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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
Manamai, Tamil Nadu 603102
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: Behavioural Finance, Tone Analysis, Text Analysis, Central Bank Speech, European Central Bank

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Abhinav Anand, Sankarshan Basu, Jalaj Pathak, Ashok Thampy

Abstract

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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. To compare their relative importance in explaining stock market returns, we also analyze days on which both institutions deliver speeches on similar topics.

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 & McDonald 2011) and polar phrases extracted in line with Apel & Grimaldi (2012) and Apergis & Pragidis (2019), along with appropriately weighed valence shifters (adjectives and adverbs) which modify the meaning of words (adjectives and adverbs such as "but", "very", "however" etc.) but have not been given weightage in the LM dictionary.

The studies on central bank communication can be broadly classified into two categories. 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. In a related study, Hansen & McMahon (2016) study the FOMC communication using topic analysis to examine its impact on the market using a FAVAR framework. 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 annoucements affect market returns and Sharpe ratios.

However, there are drawbacks to both categories of studies. For the first 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 (2012). 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) and Schulder et al. (2018)).

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 individually both the national central bank speeches and the ECB speeches impact the national stock market indices for the countries in our sample. We also study the joint impact of the national central bank and ECB speeches for speeches delivered on the same day on similar topics and find that both set of institutions influence market indices significantly. We corroborate our findings by conducting panel estimations with fixed effects (in addition to speech controls) and clustered robust standard errors; as well as by testing the effect of speeches on the smallcap market indices and find that the results stay the same. For robustness we also consider the case of Sweden and UK—two countries which are not in the Eurozone but are closely integrated with the EU markets—and find the results qualitatively similar to those for the rest of the nations in our sample.

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.

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 et al. (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 et al. (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. Schmeling & Wagner (2019) and Apergis & Pragidis (2019) also quantify central bank tone and analyze its impact on market return and volatility. Bennani (2020) uses media coverage of confidence in Fed chairmen and analyzes its impact on investor tone using the Baker and Wurgler index as a proxy.

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. Fraccaroli & Giovannini (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.[1] They find that unlike policy outputs from other policymaking systems, ECB communications (due to its information processing capacities) evolve in a more proportional manner. 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. 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. 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

[1]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)).

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. Siganos et al. (2014) examine the relation between daily tone and trading behavior using Facebook's Gross National Happiness Index and find significant positive relations between the two variables. 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. 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.

3 Data and Methodology

3.1 Data

There are two 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.[2] Out of all the EU members, nineteen have historical data on speeches and among those nineteen only six have more than 100 speeches. These are Germany, France, Italy, Spain, Finland and Ireland. Further, these six nations are endowed with the largest economies and stock market capitalization in the Eurozone. 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

[2]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.

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.

Insert table 1 about here.

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.[3] 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.[4] 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

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

[4]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.

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 union for investment and innovation - and a common budget for the euro area.*[5]

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:

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

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

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

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

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

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

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. This leads to a drastic fall in the number of observations if VAR is used. Also, since the impact of tone can be delayed due to socio-economic reasons it is tested for up to five lags.[6]

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

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

$$R_t = a_0 + \sum_{n=1}^{5} a_n Tone_{t-n} + \sum_{i=1}^{3} b_i R_{t-i} + d_1 * Controls + d_2 * SpeechControls + \gamma_t \quad (1)$$

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) as speech level controls in line with the methodology outlined in Anand et al. (2021).

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.

4 Results and Analysis

We first look at the summary statistics for index returns as well as speech variables for all nations. Tables 4 and 5 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 six nations as well as for the ECB.

Insert tables 4 and 5 about here.

Table 6 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 6 about here.

4.1 Market indices and central bank speeches

Figures 1, 2, 3, 4, 5 and 6 show the movement of monthly speech tone extracted from national central bank speeches and the main index return across time for all six nations.[7] It can be conjectured from an initial visual inspection that for Italy, Spain, Ireland and Finland, the variables tend to co-move.

Insert figures 1, 2, 3, 4, 5 and 6 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.[8] The results are presented in table 7. 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

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

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

national central bank speech tone significantly impacts the respective stock market indices.

Insert table 7 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 7, 8, 9, 10, 11 and 12. It can be seen that for Germany, Spain, Ireland and Finland, the variables seem to co-move. Thus, we expect to see a significant relationship between speech tone and return for Germany, Spain, Ireland and Finland.

Insert figures 7, 8, 9, 10, 11 and 12 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 8. 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 or for 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 8 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 13, 14, 15, 16, 17 and 18. We find that the ECB and the national central banks' speech tone tends to co-move for all nations.

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

To test the joint effect of ECB and national central bank (NCB) speech tones we include both their lags in the estimating equation as shown below:[9]

$$R_t = a_0 + \sum_{n=1}^{5} a_n NCBTone_{t-n} + \sum_{n=1}^{5} b_n ECBTone_{t-n} + \sum_{i=1}^{3} c_i R_{t-i} + d_1 * Controls + d_2 * SpeechControls + \gamma_t \quad (2)$$

The results are presented in table 9. For Spain, both the national central bank and the ECB tone were significant in explaining market returns individually as shown in tables 7 and 8. 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

[9]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.

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 9 about here.

4.4 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. The results are presented in table 10. 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 10 about here.

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 Jr (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.[10] It can be seen in figure 19 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 8 and the results are presented in table 11. 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 7 and 9. 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 19 about here.

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

Insert table 11 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 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 20 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.[11] 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 20 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

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

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 21, 22 and 23 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 (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 21, 22 and 23 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 24 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 24 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 three 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. Finally, 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.

6.1 Impact of Central Bank Communication Tone on Smallcap Indices

Tables 12, 13 and 14 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 12, 13 and 14 about here.

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 15 and 16. The results are similar to tables 7, 8 and 9 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 15 and 16 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 thier geo-political proximity to the EU nations. Tables 18 and 19 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 table 18 and 19 about here.

7 Conclusion

Our study attempts to compare the absolute and relative importance of the tone extracted from the speeches of the European Central Bank and the national central banks of six leading European nations on the behavior of

national stock market indices of their respective countries. We find that national central bank speeches affect index return in Ireland and Italy for the main as well as the smallcap index. On the other hand, the ECB speech tone significantly impacts market indices of Germany, Finland and Spain in case of the main index. Also, in case of both institutions' speeches on the same day, the ECB speech tone displays significance for three out of the six nations (Ireland, France, and Finland) whereas the national central bank speech tone is significant for France and Italy. 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 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	-0.00006	The presence of "but" captures accurately, the impact of the phrase "conequences 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.

Table 4: Speech Statistics

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 5: 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 6: 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 7: 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 8: 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 9: National central bank and the ECB speech joint impact on Market Indices

	Lag 0		**Lag 1**		**Lag 2**		**Lag 3**		**Lag 4**		**Lag 5**	
Country/Variable	CB	ECB	CB	ECB	CB	ECB	CB	ECB	CB	ECB	CB	ECB
France	0.005	0.036*	0.009	0.013	0.009	0.042	−0.020	0.004	0.052**	−0.024	0.015	0.013
	(0.020)	(0.021)	(0.018)	(0.018)	(0.020)	(0.036)	(0.024)	(0.034)	(0.029)	(0.034)	(0.024)	(0.029)
Germany	−0.003	−0.014	−0.004	0.005	−0.008	0.020	0.016	−0.003	−0.011	0.005	−0.001	0.007
	(0.012)	(0.009)	(0.012)	(0.010)	(0.015)	(0.013)	(0.014)	(0.011)	(0.013)	(0.012)	(0.015)	(0.017)
Italy	0.024*	−0.012	−0.001	0.014	−0.010	0.0001	−0.001	−0.019	0.021	−0.026	0.004	0.014
	(0.013)	(0.014)	(0.015)	(0.019)	(0.019)	(0.020)	(0.017)	(0.021)	(0.017)	(0.017)	(0.014)	(0.017)
Spain	0.004	−0.001	0.005	0.014	0.013	0.018	−0.0007	0.016	0.009	0.020	0.010	−0.003
	(0.010)	(0.014)	(0.013)	(0.017)	(0.015)	(0.018)	(0.014)	(0.017)	(0.012)	(0.022)	(0.011)	(0.019)
Ireland	−0.012	−0.012	0.0000	0.050***	0.001	0.015	−0.005	−0.023*	−0.001	0.016	−0.010	0.0003
	(0.009)	(0.014)	(0.010)	(0.015)	(0.008)	(0.009)	(0.008)	(0.012)	(0.009)	(0.012)	(0.012)	(0.013)
Finland	−0.015	0.032**	0.017	0.0001	−0.021	−0.003	0.002	−0.020	−0.011	0.025	0.007	0.015
	(0.019)	(0.016)	(0.014)	(0.020)	(0.018)	(0.018)	(0.014)	(0.017)	(0.019)	(0.024)	(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 7 and 8 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 10: 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). ***, ** and * indicate that the coefficient estimate are significantly different from zero at the 1 percent, 5 percent and 10 percent levels respectively.

Table 11: Political Stance - Interaction Term

Country/Variable	Lag 0	Lag 1	Lag 2	Lag 3	Lag 4	Lag 5
France	−0.0002	−0.0004	−0.0004	0.0000	−0.0002	0.0004
	(0.0005)	(0.0008)	(0.0008)	(0.0006)	(0.0008)	(0.0009)
Germany	0.0003	0.0004	0.0001	0.0001	0.0002	−0.0009
	(0.0007)	(0.0007)	(0.0007)	(0.0006)	(0.0007)	(0.0007)
Italy	0.0001	0.0004	−0.0002	−0.0004	−0.0007*	−0.0003
	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)
Spain	0.0009	0.001	−0.0008	−0.0004	−0.0004	−0.0004
	(0.0009)	(0.001)	(0.0009)	(0.001)	(0.001)	(0.001)
Ireland	−0.001	−0.0006	−0.001	−0.001	0.001	−0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Finland	0.001*	−0.0001	0.0009	−0.0001	−0.0000	0.0002
	(0.0006)	(0.0004)	(0.0009)	(0.0004)	(0.0005)	(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 8. 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 12: 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 13: 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 14: National central bank and the ECB speech joint impact on Smallcap Market Indices

	Lag 0		**Lag 1**		**Lag 2**		**Lag 3**		**Lag 4**		**Lag 5**	
Country/Variable	CB	ECB	CB	ECB	CB	ECB	CB	ECB	CB	ECB	CB	ECB
France	−0.010	0.064***	0.015	0.037	0.016	0.046*	−0.018	−0.012	0.033	0.003	0.038**	−0.012
	(0.016)	(0.016)	(0.021)	(0.029)	(0.019)	(0.027)	(0.027)	(0.040)	(0.023)	(0.028)	(0.015)	(0.023)
Germany	0.005	−0.012	−0.006	−0.001	−0.011	0.010	0.023*	−0.003	−0.0001	0.003	0.001	−0.0004
	(0.010)	(0.009)	(0.012)	(0.011)	(0.012)	(0.011)	(0.013)	(0.010)	(0.011)	(0.011)	(0.013)	(0.013)
Italy	0.028**	−0.020	0.002	0.005	0.002	0.001	0.004	−0.009	0.022	−0.028*	0.010	0.019
	(0.012)	(0.015)	(0.016)	(0.020)	(0.017)	(0.020)	(0.016)	(0.021)	(0.016)	(0.014)	(0.015)	(0.015)
Spain	0.004	−0.006	0.0003	−0.0005	0.023**	0.017	0.003	0.007	−0.011	−0.003	0.001	−0.001
	(0.009)	(0.013)	(0.012)	(0.011)	(0.010)	(0.013)	(0.009)	(0.014)	(0.015)	(0.016)	(0.008)	(0.015)
Ireland	−0.009	−0.017	−0.005	0.021**	0.018*	0.007	−0.006	0.003	−0.006	0.016	−0.009	0.004
	(0.010)	(0.011)	(0.009)	(0.009)	(0.010)	(0.011)	(0.009)	(0.012)	(0.011)	(0.017)	(0.011)	(0.011)
Finland	−0.010	0.001	−0.019	−0.003	0.001	−0.020**	−0.004	−0.003	−0.003	0.031**	−0.002	0.019
	(0.009)	(0.013)	(0.016)	(0.015)	(0.010)	(0.009)	(0.006)	(0.010)	(0.008)	(0.012)	(0.009)	(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 15: 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 16: National central bank and the ECB speech joint impact on Market Indices - Speeches in English/official translation

	Lag 0		**Lag 1**		**Lag 2**		**Lag 3**		**Lag 4**		**Lag 5**	
Country/Variable	CB	ECB	CB	ECB	CB	ECB	CB	ECB	CB	ECB	CB	ECB
Germany	−0.010	−0.013	−0.014	0.0008	−0.031	0.043**	0.013	0.004	−0.004	−0.009	0.011	−0.023
	(0.022)	(0.018)	(0.020)	(0.013)	(0.022)	(0.020)	(0.024)	(0.021)	(0.015)	(0.015)	(0.016)	(0.016)
Italy	0.045	0.011	−0.005	0.004	−0.062	0.051	0.025	−0.031	0.099***	−0.072*	0.090**	−0.038
	(0.038)	(0.031)	(0.035)	(0.041)	(0.046)	(0.039)	(0.036)	(0.050)	(0.033)	(0.036)	(0.032)	(0.035)
Spain	−0.002	0.0006	0.007	0.035*	0.023	0.026	0.023	0.025	−0.012	−0.009	0.011	−0.016
	(0.010)	(0.018)	(0.011)	(0.018)	(0.019)	(0.028)	(0.020)	(0.023)	(0.014)	(0.020)	(0.017)	(0.016)
Ireland	−0.012	−0.012	0.0000	0.050***	0.001	0.015	−0.005	−0.023*	−0.001	0.016	−0.010	0.0003
	(0.009)	(0.014)	(0.010)	(0.015)	(0.008)	(0.009)	(0.008)	(0.012)	(0.009)	(0.012)	(0.012)	(0.013)
Finland	−0.038	0.025	0.020	0.033	−0.001	−0.012	0.020	−0.041**	−0.024	0.033	0.023	−0.014
	(0.027)	(0.021)	(0.025)	(0.030)	(0.025)	(0.034)	(0.017)	(0.020)	(0.027)	(0.031)	(0.022)	(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 7 and 8 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 17: Speech Statistics

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 18: 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 19: 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.

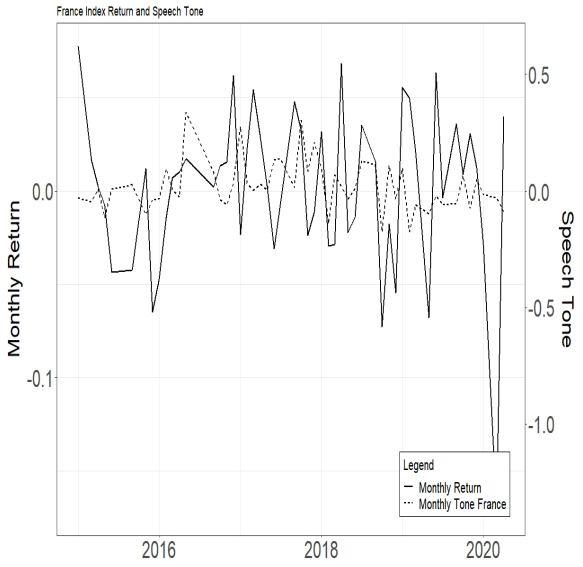

Figure 1: The monthly return (solid line) is for the CAC Index (France) whereas the speech tone (dotted line) is calculated by summing up the speeches over a month and then extracting tone using the specified methodolgy in this study. The return is represented by the primary Y axis and the speech tone by the secondary Y axis.

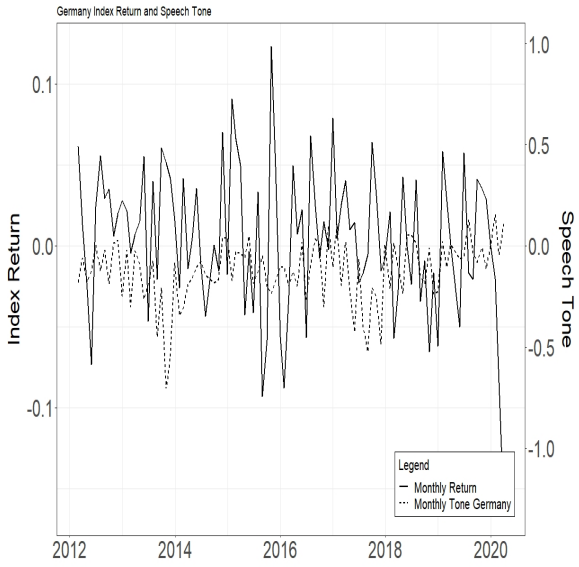

Figure 2: The monthly return (solid line) is for the DAX Index (Germany) whereas the speech tone (dotted line) is calculated by summing up the speeches over a month and then extracting tone using the specified methodolgy in this study. The return is represented by the primary Y axis and the speech tone by the secondary Y axis.

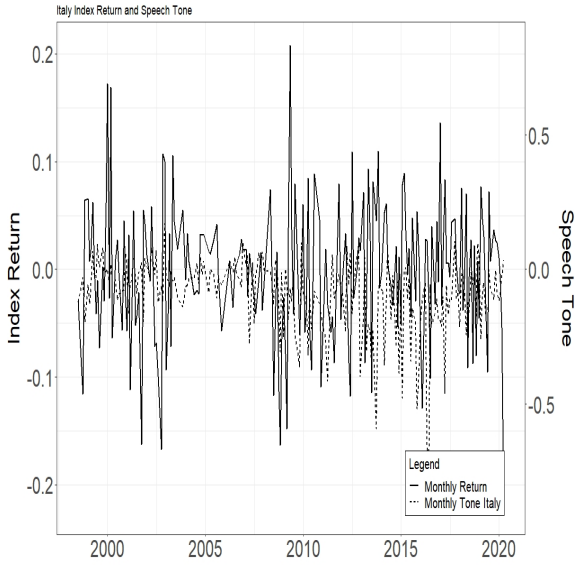

Figure 3: The monthly return (solid line) is for the OMX Index (Sweden) whereas the speech tone (dotted line) is calculated by summing up the speeches over a month and then extracting tone using the specified methodolgy in this study. The return is represented by the primary Y axis and the speech tone by the secondary Y axis.

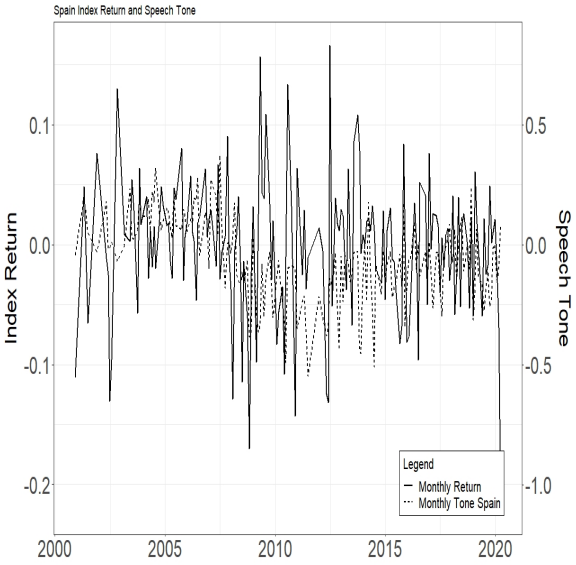

Figure 4: The monthly return (solid line) is for the MIB Index (Italy) whereas the central bank speech tone (dotted line) is calculated by summing up the speeches over a month and then extracting tone using the specified methodolgy in this study. The return is represented by the primary Y axis and the speech tone by the secondary Y axis.

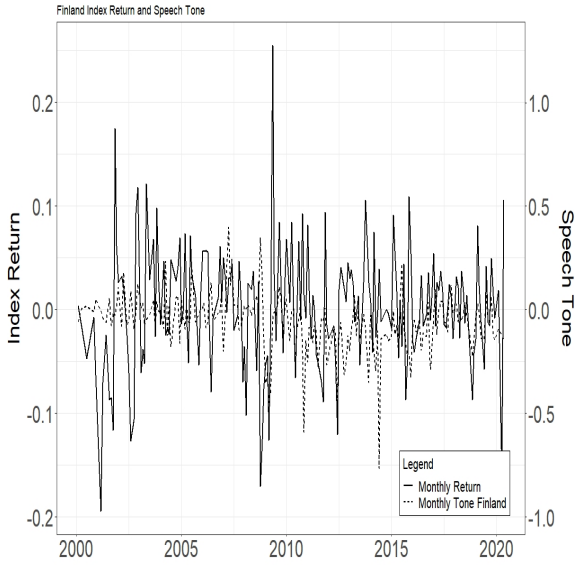

Figure 5: The monthly return (solid line) is for the OMXH Index (Finland) whereas the speech tone (dotted line) is calculated by summing up the speeches over a month and then extracting tone using the specified methodolgy in this study. The return is represented by the primary Y axis and the speech tone by the secondary Y axis.

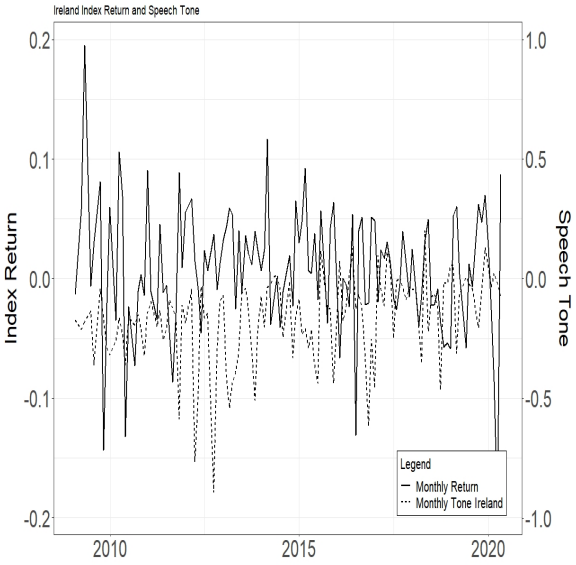

Figure 6: The monthly return (solid line) is for the ISEQ Index (Ireland) whereas the speech tone (dotted line) is calculated by summing up the speeches over a month and then extracting tone using the specified methodolgy in this study. The return is represented by the primary Y axis and the speech tone by the secondary Y axis.

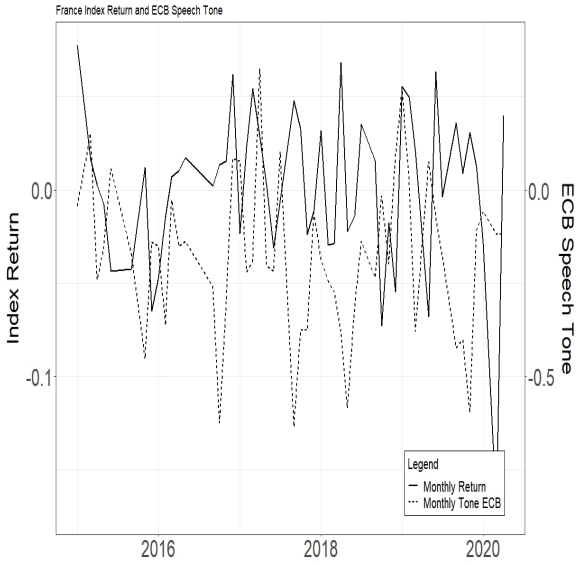

Figure 7: The monthly return (solid line) is for the CAC Index (France) whereas the ECB speech tone (dotted line) is calculated by summing up the speeches over a month and then extracting tone using the specified methodolgy in this study. The return is represented by the primary Y axis and the speech tone by the secondary Y axis.

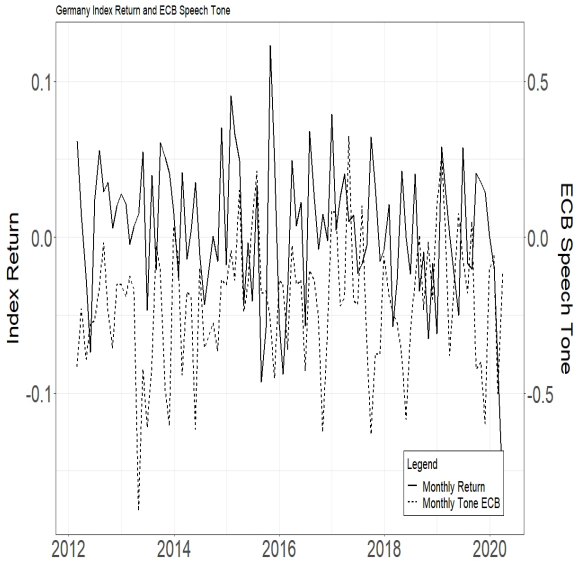

Figure 8: The monthly return (solid line) is for the DAX Index (Germany) whereas the ECB speech tone (dotted line) is calculated by summing up the speeches over a month and then extracting tone using the specified methodolgy in this study. The return is represented by the primary Y axis and the speech tone by the secondary Y axis.

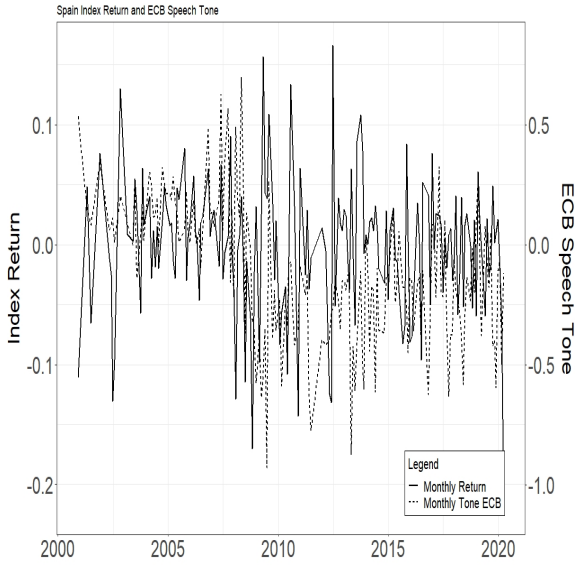

Figure 9: The monthly return (solid line) is for the IBEX Index (Spain) whereas the ECB speech tone (dotted line) is calculated by summing up the speeches over a month and then extracting tone using the specified methodolgy in this study. The return is represented by the primary Y axis and the speech tone by the secondary Y axis.

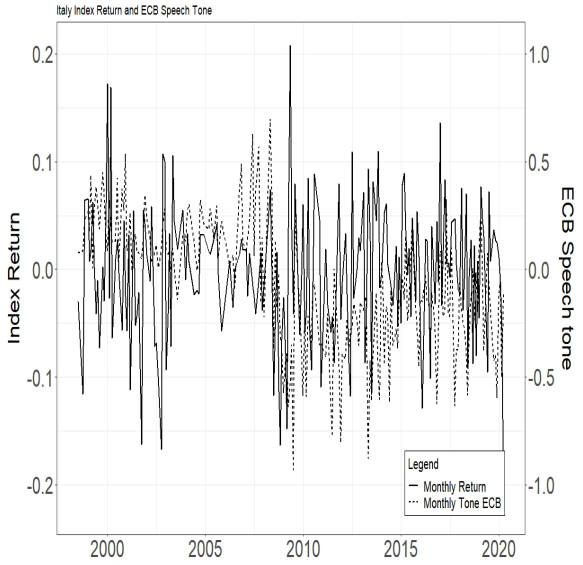

Figure 10: The monthly return (solid line) is for the MIB Index (Italy) whereas the ECB speech tone (dotted line) is calculated by summing up the speeches over a month and then extracting tone using the specified methodolgy in this study. The return is represented by the primary Y axis and the speech tone by the secondary Y axis.

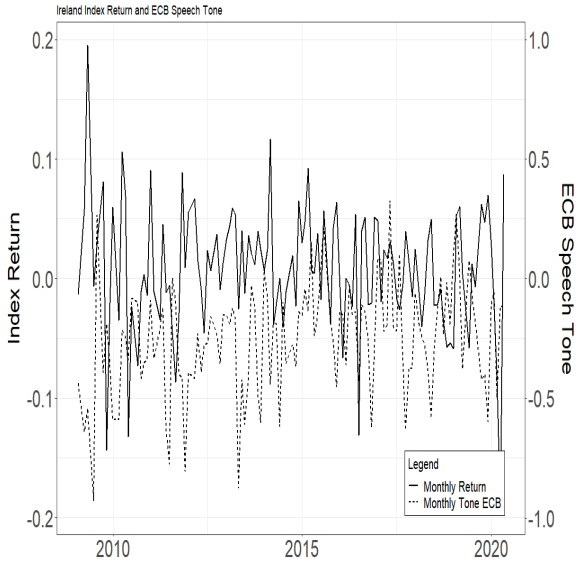

Figure 11: The monthly return (solid line) is for the ISEQ Index (Ireland) whereas the ECB speech tone (dotted line) is calculated by summing up the speeches over a month and then extracting tone using the specified methodolgy in this study. The return is represented by the primary Y axis and the speech tone by the secondary Y axis.

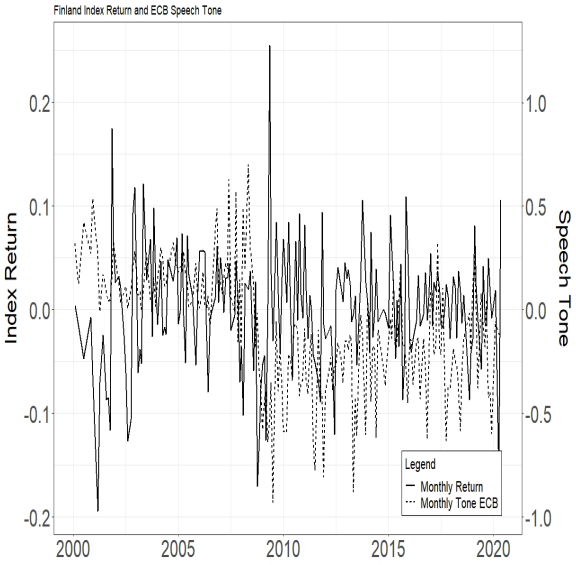

Figure 12: The monthly return (solid line) is for the OMXH Index (Finland) whereas the ECB speech tone (dotted line) is calculated by summing up the speeches over a month and then extracting tone using the specified methodolgy in this study. The return is represented by the primary Y axis and the speech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

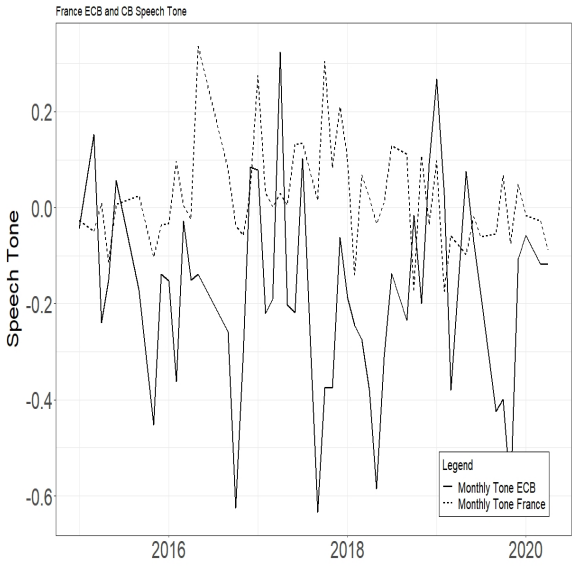

Figure 13: The central bank speech tone is represented by the dotted line whereas the ECB speech tone is presented by the solid line. Both are calculated by summing up the speeches over a month and then extracting tone using the specified methodolgy in this study.

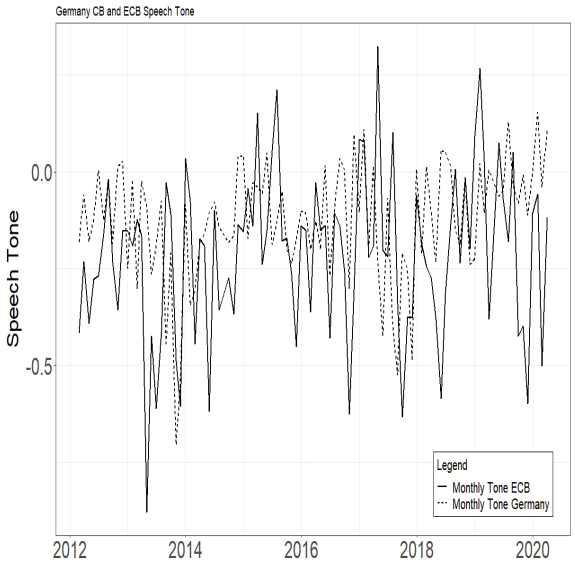

Figure 14: The central bank speech tone is represented by the dotted line whereas the ECB speech tone is presented by the solid line. Both are calculated by summing up the speeches over a month and then extracting tone using the specified methodolgy in this study.

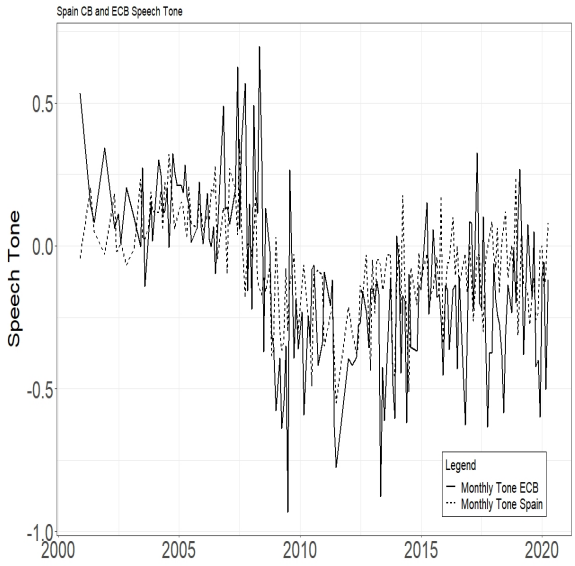

Figure 15: The central bank speech tone is represented by the dotted line whereas the ECB speech tone is presented by the solid line. Both are calculated by summing up the speeches over a month and then extracting tone using the specified methodolgy in this study.

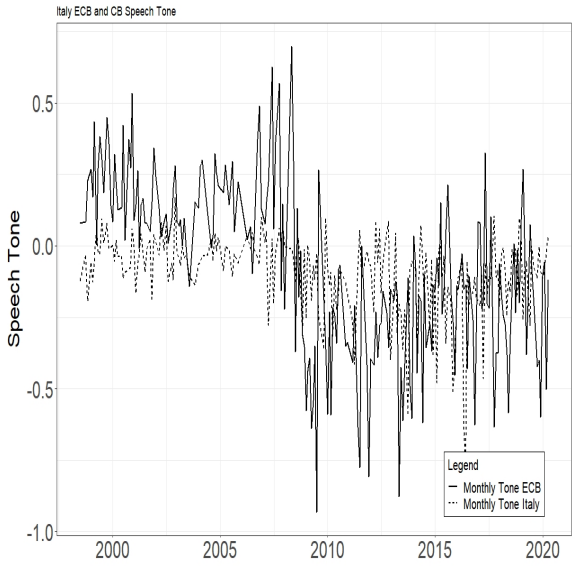

Figure 16: The central bank speech tone is represented by the dotted line whereas the ECB speech tone is presented by the solid line. Both are calculated by summing up the speeches over a month and then extracting tone using the specified methodolgy in this study.

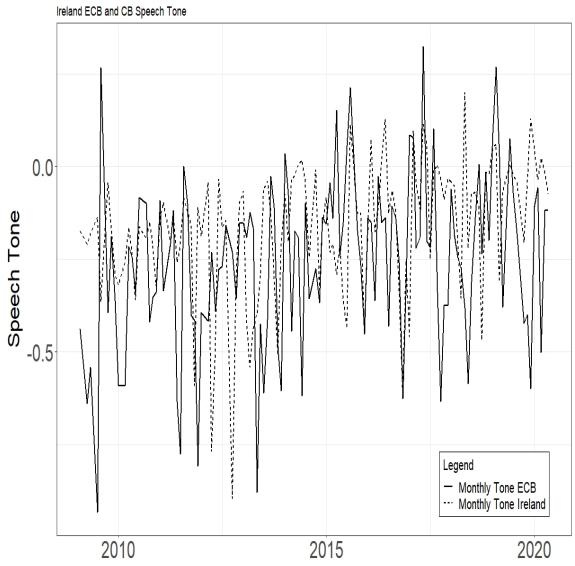

Figure 17: The central bank speech tone is represented by the dotted line whereas the ECB speech tone is presented by the solid line. Both are calculated by summing up the speeches over a month and then extracting tone using the specified methodolgy in this study.

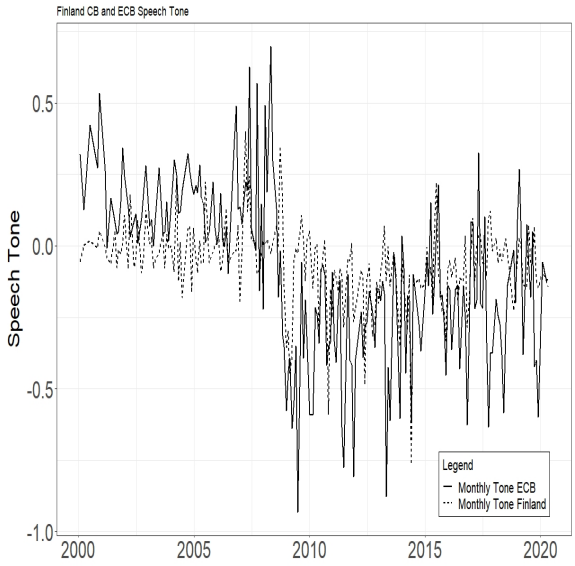

Figure 18: The central bank speech tone is represented by the dotted line whereas the ECB speech tone is presented by the solid line. Both are calculated by summing up the speeches over a month and then extracting tone using the specified methodolgy in this study.

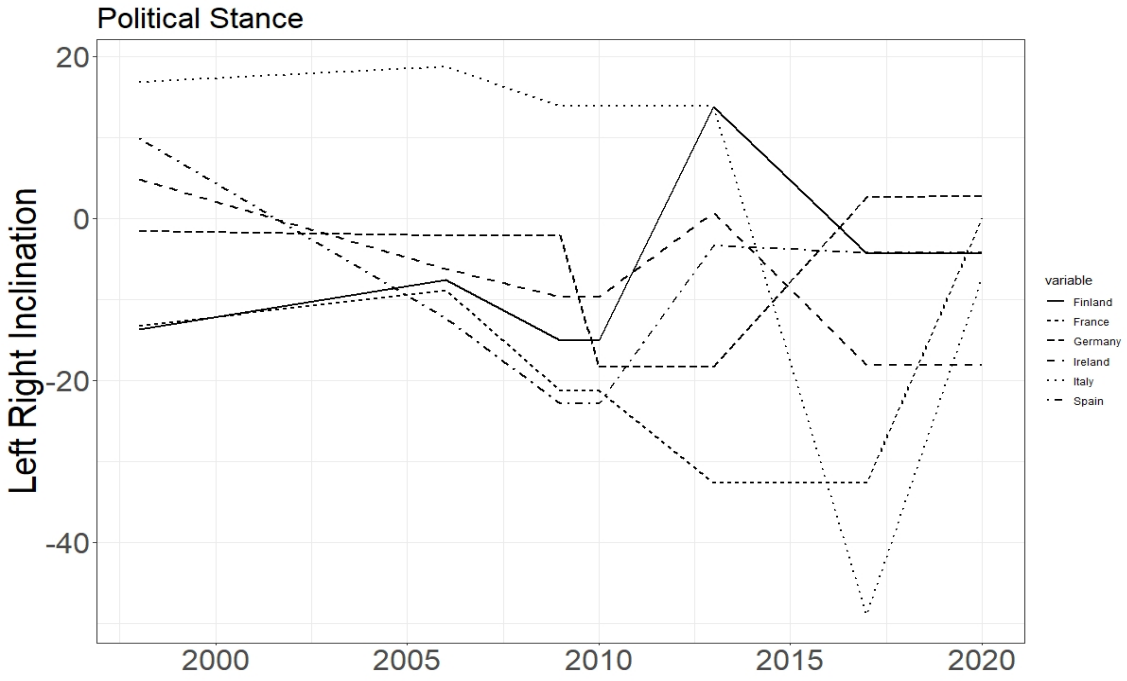

Figure 19: The lines represents the left/right inclination of the majority winning political party for each country. The left inclination is marked by the negative scale and right inclination by the positive scale.

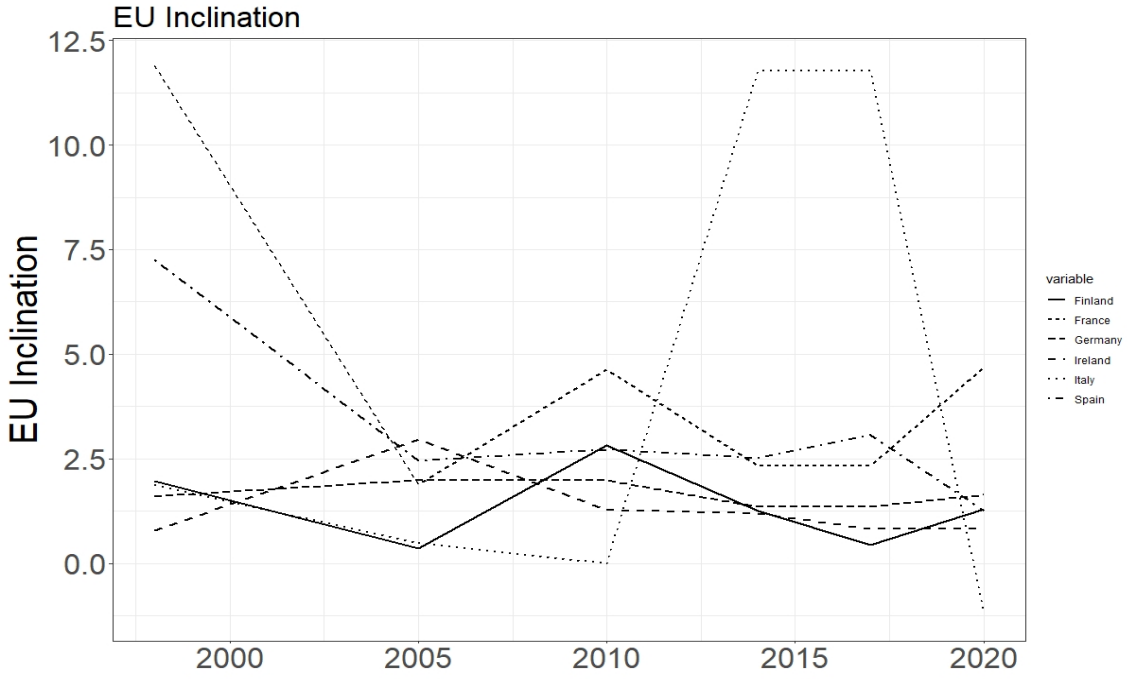

Figure 20: The lines represents the European Union inclination of the six nations used in this study. The inclination is represented by the Y axis.

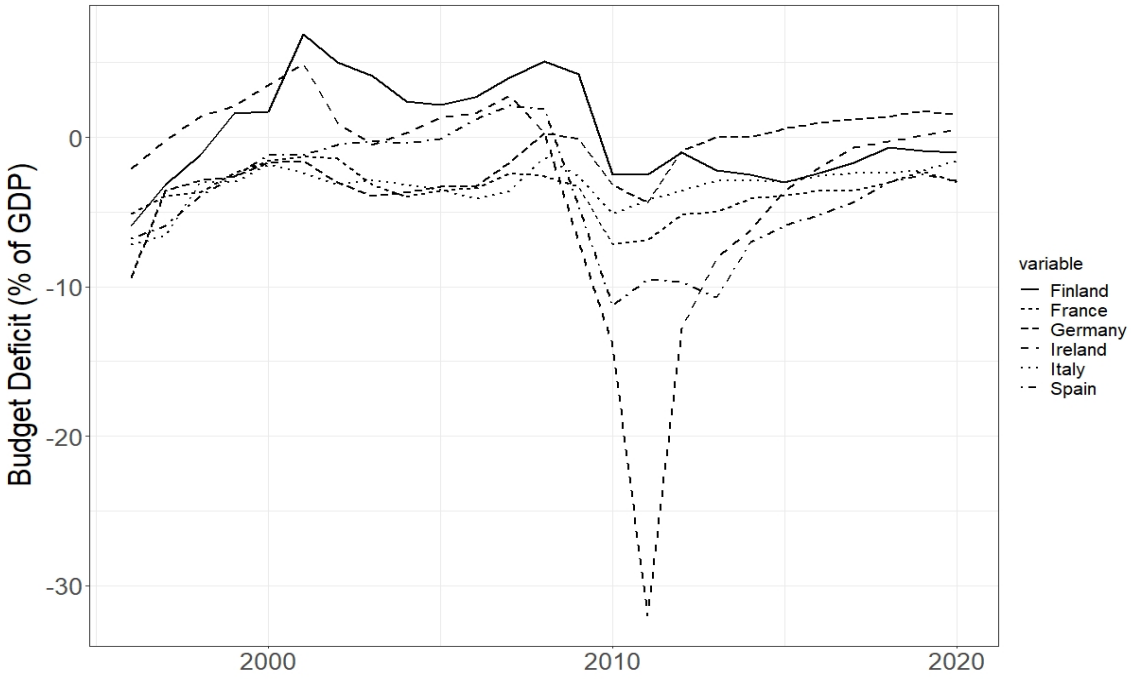

Figure 21: The lines represents the government deficit as a percentage of GDP for the six nations used in this study. The deficit is represented by the Y axis.

Figure 22: 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 23: The lines represents the inflation rate the six nations used in this study. The inflation rate is represented by the Y axis.

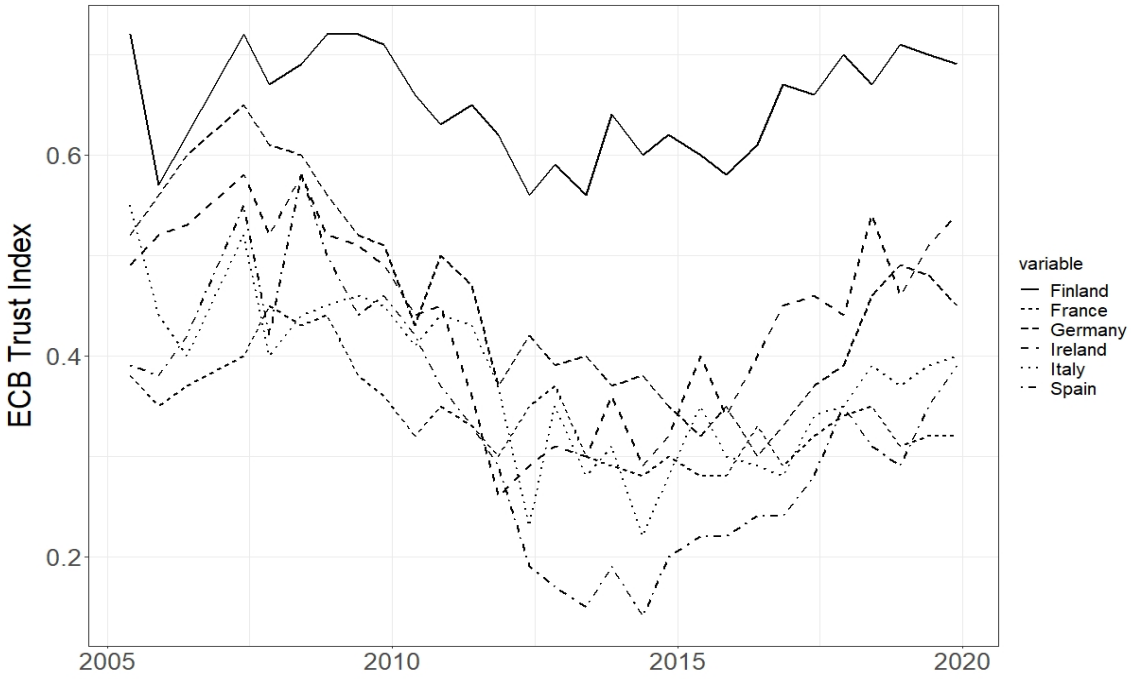

Figure 24: The line for each nation answers the question what percentage of people trust ECB.