	0.0005 (0.002)
Interval 16	−0.0007 (0.002)	0.002 (0.003)	−0.0008 (0.002)	−0.004 (0.002)
Interval 17	0.002 (0.002)	−0.002 (0.002)	−0.001 (0.002)	−0.0007 (0.003)
Controls	Yes	Yes	Yes	Yes
Macro Controls	Yes	Yes	Yes	Yes
Speech Controls	Yes	Yes	Yes	Yes

Note: This table presents the results from the regression on daily national central bank speech tone. The dependent variable is the intraday 30 min index returns. The results are reported in line with equation 1 with addtional macroeconomic controls. The number of observations are the same as number of speech-days for each country. The standard errors, reported in brackets, are Heteroskedasticity and Autocorrelation (HAC) robust. The controls include three lags of return, day of the week and month dummy. ***, ** and * indicate that the coefficient estimate are significantly different from zero at the 1 percent, 5 percent and 10 percent levels respectively.

Table 30: National central bank and the ECB speech joint impact on Market Indices (Common Topic)

Country/Variable	Lag 0		Lag 1		Lag 2		Lag 3		Lag 4		Lag 5	
	CB	ECB	CB	ECB	CB	ECB	CB	ECB	CB	ECB	CB	ECB
Germany	−0.001 (0.016)	−0.021 (0.015)	0.014 (0.041)	−0.013 (0.024)	0.008 (0.034)	0.030 (0.032)	0.041 (0.042)	−0.045 (0.029)	−0.011 (0.016)	0.019 (0.019)	0.005 (0.046)	−0.095*** (0.029)
Italy	0.034 (0.033)	−0.012 (0.037)	−0.084* (0.046)	−0.132* (0.072)	−0.090 (0.058)	−0.081 (0.082)	0.037 (0.038)	−0.124* (0.057)	0.201* (0.084)	−0.026 (0.070)	−0.051 (0.185)	−0.124 (0.227)
Finland	0.024 (0.019)	0.042 (0.035)	0.035 (0.041)	−0.016 (0.040)	−0.085* (0.038)	0.122 (0.077)	0.015 (0.046)	0.112 (0.072)	−0.011 (0.030)	0.0009 (0.058)	−0.008 (0.026)	0.067 (0.054)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Macro Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Speech Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: This table presents the results from daily regression on national central bank and the ECB speech tone. The dependent variable is the daily index return. The results are reported in line with equation 2. The number of observations are fewer compared to tables 9 and 10 since only days when both the ECB and national central bank have a speech are included in the analysis. The standard errors, reported in brackets, are Heteroskedasticity and Autocorrelation (HAC) robust. The controls include three lags of return, day of the week and month dummy. ***, ** and * indicate that the coefficient estimate are significantly different from zero at the 1 percent, 5 percent and 10 percent levels respectively.

Table 31: ECB Speech impact on EURO STOXX 50 Index with Macro controls

Country/Variable	Speech Tone Lag 0	Speech Tone Lag 1	Speech Tone Lag 2	Speech Tone Lag 3	Speech Tone Lag 4	Speech Tone Lag 5
Return	−0.033 (0.025)	−0.040** (0.018)	−0.027 (0.040)	−0.012* (0.006)	−0.001 (0.008)	0.010 (0.006)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Macro Controls	Yes	Yes	Yes	Yes	Yes	Yes
Speech Controls	Yes	Yes	Yes	Yes	Yes	Yes

Note: This table presents the results from daily regression on the ECB speech tone for the "financial market" speeches. The dependent variable is the daily index return. The results are reported in line with equation 1 with addtional macroeconomic controls. The number of observations are the same as the number of speech-days for each country. The standard errors, reported in brackets, are Heteroskedasticity and Autocorrelation (HAC) robust. The controls include three lags of return, day of the week and month dummy, as well as speech controls and macro controls. ***, ** and * indicate that the coefficient estimate are significantly different from zero at the 1 percent, 5 percent and 10 percent levels respectively.

Table 32: ECB speech impact on EURO STOXX 50 Index (Intraday)

Return Interval/Variable	EURO STOXX 50 Index	
	Speech Tone Lag 0	Speech Tone Lag 1
Interval 1	0.001 (0.004)	0.006 (0.004)
Interval 2	−0.0009 (0.001	0.002 (0.001)
Interval 3	0.0001 (0.001)	−0.001 (0.001)
Interval 4	−0.0007 (0.001)	0.0009 (0.001)
Interval 5	−0.001 (0.001)	0.0002 (0.001)
Interval 6	−0.0004 (0.001)	−0.001 (0.001)
Interval 7	0.0006 (0.001)	0.0007 (0.001)
Interval 8	0.00001 (0.001)	0.0008 (0.001)
Interval 9	−0.0001 (0.001)	−0.001 (0.001)
Interval 10	−0.0008 (0.001)	0.001* (0.001)
Interval 11	0.002* (0.001)	−0.002** (0.001)
Interval 12	0.0006 (0.001)	0.001 (0.001)
Interval 13	0.0002 (0.001)	−0.001 (0.001)
Interval 14	−0.001 (0.001)	−0.002 (0.002)
Interval 15	−0.001 (0.001)	−0.003* (0.001)
Interval 16	0.0009 (0.001)	−0.001 (0.001)
Interval 17	−0.001 (0.001)	0.0009 (0.001)
Controls	Yes	Yes
Macro Controls	Yes	Yes
Speech Controls	Yes	Yes

Note: This table presents the results from daily regression on the ECB speech tone. The dependent variable is the intraday 30 min EURO STOXX 50 index returns. The results are reported in line with equation 1 with addtional macroeconomic controls. The standard errors, reported in brackets, are Heteroskedasticity and Autocorrelation (HAC) robust. The controls include three lags of return, day of the week and month dummy, as well as speech controls and macro controls. ***, ** and * indicate that the coefficient estimate are significantly different from zero at the 1 percent, 5 percent and 10 percent levels respectively.
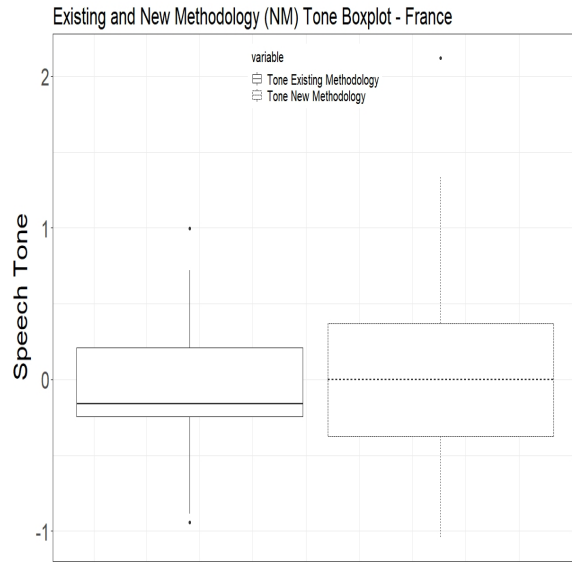
Figure 1: The existing methodology tone (solid line) is speech tone calculated using the "bag-of-words" approach whereas the new methodology tone (dotted line) is the tone calculated by the methodology specified in this study.
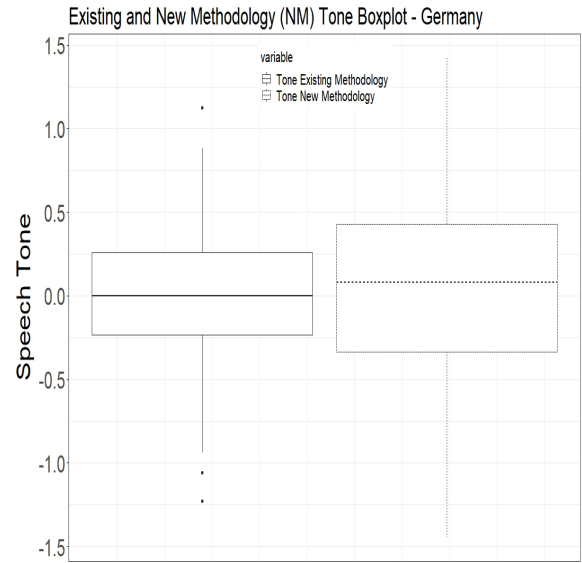
Figure 2: The existing methodology tone (solid line) is speech tone calculated using the "bag-of-words" approach whereas the new methodology tone (dotted line) is the tone calculated by the methodology specified in this study.
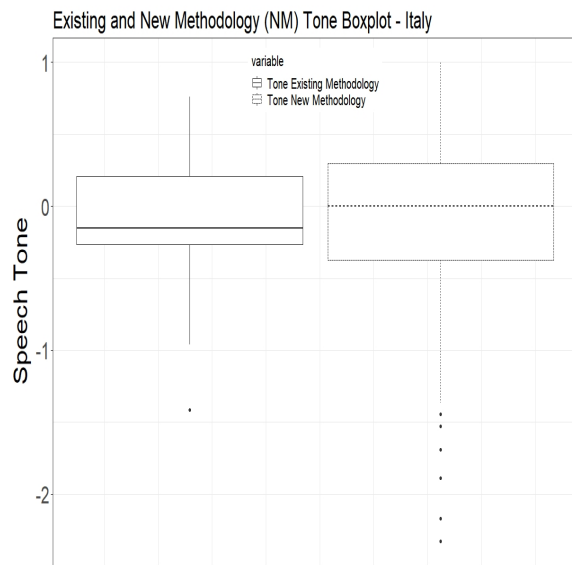
Figure 3: The existing methodology tone (solid line) is speech tone calculated using the "bag-of-words" approach whereas the new methodology tone (dotted line) is the tone calculated by the methodology specified in this study.
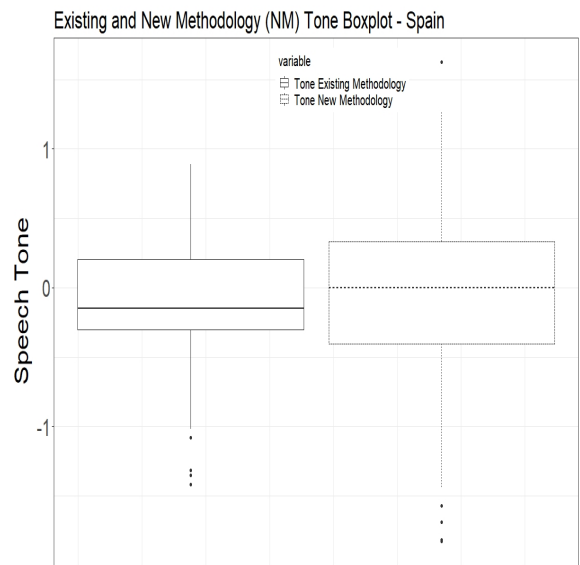
Figure 4: The existing methodology tone (solid line) is speech tone calculated using the "bag-of-words" approach whereas the new methodology tone (dotted line) is the tone calculated by the methodology specified in this study.
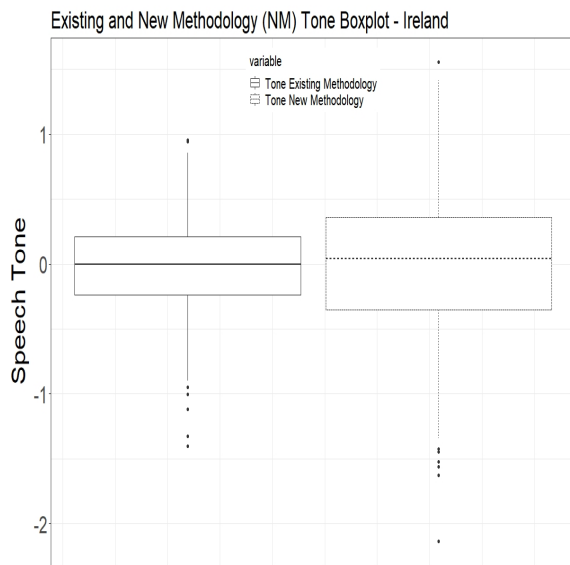
Figure 5: The existing methodology tone (solid line) is speech tone calculated using the "bag-of-words" approach whereas the new methodology tone (dotted line) is the tone calculated by the methodology specified in this study.
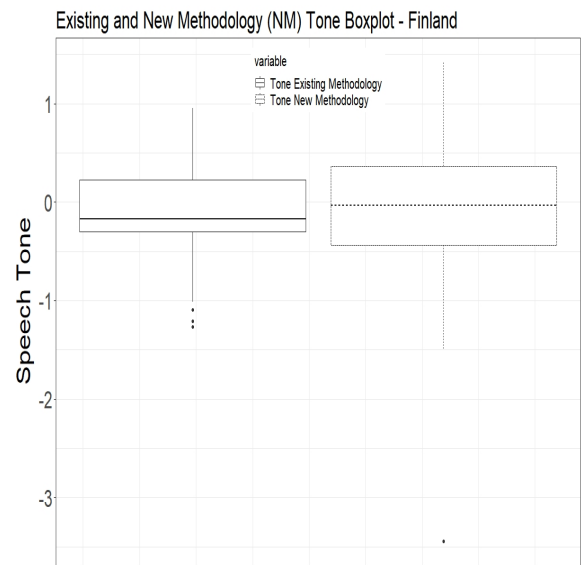
Figure 6: The existing methodology tone (solid line) is speech tone calculated using the "bag-of-words" approach whereas the new methodology tone (dotted line) is the tone calculated by the methodology specified in this study.
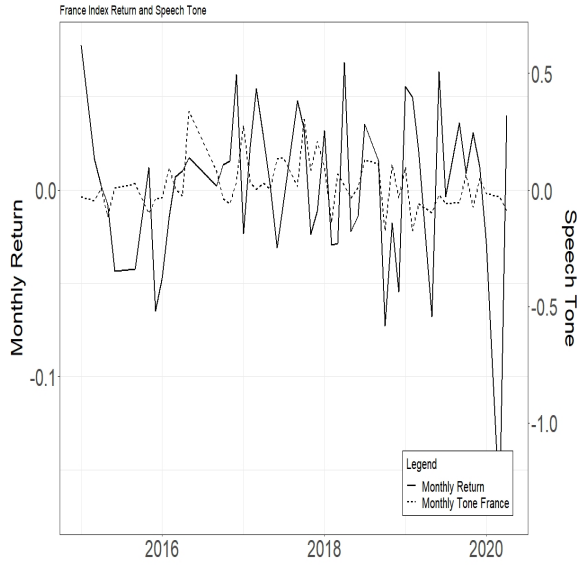
Figure 7: The monthly return (solid line) is for the CAC Index (France) whereas the speech tone (dotted line) is calculated by summing up the speeches over a month and then extracting tone using the specified methodolgy in this study. The return is represented by the primary Y axis and the speech tone by the secondary Y axis.
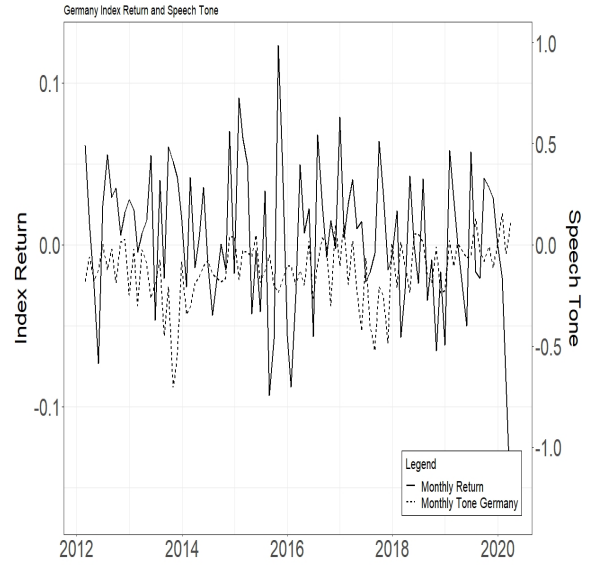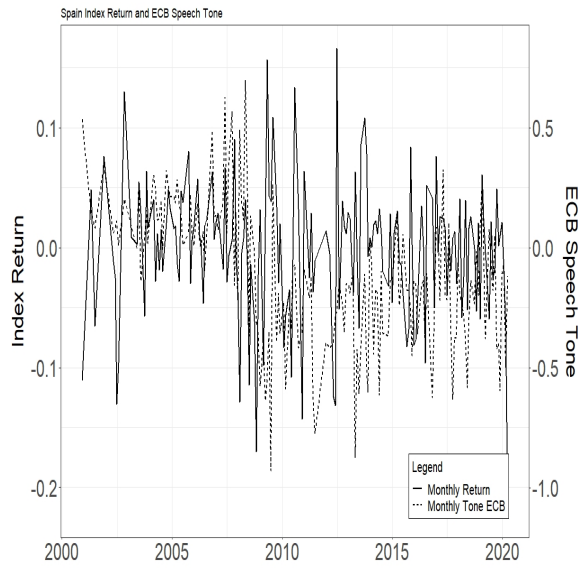

Figure 8: The monthly return (solid line) is for the DAX Index (Germany) whereas the speech tone (dotted line) is calculated by summing up the speeches over a month and then extracting tone using the specified methodolgy in this study. The return is represented by the primary Y axis and the speech tone by the secondary Y axis.
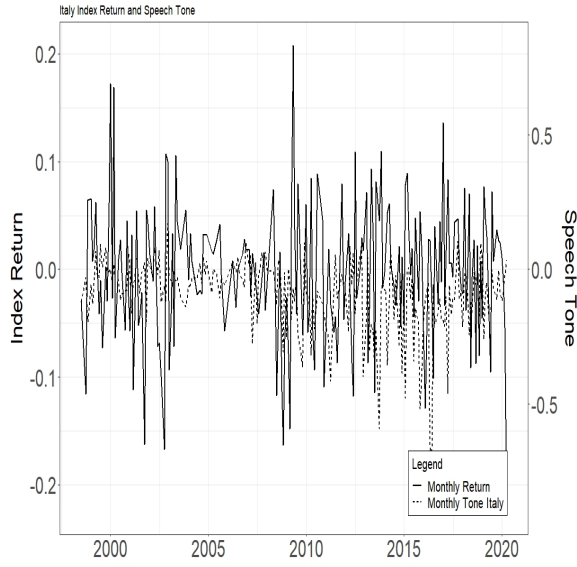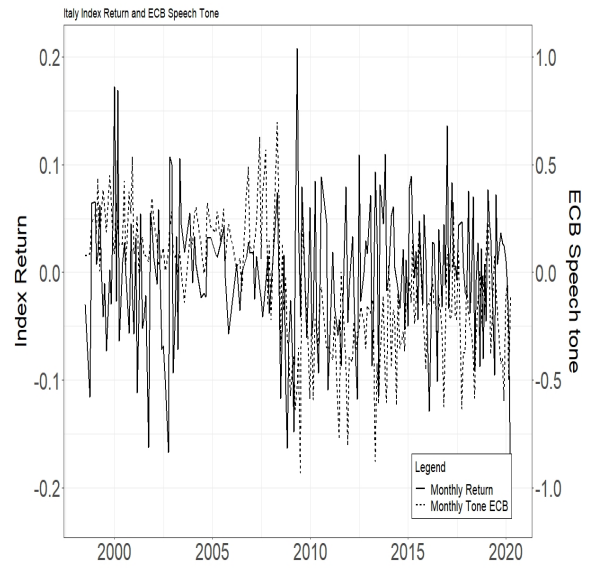
Figure 9: The monthly return (solid line) is for the OMX Index (Sweden) whereas the speech tone (dotted line) is calculated by summing up the speeches over a month and then extracting tone using the specified methodolgy in this study. The return is represented by the primary Y axis and the speech tone by the secondary Y axis.
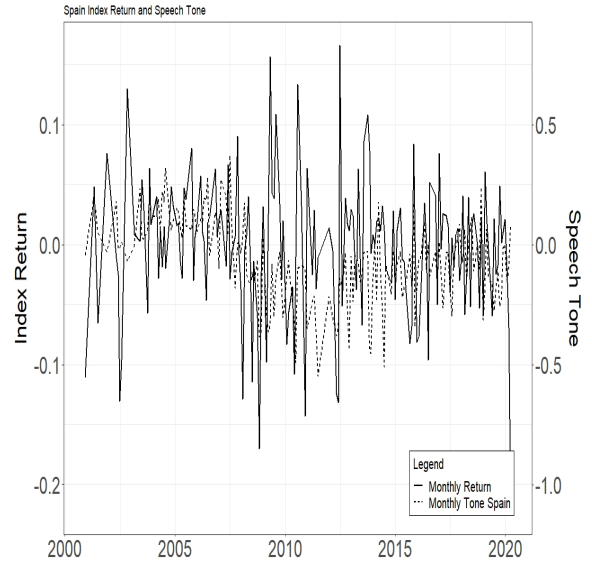
Figure 10: The monthly return (solid line) is for the MIB Index (Italy) whereas the central bank speech tone (dotted line) is calculated by summing up the speeches over a month and then extracting tone using the specified methodolgy in this study. The return is represented by the primary Y axis and the speech tone by the secondary Y axis.
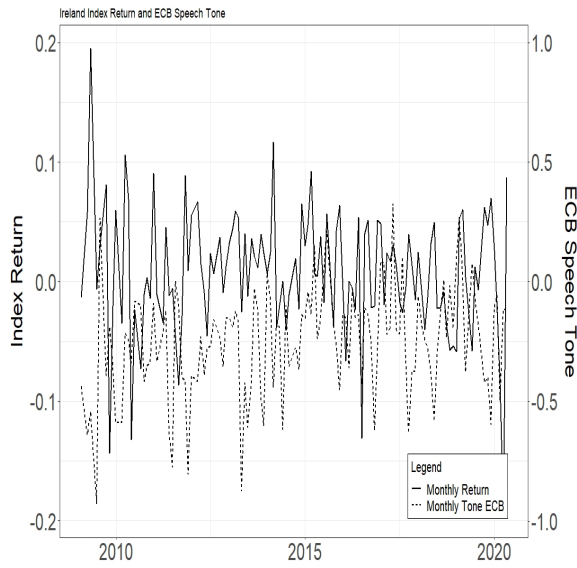
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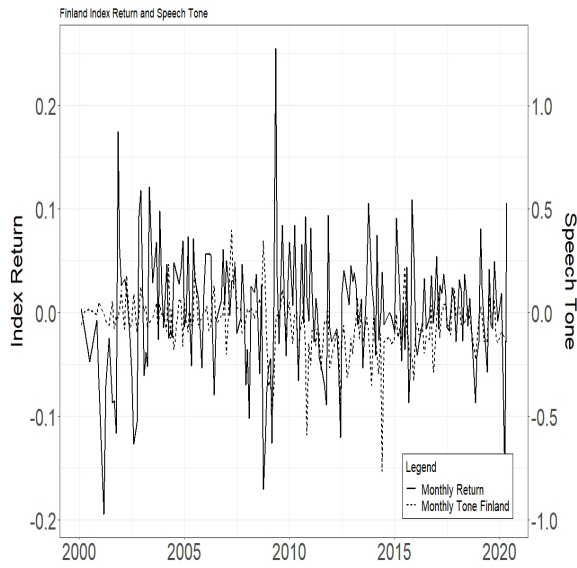
Figure 11: The monthly return (solid line) is for the OMXH Index (Finland) whereas the speech tone (dotted line) is calculated by summing up the speeches over a month and then extracting tone using the specified methodolgy in this study. The return is represented by the primary Y axis and the speech tone by the secondary Y axis.
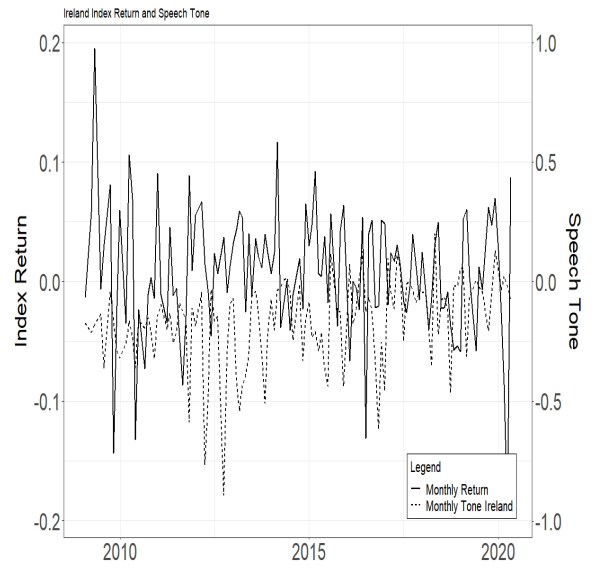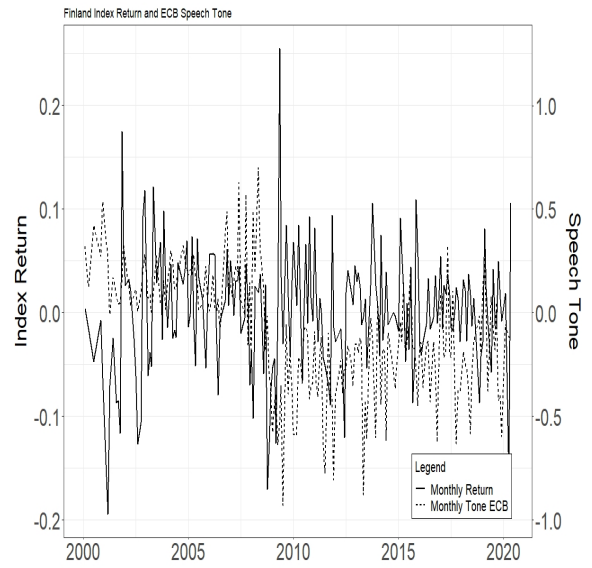

Figure 12: The monthly return (solid line) is for the ISEQ Index (Ireland) whereas the speech tone (dotted line) is calculated by summing up the speeches over a month and then extracting tone using the specified methodolgy in this study. The return is represented by the primary Y axis and the speech tone by the secondary Y axis.

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France Index Return and ECB Speech Tone

Germany Index Return and ECB Speech Tone
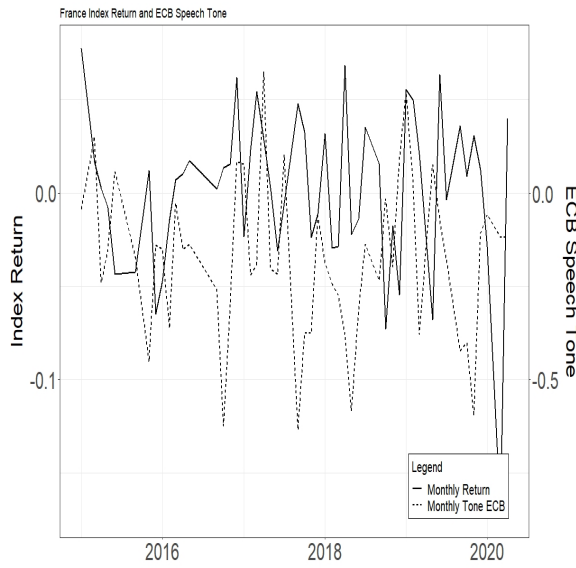
Figure 13: The monthly return (solid line) is for the CAC Index (France) whereas the ECB speech tone (dotted line) is calculated by summing up the speeches over a month and then extracting tone using the specified methodolgy in this study. The return is represented by the primary Y axis and the speech tone by the secondary Y axis.
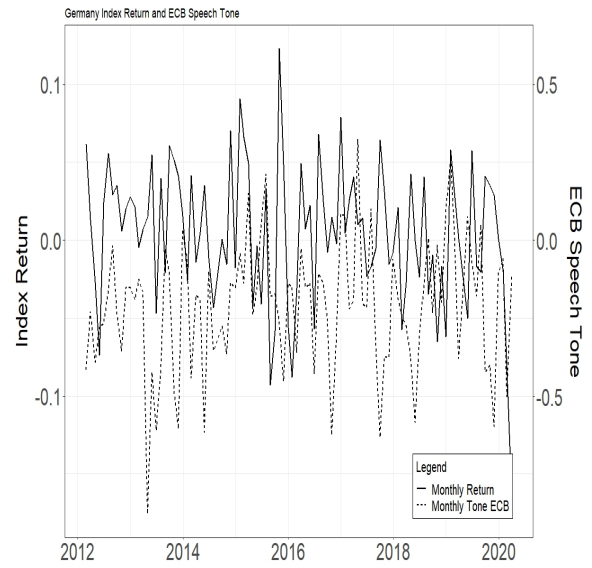
Figure 14: The monthly return (solid line) is for the DAX Index (Germany) whereas the ECB speech tone (dotted line) is calculated by summing up the speeches over a month and then extracting tone using the specified methodolgy in this study. The return is represented by the primary Y axis and the speech tone by the secondary Y axis.
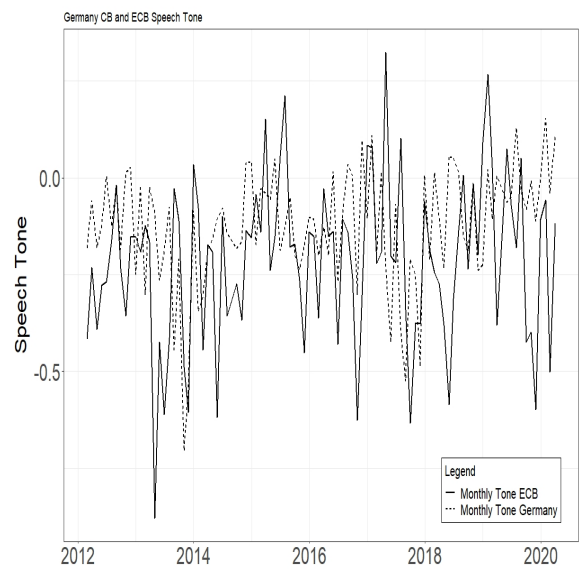
Figure 15: The monthly return (solid line) is for the IBEX Index (Spain) whereas the ECB speech tone (dotted line) is calculated by summing up the speeches over a month and then extracting tone using the specified methodolgy in this study. The return is represented by the primary Y axis and the speech tone by the secondary Y axis.
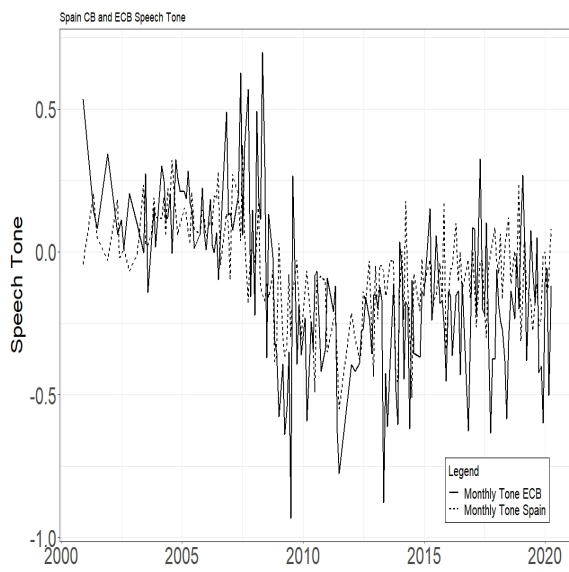

Figure 16: The monthly return (solid line) is for the MIB Index (Italy) whereas the ECB speech tone (dotted line) is calculated by summing up the speeches over a month and then extracting tone using the specified methodolgy in this study. The return is represented by the primary Y axis and the speech tone by the secondary Y axis.
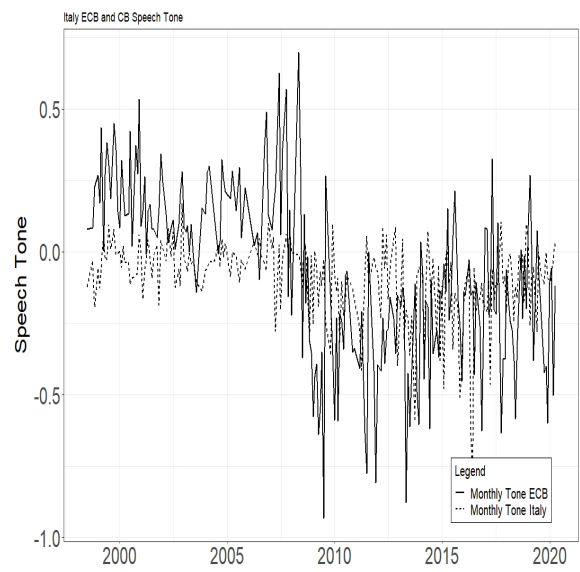
Figure 17: The monthly return (solid line) is for the ISEQ Index (Ireland) whereas the ECB speech tone (dotted line) is calculated by summing up the speeches over a month and then extracting tone using the specified methodolgy in this study. The return is represented by the primary Y axis and the speech tone by the secondary Y axis.

Figure 18: The monthly return (solid line) is for the OMXH Index (Finland) whereas the ECB speech tone (dotted line) is calculated by summing up the speeches over a month and then extracting tone using the specified methodolgy in this study. The return is represented by the primary Y axis and the speech tone by the secondary Y axis.
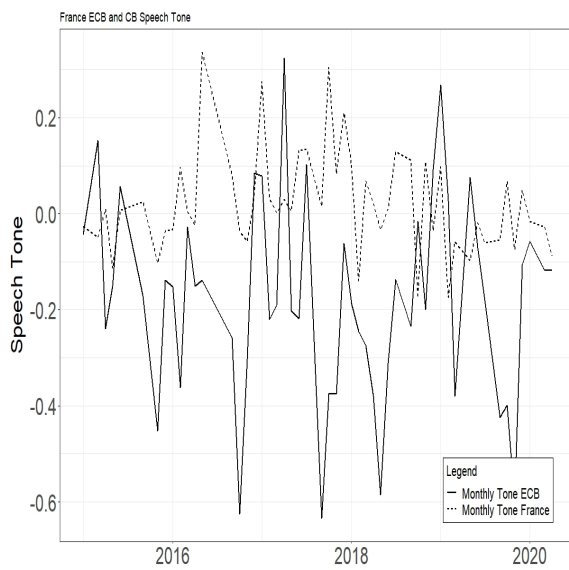
Figure 19: The central bank speech tone is represented by the dotted line whereas the ECB speech tone is presented by the solid line. Both are calculated by summing up the speeches over a month and then extracting tone using the specified methodolgy in this study.
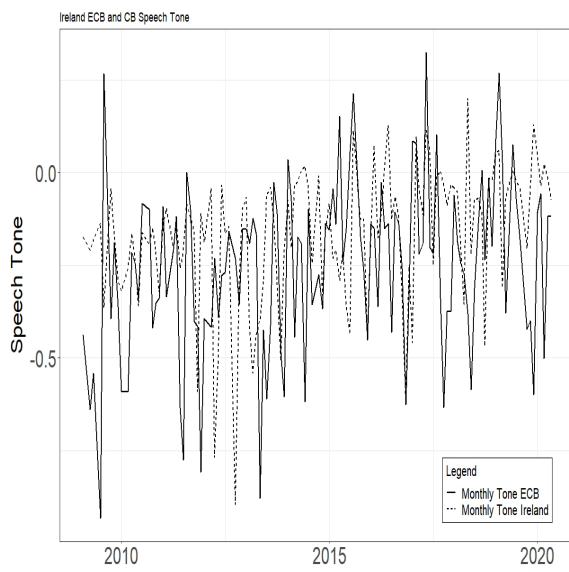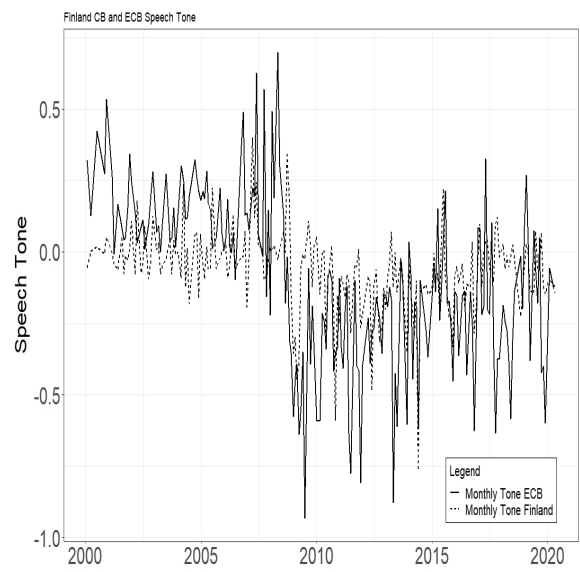

Figure 20: The central bank speech tone is represented by the dotted line whereas the ECB speech tone is presented by the solid line. Both are calculated by summing up the speeches over a month and then extracting tone using the specified methodolgy in this study.

Figure 21: The central bank speech tone is represented by the dotted line whereas the ECB speech tone is presented by the solid line. Both are calculated by summing up the speeches over a month and then extracting tone using the specified methodolgy in this study.


Figure 22: The central bank speech tone is represented by the dotted line whereas the ECB speech tone is presented by the solid line. Both are calculated by summing up the speeches over a month and then extracting tone using the specified methodolgy in this study.

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Figure 23: The central bank speech tone is represented by the dotted line whereas the ECB speech tone is presented by the solid line. Both are calculated by summing up the speeches over a month and then extracting tone using the specified methodolgy in this study.

Figure 24: The central bank speech tone is represented by the dotted line whereas the ECB speech tone is presented by the solid line. Both are calculated by summing up the speeches over a month and then extracting tone using the specified methodolgy in this study.
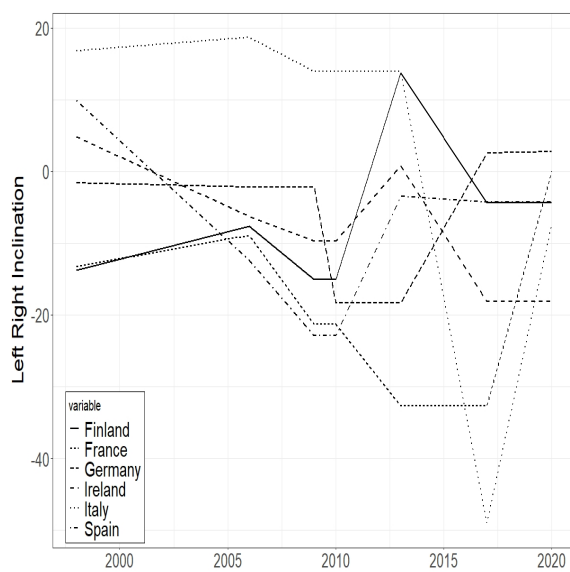
Figure 25: The lines represents the left/right inclination of the majority winning political party for each country. The left inclination is marked by the negative scale and right inclination by the positive scale.
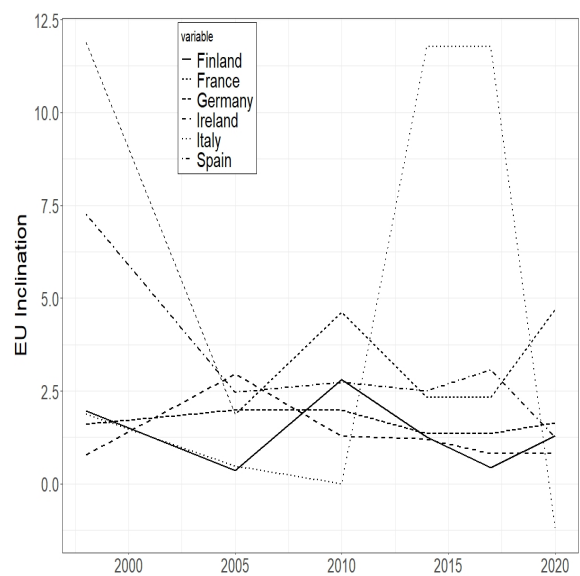
Figure 26: The lines represents the European Union inclination of the six nations used in this study. The inclination is represented by the Y axis.
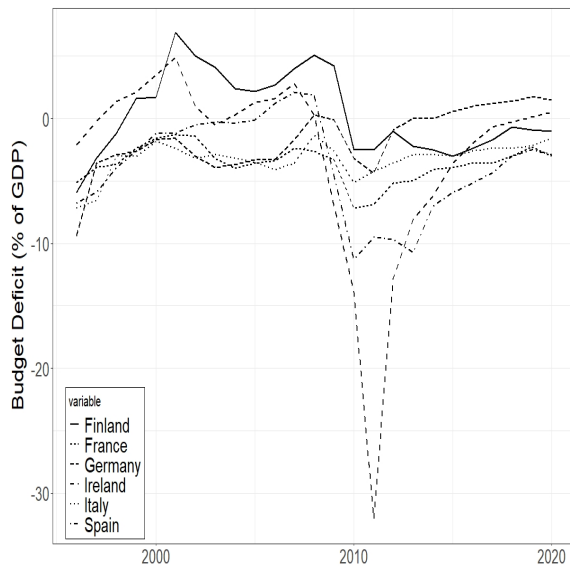
Figure 27: The lines represents the government deficit as a percentage of GDP for the six nations used in this study. The deficit is represented by the Y axis.
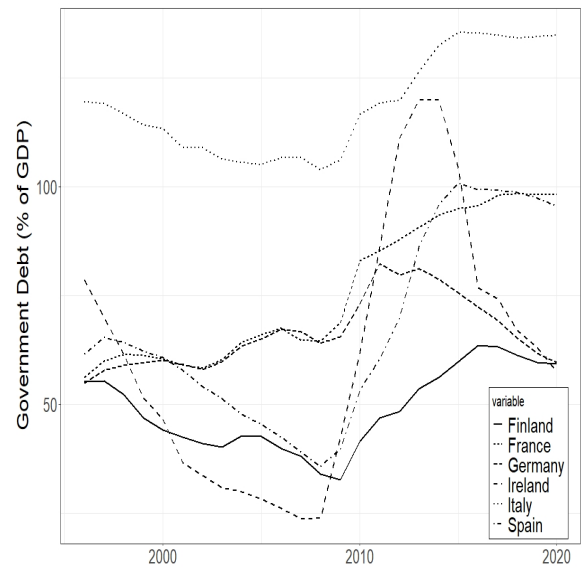

Figure 28: The lines represents the government debt as a percentage of GDP for the six nations used in this study. The debt is represented by the Y axis.
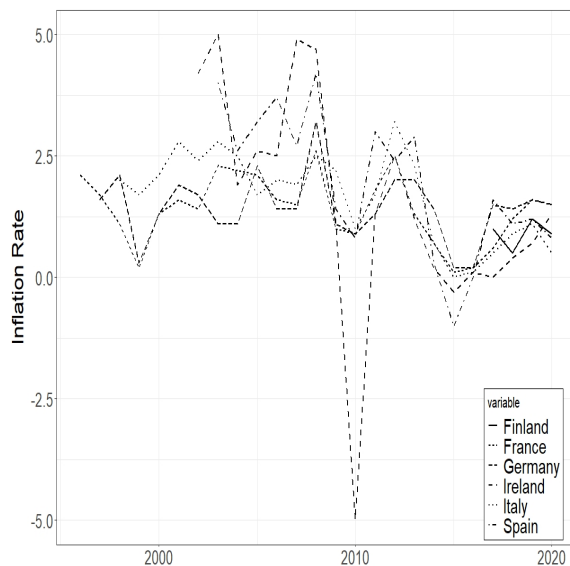

Figure 29: The lines represents the inflation rate the six nations used in this study. The inflation rate is represented by the Y axis.
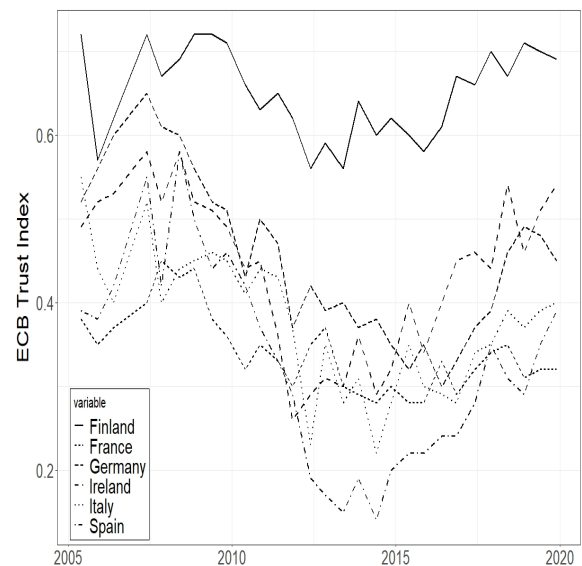

Figure 30: The line for each nation answers the question what percentage of people trust ECB.