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## Complexity of ECB communication and financial market trading

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**No. 19-2019**

**Bernd Hayo, Kai Henseler and Marc Steffen Rapp**

## **Complexity of ECB Communication and Financial Market Trading**

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# Complexity of ECB Communication and Financial Market Trading

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***Abstract:** We examine how the verbal complexity of ECB communications affects financial market trading based on high-frequency data from European stock index futures trading. Studying the 34 events between May 2009 and June 2017, during which the ECB Governing Council press conferences covered unconventional monetary policy measures, and using the Flesch-Kincaid Grade Level to measure the verbal complexity of introductory statements to the press conferences, we find that more complex communications are associated with a lower level of contemporaneous trading. Increasing complexity of introductory statements leads to a temporal shift of trading activity towards the subsequent Q&A session, which suggests that Q&A sessions facilitate market participants' information processing.*

***JEL-Classification:** D83, E52, E58, G12, G14*

***Keywords:** ECB, central bank communication, textual analysis, linguistic complexity, readability, financial markets, European stock markets*

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**'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'.**

Alan Greenspan, 1987

(cited in Appelbaum, 'A Fed Focused on the Value of Clarity',  
*New York Times*, 13 Dec 2012)

## 1 Introduction

Central banks are important players in the financial system (see, e.g., Bordo, 2007), and their role in this system came into sharp focus following the 2008 financial crisis. Indeed, in a speech earlier this year at the University of South Africa, Jens Weidmann, President of the Deutsche Bundesbank, argued that '*superpowers were often attributed to central banks as they struggled with the fallout from the financial crisis*'.<sup>1</sup> During that time—when interest rates approached the zero lower bound and novel monetary policy instruments like forward guidance emerged—central bank communication became more important (see, e.g., Dell'Ariccia, Rabanal, & Sandri, 2018; Kuttner, 2018).

There is a wide range of arguments and opinions about current central bank decisions, one that becomes even wider when the topic is these banks' future decisions (e.g., de Haan & Sturm, 2019), making central bank communication a complex issue (e.g., Bulíř, Čihák, & Jansen, 2013a; Bulíř, Čihák, & Šmídková, 2013b). There have been a fair number of studies examining the role of central bank communication, but

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<sup>1</sup> See <https://www.bis.org/review/r180511a.pdf> (accessed: 05 Mar 2019).

knowledge is still limited when it comes to how the complexity of central bank communication affects financial markets. With this paper, we add to that knowledge base by analysing this very issue.

Only about two decades ago, central banks communicated very little with the outside world (see, e.g., Brunner, 1981). Discussion of current monetary policy stance or plans about future actions were usually confined to the committees' meeting rooms and central bankers were perceived as a knowledgeable elite, characterised by a '*peculiar and protective political mystique*' (see, e.g., Brekenfeld, 1984). Even when they did engage in communication, central bankers were apparently intentionally ambiguous, as the above quote from Allan Greenspan suggests. This communication style allowed central bankers to surprise financial markets (see, e.g., Blinder et al., 2008; Brunner, 1981), and also was supported by academics. For instance, Cukierman and Meltzer (1986) make the case for so-called *creative ambiguity*, arguing that only unanticipated monetary policy can be effective.

More recently, however, transparency regarding monetary policy has become imperative across the world, a change fostered by academia as well as by an information-hungry financial market (see, e.g., Ehrmann & Fratzscher, 2007). To manage financial market expectations, central banks in several countries have institutionalised monetary policy communication (see, e.g., Blinder et al., 2008). Announcements about current monetary policy decisions as well as assessments of the economic outlook and the expected consequences of monetary policy have become an integral part of these banks' communication (see, e.g., Hansen, McMahon, & Prat, 2018; Kohn & Sack, 2003). Many central bankers have recognised the possibilities of communication as an independent instrument in a central bank's policy toolkit (see, e.g., Woodford,

2003). Hence, today, banks use transparency and communication strategically (see, e.g., Rosa, 2008), although financial market participants seem to rely more on media reports of central bank events than on their own monitoring of same (see, e.g., Hayo & Neuenkirch, 2015b).

The 2008 financial crisis had an impact on central bank communication in two ways. First, after interest rates reached the zero lower-bound, it was no longer possible to use them as the main monetary policy instrument, leading to a frantic search for alternatives. Second, the risks associated with unconventional monetary policy measures (UMPM) demanded a disciplined and coherent communication strategy. Both aspects led to central banks focussing on accountability and transparency (see, e.g., Cœuré, 2018; Siklos, 2013). Central banks began to realise that monetary policy will be more successful when financial market participants understand the rationale behind it (see, e.g., Cœuré, 2018; Lucca & Trebbi, 2011; Praet, 2017). Hayo and Neuenkirch (2015a) discuss how financial market participants themselves evaluate the success of these policies.

Communication can be defined as '*a process by which information is exchanged between individuals through a common system of symbols, signs, or behaviour*'.<sup>2</sup> In the present context, central banks utilise communication to share *information* with financial markets regarding current and future monetary policy. However, neither the

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<sup>2</sup> Definition from the Merriam Webster dictionary, available at: <https://www.merriam-webster.com/dictionary/communication> (accessed: 05 Mar 2019).

sender, i.e., the central bank, nor the receiver, i.e., the financial markets, are *individuals*. Central banks aim to co-operate with each other and speak with one voice (see, e.g., Blinder et al., 2008), even though such is not always possible (see, e.g., Hayo & Neuenkirch, 2013). Financial markets, however, are comprised of many individuals, all of which have different experiences, expectations, and objectives. Therefore, it could be misleading to view central bank communication in an aggregate, one-dimensional manner, seeing as a particular central bank statement may be interpreted in various ways by different individuals. This problem of non-uniform interpretation will be exacerbated in a situation of increased complexity/decreased understandability of communication (see, e.g., Cœuré, 2018).

Many central banks hold press conferences following meetings of their monetary policy committees, including the central banks of Japan, New Zealand, Norway, Sweden, Switzerland, and USA. The ECB instituted press conferences following its Governing Council Meetings (GCM) right from its establishment. ECB's press conferences are followed by a Q&A session in which journalists may participate, a feature not offered by most central banks. In light of the ECB's specific communication design, we study the questions of whether communication complexity/understandability is actually an issue for financial markets and, if it is, whether trading decisions are postponed to subsequent Q&A sessions.

To analyse how central bank communication complexity affects financial market trading behaviour, we focus on ECB's GCMs and review trading during the respective press conferences and the following Q&A sessions. Using descriptive analysis, we examine average trading volumes per minute during press conferences, the temporal distribution of trading volumes between the introductory statement and the Q&A session,

and the relationship between temporal distribution of trading volumes and communication complexity. Employing regression analyses, we first test the relationship between introductory statement complexity and overall trading volume during press conferences. Second, we analyse whether higher complexity temporally shifts trading activity from the introductory statement to the Q&A session.

We find that trading volume reacts visibly during GCM press conferences, both during the introductory statements and the subsequent Q&A sessions. While there is a positive correlation between trading volumes in the two periods, the relationship varies substantially. Taking this as an indication that other factors play a role, too, we discover a negative relationship between complexity and trading volume. More complex statements lead to a visual shift of the trading volume from introductory statements to Q&A sessions.

Our regression analyses support these descriptive results. We find that more complex communication corresponds with a lower level of contemporaneous trading. There is a positive relationship between introductory statement complexity and temporal shift of trading activity to the Q&A session, indicating that Q&A sessions may be helpful in mitigating understandability issues.

The remainder of this paper is structured as follows: Section 2 develops the central research question and presents our hypotheses. Section 3 describes the dataset and provides the descriptive analysis. Section 4 illustrates our empirical design and presents the regression results. Section 5 discusses the robustness of the results and Section 6 concludes.



## 2 Central Bank Communication and Financial Markets

### 2.1 Central Bank Communication and Financial Market Trading Behaviour

Finance theory suggests that trading decisions depend on information (news) (see, e.g., Stigler, 1961). In an efficient market, stock prices are expected to quickly incorporate all new information relevant for a particular firm (see, e.g., Fama, Fisher, Jensen, & Roll, 1969). Central bank communication often contains substantial information about future economic developments, which frequently have consequences for the macro-economy, specific industries, or even individual companies (see, e.g., Bernanke & Kuttner, 2005; Funke & Matsuda, 2006).

Most studies analysing the informational content of central bank communication focus on well-defined signals, such as monetary policy announcements (see, e.g., Blinder et al., 2008). These studies frequently take an event-study approach in an attempt to minimise issues arising from confounding shocks or endogeneity (see, e.g., MacKinlay, 1997; Rosa, 2011a). The dependent variables employed typically include short-term reactions by financial markets during the day or, sometimes, even during minutes around monetary policy announcements. The results generally support the expected relationship between central bank communication and financial market reactions (see, e.g., Andersson, 2010; Brand, Buncic, & Turunen, 2010; Gurkaynak, Sack, & Swanson, 2005; Hussain, 2011; Nakamura & Steinsson, 2018; Rosa, 2011b). Supporting Cukierman and Meltzer's (1986) hypothesis, Andersson (2010) and Nakamura and Steinsson (2018) show that unexpected information (surprises) in central bank communication (see, e.g., Bernanke & Kuttner, 2005; Gurkaynak et al., 2005; Kuttner, 2001; Rosa, 2008) has a fairly quick effect on financial markets.

This stream of research considers information as an objective and uniform entity. However, several studies propose that this assumption may be misleading, and they emphasise the differential interpretation of public information (see, e.g., Grossman & Stiglitz, 1976; Harris & Raviv, 1993). Kandel and Pearson (1995) suggest that the underlying reason for variety in interpretation could be differences in opinion. That is, all market participants receive and decode the same information, but their evaluations are heterogeneous. Looking at analysts' earnings forecasts, Diether, Malloy, and Scherbina (2002) provide evidence that such differences in opinion have a significant effect on trading activity. Alternatively, the underlying reason for a differential interpretation of information could be caused by the general understandability of the information (see, e.g., Loughran & McDonald, 2014; Smith & Taffler, 1992; You & Zhang, 2009). That is, all market participants receive the same information but decode it differently and/or at a different speed. Arguably, if information is difficult to understand, many financial market participants may take longer to adjust their portfolio positions in response to it.

## *2.2 Central Bank Communication Complexity and Q&A Sessions*

Studies of the complexity of central bank communication and the question of whether financial markets understand the information provided by central banks usually focus on the complexity/readability of texts or transcripts. To quantify these dimensions, they generally use methods borrowed from linguistics or educational research. The most common quantitative indicators are the *Flesch-Kincaid Grade Level* (Kincaid, Fishburne, Rogers, & Chissom, 1975), *Flesch Reading Ease* (Flesch, 1948), the *Gunning Fog Index* (Gunning, 1952), the *SMOG Index* (McLaughlin, 1969), the *Coleman-Liau Index* (Coleman & Liau, 1975), and the *Automated Readability Index* (Senter &

Smith, 1967). To derive a numerical expression of the complexity and readability of texts or transcripts, these methods usually rely on specific measures, such as *average sentence length*, *average word length*, and/or *proportion of complex words*.

Several studies in the field of finance use such quantitative indicators of understandability as explanatory variables. For example, Smith and Taffler (1992), You and Zhang (2009), and Miller (2010) investigate the complexity of corporate reporting and subsequent trading volumes and stock-price movements. Loughran and McDonald (2014) employ a slightly different measure of readability of financial disclosures, but they, too, find a corresponding effect on company valuation.

In the field of central banking, Jansen (2011) applies readability statistics to the Humphrey-Hawkins testimonies of the US Federal Reserve (Fed) and that communication clarity has a significant effect on daily financial market volatility. In a descriptive study, Hernández-Murillo and Shell (2014) discover that Federal Open Market Committee (FOMC) statements have become more complex since the beginning of UMPM. However, this trend is not observed for ECB statements, as Coenen et al. (2017) illustrate. Smales and Apergis (2017a, 2017b) analyse the linguistic complexity of FOMC statements accompanying monetary policy decisions. Using intra-day data, they find that complex language increases trading volume, as well as the volatility of returns, in stock, bond, and currency markets.

Right from its establishment in 1998, the ECB instituted Q&A sessions as a key part of all GCM press conferences. The ECB claims that its Q&A sessions are an *'important*

*tool for transparent and accountable communication*<sup>3</sup> with financial markets. Benoit Cœuré (2018), a member of ECB's Directorate, emphasises that Q&A sessions are aimed at making ECB communication as understandable as possible. The Fed appears to agree that press conferences are useful, as Chairman Jerome Powell announced at the press statement following the 12–13 June 2018 FOMC meetings that the Fed would be '*hold[ing] news conferences after every central bank meeting*' (Powell, 2018b), thus increasing the number of press conferences from four to eight per year. The Fed argues that there a necessity for '*explaining how we're thinking ... explaining what we're thinking*' (Powell, 2018a).

However, is central bank communication complexity/understandability really an issue that affects financial market trading and are trading decisions postponed to subsequent Q&A sessions? Regarding the first part of the question, we are interested in finding out whether ECB communication complexity is related to contemporaneous trading volume. For the United States, Smales and Apergis (2017a) propose a positive relationship between central bank communication complexity and trading volume. However, analysing corporate communication, You and Zhang (2009) and Miller (2010) discover the opposite relationship between complexity and trading volume. Research from behavioural studies suggests that investors will underreact to complex information. The underlying theoretical argument is based on financial market participants' cognitive behaviour and works through the speed of information diffusion, which is directly affected by the complexity of information (see, e.g., Hong & Stein,

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<sup>3</sup> See <https://www.ecb.europa.eu/ecb/orga/transparency/html/index.en.html> (accessed: 14 Feb 2019).

1999; McEwen & Hunton, 1999). Hirshleifer (2001) suggests that cognitively costly information, i.e., complex information, is less considered by investors, leading to an underreaction in trading. Therefore, we test as a first hypothesis:

**H1:** There is a negative relationship between ECB communication complexity and overall trading volume.

Regarding the second part of the above question, we assume that financial market participants who do not understand what the ECB is trying to say hesitate to execute trading decisions. Arguably, they catch up on trading during Q&A sessions. Therefore, we test as a second hypothesis:

**H2:** There is a positive relationship between ECB communication complexity and a temporal shift of trading activity to the Q&A session.

### 3 Sample and Descriptive Analysis

#### 3.1 Sample

Two important channels of central bank communication are monetary policy decisions and press conferences associated with monetary policy meetings (see, e.g., Fawcett, Hatzius, Stehn, & Chaudhary, 2017).<sup>4</sup> To learn more about the effect on financial

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<sup>4</sup> Of course, high-level officials talk to the public on an irregular basis. However, strict rules apply to these communications (see the '*Guiding Principles for External Communication for High-Level Officials of the European Central Bank*', available at: <https://www.ecb.europa.eu/ecb/orga/transparency/html/eb-communications-guidelines.en.html> (accessed: 14 Jun 2019)).

markets of *verbal complexity* of ECB communications, we examine the trading behaviour of European stock index futures on the ECB's Governing Council Meeting (GCM) days.

The Governing Council is the ECB's main decision-making body. It consists of the six members of the Executive Board as well as the governors of the national central banks of the 19 Euro area countries. The Governing Council is responsible for formulating monetary policy for the euro area, including decisions regarding monetary objectives, key interest rates, and the supply of reserves in the Euro-system.<sup>5</sup> The Governing Council assesses economic and monetary developments and makes monetary policy decisions on a regular basis at the ECB's premises in Frankfurt am Main, Germany. Following the meeting, the monetary policy decisions are explained in detail by the ECB's president during a press conference.

A typical GCM press conference proceeds as follows. Shortly after the official start at 14:30CET, the ECB's president presents an *introductory statement*, which covers all the GCM decisions and provides details, the underlying reasoning, and a monetary policy outlook. This section usually takes between 10 and 20 minutes, with mean and median at 15 minutes. Subsequently, a 40- to 60-minute *Q&A session* is held, starting at around 14:50 CET. During this part, local participants (usually press representatives) ask questions, which are answered by the president. The *Q&A session* is specifically intended to make ECB communication as understandable as possible (see,

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<sup>5</sup> A detailed and comprehensive description of the Governing Council's responsibilities can be found at: <https://www.ecb.europa.eu/ecb/orga/decisions/govc/html/index.en.html> (accessed: 17 Feb 2019).

e.g., Cœuré, 2018). The press conference ends between around 15:30CET to 15:50CET.

We focus on GCM press conferences following the 2008 financial crisis, which is when the ECB started engaging in unconventional monetary policy measures (UMPM) on a recurring basis. As a starting point for our analysis, we take the announcement of the ECB's first covered bond purchase programme on 07 May 2009. Our sample period ends in June 2017. We include only those press conferences during which details on UMPM were disclosed.<sup>6</sup> These communications exhibit a homogeneous structure but differ in their specific content, providing an appropriate basis for text analysis. Moreover, UMPM announcements have the potential to be of higher complexity, as newly developed and unprecedented measures were announced (see, e.g., Coenen et al., 2017).

We use the press conferences' *introductory statements*<sup>7</sup> to determine our communication complexity measure, since they embody communication as intended by the ECB. This approach has the added benefit of allowing comparison of events having a common structure and length. We cover 34 conferences with UMPM announcements from May 2009 until June 2017. We treat these official ECB announcements as *events*

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<sup>6</sup> All press conferences in the above-mentioned sample period are assessed with regard to the disclosure of details about Asset Purchase Programmes, Swap Agreements, Allotment Policy, and/or Forward Guidance. If at least one of these topics is discussed substantively, the press conference is included in our analysis. A comprehensive list of the resulting 34 press conference dates can be found in Table A1 in the Appendix.

<sup>7</sup> ECB press conference transcripts with introductory statements and Q&A sessions are available at: <https://www.ecb.europa.eu/press/pressconf>.

and—within a relevant time window (14:25CET to 15:55CET)—pinpoint their various parts precisely for each minute. To quantify text complexity, we rely on the most common complexity measures, calculated for all 34 text files using *ReadablePro*,<sup>8</sup> with all text pre-processing options within the programme set to 'default'.

We use trading volume of European stock index futures to proxy financial market trading activity. Futures are highly liquid trading instruments that react quickly to new information (see, e.g., Kuttner, 2001; Bomfim, 2003). Specifically, we sample the EUREX trading volume in EURO-STOXX-50 futures at a 1-minute frequency from 14:25CET–15:55CET, which we retrieve from PortaraCQG.

### *3.2 Descriptive Analysis*

In our descriptive analysis, we provide stylised facts indicating the relevance of our hypotheses. We proceed in three steps.

First, we examine the trading activity in European stock index futures during the 34 GCM press conferences in our sample to understand its extent and temporal distribution, especially with regard to the beginning and end of the introductory statement and the Q&A session.

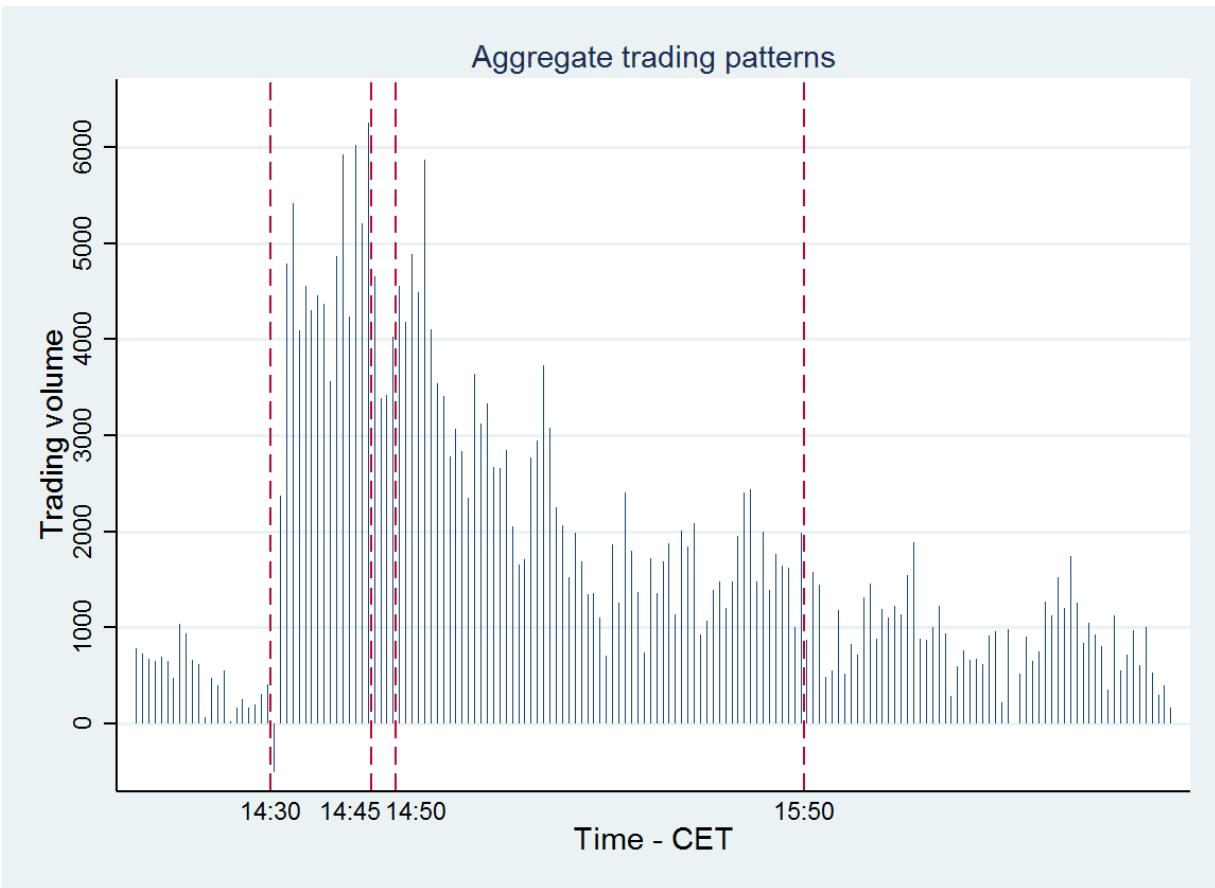
We are particularly interested in abnormal/excess trading volumes; effects stemming from regular information sources are excluded. We calculate the mean trading volume per minute from all 34 event days and subtract the mean volume per minute from

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<sup>8</sup> ReadablePro is available at: <https://readable.com>.



non-event days. The aggregate trading patterns, i.e., mean excess trading volumes, over our sample are illustrated in Figure 1.



**Fig. 1** Mean excess trading volume in stock index futures during the analysed GCM press conferences. Calculation using mean excess trading volume for 1-minute intervals of the EURO-STOXX-50 Future across 34 GCM days when UMPM were announced (May 2009–June 2017). Excess trading volume computed as mean EUREX trading volume across 34 meeting days minus mean EUREX trading volume on non-meeting days over the same period.

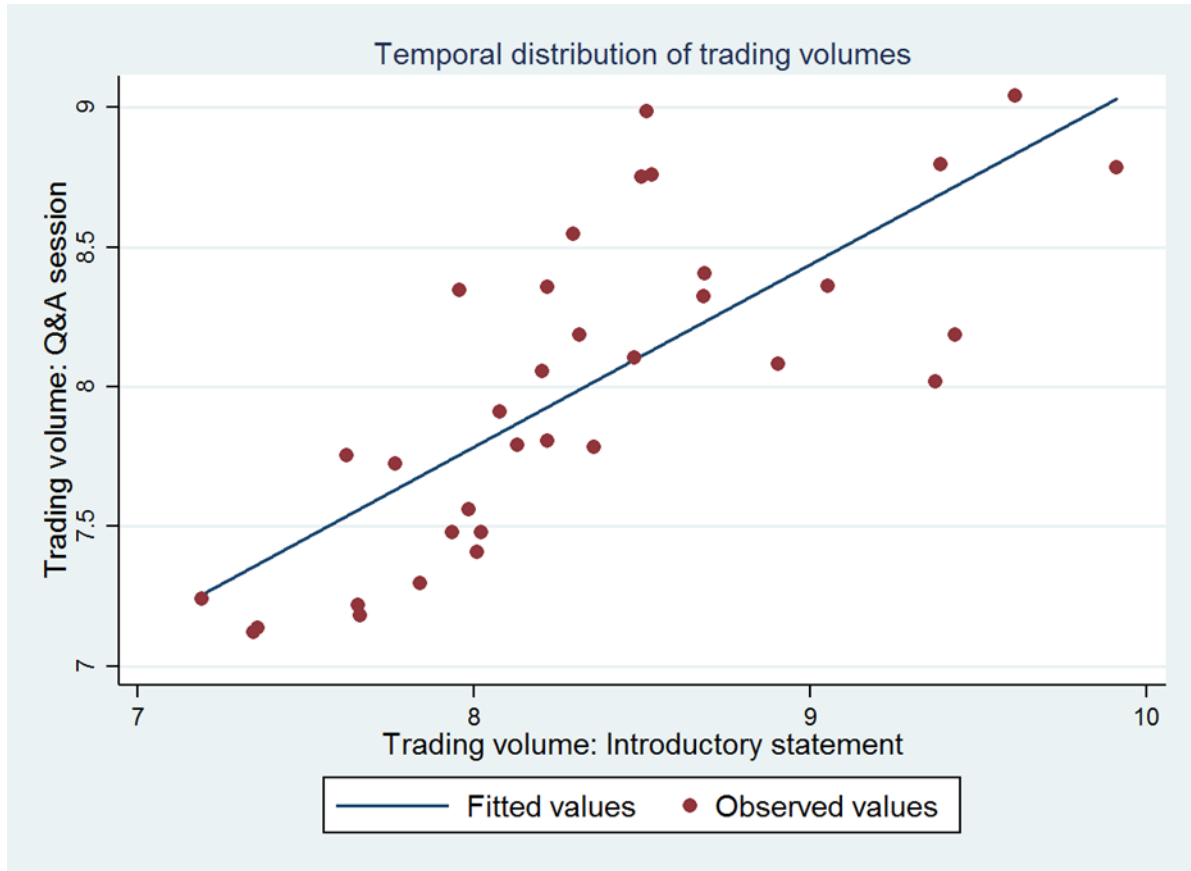
We find that at the beginning of GCM press conferences (14:30 CET), mean excess trading volume in stock index futures on UMPM event days increases notably. Arguably, relevant news (unexpected information) is being processed by financial markets. Given our precise timing, it seems likely that this news stems from GCM monetary policy decisions, which are announced and described during the introductory statements (except for interest rate decisions, which are previously communicated at

13:45CET). The significant trading volume between 14:30CET and 14:45CET is consistent with a short reaction time by financial markets (see, e.g., Andersson, 2010; Nakamura & Steinsson, 2018). After a slight decline at the end of the introductory statement (at around 14:45CET), the volume rises again when the Q&A session starts (at around 14:50CET). From 15:00CET onward, trading volumes slowly decrease until around 15:50CET, when trading activity reverts to near normal levels. As noted above, 14:50CET until 15:50CET is the period during which the Q&A session occurs.

We see that trading volume reacts visibly during the GCM press conferences. Furthermore, Q&A sessions also appear to contain relevant news (unexpected information) for financial markets. Put differently, focusing only on the 14:30CET to 14:45CET time window would be too narrow a period to capture the entire market reaction.

Second, we review whether the temporal distribution of trading activity in European stock index futures is representative of all 34 events in our sample or whether it is simply a product of aggregation across time. Thus, we analyse the temporal distribution of trading volumes between introductory statement and Q&A session for each individual event.

For the event-individual distribution of trading volumes, we calculate the average (mean) minute trading volumes for the 14:30CET–14:45CET introductory statement as well as for the 14:50CET–15:50CET Q&A session and apply the natural logarithm. To compare the events, we plot the results in a chart with the volumes of the introductory statement and those of the Q&A session on the two axes. To see the degree of divergence of our sample events, we include an auxiliary line with the fitted values in Figure 2.



**Fig. 2** Cross-plot of trading volumes across introductory statements and Q&A sessions, with observed values and a fitted regression line. Calculated using the natural logarithm of average (mean) minute trading volume of the EURO-STOXX-50 Future on EUREX over 34 GCM days with UMPM announcements (May 2009–June 2017). Separation between 14:30–14:45CET introductory statement and 14:50–15:50CET Q&A session.

Two main patterns are evident from Figure 2. First, there is a positive correlation between the trading volumes in the two periods. Second, the quantitative relationship between trading volumes during the introductory statement and those during the Q&A session can vary substantially. This indicates that the relationship is not perfectly linear across individual events and, therefore, other factors appear to be playing a role.

One explanation might be that the transmission of information depends on the medium through which the information is shared and this might change over time. However, we do not find such a trend in the data. Moreover, there is no reason to expect

the transmission to have changed substantially over the relatively short sample period. Therefore, changes in the transmission of information do not seem a sufficient explanation of the observed divergence in Figure 2. Another explanation might be that differences in opinion (see, e.g., Kandel & Pearson, 1995) influence the trading relationship between the two GCM press conference sections. However, Hayo and Neuenkirch (2015b) show that investors' opinions concerning monetary policy announcements are usually rather uniformly distributed.

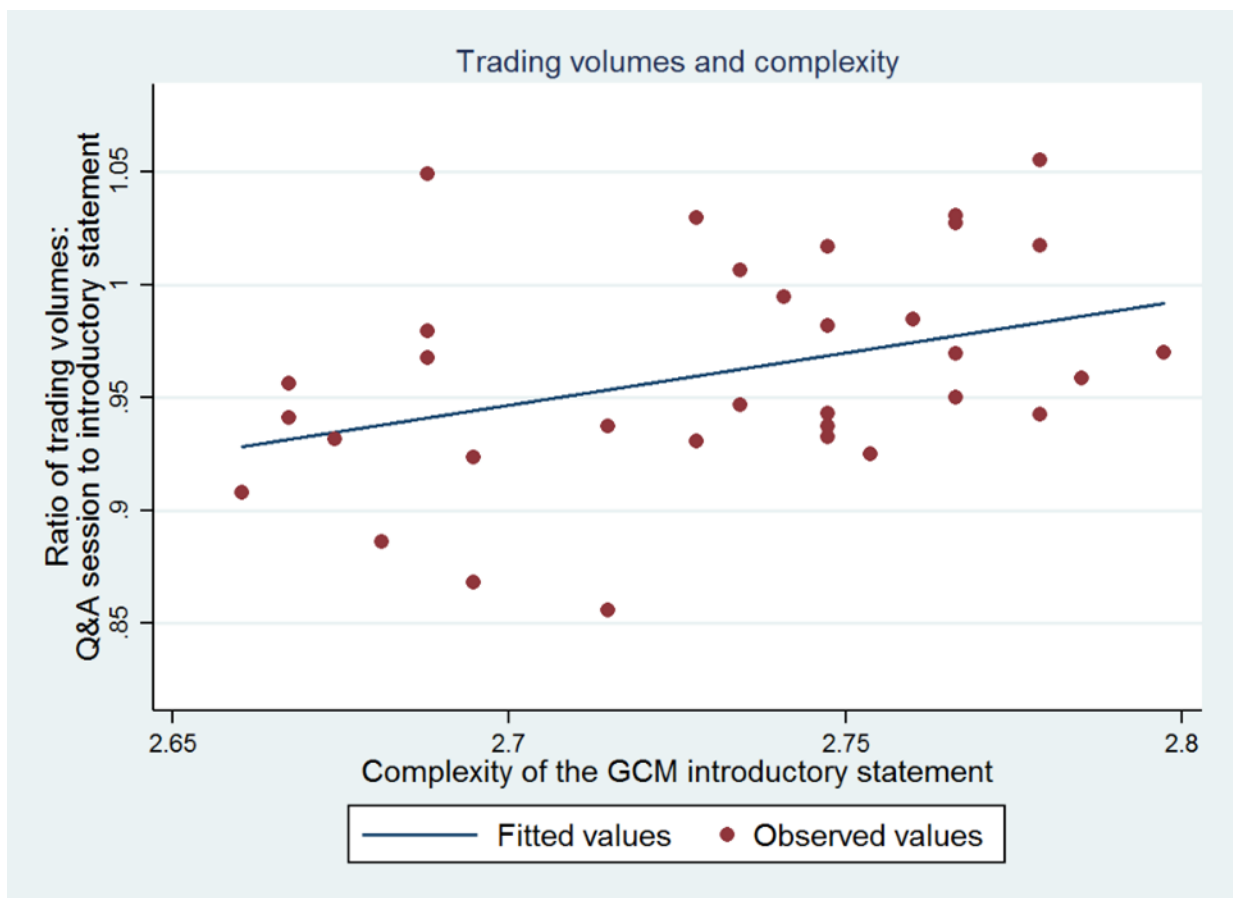
We next analyse whether there is a relationship between the temporal distribution of trading volumes and the complexity of introductory statements. This extends the analysis in the second step by a third dimension representing the ease of understanding.

To determine measure the complexity of the statements, we opt for the *Flesch-Kincaid Grade Level* (Kincaid et al., 1975), as this measure is most commonly used in practice and makes our results comparable to those of Smales and Apergis (2017a, 2017b) for the US Fed. Calculating the Flesch-Kincaid Grade Level for our sample, we find a mean value of 15.4 and a standard deviation of 0.6. The observed maximum and minimum values are 14.3 and 16.4, respectively. These statistics correspond with the findings of Coenen et al. (2017) and show that the level of complexity is relatively high across all events, which can be expected from central bank communications. However, there is still notable variation in complexity between the statements. For our subsequent analyses, we apply the natural logarithm to the Flesch-Kincaid Grade Level.

To capture the temporal distribution of trading volumes in a single variable, we calculate for each event the ratio of average (mean) minute trading volumes of the

14:50CET–15:50CET Q&A session divided by those of the 14:30CET–14:45CET introductory statement, applying the natural logarithm to both numerator and denominator.

We then determine for each event day the relation between the complexity of the GCM introductory statements and the temporal distribution of trading volumes. The result is plotted in Figure 3.



**Fig. 3.** Temporal distribution of trading volumes and complexity. Calculation based on the ratio of average (mean) minute trading volumes of the EURO-STOXX-50 Future on EUREX over 34 GCM days with UMPM announcements (May 2009–June 2017) during the 14:50–15:50CET Q&A session divided by the 14:30–14:45CET introductory statement, with the natural logarithm applied to both numerator and denominator. Communication complexity of GCM introductory statements is measured by the natural logarithm of the Flesch-Kincaid Grade Level.

Prima facie, we observe a positive relationship between the complexity of the GCM introductory statements and the temporal distribution of trading volumes. This indicates that more complex statements induce a shift of trading volume from introductory statements to Q&A sessions.

## 4 Regression Analysis

### 4.1 Empirical Design

To formally test our two hypotheses, we conduct two OLS regressions. First, focussing on H1, we investigate the relationship between statement complexity and overall trading volume. We regress the complexity measure of press conference introductory statements on trading volumes during the time of the press conference and a set of controls:

$$(1) \quad V_t = \alpha + \beta \cdot Complexity_t + \gamma \cdot Controls_t + \varepsilon_t,$$

where the dependent variable  $V_t$  represents the overall trading volume during the  $t$ -th press conference,  $\alpha$  is a constant, the independent variable  $Complexity_t$  represents the complexity of the introductory statement of the  $t$ -th press conference,  $Controls_t$  represents a vector of control variables, and  $\varepsilon_t$  is the error term. The coefficient  $\beta$  is of particular interest, as it gives an idea of the direction and significance of the relationship between statement complexity and trading volume.

Second, focussing on H2, we analyse whether increasing statement complexity is associated with a temporal shift in trading activity to the Q&A session. We regress the complexity measure of press conference introductory statements on the distribution of trading activity and a set of controls by adjusting our estimation model to

$$(2) \quad D_t = \alpha + \beta \cdot Complexity_t + \gamma \cdot Controls_t + \varepsilon_t$$

where the dependent variable  $D_t$  represents the temporal distribution of trading on the  $t$ -th press conference. In this specification,  $\beta$  provides information on the direction and significance of the relationship between statement complexity and the temporal distribution of trading activity.

The overall trading volume  $V_t$  contains the aggregate trading volumes in EURO-STOXX-50 futures at a 1-minute frequency during each press conference, covering introductory statement as well as Q&A session. We calculate the mean minute trading volumes of the 15- and 60-minute windows from 14:30CET–14:45CET and 14:50CET–15:50CET, respectively, which represent the typical durations of the introductory statement and the Q&A session. Then we take the average of both values and apply the natural logarithm, resulting in  $Volume_{Intro+Q\&A}$ . As an alternative measure, we compute the mean minute trading volume for the overall window 14:30CET–15:50CET, called  $Volume_{Conf}$ , in a similar way.

For the distribution of trading activity between Q&A session and introductory statement  $D_t$ , we use the mean minute trading volumes of the 15- and 60-minute windows from 14:30CET–14:45CET and 14:50CET–15:50CET. We construct the ratio of mean minute trading volume during the Q&A session to mean minute trading volume during the introductory statement ( $Volume_{Q\&A-to-Intro}$ ), applying the natural logarithm to both numerator and denominator. As an alternative measure, we calculate the ratio of mean minute trading volume during the Q&A session to mean minute trading volume during the overall press conference, i.e., 14:50CET–15:50CET, again applying the natural logarithm. This alternative measure is referred to as  $Volume_{Q\&A-to-Conf}$ .

The complexity of the introductory statement is approximated by the (*natural logarithm of the*) *Flesch-Kincaid Grade Level* (Kincaid et al., 1975). Alternative complexity measures are described and tested in the robustness section. We include three control variables. First, based on Kuttner (2001), we capture the surprise effect in conventional monetary policy by long-term *Bond Returns*. We use the log-return of the 10-year BUND future as traded on EUREX during 13:44CET–14:29CET. Second, we use a *Rate Change Dummy*, which indicates whether there was a change in the ECB’s deposit facility rate, which is announced at 13:45CET. Third, we include  $\Delta$ *Shadow Prime Rate*, which captures monetary tightening as conveyed in the ECB’s communications. In line with Hayo, Henseler, and Rapp (2018), we calculate this measure using the *Wordscores* approach (Laver, Benoit, & Garry, 2003), calibrated by using introductory statement transcripts of GCM press conferences from 1999–2006 and corresponding changes in the deposit facility rate. Table 1 provides details of our variable definitions.

**Table 1**

Overview of variable definitions.

<i>Dependent variables</i>		
$V_t$	Volume <sub>Intro+Q&amp;A</sub> Volume <sub>Conf.</sub>	$\ln((\text{mean minute volume}_{14:30-14:45} + \text{mean minute volume}_{14:50-15:50})/2)$ $\ln(\text{mean minute volume}_{14:30-15:50})$
$D_t$	Volume <sub>Q&amp;A-to-Intro</sub> Volume <sub>Q&amp;A-to-Conf.</sub>	$\ln((\text{mean minute volume}_{14:50-15:50})/(\text{mean minute volume}_{14:30-14:45}))$ $\ln((\text{mean minute volume}_{14:50-15:50})/(\text{mean minute volume}_{14:30-15:50}))$
<i>Independent variables</i>		
Complexity <sub>t</sub>		Flesch-Kincaid Grade Level for GCM introductory statements, calculated as: $0.39 \cdot WS + 11.8 \cdot SW - 15.59$ WS = Total number of words divided by total number of sentences SW = Total number of syllables divided by total number of words
<i>Control variables</i>		
Controls <sub>t</sub>	Bond Return Rate Change Dummy $\Delta$ Shadow Prime Rate	$\ln(\text{Price}[14:29]/\text{Price}[13:44])$ , of EUREX traded EURO-BUND Futures Deposit facility rate change announced at 13:45CET (yes=1/no=0) Calculated using <i>Wordscores</i> , calibrated based on introductory statement transcripts of GCM press conferences in 1999–2006 and corresponding changes in the deposit facility rate



## 4.2 Results from Regression Analysis

To assess H1, we review the relationship between statement complexity and the overall trading volume by estimating Equation (1). We report the results of the two proposed definitions for  $V_t$ ,  $Volume_{Intro+Q\&A}$  and  $Volume_{Conf.}$ , in each case using a specification including and a specification excluding the vector of controls. The respective coefficients are presented in Table 2.

**Table 2**

Regression results for testing H1 using Equation (1).

Specification	(1a)	(1b)	(1c)	(1d)
$D_t$	$Volume_{Q\&A+Intro}$	$Volume_{Q\&A+Intro}$	$Volume_{Conf.}$	$Volume_{Conf.}$
$X_t$	<i>excluded</i>	<i>included</i>	<i>excluded</i>	<i>included</i>
Complexity (Flesch-Kincaid Grade Level)	-7.43*** (-3.17)	-5.71** (-2.37)	-5.98** (-2.52)	-4.38* (-1.77)
Bond-Return		0.91* (1.95)		1.01** (2.12)
Rate-Change Dummy		0.72** (2.67)		0.62** (2.25)
$\Delta$ Shadow-Prime-Rate		0.06 (0.37)		-0.01 (-0.04)
Observations	34	34	34	34
R <sup>2</sup>	0.24	0.43	0.17	0.36

Notes: Coefficients are estimated using an OLS regression.  $t$ -statistics are displayed in parentheses. \*\*\*, \*\*, \* indicate significance at the 1, 5, and 10 per cent level, respectively.

In all four specifications (1a–1d), the coefficient related to our complexity measure is significantly negative. In specification (1a) using  $Volume_{Intro+Q\&A}$  and no controls, the marginal significance level is at the 1 per cent level. When using the alternative  $Volume_{Conf.}$  or when including the set of control variables (1b–1d), the marginal significance level decreases but stays at a 5 or 10 per cent level. Given the small sample

size, these significance levels are empirically meaningful. The coefficient is consistently negative; however, its absolute amount is declining in absolute terms from 7 to 4. Thus, more complex introductory statements are associated with a lower level of contemporaneous trading, which supports H1.

This result is in sharp contrast to that of Smales and Apergis (2017a, 2017b), who find that complexity of FOMC statements increases trading volume. However, our result supports the extant literature around You and Zhang (2009) and Miller (2010), who propose a negative relationship between information complexity and trading behaviour. The result also supports the argument that investors underreact to cognitively costly/complex information (Hirshleifer, 2001; Hong & Stein, 1999; McEwen & Hunton, 1999).

To assess H2, we study the relationship between statement complexity and the temporal distribution of trading activity. In Table 3, we report the results of estimating Equation (2) for the two proposed definitions of  $D_t$ ,  $Volume_{Q\&A-to-Intro}$  and  $Volume_{Q\&A-to-Conf}$ . In all four specifications (2a–2d), the coefficient of our complexity measure is significantly positive. In specifications (2a) and (2b), where we use  $Volume_{Q\&A-to-Intro}$  with and without control variables, but also in specification (2c), where we use  $Volume_{Q\&A-to-Conf}$  without control variables, the marginal significance level is at the 5 per cent level. Only when using  $Volume_{Q\&A-to-Conf}$  with control variables does the marginal significance level increase to the 10 per cent level. Again, keeping the limited sample size in mind, we believe these significance levels to be empirically meaningful. The coefficient estimates are consistently positive. Due to the difference in the de-

nominator of the two definitions of  $D_t$ , it is not surprising to find a discrepancy between the coefficients when using  $Volume_{Q\&A-to-Intro}$  (between 4 and 5) and  $Volume_{Q\&A-to-Conf.}$  (slightly more than 1). Hence, our results support H2.

**Table 3**

Regression results for testing H2 using Equation (2).

<i>Specification</i>	<i>(2a)</i>	<i>(2b)</i>	<i>(2c)</i>	<i>(2d)</i>
$D_t$	$Volume_{Q\&A-to-Intro}$	$Volume_{Q\&A-to-Intro}$	$Volume_{Q\&A-to-Conf.}$	$Volume_{Q\&A-to-Conf.}$
$X_t$	<i>excluded</i>	<i>included</i>	<i>excluded</i>	<i>Included</i>
Complexity (Flesch Kincaid Grade Level)	4.56** (2.60)	4.23** (2.18)	1.35** (2.61)	1.19* (2.09)
Bond-Return		0.29* (0.78)		0.04 (0.38)
Rate-Change Dummy		-0.23 (-1.05)		-0.10 (-1.61)
$\Delta$ Shadow-Prime-Rate		-0.19 (-1.48)		-0.05 (-1.41)
Observations	34	34	34	34
R <sup>2</sup>	0.18	0.28	0.18	0.29

Notes: Coefficients are estimated using an OLS regression.  $t$ -statistics are displayed in parentheses. \*\*\*, \*\*, \* indicate significance at the 1, 5, and 10 per cent level, respectively.

## 5 Robustness of Results

We conduct several robustness tests. Specifically, we (i) consider alternative measures of complexity, (ii) determine complexity via factor analyses based on multiple complexity measures as well as further communication-related measures, (iii) control for text similarity and learning, and (iv) capture the event-specific timing of introductory statements.

## 5.1 Alternative Measures of Complexity

As alternatives to the *Flesch-Kincaid Grade Level*, we use the most common alternative measures, which are *Flesch Reading Ease* (Flesch, 1948), the *Gunning Fog Index* (Gunning, 1952), the *SMOG Index* (McLaughlin, 1969), the *Coleman-Liau Index* (Coleman & Liau, 1975), and the *Automated Readability Index* (Senter & Smith, 1967). Table 4 sets out the respective definitions. For *Flesch Reading Ease*, we take the inverse of the measure so as to ensure that for all indicators larger values represent a higher degree of complexity.

**Table 4**

Definitions of alternative complexity measures.

<i>Complexity measures</i>	
Flesch Reading Ease (inverted)	$(206.835 - 1.015 \cdot WS - 84.6 \cdot SW) \cdot (-1)$ WS = #words divided by #sentences; SW = #syllables divided by #words
Gunning Fog Index	$0.4 \cdot WS + 40 \cdot CWW$ WS = #words divided by #sentences; CWW = #complex words divided by #words
SMOG Index	$1.0430 \cdot \sqrt{PS \cdot (30/S)} + 3.1291$ PS = #polysyllables (3 or more syllables); S = #sentences
Coleman-Liau Index	$0.0588 \cdot AL + 0.296 \cdot AS - 15.8$ AL = Average #letters per 100 words; AS = Average #sentences per 100 words
Automated Readability Index	$4.71 \cdot (C/W) + 0.5 \cdot (W/S) - 21.43$ C = #characters; W = #words; S = #sentences

Table 5 reports the coefficients for our baseline complexity measure as well as for the alternative complexity measures. We test each complexity measure individually in Equation (1), with  $V_t$  defined as  $Volume_{Intro+Q\&A}$ , and in Equation (2), with  $D_t$  defined as  $Volume_{Q\&A-to-Intro}$ . In all our robustness analyses, we apply the specification with all controls. To economise on space, however, we do not report the coefficients for the control variables.

Regardless of how complexity is defined, we find coefficients with a consistent sign. Except for the Coleman-Liau Index, all results are significant at levels of 10 per cent

or below. We conclude that our results are robust with regard to the definition of complexity.

**Table 5**  
Coefficients for alternative measures of complexity.

<i>Specification</i>	<i>(1e)</i>	<i>(2e)</i>
<i>D<sub>t</sub></i>	<i>Volume<sub>Intro+Q&amp;A</sub></i>	<i>Volume<sub>Q&amp;A-to-Intro</sub></i>
<i>X<sub>t</sub></i>	<i>included</i>	<i>included</i>
Flesch Kincaid Grade Level	-5.71** (-2.37)	4.23** (2.18)
Flesch Reading Ease	-3.08** (-2.43)	2.22** (2.16)
Gunning Fog Index	-7.35*** (2.76)	4.50* (2.02)
SMOG Index	-7.65** (-2.44)	5.68** (2.25)
Coleman-Liau Index	-4.00 (-1.09)	1.50 (0.51)
Automated Readability Index	-5.02** (-2.33)	3.26* (1.85)

Notes: Coefficients are estimated using an OLS regression. *t*-statistics are displayed in parentheses. \*\*\*, \*\*, \* indicate significance at the 1, 5, and 10 per cent level, respectively. All control variables are included (see Table 1).

## 5.2 Complexity Approximated via Factor Analyses

Since all indicators are supposed to measure the same latent variable, it is appropriate to approximate complexity using a factor analysis. We employ two sets of underlying variables. First, we conduct a factor analysis using the six complexity definitions discussed above and find one common factor (Eigenvalue > 1). Second, we conduct another factor analysis using not only the six complexity definitions but also a set of additional variables quantifying communication (see Table 6). Combining the six complexity definitions together with the seven additional variables, we discover three common factors (Eigenvalues > 1). The six complexity definitions primarily load on

the first factor. The communication indicators Future-Orientation, Uncertainty, and Overstated/Understated mainly load on the second factor, while the remaining ones tend to load on the third factor.

**Table 6**

Additional variables for quantifying communication-related aspects.

<i>Communication measures</i>	
Future-Orientation	% future verbs
Uncertainty	% uncertainty verbs
Active/Passive	(% active verbs - % passive verbs)+1
Overstated/Understated	(% overstated verbs - % understated verbs)+1
Positive/Negative	(% positive verbs - % negative verbs)+1
Positive/Negative	(% positive verbs - % negative verbs)+1 [Loughran-McDonald definition]
Strong/Weak	(% strong verbs - % weak verbs)+1

We use the one factor from the first factor analysis and the three factors from the second factor analysis to re-estimate Equation (1), with  $V_t$  defined as  $Volume_{Intro+Q\&A}$ , and Equation (2), with  $D_t$  defined as  $Volume_{Q\&A-to-Intro}$ . The results are reported in Table 7.

The factors capturing complexity lead to significantly negative results, which is in line with the results reported in Tables 2 and 3. In contrast, the two factors reflecting other communication-related aspects appear insignificant. Therefore, we conclude that our results are also robust to complexity approximated via a factor analysis as well as with regard to other aspects of communication.

**Table 7**

Coefficients for complexity measures based on factor analysis.

<i>Panel A: Factor Analysis (Complexity Measures)</i>		
<i>Specification</i>	<i>(1f)</i>	<i>(2f)</i>
Factor 1	-0.35** (-2.52)	0.24** (2.13)
Observations	34	34
R <sup>2</sup>	0.44	0.27
<i>Panel B: Factor Analysis: Complexity + Add. Measures</i>		
<i>Specification</i>	<i>(1g)</i>	<i>(2g)</i>
Factor 1	-0.42** (-2.74)	0.29** (2.28)
Factor 2	0.17 (1.15)	0.05 (0.43)
Factor 3	0.06 (0.33)	0.17 (1.12)
Observations	34	34
R <sup>2</sup>	0.47	0.32

Notes: Coefficients are estimated using an OLS regression. *t*-statistics are displayed in parentheses. \*\*\*, \*\*, \* indicate significance at the 1, 5, and 10 per cent level, respectively. All controls variables are included (see Table 1).

### 5.3 Further Control for Text Similarity and Learning

Ehrmann and Talmi (2017) discuss the relevance to financial markets of communication similarity. Using Bank of Canada press releases, they discover that larger wording differences (with respect to the previous press release) evoke higher volatility in financial markets. The authors explain this finding by the increased difficulty for market participants to absorb the new content. Amaya and Filbien (2015) suggest such a relationship for the ECB. They argue that the similarity of ECB communication has helped stock markets learn from ECB monetary policy.

To ensure that our findings are not biased by similarity/learning effects, we test the robustness of our regression results after controlling for this aspect. In line with Ehrmann and Talmi (2017), we calculate similarity as the cosine similarity (distance) between two fixed-length vector representations of two subsequent texts, in our case ECB's GCM press conference introductory statements. We take the following pre-processing steps. (i) We convert all text into lower-case letters. (ii) We remove all numbers, dates, and stop words. (iii) We construct word bi-grams (two-word combinations) in order to capture combined expressions, for example, 'quantitative *easing*'. We then calculate the cosine similarity of two subsequent texts for all 34 events in our sample by using the formula

$$Similarity_t = \frac{\sum_{b=1}^B fr_{b,t} \cdot fr_{b,t-1}}{\sqrt{\sum_{b=1}^B fr_{b,t}^2} \cdot \sqrt{\sum_{b=1}^B fr_{b,t-1}^2}},$$

where  $B$  represents the total number of unique bi-grams in all analysed press releases, and  $fr_{b,t}$  and  $fr_{b,t-1}$  are the frequencies of bi-gram  $b$  in press releases  $t$  and  $t-1$ .

We re-estimate Equation (1), with  $V_t$  defined as  $Volume_{Intro+Q\&A}$ , and Equation (2), with  $D_t$  defined as  $Volume_{Q\&A-to-Intro}$ , and add the above-described *Similarity* measure. The results are reported in Table 8. When controlling for *Similarity* in specification (1h), we find a coefficient of around  $-5$  for our complexity measure. This coefficient is smaller in absolute terms than the one in our baseline estimate (1b) in Table 2 of approximately  $-6$ . The marginal level of significance is also slightly increasing from the 5 per cent to the 10 per cent level. Specification (2h) shows that the coefficient remains relatively constant at around 4, when compared with the baseline results (2b) in Table 3. The level of significance remains constant at the 10 per cent level.



Using *t*-tests for differences in means, we find that none of these differences are significant at a 10 per cent level. Thus, we conclude that our results are robust after controlling for text similarity.

**Table 8**  
Complexity coefficients when controlling for text similarity.

<i>Specification</i>	<i>(1h)</i>	<i>(2h)</i>
Complexity	-4.90* (-1.81)	4.36* (1.99)
Similarity	-1.57 (-0.70)	-0.25 (-0.14)
Observations	34	34
R2	0.44	0.28

Notes: Coefficients are estimated using an OLS regression. *t*-statistics are displayed in parentheses. \*\*\*, \*\*, \* indicate significance at the 1, 5, and 10 per cent level, respectively. All control variables are included (see Table 1).

#### 5.4 Exact Timing of Introductory Statements

As described in Section 3.1, the introductory statement usually takes between 10 and 20 minutes, with mean and median at 15 minutes. To avoid overlaps in our baseline analysis, we rely on a fixed 15-minute window for the introductory statement and a start of the Q&A session window after 20 minutes. However, this standardisation may affect our results, as it does not account for the exact transition between the two phases of the press conference. To test the robustness of our results, we use the

publicly available webcasts of the GCM press conferences and, for each press conference, determine the individual transition point (on a minute-basis) from introductory statement to Q&A session.<sup>9</sup>

We re-estimate Equation (1), with  $V_t$  defined as  $Volume_{Intro+Q\&A}$ , and Equation (2), with  $D_t$  defined as  $Volume_{Q\&A-to-Intro}$ , but adjust the analysed windows to the press-conference-specific transition points. In a first specification, we start the Q&A session immediately after the end of the introductory statement. In a second specification, we calculate a 5-minute gap between introductory statement and Q&A session in order to allow for lagged trading decisions. The results are reported in Table 9, with the first and second specifications in Panels A and B, respectively.

For specification (1i), we find a coefficient of around  $-6$  for our *Complexity* measure. This coefficient is significant at the 5 per cent level and nearly identical to our baseline results (1b) in Table 2. Moreover, when comparing the results of specification (2i) with those from specification (2b) in Table 3, there are hardly any differences in terms of size or level of significance. The results of Panel B are nearly identical to those of Panel A. Therefore, we conclude that our results are also robust to adjusted time windows.

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<sup>9</sup> ECB press conference webcasts are available at: <https://www.ecb.europa.eu/press/tvservices/webcast/html/index.en.html> (accessed: 11 Apr 2018).

**Table 9**

Complexity coefficients when adjusting analysed windows to the press-conference-specific transition points from introductory statement to Q&A session.

<i>Panel A: No gap between introductory statement and Q&amp;A session</i>		
<i>Specification</i>	<i>(1i)</i>	<i>(2i)</i>
Complexity	-5.74** (-2.43)	4.48** (2.36)
Observations	34	34
R2	0.44	0.31
<i>Panel B: 5-minute gap between introductory statement and Q&amp;A session</i>		
<i>Specification</i>	<i>(1j)</i>	<i>(2j)</i>
Complexity	-5.71** (-2.48)	4.62** (2.31)
Observations	34	34
R2	0.45	0.29

Notes: Coefficients are estimated using an OLS regression. *t*-statistics are displayed in parentheses. \*\*\*, \*\*, \* indicate significance at the 1, 5, and 10 per cent level, respectively. All control variables are included (see Table 1).

## 6 Conclusion

In this paper, we assess the effects of central bank communication complexity on the trading behaviour of financial market participants. We analyse official ECB communication, as found in introductory statements at press conferences following regular GCMs. We cover the May 2009 to June 2017 period, during which a switch to newly developed and unprecedented UMPM substantially increased communication complexity. Using high-frequency data on contemporaneous European stock index futures, we investigate whether communication complexity is an issue for financial market participants and whether trading decisions are postponed to Q&A sessions. Our results suggest a negative relationship between ECB communication complexity and

trading volume. This finding supports the results of You and Zhang (2009) and Miller (2010) and is consistent with the argument that investors underreact to cognitively costly/complex information (Hirshleifer, 2001; Hong & Stein, 1999; McEwen & Hunton, 1999). However, our results contradict those of Smales and Apergis (2017a, 2017b) for the Fed. Thus, when the ECB intends to share information with financial markets, the complexity or, inversely, the understandability of its communication plays an important role.

Our results indicate a positive relationship between the complexity of ECB communication and a shift of trading activity from press conference introductory statements to Q&A sessions. To the best of our knowledge, this is the first paper to investigate the effect of central bank communication complexity on the timing of trading activity.

Our findings provide deeper insight into the question of how financial market participants react to the understandability of central bank communication over the course of a press conference. We move beyond studying only one point in time and consider various communication efforts, namely, introductory statements and Q&A sessions, and how they interact. Further research might be fruitfully conducted to discover what drives complexity and whether a shift of trading activity to Q&A sessions can be explained by Q&A sessions effectively solving understandability issues. In addition, it would be interesting to find out whether our findings apply to other forms of central bank communication. Finally, the question of why there are differences in market reactions across central banks seems relevant, a phenomenon revealed by comparing our results with those of Smales and Apergis (2017a, 2017b). Knowing this would enable central banks to improve their communication tools and help identify best practices for future central bank communication.

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## Appendix

**Table A1**

ECB's GCM press conferences included in the data sample.

<i>No.</i>	<i>Date</i>	<i>UMPM disclosure (predominant)</i>
1	07 May 2009	Asset Purchase Programme
2	04 Jun 2009	Asset Purchase Programme
3	06 Aug 2009	Swap Agreement
4	03 Dec 2009	Forward Guidance
5	04 Mar 2010	Allotment Policy
6	10 Jun 2010	Allotment Policy
7	02 Sep 2010	Allotment Policy
8	02 Dec 2010	Allotment Policy
9	03 Mar 2011	Allotment Policy
10	09 Jun 2011	Allotment Policy
11	04 Aug 2011	Allotment Policy
12	06 Oct 2011	Asset Purchase Programme
13	03 Nov 2011	Asset Purchase Programme
14	06 Jun 2012	Allotment Policy
15	02 Aug 2012	Asset Purchase Programme
16	06 Sep 2012	Asset Purchase Programme
17	06 Dec 2012	Allotment Policy
18	02 May 2013	Allotment Policy
19	05 Jun 2014	Allotment Policy
20	03 Jul 2014	Allotment Policy
21	04 Sep 2014	Asset Purchase Programme
22	02 Oct 2014	Asset Purchase Programme
23	22 Jan 2015	Asset Purchase Programme
24	10 Mar 2016	Asset Purchase Programme
25	21 Apr 2016	Asset Purchase Programme
26	02 Jun 2016	Asset Purchase Programme
27	21 Jul 2016	Forward Guidance
28	08 Sep 2016	Forward Guidance
29	20 Oct 2016	Forward Guidance
30	08 Dec 2016	Asset Purchase Programme
31	19 Jan 2017	Asset Purchase Programme
32	09 Mar 2017	Forward Guidance
33	27 Apr 2017	Forward Guidance
34	08 Jun 2017	Forward Guidance

Notes: ECB's GCM press conferences sampled following the 2008 financial crisis (from May 2009 onward), when the ECB started conducting UMPM on a recurring basis, apparent by the announcement of ECB's first covered bond purchase programme on 07 May 2009, and covering the period until June 2017. Limitation to press conferences where details on UMPM are disclosed, i.e., details on Asset Purchase Programmes, Swap Agreements, Allotment Policy, and/or Forward Guidance.