Discussion Papers
in Economics

No. 01/2021

Talking in a language that everyone can understand?

Transparency of speeches by the ECB Executive Board

Alexander Glas
FAU Erlangen-Nürnberg

Lena Müller
FAU Erlangen-Nürnberg

ISSN 1867-6707

Friedrich-Alexander-Universität Erlangen-Nürnberg
Institute for Economics
https://www.iwf.rw.fau.de/discussion-papers/

Talking in a language that everyone can understand? Transparency of speeches by the ECB Executive Board

Alexander Glas* and Lena Müller†

February 21, 2021

Abstract

Using novel data on speeches held by members of the European Central Bank's Executive Board, we investigate whether monetary policy transparency has increased over time. With respect to the general public as the target audience, our findings suggest that the European Central Bank successfully improved the frequency and clarity of information provision since its inception. The increase in transparency is gradual, rather than being induced by changes in the Executive Board's composition or major economic events such as the Great Recession. However, the clarity of speeches in recent years is still fairly low. Moreover, our findings indicate that clarity decreased under Christine Lagarde's presidency following the outbreak of the Coronavirus pandemic. We conclude that while the European Central Bank was able to increase transparency over time, further improvements in clarity are required to make monetary policy truly accessible to the broad public.

JEL classification: E52, E58
Keywords: Central Bank Communication, Monetary Policy Transparency, Clarity, Readability.

*School of Business, Economics and Society, FAU Erlangen-Nürnberg, Lange Gasse 20, 90403 Nuremberg, Germany, email: alexander.glas@fau.de, phone: +49 (0) 911 5302 278.

†Corresponding author. School of Business, Economics and Society, FAU Erlangen-Nürnberg, Lange Gasse 20, 90403 Nuremberg, Germany, email: lena.sophia.mueller@fau.de, phone: +49 (0) 911 5302 271.

1 Introduction

> "*Since I've become a central banker, I've learned to mumble with great incoherence. If I seem unduly clear to you, you must have misunderstood what I said.*" (Quote by Alan Greenspan when talking to reporters in 1987.)

> "*We will be open, transparent and accessible. We will try to talk in a language that everyone can understand.*" (Quote from a speech held by Christine Lagarde in 2020.)

The quotes above highlight a shift in central bankers' attitude in terms of disclosing information about monetary policy to the general public. In earlier decades, it was widely accepted that communications about monetary policy decisions are limited and purposefully vague. Besides reflecting a general culture of opaque central bankers (cf. Brunner, 1981), early theoretical models of public communication served as evidence that disclosing too much information may not be socially optimal (see Cukierman and Meltzer, 1986; Morris and Shin, 2002). Although the assumptions underlying these models have been criticized as unrealistic (e.g., Svensson, 2006; Gosselin et al., 2007), the view that central bank communication should be limited persisted for many decades. More recently, however, many central bankers have decided to strive towards greater monetary policy transparency (Hansen et al., 2018). This development aligns with the predictions of Blinder (2018). In particular, Christine Lagarde declared that improving relations with the general public is one of the primary goals during her tenure as president of the European Central Bank (ECB). A natural question is to ask whether this change in attitude is reflected in the way central banks actually communicate with the public.

In this paper, we investigate whether the ECB's communications have become more accessible to the broad public over time. Our analysis is based on a dataset of speeches held by members of the ECB's Executive Board during the period 1999 – 2020. Whereas most previous studies analyze the contents of central bank communications, we investigate *how* the ECB communicates. In particular, we examine the frequency and comprehensibility of each transcript by using popular readability indices. These aspects of the ECB speeches have not been analyzed so far.

Central banks may use communication channels to inform households about the current and expected future state of the economy, the objectives behind monetary policy decisions (including its policy function) and implementation strategies. There are two reasons for why a central bank may wish to convey these types of information to the public. First, central banks increasingly act as political leaders rather than merely as technocratic bureaucrats (Blinder et al., 2008). For example, the ECB employed forward guidance to guide the euro area during the sovereign debt crisis. In such cases, higher transparency increases the democratic legitimacy of a central bank. Second, improved communications enhance the effectiveness of monetary policy. Importantly, a central

bank may wish to better influence inflation expectations by explaining the rationale behind specific policy decisions. A better understanding of the central bank's goals can help align individual expectations and thus reduce the disagreement among economic agents. This increases the likelihood of stabilizing long-term expectations around the inflation target. Anchored expectations improve the central bank's ability to steer actual inflation rates and thus increase its chances of achieving price stability. Based on the growing importance of steering expectations, higher monetary policy transparency is generally seen as desirable. Due to extensive press coverage and the opportunity to tailor contents to specific audiences, speeches provide a unique and timely channel through which a central bank can influence public opinion and behavior.

According to the definition of the ECB, "transparency means that the central bank provides the general public and the markets with all relevant information on its strategy, assessments and policy decisions as well as its procedures in an open, clear and timely manner."[1] Thus, transparent communication requires the provision of all relevant information (i.e., *content*) at a sufficiently high *frequency* and a choice of words that conveys the message with the appropriate *clarity*. While several studies on central bank communication focus on the *content*-component (see below for an overview), we focus on the other aspects of transparency which are frequently disregarded. Broadly speaking, the *frequency*- and *clarity*-components are complements: Increasing the amount of opaque communications is no more likely to affect the behavior of economic agents than clear but scarce communications. However, the relative importance of each component varies with the target audience. In particular, while it may be acceptable to neglect the *clarity* of communications when focusing on central bank watchers and other experts, the same may not be true in case of the broad public. There is ample evidence to suggest that households are less receptive to the information provided by central bankers than experts. This conjecture can be rationalized through the lens of rational inattention: Households perceive benefits of absorbing central bank communication to be rather small and perceived costs to be high, e.g., because of low financial literacy (Blinder, 2018). Blinder (2008) notes that clearer communications have higher signal-to-noise ratios, which facilitates the extraction of the core messages the central bank attempts to convey. Thus, increases in the clarity of communications are a key channel through which central banks can reduce households' perceived costs of attention. We approximate the clarity of ECB speeches with *conciseness* (i.e., their length) and the *readability* of their transcripts based on the widely-used Flesch-Kincaid grade level (Kincaid et al., 1975).

We find that the frequency of speeches has increased over the lifetime of the ECB. The average number of speeches per month nearly doubled between 1999 and 2020. With respect to clarity, we find that the average length of a speech has declined considerably over the same period. Moreover, our findings indicate that the increase in conciseness has

[1] See `https://www.ecb.europa.eu/ecb/orga/transparency/html/index.en.html`

been accompanied by a steady rise in readability. The average years of schooling required to understand an ECB speech declined by approximately two years. Taken together, we conclude that in recent years the ECB has provided a steadily increasing quantity of information that is presented in a more concise and comprehensible way. Our findings are robust to controlling for the macroeconomic environment or changes in the ECB's personnel and pass various robustness checks. However, with almost 14 required years of schooling the overall difficulty of speeches has still been high in recent years. Moreover, we find that readability *decreased* in early 2020, negating the improvements achieved during the first few months of Lagarde's presidency. Our results suggest that it may take time before the ECB can hope to successfully connect with households.

The remainder of the paper is organized as follows: The related literature is discussed in Section 2. Section 3 describes the data. In Sections 4 and 5, we analyze the frequency- and clarity-components of transparency based on the ECB speeches. The robustness of our findings is assessed in Section 6. Section 7 summarizes and concludes.

2 Literature on central bank communication

Our research relates to the literature on the effectiveness of central bank communication. The majority of studies focus on financial markets. See Blinder et al. (2008) for a review of the early literature. More recent examples include Jansen (2011a), Campbell et al. (2012), Du et al. (2018) and Seelajaroen et al. (2019). These studies typically find that central bank announcements successfully move asset prices and financial market expectations in the desired direction. The findings for the effects of central bank communication on household expectations are more pessimistic. Due to a lack of high-frequency survey data, most studies focus on U.S. data. Binder (2017) provides an excellent overview. Prominent studies include Lamla and Vinogradov (2019) and Coibion et al. (2019).[2] Based on a survey of German households, Conrad et al. (2020) show that the inflation expectations of households who state that they inform themselves about monetary policy directly via ECB communications do not differ from those of households who do not inform themselves.[3]

The rational inattention literature proposes that households weigh perceived benefits and costs of following central bank communications. While the former are rather small, the latter are relatively high due to the difficult technical jargon used by many central bankers and insufficient economic literacy of households (Binder, 2017). As a result, the general public often lacks even the most basic knowledge of the decision-makers and goals

[2]Kumar et al. (2015) and Coibion et al. (2018) find evidence of inattentiveness of firm managers in New Zealand to the central bank's inflation target and note that the responses of the surveyed firm managers closely resemble those of households.

[3]On a more positive note, Dräger et al. (2016) find some evidence that direct channels of central bank communication increase the likelihood that the expectations of experts and households are consistent with theoretical economic relationships such as the Taylor rule or the Phillips curve.

of its central bank.[4] For example, van der Cruijsen et al. (2015) document a weak desire of Dutch households to be informed about the ECB's objectives. However, they also find that more intensive usage of information channels of central bank communication enhances an individual's understanding of the ECB and improves the ability to form reasonable inflation expectations. Similar evidence is documented in Coibion et al. (2019).

Ehrmann et al. (2013) show that citizen's trust in the ECB has eroded since the outbreak of the financial crisis. This is explained via a combination of the economic downturn, a general loss of confidence in European institutions and the fact that the ECB is associated with the (badly perceived) banking sector. However, they also find that trust is higher among citizens who state that they have heard about the ECB before. Similarly, Haldane and McMahon (2018) document positive correlations between household's satisfaction in central banks' actions, institutional understanding and central bank credibility. Importantly, Haldane and McMahon (2018) focus on a recent communication initiative by the Bank of England (BoE), which launched a new, broader-interest version of its quarterly Inflation Report that features considerably higher text accessibility. The new content was perceived to be easier to read and understand by households. As a result, activity on the BoE's website more than doubled. Those who read the new content developed an improved perception of the BoE, which in turn enhanced their ability to form inflation expectations. These considerations suggest that better communication strategies may help to break through the 'veil of inattention' (Coibion et al., 2018).[5]

As discussed above, another strand of literature focuses on variation in the content-component of transparency using the ECB speeches. These studies employ tools of quantitative text analysis such as topic modeling. Ferrara (2019) uses a combination of automated text classification and unsupervised scaling methods to detect ideational variation in the speeches of Executive Board members. His findings suggest that the ECB has become progressively more open to economic ideas by stressing the systemic – rather than fiscal – nature of the euro crisis. Moschella et al. (2020) show that the ECB reacts to negative public opinion by focusing on a wider range of topics beyond those related purely to monetary policy. Tillmann and Walter (2019) construct tone scores for speeches by the presidents of the ECB and the Bundesbank. They show that a higher tone divergence is positively related to the level of policy uncertainty, market volatility and risk premia in the euro area. Tortola and Pansardi (2019) find that the ECB president has emerged as a charismatic leader since the financial crisis. In contrast, we focus on the clarity of the language used by Executive Board members. This is relevant because the impact of a speech is likely negligible if it is conveyed in a language the public does not understand. To our knowledge, we are the first to analyze this feature of the ECB speeches.

[4] A negative consequence of the failure to directly connect with households is that central banks are dependent on (correct) dissemination of news via the media (Dräger et al., 2016).

[5] In an experimental setting, Kryvtsov and Petersen (2019) show that household expectations react most strongly to simple and relatable (backward-looking) messages.

3 Data

We use novel data about speeches published by the ECB.[6] The data contain transcripts of all speeches by members of the ECB's Executive Board since 1997. Our analysis is based on the mere body of the transcripts, i.e., we exclude other elements such as the title, subtitle or references. In total, the raw dataset includes 2,533 speeches up to the most recent update considered in our analysis (January 05, 2021).

The sample size is affected by a number of data limitations. First, we discard all speeches for which only slides but no transcript was published. Second, the euro area formally came into existence with the official launch of the euro on January 01, 1999. Therefore, we exclude speeches held during the years 1997 and 1998.[7] Third, a few speeches were held in languages other than English, most commonly in German or Spanish. Since it is not straightforward to compare readability across languages, we focus exclusively on speeches held in English.[8] In addition, we discard two speeches that combine English and other languages. Fourth, we consider only speeches held by one speaker, i.e., we exclude the joint speech by Willem Duisenberg and Eugenio Solans from August 30, 2001. The final data set includes 2,169 speeches held by 24 speakers between January 14, 1999 and December 16, 2020 (a period of 8,008 days). Figure 1 depicts the allocation of speeches according to speaker and president in office, sorted by the date of each speaker's first speech.

The data covers the mandates of all ECB presidents since its foundation, chronologically that is Wim Duisenberg (January 01, 1999 – October 31, 2003), Jean-Claude Trichet (November 01, 2003 – October 31, 2011), Mario Draghi (November 01, 2011 – October 31, 2019) and Christine Lagarde (since November 01, 2019). In addition to the president, the Executive Board consists of the vice-president, the chief economist and three additional members. Usually, all board members are replaced along with the ECB president. Thus, the data can be interpreted as a rotating panel. The six-member Executive Boards are clearly visible along the respective president's tenure in Figure 1. A notable exception is the unscheduled withdrawal from the Executive Board by Jörg Asmussen in 2014 and the subsequent entry of his successor Sabine Lautenschläger.

4 Frequency of central bank communication

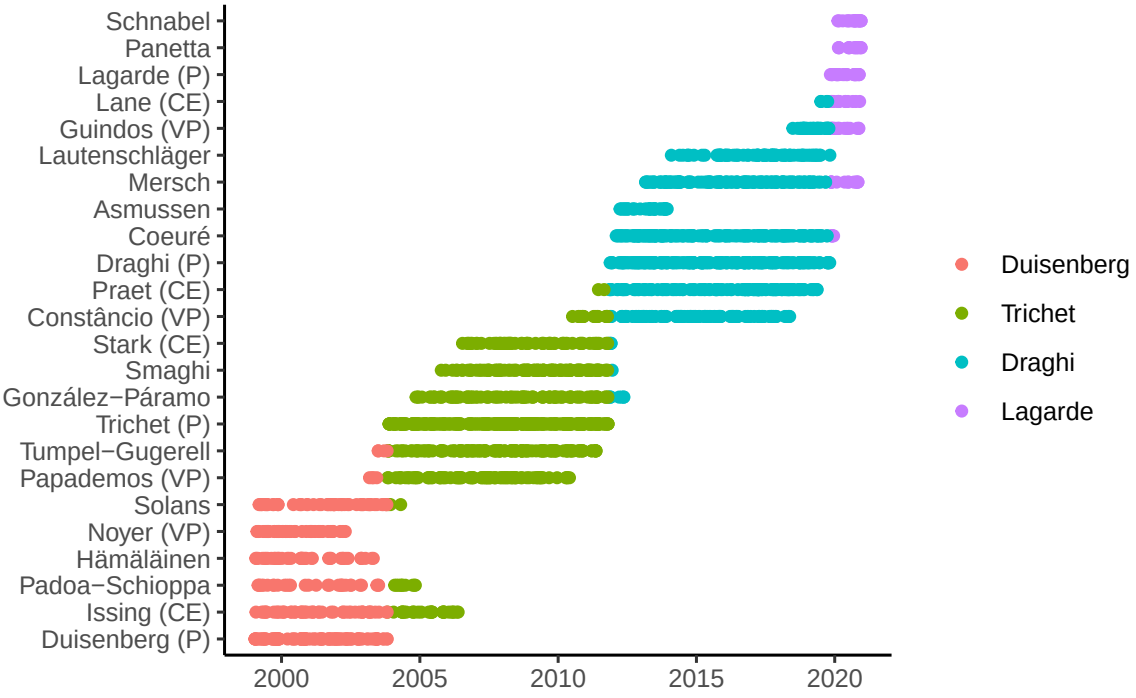
In this section, we examine the frequency of speeches by the ECB's Executive Board. Figure 2 shows that the number of speeches per year is generally upward trending but

[6] European Central Bank. (last accessed: February 02, 2021). Speeches dataset. Retrieved from: `https://www.ecb.europa.eu/press/key/html/downloads.en.html`

[7] Our findings are robust to the inclusion of the speeches held in 1997 and 1998. Results are available upon request from the authors.

[8] The number of non-English speeches steadily declined from 12.4% in 1999 to 0.7% in 2017 and equals zero thereafter.

Figure 1: Speeches held by ECB Executive Board members



Notes: This figure shows speeches held by Executive Board members. Distinct colors represent the individual presidencies. Abbreviations 'P', 'VP' and 'CE' indicate the ECB president, vice-president and chief economist, respectively. The sample period is January 14, 1999 – December 16, 2020.

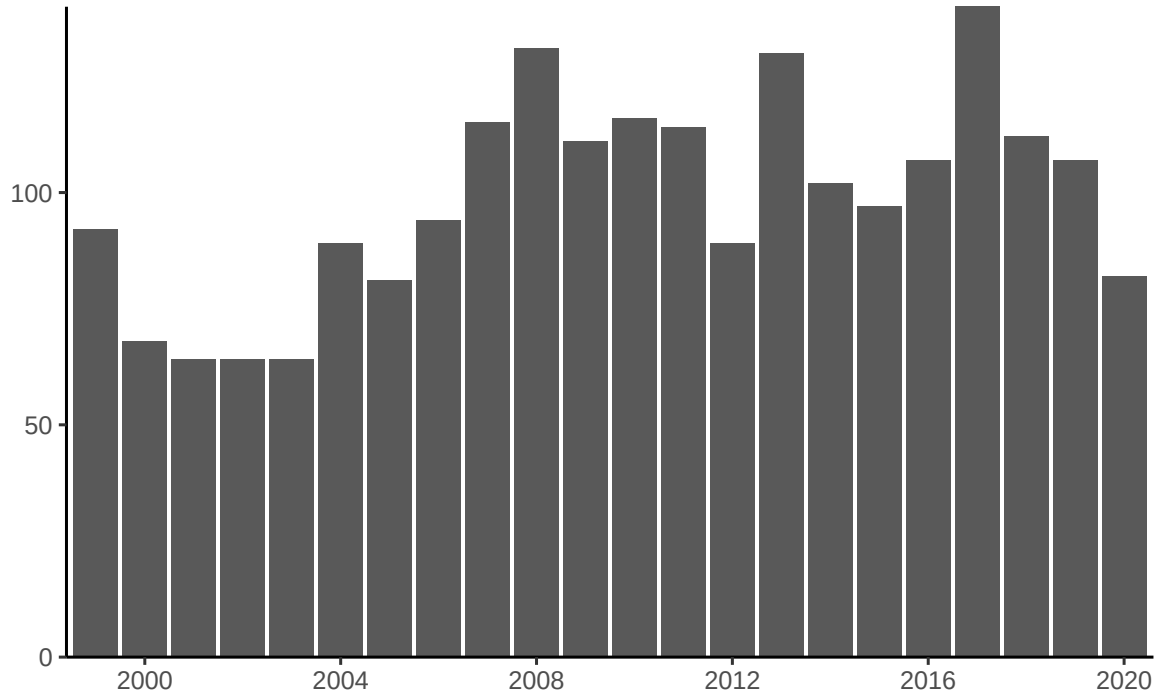
with occasional breaks (e.g., in 2012 or 2020). With usually more than 100 speeches per year since 2007, the ECB communicates more frequently with the public relative to the years following its inception. For comparison, the Federal Board of Governors of the Fed held on average 63 speeches per year in the period from 2006 to 2016 (Moschella and Pinto, 2019). Notably, communications spiked during the years 2008, 2013 and 2017, which coincide with the financial crisis, the sovereign debt crisis and the aftermath of the Brexit referendum as well as the election of Donald Trump as U.S. president. The number of speeches held is not distributed uniformly among the 24 speakers (see Figure A.1 in the Appendix). Throughout, the presidents had the highest numbers when considering only those speakers that are not members of the current Executive Board.

In order to test whether the increase in the quantity of speeches is statistically significant, we run regressions of the form

$$s_m = \alpha + \beta m + \mathbf{x}_m'\boldsymbol{\gamma} + \varepsilon_m, \tag{1}$$

where s_m denotes the number of speeches held in month $m = 1, \ldots, 264$, $\mathbf{x}_m$ is a vector of control variables and ε_m is the error term. We focus on monthly data in Eqn. (1) to maintain an appropriate sample size while ensuring that there is sufficient variation in the number of speeches across periods. The parameter of principal interest is β, i.e., the

Figure 2: Number of speeches by year



Notes: For each year, this figure depicts the number of speeches held by members of the ECB's Executive Board. The sample period is January 14, 1999 – July 31, 2020.

slope coefficient associated with the monthly time trend. The prediction of Blinder (2018) that central banks increase their efforts to communicate with the public translates into the testable hypothesis H_0: $\beta \leq 0$ against H_1: $\beta > 0$.

To account for changes in the current macroeconomic environment, which is both time-varying and may affect how much the ECB communicates, we include the unemployment rate, u_m, and absolute deviations of the inflation rate, π_m, from the inflation target,

$$|\tilde{\pi}_m| = |\pi_m - 1.9|, \tag{2}$$

as control variables in the vector $\mathbf{x}_m$.[9,10] In similar regressions based on biannual data, Jansen (2011b) includes the macroeconomic forecasts reported at the Humphrey-Hawkins testimonies as well as the uncertainty associated with the macroeconomic outlook to control for the content of speeches. In case of speeches delivered by the ECB's Executive Board members, speakers do not provide macroeconomic expectations on a regular basis and even if they do, the predictions are usually qualitative in nature. To account for the forward-looking component of monetary policy, we use data from the ECB's Survey

[9]Data on macroeconomic variables is taken from Eurostat (last accessed: February 02, 2021.)

[10]Unlike Jansen (2011b), we include the unemployment rate instead of real GDP growth because the former is observed at the monthly frequency.

of Professional Forecasters (SPF), a quarterly survey of macroeconomic expectations in the euro area among experts from financial and research institutions.[11] In particular, $\mathbf{x}_m$ includes the absolute difference between the average four-quarter-ahead inflation forecast, $E(\pi_{q+4|q})$, and the inflation target,

$$|E(\tilde{\pi}_{q+4|q})| = |E(\pi_{q+4|q}) - 1.9|. \tag{3}$$

We also include the average standard deviation of the SPF histogram forecasts for inflation, $\bar{\sigma}_{q+4|q}$, as a measure of inflation uncertainty. To derive the latter, we assume that the probabilities reported for each outcome interval in the survey questionnaire are centered at the interval midpoint.[12] We account for differences in the frequency of communications during economic downturns and upswings by including the recession indicator D_m^{Rec}, which equals unity if month m is part of a recession quarter, and zero otherwise.[13] To absorb any shocks induced by the replacement of Executive Board members, we include the dummy variables $D_m^{Trichet}$, D_m^{Draghi} and $D_m^{Lagarde}$ for the various ECB presidents with Wim Duisenberg serving as the reference group.

We estimate the parameters in Eqn. (1) by ordinary least squares (OLS) and apply the variance-covariance estimator of Newey and West (1987) to account for arbitrary levels of heteroskedasticity and autocorrelation in the data. Table 1 presents the estimates. To test whether the slope coefficient on the trend is significantly positive, we additionally report one-sided p-values for H_0: $\beta \leq 0$ at the bottom of the table.

The estimate of β is significantly positive at the 1% significance level throughout all columns in Table 1. The effect size is also economically significant. When taken at face value, the estimates in column (1) suggest that the predicted number of speeches per month increased from approximately six in 1999 to ten at the end of 2020. Thus, the number of speeches has almost doubled. The magnitude of this effect is the same or even larger across the specifications in the remaining columns. Thus, we conclude that the ECB considerably increased the frequency of its communications with the public over its lifespan. The estimates for the control variables suggest that the ECB communicates less frequently at times when inflation deviates more strongly from the inflation target. This may be because the ECB needs time to prepare and implement adequate monetary policy measures to counter the rising pressure on price stability and postpones communications

[11] `https://www.ecb.europa.eu/stats/ecb_surveys/survey_of_professional_forecasters/html/index.en.html`

[12] In alternative regressions, we have used monthly averages of the KOF Monetary Policy Communicator instead of the SPF expectations to control for expected future path of inflation. The continuous index quantifies the ECB's communication of risks regarding future price stability. It takes values between -1 and $+1$ with negative (positive) values indicating downward (upward) pressure on prices. The results are very similar in this case and will be provided upon request by the authors.

[13] The recession classification is based on Eurostat's Business Cycle Clock (`https://ec.europa.eu/eurostat/cache/bcc/bcc.html`). Based on this definition, three recession periods are identified in our sample: 2008Q1 – 2009Q2, 2011Q3 – 2013Q1 and 2020Q1 – 2020Q2.

with the public until it has decided on the optimal strategy. In contrast, the number of speeches is higher when expected inflation deviates from the target and at times of heightened inflation uncertainty.

In sum, the evidence from this section indicates that the ECB's Executive Board members communicate more frequently in recent years. Therefore, our findings support the hypothesis of Blinder (2018) with respect to the frequency-component of transparency. In the next section, we turn our attention to the clarity-component.

Table 1: Trend in the monthly frequency of ECB speeches

	Dependent variable: Number of speeches per month (s_m)				
	(1)	(2)	(3)	(4)	(5)
m	0.014***	0.014***	0.017***	0.017***	0.024***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.008)
u_m		0.134	0.346	0.358	0.260
		(0.246)	(0.215)	(0.225)	(0.206)
$\lvert\tilde{\pi}_m\rvert$		−0.723*	−0.642*	−0.645*	−0.568*
		(0.404)	(0.359)	(0.340)	(0.302)
$\lvert E(\tilde{\pi}_{q+4\lvert q})\rvert$			2.908*	3.052*	2.017
			(1.582)	(1.740)	(1.350)
$\bar{\sigma}_{q+4\lvert q}$			4.583***	4.800***	2.644*
			(1.194)	(1.628)	(1.417)
D_m^{Rec}				−0.268	0.118
				(1.116)	(0.915)
$D_m^{Trichet}$					0.770
					(0.626)
D_m^{Draghi}					−1.023
					(1.181)
$D_m^{Lagarde}$					−3.131*
					(1.763)
Constant	6.397***	6.441**	−4.387	−4.886	−1.044
	(0.569)	(2.510)	(3.939)	(5.001)	(4.546)
p-value (H_0: $\beta \leq 0$)	0.000	0.000	0.000	0.000	0.001
Observations	264	264	264	264	264
Adjusted R^2	0.046	0.044	0.060	0.057	0.065

Notes: This table depicts the estimates of Eqn. (1). The estimation sample covers the period January 14, 1999 – December 16, 2020. We estimate parameters by OLS. To account for arbitrary levels of heteroskedasticity and autocorrelation we report Newey-West (1987) standard errors in parentheses. Asterisks '*', '**' and '***' indicate significance at the 10%, 5% and 1% critical level, respectively.

Table 2: Summary statistics for characteristics of ECB speeches

	Full sample (Obs. = 2169)	W. Duisenberg 01.01.99–31.10.03 (Obs. = 337)	J.C. Trichet 01.11.03–31.10.11 (Obs. = 847)	M. Draghi 01.11.11–31.10.19 (Obs. = 879)	C. Lagarde 01.11.2019–today (Obs. = 106)
#words per speech					
Mean	2896.77	3583.13	3094.17	2517.73	2280.51
SD	1700.96	2659.55	1494.06	1317.25	1094.50
#sentences per speech					
Mean	122.05	143.94	125.95	112.66	99.22
SD	68.99	106.27	59.13	58.82	45.86
#syllables per speech					
Mean	5418.46	6627.71	5845.68	4680.52	4279.50
SD	3096.34	4541.31	2857.61	2445.30	2032.88
Flesch-Kincaid grade level					
Mean	14.6	15.22	15.11	13.89	14.35
SD	1.93	1.48	1.77	2.04	1.54

Notes: This table presents mean and standard deviation of the number of words, sentences and syllables per speech as well as the Flesch-Kincaid grade level for the sample from January 14, 1999 to December 16, 2020.

5 Clarity of central bank communication

In this section, we analyze the clarity of ECB speeches. Section 5.1 focuses on conciseness, whereas Section 5.2 investigates readability. Section 5.3 provides a critical discussion of our results with a focus on recent developments in ECB communication.

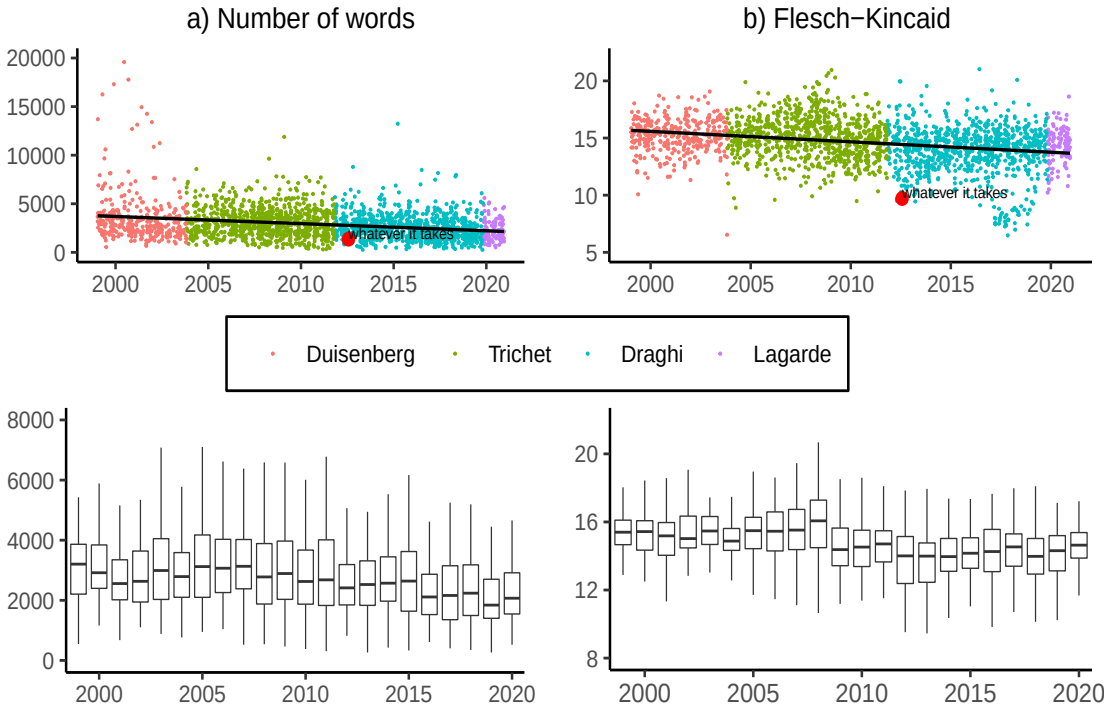
5.1 Conciseness of ECB speeches

Text length is a widely used proxy for conciseness (e.g., Melloni et al., 2017). To evaluate the length of ECB speeches, Table 2 reports summary statistics for textual characteristics based on the full sample as well as individual presidencies.

The average speech in the data set consists of approximately 120 sentences and close to 3,000 words. Moreover, the length of speeches declined over time. Speeches at the time of Wim Duisenberg's presidency were on average almost 3,600 words long. Compared to that, the average speech held by Christine Lagarde's Executive Board is considerably shorter with a little less than 2,300 words. Considering that a person holding a lecture articulates approximately 140 words per minute, the average duration of a speech fell by an estimated time of more than nine minutes (cf., Tauroza and Allison, 1990).

Panel a) of Figure 3 shows that the decrease in the number of words per speech has been rather gradual. The solid line in the upper panel is obtained by regressing the number of words per speech on a constant and a time trend. The lower panel provides year-specific boxplots for the number of words per speech (excluding all outliers).

Figure 3: Clarity of ECB speeches



Notes: Panel a) depicts the number of words per speech and panel b) the Flesch-Kincaid grade level of each speech. Distinct colors represent the individual presidencies. The solid black lines represent linear regressions of the respective measure on a constant and a time trend. The plots at the bottom show year-specific boxplots excluding all outliers. The sample period is January 14, 1999 – December 16, 2020.

Notably, there are a few extremely long speeches exceeding 10,000 words. Most of these were held under the presidency of Willem Duisenberg. In June 2000, Duisenberg held the longest speech included in the data set, reaching almost 20,000 words. Generally speaking, speech length varies considerably across speakers and within one speaker without apparent systematic pattern (see Figure A.1). The red dot in Figure 3 highlights Draghi's 'whatever it takes' speech, which was relatively short compared to most other speeches.

To formally test if the reduction in the number of words per speech depicted in Figure 3 is statistically significant, we consider the linear regression model

$$\#words_{it} = \alpha + \beta t + \mathbf{x}_t'\boldsymbol{\gamma} + \lambda_i + \varepsilon_{it}, \tag{4}$$

where $\#words_{it}$ is the number of words contained in the speech by speaker $i = 1, \ldots, 24$ on day $t = 1, \ldots, 8008$ and λ_i denotes a speaker-fixed effect. As in Section 4, the parameter of interest is the coefficient on the time trend, β. The expectation of higher conciseness of communications translates into the hypotheses pair H_0: $\beta \geq 0$ against H_1: $\beta < 0$. The vector of control variables includes the same covariates as in Eqn. (1). To account for potential differences in the length of speeches given by members of the Executive Board

that are more frequently featured in media reports, we additionally include a dummy variable that equals unity for speeches given by the respective president or chief economist, and zero else. Table 3 presents the estimates of Eqn. (4). Note that the estimates in column (1) correspond to the black line in the upper left panel of Figure 3.

Table 3: Trend in the number of words in ECB speeches

	Dependent variable: Number of words per speech ($\#words_{it}$)						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
t	-0.201^{***}	-0.200^{***}	-0.138^{***}	-0.128^{***}	-0.091	-0.130^{***}	-0.164^{**}
	(0.019)	(0.019)	(0.036)	(0.037)	(0.084)	(0.036)	(0.069)
u_m		10.588	55.290*	63.399**	94.789*	62.108**	50.326
		(21.522)	(31.342)	(31.523)	(50.800)	(31.505)	(42.210)
$\lvert\tilde{\pi}_m\rvert$		-138.237^{*}	-155.196^{**}	-153.568^{**}	-154.900^{**}	-155.392^{**}	-143.731^{*}
		(79.827)	(76.959)	(77.041)	(77.722)	(77.034)	(73.817)
$\lvert E(\tilde{\pi}_{q+4\lvert q})\rvert$			441.686***	493.211***	468.066***	491.896***	526.140***
			(158.026)	(160.596)	(168.498)	(161.582)	(157.719)
$\bar{\sigma}_{q+4\lvert q}$			$-2,634.845^{***}$	$-3,078.100^{***}$	$-3,559.567^{***}$	$-3,057.945^{***}$	$-3,505.033^{***}$
			(958.267)	(995.866)	(1,207.395)	(993.972)	(1,010.384)
D_m^{Rec}				131.715	130.638	134.168	
				(82.185)	(87.185)	(82.221)	
$D_{it}^{Trichet}$					-25.297		
					(212.381)		
D_{it}^{Draghi}					-150.877		
					(370.281)		
$D_{it}^{Lagarde}$					-2.726		
					(398.551)		
$D_{it}^{P/CE}$						-68.385	
						(77.703)	
Constant	3,762.935***	3,899.460***	4,433.618***	4,494.341***	4,374.327***	4,537.666***	5,231.430***
	(101.659)	(264.928)	(295.682)	(301.319)	(356.229)	(293.976)	(507.218)
p-value (H_0: $\beta \geq 0$)	0.000	0.000	0.000	0.000	0.140	0.000	0.009
Speaker fixed-effects	No	No	No	No	No	No	Yes
Observations	2,169	2,169	2,169	2,169	2,169	2,169	2,169
Adjusted R^2	0.068	0.068	0.072	0.072	0.071	0.072	0.145

Notes: This table depicts the estimates of Eqn. (4). The estimation sample covers the period January 14, 1999 – December 16, 2020. We estimate parameters by OLS. To account for arbitrary levels of heteroskedasticity and autocorrelation we report Newey-West (1987) standard errors in parentheses. Asterisks '*', '**' and '***' indicate significance at the 10%, 5% and 1% critical level, respectively.

Based on the p-values reported at the bottom of the table, the hypothesis H_0: $\beta \geq 0$ is rejected in all specifications except column (5). The estimates in column (1) indicate that over the 8,008 days included in our sample, the average number of words per speech declined from almost 3,800 to less than 2,200. We conclude that the ECB speeches have indeed become considerably shorter and more concise over time. The coefficients on $|\tilde{\pi}_m|$ and $|E(\tilde{\pi}_{q+4|q})|$ suggest that speeches by Executive Board members are shorter at times when the inflation rate deviates more strongly from 1.9% but longer when expected inflation deviates from the target.

The relationship between document length and readability is theoretically ambiguous. The usage of more words for describing complicated issues can contribute to comprehensibility on the one hand, shorter speeches require a lower time investment by the listener and thus reduce the cost of attention on the other. Additionally, a concise speech, compared to a long one, is likely to better convey complex points to the listener. Consequently, the importance of the observed downward trend in speech length on the signal-to-noise ratio of ECB communication remains opaque. Therefore, the readability of speeches is a natural candidate to investigate next.

5.2 Readability of ECB speeches

To assess the comprehensibility of the language used in ECB speeches, we rely on so-called readability measures. These statistics are based on various text characteristics such as sentence length, syllables per word or the share of 'easy' words. Thus, they are based purely on objective elements of a text. No subjective judgement of the tone or content of words is needed to classify a document according to its readability. Validation studies have found that they are good predictors of text difficulty (Crossley et al., 2017).

One of the earliest text-based readability measures is the Flesch reading ease score (Flesch, 1948), which is based on average sentence length and word length. An attractive feature of this index is that it is easy to compute. However, the level of the Flesch score has no meaningful interpretation. The widely used Flesch-Kincaid grade level, an extended version of the Flesch score, attributes to a document a value that corresponds to the U.S. grade level needed to fully comprehend a text (Kincaid et al., 1975). The Flesch-Kincaid grade level is defined as

$$FK = 0.39 \cdot \frac{\#words}{\#sentences} + 11.8 \cdot \frac{\#syllables}{\#words} - 15.59. \tag{5}$$

The first expression on the right-hand-side of Eqn. (5) is the average number of words per sentence. The second expression measures the average number of syllables per word. Both higher sentence and word length are associated with lower readability.[14]

[14]We consider the constituent parts of hyphenated words as single words when calculating readability.

More difficult texts require a higher level of schooling and are therefore associated with a higher Flesch-Kincaid grade level. Although the index measures readability in years of U.S. schooling, we retain the original definition of the index for three reasons: First, there is no clear rule that can be used to 'translate' years of U.S. schooling to years of education in other geographical areas. Second, the vastly different educational systems within member countries of the euro area make it next to impossible to decide on a representative schooling system. Third, by using the original definition of the Flesch-Kincaid grade level we are able to compare our findings with those from other studies such as Jansen (2011b).

Table 2 shows that the average Flesch-Kincaid grade level is 14.6 years with a standard deviation of approximately two years. Thus, the overall readability of ECB speeches is low. The mean is in a similar range as the levels previous studies have documented for central bank texts. For example, the Flesch-Kincaid readability of Federal Open Market Committee (FOMC) statements issued by the Federal Reserve ranges from 9 to 14 years (Hernández-Murillo and Shell, 2014). For the Humphrey-Hawkins testimonies given by the Federal Reserve's Chairman, Jansen (2011a) reports a required level of schooling between 14 and 16 years. Focusing on a wider cross-section, Bulíř et al. (2013) analyze the readability of inflation reports and press statements of central banks in six countries plus the euro area. The texts from the majority of central banks, including the ECB, require at least 16 years of schooling and are thus less accessible than the ECB speeches. Only the documents in Sweden, the UK and the Czech Republic are easier to read and require only 12 to 14 years of schooling. Notably, the difficulty of ECB inflation reports and press statements peaked right before the subprime crisis in 2007, followed by a tentative decline. Haldane and McMahon (2018) document a Flesch-Kincaid grade level of 13.4 years for the BoE's quarterly Inflation Reports. In contrast, Haldane and McMahon (2018) find that the new broader-interest version of the report requires only 7.8 years of schooling.

Panel b) of Figure 3 shows that the Flesch-Kincaid grade levels of ECB speeches exhibit a gradual downward trend over the sample period. Although both the average sentence length and the average number of syllables per word have declined over time (see Figure A.2 in the Appendix), the improvements in readability are more strongly attributed to a fall in the average number of words per sentence. Section 6.2 explores the evolution of the constituent parts of the Flesch-Kincaid grade level in more detail. Our finding of a rising readability of ECB speeches contrasts with the evidence for the Federal Reserve. For example, Hernández-Murillo and Shell (2014) find that required schooling for comprehension of the post-meeting statements by the FOMC increased considerably over the period 1994 – 2014. Similarly, Jansen (2011a) notes that the Humphrey-Hawkins testimonies have become increasingly more difficult to read, although his period under consideration (1979 – 2009) overlaps only partially with our data. In contrast to the findings for the U.S., we find that the readability of ECB speeches has *increased* over time.

The downward trend in difficulty of ECB speeches appears to be continuous over the transitional periods between presidents in 2003, 2011 and 2019 or the crises of 2008 and 2012.[15] Nonetheless, Figure 3 documents some heterogeneity in the readability of ECB speeches across presidencies. The maximum Flesch-Kincaid grade level of 21 years was observed during Trichet's presidency, whereas the minimum value of 6.5 is assigned to a speech under Draghi's presidency. Generally speaking, the highest readability levels have been achieved during Draghi's tenure with an average Flesch-Kincaid grade level of 13.9 years (see Table 2). His 'whatever it takes speech' is accessible for readers with at least 9.7 years of schooling. The notable cluster of 40 speeches with distinctively low Flesch-Kincaid grade levels between 2016 and 2019 consists mostly of speeches by Sabine Lautenschläger and a further two by Mario Draghi. Generally speaking, the speeches held by Sabine Lautenschläger yield the lowest Flesch-Kincaid grade levels (see Figure A.1). Notably, the average Flesch-Kincaid grade level under Lagarde's presidency is *higher* than that under Draghi's presidency.[16] This finding is firmly at odds with her explicit target of improving communications with the general public. It is possible that this is at least partly due to the outbreak of the Coronavirus pandemic in 2020 (see Section 5.3).

As before, we use regression analysis to investigate the statistical significance of our findings. Table 4 shows the estimates of Eqn. (4) when we replace $\#words_{it}$ with the Flesch-Kincaid grade level, FK_{it}, associated with the same speech as dependent variable. Christine Lagarde's explicit agenda of 'talking in a language that everyone can understand' translates into the testable hypothesis of a negative slope coefficient on the trend variable. To improve readability, the reported coefficients and standard errors for the time trend are the estimated ones times 1,000. The remaining figures correspond to the actual estimates.

The estimate of β is significantly negative at the 1% level in columns (1)-(7). Using as a benchmark the estimates in column (1), we find that the Flesch-Kincaid grade levels of the ECB's speeches have been predicted to decline from approximately 15.7 to 13.7 years.[17,18] With respect to the control variables, we observe a negative correlation between

[15] In contrast, Bulíř et al. (2013) show that difficulty of ECB press statements only started to decline in 2007. Text difficulty of FOMC statements was particularly accelerated by the period after the financial crisis in 2008/2009 when unconventional monetary policy was introduced and the beginning of Janet Yellen's term as Federal Chair.

[16] Table A.1 in the Appendix shows that the difference in the average Flesch-Kincaid grade levels under Draghi's and Lagarde's presidencies is statistically significant.

[17] To account for the potential influence of outliers we estimate monthly regressions using the median Flesch-Kincaid grade level as the dependent variable. Table A.2 in the Appendix presents the results. These regressions yield significantly negative coefficients on the monthly trend variable. The estimates imply that the median monthly Flesch-Kincaid grade level declined from 15.6 to 14.0 years, which is close to our findings based on the daily data. Note that we lose two observations due to a lack of speeches in August 2006 and January 2012.

[18] We also estimate regressions using the Flesch score, $F = 206.835 - (1.015 \cdot \#words/\#sentences) - 84.6 \cdot (\#syllables/\#words)$, instead of the Flesch-Kincaid grade level. Figure A.3 shows graphical summaries and Table A.3 presents the estimates. We obtain very similar results with opposite signs of the coefficient estimates. This is to be expected given that the Pearson correlation coefficient between the Flesch score and the Flesch-Kincaid grade level is -0.95.

the Flesch-Kincaid grade level and the unemployment rate. This finding suggests that the central bank attempts to send simple messages at times when unemployment is rising. However, the coefficient on the recession indicator is significantly *positive*, which implies that readability is low during contractions in real economic activity. This may serve as

Table 4: Trend in the Flesch-Kincaid grade level of ECB speeches

	Dependent variable: Flesch-Kincaid grade level (FK_{it})						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
t	−0.250***	−0.229***	−0.309***	−0.271***	−0.346***	−0.271***	−0.286***
	(0.023)	(0.023)	(0.052)	(0.051)	(0.106)	(0.051)	(0.083)
u_m		−0.199***	−0.258***	−0.229***	−0.228***	−0.229***	−0.236***
		(0.037)	(0.049)	(0.046)	(0.065)	(0.046)	(0.055)
$\lvert\tilde{\pi}_m\rvert$		0.012	0.007	0.012	0.020	0.012	0.041
		(0.118)	(0.118)	(0.115)	(0.110)	(0.115)	(0.092)
$\lvert E(\tilde{\pi}_{q+4\lvert q})\rvert$			0.165	0.349*	0.454**	0.348*	0.392**
			(0.182)	(0.187)	(0.197)	(0.187)	(0.171)
$\bar{\sigma}_{q+4\lvert q}$			2.192	0.614	0.934	0.620	0.974
			(1.438)	(1.474)	(1.722)	(1.476)	(1.340)
D_t^{Rec}				0.469***	0.352***	0.470***	
				(0.117)	(0.124)	(0.116)	
$D_{it}^{Trichet}$					0.625***		
					(0.225)		
D_{it}^{Draghi}					0.511		
					(0.420)		
$D_{it}^{Lagarde}$					0.793		
					(0.487)		
$D_{it}^{P/CE}$						−0.021	
						(0.089)	
Constant	15.670***	17.408***	17.129***	17.345***	16.973***	17.358***	17.528***
	(0.107)	(0.430)	(0.471)	(0.461)	(0.450)	(0.462)	(0.631)
p-value (H_0: $\beta \geq 0$)	0.000	0.000	0.000	0.000	0.001	0.000	0.000
Speaker fixed-effects	No	No	No	No	No	No	Yes
Observations	2,169	2,169	2,169	2,169	2,169	2,169	2,169
Adjusted R^2	0.081	0.100	0.101	0.108	0.115	0.108	0.108

Notes: This table depicts the estimates of Eqn. (4) when we use the Flesch-Kincaid grade level, FK_{it}, as the dependent variable. The estimation sample covers the period January 14, 1999 – December 16, 2020. We estimate parameters by OLS. To account for arbitrary levels of heteroskedasticity and autocorrelation we report Newey-West (1987) standard errors in parentheses. Trend coefficients and standard errors are multiplied by 1000. Asterisks '*', '**' and '***' indicate significance at the 10%, 5% and 1% critical level, respectively.

an indication that there is a tradeoff between communicating clearly and the necessity to implement and justify complex policy measures aimed at improving macroeconomic conditions. We explore this possibility in the next section.

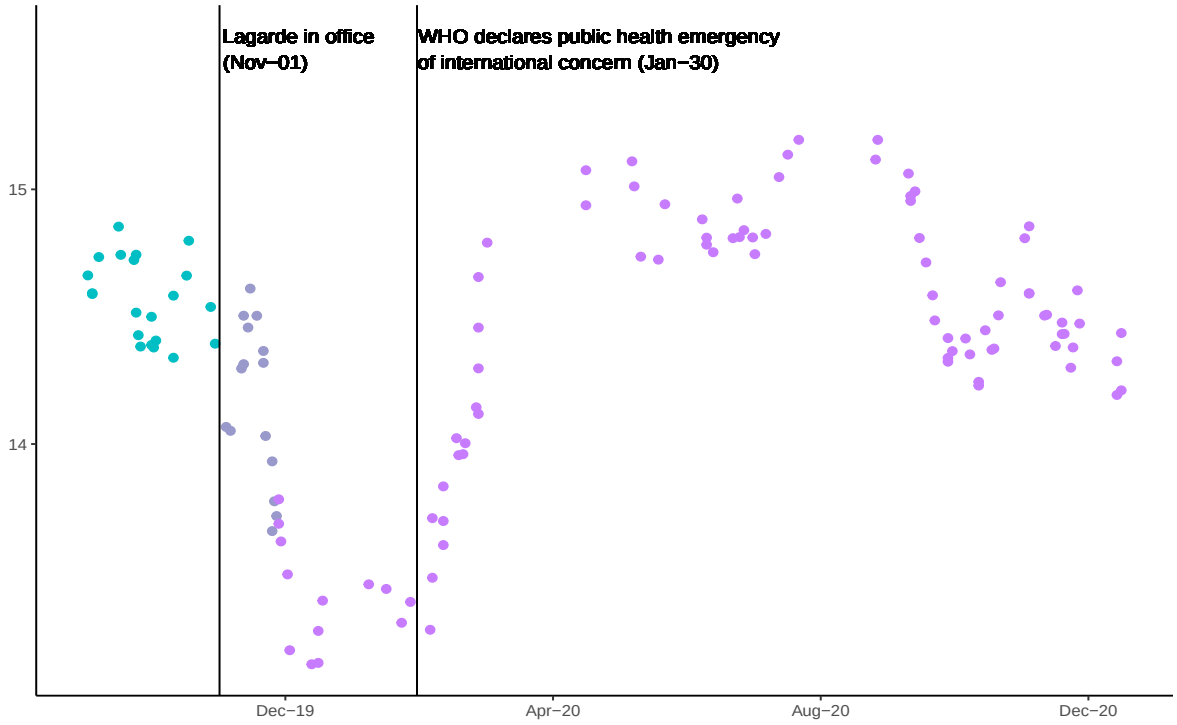
5.3 Discussion of results

Overall, the evidence from the previous sections supports the prediction of Blinder (2018) that central banks intensify their attempts to communicate in a way that is accessible to the general public. In particular, members of the Executive Board communicate more frequently than in the past, delivering speeches that are more concise and easier to understand by non-experts.

However, there are two caveats to our findings. First, the readability of speeches is relatively low even in recent years. On average, it takes 14.3 years of schooling to understand a speech of an Executive Board member during Christine Lagarde's presidency (see Table 2). For comparison, this is almost twice as much as is required when reading the BoE's new broader-interest version of its Inflation Reports. Second, the evidence suggests that Christine Lagarde has not succeeded in sustaining the trend towards clearer communications observed for each of her predecessors. In fact, readability has declined during her tenure compared to that of Mario Draghi. It is possible that the ECB was forced to abandon or delay its plans to improve communications with the public once the Coronavirus pandemic started to affect the euro area. To explore this possibility, Figure 4 depicts rolling averages of the Flesch Kincaid grade levels shortly before and during Lagarde's presidency. Each dot represents the average across the Flesch-Kincaid grade levels of the corresponding speech and the 14 preceding speeches.

Figure 4 shows that speeches held during the final two months of Mario Draghi's presidency are associated with a Flesch-Kincaid grade level of approximately 14.5 years. In line with Christine Lagarde's original agenda, we document a notable increase in readability after she became president in November 2019. Over the following three months, the average Flesch-Kincaid grade level fell by almost 1.5 years. The World Health Organisation (WHO) declared the Coronavirus a Public Health Emergency of International Concern, its highest level of alarm, on January 30, 2020. After that point, Figure 4 documents a steep decline in readability. Within the span of a single month (February), Flesch-Kincaid grade levels rose to the levels observed before Lagarde became ECB president. Notably, the ECB then ceased communications for more than a month (March to mid-April) after Europe was declared as the global centre of the virus outbreak. The series appears to have stabilized since the ECB resumed communications. However, average Flesch-Kincaid grade levels have been approximately half a year *higher* than before Lagarde's presidency. This increase closely corresponds to the estimated coefficient on the recession indicator in Table 4. Most of the speeches held during this period focused on the ECB's Pandemic Emergency Purchase Programme (PEPP), which was designed to counter risks to financial stability and mitigate the expected decline in economic activity caused by the

Figure 4: 15-speeches moving average – Flesch-Kincaid grade level



Notes: This figure indicates the 15-speeches moving average of the Flesch-Kincaid grade level over the period from September 01, 2019 to December 16, 2020. The colors correspond to the president in office when the moving average is calculated, i.e., turquoise and purple depict Mario Draghi's and Christine Lagarde's presidencies and gray depicts the period of overlap.

pandemic. The PEPP was introduced on March 26 and expanded on June 04. While it may be expected that the complexity of communications increases temporarily during periods of extended discretionary monetary policy, it is also these times when clear and concise communications are needed the most. Notably, readability rises again towards the end of the sample, which may indicate a return to Lagarde's original agenda.

6 Extensions and Robustness

In this section, we assess the robustness of our findings. Moreover, we consider several extensions to our baseline regressions. The corresponding tables are available in the Appendix.

6.1 Alternative communication channels

The evidence from Section 5.3 suggests that the clarity of ECB communication has decreased during the Coronavirus pandemic. However, it is important to note that the ECB recently started exploring several other communication avenues to connect with house-

holds. For example, the homepage of the ECB provides a series of 'explains by topic', which consist of short descriptions of the ECB, its mandate and the most important aspects of monetary policy.[19] While these texts are purposefully written to be accesible to the broad public, they usually do not provide information on recent policy decisions and are updated with a considerable time lag. Therefore, they do not fulfill the definition of transparency as outlined by the ECB (see Section 1).

Since March 2020, the ECB also publishes 'The ECB Blog' in which Executive Board members provide insights and discussions on recent policy decisions.[20] Table A.4 shows summary statistics for the 19 blogpots published during the period March 13 – December 02, 2020 and the 58 speeches held during the same time. We find that the ECB blogposts are shorter, on average, than speeches held during the same period. This can at least partially be explained by the lack of introductory and closing remarks. However, readability is actually lower. Average Flesch-Kincaid grade levels for blogposts and speeches are 14.9 and 14.7, respectively. Since the difference in the means is not statistically significant ($p = 0.59$), we conclude that Executive Board members use similar speaking patterns in blogposts and speeches. Thus, the former do not represent a more comprehensible alternative to households.

6.2 Flesch-Kincaid components

The evidence from Section 5 indicates that the readability of ECB speeches has increased over time. Figure A.2 suggests that this improvement is primarily driven by a reduction in the average sentence length, although average word length also appears to have declined over the sample period. In order to formally test whether the components of the Flesch-Kincaid grade level exhibit significant downward trends, we repeat the analysis from Table 4 and replace the Flesch-Kincaid grade level with the average number of words per sentence (Table A.5) or the average number of syllables per word (Table A.6). In both cases, the coefficient on the time trend is significantly negative. Therefore, we conclude that the improved readability of ECB speeches is related to a reduction in both constituents of the Flesch-Kincaid grade level. However, it should be noted that both the significance levels and the goodness of fit statistics are considerably higher in Table A.5, suggesting that time-variation in average sentence length is more pronounced than that in average word length.

6.3 Alternative readability measures

When relying exclusively on the Flesch-Kincaid grade level, other aspects of readability not related to textual characteristics, such as the amount of uncommon or technical

[19] `https://www.ecb.europa.eu/explainers/topic/banking-supervision/html/index.en.html`
[20] `https://www.ecb.europa.eu/press/blog/html/index.en.html`

terms are omitted. The Dale-Chall readability score corrects for this shortcoming. This readability measure takes into account the share of 'difficult words' in a text based on the number of words not matching the Dale-Chall list of words, which is a dictionary of 3,000 'familiar words' (Chall and Dale, 1995). The Dale-Chall readability formula is

$$DC = 64 - 95 \cdot \frac{\#difficult\,words}{\#words} - 0.69 \cdot \frac{\#words}{\#sentences}. \tag{6}$$

The ratio of 'difficult words' and the average sentence length enter the calculation of the formula as subtrahends. A high Dale-Chall score is therefore attributed to easy texts. However, there is no straightforward interpretation of the level of the Dale-Chall score.

The right column of Figure A.3 depicts graphical summaries of the Dale-Chall score. The Pearson correlation coefficient between the Flesch-Kincaid grade level and the Dale-Chall readability equals -0.91. Thus, we employ the measure from Eqn. (6) to assess the robustness of our main findings from Table 4. The prediction of increasing clarity of central bank communications translates into a positive slope coefficient on the trend variable. Table A.7 presents the findings for the Dale-Chall score. The estimates of β are significantly positive, which is in line with our findings for the Flesch-Kincaid grade level. An exception is the estimated slope coefficient once we include speaker-fixed effects in column (7) of Table A.7.

6.4 Sentiment analysis

The results from Table 4 indicate that the readability of ECB speeches is lower in recession periods. A possible explanation is that it becomes more difficult to communicate clearly during severe economic downturns due to the complicated monetary policy measures needed to improve macroeconomic conditions. Sentiment analysis provides a useful tool to investigate this question formally. Based on readily available dictionaries, each speech is assigned a sentiment score based on the number of negative, neutral and positive words. These scores can be used to determine whether a speech is considered as having a negative, neutral or positive sentiment overall.

Using the financial dictionary of Loughran and McDonald (2011), 1,449 speeches are classified as 'negative', 23 as 'neutral' and 657 as 'positive'. Based on this classification of speeches, we re-run the regressions from Table 4 while focusing on the specifications in columns (1) and (7) to conserve space. Table A.8 presents the estimates. We find that the readability of both negative and positive speeches has increased over time, although the coefficient for the positive speeches becomes insignificant once the control variables are included. Since the estimated coefficients on the time trend are relatively similar, it appears that our main results from Table 4 are not driven by a change in the tone or sentiment of the ECB's speeches. The estimates for the neutral speeches are not very reliable due to the small number of speeches classified into this category.

7 Conclusion

We analyze whether the European Central Bank has become more transparent over time. Based on a sample of speeches held by members of the Executive Board during the period January 14, 1999 – December 16, 2020, we find that the frequency of ECB communications with the public has increased over time. This upward trend has been accompanied by an increase in the clarity of speeches. More specifically, we find that speeches have become significantly more concise and readable over the lifetime of the ECB. However, the overall level of readability is still relatively low when compared to the achievements of other central banks such as the Bank of England. Moreover, we find that the readability of speeches held during Christine Lagarde's presidency has actually *decreased* when compared to those held under Mario Draghi's presidency. It is likely that the ECB's response to the outbreak of the Coronavirus pandemic is at least partially responsible for this development.

On the one hand, our results underscore the attempts by the ECB to better connect with private households. On the other hand, we provide insights into how communicating clearly becomes more difficult during times of crisis when monetary policy tends to become increasingly more discretionary and complex. However, it is precisely these times when the public is looking for guidance and leadership. The evidence for the BoE's broader interest version of its Inflation Report documented in Haldane and McMahon (2018) suggests that it is possible to communicate clearly and that households respond to such stimuli by paying more attention to central bank communication. Thus, the ECB may improve its clarity by drawing upon the lessons learned by other central banks.

Further analyses may investigate the connection between clarity of central bank communication and discretionary monetary policy measures in a broader context. Moreover, it would be interesting to see whether readability improves again after the pandemic is over as it is suggested by the speeches held towards the end of the sample. We leave these questions for future research.

8 Acknowledgements

Our research has been improved by the comments and suggestions of Jonas Dovern, Onno Kleen, Daniel Perico Ortiz, Matthias Schnaubelt, Fabian Winkler and the participants of the Statistics Seminar at the FAU Erlangen-Nürnberg. Any remaining errors are ours.

References

Binder, C., 2017. Fed speak on main street: Central bank communication and household expectations. Journal of Macroeconomics 52, 238–251.

Blinder, A. S., May 2008. Talking about monetary policy: The virtues (and vices?) of

central bank communication. Working Papers 1048, Princeton University, Department of Economics, Center for Economic Policy Studies.

Blinder, A. S., May 2018. Through a crystal ball darkly: The future of monetary policy communication. AEA Papers and Proceedings 108, 567–571.

Blinder, A. S., Ehrmann, M., Fratzscher, M., de Haan, J., Jansen, D.-J., 2008. Central bank communication and monetary policy: A survey of theory and evidence. Journal of Economic Literature 46 (4), 910–945.

Brunner, K., 1981. The art of central banking. Graduate School of Management, University of Rochester.

Bulíř, A., Čihák, M., Jansen, D.-J., 2013. What drives clarity of central bank communication about inflation? Open Economies Review 24 (1), 125–145.

Campbell, J., Evans, C. L., Fisher, J., Justiniano, A., 2012. Macroeconomic effects of Federal Reserve forward guidance. Brookings Papers on Economic Activity 43 (1 (Spring)), 1–80.

Chall, J. S., Dale, E., 1995. Readability revisited: The new Dale-Chall readability formula. Brookline Books.

Coibion, O., Gorodnichenko, Y., Kumar, S., 2018. How do firms form their expectations? New survey evidence. American Economic Review 108 (9), 2671–2713.

Coibion, O., Gorodnichenko, Y., Weber, M., 2019. Monetary policy communications and their effects on household inflation expectations. Working Paper 25482, National Bureau of Economic Research.

Conrad, C., Enders, Z., Glas, A., 2020. The role of information and experience for households inflation expectations. Working Papers of the Priority Programme 1859 "Experience and Expectation. Historical Foundations of Economic Behaviour", No 20 (August), Berlin.

Crossley, S. A., Skalicky, S., Dascalu, M., McNamara, D. S., Kyle, K., 2017. Predicting text comprehension, processing, and familiarity in adult readers: New approaches to readability formulas. Discourse Processes 54 (5-6), 340–359.

Cukierman, A., Meltzer, A. H., 1986. A theory of ambiguity, credibility, and inflation under discretion and asymmetric information. Econometrica 54 (5), 1099–1128.

Dräger, L., Lamla, M. J., Pfajfar, D., 2016. Are survey expectations theory-consistent? The role of central bank communication and news. European Economic Review 85, 84–111.

Du, B., Fung, S., Loveland, R., 2018. The informational role of options markets: Evidence from FOMC announcements. Journal of Banking & Finance 92, 237–256.

Ehrmann, M., Soudan, M., Stracca, L., 2013. Explaining European Union citizens trust in the European Central Bank in normal and crisis times. The Scandinavian Journal of Economics 115 (3), 781–807.

Ferrara, F. M., 2019. The battle of ideas on the euro crisis: evidence from ECB intermeeting speeches. Journal of European Public Policy, 1–24.

Flesch, R., 1948. A new readability yardstick. Journal of Applied Psychology 32 (3), 221–233.

Gosselin, P., Lotz, A., Wyplosz, C., 2007. Interest rate signals and central bank transparency. IHEID Working Papers 19-2007, Economics Section, The Graduate Institute of International Studies.

Haldane, A., McMahon, M., 2018. Central bank communications and the general public. In: AEA Papers and Proceedings. Vol. 108. pp. 578–583.

Hansen, S., McMahon, M., Prat, A., 2018. Transparency and Deliberation Within the FOMC: A Computational Linguistics Approach. The Quarterly Journal of Economics 133 (2), 801–870.

Hernández-Murillo, R., Shell, H., 2014. The rising complexity of the FOMC statement. Economic Synopses 23.

Jansen, D.-J., 2011a. Does the clarity of central bank communication affect volatility in financial markets? Evidence from Humphrey-Hawkins testimonies. Contemporary Economic Policy 29 (4), 494–509.

Jansen, D.-J., 2011b. Mumbling with great incoherence: Was it really so difficult to understand Alan Greenspan? Economics Letters 113 (1), 70–72.

Kincaid, J. P., Fishburne Jr, R. P., Rogers, R. L., Chissom, B. S., 1975. Derivation of new readability formulas (automated readability index, fog count and flesch reading ease formula) for navy enlisted personnel. Institute for Simulation and Training 56.

Kryvtsov, O., Petersen, L., 2019. Central bank communication that works: Lessons from lab experiments. Staff working papers, Bank of Canada.

Kumar, S., Coibion, O., Afrouzi, H., Gorodnichenko, Y., 2015. Inflation targeting does not anchor inflation expectations: Evidence from firms in New Zealand. Brookings Papers on Economic Activity Fall 2015, 151–225.

Lamla, M. J., Vinogradov, D. V., 2019. Central bank announcements: Big news for little people? Journal of Monetary Economics 108, 21–38.

Loughran, T., McDonald, B., 2011. When is a liability not a liability? Textual analysis, dictionaries, and 10-Ks. The Journal of Finance 66 (1), 35–65.

Melloni, G., Caglio, A., Perego, P., 2017. Saying more with less? Disclosure conciseness, completeness and balance in Integrated Reports. Journal of Accounting and Public Policy 36 (3), 220–238, sustainability Accounting, Reporting and Assurance.

Morris, S., Shin, H. S., December 2002. Social value of pblic information. American Economic Review 92 (5), 1521–1534.

Moschella, M., Pinto, L., 2019. Central banks communication as reputation management: How the Fed talks under uncertainty. Public Administration 97 (3), 513–529.

Moschella, M., Pinto, L., Diodati, N. M., 2020. Let's speak more? How the ECB responds to public contestation. Journal of European Public Policy 27 (3), 400–418.

Newey, W. K., West, K. D., 1987. A simple, positive semi-definite, heteroskedasticity and autocorrelation consistent covariance matrix. Econometrica 55 (3), 703–708.

Seelajaroen, R., Budsaratragoon, P., Jitmaneeroj, B., 2019. Do monetary policy transparency and central bank communication reduce interest rate disagreement? Journal of Forecasting 39 (3), 368–393.

Svensson, L. E. O., March 2006. Social value of public information: Comment: Morris and Shin (2002) is actually pro-transparency, not con. American Economic Review 96 (1), 448–452.

Tauroza, S., Allison, D., 1990. Speech rates in british english. Applied linguistics 11 (1), 90–105.

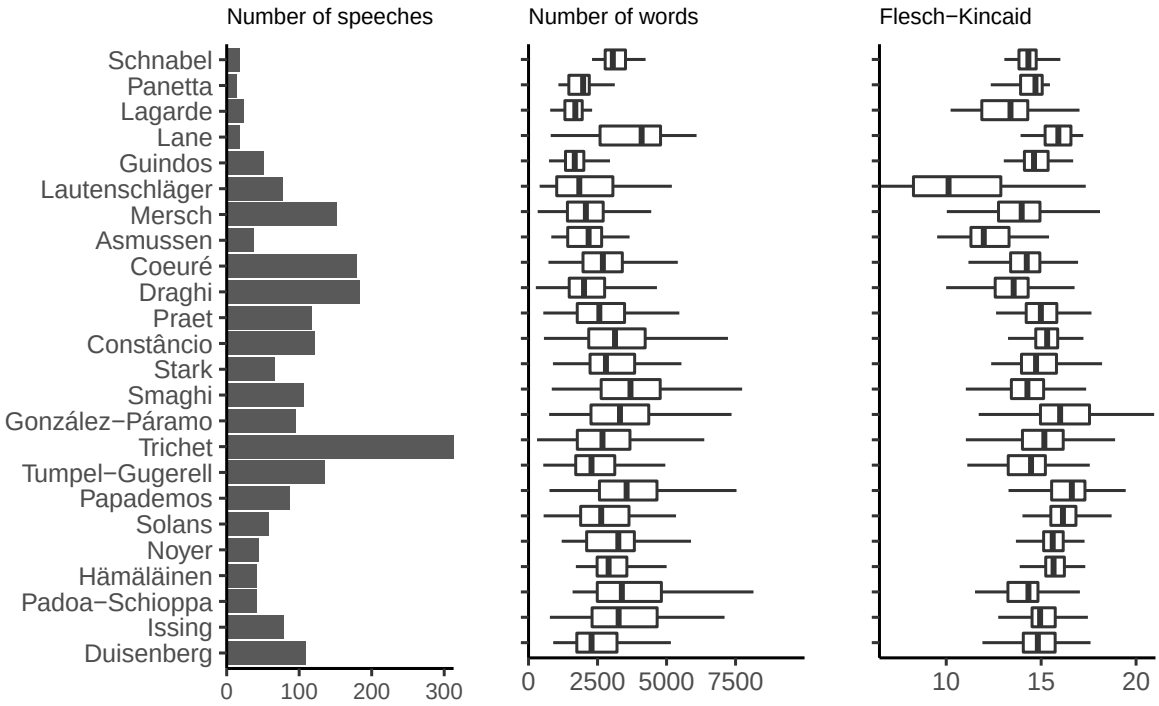
Tillmann, P., Walter, A., 2019. The effect of diverging communication: The case of the ECB and the Bundesbank. Economics Letters 176 (C), 68–74.

Tortola, P. D., Pansardi, P., 2019. The charismatic leadership of the ECB presidency: A language-based analysis. European Journal of Political Research 58 (1), 96–116.

van der Cruijsen, C., Jansen, D.-J., de Haan, J., 2015. How much does the public know about the ECBs monetary policy? Evidence from a survey of Dutch households. International Journal of Central Banking 11 (4), 169–218.

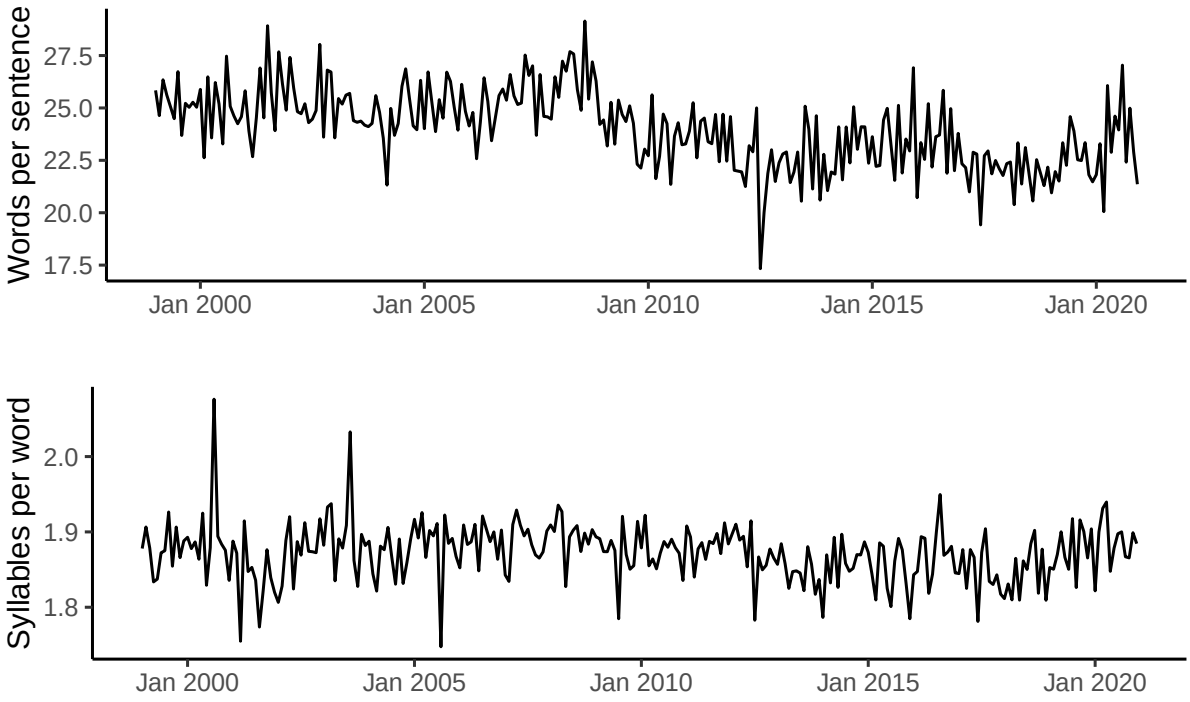
Appendix

Figure A.1: Frequency and clarity of ECB speeches by speaker



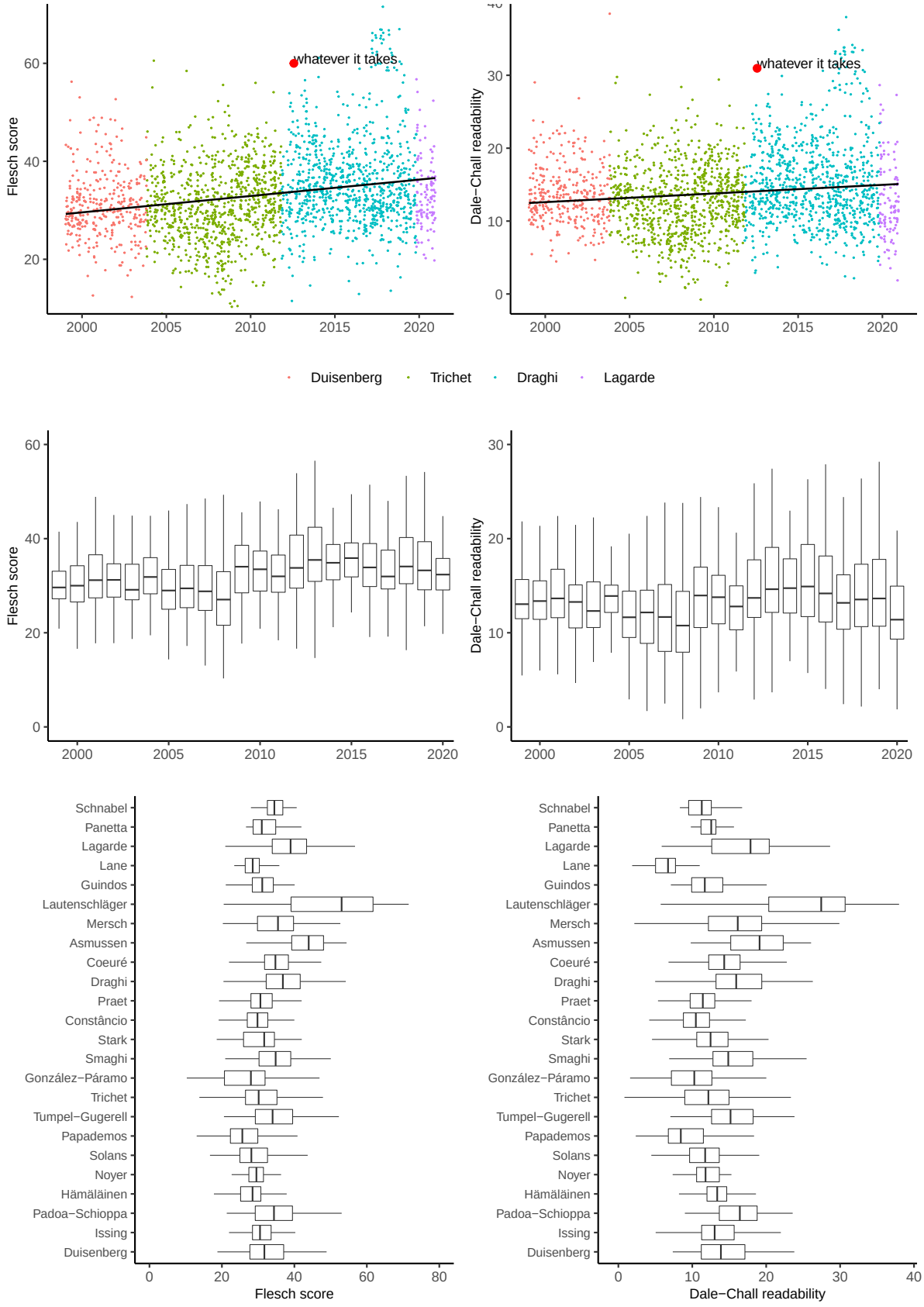
Notes: This figure depicts the number of speeches per speaker (left) as well as boxplots for the number of words per speech (middle) and the Flesch-Kincaid grade levels (right). The sample period is January 14, 1999 – December 16, 2020.

Figure A.2: Development of Flesch-Kincaid components



Notes: This figure depicts monthly averages of the Flesch-Kincaid components, i.e., average sentence length and average word length. The sample period is January 14, 1999 – December 16, 2020.

Figure A.3: Flesch reading ease score and Dale-Chall readability



Notes: This figure depicts the Flesch reading ease score and the New Dale-Chall readability score by speech, year and speaker, respectively. The sample period is January 14, 1999 – December 16, 2020.

Table A.1: t-tests for differences in averages of Flesch-Kincaid grade levels

	Duisenberg	Trichet	Draghi
Trichet	-0.12		
	[0.24]		
Draghi	-1.33	-1.21	
	[0.00]	[0.00]	
Lagarde	-0.87	-0.75	0.46
	[0.00]	[0.00]	[0.01]

Notes: This table depicts the differences in the average Flesch-Kincaid grade levels across presidencies as well as the corresponding p-values.

Table A.2: Trend in Flesch-Kincaid grade level – monthly median

	Dependent variable: Flesch-Kincaide grade level (FK_m)				
	(1)	(2)	(3)	(4)	(5)
m	-0.006^{***}	-0.005^{***}	-0.005^{***}	-0.006^{***}	-0.006^{***}
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
u_m		-0.251^{***}	-0.209^{***}	-0.214^{***}	-0.197^{***}
		(0.053)	(0.042)	(0.042)	(0.045)
$\lvert\tilde{\pi}_m\rvert$		-0.144	-0.149	-0.145	-0.148
		(0.109)	(0.112)	(0.112)	(0.114)
$\lvert E(\tilde{\pi}_{q+4\lvert q})\rvert$			1.743^{***}	1.670^{***}	1.506^{***}
			(0.377)	(0.391)	(0.338)
$\bar{\sigma}_{q+4\lvert q}$			1.580^{***}	1.474^{***}	1.304^{***}
			(0.293)	(0.310)	(0.320)
D_m^{Rec}				0.128	0.072
				(0.129)	(0.144)
$D_m^{Trichet}$					0.285
					(0.219)
D_m^{Draghi}					0.155
					(0.380)
$D_m^{Lagarde}$					0.503
					(0.534)
Constant	15.590^{***}	18.040^{***}	14.552^{***}	14.789^{***}	14.899^{***}
	(0.146)	(0.585)	(0.867)	(0.876)	(0.895)
p-value (H_0: $\beta \geq 0$)	0.000	0.000	0.000	0.000	0.000
Observations	262	262	262	262	262
Adjusted R^2	0.223	0.334	0.374	0.374	0.378

Notes: This table depicts the estimates of Eqn. (4) with the monthly median of the Flesch-Kincaid grade level as the dependent variable. The estimation sample covers the period January 14, 1999 – December 16, 2020. We estimate parameters by OLS. To account for arbitrary levels of heteroskedasticity and autocorrelation we report Newey-West (1987) standard errors in parentheses. Asterisks '*', '**' and '***' indicate significance at the 10%, 5% and 1% critical level, respectively.

Table A.3: Trend in the Flesch score of ECB speeches

	Dependent variable: Flesch score (F_{it})						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
t	0.916***	0.834***	1.199***	1.026***	1.279***	1.017***	1.133***
	(0.106)	(0.104)	(0.241)	(0.236)	(0.460)	(0.234)	(0.354)
u_m		0.750***	1.018***	0.886***	0.784***	0.881***	0.847***
		(0.158)	(0.213)	(0.201)	(0.281)	(0.201)	(0.226)
$\lvert\tilde{\pi}_m\rvert$		0.043	0.028	0.002	−0.017	−0.005	−0.085
		(0.525)	(0.515)	(0.507)	(0.492)	(0.508)	(0.416)
$\lvert E(\tilde{\pi}_{q+4\lvert q})\rvert$			0.260	−0.579	−0.906	−0.584	−0.605
			(0.807)	(0.831)	(0.872)	(0.835)	(0.760)
$\bar{\sigma}_{q+4\lvert q}$			−11.685*	−4.472	−4.461	−4.393	−6.311
			(6.430)	(6.574)	(7.473)	(6.580)	(5.586)
D_t^{Rec}				−2.143***	−1.601***	−2.134***	
				(0.488)	(0.526)	(0.484)	
$D_{it}^{Trichet}$					−2.742***		
					(1.017)		
D_{it}^{Draghi}					−1.966		
					(1.840)		
$D_{it}^{Lagarde}$					−3.916*		
					(2.133)		
$D_{it}^{P/CE}$						−0.267	
						(0.391)	
Constant	29.250***	22.550***	24.391***	23.402***	25.377***	23.572***	23.454***
	(0.490)	(1.858)	(2.089)	(2.028)	(2.008)	(2.035)	(2.631)
p-value (H_0: $\beta \leq 0$)	0.000	0.000	0.000	0.000	0.003	0.000	0.001
Speaker fixed-effects	No	No	No	No	No	No	Yes
Observations	2,169	2,169	2,169	2,169	2,169	2,169	2,169
Adjusted R^2	0.056	0.069	0.070	0.078	0.086	0.078	0.315

Notes: This table depicts the estimates of Eqn. (4) when we use the Flesch score, F_{it}, as the dependent variable. The estimation sample covers the period January 14, 1999 – December 16, 2020. We estimate parameters by OLS. To account for arbitrary levels of heteroskedasticity and autocorrelation we report Newey-West (1987) standard errors in parentheses. Trend coefficients and standard errors are multiplied by 1000. Asterisks '*', '**' and '***' indicate significance at the 10%, 5% and 1% critical level, respectively.

Table A.4: Summary statistics for characteristics of ECB blogposts

	Blogposts (Obs. = 19)	Speeches (Obs. = 58)
#words		
Mean	1655.63	2267.98
SD	781.88	907.30
#sentences		
Mean	69.95	96.21
SD	33.6	38.31
#syllables		
Mean	3171.42	4263.78
SD	1577.55	1702.57
Flesch-Kincaid grade level		
Mean	14.90	14.65
SD	1.79	1.43

Notes: This table presents mean and standard deviation of the number of words, sentences and syllables per blogpost/speech as well as the Flesch-Kincaid grade level for the sample from March 12, 2020 to December 02, 2020.

Table A.5: Trend in the number of words per sentence in a speech

	Dependent variable: Average number of words per sentence						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
t	-0.490^{***}	-0.452^{***}	-0.563^{***}	-0.506^{***}	-0.652^{***}	-0.513^{***}	-0.507^{***}
	(0.039)	(0.038)	(0.088)	(0.088)	(0.191)	(0.087)	(0.158)
u_m		-0.367^{***}	-0.450^{***}	-0.406^{***}	-0.455^{***}	-0.410^{***}	-0.457^{***}
		(0.068)	(0.088)	(0.084)	(0.123)	(0.084)	(0.111)
$\lvert\tilde{\pi}_m\rvert$		0.081	0.054	0.063	0.086	0.058	0.133
		(0.212)	(0.213)	(0.208)	(0.201)	(0.208)	(0.174)
$\lvert E(\tilde{\pi}_{q+4\lvert q})\rvert$			0.788^{**}	1.066^{***}	1.328^{***}	1.062^{***}	1.236^{***}
			(0.334)	(0.341)	(0.353)	(0.342)	(0.324)
$\bar{\sigma}_{q+4\lvert q}$			2.112	-0.279	0.928	-0.220	0.254
			(2.485)	(2.607)	(3.148)	(2.609)	(2.670)
D_t^{Rec}				0.710^{***}	0.546^{**}	0.718^{***}	
				(0.231)	(0.237)	(0.230)	
$D_{it}^{Trichet}$					0.992^{**}		
					(0.395)		
D_{it}^{Draghi}					0.902		
					(0.763)		
$D_{it}^{Lagarde}$					0.904		
					(0.893)		
$D_{it}^{P/CE}$						-0.199	
						(0.166)	
Constant	25.925^{***}	29.034^{***}	28.960^{***}	29.288^{***}	28.843^{***}	29.414^{***}	29.990^{***}
	(0.187)	(0.765)	(0.822)	(0.823)	(0.804)	(0.830)	(1.237)
p-value (H_0: $\beta \geq 0$)	0.000	0.000	0.000	0.000	0.000	0.000	0.001
Speaker fixed effects	No	No	No	No	No	No	Yes
Observations	2,169	2,169	2,169	2,169	2,169	2,169	2,169
Adjusted R^2	0.094	0.113	0.116	0.120	0.124	0.121	0.314

Notes: This table depicts the estimates of Eqn. (4) when we use the average number of words per sentence in a speech as the dependent variable. The estimation sample covers the period January 14, 1999 – December 16, 2020. We estimate parameters by OLS. To account for arbitrary levels of heteroskedasticity and autocorrelation we report Newey-West (1987) standard errors in parentheses. Trend coefficients and standard errors are multiplied by 1000. Asterisks '*', '**' and '***' indicate significance at the 10%, 5% and 1% critical level, respectively.

Table A.6: Trend in the number of syllables per word in a speech

	Dependent variable: Average number of syllables per word						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
t	-0.003^{***}	-0.002^{**}	-0.006^{**}	-0.004^{**}	-0.007^{*}	-0.004^{**}	-0.008^{**}
	(0.001)	(0.001)	(0.002)	(0.002)	(0.004)	(0.002)	(0.003)
u_m		-0.005^{***}	-0.007^{***}	-0.006^{***}	-0.005^{**}	-0.006^{***}	-0.006^{***}
		(0.001)	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)
$\lvert\tilde{\pi}_m\rvert$		-0.003	-0.002	-0.002	-0.002	-0.002	-0.002
		(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.004)
$\lvert E(\tilde{\pi}_{q+4\lvert q})\rvert$			-0.008	-0.002	-0.000	-0.002	-0.003
			(0.008)	(0.008)	(0.009)	(0.008)	(0.008)
$\bar{\sigma}_{q+4\lvert q}$			0.115^{**}	0.063	0.066	0.063	0.088^{*}
			(0.057)	(0.059)	(0.067)	(0.059)	(0.053)
D_t^{Rec}				0.015^{***}	0.011^{**}	0.015^{***}	
				(0.005)	(0.005)	(0.005)	
$D_{it}^{Trichet}$					0.023^{**}		
					(0.010)		
D_{it}^{Draghi}					0.019		
					(0.017)		
$D_{it}^{Lagarde}$					0.038^{*}		
					(0.020)		
$D_{it}^{P/CE}$						-0.001	
						(0.004)	
Constant	1.883^{***}	1.928^{***}	1.908^{***}	1.915^{***}	1.901^{***}	1.916^{***}	1.924^{***}
	(0.004)	(0.016)	(0.019)	(0.019)	(0.019)	(0.019)	(0.024)
p-value (H_0: $\beta \geq 0$)	0.001	0.006	0.006	0.023	0.044	0.021	0.011
Speaker fixed effects	No	No	No	No	No	No	Yes
Observations	2,169	2,169	2,169	2,169	2,169	2,169	2,169
Adjusted R^2	0.006	0.012	0.013	0.017	0.023	0.017	0.196

Notes: This table depicts the estimates of Eqn. (4) when we use the average number of syllables per word in a speech as the dependent variable. The estimation sample covers the period January 14, 1999 – December 16, 2020. We estimate parameters by OLS. To account for arbitrary levels of heteroskedasticity and autocorrelation we report Newey-West (1987) standard errors in parentheses. Trend coefficients and standard errors are multiplied by 1000. Asterisks '*', '**' and '***' indicate significance at the 10%, 5% and 1% critical level, respectively.

Table A.7: Trend in the Dale-Chall readability of ECB speeches

	Dependent variable: Dale-Chall readability (DC_{it})						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
t	0.324***	0.270***	0.569***	0.472***	0.550*	0.453***	0.329
	(0.072)	(0.071)	(0.149)	(0.146)	(0.283)	(0.146)	(0.212)
u_m		0.455***	0.676***	0.601***	0.423**	0.591***	0.460***
		(0.100)	(0.139)	(0.131)	(0.174)	(0.131)	(0.134)
$\lvert\tilde{\pi}_m\rvert$		0.270	0.253	0.238	0.233	0.223	0.136
		(0.340)	(0.332)	(0.329)	(0.303)	(0.330)	(0.246)
$\lvert E(\tilde{\pi}_{q+4\lvert q})\rvert$			0.363	−0.110	−0.237	−0.121	−0.356
			(0.519)	(0.536)	(0.529)	(0.542)	(0.450)
$\bar{\sigma}_{q+4\lvert q}$			−9.862**	−5.795	−4.219	−5.630	−3.546
			(4.148)	(4.212)	(4.547)	(4.219)	(3.410)
D_t^{Rec}				−1.208***	−0.802**	−1.188***	
				(0.313)	(0.328)	(0.310)	
$D_{it}^{Trichet}$					−1.928***		
					(0.599)		
D_{it}^{Draghi}					−1.001		
					(1.114)		
$D_{it}^{Lagarde}$					−3.015**		
					(1.299)		
$D_{it}^{P/CE}$						−0.561**	
						(0.248)	
Constant	12.485***	8.011***	9.609***	9.052***	10.863***	9.408***	9.772***
	(0.321)	(1.131)	(1.309)	(1.270)	(1.182)	(1.267)	(1.526)
p-value (H_0: $\beta \leq 0$)	0.000	0.000	0.000	0.001	0.026	0.001	0.060
Speaker fixed-effects	No	No	No	No	No	No	Yes
Observations	2,169	2,169	2,169	2,169	2,169	2,169	2,169
Adjusted R^2	0.018	0.032	0.035	0.041	0.057	0.043	0.358

Notes: This table depicts the estimates of Eqn. (4) when we use the Dale-Chall readability, DC_{it}, as the dependent variable. The estimation sample covers the period January 14, 1999 – December 16, 2020. We estimate parameters by OLS. To account for arbitrary levels of heteroskedasticity and autocorrelation we report Newey-West (1987) standard errors in parentheses. Trend coefficients and standard errors are multiplied by 1000. Asterisks '*', '**' and '***' indicate significance at the 10%, 5% and 1% critical level, respectively.

Table A.8: Subsamples based on Loughran and McDonald (2011) dictionary

	Dependent variable: Flesch-Kincaide grade level (FK_{it})					
	Negative	Negative	Neutral	Neutral	Positive	Positive
	(1)	(2)	(3)	(4)	(5)	(6)
t	-0.203^{***}	-0.287^{***}	-0.395^{***}	2.994	-0.269^{***}	-0.181
	(0.038)	(0.088)	(0.133)	(2.062)	(0.031)	(0.149)
u_m		-0.204^{***}		2.529^{*}		-0.287^{**}
		(0.058)		(1.144)		(0.115)
$\lvert\tilde{\pi}_m\rvert$		-0.009		-1.063		0.096
		(0.104)		(0.849)		(0.184)
$\lvert E(\tilde{\pi}_{q+4\lvert q})\rvert$		0.659^{***}		-3.262		-0.345
		(0.181)		(2.744)		(0.409)
$\bar{\sigma}_{q+4\lvert q}$		1.344		-10.352		-0.137
		(1.383)		(26.243)		(2.502)
Constant	15.360^{***}	16.907^{***}	16.198^{***}	-18.229	15.926^{***}	18.568^{***}
	(0.192)	(0.732)	(0.468)	(17.682)	(0.113)	(1.239)
p-value (H_0: $\beta \geq 0$)	0.000	0.001	0.004	0.890	0.000	0.113
Speaker fixed effects	No	Yes	No	Yes	No	Yes
Observations	1,487	1,487	23	23	659	659
Adjusted R^2	0.045	0.371	0.173	0.352	0.099	0.301

Notes: This table depicts the estimates of Eqn. (4) when we use the Flesch-Kincaid grade level, FK_{it}, as the dependent variable for three subsamples based on positive, neutral and negative sentiment based on the Loughran and McDonald (2011) dictionary. The estimation sample covers the period January 14, 1999 – December 16, 2020. We estimate parameters by OLS. To account for arbitrary levels of heteroskedasticity and autocorrelation we report Newey-West (1987) standard errors in parentheses. Trend coefficients and standard errors are multiplied by 1000. Asterisks '*', '**' and '***' indicate significance at the 10%, 5% and 1% critical level, respectively.