Central Banks in Parliaments: A Text Analysis of the Parliamentary Hearings of the Bank of England, the European Central Bank, and the Federal Reserve*

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This paper investigates whether parliamentary hearings are effective in holding central banks accountable against their mandates. To this end, it applies text analysis on the hearings of the Bank of England, the European Central Bank, and the Federal Reserve from 1999 to 2019. It finds that central bank objectives play a crucial role in determining the topic of the hearings. It also shows that sentiments are more negative when the distance between inflation and the central bank's

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inflation aim increases. These results suggest that parliamentary scrutiny serves its intended purpose. However, topics and sentiment react more to inflationary rather than deflationary deviations of inflation away from target.

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1. Introduction

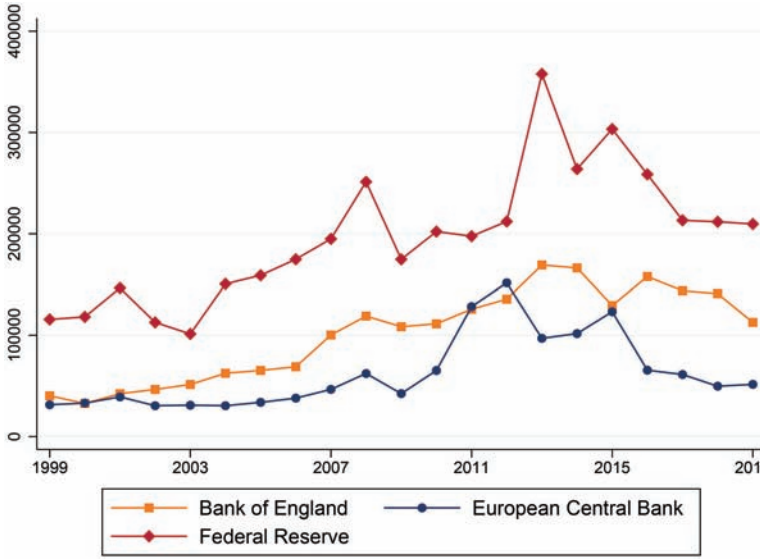
Delegation of responsibilities to unelected institutions might give rise to a perceived democratic deficit over time, even when they originate from a democratic decision. For such delegation to be acceptable in a constitutional democracy, unelected officials need to be accountable to democratically elected institutions, which represent the view of the people.

This fundamental norm is an essential basis of the delegation of monetary policy to an independent institution, the central bank. Governments delegate monetary policy to central banks that can conduct policies independently from pressures in order to achieve lower levels of inflation, as shown theoretically and empirically by Barro and Gordon (1983), Alesina (1989), and Grilli, Masciandaro, and Tabellini (1991). As they do so, they put in place a series of arrangements that allow elected representatives to monitor the central bank's achievement of its objective. The most common of these arrangements across central banks is parliamentary hearings (Bank for International Settlements 2009), i.e., the requirement for the central bank (generally the governor) to explain and justify its policy decisions before the parliament on a regular basis.

For a long time, this principle had been hardly a subject of discussion, either in the academic or public debate. However, with the recent financial crisis the trade-off between independence and accountability has become more complex. On the one hand, the key role of central banks during the crisis led to increased public attention being paid to their policies compared with the precrisis period (see Figure 1). On the other hand, the adoption of non-standard measures made the scrutiny of monetary policy more complex (Coeuré 2018).

This revived the debate around the legitimacy of granting independence to unelected powers in constitutional democracies (Tucker

Figure 1. Number of Newspaper Articles Citing the Bank of England, the European Central Bank, and the Federal Reserve, 1999–2019



Sources: Authors' elaboration on data from Factiva as of December 2019. The data used cover newspapers in all the languages available on Factiva.

2018). Moreover, with the emergence of populism during the crisis, the institutional tenets of central banks have been increasingly challenged. The literature emphasize this change of public perception toward central banks, arguing that the rise of populism might put their independence at risk (Buiter 2016, De Haan and Eijffinger 2017, Goodhart and Lastra 2017, Rodrik 2018; for a review, see Merler 2018). In contrast to the past, critical voices toward central bank independence now dominate (Masciandaro and Romelli 2015, Issing 2018).

As a result, central bankers around the world now see preserving central bank independence as a challenging task. This is also confirmed by a survey we conducted among 30 experts working on institutional matters in their respective central banks worldwide: the majority of the respondents identified the preservation of central bank independence as the main challenge for central banks in

2019 (Figure A.1 in the appendix). These results are in line with those of a similar expert survey in which 39 of the 70 respondents agree with the statement that there will be significant changes in the independence of monetary policy in the United Kingdom and the euro zone in the foreseeable future (Den Haan et al. 2017).

In this context, it is therefore crucial to understand how independent central banks interact with their elected counterparts. Over the recent years, the latter have started discussing the desirability and possible ways to better exercise parliamentary control over central bank activities. The "Audit the Fed" bill was presented by U.S. Senator Rand Paul to strengthen Congress's control over and access to the Federal Reserve's information and possibly make meeting-by-meeting monetary policy decisions subject to congressional review (Bernanke 2016, 2022). On the other side of the Atlantic, the European Parliament has requested several inputs to academics to benchmark the European Central Bank's accountability against other central banks and assess possible avenues to reinforce the parliamentary control over its activities (Lastra et al. 2020).

If the academic discussion has so far mainly focused on whether central banks have become too independent (Balls, Howat, and Stansbury 2018), it is equally important to give attention to the aspect on which the legitimacy of central bank independence rests—namely central bank accountability and, in particular, on how this is ensured. Moreover, the limited literature on central bank accountability focuses on how to enhance legitimacy in the statute of the central bank, limiting its considerations to understanding which arrangements are best suited to hold the central bank accountable (Tucker 2018), and not on what actually happens in a given arrangement.

This leaves open the fundamental question on how elected representatives actually monitor the central bank in a given arrangement. In other words, it is not clear whether accountability works in practice. This broad question can be narrowed down to two queries related to parliamentary hearings: (i) what topics are discussed? and (ii) what drives the tone of the hearings? The answers to these questions are not trivial. The topic of the discussion is meant to be the fulfillment of the objective(s) of the central bank. However, scholars argue that often this is not the case (Schonhardt-Bailey 2013; Claeys, Hallerberg, and Tschekassin 2014a). Politicians may

find monetary policy too technical or simply not appealing before the electorate, and may prefer to discuss other topics. Similarly, we expect the tone of the discussion to turn more negative when the central bank diverges from its objective. At the same time, sentiments may be driven by negative economic conditions, regardless of the central bank's ability to cope with them. Moreover, politicians may assume a more aggressive tone toward the central bank for electoral reasons, regardless of its performance in fulfilling the objective (Goodhart and Lastra 2017).

In this paper we intend to fill this gap and answer these questions empirically. To do so, we apply text analysis techniques to the transcripts of the parliamentary hearings of three central banks, the Bank of England (BoE), the European Central Bank (ECB), and the Federal Reserve (Fed), for the period 1999–2019. In particular, we use *topic* and *sentiment* analysis to inspect, respectively, what drives the focus and the tone of the hearings. By doing so, we are able to test through panel data regressions whether the focus and the tone of the hearings are associated with the objective of the central bank or whether other factors play a more relevant role.

Our contribution to the literature is threefold. First, we provide a new empirical methodology to assess parliamentary hearings, an essential aspect of central bank accountability, as well as new findings on the three cases we examine. This is relevant compared with the existing empirical literature on central bank accountability, which focuses on de jure accountability, i.e., accountability as enshrined in laws and regulations (see De Grauwe and Gros 2008 for a review), rather than on de facto accountability, i.e., the actual interaction between the central bank and elected bodies in a given framework.

Second, we enrich the literature on central bank communication. While existing research mostly looks at central bank announcements to the public through press conferences (Altavilla et al. 2019; Lamla and Vinogradov 2019), publications (Born, Ehrmann, and Fratzscher 2014; Bholat et al. 2019; Hansen, McMahon, and Tong 2019), speeches (Hansen, McMahon, and Tong 2019; Neuhierl and Weber 2019; Moschella, Pinto, and Diodati 2020), minutes of their meetings (Apel and Blix-Grimaldi 2012; Hansen, McMahon, and Prat 2017), our work is the first to explore the communication between central banks and parliaments in a comparative setting.

Third, our work adds to the emerging literature that applies text mining to central banking (for a review, see Bholat et al. 2015). While existing works analyze the text of central bank policy announcements and speeches (Lucca and Trebbi 2009; Born, Ehrmann, and Fratzscher 2014; Tobback, Nardelli, and Martens 2017; Hansen, McMahon, and Tong 2019; Gorodnichenko, Pham, and Talavera 2021), the minutes of their meetings (Apel and Blix-Grimaldi 2012; Hansen, McMahon, and Prat 2017; Shapiro and Wilson 2019), or of news and tweets related to central banks (Bianchi, Kung, and Kind 2019; Binder 2021; Ehrmann and Wabitsch 2022), we provide evidence on a type of central bank text which has been largely left unexplored, i.e., the transcripts of central banks' parliamentary hearings. Few exceptions in the political science literature analyzed these text sources, but they all focused on specific case studies (Schonhardt-Bailey 2013; Sanders, Lisi, and Schonhardt-Bailey 2018; Bisbee, Fraccaroli, and Kern 2022; Ferrara et al. 2022; Fraccaroli et al. 2022a, 2022b).

Three important caveats apply to our findings. First, our analysis focuses on the monetary policy functions of the central banks—thus leaving aside the supervisory functions and the accountability provisions applicable to them. Second, we look at one specific arrangement of central bank accountability, namely parliamentary hearings. While this is the most diffused and, generally, the most relevant tool to hold central banks accountable, there exist other provisions too (Fraccaroli, Giovannini, and Jamet 2018). Third, in some jurisdictions the executive plays an important role in holding the central bank accountable together with the parliament. As we focus on parliamentary hearings, our study does not encompass the relationship between the central bank and the government.

For these reasons, our analysis is limited to the accountability of the central bank vis-à-vis the parliament for monetary policy matters. While this represents one of the most relevant and widely used accountability practices, our evidence is not necessarily valid for other accountability practices, such as those between the central bank and the executive, or the hearings on non-monetary policy matters.

The remainder of this paper is structured as follows. In the next section we define central bank accountability in a principal-agent framework and discuss the limitations of existing measures that aim

to capture and assess accountability. Section 3 briefly describes the parliamentary hearings of the BoE, the ECB, and the Fed, explaining in particular their objectives and functioning. Section 4 outlines our database and text-based methodology to account for accountability practices. Moreover, it presents the empirical model we use to explore the topic and sentiments of the hearings. In Section 5 we present and discuss the empirical results. The final section concludes.

2. Central Bank Accountability: Theory and Measurement

2.1 Theoretical Framework

Central bank accountability (CBA) can be understood as the legal and political obligation for a central bank to explain and justify its decisions to citizens and their elected representatives. According to the Bank for International Settlements (2009), accountability encompasses three main characteristics: (i) scrutiny by others; (ii) regular accounting for one's actions; and (iii) the risk of negative repercussions, if performance is considered unsatisfactory.

The rationale for CBA can be envisaged in a principal-agent framework, where powers are delegated to an agent to be exercised independently of its principal (Fratianni, Hagen, and Waller 1997; Gailmard 2014). In this setup, as noted by Fischer (1995), accountability is needed for two main reasons. First, it sets incentives for the central bank to meet its goals; and second, it provides democratic oversight of its policies. CBA is indeed key to ensure that independence does not lead to arbitrariness and that the mandate is fulfilled, while preserving the benefits of independence.

In a nutshell, this principal-agent framework can be described as follows. Assume that there are two principals, A and B, with divergent preferences over inflation, i.e., A is more inflation averse than B. The two principals are elected representatives: they could be two contending political parties or, in the special case of a monetary union, the representatives of two countries. When they delegate monetary policy to an independent agent (the central bank), they agree on a mandate, or objective, which is equidistant from their preferences. If the central bank were to drift away from the objective

agreed by the two principals, it would benefit one of the principals to the detriment of the other. To avoid this, the two principals establish (ex ante) a commonly agreed objective, independence from external influence, and an accountability framework. The latter aims to provide a set of arrangements that allow them to scrutinize whether the central bank is respecting its mandate.

As accountability centers on an evaluation of performance, this is translated in practical terms in the establishment of a legal obligation for the central bank to testify before its principal(s). The latter is eventually the people as represented by the parliament or the government (or other institutions) according to the jurisdiction in which they operate.

According to the theory, therefore, the focus of parliamentary hearings should be the objective of the central bank, and whether the central bank has been able to fulfill it. Nevertheless, scholars raised doubts around the ability of the parliamentary hearings to actually assess the performance of the central bank, as monetary policy is highly technical (Schonhardt-Bailey 2013; Claeys, Hallerberg, and Tschekassin 2014a, 2014b) and may therefore have a low political appeal to the electorate than other matters, as for example issues related to the transparency of the central bank.

Moreover, a number of political and economic drivers may divert the focus of the discussion away from the objective and affect the tone of the debate. First, macroeconomic conditions could influence both the focus and the tones of the hearings. For example, an increase in unemployment may divert the discussion away from price stability considerations.[1] The same might hold for financial distress, which would shift the focus from price stability to financial stability. While we might expect negative economic conditions to worsen the tone of the discussion, the opposite could also be true. In times of financial distress, the interactions between the central bank

[1]This example holds for the cases of the BoE and of the ECB, where price stability is a statutory objective whereas employment is not. In the case of the Fed, this would not represent a divergence from the objective, as its mandate includes the promotion of maximum employment. The example still applies to all three central banks if we substitute unemployment with another macroeconomic variable that is not included in the objective(s) of the central bank. For a more detailed discussion on the objectives of the three central banks, see the next section.

and parliamentarians could intensify, as they did in Europe during the euro crisis (Fraccaroli, Giovannini, and Jamet 2018), since both bodies, under different roles, cooperated to tackle the euro area's problems (Torres 2013; Collignon and Diessner 2016).

A second factor is elections. According to the political business cycle theory, as elections approach, politicians tend to exert higher pressures on central banks, calling for a more expansionary monetary policy which would result in short-term gains at the expenses of higher inflation in the long run (Nordhaus 1975; Alesina 1989). For this reason, the occurrence of an election in the near future may divert the discussion away from price stability to issues related to employment. However, the opposite could also be true: as elections approach, politicians want to signal to their voters that they are effective scrutineers, and might therefore increase their focus on the objective of the central bank. In both cases, we might expect tones to become more negative. On the other hand, tones might be more positive if the incumbent exploits the hearings to praise existing economic conditions in order to get reelected.

A third element is uncertainty. Baker, Bloom, and Davis (2016) find that greater economic policy uncertainty is associated with both political (e.g., tight presidential elections) and economic (e.g., failure of Lehman Brothers) events and has negative repercussions on the economy, such as greater stock price volatility and reduced investment. Uncertainty can also affect negatively perceptions toward the central bank's policies. Using data on citizens' perceptions toward the BoE, the ECB, and the Bank of Japan, Istrefi and Piloiu (2020) show that shocks to economic policy uncertainty deteriorate public trust in central banks. Uncertainty is therefore likely to be associated with more negative tones.

2.2 Measurement Issues in the Empirical Literature

It follows that from a theoretical standpoint it is not clear which factors drive in practice the topics and the tones of the hearings, nor how these factors may influence them. These gaps in the theory motivate an empirical analysis.

However, the existing empirical literature on CBA mostly focuses on the design of accountability arrangements, and not on how

accountability is discharged.[2] By looking at a number of aspects in the statutes of central banks (e.g., the possibility for the government to override a decision of the central bank), scholars created CBA indices to rank and compare the degree of de jure accountability of different central banks across the world (Briault, Haldane, and King 1998; De Haan, Amtenbrink, and Eijffinger 1999; Bini-Smaghi and Gros 2000; see De Grauwe and Gros 2008 for a review). These indices, which are summarized in Table A.1 in the appendix, are similar to the widely used indices of central bank independence (e.g., the ones constructed by Grilli, Mascandiaro, and Tabellini 1991 and Cukierman, Webb, and Neyapti 1992, which was updated by Garriga 2016). While these measures can be useful to compare the legal provisions in place in different countries for the principal(s) to scrutinize the central bank (de jure accountability), they do not describe whether this scrutiny serves its intended purpose (de facto accountability). This shortcoming is even more problematic considering that the absence of changes in de jure accountability[3] has been seen by some as a factor that negatively affect public opinion towards central banks, increasing threats toward their independence (Goodhart and Lastra 2017; Merler 2018).

Whether accountability frameworks actually work remains therefore an open question. To fill this gap, we propose a new methodology based on text analysis of the parliamentary hearings, one of the most common and relevant tools to hold central banks accountable. The next section describes why parliamentary hearings offers a good basis for analysis across several jurisdictions and provides a brief overview of the hearings of the BoE, the ECB, and the Fed.

3. The Parliamentary Hearings and the Cases of the BoE, the ECB, and the Fed

While there exist other accountability practices (for a review of the accountability practices of the ECB, see Fraccaroli, Giovannini,

[2]In the political science jargon, we could say that the empirical literature tend to focus mostly on CBA from an *input legitimacy* perspective rather than from a *throughput* one (Schmidt 2013).

[3]We refer to changes in CBA for the monetary policy functions. Reforms have been implemented for the new function of banking supervision, as we discuss later in the paper.

and Jamet 2018), parliamentary hearings provide a good basis to examine the practice of central bank accountability for two main reasons.

First of all, according to the Bank for International Settlements (2009), most central banks are accountable to parliaments. Out of a sample of 47 countries, in 64 percent of them central banks are accountable to parliament, in 30 percent to the minister of finance, in 21 percent to the government or its head, in 9 percent to the head of state, and in 17 percent to other bodies (e.g., cantons in Switzerland or private shareholders in the Republic of South Africa and other cases). Moreover, the transcripts of the hearings are generally publicly accessible online. For these reasons, the methodology we propose in this work is applicable to a wider number of central banks allowing for cross-country comparisons.

Secondly, the hearings are the direct expression of CBA. This characteristic can be appreciated in comparison with other methodologies adopted to study the relationship between central banks and politicians. For example, Binder (2021) studies the pressures of the executive on the central bank using the text of news reports, whereas Bianchi, Kung, and Kind (2019) analyze the tweets of U.S. President Trump against the Fed. While only the first of these methodologies has the advantage of being comparable across countries, both approaches provide fundamental information on the relationship between the central bank and the executive. This is particularly relevant, as the executive can be influential over the central bank's policy since in many jurisdictions it holds the power to remove the central bank governor.[4] However, this data is unidirectional, as it does not incorporate information on how the central bank responds to these pressures. On the contrary, parliamentary hearings are based on a question-and-answer (Q&A) session where the staff of the

[4]This is not the case for the President of the ECB. The governor of the BoE can be removed only by the Bank's Court of Directors, whose members are appointed by the Crown, with the exception of the Chair of the Court, who is appointed by the Chancellor of the Exchequer. To do so, the Court first needs the consent of the Chancellor of the Exchequer (UK Parliament 2016). In the United States, the President can remove a member of the Board of Governors for inefficiency, neglect of duty, or malfeasance in office. However, it is not clear whether the U.S. President has the authority to fire the Chair of the Fed's Board of Governors (Conti-Brown 2015, 2019).

central bank and parliamentarians interact in real time. Moreover, and more importantly, as previously described, the hearings rest on an explicit legal requirement to scrutinize the central bank. Moreover, it can be argued that the information on the executive's policy preferences toward the central bank is indirectly captured in our data through the participation to the hearings of parliamentarians from the governing parties, who are likely to share the policy preferences of the government.

Thirdly, although they have different electoral and party systems, parliaments tend to reflect a more plural picture of the political environment the central bank is exposed to, as they generally include both parties in support and against the existing government. This is an advantage compared with approaches that look exclusively at the relationship between the central bank and the executive, such as that of Bianchi, Kung, and Kind (2019) and Binder (2021).

An important caveat to our analysis is that we examine only those hearings that are related to monetary policy. This is relevant since, following the crisis, the increased involvement of central banks in financial stability and banking supervision led in some cases to the establishment of separate hearings for these functions.

The United Kingdom established separate hearings for the members of the newly created Financial Policy Committee to discuss the Financial Stability Report. In Europe, the creation of the Single Supervisory Mechanism in 2014 included the establishment of the hearings of the Chair of the Supervisory Board on the topic of banking supervision. In the United States, the 2010 Dodd-Frank Act created the Financial Stability Oversight Council (FSOC), which testifies on an annual basis before the Senate Committee on Banking, Housing, and Urban Affairs on its Annual Report. However, while the Chairman of the Federal Reserve is a voting member of the FSOC, its chair is the Secretary of the Treasury (analogous to the minister of finance), who is also the one that testifies before Congress.

While these hearings offer an interesting data source, they are relatively recent compared with the ones on monetary policy, and therefore leave little room for comparison due to their short time series. Moreover, the three cases we analyze have very different institutional structures to deal with banking supervision and financial stability more broadly, making the comparison on this function more

cumbersome. For example, while in the United Kingdom the creation of the Financial Policy Committee was accompanied by a change in the statute of the BoE to include a financial stability objective, the statutory objectives of the ECB and of the Fed were left unchanged (for a recent discussion on the case of the FSOC, see Kashyap and Siegert 2020).

We acknowledge, though, that monetary policy and financial stability can be interlinked, as noted by Smets (2014). Theoretically, this link leaves room for discussions on financial stability during the hearings for monetary policy too. Therefore, while we do not investigate this issue directly, as it goes beyond the scope of our research, we include the topic of financial stability in our analysis.

Following these considerations, in the next subsection we describe the hearings envisaged for the monetary policy functions of the three central banks.

3.1 The Regular Hearings of the BoE, the ECB, and the Fed

As previously discussed, parliamentary hearings are meant to be a tool for elected representatives to scrutinize whether and how the central bank is achieving its mandate. One of the advantages of comparing the BoE, the ECB, and the Fed is that for all three price stability is a primary objective.

The Bank of England Act states that "in relation to monetary policy, the objectives of the Bank of England shall be to maintain price stability" and "subject to that, to support the economic policy of Her Majesty's Government, including its objectives for growth and employment" (Part II, Article 11). The definition of price stability is a task of the British Treasury (Art. 12), which set the inflation target at 2 percent.[5] Similarly, the primary objective of the ECB is "to maintain price stability" as enshrined in Article 2 of the Statute of the European System of Central Banks and of the European Central Bank.[6] In 1998 the Governing Council of the ECB provided a

[5]The full text of the Act is available at the following link: https://www.bankofengland.co.uk/-/media/boe/files/about/legislation/1998-act.

[6]The statute is available at the following link: https://www.ecb.europa.eu/ecb/legal/pdf/oj_c_2016_202_full_en_pro4.pdf. In the statute the price stability objective applies to all the European System of Central Banks (ESCB), which

quantitative definition of this objective: inflation rates of below, but close to, 2 percent over the medium term.[7] The price stability objective of the Fed is enshrined in Section 2A of the Federal Reserve Act, which states that "the Board of Governors of the Federal Reserve System and the Federal Open Market Committee shall maintain [. . .] stable prices."[8] The Federal Open Market Committee then stated that inflation at the rate of 2 percent is consistent with the Fed's statutory mandate.[9]

However, there are also relevant differences. A first crucial difference is the higher independence enjoyed by the ECB and the Fed in defining price stability compared with the BoE. As described in the previous paragraph, while the ECB and the Fed have the autonomy to provide a quantitative definition of their price stability objective (which is decided by the Governing Council and by the Federal Open Market Committee, respectively), this is not the case for the BoE, whose inflation target is set by the government. Second, while for the BoE and the ECB price stability is the main monetary policy objective, the Fed has also the objective to promote the goal of maximum employment, which is in no way subordinated to the price stability mandate. This is an important difference compared with the BoE and the ECB, where employment is a secondary objective, i.e., an objective that is subject to the achievement of price stability.[10]

In our empirical analysis we exploit these commonalities and differences to investigate how the mandates democratically assigned to

extends also to those national central banks that are members of the European Union but not of the euro area.

[7]The Governing Council of the ECB is composed of the President, the Vice-President, the other members of the ECB Executive Board, and the governors of the National Central Banks that are part of the euro area. The precise definition of price stability provided by the Governing Council is the following: "Price stability is defined as a year-on-year increase in the Harmonised Index of Consumer Prices (HICP) for the euro area of below 2%."

[8]The Federal Reserve Act is available at this link: https://www.federalreserve.gov/aboutthefed/section2a.htm.

[9]The statement is available at this link: https://www.federalreserve.gov/newsevents/pressreleases/monetary20120125c.htm.

[10]In the case of the BoE this subordination is explicit in Article 11b of the Bank of England Act. In the case of the ECB, this subordination is set in the requirement for the ECB (Article 2 of the Statute), without prejudice to the objective of price stability, to contribute to the achievement of the objectives set in Article 3 of the Treaty on European Union. These objectives include, among others, full employment.

the central banks can influence the focus of the discussion. Before doing so, we briefly describe the arrangements that set the interactions between each central bank and its respective parliament.

Bank of England. The BoE is held accountable by the House of Commons Treasury Committee through regular hearings. The members of the Treasury (Select) Committee are elected representatives of the House of Commons, the lower chamber of the U.K. Parliament. They belong to different parties and are appointed by the House of Commons, which also elects the chair of the Committee. The BoE's hearings typically take place when the Bank of England Inflation Report is published.[11] In these reports, the BoE explains its inflation projections on which the BoE's Monetary Policy Committee (MPC) bases its policy decisions. The report is a tool to scrutinize whether and how the BoE reaches its inflation target, which is set at 2 percent by the government (specifically by the Treasury). The BoE then discusses the Inflation Report with the Treasury Committee, which is responsible for overseeing the spending, policies, and administration of the BoE. Differently from the ECB and the Fed, the BoE Governor participate to the hearings together with other members of the MPC. While the Treasury Committee has sole statutory authority to scrutinize the BoE, also the Economic Affairs Committee of the House of Lords holds hearings with the BoE (Schonhardt-Bailey 2015; Sanders, Lisi, and Schonhardt-Bailey 2018). The textual data we collect is, however, dominated by hearings before the House of Common's Treasury Committee, which are 58, against only 8 hearings before the House of Lords' Economic Affairs Committee, which are the only available transcripts online for the period of our study. We include both sets of hearings, as the separation of tasks between the two committees is "not necessarily clear," as argued by Russell (2013). However, Russell (2013) also notes that while the Treasury Committee is officially responsible to hold the BoE accountable for its policy, the Economic Affairs Committee focuses more on issues related to administration, clarification, and simplification. Our database on the BoE comprehends 66 transcripts of the hearings from 1999 to 2018, including the mandates of three governors, namely

[11]The BoE is required to publish a report on inflation by Art. 18.2b of the Bank of England Act.

those of Edward George (1993–2003), Mervyn King (2003–13), and Mark Carney (2013–20).

European Central Bank. The ECB's accountability obligations are set out explicitly in primary EU law. Article 284(3) of the Treaty on the Functioning of European Union (TFEU) and Article 15.3 of the Statute of the European System of Central Banks and of the European Central Bank provide that the ECB is primarily accountable to the European Parliament, as the representative of EU citizens. A cornerstone of this accountability framework is the "monetary dialogue," i.e., the ECB President's participation in the regular public quarterly hearings before the Committee on Economic and Monetary Affairs (ECON committee), where he delivers a statement on the ECB's actions and answers questions from members of the European Parliament (MEPs) attending the hearing. The members of the ECON Committee are MEPs appointed by the political groups and the non-attached members of the European Parliament. All political groups are represented in ECON, as the committees are required to reflect as far as possible the political composition of the parliament.[12] Moreover, MEPs are from different EU member states, including those countries which are not part of the euro. Our text data for the case of the ECB hence relies on the transcripts of the monetary dialogues for the period 1999–2018. This time span covers three ECB presidencies, including those of Wim Duisenberg (1998–2003), Jean-Claude Trichet (2003–11), and Mario Draghi (2011–19).

Federal Reserve. The Fed is accountable to the public and the U.S. Congress. Although the formalization of the hearings took place in the Humphrey-Hawkins Act in 1978 (Full Employment and Balanced Growth Act of 1978 (P.L. 95-523)), the Fed appeared before Congress since 1976. The Federal Reports Elimination and Sunset Act of 1995 provided for the cessation of the legal requirements for the Humphrey-Hawkins Act reports to Congress after 1999, but the Fed and Congress agreed to continue their reporting arrangements (Schonhardt-Bailey 2013). According to these practices, the Chair of the Board of Governors of the Federal Reserve System appears each

[12]Pursant of Rule 209 of the Rules of Procedure of the European Parliament: https://www.europarl.europa.eu/doceo/document/RULES-9-2019-07-02_EN.pdf.

year twice before the Senate Committee on Banking, Housing, and Urban Affairs and twice before the House Committee on Financial Services. In such hearings the Fed Chairman reports to Congress on its semiannual Monetary Policy Report, which focuses on recent economic developments and on the Fed's plans for monetary policy, and replies to congressmen's questions. Each committee is composed of a chairman, who is generally the majority party member with the greatest seniority, a vice-chairman, and a ranking member, the latter being the most senior member from the opposition party. In the practice of recent years, the assignment of congressmen to the committee takes place during party conferences, where each conference prepares a roster of party members.[13] Our database for the Fed consists therefore of four hearings per year, two before the Senate and two before the House, from 2000 to 2018, covering the chairmanships of Alan Greenspan (1987–2006), Ben Bernanke (2006–14), Janet Yellen (2014–18), and Jerome Powell (2018–). A part of the oversight hearings, Fed Chairmen appear before Congress for reconfirmation hearings. This was the case for Volcker (1983), Greenspan (1992, 1996, 2000, 2004), and Bernanke (2009). However, also in this case we comprehend in our textual database only semiannual hearings to ensure consistency.

4. Methodology

We apply topic and sentiment analysis to the transcripts of central banks' parliamentary hearings in order to capture, respectively, the focus and the tone of the discussions. In this section we first briefly describe the text data preprocessing and then the text analysis methodology we implement.

4.1 Text Data and Preprocessing

For each central bank we collect the transcripts of their parliamentary hearings from 1999 to 2019, which are available in all three cases on the websites of the respective parliaments. In all three cases, transcripts are available in English. However, 10 of the transcripts of the

[13] For more details, see https://www.senate.gov/artandhistory/history/common/briefing/Committees.htm.

Table 1. Data Description of the Transcripts for the ECB, Fed, and BoE Hearings

	ECB	Fed	BoE
Number of Transcripts	81	64	66
Average Number of Words per Transcript	6,783	14,647	8,366
Total Number of Words	549,423	937,408	552,156

Note: Values relative to the average number of words and to the total number of words refer to the transcripts after cleaning the data from stop words, numbers, and white spaces.

ECB are not available fully in English, as some parts are reported in the original language used by MEPs. We translate in English the non-English text in this subset of transcripts using Google Translate. Our method is motivated by De Vries, Schoonvelde, and Schumacher (2018) who, by comparing different translating methodologies on the corpus of debates in the European Parliament, find that Google Translate performs well for text analysis models based on bag-of-words, as the ones we intend to apply.

Then, we preprocess the text in each transcript. This implies tokenizing the text, i.e., splitting raw character strings into individual elements, removing English stop words (e.g., "the," "for," "and"), numbers, punctuation, and white spaces. Text preprocessing is a common method in text analysis to reduce the data dimensionality, which is beneficial for both the computation and the interpretability of the model (Gentzkow, Kelly, and Taddy 2019). Descriptive statistics of the three databases following the preprocessing are summarized in Table 1.

4.2 Topic Analysis

First, we use topic analysis to investigate whether central banks and parliamentarians focus on the central bank's objectives during the debate. We apply a dictionary technique, which consists in creating a list of key words related to a specific topic and in matching

these words with those present in the transcripts.[14] The number of matches in each transcript is then divided by the total number of words in each transcript to avoid the score being inflated by the length of the text. In this way, we obtain a measure of the intensity of the focus on a specific topic at transcript level based on the frequency of key words for each document.

We create multiple text bags to account for different topics. To investigate whether parliamentary debates actually focused on the central banks' monetary policy objective(s), we first create a list of key words related to the topic of price stability, which is a primary objective for all three central banks. The advantage of applying this method to the cases of the ECB and of the BoE is that they both have a clearer prioritization of price stability as their primary objective. To compare price stability with the evolution of other topics, we create two other lists of text related to major topics of discussions, namely employment, which is the other primary objective of the Fed and a highly relevant macroeconomic variable, and financial stability. All the key words selected for the three lists are available in Section A.3 of the appendix.

The lists on price and financial stability are based on common English words related to the two topics and which abstract from the specific language features of each country. They hence have the advantage of being applicable to transcripts in English of other central banks, providing an overview of the evolution of topics in other countries. The cost associated to generality stems from the omission of those words used to address central-bank-specific monetary policy programs of the three central banks (e.g., the term "APP" that refers to the ECB's Asset Purchase Programme). However, since our aim is to compare the discussion around price stability across central banks and over time, a parsimonious and general dictionary better suits the purposes of our research question.

The dictionary approach is also more suitable to our database than the Latent Dirichlet Allocation (LDA) approach introduced by Blei, Ng, and Jordan (2003). LDA is an unsupervised method that proved successful in extracting the topics in different types of texts of individual central banks (Hansen and McMahon 2016; Hansen,

[14]For an application of dictionary techniques to extract the topics of central bank communication, see Hansen and McMahon (2016).

McMahon, and Prat 2017; Hartmann and Smets 2018; Hansen, McMahon, and Tong 2019). Compared with the dictionary approach, LDA has the advantage of identifying the topics discussed in each document without requiring any prior input from the researcher (a part of the selection of a fixed number of topics to identify).[15] However, since LDA defines topics based on the distribution of words across documents (i.e., each hearing in our case), it rests on the assumption that the set of terms used to discuss a certain topic is comparable across documents. While this assumption is reasonable when the textual database is composed of speeches of the same central bank (as in the literature mentioned above), it is problematic when applied to our database, where common terms related to the same topics co-occur with terms that are country specific.

For example, while the term "rate" features in all three cases as it may refer to "interest rate" or "inflation rate", in the case of the Fed it often appears as part of the trigram "federal funds rate". This leads LDA to identify a topic based on terms that co-occur with such trigram, a limitation also highlighted in Thomas, McNaught, and Ananiadou (2011). While such topic is helpful to detect when monetary policy is discussed in the Fed's hearings, it is not general enough to capture monetary policy discussions in the hearings of the BoE and ECB as well. For this reason, LDA does not identify latent topics that are general enough to allow a comparison across the three cases. The issue persists if we estimate the distribution of topics separately for each central bank. By doing so, the latent topics extracted by the LDA would not be comparable across central banks, as they would be based on different combinations of words. For these reasons, while the dictionary approach necessarily relies on a subset of terms chosen ex ante, it is preferable to LDA, as it provides comparable indicators of topics.[16]

[15]More precisely, LDA considers each document as a mixture of latent topics, where the topic distribution is assumed to have a Dirichlet prior.

[16]As a test, we apply the LDA approach to our database, setting the number of topics, K, equal to seven. We choose seven topics based on the output of the pre-estimation test developed by Cao et al. (2009), which selects the optimal number of topics based on topic density (formally, it identifies the K that minimizes the average cosine distance of topics). Before running the pre-estimation test and the LDA, we remove the names of the heads of the three central banks, to reduce

We estimate the following linear regression in order to identify which factors are more likely associated with changes in the focus on the central bank objective:

$$Y_{it} = \alpha + \delta O_i + \lambda(|\pi_{it} - \pi^*_{it}|) + \gamma[(|\pi_{it} - \pi^*_{it}|) \times D_{it}] + \eta E_{it} + \zeta \mathbf{X}_{it} + \phi \mathbf{W}_{it} + e_{it},$$

where Y_{it} is the score of a topic text bag for central bank i during hearing t. Since we aim to see whether the objective of the central bank is a relevant driver of the debate on a specific topic, we include a dummy O_{it} which equals 1 if i has O as main statutory objective at time t. In our main specification Y_{it} is the topic of price stability and O_i equals 1 for the cases of the BoE and for the ECB. If the objective of the central bank is a crucial driver of the focus on a topic, we expect the coefficient δ to be positive and significant.

As pointed out in the theoretical framework section, policy drifts can be relevant drivers of the discussion too. We therefore include $|\pi_{it} - \pi^*_{it}|$, which captures the absolute distance of the actual rate of inflation, π, from the targeted rate of inflation, π^*, which we set equal to 2 percent, as it approximates the aim of all three central banks.[17] Importantly, we look at the absolute distance between the two values to account for both inflationary and deflationary deviations from the aim.

The relevance of policy drifts for the topic of discussion could vary depending on whether deviations of inflation from π^* are positive (i.e., inflationary) or negative (deflationary). To capture this difference, we interact $|\pi_{it} - \pi^*_{it}|$ with a dummy, D_{it}, that equals 1 when the rate of inflation is higher than the 2 percent target, and 0 otherwise. The interaction allows us to analyze how the relationship between the focus of the hearings and the policy drift changes when inflation deviates from π^* above ($D_{it} = 1$) and below ($D_{it} = 0$) the target.

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the probability of generating central-bank-specific topics. Despite this adjustment, the latent topics identified fail to capture general subjects of discussions that are applicable to all three central banks for comparison. For brevity, we do not report here the results of the LDA estimation, which are available upon request.

[17] The inflation target of the BoE, as set by the British government, and of the Fed, as set by the FOMC, is 2 percent. The ECB aims at inflation rates close to but below 2 percent.

E_{it} is a dummy equal to 1 if hearing t precedes an election in the country of central bank i. For the case of the BoE we look at general elections, for the ECB at European elections,[18] and for the Fed at presidential elections.

X_{it} is a vector of macroeconomic controls including unemployment, GDP growth, and credit-to-GDP, which is a good proxy for financial stability (Schularick and Taylor 2012).[19] In particular, we employ quarterly data on total credit to private non-financial sector in the United Kingdom, the euro area, and the United States. This variable displays a strong correlation with the scores of our financial stability text bag, as shown in Figure A.3 in the appendix.

W_{it} is a vector of text-based variables including uncertainty and a text-based index of hawkish-dovish ratio. Our measure of uncertainty is similar to the one built by Baker, Bloom, and Davis (2016) and is based on the matches of the terms "uncertainty(-ies)" and "uncertain", which are then weighted by the number of words in the text. The hawkish-dovish ratio is taken from Apel and Blix-Grimaldi (2012) and is detailed in Section 5.

4.3 Sentiment Analysis

We apply a similar methodology to measure the tone of hearings. Following the literature on sentiment analysis applied to texts, it is possible to obtain a quantitative estimate of the tone of a document by matching the words in the text with predefined lists of positive and negative terms (Loughran and McDonald 2011; Kearney and Liu 2014).

Differently from the topic analysis, in this case we do not create our own dictionary, but rely on the lists of positive and negative

[18]We look at European elections since they are the elections for the legislators involved in the parliamentary hearings of the ECB.

[19]While credit growth is a good predictor of financial crises (Schularick and Taylor 2012), we acknowledge that there can be other measures to proxy for financial stability, such as the occurrence of a systemic crisis in a specific year (Laeven and Valencia 2012) or bank-level indicators (e.g., non-performing loans, Tier 1 capital, and so on). Data on credit growth have the advantage of being at quarterly level, differently from data on crises which are on a yearly basis, and of being harmonized and adjusted for breaks by the Bank for International Settlements, differently from bank-level data which often refer to different accounting standards and cannot always be compared across countries.

sentiments created by Hu and Liu (2004) (HL, henceforth). The lists contain 2,006 positive terms and 4,791 negative terms. We choose this lexicon instead of other sentiment dictionaries, such as the Harvard General Inquirer Dictionary (GI) used by Tetlock (2007) and the lexicon built by Loughran and McDonald (2011) (LM), for two main reasons.

First of all, HL has a predictive accuracy on economic texts that is comparable to LM and higher than GI, as found by Shapiro, Sudhof, and Wilson (2019). By evaluating the performance of GI, LM, and HL on a database of economic and financial news and comparing the scores of each dictionary with the human ratings on the same articles, they find that LM and HL lexicons have a similar rank correlations with human ratings and that are larger than the correlation of the GI lexicon.

Second, HL contains a larger number of terms and of terms that are unique compared with the other two (Shapiro, Sudhof, and Wilson 2019). This is not an advantage per se. In fact, the smaller size of LM is related to the fact that it is built specifically for the economic and financial domain, as it uses words extracted from the annual reports that U.S. firms submit to the Securities Exchange Commission to summarize their financial performance. On the other hand, the terms in HL are extracted from a feature space of movie reviews, and have therefore the disadvantage of not being specific to economics. However, the specificity of LM is not necessarily beneficial for our application. Since LM terms derive from companies' reports, the sentiments they report in that context do not necessarily fit the context of the hearings. For example, "persistent", which does not have a necessarily negative connotation in parliamentary hearings, features in the negative list in LM, whereas it does not feature in the HL dictionary. Second, LM may not be able to capture the wide range of lexicon, or sentiments, that populate parliamentary debates. For example, in one hearing a parliamentarian blames the central bank for "blackmailing" his jurisdiction. The term "blackmail-" is not present in LM, which therefore does not assign any score to this word, whereas HL assigns a negative score to it. Moreover, an additional benefit of HL, which derives from its construction, is that it relies on more robust sentiment scores, as they are extracted from the rating assigned by the reviewers on their own reviews.

As the HL text bags have been created externally to evaluate tones, they do not necessarily fit with the lexicon adopted for parliamentary debates. For this reason we removed some terms that did not match with positive or negative tones in the specific context of parliaments. For instance, we remove "accommodative" from the positive text bag, as such term has a descriptive connotation when referring to monetary policy, and not necessarily a positive one as in common texts. Following our changes, the list of positive words amounts to 1,968 terms, whereas the list of negative ones amounts to 4,782.

Then, we compute positive and negative scores based on the count of words matched with each bag in each transcript. Once we have obtained these scores, we take the difference between positive and negative terms, to get an estimate of net sentiments (Twedt and Rees 2012). Moreover, we weight net sentiments by the total number of terms in each transcript, to prevent the length of hearings from inflating sentiments upward or downward due to a larger number of terms rather than due to the intensity of the tones. A similar sentiment ratio is proposed in Nyman et al. (2018) and Shapiro, Sudhof, and Wilson (2019), with the difference that the latter subtract matches of terms related to excitement to those related with anxiety to capture sentiments shifts in financial markets. Formally, for each transcript t associated with each central bank i we compute the following ratio:

$$SentimentRatio_{it} = \frac{|Positive_{it}| - |Negative_{it}|}{N_{it}},$$

where $Positive_{it}$ and $Negative_{it}$ are the number of terms matched in each transcript and N_{it} is the total number of words in each transcript. As pointed out by Shapiro, Sudhof, and Wilson (2019), one advantage of this approach is that it is simple and transparent. In addition, they note that this approach is mathematically equivalent to assigning a score of 1 to positive matches and a score of –1 to negative matches and averaging the word-specific valence scores across all words in a text.

Other works propose a different sentiment ratio, where the number of matches per sentiment is weighted by total sum of matches of both sentiments and add unity to get rid of negative values (Birz and Lott 2011; Apel and Blix-Grimaldi 2012). For robustness, we

compute an alternative estimate of sentiment ratio based on this methodology. In particular, we estimate the following equation:

$$SentimentRatio_{it} = \left[\frac{Positive_{it}}{Positive_{it} + Negative_{it}} - \frac{Negative_{it}}{Positive_{it} + Negative_{it}}\right] + 1.$$

For simplicity, in the rest of the paper we discuss sentiment ratio referring implicitly to the first measure. We provide the results for the alternative measure for sentiment ratio in the appendix.

We estimate a similar regression model to the one used for topics:

$$SentimentRatio_{it} = \alpha + \lambda(|\pi_{it} - \pi^*_{it}|) + \gamma[(|\pi_{it} - \pi^*_{it}|) \times D_{it}] + \eta E_{it} + \zeta \mathbf{X}_{it} + \rho \mathbf{V}_{it} + \mu_i + e_{it}.$$

This model differs from the one used for topics in three main aspects. First, in this model we do not include the objective dummy as an explanatory variable for sentiments. Second, we now include central bank fixed effects, which are captured by μ_i, that we did not include in the topic model to avoid collinearity with the objectives' dummies.

Third, in this equation we replace the text-based indicator of uncertainty (described in Section 4.2) with a vector of variables that captures macroeconomic uncertainty, V_{it}. This choice is motivated by the concern that the text-based indicators of sentiments and uncertainty rely on similar key terms and may hence capture the same phenomenon. To circumvent this problem, we replace the text-based measure of uncertainty with the volatility of inflation, unemployment, and growth, which can be considered as exogenous to the sentiment index. In line with previous studies (Judson and Orphanides 1999; Caglayan and Xu 2016), we take the within-year variance of each variable to measure its volatility.

As a robustness check, we estimate another model where we replace the indicators of macroeconomic volatility with the same text-based indicator of uncertainty used in the topic analysis. However, in this case we remove from the sentiment text bags those terms that feature also in the uncertainty text bag. This allows us to estimate separately the relationship between sentiments and uncertainty.

5. Results

5.1 Results on Topics

We first regress the price stability score, given by the number of matches of the price stability text bag, on the presence of an inflation objective as the sole primary objective of the central bank. As mentioned in the previous section, the inflation objective dummy equals 1 for the cases of the BoE and of the ECB.

The results of the regression are displayed in Table 2.[20] We notice that the inflation objective is positively and significantly correlated with the frequency of price stability terms. This suggests that the presence of price stability as primary statutory objective is associated with a more intense focus of the hearings on the topic of price stability. This result is significant also once we control for the divergence of inflation rates from the 2 percent aim. Moreover, the coefficient of the objective dummy remains positive and significant also once we control for uncertainty, the presence of elections, and macroeconomic factors such as unemployment, GDP, and credit.

The distance of inflation from the target shows a strong positive correlation with the focus on price stability, but only when interacted with the above target dummy. This suggests that the more inflation grows above the central bank target, the higher the attention of the hearing on the issue of price stability. The same does not hold for deflationary drifts. When inflation decreases below target—i.e., when the above target dummy is equal to 0—the correlation with price stability is not significant. Therefore, the focus on price stability increases only when inflation grows above the inflation target, and not when it decreases below the target.

Moreover, it is interesting to notice that unemployment is negatively and significantly correlated with the focus on price stability. This result may indicate that, as unemployment increases, the attention shifts away from price stability. This may also reflect that the hearings react swiftly to changes in inflation or unemployment in a

[20]We apply the variance inflation factor to detect the presence of collinearity in this and the following models. The mean variance inflation factors for the topic and sentiment regression models are 2.04 and 1.51, respectively. These results indicate that our estimates are robust to multicollinearity.

Table 2. OLS Estimates on Topic Price Stability as Dependent Variable

Variables	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
Inflation Objective	1.102***	1.308***	1.653***	1.595***	1.603***	1.139***	1.033***
	(0.182)	(0.174)	(0.207)	(0.204)	(0.205)	(0.331)	(0.336)
$\lvert\pi - 2\%\rvert$		–0.325***	–0.187	–0.187	–0.192	–0.208*	–0.150
		(0.122)	(0.115)	(0.118)	(0.119)	(0.113)	(0.115)
$\lvert\pi - 2\%\rvert \times D$		0.360***	0.349***	0.352***	0.349***	0.298**	0.387***
		(0.122)	(0.120)	(0.123)	(0.123)	(0.129)	(0.135)
Unemployment Rate (log)			–1.667***	–1.555***	–1.552***	–1.090**	–0.947**
			(0.364)	(0.368)	(0.368)	(0.453)	(0.454)
Uncertainty				1.177	1.193	0.362	0.364
				(1.333)	(1.334)	(1.429)	(1.472)
Elections					0.188	0.181	0.167
					(0.173)	(0.155)	(0.161)
GDP (log)						–0.280*	–0.395**
						(0.166)	(0.171)
Credit-to-GDP (%)							–0.010*
							(0.005)
Observations	162	151	151	151	151	151	151
R-squared	0.116	0.229	0.352	0.357	0.358	0.370	0.382
Central Bank FE	No	No	No	No	No	No	No

Note: Robust standard errors are in parentheses. *p < .05; **p < .01; ***p < .001.

"Phillips curve" fashion, decreasing the attention on price stability when unemployment grows and inflation decreases, and vice versa.

It is not clear whether the mandate of the BoE foresees a hierarchy between the price stability and financial stability objectives. While this might seem surprising, there are a number of other cases where the subordination is not specified by the law, as documented in a survey of 114 central bank statutes by (Jeanneau 2011). To account for this issue, we provide a new specification, where the inflation objective dummy equals 1 for the whole time series if the central bank is the ECB, whereas it equals 0 for the BoE after 2011, when the BoE is entrusted the objective of financial stability.[21] The results, displayed in Table A.3 in the appendix, are robust to this specification. Both the objective dummy and the interaction between distance from inflation and the above-target dummy remain positively and significantly correlated with the focus on price stability under all specifications. The other regressors display similar coefficients to the ones of Table 2.

Another difficulty is related to the inflation target of the Fed. The FOMC stated its first formal and public commitment to an inflation target of 2 percent on January 24, 2012 (Powell and Wessel 2020).[22] For this reason, distance of inflation from 2 percent might not necessarily capture perceived drifts from the price stability objective in the Fed hearings preceding 2012. To address this limitation, we test the robustness of our results under three potential inflation targets for the case of the Fed. More precisely, we replace the inflation target of 2 percent (π^*) with three alternative targets, namely 1, 1.5, and 2.5 percent for the case of the Fed before January 2012. Accordingly, we change the above-target dummy D to fit each of these targets.

[21]This date refers to the Financial Services Act 2012, which amended the Bank of England Act 1998 (Tucker, Hall, and Pattani 2013). It is however not easy to set a precise date for the start of the BoE's financial stability mandate. As pointed out in Murphy and Senior (2013), the Financial Policy Committee existed in non-statutory form since 2011. Moreover, as noted by Jeanneau (2011), the details of the BoE's financial stability mandate, which is quite general in its statutory form, are spelled out in the antecedent 2009 Banking Act. We therefore adopted alternative inflation objective dummies referring to these years, finding that the results, which for simplicity we do not report in this work, do not substantially differ from the ones in Tables 2 and 9.

[22]The FOMC announced the target via the "Statement on Longer-Run Goals and Monetary Policy Strategy" published on January 24, 2012.

The results, which are displayed in Table A.4 in the appendix, are similar to the ones of the baseline model.[23] Both the inflation objective and distance of inflation above the inflation target are positively and significantly correlated with the focus on price stability under all three alternative targets.

These initial results suggest that the focus on price stability is motivated by accountability concerns. When price stability is a primary objective, the focus of the hearings on price stability is higher. Moreover, as inflation grows away from the target, the principal and the agent focus more on the topic of price stability.

To further test the relevance of the statutory objective in shaping the topic of the discussion, we focus on the employment objective of the Fed. We replace the dependent variable with the frequency of employment-related terms. We keep the objective dummy as the main regressor: since the Federal Reserve is the only central bank of the three that has employment (and not only price stability) among its primary objectives, this is equivalent to the inverse of a dummy that equals 1 if the central bank is the Federal Reserve.

Results are displayed in Table 3. The inflation objective dummy is negatively and significantly correlated with the focus on employment. This means that the focus on employment is higher in the hearings of the Federal Reserve than in those of the other central banks, which do not have full employment as their primary objective. This result provides further evidence of a significant and positive association between the statutory objective and the focus of the discussion on the topic of the objective.

The coefficient of unemployment may seem puzzling at a first glance: its negative sign suggests that, as unemployment grows, the focus on employment in the hearings decreases. This result may appear counterintuitive, as we might expect higher unemployment to trigger the concerns of the speakers on the subject, and not the opposite. However, this result might also indicate that the focus of the hearings on the topic of employment increases as employment grows. In other words, the negative correlation between the topic of employment and unemployment rates may mirror the

[23] Table A.4 presents the results for the models with the topic of price stability, the topic of employment, and the sentiment ratios as dependent variables.

Table 3. OLS Estimates on Topic Employment as Dependent Variable

Variables	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
Inflation Objective	–0.751***	–0.770***	–0.656***	–0.648***	–0.644***	–0.718***	–0.678***
	(0.102)	(0.098)	(0.104)	(0.107)	(0.107)	(0.155)	(0.160)
$\lvert\pi - 2\%\rvert$		–0.169***	–0.123***	–0.124***	–0.126***	–0.128***	–0.150***
		(0.048)	(0.045)	(0.044)	(0.044)	(0.044)	(0.048)
$\lvert\pi - 2\%\rvert \times D$		–0.140**	–0.144**	–0.144**	–0.145**	–0.153**	–0.187**
		(0.061)	(0.062)	(0.063)	(0.064)	(0.068)	(0.073)
Unemployment Rate (log)			–0.550***	–0.567***	–0.566***	–0.492***	–0.547***
			(0.133)	(0.149)	(0.149)	(0.180)	(0.183)
Uncertainty				–0.177	–0.171	–0.303	–0.304
				(0.477)	(0.481)	(0.554)	(0.546)
Elections					0.078	0.077	0.082
					(0.091)	(0.092)	(0.097)
GDP (log)						–0.045	–0.001
						(0.070)	(0.074)
Credit-to-GDP (%)							0.004**
							(0.002)
Observations	162	151	151	151	151	151	151
R-squared	0.299	0.338	0.412	0.412	0.414	0.415	0.425
Central Bank FE	No	No	No	No	No	No	No

Note: Robust standard errors are in parentheses. *p < .05; **p < .01; ***p < .001.

positive correlation between the topic of employment and employment rates.[24]

To test this claim, we select the 50 parts of speech of the transcripts that display the highest scores in the employment dictionary, i.e., those that have the highest number of key terms that are matched with the employment dictionary.[25] By inspecting each of them, we notice that the great majority of the excerpts express concerns on a number of issues related to the growth of employment. Moreover, the minority of excerpts that focus on unemployment mostly discuss the level of unemployment or its side effects, rather than unemployment growth.[26] This evidence is informative on why discussions on employment vary as a reaction to changes in employment, providing an explanation for the negative and significant coefficient of the unemployment rate.

Overall, these results suggest that parliamentary scrutiny serves its intended role, as the statutory objective and deviations from the inflation target are among the main drivers of the discussion. The focus on price stability is higher where it represents the main statutory objective of the central bank. In line with this, the focus on employment is positively associated with the Fed dummy (i.e., the inverse of the inflation objective dummy).

Nevertheless, it should be noted that the inflation objective dummy risks being correlated with other unobserved variables and should therefore be interpreted with caution. For example, the focus of price stability could be lower in the hearings of the Fed due to

[24]If we run the same model of Table 3 and replace the rate of unemployment with the rate of employment, the coefficient of employment is positive and significant under all specifications. The estimates of this test are reported in Table A.2 in the appendix.

[25]To provide an illustration, we report the top 10 excerpts in Section A.5 of the appendix. All terms are in lowercase to allow matches with the terms in the dictionaries. The other excerpts are available upon request.

[26]More in detail, the majority of the 50 excerpts (74 percent) does not express disquietude about rising unemployment. On the contrary, the excerpts reflect concerns on a number of issues related to employment growth, such as the quality of jobs being created and how this is captured by employment statistics. Moreover, among the remaining 26 percent of speeches, the majority does not discuss raising unemployment in most instances. These speeches rather focus on the level of unemployment, or on the social and psychological side effects of high levels of unemployment.

unobserved political, economic, or cultural reasons which are specific to the United States, regardless of the central bank mandate.

While our model does not rule out this possibility, the significant coefficient of the distance between inflation and the inflation target lends support to the view that the mandate matters. In other words, central banks and parliaments increase their focus on price stability not only when this is the main objective but also when inflation drifts away from the central bank objective. However, the interaction term shows that this reaction is not symmetric, as the focus on price stability increases only when such deviations are inflationary, and not when they are deflationary.

5.2 Results on Sentiments

We now investigate which variables are associated with shifts in the sentiment ratio presented in Section 4. As discussed, sentiments can be a good proxy of the tone adopted in the hearings. For example, if the central bank is deviating from the objective assigned by its principal, we would expect the tone of the discussion to be more negative.

We first test separately the correlation between sentiments and three variables: distance from the inflation aim, unemployment, and economic uncertainty (Table 4, columns 1–3). Distance from the inflation aim above the target is significantly associated with a decrease in the sentiment ratio (Table 4, column 1). The negative coefficient of the interaction term indicates that the more central banks deviate upward from their inflation aim, the worse net sentiments become.

Once we control for economic uncertainty (inflation, unemployment, and GDP volatility), macroeconomic conditions, and elections, the coefficient for above-target deviations from inflation remains significant. The results under the alternative approach to compute sentiment ratio, shown in Table A.5 in the appendix, do not differ substantially from the ones presented in Table 4. On the other hand, the results for deflationary deviations are less robust. While also the coefficient of deflationary deviations is negative, it is (weakly) significant only once we control for macroeconomic conditions (columns 7 and 8). Furthermore, under the alternative sentiment ratio indicator, the coefficient of deflationary deviations is not

Table 4. OLS Estimates on Sentiment Ratio as Dependent Variable

Variables	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
$\|\pi - 2\%\|$	–0.119			–0.207	–0.214	–0.214	–0.302*	–0.265*
	(0.106)			(0.159)	(0.159)	(0.159)	(0.165)	(0.154)
$\|\pi - 2\%\| \times D$	–0.471***			–0.486***	–0.490***	–0.490***	–0.510***	–0.333**
	(0.131)			(0.161)	(0.162)	(0.162)	(0.160)	(0.156)
Unemployment Rate (log)		–0.295		–0.034	–0.036	–0.036	–0.040	0.723
		(0.378)		(0.408)	(0.412)	(0.412)	(0.400)	(0.472)
Inflation Volatility			–0.882***	–0.723**	–0.723**	–0.723**	–0.768**	–0.583*
			(0.287)	(0.289)	(0.292)	(0.292)	(0.295)	(0.297)
Unemployment Volatility			0.598	1.303*	1.299*	1.299*	1.426*	1.796**
			(0.651)	(0.770)	(0.773)	(0.773)	(0.746)	(0.740)
GDP Volatility			–0.040	–0.072	–0.079	–0.079	–0.056	–0.007
			(0.072)	(0.074)	(0.072)	(0.072)	(0.074)	(0.077)
Elections					0.164	0.164	0.149	0.076
					(0.312)	(0.312)	(0.315)	(0.303)
GDP (log)							1.331**	2.920***
							(0.524)	(0.689)
Credit-to-GDP (%)								–0.032***
								(0.008)
Observations	151	151	153	147	147	147	147	147
R-squared	0.457	0.423	0.436	0.477	0.478	0.478	0.503	0.553
Central Bank FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: Robust standard errors are in parentheses. *p < .05; **p , .01; ***p < .001.

significant under all specifications. Overall, the result of the interaction suggests that sentiments tend to worsen following inflationary deviations from the target rather than deflationary ones.

A relevant issue regards the content captured by our measure of sentiments. Lower sentiment scores may proxy not only for a negative, aggressive, or confrontational tone in the discussion but also for the speakers' depictions of the negative economic outlook or uncertainty.

To account for this issue, we include among the regressors the text-based measure developed by Apel and Blix-Grimaldi (2012) to capture hawkish and dovish stances in monetary policy. Their index is built on two dictionaries able to capture hawkish and dovish stances on monetary policy. Applied to the minutes of the monetary policy meetings of the Swedish central bank, these measures proved useful to predict future policy rate decisions (Apel and Blix-Grimaldi 2012). Their dictionaries are therefore helpful to disentangle sentiments from negative economic considerations. We first remove from the sentiment dictionaries those terms that also feature in the hawkish and dovish dictionaries. Then, we apply the same dictionaries to the transcripts and obtain two scores capturing the degree of hawkish and dovish sentiments of each hearing. From these scores, we extract a hawkish-dovish ratio, based on the difference between the hawkish and dovish score divided by the number of total words in the transcript, similarly to the sentiment ratio.[27]

Table 5 displays the results including the hawkish-dovish ratio. The hawkish-dovish ratio is positively correlated with sentiments, suggesting that more hawkish stances are associated with a more positive tone during the hearing. This relationship can be explained by the fact that hawkish policy stances are generally associated with periods of economic growth, and therefore of positive economic conditions. However, the coefficient is not significantly correlated with sentiments. The inclusion of the hawkish-dovish ratio does not affect the sign nor the significance of the coefficients of the indices of policy drift. Inflationary drifts from target remain negatively correlated with sentiments under all specifications.

[27]This measure could also be defined as "net hawkishness," as suggested by Apel and Blix-Gimaldi (2012).

Table 5. OLS Estimates on Sentiment Ratio (adjusted to Hawkish-Dovish terms) as Dependent Variable

Variables	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
Hawkish-Dovish Ratio	0.101	0.128	0.126	0.107	0.106	0.106	0.139	0.089
	(0.084)	(0.089)	(0.092)	(0.101)	(0.100)	(0.100)	(0.098)	(0.099)
$\lvert\pi - 2\%\rvert$		–0.079	–0.074	–0.157	–0.165	–0.165	–0.225	–0.220
		(0.109)	(0.114)	(0.163)	(0.163)	(0.163)	(0.164)	(0.157)
$\lvert\pi - 2\%\rvert \times D$		–0.490***	–0.486***	–0.489***	–0.494***	–0.494***	–0.512***	–0.340**
		(0.126)	(0.129)	(0.154)	(0.155)	(0.155)	(0.153)	(0.150)
Unemployment Rate (log)			–0.086	0.024	0.020	0.020	0.034	0.753
			(0.382)	(0.399)	(0.403)	(0.403)	(0.393)	(0.455)
Inflation Volatility				–0.687**	–0.687**	–0.687**	–0.722***	–0.550*
				(0.273)	(0.275)	(0.275)	(0.276)	(0.285)
Unemployment Volatility				0.992	0.989	0.989	1.025	1.507**
				(0.784)	(0.784)	(0.784)	(0.747)	(0.756)
GDP Volatility				–0.064	–0.072	–0.072	–0.052	–0.002
				(0.073)	(0.070)	(0.070)	(0.072)	(0.074)
Elections					0.188	0.188	0.172	0.104
					(0.291)	(0.291)	(0.290)	(0.280)
GDP (log)							1.240**	2.753***
							(0.517)	(0.661)
Credit-to-GDP (%)								–0.032***
								(0.008)
Observations	162	151	151	147	147	147	147	147
R-squared	0.429	0.471	0.471	0.487	0.488	0.488	0.511	0.560
Central Bank FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: Robust standard errors are in parentheses. *p < .05; **p < .01; ***p < .001.

As a further test, we replace the measures of economic uncertainty with the broader text-based indicator of uncertainty used in the topic analysis. To this end, we remove from the negative text bag those terms that overlap with the uncertainty indicator. This test is motivated by the works of Baker, Bloom, and Davis (2016) and of Istrefi and Piloiu (2020), who find that text-based measures of uncertainty are correlated with factors that are not strictly economic, such as major (geo)political events, and lower public trust toward central banks.[28] As monetary policy is generally effective in reducing uncertainty in the markets (Bekaert, Hoerova, and Lo Duca 2013), it is possible that high uncertainty is seen by some parliamentarians as the sign that central banks are not doing enough. For these reasons, uncertainty may play a relevant role in worsening sentiments.

Results are presented in Table 6. Uncertainty displays a negative and significant correlation with sentiments under all specifications. Nevertheless, the sign and significance of inflationary deviations remain robust to the inclusion of uncertainty. This evidence strengthens the finding that sentiment reacts negatively to inflationary deviations from the central bank mandate.

6. Conclusion

Our results suggest that parliamentary hearings overall serve their intended purpose. We show that the hearings tend to focus on the statutory objective of the central bank and that this focus increases as the central bank deviates from the mandate. Moreover, we find that the tone of the debates worsens when inflation surpasses the central bank's inflation aim. However, topics and sentiments react more to inflationary rather than deflationary deviations of inflation away from target. This evidence is particularly relevant in light of

[28]Examples of geopolitical events highlighted by Baker, Bloom, and Davis (2016) include the 9/11 terrorist attack for the United States, and the Scottish independence referendum and the Brexit referendum for the United Kingdom. The peak for the Brexit referendum is documented in the updated index provided by the authors at this link: https://www.policyuncertainty.com/uk_monthly.html. Based on data on the BoE, the ECB, and the Bank of Japan, Istrefi and Piloiu (2020) show that shocks in uncertainty deteriorate public trust toward central banks.

Table 6. OLS Estimates on Sentiment Ratio (negative terms adjusted to uncertainty) as Dependent Variable

Variables	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
$\lvert\pi - 2\%\rvert$	–0.119			–0.130	–0.133	–0.133	–0.213*	–0.161
	(0.106)			(0.114)	(0.114)	(0.114)	(0.118)	(0.110)
$\lvert\pi - 2\%\rvert \times D$	–0.471***			–0.504***	–0.505***	–0.505***	–0.528***	–0.316**
	(0.131)			(0.135)	(0.135)	(0.135)	(0.134)	(0.139)
Unemployment Rate (log)		–0.280		–0.095	–0.094	–0.094	–0.122	0.729
		(0.376)		(0.389)	(0.391)	(0.391)	(0.373)	(0.455)
Uncertainty			–2.648**	–3.056***	–3.043***	–3.043***	–2.733***	–2.988***
			(1.158)	(1.124)	(1.127)	(1.127)	(1.034)	(0.966)
Elections					0.120	0.120	0.123	0.075
					(0.298)	(0.298)	(0.297)	(0.300)
GDP (log)							1.380***	2.938***
							(0.504)	(0.631)
Credit-to-GDP (%)								–0.033***
								(0.007)
Observations	151	151	151	151	151	151	151	151
R-squared	0.456	0.421	0.436	0.478	0.479	0.479	0.507	0.559
Central Bank FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: Robust standard errors are in parentheses. *p < .05; **p < .01; ***p < .001.

the criticism that elected representatives tend to focus on topics other than the central bank's performance in fulfilling its mandate, which should be the object of scrutiny.

In exploring these questions, we introduce a new empirical approach to study central bank accountability practices based on text analysis. We apply this method on a novel database, which consists of the parliamentary hearings of the BoE, the ECB, and the Fed. The dictionary-based techniques that we present in this paper can be extended to other central banks in order to track the topic and tones of their parliamentary hearings. This approach opens new avenues for the research on central bank accountability, which so far has been largely dominated by theoretical or qualitative considerations.

Looking forward, future works could improve this method by overcoming its existing limitations. While our approach is effective in identifying changes in the topics and sentiments in parliamentary hearings, it analyzes accountability based on the hearing as unit of analysis. This provides us with partial information on how accountability is discharged, since it presents the interactions between central banks and parliaments as a single block. In future research, we intend to develop further this rich database and look at whether shifts in sentiments are mainly driven by the central bank or by parliamentarians. This would allow us to study whether parliamentarians' individual characteristics play a role in explaining the tone and focus of their participation in hearings. For example, by analyzing news on the pressures from the governments on the central banks in a number of countries, Binder (2021) finds that pressures are more likely when the executive is left-wing or nationalist. It is worth exploring whether this applies also to the context of parliamentary hearings, where—differently from the approach based on governments—it is possible to compare how different parties interact simultaneously with the central bank. Therefore, while our contribution already provides new insights on central banks' parliamentary hearings, it also opens promising avenues for further research.

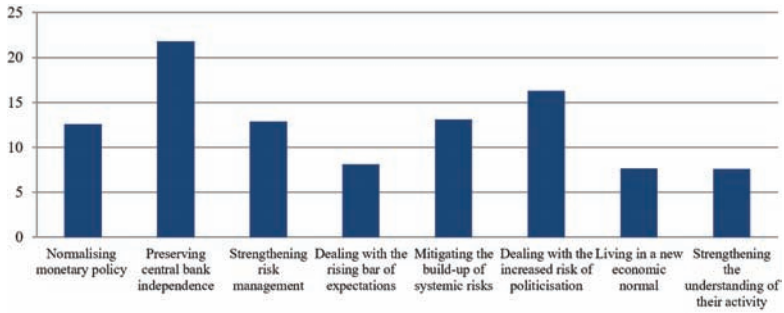
In conclusion, our work sheds new light on the central banks' parliamentary hearings, a key accountability practice, as an unexplored but rich source of data. Fraccaroli, Giovannini, and Jamet (2018) provide evidence of how other types of accountability practices could be exploited to obtain quantitative estimates of the evolution of accountability. Some of them, such as the written questions

that parliamentarians address to the central bank, can be potentially assessed through text analysis tools.

Appendix

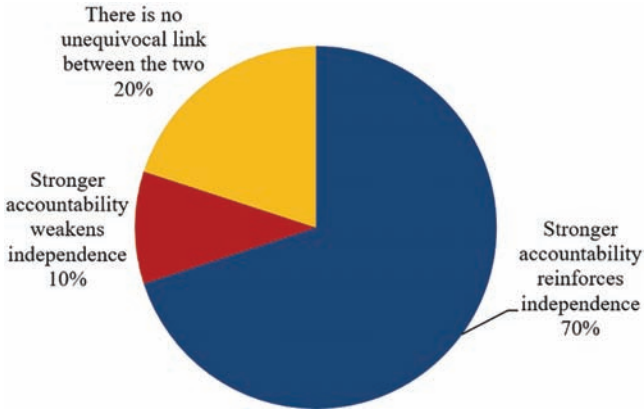
A.1 Survey Results

Figure A.1. The Main Challenges for Central Banks in 2019



Sources: Authors' elaboration on a survey conducted in January 2019 among 30 central bank staff working on institutional matters in their respective central banks.
Note: The following central banks participated in the survey: Central Bank of Malta, Central Bank of Luxembourg, Reserve Bank of Australia, Bank of Mexico, Federal Reserve, European Central Bank, Bank of Ghana, Central Bank of Ireland, Bank of Estonia, Croatian National Bank, National Bank of Ukraine, Central Bank of Norway, Danmarks Nationalbank, Central Bank of Brazil, Swiss National Bank, Sveriges Riksbank, National Bank of Belgium, Bank of Portugal, Deutsche Bundesbank, Netherlands Bank, Central Bank of Cyprus, Bank of England. Moreover, representatives of the International Monetary Fund (IMF) and the Financial Stability Board (FSB) also participated in the survey.

Figure A.2. The Relationship between Central Bank Independence and Accountability



Sources: Authors' elaboration on a survey conducted in January 2019 among 30 central bank staff working on institutional matters in their respective central banks.
Note: The following central banks participated in the survey: Central Bank of Malta, Central Bank of Luxembourg, Reserve Bank of Australia, Bank of Mexico, Federal Reserve, European Central Bank, Bank of Ghana, Central Bank of Ireland, Bank of Estonia, Croatian National Bank, National Bank of Ukraine, Central Bank of Norway, Danmarks Nationalbank, Central Bank of Brazil, Swiss National Bank, Sveriges Riksbank, National Bank of Belgium, Bank of Portugal, Deutsche Bundesbank, Netherlands Bank, Central Bank of Cyprus, Bank of England. Moreover, representatives of the IMF and FSB also participated in the survey.

A.2 Indices of Central Bank Accountability

Measuring central bank accountability empirically is challenging. As central banks are institutions embedded in their specific political and legal national context, they are characterized by different governance traits and legal foundations (constitutions, central bank statutes, additional regulations, etc.) that make cross-country comparisons more difficult (see Frisell, Roszbach, and Spagnolo 2008, Hasan and Mester 2008, and Bank for International Settlements 2009).

Despite these differences, some works identify a number of common criteria to evaluate the statutory accountability of central banks. Building on the example of the widely diffused central bank

Table A.1. Overview of the Most Widely Used Measures of Central Bank Accountability

Authors	Type of Index	Aspects Covered by the Index
Briault, Haldane, and King (1996)	Binary	• External monitoring by parliament • Minutes of the meetings are published • Inflation or monetary policy report are published • Government can override a decision of the central bank
De Haan, Amtenbrink, and Eijffinger (1999)	Binary	• Clarity of the monetary policy objective (e.g., quantification of the objective) • Transparency of monetary policy (e.g., publication of inflation or monetary reports) • Final responsibility of monetary policy (e.g., central bank law can be changed by simple majority)
Bini-Smaghi and Gros (2000)	Binary	• Ex ante accountability (e.g., definition of the central bank objectives) • Ex post accountability (e.g., public hearings and meetings) • Procedures (transparency of the central bank vis-à-vis the parliament and the public)

independence indexes (such as those developed by Bade and Parkin 1988; Alesina 1989; Grilli, Mascandiaro, and Tabellini 1991; Cukierman, Webb, and Neyapti 1992), researchers constructed accountability indices based on central banks' legal frameworks (Briault, Haldane, and King 1998; De Haan, Amtenbrink, and Eijffinger 1999; Bini-Smaghi and Gros 2000). These indices, summarized in Table A.1, are constructed by selecting a number of common criteria that are applicable to the statutes of most, if not all, central banks.

One limitation of these measures is their low time-variation, due to the dependence of their variability on reforms in central bank laws. For example, in its 20 years of history, the ECB has experienced no change in its accountability indices, as the relevant statutory provisions for its central banking role (i.e., excluding banking supervision) have not been reformed. The same applies to other central banks (De

Grauwe and Gros 2008) once supervisory functions, which are not the focus of this paper, are excluded.

While the stability of the indices through time cannot be considered a problem per se, as it still offers a useful cross-country comparison, it does not provide information on the continuous evolution and changes in the interactions between central banks and their principal. In other words, an analysis based on indices provides essential insights on the de jure setting of the accountability framework defined in the contact between the principal and the agent; nevertheless, it is silent on the way in which the agent de facto discharges its accountability over time and how the principal reacts to that.

In this context, it is interesting to note that while the Bank of Japan is assessed by CBA indices as the least accountable central bank when compared with the FED, the BoE, and the ECB (De Grauwe and Gros 2008), it is one of the central banks that has held by far the highest number of parliamentary appearances for accountability reasons. In 2005 and 2006, the Bank of Japan appeared before the Diet (the Japanese parliament), respectively, 33 and 35 times, hence more frequently than the Fed's appearances (21 and 15 times, respectively) and the ECB's (5 times in both years) (Shirakawa 2008; Heckel 2014).

A.3 Text Bags for Topic Analysis

Price Stability:

- price(s), inflate, inflation, inflationary, HICP, CPI, PCE, PCE index, PCE inflation, deflation, deflator, deflationary, deflate, hyperinflation, hyperinflationary.

Employment:

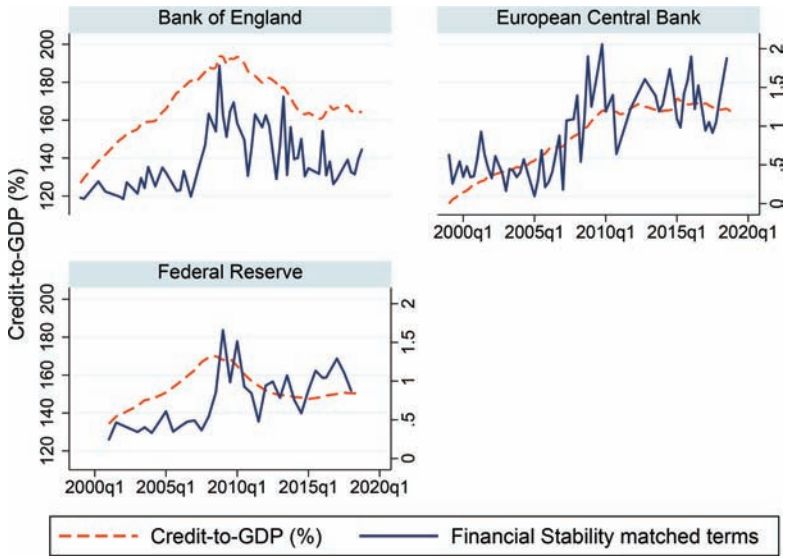
- employ(-ee/-er), (un)employment, underemployment, firing, fixed-term, full-time, part-time, inactivity, job(s), jobless, labo(u)r, labo(u)r force, labo(u)r market, self-employed, temporary, vacancy(-ies), work(er), workers, working, working (age/time), works.

Financial Stability:

- financial (in)stability, bank (in)stability, (financial) crisis, financial stress, financial risk, systemic risk, contagion, financial shocks, bubble, financial imbalance, misalignment, credit growth, banks, insurers, hedge funds, investment funds, financial markets, securities markets, leverage, capital, derivatives, off-balance sheet exposures, special purpose vehicles, off-balance sheet vehicles, payment systems, settlement systems, central securities depositories, non-performing loans, npls, non-performing exposures, foreign currency loans, correlated exposures.

A.4 Financial Stability and Credit Growth

Figure A.3. Credit-to-GDP and Focus on Financial Stability in the Parliamentary Hearings by Central Bank



Note: Credit-to-GDP is total credit to private non-financial sector, using Bank for International Settlements data. Data for the ECB refer to the euro area.

A.5 Robustness Check for the Employment Topic

A.5.1 Top 10 Speeches with the Highest Scores in the Employment Dictionary

Bank of England, 2006: "for example, the measure of unemployment on the claimant count may be an accurate measure of the unemployment statistics for those claiming unemployment benefit, but ignores the large chunk of migrant workers who, at least not yet, have qualified for unemployment benefit, and may be understating unemployment a little bit."

Federal Reserve, 2009: "the longer-run projections for output growth and unemployment may be interpreted as the committee's estimates of the rate of growth of output and unemployment that are sustainable in the long run in the united states, taking into account important influences such as trend growth rates of productivity and the labor force improvements in worker education and skills, the efficiency of the labor market and matching workers in jobs, government policies affecting technological development or the labor market and other factors."

Federal Reserve, 2013: "unemployment is one problem, but long-term unemployment and underemployment—and by "underemployment," i mean people who are either working fewer hours than they would like or possibly are working at jobs well below their skill level—are also indicative of a weak labor market."

Federal Reserve, 2016: "so there are an enormous number of job openings, and there is a certain degree of mismatch of workers who are looking for work with the job openings that are available within the federal reserve, and i personally have been looking at workforce development programs, job training programs, some of which i think are doing a very good job of trying to build the skills and that are needed to fill available jobs and work to match workers with jobs."

Bank of England, 2013: "i would remind you that there are a very large number of workers, who have jobs, who want to work much more than they are working today, and i would not underestimate the extent to which there is slack not just of people looking for a job."

Federal Reserve, 2004: "contracted workers will either be in the payroll series itself—you will remember that temporary

employment is part of the payroll series, and the number of contractual types of work are there as well—but to the extent that they are proprietors, or they are essentially self-employed, they will be picked up in the denominator of the productivity estimate largely from the household survey data, which is really the sole source of self-employed."

Federal Reserve, 2004: "if you include workers who are working part-time because they cannot find a full-time job and workers who want to work but are not in the labor force, the unemployment rate is roughly 9.6 percent."

Bank of England, 2013: "what i said in my speech was that i do believe that the nature of the way in which employers and employees work together within the labour market has changed, and that one of the values employers are increasingly recognising is of the longevity of some of their employees, that they gain productivity and they gain skills through working with individual companies over a longer time frame, which makes employers reluctant to lose those employees, simply because short-term demand conditions are less than they would like, or certainly deficient in this case."

Federal Reserve, 2014: "probably the unemployment rate is the single best indicator, and it has come down to 6.1 percent, which is really notable progress, and broader indicators that include marginally attached workers, discouraged workers, and those with involuntary unemployment, parttime employment, those have come down as well."

Federal Reserve, 2015: "in addition, long-term unemployment has declined substantially, fewer workers are reporting that they can find only part-time work when they would prefer full-time employment, and the pace of quits—often regarded as a barometer of worker confidence in labor market opportunities—has recovered nearly to its pre-recession level."

A.5.2 Focus on Employment and Employment Rate

Table A.2. OLS Estimates on Topic Employment as Dependent Variable and Employment Rate as Regressor

Variables	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
Inflation Objective	–0.751***	–0.770***	–0.693***	–0.674***	–0.670***	–0.568***	–0.567***
	(0.102)	(0.098)	(0.102)	(0.104)	(0.105)	(0.182)	(0.191)
$\lvert\pi - 2\%\rvert$		–0.169***	–0.161***	–0.163***	–0.165***	–0.169***	–0.168***
		(0.048)	(0.043)	(0.042)	(0.042)	(0.043)	(0.048)
$\lvert\pi - 2\%\rvert \times D$		–0.140**	–0.186***	–0.190***	–0.191***	–0.189***	–0.189**
		(0.061)	(0.062)	(0.064)	(0.065)	(0.067)	(0.072)
Unemployment Rate (log)			3.164***	3.440***	3.440***	4.182***	4.197**
			(0.779)	(0.930)	(0.931)	(1.492)	(1.707)
Uncertainty				–0.421	–0.416	–0.318	–0.318
				(0.522)	(0.527)	(0.553)	(0.552)
Elections					0.086	0.089	0.089
					(0.094)	(0.094)	(0.095)
GDP (log)						0.062	0.062
						(0.089)	(0.090)
Credit-to-GDP (%)							–0.000
							(0.002)
Observations	162	151	150	150	150	150	150
R-squared	0.299	0.338	0.418	0.420	0.422	0.424	0.424
Central Bank FE	No	No	No	No	No	No	No

Note: Robust standard errors are in parentheses. *p < .05; **p < .01; ***p < .001.

A.6 Robustness Check for the Price Stability Topic

Table A.3. OLS Estimates on Topic Price Stability as Dependent Variable and with a Second Version of the Inflation Objective Dummy

Variables	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
Inflation Objective v2	0.773***	1.062***	1.709***	1.664***	1.669***	1.369***	1.325***
	(0.187)	(0.180)	(0.202)	(0.194)	(0.195)	(0.202)	(0.212)
$\lvert\pi - 2\%\rvert$		–0.307**	–0.097	–0.095	–0.099	–0.115	–0.082
		(0.131)	(0.117)	(0.121)	(0.120)	(0.109)	(0.110)
$\lvert\pi - 2\%\rvert \times D$		0.425***	0.489***	0.496***	0.494***	0.430***	0.481***
		(0.132)	(0.159)	(0.155)	(0.158)	(0.139)	(0.140)
Unemployment Rate (log)			–2.278***	–2.083***	–2.080***	–1.468***	–1.392***
			(0.347)	(0.351)	(0.352)	(0.357)	(0.368)
Uncertainty				2.141*	2.161**	0.076	0.102
				(1.090)	(1.091)	(1.174)	(1.199)
Elections					0.165	0.198	0.190
					(0.235)	(0.175)	(0.175)
GDP (log)						–0.452***	–0.506***
						(0.102)	(0.110)
Credit-to-GDP (%)							–0.006
							(0.005)
Observations	162	151	151	151	151	151	151
R-squared	0.081	0.210	0.408	0.424	0.425	0.492	0.497
Central Bank FE	No	No	No	No	No	No	No

Note: Robust standard errors are in parentheses. *p < .05; **p < .01; ***p < .001.

Table A.4. OLS Estimates with Fed Inflation Target as 1%, 1.5%, and 2.5% before January 2012 on Price Stability (PriceStab), Employment (Empl), and Sentiment Ratio (SRatio)

	1%			1.5%			2.5%		
Variables	**PriceStab (1)**	**Empl (2)**	**SRatio (3)**	**PriceStab (4)**	**Empl (5)**	**SRatio (6)**	**PriceStab (7)**	**Empl (8)**	**SRatio (9)**
$\lvert\pi - 2\%\rvert$	0.192	0.176***	0.164	–0.166	–0.173***	–0.207	–0.170	–0.168***	–0.212
	(0.125)	(0.051)	(0.159)	(0.121)	(0.050)	(0.164)	(0.121)	(0.049)	(0.164)
$\lvert\pi - 2\%\rvert \times D$	0.274**	–0.192***	–0.379***	0.334***	–0.202***	–0.438***	0.334***	–0.207***	–0.433***
	(0.114)	(0.058)	(0.130)	(0.125)	(0.067)	(0.153)	(0.125)	(0.068)	(0.153)
Unemployment Rate (log)	–0.958**	–0.576***	1.433***	–0.950**	–0.561***	1.504***	–0.947**	–0.562***	1.510***
	(0.448)	(0.180)	(0.353)	(0.450)	(0.181)	(0.337)	(0.450)	(0.181)	(0.337)
Inflation Volatility			–0.922***			–0.973***			–0.984***
			(0.342)			(0.345)			(0.345)
Unemployment Volatility			0.871			1.082			1.099
			(0.861)			(0.883)			(0.882)
GDP Volatility			–0.068			–0.080			–0.081
			(0.088)			(0.090)			(0.090)
Elections	0.182	0.090	0.069	0.173	0.088	0.076	0.172	0.087	0.077
	(0.167)	(0.097)	(0.367)	(0.163)	(0.096)	(0.363)	(0.164)	(0.095)	(0.364)
GDP (log)	–0.388**	0.002	0.351***	–0.392**	0.000	0.325***	–0.393**	–0.001	0.324***
	(0.172)	(0.074)	(0.122)	(0.171)	(0.074)	(0.117)	(0.171)	(0.074)	(0.117)
Credit-to-GDP (%)	–0.009*	0.004**	–0.017***	–0.009*	0.004**	–0.016***	–0.009*	0.004**	–0.016***
	(0.005)	(0.002)	(0.006)	(0.005)	(0.002)	(0.006)	(0.005)	(0.002)	(0.006)
Inflation Objective	1.170***	–0.749***		1.115***	–0.718***		1.108***	–0.721***	
	(0.341)	(0.165)		(0.338)	(0.162)		(0.336)	(0.163)	
Uncertainty	0.333	0.390		0.365	–0.367		0.351	–0.370	
	(1.477)	(0.532)		(1.478)	(0.535)		(1.474)	(0.536)	
Observations	151	151	147	151	151	147	151	151	147
R-squared	0.376	0.441	0.421	0.379	0.437	0.422	0.380	0.438	0.421
Central Bank FE	No	No	No	No	No	No	No	No	No

Note: Robust standard errors are in parentheses. *p < .05; **p < .01; ***p < .001.

A.7 Sentiment Analysis under the Alternative Weighting Methodology

Table A.5. OLS Estimates on Sentiment Ratio (alternative weighting method) as Dependent Variable

Variables	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
$\lvert\pi - 2\%\rvert$	–0.021			–0.040	–0.041	–0.041	–0.035
	(0.022)			(0.034)	(0.033)	(0.033)	(0.034)
$\lvert\pi - 2\%\rvert \times D$	–0.119***			–0.126***	–0.127***	–0.127***	–0.119***
	(0.035)			(0.042)	(0.042)	(0.042)	(0.042)
Unemployment Rate (log)		–0.085		–0.042	–0.042	–0.042	–0.010
		(0.095)		(0.102)	(0.103)	(0.103)	(0.106)
Inflation Volatility			–0.197***	–0.135*	–0.135*	–0.135*	–0.125
			(0.074)	(0.080)	(0.080)	(0.080)	(0.080)
Unemployment Volatility			0.204	0.318*	0.317*	0.317*	0.327*
			(0.151)	(0.179)	(0.179)	(0.179)	(0.180)
GDP Volatility			–0.001	–0.013	–0.014	–0.014	–0.013
			(0.017)	(0.018)	(0.017)	(0.017)	(0.017)
Elections					0.034	0.034	0.032
					(0.060)	(0.060)	(0.0060)
Credit-to-GDP (%)							–0.001
							(0.001)
Observations	151	151	153	147	147	147	147
R-squared	0.452	0.411	0.433	0.467	0.468	0.468	0.471
Central Bank FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: Robust standard errors are in parentheses. *p < .05; **p < .01; ***p < .001.

Table A.6. OLS Estimates on Sentiment Ratio (adjusted to Hawkish-Dovish terms and alternative weighting method) as Dependent Variable

Variables	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
Hawkish-Dovish Ratio	0.026	0.037*	0.036	0.030	0.030	0.030	0.026
	(0.020)	(0.021)	(0.022)	(0.024)	(0.024)	(0.024)	(0.026)
$\lvert\pi - 2\rvert$		–0.007	–0.005	–0.024	–0.026	–0.026	–0.022
		(0.023)	(0.024)	(0.035)	(0.035)	(0.035)	(0.035)
$\lvert\pi - 2\%\rvert \times D$		–0.124***	–0.122***	–0.127***	–0.128***	–0.128***	–0.119***
		(0.033)	(0.033)	(0.040)	(0.040)	(0.040)	(0.040)
Unemployment Rate (log)			–0.040	–0.029	–0.030	–0.030	0.003
			(0.091)	(0.099)	(0.100)	(0.100)	(0.100)
Inflation Volatility				–0.125*	–0.125*	–0.125*	–0.115
				(0.074)	(0.074)	(0.074)	(0.074)
Unemployment Volatility				0.233	0.233	0.233	0.253
				(0.183)	(0.183)	(0.183)	(0.187)
GDP Volatility				–0.011	–0.013	–0.013	–0.012
				(0.018)	(0.017)	(0.017)	(0.017)
Elections					0.039	0.039	0.037
					(0.057)	(0.057)	(0.056)
Credit-to-GDP (%)							–0.001
							(0.001)
Observations	162	151	151	147	147	147	147
R-squared	0.431	0.467	0.467	0.478	0.479	0.479	0.482
Central Bank FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: Robust standard errors are in parentheses. *p < .05; **p < .01; ***p < .001.

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