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Central bank communication and social media: From silence to Twitter

Donato Masciandaro[1] | **Oana Peia**[2] | **Davide Romelli**[3]

[1]Bocconi University, Milan, Italy

[2]University College Dublin, Dublin, Ireland

[3]Trinity College Dublin, Dublin, Ireland

Correspondence
Davide Romelli, Department of Economics, Trinity College Dublin, Arts Building, Dublin 2, Ireland.
Email: romellid@tcd.ie

Abstract

This paper discusses the evolution of central bank communication, focusing on recent efforts by central banks to engage with a wider audience via social media. We document the social media presence of major central banks and discuss how analyzing Twitter content by and about monetary policy makers can inform about the effectiveness of communication in influencing beliefs. We focus on recent techniques employed in analyzing social media content in order to understand how central bank communication affects expectations and, subsequently, behavior in financial markets.

KEYWORDS
central bank communication, expectations, monetary policy, social media, text analysis, transparency, Twitter

JEL CLASSIFICATION
E44, E52, E58, G14, G15, G41

1 | INTRODUCTION

Central banks have transformed their communication practices significantly over the past three decades (Issing, 2005; Assenmacher et al., 2021). Whereas prior to the 1990s, communication around monetary policy was surrounded by silence and secrecy, in recent decades, central bank transparency and communication have become key instruments in central bankers' policy toolkit and have drastically transformed the way monetary policy is conducted (Smaghi, 2007; Blinder

et al., 2008). Communication can enhance the effectiveness of monetary policy either by creating news that are complementary to policy actions or by "reducing noise" and, thereby, uncertainty in the public's interpretation of policy actions (Blinder et al., 2008). This is achieved through increasing the predictability of monetary policy, clarifying policy objectives and strategies to allow for more informed decisions by firms and households, as well as enabling financial market participants to gain a better understanding of how policy is likely to respond to incoming information (Bernanke, 2004). Beyond its role in enhancing policy effectiveness, the importance of communication also rests on its democratic accountability: the way central banks communicate their policy objectives, deliberations, and decisions to the public is central to their accountability as a public policy institution (Bank for International Settlements, 2009).

Moreover, the adoption of unconventional monetary policy tools such as forward guidance and quantitative easing (QE) since the 2008 global financial crisis has further stressed the importance of communication as a monetary policy instrument. Central bank communication has become more frequent and diverse since the crisis and is increasingly aiming to reach a wider nonexpert audience (ECB, 2021).

In this survey, we review a large literature on central bank communication. While there are numerous other surveys on central bank communication in the literature (see, among others, Blinder et al., 2008; Moessner et al., 2017), our intention here is to focus on the new tools that central banks employ in their communication to both experts and the general public. We show that major central banks are employing Twitter as the main social media platform to engage with both experts and a wider nonexpert public. We document Twitter activity by central banks of G20 countries and classify the content of a large sample of tweets into several categories. We show that tweets announcing the launch of new coins and banknotes, but also those related to monetary policy decisions and operations are associated with a higher public engagement in the form of likes and re-tweets.

We then discuss a burgeoning literature that examines the impact of communication by central banks via Twitter. These recent works exploit high-frequency social media data to understand the effects of central bank communication by analyzing both content *by* monetary policy makers, as well as content by social media users *about* policy decisions. The bulk of evidence suggests that central banks have made significant progress in using social media to reach a wider public. This increased social media engagement, particularly around policy announcements, is shown to affect expectations, as well as behavior in financial markets (Ehrmann & Hubert, 2022; Ehrmann & Wabitsch, 2022).

An important recent avenue of research in central bank communication relies on computational text analysis tools and machine learning techniques to analyze social media content. This literature provides strong evidence that social media data can reveal useful information about expectation formation and market sentiment around monetary policy events. Most evidence relies on high-frequency identification from social media traffic around major monetary policy events such as the U.S. "taper tantrum" or the ECB's Outright Monetary Transactions (OMT) announcement as well as other regular monetary policy announcements (Meinusch & Tillmann, 2017; Lüdering & Tillmann, 2020; Stiefel & Vivès, 2021; Ehrmann & Hubert, 2022; Ehrmann & Wabitsch, 2022; Masciandaro et al., 2022). These methodologies highlight the usefulness of social media content in understanding how central bank communication via social media affects expectation and, subsequently, financial market outcomes such as government bond yields and stock market prices.

Yet, the literature on the impact of central bank communication via social media on expectation formation is still in its infancy. Advancements in text analysis techniques will, undoubtedly, allow

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for significant future research on how social media can be employed as an effective monetary policy tool. Evidence from controlled laboratory experiments and large randomized surveys shows that *how* and *what* central banks communicate matters greatly for how the general public forms inflation expectations (Binder & Rodrigue, 2018; Kryvtsov & Petersen, 2021; Coibion et al., 2022). In particular, simple and repeated forms of communication such as communicating the central bank target or simple statistics on current and forecasted inflation are shown to be better at influencing beliefs and anchoring inflation expectations.

Given the simple format of social media communication and its ease and frequency of reaching the general public as well as a targeted population, social media can be a powerful tool that can allow central banks to deliver effective communication.

The remainder of this paper is organized as follows. In Sections 2 and 3, we present a brief review of how central bank communication has evolved over time. We focus on the theoretical channels that motivate the relevance of communication as a separate monetary policy tool. We then review an empirical literature that looks at how central banks have historically communicated with expert groups. This literature places a special focus on the contents, types, and timing of communication. In Section 4, we zoom on a particular form of communication via social media. Finally, Section 5 concludes.

2 | MONETARY POLICY AND EXPECTATIONS: FROM SECRECY TO TRANSPARENCY

Up until the late 1980s, central banks around the world appeared to operate by the motto "never explain, never excuse" voiced by the Governor of the Bank of England, Montagu Norman, in the early 20th century. The first public account into the reasons behind this veil of secrecy came in 1975 when the Federal Open Market Committee (FOMC) of the U.S. Federal Reserve System was sued under the Freedom of Information Act to make public the policy directive and minutes of the FOMC meeting immediately after the meeting (Goodfriend, 1986). After 6 years of court proceedings, the case was ultimately decided in favor of the FOMC. However, the FOMC's defense of its secrecy revealed during the trial spurred a large body the research into the social benefits of secrecy of monetary policy-making.[1]

Since then, central banking practices have been significantly reshaped as a growing number of central banks, which have directed their communication towards the principles of openness and transparency (Geraats, 2002; Demertzis & Hallett, 2007; Blinder et al., 2008; Dincer & Eichengreen, 2014). Although limitations to central bank transparency exist (see, for example, Morris & Shin, 2002; D'Amato et al., 2002; Mishkin, 2004; Svensson, 2006) and there is still much debate on what constitutes an optimal communication strategy, the existing consensus in monetary theory stresses the importance of transparent communication for an effective transmission of monetary policy decisions (see Eijffinger & Masciandaro, 2014, for a review).

The increasing importance of transparency reflects the evolution of the monetary policy rationale. It has been widely stressed that the ability of central banks to affect the economy critically depends on their ability to influence market expectations regarding the future path of interest rates and not just their current level (Woodford, 2005).[2] In this context, the provision of better information to market participants on current and future monetary policies should enhance the degree to which policy decisions can influence expectations and, thereby, increase the effectiveness of monetary policy.

The increase in central bank transparency that started in the early 1990s was not only motivated by the desire of central banks to influence market expectations, but also by institutional changes in central bank design. In fact, an important trigger of increased transparency has been the demand for greater accountability of independent central banks. As central banks have become more independent, they pay more attention to explaining what they do and the reasoning behind their decisions (Briault et al., 1997). More transparency and the increased use of communication are logical consequences of this development. As Woodford (2005) argues, to satisfy the requirements of democratic legitimacy associated with increased independence, central bankers have been forced to issue more and better information on their activities.

Even though central bank accountability justifies this trend towards more transparency, whether this transparency is beneficial from a general economic standpoint is less obvious. A large body of theoretical literature starting with Morris and Shin (2002) analyzes the welfare effects of public announcements, particularly when public information is noisy. A key result in this literature is that the release of public information can be welfare reducing if agents use public signals not only for their intrinsic information, but mostly as a coordination device (Angeletos & Pavan, 2007). In such cases, they will overreact to the announcement. To reduce such inefficiencies, central bank communication should be as precise as possible and come from different channels to avoid that agents focus too much attention on a single release (Sims, 2010). Other studies focus on how increased transparency could be effective in anchoring inflation expectations (Eusepi & Preston, 2010a; Campbell et al., 2017; Bianchi & Melosi, 2018).

In addition to this theoretical research on the economic effects of central bank transparency, a large body of empirical studies builds institutional indices of central bank transparency along five main areas of focus: political, economic, procedural, policy, and operational transparency (see Eijffinger & Geraats, 2006; Dincer & Eichengreen, 2014; Horváth & Vaško, 2016; Dincer et al., 2022, among others). In line with anecdotal evidence, these studies document a trend towards greater transparency since the late 1990s, which started among advanced economies and is nowadays continuing to diffuse among emerging markets and developing countries alike.

3 | VOICE AS POLICY: CENTRAL BANK COMMUNICATION WAS BORN

"The actions of central banks are no longer cloaked in silence, and perhaps never will be again. Whereas in the past silence was seen as a guarantee of independence, today this is achieved by giving an explicit account of one's actions." —PAOLO BAFFI, GOVERNOR OF THE BANK OF ITALY, MAY 31, 1979

Within the issue of monetary policy transparency, an increasing body of evidence highlights the importance of communication as a monetary policy tool. First, communication is a very direct and effective tool for influencing expectations and, therefore, plays a seminal role in improving the effectiveness of monetary policy (Österholm et al., 2008; Eusepi & Preston, 2010a; Sturm & De Haan, 2011; Dräger et al., 2013). Second, monetary policy communication can be a way to strengthen the credibility and independence (Hayo & Neuenkirch, 2015), as well as the conservativeness of central bankers (Hoeberichts et al., 2009). In fact, communication may help the central bank demonstrate that its policies are consistent with its mandate. Third, in the presence of the two channels above, communication may greatly influence macroeconomic outcomes. An

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extensive literature sheds light on the impact of central bank communication on macroeconomic variables, such as exchange rates (Jansen & De Haan, 2004; Fratzscher, 2008; Conrad & Lamla, 2010; Gürkaynak et al., 2005), interest rates (Lucca & Trebbi, 2009; Hayo & Neuenkirch, 2011; Lamla & Sturm, 2013; Neuenkirch, 2013; Altavilla et al., 2014; Lucca & Moench, 2015; Altavilla et al., 2019; Hansen et al., 2019), asset prices (Hayo et al., 2010; Rosa, 2011; Cieslak & Schrimpf, 2019; Ehrmann & Talmi, 2020; Gürkaynak et al., 2021; Gorodnichenko et al., 2021), and real economic variables (Hansen & McMahon, 2016), as well as future monetary policy decisions (Bennani et al., 2020).

Yet, in a setting where the public has rational expectations, the role of central bank communication is not obvious, as any systematic pattern in the way that policy is conducted should be correctly inferred from the central bank's monetary policy rules. Therefore, we can define central bank transparency as how easily the public can understand the central bank's strategy solely from "observables" or (forecasted) economic data. As such, a central bank can be fully transparent without any communication. However, the less monetary transparency is automatically guaranteed, the more the design and implementation of an effective communication policy become necessary, that is, "discovering the observables."

A more effective communication policy can lead to greater predictability of central banks' actions, which, in turn, reduces uncertainty in financial markets. The ability of policy makers to influence macroeconomic outcomes and the predictability of policy decisions are not independent, as communication that leads to high predictability may have a significant effect on the economic system as a whole. In other words, the more the market's reaction is not mechanically guaranteed, the more communication matters as a tool for increasing the likelihood that expectations, announcements, and sentiments are consistent.

As such, modern monetary policy theory adopts several assumptions that highlight the relevance of communication in the link between expectations, announcements and market behavior, which include: nonrational expectations, asymmetrical information, or the absence of policy rules and reputation. If one or more of these conditions hold, then central bank communication may have an impact on financial markets (see de Haan et al., 2007). The intuition is straightforward: if monetary policy discretion becomes an unpalatable quality, then ambiguity is a central bank shortcoming that has to be eliminated via effective communication policies. Therefore, any kind of market imperfection reinforces the need for effective communication.

The three channels that motivate the relevance of central bank communication work as follows. First, the assumption that the public will perfectly understand monetary policy regardless of the efforts made to explain it may be unrealistic. King (2005) suggests that the public may follow simple (but possibly fairly robust) heuristics in making decisions instead of adopting optimizing behavior. He argues that, in this case, central bank communication can play an important role in leading people to choose the right heuristics: "the more the central bank can do to behave in a way that makes it easy for the private sector to adopt a simple heuristic to guide expectations the better. A good heuristic from that point of view would be expect inflation to be equal to target" (King, 2005, pp. 6).

Consequently, alternative frameworks to the traditional DSGE models have been proposed, where departures from rational expectations take the form of cognitive distortions that might affect the understanding of the state of the economy and, thereby, monetary policy. For example, Angeletos and Lian (2018) model these distortions through high-order uncertainty that allows agents to be uncertain of the beliefs and responses of others. They show that this friction implies that agents respond to news about the future as if they were myopic, which attenuates the general-equilibrium effects of policies such as forward guidance.[3] This occurs because individuals fail to

coordinate on a homogeneous response to any exogenous shock, and, as such, fail to homogeneously interpret the forward guidance. In this case, the provision of more information does not necessarily enhance the effectiveness of monetary policy.[4]

On the other hand, a large literature on adaptive learning provides a rationale for how communication might enhance monetary policy effectiveness (see, Eusepi & Preston, 2018, for a review). In these models, the public does not know the central bank's reaction function, but instead must estimate it. This allows for the possibility that beliefs are "unanchored," that is, inconsistent with the monetary-policy strategy. Effective central bank communication in this setting can help agents' forecast problem and anchor expectations. This literature also suggests that effective central bank communication should include interest-rate forecasts, together with a fully articulated rationale behind the forecasts, allowing agents to learn about the central bank reaction function.

The second assumption that underpins the role of central bank communication refers to the asymmetry of information between central banks and the public. Financial market participants generally do not have as much information as monetary policymakers about a number of key inputs in policy making, including the policymakers' objectives, their assessment of the economy and their policy strategy. As such, communication policies through which the central bank provides information about their reaction function, such as the relative weights placed on output and inflation objectives or the inflation target, should lead to an increase in the private sector's ability to forecast the central bank's policy. Central banks may also have better information about the economic outlook. Kohn and Sack (2003) argue that private agents may lend special credence to central bank communication about the economy, especially if the central bank has established credibility as an effective forecaster of the economy. However, even if the central bank has better information, an important issue that remains to be settled is the circumstances under which the release of that information may be beneficial, that is, contribute to realizing the central bank's objectives.

The third argument in favor of central bank communication stems from the fact that most central banks do not follow a fixed rule. For example, Bernanke (2004) argues that "specifying a complete and explicit policy rule, from which the central bank would never deviate under any circumstances, is impractical. The problem is that the number of contingencies to which policy might respond is effectively infinite (and, indeed, many are unforeseeable)." Consequently, by communicating on recent or expected economic developments or by giving hints, the central bank may influence financial markets' expectations regarding the path of monetary policy (Siklos & Sturm, 2013).

Despite all these arguments, what constitutes an optimal communication strategy remains unclear. As argued in the previous section, any communication strategy can produce intended and unintended welfare effects. Therefore, the literature has analyzed the role and consequences of different aspects on central banks' communication policy ranging from content and procedures to timing and audience.

First, the content of the communication can be either quantitative (Hayo & Neuenkirch, 2011) or qualitative, and the statements can be backward or forward looking. For example, the introduction of unconventional monetary policy tools, such as forward guidance, has highlighted the importance of the content of communication. Intuitively, forward guidance should reduce uncertainty about the future path of interest rates. However, Coenen et al. (2017) and Ehrmann et al. (2019), among others, document that the effectiveness of this tool depends on the precise form of forward guidance adopted. Ehrmann et al. (2019) find that short-horizon, calendar-based forward guidance can have the perverse effect of increasing uncertainty rather than assuring markets of

a policy path. In contrast, long-horizon forward guidance reduces both the market reaction to macroeconomic news and disagreement among forecasters.

Second, communication procedures vary from regular press releases as it is the case for the Bank of Canada, Bank of England, and the Federal Reserve (see Lucca & Trebbi, 2009; Fay & Gravelle, 2010; Jansen & de Haan, 2013; Acosta & Meade, 2015; Hansen & McMahon, 2016; Ehrmann & Talmi, 2020) to a press release followed by a press conference, in the case of the ECB (see Heinemann & Ullrich, 2007; Rosa & Verga, 2007; Ullrich, 2008; Berger et al., 2011; Sturm & De Haan, 2011). Apart from standard policy announcements, central bankers also give interviews and public speeches. Lustenberger et al. (2020) study the effect of these alternative communication channels using the Bank for International Settlements (BIS) database on central bankers' speeches. They document how more-frequent communication worsens the accuracy and precision of financial and macroeconomic forecasts. In order to avoid excessive volatility around monetary policy meetings, central banks have also adopted blackout periods, also known as "quiet periods" or "purdah," that is, a practice that requires monetary policy-makers to avoid making comments that could influence expectations about monetary policy decisions in the days before key meetings (Ehrmann & Fratzscher, 2009). Using confidential data collected by the ECB's Directorate General Communications, Gnan and Rieder (2022) document that quiet period breaches are associated with much larger financial market reactions than other speeches released in inter-meeting periods. Informal communication can also play a role. Cieslak et al. (2019) find that systematic informal communication by Fed officials in the form of media leaks or via preferential access to the Fed by private financial institutions is associated with stock market reactions even outside the FOMC announcement windows.

The literature has also investigated the role of the communication sender, that is, whether communication is done by a committee (Kohn & Sack, 2003; Andersson et al., 2006; Reinhart & Sack, 2006; Reeves & Sawicki, 2007; Andersson et al., 2009) or an individual (Jansen & De Haan, 2004; Ehrmann & Fratzscher, 2007; Rozkrut, 2008). For example, Reeves and Sawicki (2005) find that communication made on behalf of the entire policy-making committee is a particularly strong market mover relative to communication delivered on a personal basis.

Another aspect to be considered in relation to procedures is the consistency of communication. Jansen and de Haan (2013) test the extent to which the ECB uses consistent language in its communication. They find consistency overall, even though the ECB's communication is flexible enough to adapt to changing circumstances. Acosta and Meade (2015) study the similarity of FOMC post-meeting statements and show that they have become more similar over time, especially since the global financial crisis. Nevertheless, FOMC statements have also become more complex since the adoption of unconventional monetary policies, as shown by Hernández-Murillo et al. (2014). Another aspect of interest regarding consistency is how much importance a central bank attributes to the personal views of its committee members. This aspect differs across institutions. For example, the ECB and the Bank of England follow a collegial approach to communication and they exhibit a high degree of consistency. In contrast, communication from the Federal Reserve is significantly more dispersed (Ehrmann & Fratzscher, 2005).

The language of communication has also been extensively studied (Gerlach, 2004; Boukus & Rosenberg, 2006; Heinemann & Ullrich, 2007; Rosa & Verga, 2007; Cihak et al., 2008; Berger et al., 2011; Kawamura et al., 2016). Two approaches are mainly employed to analyze the content and tone of central bank communication: human and automated coding (see Ehrmann & Talmi, 2017). Yet, given the consistency and replicability of the results obtained using automated coding, as well as the fact that automated content analysis appears to be less subjective, this approach has become dominant in recent years (see Lucca & Trebbi, 2009; Hendry & Madeley, 2010; Hernández-Murillo

et al., 2014; Acosta & Meade, 2015; Amaya & Filbien, 2015; Hansen & McMahon, 2016; Picault & Renault, 2017; Schmeling & Wagner, 2019; Hubert & Labondance, 2021, among others).[5] Overall, this literature shows that the content of central bank statements has a significant effect on real economic variables.

Next, the timing of communication might also matter from at least two points of view: in absolute terms, by distinguishing periodical, institutional announcements, which are predictable, from announcements that are not; and in relative terms with respect to the functioning of financial markets, for example, if the announcements are communicated when markets are closed or open (Al Guindy & Riordan, 2017; Ehrmann & Fratzscher, 2007; Hu et al., 2015). With regards to institutional communication, the literature has also emphasized the role of minutes and their timeliness (Reinhart & Sack, 2006; Reeves & Sawicki, 2007).

Last, central banks have traditionally communicated with financial experts, but more recently they are increasingly tailoring their communication for a more general audience, focusing on households and firms (Binder, 2017; Blinder et al., 2022). In the next section, we zoom in on this recent trend in central bank communication, by focusing on communication via social media in particular.

4 | BEYOND THE PILLARS OF HERCULES: CENTRAL BANK COMMUNICATION AND SOCIAL MEDIA

"Central banks will keep trying to communicate with the general public, as they should. But for the most part, they will fail." —BLINDER (2018)

"It is important for me that our focus on connecting with the people of the euro area, those we serve, continues and grows much stronger, in particular by improving the way in which we communicate with the general public." —LAGARDE (2019)

As central banks have started employing communication as a core part of their monetary policy toolkit in the early 1990s, they primarily targeted expert audiences such as financial market participants, academics, policymakers, and specialized media, rather than the wider public (Assenmacher et al., 2021). Although this strategy has been largely successful in explaining monetary policy decisions to expert audiences, the communication with the general public has lagged behind. Consequently, in an effort to strengthen their accountability, central banks have increasingly devoted their attention to communicating with the general public (Moschella et al., 2020).[6] For example, during the September 2019 hearings for the appointment of the President of European Central Bank, Christine Lagarde indicated communication with nonexperts as one of the priorities of her presidency (as reflected in the quote above). The need for improving communication with the general public is also shared by former members of the ECB's Governing Council surveyed in Ehrmann et al. (2022). The results of this survey show that the large majority of these former ECB policy makers consider the communication with the general public as inadequate and see substantial room for improvement in this area. Respondents also suggest that, in order to reach the target groups of interest, central bank communication ought to be tailored on the basis of the communication channels employed.

In this context, two channels are typically used: an indirect communication using traditional media outlets or a more direct approach via central bank websites and social media platforms.

TABLE 1 Central banks' social media presence and followers as of September 2022.

Central bank	Facebook	LinkedIn	Twitter
Central Bank of Argentina	48,977	126,001	150,003
Reserve Bank of Australia	10,560	113,194	61,301
Central Bank of Brazil	188,659	385,901	446,579
Bank of Canada	n.a.	112,850	215,786
People's Bank of China	n.a.	n.a.	n.a.
Bank of France	14,562	167,749	44,042
Deutsche Bundesbank	8789	29,286	34,139
Reserve Bank of India	n.a.	n.a.	1791,333
Bank Indonesia	110,253	n.a.	844,242
Bank of Italy	n.a.	102,544	31,864
Bank of Japan	3747	n.a.	171,752
Bank of Korea	39,299	1515	3333
Bank of Mexico	234,636	n.a.	895,675
Bank of Russia	n.a.	n.a.	18,547
Saudi Central Bank	12,701	155,761	797,799
South African Reserve Bank	41,902	149,730	108,844
Central Bank of the Republic of Turkey	41,778	54,280	490,275
Bank of England	42,113	214,930	370,722
Federal Reserve System	37,590	99,550	995,453
European Central Bank	n.a.	403,098	706,708

[7]*Note*: The table presents data on the followers on social media platforms of G20 countries as of September 2022. The data are collected from the social media accounts advertised on the official website of these central banks. The European Central Bank is included as the central bank of the European Union. Whenever multiple profiles were advertised in relation to the same platform, the reported data only refer to the most followed account.

Focusing on the first channel, Ter Ellen et al. (2021) build a measure of "narrative monetary policy surprises' based on the difference between media narratives prior to monetary policy announcements and the actual communication of Norges Bank." They show that households' beliefs are shaped by media coverage on the central bank policy and that monetary policy surprises affect interest rates, the stock market, consumer confidence, house prices, and industrial production.

However, in recent years, major central banks are increasingly relying on the more direct channel of disseminating policy communication by using their website and social media accounts. To this end, not only have central banks made their websites more user friendly through, for example, educational resources and tools, but they have also strengthened their presence on social media platforms such as Facebook, LinkedIn, and Twitter. Table 1 provides information on the number of followers recorded on the social media platforms of the G20 countries' central banks as of September 2022.[7] Twitter appears to be the most popular social media channel among most of the central banks, with the exceptions of the Reserve Bank of Australia, Bank of France, Bank of Italy, the South African Reserve Bank, which are mainly followed on LinkedIn, and Bank of Korea, which is more popular on Facebook.

To provide more details on how central banks use social media as a communication tool, we use the Twitter Academic API to extract all the Twitter messages generated by G20 central banks since the creation of their accounts. For each tweet, we extract the text, date, and language of the

TABLE 2 Central banks' Twitter engagement statistics (as of September 2022).

Central bank	Joined	Nr of tweets	of which Replies (%)	Engagement by users	
				Likes	Retweets
Central Bank of Argentina	May-14	11,734	1	14.04	13.89
Reserve Bank of Australia	Oct-10	2529	1	8.19	11.77
Central Bank of Brazil	Dec-10	9079	13	25.95	8.74
Bank of Canada	Jun-08	4762	0	10.88	10.64
Bank of France	Dec-10	19,282	1	2.57	3.08
Deutsche Bundesbank	Aug-12	5432	2	3.17	3.32
Reserve Bank of India	Jan-12	17,850	0	25.8	7
Bank Indonesia	Jun-10	39,643	38	14.01	7.71
Bank of Italy	Feb-12	8249	0	1.96	2.48
Bank of Japan	Oct-11	13,458	0	93.79	37.24
Bank of Korea	Feb-14	2086	0	1.72	1.41
Bank of Mexico	Oct-09	27,623	0	9.22	9.6
Bank of Russia	Feb-16	4915	11	3.26	2.84
Saudi Central Bank	Oct-14	3196	0	43.42	44.12
South African Reserve Bank	Sep-11	4302	3	19.01	14.94
Central Bank of the Republic of Turkey	Oct-11	5009	0	35.14	16.6
Bank of England	Jan-09	9969	20	15.37	15.59
Federal Reserve System	Mar-09	7823	0	24.06	20.9
European Central Bank	Oct-09	18,070	2	18.3	19.14
Total		**215,011**	**9.28**	**19.43**	**12.04**

11*Note*: The table presents data on the number of tweets made by G20 central banks as of September 2022, together with the average number of likes and retweets received by their tweets. The data are collected using the Twitter Academic API. The European Central Bank is included as the central bank of the European Union. All retweets made by central bank in reaction to tweets made by other users have been excluded.

tweet as well as the number of likes and retweets. We end up with a database of 215,011 tweets (excluding retweets) sent between June 2009 and September 2022.[8] Table 2 provides information on the number of tweets and other engagement statistics with the social media content of major central banks.[9] Since joining Twitter in June 2010, Bank Indonesia has posted around 40,000 tweets and its number of social media posts is more than double that of the second most active central bank in our sample, Bank of France. Bank of Indonesia is also the central bank with the highest number of replies to tweets by other users. However, with the exception of this central bank, on average, only 2.5% of the tweets of the other central banks are replies to other social media users.

Yet, the number of tweets only measures the effort made by central banks to draw attention to their communication. Another important aspect to consider is the public engagement with the social media posts of central banks, which can be derived, for example, from the number of likes and retweets.[10] The last two columns of Table 2 provide information on the average influence of the central bank tweets. The Saudi Central Bank has the highest average number of retweets

TABLE 3 Distribution of classified tweets by topic.

Topic	Frequency	Words
Banknotes	318	Banknote; coin
Bulletins and reports	10,104	Report; bulletin
Data releases and statistics	15,487	Weekly; data
Exchange rate information	10,616	Dollar; exchange rate; usd
Monetary policy	6048	Operations; press conference; press release
Other info	3100	#askecb; #bdfeco; blog
Reply to tweets	31,019	
Research and conferences	4899	Conference; paper; seminar
Speeches and interviews	7752	Interview; speech
Total	**89,343**	

13 *Note*: The table presents data on the number of tweets associated to the nine topics identified in the classification of tweets. The last column shows the most frequent words in each classification.

per tweet, followed by Bank of Japan, the Federal Reserve System, and the European Central Bank. Bank of France, Bank of Korea, and Bank of Russia are characterized by the lowest average engagement per tweet.

We then investigate the content of individual tweets to understand if certain topics are associated with a higher public engagement. To do so, we first translated all the tweets written in a language different from English by using Microsoft Translator (138,667 tweets or 65% of the sample).[11]

We then extract a random sample of 5000 tweets and manually classify them into nine different topics, that is, Banknotes, Bulletins, and reports; Data releases and statistics, Exchange rate information, Monetary policy, Other info, Reply to tweets, Research and conferences, and Speeches, and Interviews.[12] After this classification, we compute the set of the most frequently used unigrams and bigrams terms for each topic, and we use them to further classify the remaining tweets. This procedure allows us to classify a total of 89,343 tweets, or 42% of the sample. Table 3 shows the distribution of the classified tweets across the different topics, together with the most frequent words associated to each topic.

Using this classification and looking at the 10 most liked and retweeted tweets, we find that all of them were made to announce the introduction of new coins or banknotes.[13]

To provide a more systematic analysis of which topics are associated with higher public engagement, we estimate the following Poisson pseudo-maximum likelihood (PPML) model[14]:

$$Retweets_{i,c} = \alpha_c + \gamma'Topic_{i,c} + \theta_t + \varepsilon_{i,c} \qquad (1)$$

where $Retweets_{i,c}$ is the number of retweets received by tweet i made by central bank c. $Topic_{i,c}$ is a vector of dummies assigning tweet i to one of the nine topics in Table 3. α_c and θ_t are central bank and year fixed effects, respectively.

The results are presented in Table 4. In column (1), we regress the number of retweets received by a tweet on the dummy associated to banknotes-related topics. As mentioned above, banknotes announcements attract a disproportionally larger number of retweets as compared to tweets related to all other topics. In columns (2)–(7) we gradually add the dummy variables associated

TABLE 4 Retweets to Twitter topics.

	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
Banknotes	4.321***	4.385***	4.377***	4.413***	4.476***	4.459***	4.437***
	(0.629)	(0.624)	(0.625)	(0.627)	(0.642)	(0.602)	(0.311)
Monetary policy		.510*	.500*	.550*	.628**	.610*	.585***
		(0.292)	(0.298)	(0.297)	(0.298)	(0.365)	(0.194)
Speeches and interviews			−0.069	−0.021	0.049	0.032	0.004
			(0.149)	(0.151)	(0.162)	(0.242)	(0.165)
Data releases and statistics				0.239	0.308	0.296	0.278
				(0.320)	(0.366)	(0.412)	(0.200)
Exchange rate information					0.527	0.510	.489***
					(0.347)	(0.378)	(0.184)
Bulletins and reports						−0.046	−0.071
						(0.325)	(0.215)
Research and conferences							−0.119
							(0.149)
Constant	2.878***	2.820***	2.827***	2.780***	2.702***	2.718***	2.740***
	(0.209)	(0.197)	(0.194)	(0.204)	(0.241)	(0.217)	(0.115)
R-squared	0.5552	0.5574	0.5575	0.5581	0.5598	0.5598	0.5599
Observations	89,331	89,331	89,331	89,331	89,331	89,331	89,331

15*Note*: The table presents a series of Poisson pseudo-maximum likelihood regressions where the dependent variable is the number of retweets received by a tweet. The main covariates are dummy variables corresponding to the topics presented in Table 3. Central bank and year fixed effects are included. Robust standard errors in parenthesis. *, **, *** represent significance at 10, 5, and 1%, respectively.

with the remaining topics, ordered on the basis of their monetary policy relevance.[15] In addition to the tweets related to banknotes, tweets discussing monetary policy decisions and operations also attract a larger reaction from Twitter users as compared to all other topics.

Overall, this suggests that the increased use of social media by central banks might represent an effective tool to communicate monetary policy decisions. Together with the raising popularity of quantitative text analysis techniques, this gave rise to a burgeoning literature that studies the role played by central bank social media communication. In what follows, we will focus on two aspects of central bank communication in greater detail. Specifically, Section 4.1 will review studies that try to understand how central bank communication is done *by* central banks via social media, while Section 4.2 discusses the literature on how tweets *about* central banks and/or their policies are associated with stock market reactions and changes in consumers' expectations.

4.1 | Communication by central banks on Twitter

"There are few Federal Reserve blogs. Th927 e Atlanta Fed has one. The New York Fed has one and we have Twitter. We have Facebook. We are really moving along here. [Laughter] So, we're still a little bit old-fashioned, but I think that social media do provide a really convenient way to communicate quickly to a group of people, to

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exchange ideas, and to keep track on what's going on in a particular area. So, you know, I think there are some positive developments there." —BERNANKE (2013)

As discussed above, in recent years, a growing number of central banks have started to use social media channels to engage with the general public. Kyriakopoulou and Ortlieb (2019) document that 113 central banks have joined Twitter between June 2008 and September 2018, which appears to be the most popular social media platform among central banks. As such, the vast majority of the literature on central banks communication and social media has focused on Twitter. For example, Korhonen and Newby (2019) analyze the Twitter activity of European central banks and financial supervisors and find that their activity, measured in terms of the average number of tweets per day, fluctuated over time and for most of them, there is no clear trend up or down after they joined Twitter. In addition, they find that central banks' Twitter activity has no relation to citizens' online participation and that communication on financial stability has increased more in comparison to that on monetary policy.[16] Similarly, Ferrara and Angino (2021) rely on classical readability metrics to measure the clarity of the speeches, press conferences, and tweets made by the European Central Bank (ECB) and show that greater clarity of communication is correlated with higher levels of media coverage and is also a strong predictor of the social media engagement generated by the central bank on Twitter.

Looking at the Federal Reserve System (Fed), Gorodnichenko et al. (2021) document that its social media content focuses on monetary policy, financial markets, and economic issues in around 50% of the cases, while the remaining posts are used to disseminate research output, advertise media interviews or job vacancies.[17] Importantly, they also show that the majority of Twitter users that engage with the Fed by retweeting or mentioned it are indeed users which cannot be classified as media, academics, investors, government organizations, or politicians, that is, the general public. Their investigation also suggests that Twitter users are more engaged on days when the meeting of the FOMC takes place. However, despite this increased engagement in FOMC announcement days, the authors find no conclusive evidence of the impact of the Fed communication on social media on stock returns and volatility. Nevertheless, they do find a positive relationship between the number of economic and financial markets-related posts and market participants' inflation forecasts, which suggest the importance of central bank communication in shaping expectations. Importantly, they also show that market participants do update their inflation expectations based on information contained in the Fed's social media posts.

Other interesting evidence on how social media access shapes beliefs about the economy and monetary policy comes from household surveys. For example, Conrad et al. (2022) look at a survey of German households conducted in 2019 by the Bundesbank that focuses on the role that information channels, such as traditional media or social media, as well as lifetime experiences play in shaping inflation expectations. They find that households that report informing themselves about monetary policy via Twitter and Facebook also report greater uncertainty regarding future inflation (see also Bundesbank, 2019).

Lamla and Vinogradov (2021) also employ survey evidence to study the effect of monetary policy announcements by the Bank of England on the expectations of around 10,000 consumers in 2018–2019. Their results suggest that respondents who receive monetary policy news have better perceptions and expectations than those who do not and that policy announcements trigger an increase in the share of consumers who receive monetary policy news, especially among those who use Twitter. However, their results suggest that, despite reporting higher confidence in their estimates, Twitter users are characterized by greater expectation/perception errors.

The impact on central bank communication via social media on expectation formation by the general public is still a relatively underdeveloped research area. As recent research suggests that the way in which communication about monetary policy is delivered matters greatly for expectation formation, the social media content of monetary policy institutions might play a key role in shaping inflation expectations. For instance, Coibion et al. (2022) conduct a large randomized survey of US households where monetary policy decisions are communicated in different ways. Surprisingly, they find that receiving the entire post-meeting statements of the FOMC or even newspaper articles from popular media outlets has a lower impact on inflation expectations as compared to simple messages about the FOMC's inflation forecast. Their results show that a simple and repeated communication strategy might be the most effective at influencing the beliefs of households. This suggests that social media content might be an important channel to deliver effective communication with the general public. Similar findings arise from controlled laboratory experiments. For example, Kryvtsov and Petersen (2021) use a learning-to-forecast experiment to test the effectiveness of different types of monetary policy communication and find that communication based on simple and backward-looking announcements has a stronger influence on less-accurate forecasters as compared to more complex messaging.

Overall, these findings suggest that social media content such as tweets can be a powerful tool in managing expectations due to its simple format, ease, and frequency in reaching the general public.

4.2 | Between Scylla and Charybdis: Social media and conversations about central banks

"Russia and China are playing the Currency Devaluation game as the U.S. keeps raising interest rates. Not acceptable!" —Donald Trump, 45th President of the United States, April 16, 2018

The use of social media not only provides central banks with a platform that can improve its communication, but it also allows both experts as well as the general public to easily express their opinions on monetary policy decisions or the conduct of central bank operations, in general. Before the permanent suspension of his Twitter account, Donald Trump was one of the most prolific Twitter users. Before his election as 45th President of the United States, he openly criticized the Chair of the Federal Reserve, Janet Yellen, for "keeping the rates artificially low so the economy doesn't go down." Social media attacks on the Federal Reserve and its Chair, Jerome Powell, similar to the tweet above, continued throughout his presidency. Many viewed these tweets as a threat to the independence of the Federal Reserve and an effort to politicize the work of the Fed for partisan political reasons (Conti-Brown & Feinstein, 2020).

For instance, Bianchi et al. (2019) investigate whether Trump's tweets criticizing the Federal Reserve had any effects on financial markets' perceptions of future monetary policy. They rely on a high-frequency identification by exploiting changes in the expected federal fund rate (implied by fed fund futures) in a 30-min window around Trump's tweets advocating looser monetary policy. Their results suggest that the Fed's independence is not immune to political pressure as expected fund rates drop significantly following the tweets, suggesting that markets believe that the President can influence the conduct of monetary policy. Using a similar approach, but with daily data, Camous and Matveev (2019) also find that financial markets reacted to Trump's tweets

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by assigning a higher probability of a policy rate cut at the upcoming FOMC meeting. Similarly, Tillmann (2020) finds that Trump's remarks about the Fed done via Twitter or during interviews reduce market expectations of future interest rates, even if the impact on his statements declined over time.

Binder (2021) studies the effect of Trump's criticism of the Federal Reserve on consumers' inflation expectations in an online randomized experiment. In the survey, respondents are shown either one of Trumps' actual tweets criticizing the Fed or the tweet together with a media article discussing the President's threat to central bank independence. She studies how these tweets affect consumers' long-run inflation expectations, confidence in the Federal Reserve, and their responsiveness to information about inflation. She shows that respondents who only saw the tweet were more likely to have long-run inflation forecasts that were farther from the Federal Reserve's target. In addition, the treated individuals who saw both the critical tweets and the news article discussing the President as a threat to the Fed's independence were more likely to have more polarized views: Trump supporters reduced their confidence in the Fed, and vice versa.

A second body of work has focused on tweets about monetary policy made by large populations of Twitter users employing text analysis techniques. Azar and Lo (2016) collect a sample of tweets referring to the Federal Reserve and identify the sentiment in the text using natural language processing techniques. They show that the market sentiments captured in the tweets about monetary policy, especially around FOMC announcements, are significantly correlated with excess daily returns.

Meinusch & Tillmann (2017) collect the universe of Twitter messages around the exit of the Federal Reserve from its QE ("tapering") in 2013 to produce a time series of changing beliefs about the timing of the tapering. They filter tweets containing a predefined set of words that capture beliefs of a "too soon" or "too late" end of the QE program, which they then manually classify into the two categories. They can then observe how these beliefs change over time and build measures of disagreement (based on the relative dominance of one view on tapering, i.e.,"too soon" or "too late") or measures of uncertainty about monetary policy (by counting specific words reflecting uncertainty in Twitter content). They then identify the effects of shocks to beliefs or uncertainty on interest rates, exchange rates, and other asset prices in a VAR framework. They show that, for example, shocks to "tapering soon" beliefs correspond to significant increases in long-term interest rates and an appreciation of the U.S. dollar. Their results highlight the importance of central banks clearly communicating exit strategies from unconventional monetary policies to ensure a smooth return to normal.

Similar evidence is provided in Lüdering and Tillmann (2020) who employ a popular computational text analysis tool developed by Blei et al. (2003) called the Latent Dirichlet Allocation (LDA) to extract latent topics from Twitter conversations about tapering. The method uses a Markov Chain Monte Carlo estimation to dissect a text document into different topics based on the frequency of words. The resulting topics are then manually labeled. Lüdering and Tillmann (2020) then include the topic frequencies, which captures the likelihood that a given tweet contains words belonging to a specific topic, in a VAR model that includes daily asset prices. They show that shocks to selected topic frequencies have significant effects on U.S. bond yields, exchange rates, and stock prices.

Stiefel and Vivès (2021) focus on other significant monetary policy events this time by the ECB: Mario Draghi's "whatever it takes" speech and the announcement of the OMT program. Twitter volume around these events increased significantly as market participants communicated and interpreted the events. They manually classify a sample of tweets discussing the two events in two categories or labels based on whether the content suggests that intervention by the ECB is

likely or not. They then employ machine learning techniques such as Support Vector Machines (SVM) to label the remaining tweets in the dataset. Based on this classification, they create a belief index of the perceived likelihood of central bank intervention, which is found to jump significantly during the two event days. The large increase in the belief index also coincides with drops in the sovereign yield spreads of the distressed countries on the same and the following day. Their empirical approach can improve classical event studies as it accounts for expectation formation around longer time horizons around the event days and can capture rumors or information leaks outside the event window. At the same time, capturing beliefs from social media content can also help distinguish the relative importance of different announcements on market expectations.

Finally, several recent works focus on broader samples of tweets on a continuous basis, and not just around specific events, in order to understand how social media interacts with a broad set of central bank announcements. Ehrmann and Wabitsch (2022) analyze tweets about the ECB to understand the extent to which its communication is received by nonexperts and how it affects their views. They distinguish between experts and nonexperts by looking at the frequency of their engagement (experts comment on most policy announcements) or the content of their tweets (nonexperts write on many issues and occasionally on the ECB or its policies). Ehrmann and Wabitsch (2022) find that tweets from experts or longer tweets are more likely to be retweeted or liked and that nonexperts are less responsive to ECB communication as compared to experts. Importantly, Twitter communications by the ECB spark significant ECB-related traffic, which tends to be more factual and less subjective.[18] However, some events, such a President Draghi's "Whatever it takes" statement, can spark very subjective and controversial discussions, which are likely to receive higher engagement from the Twitter community. Overall, their results suggest that central banks can use social media to engage with nonexperts, which leads to a somewhat more factual and less subjective engagement among nonexperts. Ehrmann and Hubert (2022) use the database created by Ehrmann and Wabitsch (2022) to investigate how ECB-related tweets made in the days preceding an ECB press conference are associated with the magnitude of the monetary policy surprise on the announcement day. In particular, using data on disagreement about the economic outlook, they find that Twitter traffic is correlated with the size of monetary policy surprises as Twitter users pay more attention to meetings in which they expect larger changes in the monetary policy stance.

Masciandaro et al. (2022) also employ high frequency, intraday data around the release of all the monetary policy decisions of three major central banks (the Bank of England, the European Central Bank, and the Federal Reserve) between 2011 and 2020. They employ machine learning techniques to identify Twitter messages related to monetary policy and construct a measure of similarity between the tweets and the information provided in the central bank announcements. They show that changes in similarity matter and have an important effect on financial markets volatility. In particular, large changes in the similarity between tweets and official central bank communication around the time of the announcement is associated with higher market volatility.

5 | CONCLUSION

This survey discusses the evolution of central bank communication from silence to social media. We highlight that not only the communication tools, but also the target audience has evolved over the time. Traditionally, central banks have mainly communicated with financial markets participants that had a well-defined profile: a professional interest to follow monetary policy information and the necessary knowledge to understand central bank messages (Ehrmann & Wabitsch, 2022).

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But the widespread use of unconventional monetary policy tools in recent years has called for better explanations of what central banks do and led many central banks to step up their efforts to communicate to a wider audience, that is, nonexperts. However, communication with nonexperts raises a number a challenges, starting from the fact that audiences are far more segmented and less likely to take interest in monetary policy announcements.

As such, central banks are increasingly engaging in social media as a regular feature of their communication policy. In this survey, we have mainly focused on the emerging literature on central banks and social media communication. We show that analyzing social media content can inform policy makers about the effectiveness of communication in influencing beliefs. It can also provide a useful tool to understand how communication could be targeted more precisely to anchor expectations and influence beliefs, in particular among nonexpects. Future research can thus delve deeper into the analysis of high frequency social media content as a tool for measuring market expectations and the effectiveness of central bank communication. Another avenue for future research is the role of social media presence by monetary policy committee members who have also significantly increased their efforts to engage with the wider public.

ORCID

Donato Masciandaro https://orcid.org/0000-0003-2745-3387
Davide Romelli https://orcid.org/0000-0002-5405-6451

ENDNOTES

[1] The arguments for lack of transparency related to unfair speculation, inappropriate market reaction, harm to the government's commercial interest, undesirable precommitment and more difficult interest rates smoothing (Goodfriend, 1986).

[2] Traditionally, the key monetary policy instrument available to central bankers was the overnight lending rate, that is, the short-term interest rate. Nevertheless, spending decisions ultimately rely on longer-term interest rates, such as mortgage rates and long-term treasury bonds, which, in turn, largely depend on private expectations regarding future central bank decisions (Woodford, 2005). Therefore, the ability of a central bank to affect the economy depends critically on its ability to influence market expectations about the future path of overnight interest rates, and not merely on their current level (Blinder et al., 2008).

[3] In models with rational expectations, consumers behaving according to the Euler equation (and expecting others to do the same) will be very responsive to future interest rates. This is known as the "forward-guidance puzzle" (Del Negro et al., 2012; McKay et al., 2016).

[4] Similarly, Gabaix (2020) assumes a "cognitive discounting" parameter that implies agents heavily discount the future relative to the rational benchmark. This myopia parameter also mutes the effects of communication policies such as forward guidance.

[5] Similar techniques have been used to analyze the informational content of FOMC transcripts (see Bailey & Schonhardt-Bailey, 2008; Schonhardt-Bailey, 2013; Fligstein et al., 2014; Hansen et al., 2018; Bennani & Romelli, 2021; Acosta,2023, among others).

[6] Haldane et al. (2020) highlight three pillars of communication with the public that can help central banks to avoid potential pitfalls of communication with non-experts: explanation, engagement, and education. For instance, most central bank websites of advanced economics host educational pages. In particular, the "The ECB explains" page aims to make complex central banking topics understandable for all audiences. The ECB also tries to educate and engage with young people by creating national competitions such as the "Generation € uro Students' award"

which asks young economists to play the role of the ECB's Governing Council, perform their own analysis of the economy, and set what they believe is an appropriate interest rate for the euro area (see also Moschella & Romelli, 2022). Other examples include the US Fed's page: https://www.federalreserve.gov/monetarypolicy/review-of-monetary-policy-strategy-tools-and-communications.htm.

[7] Note that the information presented in Table 1 only pertains to the institutional account of the central banks in our sample. However, an increasing number of monetary policy committee members use their personal Twitter account to inform the general public about their speeches. Appendix Table A.1 provides information on the share of current monetary policy committee members that have an active Twitter account. In more than 50% of the central banks in our sample, Twitter is used not only by the institution but also by at least a member of its monetary policy board. In the case of the ECB, 60% of the members of the Executive Council use their personal Twitter account.

[8] Around 80% of these tweets contain a link to the central bank's webpage where more details are provided. This suggests that social media postings by central banks are aimed at catching users' attention to specific topics with the goal of directing them to their websites, where the full set of information is provided.

[9] China is excluded from the list as the People's Bank of China does not have a Twitter account.

[10] As discussed in Baker et al. (2021), the number of retweets of a message can be considered a good measure of users' influence.

[11] The appropriateness of our strategy is supported by the findings in De Vries et al. (2018). These authors use the corpus of multilanguage debates in the European Parliament to show a considerable overlap in the set of features generated from human-translated documents and those translated using Google Translate.

[12] The "replied to id" information extracted from the Twitter API allows us to identify the code associated with the original tweet generated by a user. Whenever the original tweets have been created by the central bank of reference, we consider this tweet part of a thread and assign the tweet to the topic of the first message. All other replies to other users are assigned to the Reply to tweets topic.

[13] Among the top-20 most liked and retweeted tweets, we also found the one made by the ECB on Valentine's Day in 2021, a parody of the love poem "Roses are red": "Roses are red Violets are blue We'll keep financing conditions favourable 'Til the crisis is through'." As discussed by Sakari Suoninen, team leader of the European Central Bank's (ECB) digital content team, this tweet went viral but his team "also got a lot of criticism for trying to be too light-hearted" (Choi, 2022).

[14] This methodology has also been used in Gorodnichenko et al. (2021) (see Section 4.1 for a summary of their findings).

[15] Given the limited monetary policy relevance of the topics associated with other info as well as the replies to tweets by other users, there two topics are the excluded categories in the most extensive specification, in column (7).

[16] Carretta et al. (2016) also look at the Twitter content of the European national central banks' and document that banking supervision, inflation, Monetary Union, European economic integration and macroeconomic forecasts were the most frequent areas of discussion in 2016.

[17] Conti-Brown and Feinstein (2020) also document how the Fed uses Twitter and compares it with other independent agencies. They show that the regional Federal Reserve Banks are more active than the Board of Governors of the Federal Reserve. The Twitter engagement of the Fed, as a whole, is similar to the one of other central banks, such as the Bank of England, Bank of Canada, the European Central Bank, the Reserve Bank of Australia, and the Reserve Bank of India. However, looking at other US agencies, it appears that the Fed is more active than other independent agencies, but less than US executive departments.

[18] The subjectivity and favorableness of tweets is measured using a dictionary approach that employ a predetermined list of words to capture different sentiments. This approach, however, has some important shortcomings as words such as "negative interest rate" can be misinterpreted as having a low favorability value and a positive subjectivity score.

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APPENDIX A

TABLE A.1 Monetary Policy Committee members' Twitter presence as of September 2022.

Central bank	% of Members using Twitter	Central bank	% of Members using Twitter
Central Bank of Argentina	0	Bank of Korea	0
Reserve Bank of Australia	0	Bank of Mexico	20
Central Bank of Brazil	0	Bank of Russia	0
Bank of Canada	18.18	Saudi Central Bank	0
Bank of France	36.36	South African Reserve Bank	26.67
Deutsche Bundesbank	16.67	Central Bank of the Republic of Turkey	28.57
Reserve Bank of India	13.33	Bank of England	33.33
Bank Indonesia	0	Federal Reserve System	17.65
Bank of Italy	0	European Central Bank	60
Bank of Japan	11.11		

Note: The table presents data on the percentage of monetary policy committee members, which have an active Twitter account.